Washington State Department of Transportation

SR 520 Bridge Replacement and HOV Program

STATE ROUTE 520

LETTER OF TRANSMITTAL

To:	Alan Chan	**Contract & Task Order:**	Y-9761, BD
From:	Larry Kyle	**File Code:**	BD 12.7
Date:	7/20/2009	**LOT #:**	00658
Copies To:	John Villager Christine Lavra Bill Hegge Patrick Clarke Jim Slavicek Paul Bott	Shane Weber Brian Harris WSDOT Doc Control GEC Project Files Pontoon Project Files	

These are:

- ☐ Per Your Request
- ☐ For Your Information
- ☒ For Your Acceptance
- ☐ For Your Files
- ☐ For Your Review and Comment

Sent Via:

- ☐ U.S. Mail
- ☐ Ground Service
- ☐ Express Overnight
- ☐ E-mail
- ☐ Courier
- ☒ Hand Deliver / Pick up via inter-office WSDOT courier

We are transmitting the following materials:

- Final Geotechnical Report – Summary of the Findings of the Investigation and Design Recommendations (BD 12.7)

Comments:

Please find the above document enclosed. We are submitting the Final Geotechnical Report in accordance with Contract Y-9761, Task Order BD, Section 12.7.

If you have questions please contact Reda Mikhail at 425.778.0907.

Laurence A. Kyle

Larry Kyle, Engineering Manager

7.21.09

Date

Plaza 600 Building
600 Stewart Street, Suite 520
Seattle, Washington 98101-1217
Phone: 206-770-3500
Fax: 206-770-3569

Geotechnical Design Study
WSDOT SR 520 Pontoon Construction Project
Grays Harbor, Washington

March 25, 2009

Prepared for

WSDOT
and HDR Engineering, Inc.
Seattle, Washington

LANDAU ASSOCIATES
130 2nd Avenue South
Edmonds, WA 98020
(425) 778-0907

EXECUTIVE SUMMARY

This report presents the results of our design-level geotechnical study to provide design and construction recommendations for the proposed Washington State Department of Transportation (WSDOT) State Route (SR) 520 Pontoon Construction Project at the Industrial Development District (IDD) #1 site at the Port of Grays Harbor, Washington.

The text below summarizes the key points presented in the report. The full text of the report and accompanying figures and appendices should be consulted for a more complete understanding of the project site.

- Deep borings were drilled to perform *in-situ* testing to obtain design parameters related to seismic and settlement analyses.

- Deep and shallow borings and tests pits were completed at the site to support the civil design of the project.

- Wood waste extending to depths ranging from approximately 6 to 9 feet (ft) below ground surface (BGS) was encountered in many of the borings and test pits.

- The general subsurface profile consists of four soil units, Soil Units 1 through 4, extending to an approximate depth of 250 ft BGS. Groundwater was encountered a few feet BGS.

- The site is located close to the Cascadia Subduction Zone (CSZ), which is capable of generating earthquakes of magnitude 8.0 to 9.0. Soil Unit 2, which predominately consists of loose to medium dense silty sand, has high potential for widespread liquefaction under the 1,000-year design earthquake.

- Based on our advanced analysis using FLAC2D software, lateral spreading toward the Chehalis River would occur in the case of widespread liquefaction. Three earthquake motions were used in the analysis. The results suggest that lateral spreading would vary from approximately 2 ft at the existing railroad tracks along the north boundary of the site to about 18 ft at the top of slope location.

- Two foundation alternatives (deep foundations and mat foundations) were evaluated in the study and design recommendations were provided.

- The deep foundations option consists of closed-end 24-inch steel pipe piles filled with concrete. Design recommendations and construction consideration were provided for this alternative. Additionally, 30- and 36-inch open-ended steel pile piles were evaluated.

- Backfilling behind the subgrade walls would cause downdrag loads on perimeter piles. Our FLAC3D analysis predicts less downdrag loads on piles, as compared to previous estimates. This could lead to a reduction in the number of perimeter piles.

- The main uncertainty regarding the pile foundations is pile driving (i.e., hammer size and wall thickness). To reduce cost and potential delays during construction, we recommend static pile load testing or at least dynamic pile testing be performed in advance of construction.

- Based on our FLAC analysis, the deep foundations would reduce lateral spreading as compared to the free field case. Lateral spreading may not impact the subgrade wall as predicted by empirical approaches. However, the subgrade walls would be subjected to significant lateral loading due to earthquake shaking.

- The results of our analysis for the proposed MSE walls indicate potential large deformations (up to several feet) of the MSE walls in the case of liquefaction. WSDOT reviewed our draft report and made a policy decision not to consider this option further.

- Design recommendations and construction considerations were provided for the mat foundations alternative. The main design soil parameter in designing the mat foundations is the subgrade reaction modulus. This parameter was estimated based mainly on the results of *in-situ* testing.

- Based on our discussion with the design team and our engineering analysis, the mat foundations alternative appears to be feasible from an engineering perspective, depending on the risk level acceptable to WSDOT. However, there is risk associated with the construction of this alternative, particularly in case of wet construction.

- The temporary construction slopes should not be steeper than 1.75 horizontal to 1.0 vertical.

- The shoreline slopes have adequate factors of safety under static loading. However, under seismic loading, the slopes would experience significant deformations.

- Site dewatering would likely cause 2 to 8 inches of settlement. Settlement would generally increase near the basin as a result of greater groundwater drawdown at that location.

- Up to 6 ft (typically 3 to 4 ft) of granular fill will be placed to raise the site grade. Site filling would cause approximately 2 to 6 inches of settlement. Wick drains would likely do little to reduce the time required to complete the primary settlement, which we estimate would take on the order of 6 to 8 months to complete.

- Site filling would likely cause significant impacts to a nearby stormwater pump station due to differential settlements. The pump station, owned by the City of Hoquiam, is located along the northern border of the IDD site. The pump station may need to be retrofitted or replaced, depending on actual settlement impacts.

- Utility installation can take place using conventional methods (i.e., trenching and backfilling). Where soft subgrade or wood debris is encountered, up to 2 ft of overexcavation will be necessary.

- A trenchless crossing beneath tracks owned by Puget Sound Pacific Railroad will be necessary to connect to the City of Hoquiam municipal water system. The crossing is feasible using horizontal directional drilling or pipe jacking; however, wood debris and a pile supported trestle may complicate installation. The pipe alignment should be located below the wood layer present at the crossing location. Additional test pits and borings should be conducted along the crossing alignment to better define the location of the wood layer.

- Site filling and dewatering will likely cause the railroad trackbed to settle 1 to 2 inches in the vicinity of the IDD site. This will require routine monitoring of the tracks and periodic leveling until settlements are complete.

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1-1
	1.1 SITE AND PROJECT DESCRIPTION	1-1
	1.2 SCOPE OF SERVICES	1-2
2.0	REVIEW OF AVAILABLE LITERATURE	2-1
	2.1 GEOLOGIC SETTING	2-1
	2.2 GEOTECHNICAL DATA	2-1
	2.3 OTHER INFORMATION	2-1
3.0	VERTICAL DATUM AND SITE HISTORY	3-1
4.0	SUBSURFACE CONDITIONS	4-1
	4.1 FIELD EXPLORATION	4-1
	4.2 GEOTECHNICAL LABORATORY TESTING	4-1
	4.3 GEOTECHNICAL *IN SITU* TESTING	4-2
	4.4 SOIL CONDITIONS	4-2
	4.4.1 Soil Unit 1 – Fill and Silt	4-2
	4.4.2 Soil Unit 2 – Sand and Silt	4-3
	4.4.2.1 Soil Unit 2A - Sandy Silt	4-3
	4.4.2.2 Soil Unit 2B - Silty Sand	4-3
	4.4.3 Soil Unit 3 – Silt	4-3
	4.4.4 Soil Unit 4 – Sand and Gravel	4-4
	4.5 GROUNDWATER	4-4
	4.6 ENVIRONMENTAL AND CULTURAL CONSIDERATIONS	4-4
5.0	ENGINEERING CONCLUSIONS AND RECOMMENDATIONS	5-1
	5.1 SOIL PROPERTIES AND DESIGN PARAMETERS	5-1
	5.1.1 Soil Variability and Sample Disturbance	5-1
	5.1.2 Consistency of Cohesive Soils	5-3
	5.1.3 Cone Penetration Tests Versus Standard Penetration Tests	5-3
	5.1.4 SOIL COMPRESSIBILITY	5-4
	5.1.5 SHEAR WAVE VELOCITY	5-4
	5.2 DESIGN CODES	5-5
	5.3 SEISMIC CONSIDERATIONS	5-5
	5.3.1 Site Seismicity	5-5
	5.3.2 Seismic Design Parameters	5-6
	5.3.3 Liquefaction and Lateral Spreading Potential	5-7
	5.3.3.1 Previous Analysis	5-7
	5.3.3.2 Current Liquefaction Analysis	5-8
	5.3.3.3 Current Lateral Spreading Results	5-9
	5.3.3.4 Liquefaction and Lateral Spreading Impacts and Mitigation	5-11
	5.4 FOUNDATION ALTERNATIVES	5-12
	5.5 ALTERNATIVE I - DEEP FOUNDATIONS WITH CANTILEVER WALLS	5-12

5.5.1 Subgrade Perimeter walls 5-13
5.5.2 Casting Basin Deep Piles 5-16
5.5.2.1 Downdrag on Piles 5-16
5.5.2.2 Axial Capacity 5-17
5.5.2.3 Contribution of Soils between Piles 5-19
5.5.2.4 Resistance Factors for Different Limit States 5-19
5.5.2.5 Pile Settlement 5-20
5.5.2.6 Pile Lateral Capacity 5-20
5.5.2.7 Pile Drivability 5-20
5.5.2.8 Site Preparation Related to Pile Driving 5-24
5.5.3 Seismic Loads 5-25
5.5.4 Crane Foundations 5-26
5.5.4.1 Axial Capacity 5-26
5.5.4.2 Lateral Capacity 5-27
5.6 ALTERNATIVE II - ON-GRADE MAT FOUNDATIONS WITH MSE WALLS 5-27
5.6.1 Mat Foundation 5-27
5.6.2 Subgrade Reaction Modulus 5-28
5.6.2.1 Subgrade Disturbance and Mitigation Measures 5-29
5.7 MOORING DOLPHIN PILES 5-30
5.8 GATE FOUNDATIONS 5-30
5.9 BATCH PLANT FOUNDATIONS 5-31
5.10 SLOPE STABILITY 5-31
5.10.1 Armored Shorelines 5-32
5.10.2 Entrance Channel Slopes 5-33
5.11 TEMPORARY AND PERMANENT DEWATERING 5-33

6.0 CIVIL DESIGN AND CONSTRUCTION CONSIDERATIONS 6-1
6.1 TEMPORARY CONSTRUCTION SLOPES 6-1
6.2 SITE GRADING AND FILLING 6-2
6.2.1 Subgrade Preparation and Grading 6-2
6.2.2 Fill Selection, Placement, and Compaction 6-3
6.2.3 Wet Weather Considerations 6-4
6.3 SITE SETTLEMENT 6-5
6.3.1 Settlement Due to Site Filling 6-5
6.3.2 Settlement Due to Basin Excavation Dewatering 6-5
6.3.3 Rate of Settlement 6-6
6.3.4 Impacts to Existing Structures 6-6
6.3.5 Impacts to Construction Sequence 6-7
6.3.6 Increasing the Rate of Settlement 6-8
6.4 UTILITIES 6-8

6.4.1 Utility Installation Sequence 6-9
6.4.2 Conventional Utilities 6-9
6.4.3 Utility Construction Dewatering 6-9
6.4.4 Trench and Excavation Support 6-10
6.4.5 Pipe Foundations, Bedding, and Backfill 6-11
6.4.5.1 Bedding and Pipe Zone Backfill 6-12
6.4.5.2 Trench Backfill and Compaction 6-12
6.4.5.3 Loads on Pipes 6-12
6.4.5.4 Resistance to Lateral Loads 6-13
6.4.6 Utility Trench Settlements 6-14
6.4.7 Trenchless Pipe Installation 6-14
6.4.7.1 Launching and Receiving Excavations 6-15
6.4.7.2 Settlement Monitoring and Control Considerations 6-15
6.4.7.3 Obstruction Considerations 6-16
6.4.8 Methane Gas 6-16
6.5 RAILROAD SPUR CONSTRUCTION 6-17
6.6 MATERIAL STOCKPILING 6-17

7.0 USE OF THIS REPORT 7-1

8.0 REFERENCES 8-1

LIST OF FIGURES

Figure	Title
1	Vicinity Map
2	Site Plan
3	Site and Exploration Plan
4	Cross Section A-A’
5	Cross Section B-B’
6	Cross Section C-C’
7	Cross Section D-D’
8	Cross Section E-E’
9	Cross Section F-F’
10	Cross Section G-G’
11	Cross Section H-H’
12	Cross Section I-I’
13	Cross Section J-J’
14	Top of Unit 2 Elevation Contour Map
15	Top of Unit 3 Elevation Contour Map
16	Top of Unit 4 Elevation Contour Map
17	Extent of Shallow Wood Layer
18	Approximate Extent of Areas A and B
19	Site-Specific Site Response Results and AASHTO Spectra
20	Recommended Design Spectrum
21	Extent of Liquefaction 1,000-Year Event – Three Earthquake Motions
22	Ultimate Bearing Capacity of Driven 24-inch Piles
23	Ultimate Bearing Capacity of Driven 30-inch Piles
24	Ultimate Bearing Capacity of Driven 36-inch Piles
25	Bending Moments on Piles Due to Lateral Spreading
26	Vertical Subgrade Reaction Modulus (K)

LIST OF TABLES

Table	Title
1	Summary of Measured Soil Properties from In Situ and Laboratory Tests
2	Soil Properties for Design
3	Earth Pressures Recommendations
4a	LPILE Design Input Parameters, 1,000-Year Earthquake
4b	DFSAP Design Input Parameters, 1,000-Year Earthquake
5a	LPILE Design Input Parameters, Mooring Dolphins
5b	DFSAP Design Input Parameters, Mooring Dolphins

LIST OF APPENDICES

Appendix	Title
A	Field Explorations
B	Geotechnical Laboratory Testing
C	Geotechnical In-Situ Testing
D	Information from Reviewed Literature
E	Results of Seismic Numerical Analyses
F	Results of Numerical Analyses – Settlement

1.0 INTRODUCTION

This report presents the results of our design-level geotechnical study to provide design and construction recommendations for the proposed Washington State Department of Transportation (WSDOT) State Route (SR) 520 Pontoon Construction Project at the Industrial Development District (IDD) #1 site at the Port of Grays Harbor, Washington. The general project location is shown on Figure 1. Landau Associates previously completed several studies for the subject project as follows:

- Geotechnical and Hydrogeologic Study (Landau Associates 2006a)
- Geotechnical Design Study (Landau Associates 2007a)
- Dewatering Evaluation Report (Landau Associates 2007b)
- Dewatering System Cost Estimate technical memorandum (Landau Associates 2007c)
- Preliminary Site Investigation environmental report (Landau Associates 2006b)
- Radiocarbon Dating Report (Landau Associates 2006c).

1.1 SITE AND PROJECT DESCRIPTION

Approximately 44 acres are available at the Port of Grays Harbor for the project. The site is partially covered by Category III and Category IV wetlands and is not currently in use. It is bounded by the Chehalis River on the south, the Hoquiam River on the east, and the Puget Sound Pacific Railroad tracks to the north. To the west, the site is bounded by a mill pond and a vacant log yard. An existing pump station is located at the northern boundary of the site. Site features are shown on the Site Plan (Figure 2).

Topography of the site is relatively flat with average surface elevations varying from 13 to 15 ft mean lower low water (MLLW), according to a topographic map prepared for the Port of Grays Harbor in 2005. The site is predominately covered with grass, except for an approximately 10-foot-wide gravel access road/dike that runs along the west, south, and east boundaries of the site. The site was originally a saltmarsh (IDD[1] package 2006) before it was filled with dredge material in 1977 and 1978.

WSDOT is currently evaluating the subject site for pontoon construction required for the proposed new SR 520 floating bridge across Lake Washington. The casting basin at the subject site will be approximately 450 feet (ft) by 965 ft in plan view. The location of the facility within the site is shown on Figure 2. Laydown, staging, and work areas will surround the facility. Stormwater collection and

[1] Port of Grays Harbor Industrial Development District No. 1, discussed in Section 2.3.

infiltration, plus process water collection, treatment, and discharge will occur at the site. A proposed concrete batch plant may also be constructed at the site.

1.2 SCOPE OF SERVICES

The purpose of this design study is to refine conclusions reached during the previous design geotechnical study (Landau Associates 2007a) using additional analysis methods, to provide geotechnical engineering recommendations for general civil site development, and to provide geotechnical engineering recommendations related to changes to the casting basin design. Our scope of services included the following:

- A subsurface exploration program primarily to perform *in-situ* geotechnical testing and to support the civil and hydraulic structures at the site. The logs of the current and previous explorations are presented in Appendix A.
- Laboratory testing programs, the results of which are presented in Appendix B.
- *In situ* testing programs, the results of which are presented in Appendix C.
- Seismic analyses to account for the change in the earthquake design level from a 475- to a 1,000-year event. The seismic analyses were performed using FLAC-2D (Itasca Consulting Group, Inc. 2008), OpenSees (Pacific Earthquake Engineering Research Center 2006), D-MOD2000 (Matasović and Ordonez 2007), and SHAKE2000 (Ordonez 2000) software.
- Geotechnical foundation analyses for the deep foundation option, including numerical analyses with FLAC2D (Itasca Consulting Group, Inc. 2008) and FLAC3D (Itasca Consulting Group, Inc. 2006) software.
- Geotechnical foundation analyses for the on-grade mat foundation and mechanically stabilized earth (MSE) walls option, including numerical analyses using FLAC2D software to assess stability under seismic conditions.
- Geotechnical analyses to support the civil design.
- Geotechnical design report.

These services were provided as a subconsultant to HDR, the General Engineering Consultant to WSDOT for the SR 520 Bridge Replacement and HOV project, under a multi-task Subconsultant Agreement for Geotechnical Services No. Y-9761, Task BD, Amendments 03, 04, and 05. Note that the results of part of the scope of Amendment 04 are presented in our technical memorandum dated December 5, 2008 (Landau Associates 2008a).

2.0 REVIEW OF AVAILABLE LITERATURE

In our preliminary geotechnical investigation, we reviewed available geologic maps, geotechnical reports, and other information provided by WSDOT related to the subject site, and that information is summarized below.

2.1 GEOLOGIC SETTING

Geologic information at the subject site was obtained from the *Geologic Map of the Humptulips Quadrangle and Adjacent Areas, Grays Harbor County, Washington* (Rau 1987) and from the *Geologic Map of the Chehalis River and Westport Quadrangles, Washington* (Logan 1987). In general, the primary information in these two maps is related to bedrock rather than soil deposits. However, these geologic maps indicate that the site is underlain by recent alluvial deposits consisting of sand and silt, which are in turn underlain by glacial recessional deposits.

2.2 GEOTECHNICAL DATA

In the preliminary phase of this project (Landau Associates 2006a), we reviewed the geotechnical reports for grading of the subject site (Roger Lowe Associates 1976, 1978, 1980) provided by WSDOT. Some previous site drawings were enclosed with these reports. For brevity, the Roger Lowe Associates reports and enclosed drawings will be referred to as the "Roger Lowe package." Relevant subsurface and topographic information from this package was considered in this study and is presented in Appendix D.

2.3 OTHER INFORMATION

We also reviewed the package titled "I.D.D. #1 – Brief History," in the preliminary phase of this project (Landau Associates 2006a) provided to us by WSDOT. The package includes a topographic map of the site (which appeared to be completed sometime in 2005); a wetland report dated September 1997 prepared by Pentec Environmental, Inc.; and some design drawings dated 1984. This package will be referred to as the "IDD package." A drawing from this package is included in Appendix D.

3.0 VERTICAL DATUM AND SITE HISTORY

Prior to presenting relevant information related to the site history, it is important to note that there are differences between the elevations reported in the documents from 1984 and earlier, and those shown on the topographic map included in the IDD package and the cross sections developed by WSDOT. For example, in the Roger Lowe package, the top of the dike is shown at elevation (El.) 18 ft MLLW, whereas the WSDOT cross sections and the IDD package indicate that the average top of the dike is at El. 15 ft MLLW.

Based on our conversations with the Port of Grays Harbor and its consultant during the preliminary phase of this project, no site grading has been completed since the early 1980s to explain the elevation difference. We understand that the MLLW datum was raised a few years ago. The difference between the old datum and the new datum is not known to us, but such datum changes are typically minor and would not likely explain a 3-ft elevation difference. Comparing subsurface conditions encountered in the 1970s borings with those encountered in the borings drilled for this study did not explain the difference in elevation. The difference in elevation, which can be partially attributed to long-term settlement, does not impact the results of the analysis, conclusions, and recommendations presented in this report.

In this paragraph, the elevations are referenced to the older MLLW datum, as discussed above. Based on our review of the Roger Lowe package, we understand the subject site reportedly sloped gently upward from El. 1 ft near the southern site boundary to El. 15 ft near the northern boundary. Prior to filling, the site was inundated by tides ranging up to El. 12 ft. Wood waste associated with local milling operations was reportedly deposited in the northwest corner of the site (Roger Lowe Associates 1976). (Our current study indicates the presence of wood waste along the northern portion of the site as shown on Figure 17.) A dike consisting of pit-run quarry rock was constructed in 1976 and 1977 along the west, south, and east property boundaries. Dredge fill from the Chehalis River was placed on the inside of the pit-run dike. The 1976 report indicates that the site would be filled to El. 16 ft and surcharged to El. 22 ft, with an estimated settlement of 2 to 7 ft due to fill placement. The report indicated a substantial portion of the settlement was expected to be completed within 3 months of filling.

We understand that site grading was proposed as indicated in the 1978 report and as illustrated on the 1981 Proposed Dredge Fill Map (Appendix D). Given the current flatness of the site, we assume that site grading was performed as planned.

4.0 SUBSURFACE CONDITIONS

The following sections summarize our subsurface exploration and geotechnical *in situ* and laboratory testing programs as well as the soil and groundwater conditions encountered in the explorations. The subsurface conditions described below incorporate field and laboratory observations obtained during the current and previous studies.

4.1 FIELD EXPLORATION

Subsurface conditions within the limits of the project area were explored during the current design study and previous studies. Exploration for the current design phase included one offsite boring to assist with the design of a proposed utility crossing beneath railroad tracks along the northern boundary of the project site.

Previous explorations include 20 geotechnical borings (designated B-1 through B-20), 6 borings installed with vibrating wire pressure transducers (designated VW-1 through VW-6), and 23 cone penetration tests (CPTs) (designated CPT-1 through CPT-23).

The current exploration program included drilling and sampling a total of 42 exploratory borings (designated TH-27-08 through TH-67-08) and 28 test pits (designated TP-1-08 through TP-27-08)[2]. Seven borings were drilled to depths exceeding 140 ft and encountered dense gravels. Other borings were drilled to depths of 20 to 60 ft. Test pits extended approximately 8 to 19 ft below the ground surface (BGS). The locations of all explorations (current and previous) are shown on Figure 3. A discussion of the exploration program for this phase of work, along with logs of previous and current explorations, is included in Appendix A.

4.2 GEOTECHNICAL LABORATORY TESTING

Geotechnical laboratory testing of soil samples obtained from the explorations consisted of water content determinations, grain size analyses, fines content determination, combined grain size analyses, Atterberg limits, unconsolidated undrained (UU) compression, consolidated undrained (CU) compression, consolidation tests, and pH and resistivity measurements. A more detailed discussion of the geotechnical laboratory test procedures and test results are presented in Appendix B.

---

[2] The numerical designation of the test pits does not match the number of tests pit excavated at the site because one of the test pits is designated TP-18A.

4.3 GEOTECHNICAL *IN SITU* TESTING

In situ tests completed during the current design phase include pressuremeter testing (PMT) and shear wave velocity measurements using downhole suspension techniques. *In situ* tests performed during the previous explorations include downhole vane shear testing at selected borings, CPT dissipation tests to estimate the horizontal coefficient of consolidation, and shear wave velocity measurement in selected CPTs. A more detailed discussion of the *in situ* test procedures and test results are presented in Appendix C.

4.4 SOIL CONDITIONS

We have grouped soil deposits encountered in our explorations at the subject site into four soil units (Soil Units 1 though 4). Soil Unit 2 is further subdivided into Soil Units 2A and 2B based on the composition of the material. The soil units are grouped primarily on the basis of engineering properties and classifications and, in general, reflect depositional environments as well. Generalized subsurface cross sections are illustrated on Figures 4 through 13. Three contour maps showing the interpreted top elevations of Soil Units 2 through 4 are illustrated on Figures 14 through 16.

4.4.1 SOIL UNIT 1 – FILL AND SILT

The uppermost subsurface soil unit (referred to as Soil Unit 1) encountered in our subsurface explorations varies in thickness from about 22 to 42 ft. Soil Unit 1 includes dredge fill from previous site filling overlying native, massive to slightly laminated silt with variable sand content. The dredge fill predominately consists of very loose to medium dense silty sand to sandy silt. The thickness of the fill varies across the site with a maximum depth of about 10 ft.

Wood waste extending to depths ranging from approximately 6 to 9 ft BGS, or to about El. 5 ft, was encountered in several borings and test pits. The test pits revealed that the wood waste consists of debris varying in size from sawdust to dimensioned timbers several feet in length. Numerous buried large logs are also present. During test pit digging, many of the excavations exhibited a strong hydrogen sulfide (rotten egg) odor. Methane was also present in many of the test pits. The hydrogen sulfide odor and presence of methane is likely the result of ongoing decomposition of the wood waste and wood debris. The approximate extent of this shallow wood layer is shown on Figure 17. Photographs showing the wood waste, debris, and logs disclosed in some of the test pits are included in Appendix A.

The underlying native silt generally consists of high plasticity, medium stiff silt with variable content of sand, clay, and organics. Because of its plastic, fine-grained nature, Soil Unit 1 will experience consolidation settlements as a result of loads caused by construction and dewatering operations associated

with the project. Because of localized areas with significant organic content, settlements resulting from secondary compression may also be significant for this soil.

4.4.2 SOIL UNIT 2 – SAND AND SILT

Soil Unit 2 encountered in our explorations was observed to primarily consist of stratified deposits of silt and sand. This soil unit was encountered down to about El. -62 to -78 ft. Soil Unit 2 is further subdivided laterally into Soil Units 2A and 2B as described in the following sections. Because of the distinct differences between Soil Units 2A and 2B, we divided the subject site into two areas, Area A and Area B, as shown on Figure 18.

4.4.2.1 Soil Unit 2A - Sandy Silt

Soil Unit 2A was observed in previous explorations advanced within an area located south of the footprint of the proposed facility. No borings completed in this area for the current design phase were extended to depths sufficient to further delineate the extent of Soil Unit 2A. Soil Unit 2A predominately consists of silt with thin sand interbeds and some relatively thick layers of sand. The silt in Soil Unit 2A is generally of medium plasticity and varies in consistency from medium stiff to stiff. Based on its plasticity, the silt is not susceptible to liquefaction. The sand layers within Soil Unit 2A consist of loose to medium dense, silty to very silty, fine to medium sand. These sand layers within Soil Unit 2A are susceptible to localized liquefaction.

4.4.2.2 Soil Unit 2B - Silty Sand

The portion of Soil Unit 2 observed in the remaining portion of the site (Soil Unit 2B) predominately consists of sand with silt to silty sand with thin laminations of silt. The sand was observed to be loose to medium dense. The silt within Soil Unit 2B is medium stiff in consistency and varies in thickness from 5 to 10 ft. The sand within Soil Unit 2B is susceptible to liquefaction.

4.4.3 SOIL UNIT 3 – SILT

Soil Unit 3 consists of slightly laminated to massive silt with lenses of abundant organics and sand. The organic content would influence the compressibility properties of Soil Unit 3. Soil Unit 3 was encountered beneath Soil Unit 2 across the entire site. The silt varies in consistency from medium stiff to very stiff. A 5- to 10-ft layer of silty sand to sandy silt was observed within Soil Unit 3 from about El. -73 to -83 ft MLLW. The sandy silt to silty sand was observed to be stiff to very stiff and medium dense in consistency/density. This unit is not susceptible to liquefaction.

4.4.4 SOIL UNIT 4 – SAND AND GRAVEL

Soil Unit 4 typically consists of very sandy gravel with silt. The sandy gravel is generally dense to very dense with some medium dense layers (refer to Table 1 for statistical information about the blow counts in Soil Unit 4). Some zones of predominately sand or gravelly sand are also present within Soil Unit 4. During exploration conducted for the previous design phase (Landau Associates 2007a), decomposed wood was encountered 8 ft below the top of Soil Unit 4 in Boring B-8. As part of explorations conducted for the current study, an additional deep boring (Boring TH-27-08) was drilled in the vicinity of Boring B-8 and extended into the gravel layer but did not encounter wood.

The surface of this deep deposit generally slopes downward to the south as shown on Figure 16. Based on our review of geologic information and grain size analyses, the geologic origin of this unit appears to be glacial recessional outwash. In the current study, four deep borings (TH-28-SW-08, TH-29-SW-08, TH-30-SW-08, and TH-31-SW-08), extending about 154 to 250 ft BGS, were drilled for the purpose of measuring shear wave velocities. The four borings were terminated in Soil Unit 4.

4.5 GROUNDWATER

The groundwater table at the site generally slopes downward from the northwest to the southeast, toward the Chehalis and Hoquiam rivers. Groundwater is typically encountered at El. 8 ft MLLW near the northwest corner. In areas adjacent to the river shores, groundwater is typically encountered at El. 6 to 7.5 ft MLLW, and is somewhat influenced by tidal fluctuations in the rivers. More significant increases in groundwater elevations occur seasonally, with highest levels generally occurring during the winter and spring months. During test pit digging, moderate to rapid groundwater seepage and flow into the excavation was observed in the wood debris layer.

Further discussions about groundwater are presented in our dewatering report (Landau Associates 2009).

4.6 ENVIRONMENTAL AND CULTURAL CONSIDERATIONS

Our field representatives screened soil samples from borings drilled at the site for volatile organic compounds (VOCs) using a photoionization detector (PID). The PID readings, which are presented on the summary boring logs in Appendix A, indicated no detectable concentrations of VOCs. During test pit digging, methane levels around the test pit excavation were monitored using a handheld multi-gas meter. At test pits where significant amounts of methane were detected, a note was made on the test pit log. The

methane was generally detected in association with a shallow wood layer and is likely a byproduct of wood decomposition. A hydrogen sulfide odor (rotten egg smell) was also noted in some of the test pits.

Landau Associates previously performed a preliminary site investigation (environmental) study on the site, the results of which were summarized in a report submitted to WSDOT (Landau Associates 2006b).

WSDOT performed cultural resources studies at the project site (BOAS 2007). WSDOT's cultural resources consultant (BOAS, Inc.) also made field observations and collected samples during test pit excavations in the current field investigation.

5.0 ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

This section presents our geotechnical engineering conclusions and recommendations for the design and construction of the proposed facility. We developed our conclusions and recommendations based on our current understanding of the project and the conditions encountered in the subsurface explorations.

5.1 SOIL PROPERTIES AND DESIGN PARAMETERS

A summary of the *in situ* and laboratory testing results along with statistical analyses of the results are presented in Table 1. The soil parameters used in the design are presented in Table 2. The following sections present discussions about soil properties and critical soil design issues.

5.1.1 SOIL VARIABILITY AND SAMPLE DISTURBANCE

As indicated in Table 1, the soil properties for Soil Units 1 through 3 are quite variable. The variation of soil properties can be attributed in part to the natural variation of a soil deposit and in part to the quality of the undisturbed samples of cohesive soils collected using piston samplers and Shelby tubes. Piston samplers were used to obtain samples from Soil Unit 3 to attempt to reduce sample disturbance in this design phase.

Sample disturbance usually results in a lower undrained shear strength and preconsolidation pressure than actual values and overestimation of the soil compressibility. Sample quality can be assessed from the results of the consolidation test (FHWA 2002). Accounting for the overconsolidation and depth, three quality levels are used to classify sample quality: (1) very good, (2) acceptable, and (3) likely to be very disturbed. Our evaluation of the disturbance of samples tested for consolidation properties is presented below.

SAMPLE QUALITY

Soil Unit	Boring	Project Phase	Depth (ft)	Sample No.	OCR	ε_v	Quality (Range)
Unit 1	B-1	Preliminary	32	19	1.9	3	Acceptable (1.5-3.5)
	B-4		23	14	3.8	3	Acceptable (1-3)
	B-13	Phase I Design	17	6	2.2	5	Likely to be very disturbed (>3)
	B-15		23	8	1.6	4	Likely to be very disturbed (>3)
	B-16		21	7	1.7	3	Acceptable (1.5-3.5)
	B-17		23	8	2.2	3	Acceptable (1.5-3.5)
	TH-32-08	Phase II Design (Current Study)	13.2	4	1.3	5	Likely to be very disturbed (>3)
	TH-29-SW-08		15.9	1	1.3	4.5	Likely to be very disturbed (>3)
	TH-27-08		15.1	3	2.4	3	Likely to be very disturbed (>3)
Unit 3	B-1	Preliminary	101	38	1.5	7	Likely to be very disturbed (>3)
	B-4		95	36	1.7	7	Likely to be very disturbed (>3)
	B-10	Phase I Design	106	28	1.3	8	Likely to be very disturbed (>3)
	B-12		101	27	1.6	4	Likely to be very disturbed (>3)
	TH-30-SW-08	Phase II Design (Current Study)	124.5	15	1.2	6	Likely to be very disturbed (>3)
	TH-30-SW-08		85.8	5	1.5	4	Likely to be very disturbed (>3)
	TH-31-SW-08		85.0	9	1.6	3	Likely to be very disturbed (>3)
	TH-30-SW-08		105.0	10	1.6	5	Likely to be very disturbed (>3)
	TH-27-08		99.7	23	1.2	5	Likely to be very disturbed (>3)
	TH-33-08		105.3	31	1.1	7	Likely to be very disturbed (>3)
	TH-29-SW-09		105.1	10	1.2	5	Likely to be very disturbed (>3)

OCR = Overconsolidation ratio
ε_v = Strain required to reach *in situ* effective stress
Samples were obtained using Shelby tubes or a piston sampler. All samples obtained during the Preliminary phase and Unit I, Phase I samples were collected using Shelby tubes. Phase I, Unit 3 samples and all Phase II samples were collected using a piston sampler.

As indicated above, samples collected from Soil Unit 3 were quite disturbed (except for Sample 27 from Boring B-12), which might affect the laboratory results and, subsequently, design parameters. Many factors can contribute to sample disturbance, such as type of soil, sampling method, and sample handling during transportation and testing. In our opinion, the structure of Soil Unit 3 may be sensitive to sampling, resulting in relatively disturbed samples. The results of the vane shear tests suggest that Soil Unit 3 is quite sensitive, as indicated in Table C-1 in Appendix C. To overcome sample disturbance in tested samples from Soil Unit 3 observed in the preliminary phase, Shelby tube samples were pushed with a piston during the design phase. However, the samples from the design phase still exhibited a considerable amount of disturbance.

Considering the above, sample disturbance was considered in our settlement analysis of Soil Unit 3 and, therefore, the results of the pressuremeter[3] were given more weight than the consolidation test.

5.1.2 CONSISTENCY OF COHESIVE SOILS

The consistency of cohesive soils (Soil Units 1 and 3, plus portions of Soil Unit 2) will have an impact on foundation design and site grading. Soil consistency was evaluated based on the results of *in situ* and laboratory testing completed for this phase and previous phases. These tests included vane shear tests, triaxial tests (TXUU and TXCU), CPT soundings, and pressuremeter testing. Standard Penetration Test (SPT) blow counts were also performed during drilling and indicate lower consistency; however, SPT values are an unreliable indicator of soil consistency in softer cohesive soils. For example, the average SPT blow counts of 4 (refer to Table 2) of the silt of Soil Unit 3 indicates a consistency of soft to medium stiff. However, the average vane shear results [0.9 tons per square foot (tsf)] and undrained shear strength (0.8 tsf) indicate a higher consistency of stiff.

5.1.3 CONE PENETRATION TESTS VERSUS STANDARD PENETRATION TESTS

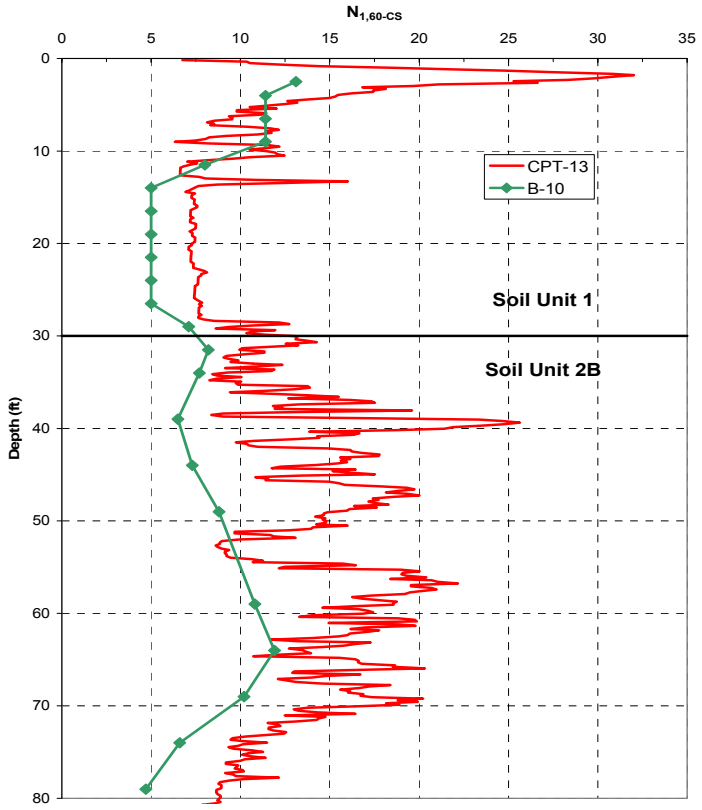
As discussed in the above section, SPTs tend to underestimate undrained shear strength of cohesive soils. Additionally, SPTs may underestimate the relative density of granular soils, particularly those with significant fines content similar to Soil Unit 2. On the other hand, CPTs tend to give a better estimate of the relative density of these soils (Lunne et al. 1997).

To evaluate the difference between the CPTs and SPTs, three cone penetration tests were pushed adjacent to exploratory borings CPT-13/B-10, CPT-18/B-12, and CPT-23/B-15. The graph below demonstrates the difference between the measured $N_{1,60\text{-}cs}$[4] in Boring B-10 versus $N_{1,60\text{-}cs}$ estimated from the adjacent CPT-13.

---

[3] The pressuremeter measures soil stiffness, which can be used in the settlement analysis.

[4] $N_{1,60\text{-}cs}$ = Blow counts per foot using a standard hammer with 60 percent efficiency, corrected for 1.0 ton overburden and adjusted to equivalent clean sand.



5.1.4 SOIL COMPRESSIBILITY

Site soils will be subject to settlement following application of loads during site dewatering, basin construction, site grading, and pontoon production. For cohesive soil units (Soil Units 1 and 3), soil compressibility parameters were estimated using results from laboratory one-dimensional consolidation testing. For load applications below the estimated maximum past pressure, the compressibility of cohesive soils was also approximated using pressuremeter data. The latter approach was also applied for Soil Unit 2B, which is cohesionless. Soil Unit 4 can be considered incompressible under the anticipated loads. Our estimates of soil compressibility parameters are provided in Table 2.

5.1.5 SHEAR WAVE VELOCITY

In the previous design study (Landau Associates 2007a), we measured shear wave velocity of Soil Units 1 and 2 using a seismic CPT. Measurements of shear wave velocities of deeper soils (Soil Unit 3 and 4) were not feasible due to equipment limitation. For the current design study, we conducted *in situ* shear wave measurements using down-hole shear wave suspension logging equipment, and measurements

down to 228 ft BGS were obtained. Details regarding this test method and a report summarizing the test results are provided in Appendix C.

The results of the down-hole suspension logging within the upper 80 ft are practically consistent with the shear wave measurements from the CPT. Within Soil Unit 2, the measured shear wave velocities from the CPTs and the suspension logging method were both significantly less than those values estimated based on empirical methods, such as the one by Seed et al. (1986). Below 228 ft, we extrapolated the measured shear wave velocities and assumed that bedrock[5] is at 300 ft BGS. This assumption is discussed further in Appendix E.

5.2 DESIGN CODES

Our analyses were based on the following code and design guidelines:

- American Association of State Highway and Transportation Officials (AASHTO) Specifications and Guide Specifications for LRFD Bridge Design (AASHTO 2007a,b)
- WSDOT Geotechnical Design Manual (GDM) (WSDOT 2006).

The seismic chapter (Chapter 6) of the 2006 WSDOT GDM was revised (WSDOT 2008a) after our scope of services had been negotiated and authorized by WSDOT and was well underway. Therefore, our seismic analysis was based on the 2006 manual rather than the revised Chapter 6 of the 2008 manual.

5.3 SEISMIC CONSIDERATIONS

The following sections present the site seismicity and the results of our seismic analyses.

5.3.1 SITE SEISMICITY

The west coast of Washington State is located near the convergent continental boundary known as the Cascadia Subduction Zone (CSZ). The CSZ is the location where the North American Plate is overriding the subducting Juan de Fuca Plate. The interaction of these two plates results in three potential seismic source zones: (1) the shallow crustal zone, (2) the deep subcrustal zone, and (3) the CSZ.

Regarding the subject site, major earthquakes in the region are generally associated with the CSZ off the Washington coast. The CSZ is capable of generating earthquakes of magnitude 8.0 to 9.0. No subduction earthquakes have been recorded within the region in the recent historical period. The most recent large (magnitude 8.0 or more) event appears to have occurred in 1700.

[5] A shear wave velocity of 2,500 foot per second is typically assumed to be consistent with soft rock.

In addition to the large CSZ earthquakes, several active and potentially active faults are present within and near the project region. Seismic events on these faults are generally associated with the deep subcrustal zone. They are similar in nature to the historical Puget Lowland earthquakes, including the 1949 Olympia earthquake (Richter magnitude 7.0), the 1965 Seattle earthquake (Richter magnitude 6.5), and the 2001 Nisqually earthquake (Richter magnitude 6.8).

The seismic risk from the various potential seismic source zones have been assessed in a number of recent seismic studies and the results incorporated into U.S. Geological Survey (USGS) seismic hazard mapping. The USGS seismic hazard mapping has been used as the basis for the peak ground acceleration on bedrock that could be expected for the identified seismic design level at the site.

5.3.2 SEISMIC DESIGN PARAMETERS

According to the AASHTO LRFD seismic design guide specifications (AASHTO 2007b), the near-surface soil profile is classified as **Site Class E,** as the average measured shear wave velocity within the upper 100 ft is less than 600 ft/second.

The 2007 AASHTO specifications allow the use of a site-specific response spectrum provided that the design spectrum shall not be less than two-thirds of the code-based spectrum. The code-based spectrum can be constructed using the following parameters (USGS 2002):

Spectral Acceleration for Short Periods (S_S):	105% of gravity (1.05g)
Spectral Acceleration for a 1-Second Period (S_1):	48% of gravity (0.48g)
Peak Horizontal Ground Acceleration (Bedrock) Coefficient (PGA):	45% of gravity (0.44g)

As per our scope of services, we performed a site response analysis using several computer programs rather than one (as typically done) because of uncertainties with soil behavior in case of liquefaction as discussed subsequently in Section 5.3.3. A summary of the results of our site-specific response spectrum are presented below.

Figure 19 shows the code-based full spectrum and the reduced (by one-third) spectrum. Figure 19 also shows the results of the site-specific response spectrum using FLAC2D. The recommended spectrum is presented on Figure 20 along with the reduced code-based spectrum and the geometric mean of the three site-specific response spectra for comparison purposes.

Details of our site response analysis, including the selection of the earthquake time histories, are discussed in detail in Appendix E.

5.3.3 LIQUEFACTION AND LATERAL SPREADING POTENTIAL

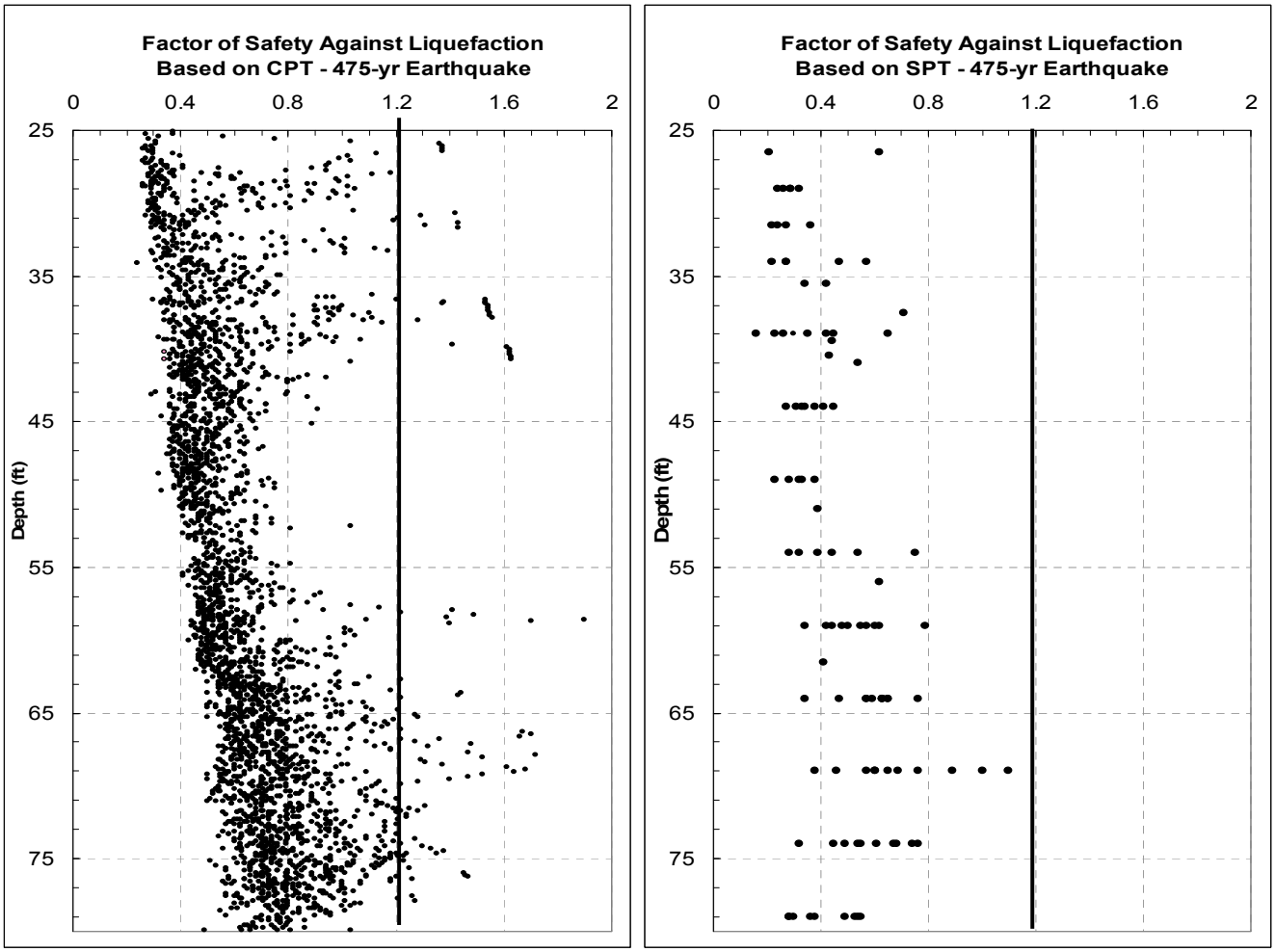
Liquefaction is defined as a significant rise in pore water pressure within a soil mass caused by earthquake-induced cyclic shaking. The shear strength of liquefiable soil is reduced during large and/or long-duration earthquakes as the soil consistency approaches that of a semi-solid slurry, which can result in significant and widespread structural damage if not properly mitigated. Deposits of loose, granular soil below the water table are most susceptible to liquefaction. In the case of liquefaction, lateral spreading may occur on sites adjacent to bodies of water or on gently sloping sites.

At the subject site, Soil Unit 2B consists primarily of soils that are susceptible to widespread liquefaction. This soil unit underlies the entire footprint of the proposed facility as shown on Figures 5 through 7 and Figure 18. Soil Units 1 and 2A consist predominately of relatively high plasticity silt that is not susceptible to liquefaction. Some granular layers of Soil Units 1 and 2A, however, are susceptible to liquefaction. Soil Units 3 and 4 are deeper than 80 ft, below which liquefaction is not typically considered (WSDOT 2006). Therefore, Soil Units 3 and 4 are not susceptible to liquefaction.

5.3.3.1 Previous Analysis

In our previous geotechnical design study (Landau Associates 2007b), we completed a liquefaction analysis using the results of a site specific analysis based on one 475-year earthquake motion (Vina del Mar motion)[6]. The results of our previous liquefaction analysis are shown on the graph below.

[6] The Vina del Mar motion is one of the motions used in our site response spectrum but after modifying it to a 1,000-year level.



As indicated on the graph above, almost the entire Soil Unit 2B would liquefy in the case of a 475-year earthquake, based on the "modified simplified approach" for granular soils (Youd et al. 2001). So, a conclusion can be drawn that Soil Unit 2B would liquefy in the case of a 1,000-year earthquake.

As for lateral spreading, we previously performed a lateral spreading analysis using an empirical method (Youd et al. 2002), as discussed in our 2006 and 2007 reports (Landau Associates 2006a, 2007a). We also performed a lateral spreading analysis using FLAC2D (Landau Associates 2007a). The results of the previous analyses suggest that the lateral spreading toward the Chehalis River would occur in the case of a 475-year earthquake (Landau Associates 2006a, 2007a).

5.3.3.2 Current Liquefaction Analysis

Our liquefaction analysis for the current study was completed using a non-linear, effective-stress analysis using FLAC2D. Three earthquake motions were used in the FLAC2D analysis. For verification

purposes, we used computer programs D-MOD2000 and OpenSees to evaluate liquefaction using only one earthquake motion (Vina del Mar motion). These three computer programs estimate pore water pressure buildup during earthquake shaking, which can be used to evaluate liquefaction. Our liquefaction analysis is based on soil parameters presented in Table 2. In our analysis, we assumed free field conditions (i.e., no facility at the site and no site grading). Also, our liquefaction analysis was based on the results of SPTs rather than results of the CPTs (refer to the discussion in Section 5.1.3), as per our discussion with WSDOT during the previous design phase (Landau Associates 2007a).

Our liquefaction analysis suggests that most of Soil Unit 2B would liquefy under each of the three earthquake motions as shown on Figure 21. In Figure 21, liquefaction is expressed in terms of excess pore water pressure ratio (r_u), which represents initiation of liquefaction when r_u reaches 100 percent. A further discussion about the use of r_u in evaluating liquefaction and whether the FLAC2D results are consistent with the results of the simplified approach (Youd et al. 2001) are presented in Appendix E.

Liquefaction typically induces settlement. Based on our previous analysis (Landau Associates 2007a), we estimate that liquefaction-induced settlement can range from 15 to 30 inches. This variation of estimated settlement reflects potential differential settlement across the facility site, assuming no liquefaction mitigation. Also, liquefaction-induced settlement would cause downdrag forces on the deep piles as discussed in Section 5.5.2.1.

The actual magnitude and extent of liquefaction will depend on many factors, including the duration and intensity of the ground shaking during the earthquake and local soil and groundwater conditions. Therefore, the extent of liquefaction and magnitude of settlement may vary from that estimated above.

Appendix E presents further details about our liquefaction analysis, including discussion regarding the timing of liquefaction and a comparison of the results of the three computer programs (FLAC2D, OpenSees, and D-MOD2000).

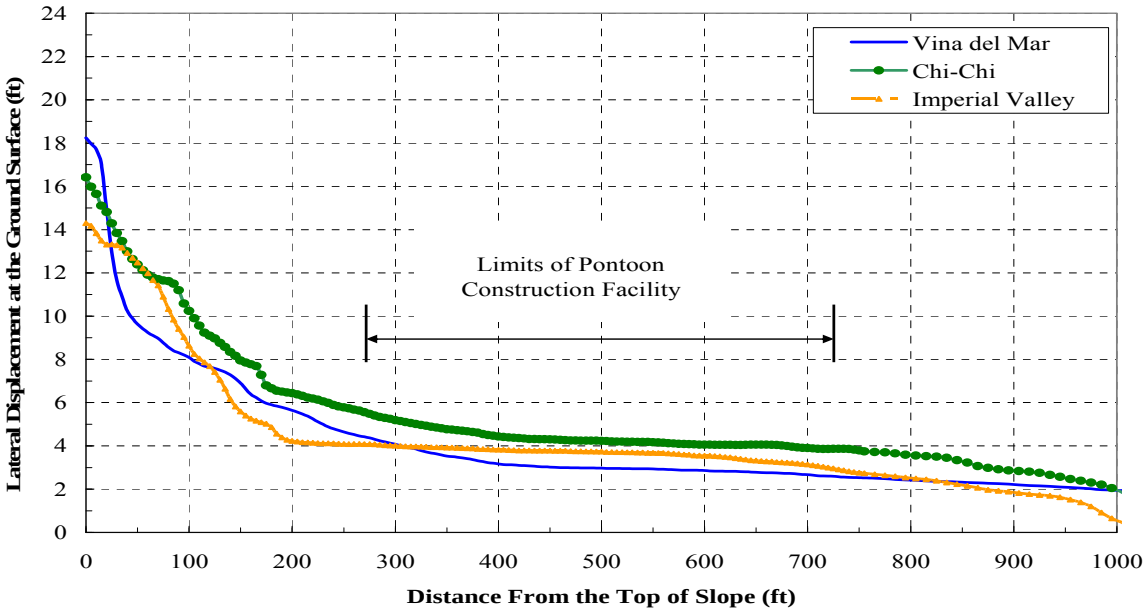
5.3.3.3 Current Lateral Spreading Results

As mentioned in Section 5.3.3.1, we previously performed lateral spreading analyses using the Youd et al. method (2002) and using FLAC2D. For this phase, we revised our FLAC2D analysis to assess lateral spreading based on measured shear wave velocities and using 1,000-year earthquake motions.

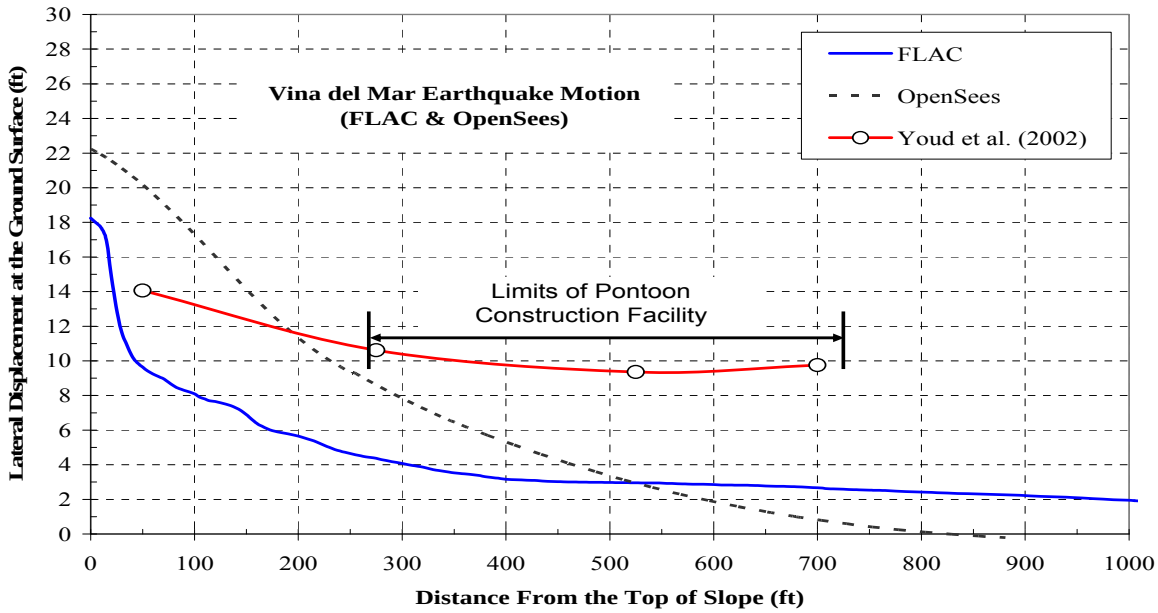
In our lateral spreading analysis, we used three artificial earthquake motions (Vina del Mar, Imperial Valley, and Chi-Chi motions). Also, lateral spreading was assessed with OpenSees using one motion (Vina del Mar). The OpenSees analysis was performed by Dr. Pedro Arduino, and the details of the OpenSees analysis are summarized in a report in Appendix E. The geometry of the model was based

on cross section D-D' shown on Figure 7. Section D-D' is relatively representative of the worst-case scenario from a lateral spreading perspective compared to Sections A-A', B-B', and C-C' (refer to Figures 4 through 6)[7]; Section E-E' is similar to Section D-D'.

The lateral spreading results of the free field (no facility and no site grading) are presented in the two graphs below. The first graph shows the estimated lateral spreading for the three motions based on the FLAC2D analysis. The second graph compares the displacements predicted using FLAC2D versus the OpenSees lateral displacements using the Vina del Mar motion. Also shown on the second graph, for comparison purposes, are lateral spreading values using the Youd et al. (2002) method, based on the 1,000-year earthquake level. Note that the limits of facility shown on the two graphs refer to the south and north wall. The south wall is about 270 ft from the top of the slope and the north wall is about 720 ft measured from top of the slope.



[7] Along Section D-D', liquefiable soils extend to the southern edge of the site. Along Sections A-A', B-B', and C-C', Soil Unit 2A is present and liquefiable soils extend only slightly south of the facility.



The first and the second graphs suggest that lateral spreading would occur at the site in the case of the design earthquake. However, construction of the facility, regardless of the type of the foundation, would impact the magnitude of the lateral spreading. The impact to the facility on magnitude of lateral spreading and forces induced by lateral spreading are discussed subsequently in Section 5.5.3 for the deep foundations alternative.

5.3.3.4 Liquefaction and Lateral Spreading Impacts and Mitigation

We understand that WSDOT is not planning to mitigate liquefaction and lateral spreading within the footprint of the casting basin in the case of using deep foundation piles. However, ground improvement may be considered at the gate area. (Note that we did not perform a seismic analysis to evaluate the stability of the gate structure in case of liquefaction and lateral spreading.)

Our preliminary[8] recommendations for ground improvements are to use a stone columns system with a minimum area replacement ratio of 15 percent in conjunction with the use of wick drains. Without the use of wick drains, stone columns would not be effective in mitigating liquefaction of Sand Unit 2B because of the silt content (Idriss and Boulanger 2008). The use of wick drains before the installation of stone columns at some sites has facilitated a more rapid dissipation of the excess pore water pressures generated by the stone column vibrator, thereby increasing the degree of densification of the silty soils. A

[8] Design of the gate structure has not been advanced yet to warrant final geotechnical design recommendations. Additionally, ground improvement should be based on an advanced numerical analysis, which is not in our current scope of services.

case history by Luehring et al. (2001) about the effectiveness of wick drains with stone columns was cited in Idriss and Boulanger (2008). Even with wick drains, a field test in advance of construction may be warranted given uncertainties about the effectiveness of stone columns.

As an alternative to stone columns with wick drains, compaction grouting can be used for liquefaction and lateral spreading mitigation. Compaction grouting has been relatively effective in soil with high fines content, but is relatively expensive compared to stone columns with wick drains. A further evaluation needs to be performed to select the appropriate ground improvement. This evaluation should include review of ground improvement case histories in Washington and discussions with ground improvement contractors.

5.4 FOUNDATION ALTERNATIVES

The current design calls for two casting basins, identified on the project drawings (see Figure 2) as the East Basin and the West Basin, separated by a concrete wall or portable dams. Two foundation alternatives are currently under consideration:

- Alternative I - Deep Foundations with Cantilever Walls
- Alternative II - On-Grade Mat Foundations with MSE Walls.

The following sections provide the results of our foundation analyses and our design and construction recommendations for these alternatives.

5.5 ALTERNATIVE I - DEEP FOUNDATIONS WITH CANTILEVER WALLS

This option consists of either 24-inch diameter cast in-place reinforced concrete piles constructed inside driven closed-end steel pipe piles or 24-inch diameter structural steel pipe piles filled with non-structural concrete, controlled density fill (CDF), or sand. The piles would be embedded in Soil Unit 4 (dense to very dense sand and gravel).

The basin floor will be structural slabs supported on the deep piles. Subgrade perimeter walls will be connected at their base to the structural slab along the basin perimeter. Current plans provided by WSDOT indicate that the top of the East Basin slab will be at El. -9 ft and the top of the West Basin Slab will be at El. -13 ft. The interior piles under the slab will be spaced at about 20 ft on-center, and the perimeter piles will be spaced at 10 to 15 ft on-center (refer to Appendix F for a sketch showing the pile layout).

Piles will be supporting the dead load of the basin, the live loads of the pontoon, and downdrag loads due to backfilling behind the perimeter walls.

5.5.1 SUBGRADE PERIMETER WALLS

The perimeter concrete walls of the proposed facility will be subjected to lateral static and dynamic earth pressures. The lateral earth pressures on the walls will depend on the type of backfill to be placed behind the walls and the level of compaction. Based on our discussions with WSDOT, we understand that import structural fill will be used for backfill. Soil Unit 1, where excavation will take place, is not suitable for use as structural fill because of the generally high moisture and silt content (refer to grain size distributions in Appendix B). As such, structural fill will need to be imported to the site.

Table 3 presents our static earth pressure recommendations for structural fill meeting the requirements of the 2008 WSDOT *Standard Specifications for Roadway, Bridge, and Municipal Construction Materials* (WSDOT 2008b). The earth pressures values recommended in Table 3 are based on the assumption of free drainage behind the perimeter walls.

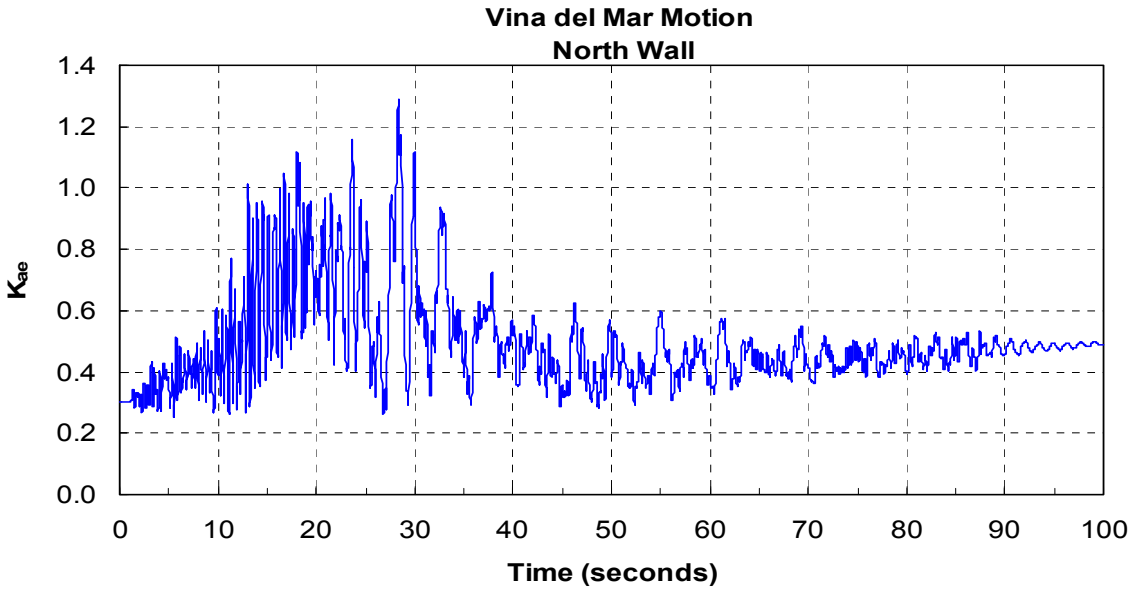
For seismic loading, the earthquake shaking (inertial load of retained soils) and the effect of lateral spreading were evaluated. As per Section 6.4.4.2 of the 2006 WSDOT GDM (WSDOT 2006), in the case of lateral spreading, non-liquefiable soils overlying liquefiable soils may exert passive pressure on foundations that impede lateral spreading. This method is known as a force-based method or the Japanese method.

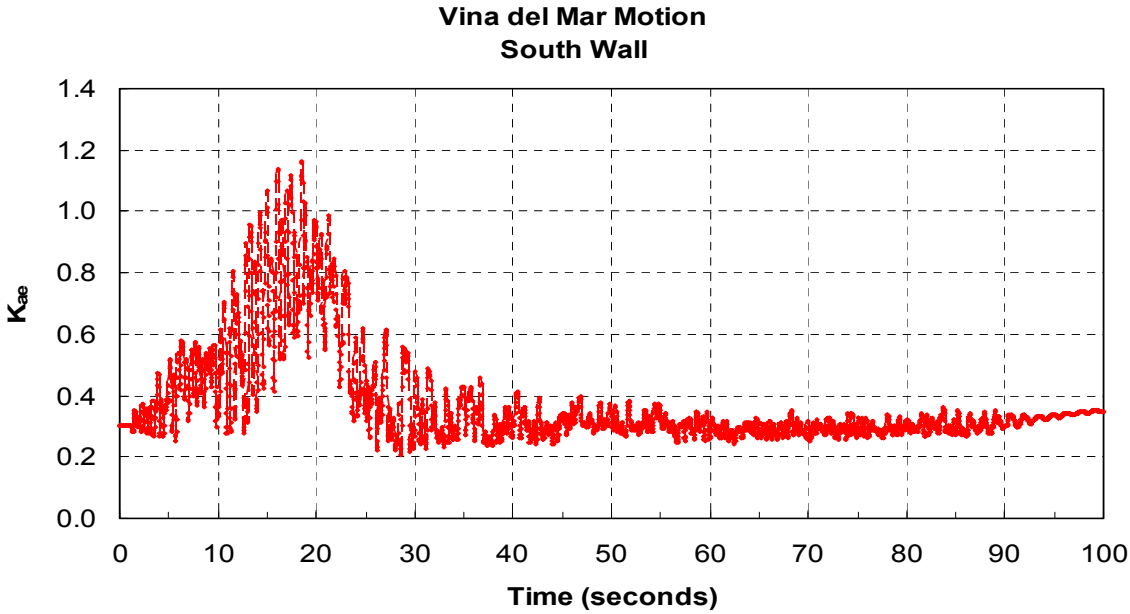
For the subject project, this applies to the northern subgrade wall which would stop the non-liquefiable compacted structural fill from moving toward the Chehalis River due to the liquefaction of Soil Unit 2 (refer to Section 5.3.3.3). Designing the northern wall to resist passive pressure is probably infeasible. Our previous FLAC2D analysis (Landau Associates 2007a) suggests that lateral spreading would increase lateral loads on the subgrade walls, but the lateral loads would be much less than the passive pressures suggested by the force-based method. In our 2007 report, we indicated the increase in lateral load was partly due to the heave of the flexible slab and, therefore, stiffening the slab should reduce lateral pressures on the subgrade walls.

For the current study, we revised our FLAC2D model to reflect the increase of the slab stiffness (from 15 to 48 inches) in the vicinity of the subgrade walls, the increase of the number of piles along the perimeter, and the increase of the thickness of the subgrade walls. Using the revised model, we evaluated two cases as follows:

- **Case I – Liquefaction.** Our FLAC model was set up for pore water pressure buildup to allow liquefaction to occur. For this case, piles were included in the model according to the current preliminary design provided to us by WSDOT. The three earthquake motions described in Appendix E were used to evaluate the earth pressure on the perimeter walls. The

seismic earth pressure coefficients (K_{ae})[9] for the north and south walls during shaking of the Vina del Mar earthquake motion (the worst case scenario in terms of seismic earth pressure) are presented in the graphs below. A K_{ae} value of 0.6 is recommended for the liquefaction case. Refer to the footnote below and to Table 3 regarding how to use K_{ae} in calculating the seismic pressure on the subgrade walls. It is important that the static pressure should not be added to the seismic pressure based on K_{ae}.





[9] Total seismic and static force = 0.5 * K_{ae} * (γ_t) * $(H)^2$; γ_t = unit weight = 135 pounds per cubic foot (pcf) in our model and H = wall height = 31 ft. Refer to Table 3 for the earth pressure diagram.

- **Case II - No Liquefaction.** We assumed no liquefaction within Soil Unit 2, as soil liquefaction may reduce the earthquake loading on the wall. For this case, we did not include the piles in the model to accelerate the run time of the model (for no liquefaction, piles should have a negligible impact on earth pressures). The FLAC2D analysis indicated unexpected high K_{ae} values for both walls at the end of shaking, compared to the values based on the at-rest condition using the Mononobe-Okabe method. The FLAC2D-based K_{ae} values, in our opinion, are not realistic, and therefore, the Mononobe-Okabe K_{ae} of 0.57 based on at-rest conditions is recommended.

Based on the results of our analyses and our engineering judgment, Case I (liquefaction case) is the critical seismic earth pressure case and the pressure on the north wall would be higher than the pressure on the south wall. The seismic earth pressures on the east and west walls are expected to be similar to the seismic earth pressure on the south wall. The recommended K_{ae} values based on Case I are presented in Table 3. It is important to note that "at-rest" rather than "active" seismic earth pressure coefficient is recommended because the perimeter walls are relatively very stiff and connected to a pile-supported stiff slab.

As indicated in Table 3, our recommendations are based on the assumption of free-drainage behind the walls so that no hydrostatic pressure acts on the walls. Our wall drainage recommendations are presented in our Dewatering Evaluation Report (Landau Associates 2007b; Landau Associates 2009).

For surcharge loads acting on the perimeter walls, Article 3.11.6 in the AASHTO design manual (AASHTO 2007a) should be used So for walls not restrained from movement, as an example, a uniform surcharge load of 250 pounds per square foot (psf) would result in a constant horizontal earth pressure of about 60 psf, assuming structural fill meeting the requirement of Gravel Backfill for Walls [Section 9-03.12(2)] of the 2008 WSDOT *Standard Specifications for Roadway, Bridge, and Municipal Construction Materials* (WSDOT 2008b). For walls restrained from movement (probably not applicable to the subject walls), assume a Poisson ratio of 0.35 to estimate lateral pressures due to point, line, and strip loads.

During the flooding phase, the water pressure on the walls will exceed the active soil pressure on the opposite side by about 30 to 50 percent, depending on soil type. This would result in outward movement of the wall and, consequently, an increase in earth pressure until the pressures on the two sides are balanced. For this case, no net lateral pressure would be acting on the perimeter walls (i.e., no bending moment or shear on the wall). The earth pressure required to balance the water pressure is approximately equal to the at-rest earth pressure. To achieve balanced pressures on both sides of the wall, we anticipate that the required outward wall movement would be approximately 0.005H to increase the active earth pressure to at-rest earth pressure. (Note that typically for earth pressures on walls, lateral movement at the top of the wall of approximately 0.005H results in an earth pressure drop from at-rest to active pressure.)

5.5.2 CASTING BASIN DEEP PILES

The followings sections present the results of our deep foundations analysis and our design and construction recommendations and considerations.

5.5.2.1 Downdrag on Piles

Backfilling behind the subgrade walls in the case of the deep foundations case would cause settlement beneath the slab due to the recompression of Soil Units 2 and 3. So, for the West Basin (the deeper basin), assuming an average unit weight of 135 pounds per cubic foot (pcf) and the bottom of the excavation is at approximately or below El. -17, the applied vertical pressure immediately adjacent to the wall would be about 4,700 psf, corresponding to 35 ft of soil height. Settlement due to backfilling would cause downdrag loads on the piles.

Downdrag loads were estimated in our previous studies. In the preliminary analyses (Landau Associates 2006a), the loads and the extent of downdrag were estimated using settlement calculated based on the theory of elasticity. In the 2007 study (Landau Associates 2007a), our FLAC2D analysis suggested less lateral extent of the downdrag influence and less loads on piles as compared to the analysis based on the theory of elasticity.

For the current study, we performed FLAC3D analysis rather than FLAC2D analysis to account for the three dimensional nature of the design. Prior to analyzing the current pile layout, we used FLAC3D to estimate downdrag loads for the 2007 pile layout. The FLAC3D results were comparable to the results of FLAC2D presented in our 2007 report (Landau Associates 2007a). Given that the current pile layout (refer to Appendix F) is not as simple as the one used in the 2007 study (20 ft on center for all piles), we concluded that the use of FLAC3D (per our scope of services) could be more accurate than FLAC2D. However, WSDOT has recently expressed concern about the use of FLAC3D and prefers the use of FLAC2D for the subject analysis. As such, the FLAC3D results presented below should be considered preliminary, and future analysis should be completed using FLAC2D.

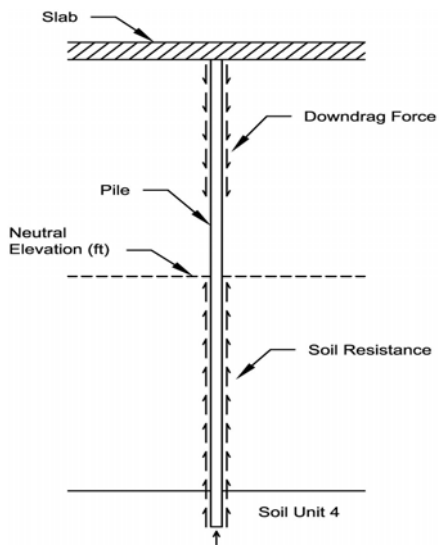
Our FLAC3D analysis also accounted for the revised design of the walls, the pile layout, and the revised wall height. Surcharge loads of 250 psf on the ground surface adjacent to the wall were assumed in the FLAC3D models. Refer to Appendix F for details about the FLAC3D analysis.

The results of our FLAC3D analysis suggest that only the perimeter piles (located immediately beneath the perimeter walls) would be subjected to downdrag loads. The results are presented in the table below. The values in the table below are based on the β method.

PILE DOWNDRAG FORCES

	Perimeter Piles	10 ft from Outside Face of Perimeter Wall
Downdrag Loads (tons)	150	0
Neutral Elevation (ft)	-90	Not applicable

The neutral elevation is the elevation below which soil resistance can be accounted for as illustrated in the sketch below. Downdrag loads should be added to the factored dead and live loads. The AASHTO manual does not specify a Strength Limit downdrag load factor for the β method. Therefore, in the next phase of the project, we will revise our analysis to be based on the Nordlund method, which has a corresponding Strength Limit downdrag load factor of 1.1, according to our verbal communication with WSDOT.



Note the downdrag loads in the table above are much less than the downdrag loads estimated in the previous study (Landau Associates 2007a). The main reason for less downdrag loads is the closer spacing between the perimeter piles (10 ft – refer to Appendix F for pile layout sketch) as compared to the spacing (20 ft) in both directions assumed in the previous study.

5.5.2.2 Axial Capacity

Based on information provided by WSDOT, the service loads on the basin piles would vary from about 385 to 490 tons and the ultimate bearing capacity (assuming a resistance factor = 0.65) would vary from 515 to 730 tons.

To reduce potential settlement and to achieve high capacity, the driven steel pipe piles should be embedded at least 5 ft into the dense to very dense sand and gravel of Soil Unit 4 (i.e., minimum pile tip

elevations would vary from about El. -117 to -142 ft; refer to Figure 16 for the interpreted top of Soil Unit 4 elevation contour map), depending on pile drivability as discussed in Section 5.5.2.7.

Pile capacity will be carried by a combination of side friction and end bearing. The side friction along a pile extending through Soil Units 2B through 4 can be considered in estimating the pile capacity except along the perimeter walls, where the piles could be subject to downdrag as discussed previously in Section 5.5.2.1. In the case of downdrag, the soil resistance should only be considered below the neutral elevation presented in Section 5.5.2.1. The recommended ultimate unit skin friction and end bearing are presented below:

- Ultimate Unit Skin Friction:
  - Soil Unit 2 — 0.2 tsf from bottom of slab to El. -66 ft
  - Soil Unit 3 — 0.6 tsf from El. -66 ft to top of Soil Unit 4
  - Soil Unit 4 — 1.0 tsf from top of Soil Unit 4 to bottom of piles
- Ultimate End Bearing:
  - Soil Unit 4 — 175 tsf for 24-inch piles (assuming **10 ft** of penetration in Soil Unit 4)[10]

At some locations on the site, Soil Unit 4 has zones of medium dense sand above the dense to very dense sand and gravel portions of the soil unit. In areas where the medium dense sand is present, the piles may need to be driven deeper than 10 ft penetration depth in order to develop their full end-bearing capacity.

As an example, Figure 22 presents the recommended ultimate pile capacities for the proposed pile diameter of 24 inches, assuming the top of Soil Unit 4 is at El. -130 ft. Figure 22 does not illustrate the loss of soil strength above the neutral zone associated with potential downdrag loading conditions. The actual ultimate pile capacity, however, may be controlled by pile drivability as discussed subsequently.

We estimated the end bearing values based on several design methods. One of these methods is based on the SPTs from the borings, also known as the Meyerhof method (Meyerhof 1976)[11]. The Meyerhof method is one of the methods presented in the 2007 AASHTO manual. However, the Meyerhof method as described in the AASHTO manual is somewhat different than the one described in the original paper. We used the method as described in the original paper, with about 12 percent reduction to account for the difference in the approach between the AASHTO manual and original paper. (Note that our unit end bearing recommendation in the previous design phase was based on the original paper without any reduction.)

---

[10] The 10-ft embedment should be used to estimate pile length. The actual embedment will be determined based on soil resistance during pile driving, but should not be less than 5 ft into Soil Unit 4.

[11] The difference is in terms of using corrected blow counts (N_{1-60}) in the AASHTO manual versus using N_{60} in the original paper.

In addition to 24-inch diameter steel pile piles, our scope of services included evaluation of 24-inch diameter precast concrete piles, and 30-inch and 36-inch diameter open-ended steel pipe piles. During the course of design, however, WSDOT informed us that pre-cast concrete piles will not be used. Also, WSDOT directed us to assume closed-end rather open-ended steel pile piles.

The recommended ultimate unit skin friction values for 30- and 36-inch steel piles are the same values recommended for the 24-inch steel piles. For end bearing, we recommend an ultimate end bearing of 150 and 125 tsf for 30- and 36-inch diameter piles, respectively. The reduction in unit end bearing with increasing pile diameter is to reflect that to achieve a similar unit end bearing would require a greater penetration depth into Soil Unit 4 for the larger diameter piles (Meyerhof 1976), which is probably not practical.

As illustrative examples for pile capacity estimates, Figures 23 and 24 present the recommended ultimate pile capacities for the proposed 30- and 36-inch diameter piles, assuming the top of Soil Unit 4 is at El. -130 ft.

5.5.2.3 Contribution of Soils between Piles

We understand that the structural slab would be designed assuming the slab is supported only on piles, ignoring the contribution of soils between piles. Case histories suggest, however, that soils underlying the slab would carry a portion of the foundation loads. For example, a case history (Tomlinson 1986) for a raft supported by 77 deep piles indicates that the soils underlying the slab carried about 35 percent and the piles carried 65 percent of foundation loads. Accounting for the soil-carrying capacity would reduce the design loads on piles at the subject site. The soil-structure interaction between the slab, underlying soils, and piles is relatively complicated, and we are not aware of an established method of analyzing this interaction. Based on our review of literature, this is typically completed using a numerical analysis, which is not in our scope of services.

5.5.2.4 Resistance Factors for Different Limit States

As per AASHTO (2007b), we recommend that the following resistance factors be used when evaluating the strength, service, and extreme event limit states.

RESISTANCE FACTORS FOR DRIVEN PILES

	Resistance Factor	
	Side Friction	End Bearing
Strength	0.65	0.65
Service	1.00	1.00
Extreme	1.00	1.00

These resistance factors are based on the assumption that dynamic testing (CAPWAP and PDA) will be performed on 2 to 5 percent of the production piles to develop pile driving criteria.

5.5.2.5 Pile Settlement

For 24-inch diameter, closed-end steel pipe piles (filled with non-structural concrete, CDF, or sand), or cast in-place reinforced concrete (with steel casing) embedded into Soil Unit 4, we estimate total settlement and differential settlement of about 1.0 and 0.5 inch, respectively. Unless there is the presence of weak materials within Soil Unit 4 such as the decomposed wood debris encountered in Boring B-8, we expect that the anticipated differential settlement of 0.5 inch under live loads to occur over a relatively long distance (more than 100 ft). This is based on our evaluation of the subsurface conditions.

For secondary settlement, we anticipate that ongoing secondary compression due to the dredge fill placed in the late 1970s and early 1980s would cause negligible settlement due to the compression of Soil Unit 3, about 0.15 inch every 10 years for the next 30 years. Secondary settlement would not induce downdrag on the piles given the relatively short period (up to 4 years) required to construct the bridge pontoons.

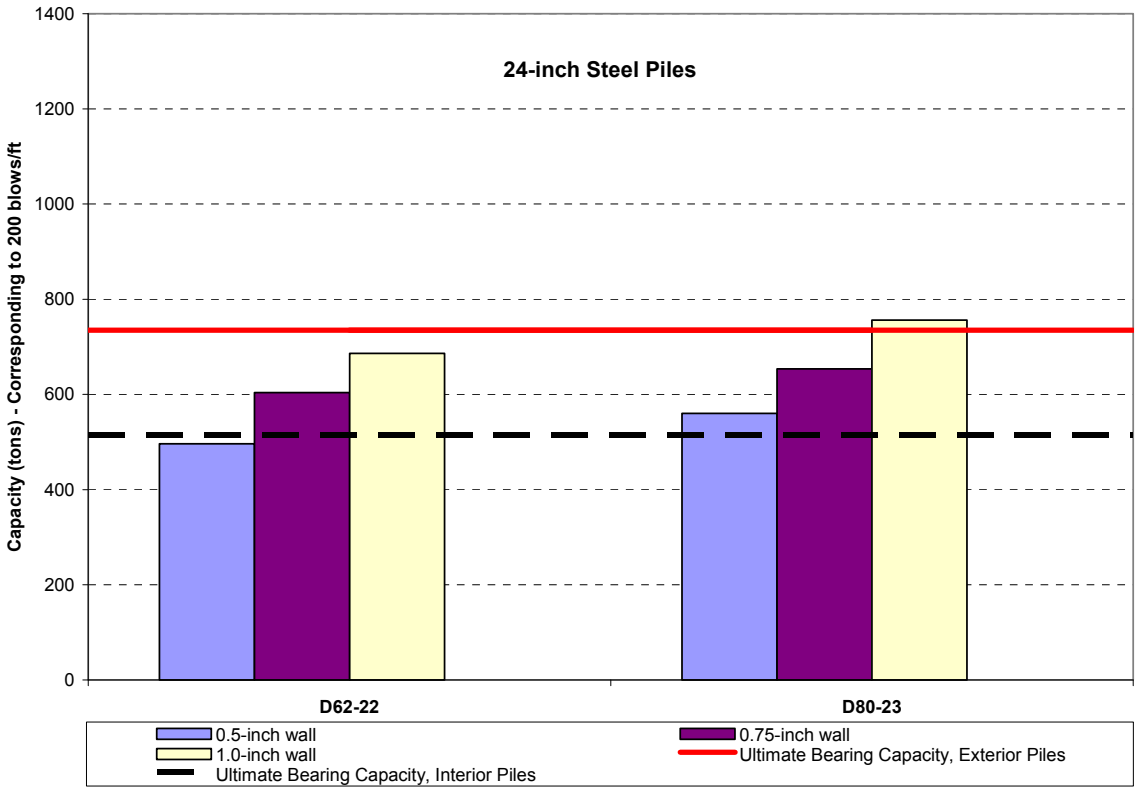
5.5.2.6 Pile Lateral Capacity

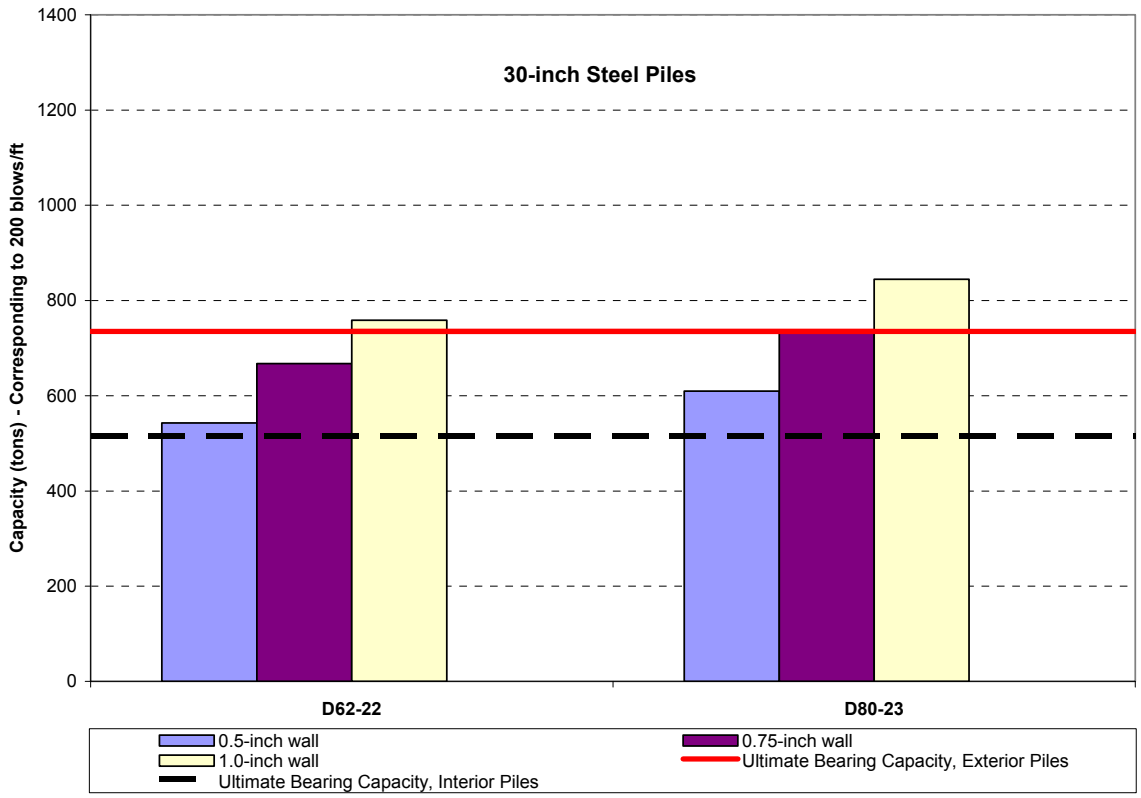
Our recommended input soil parameters for pile lateral analyses using the LPILE and DFSAP software are presented in Tables 4a and 4b. In addition to static conditions, soil parameters related to the design earthquake level are included in Tables 4a and 4b.

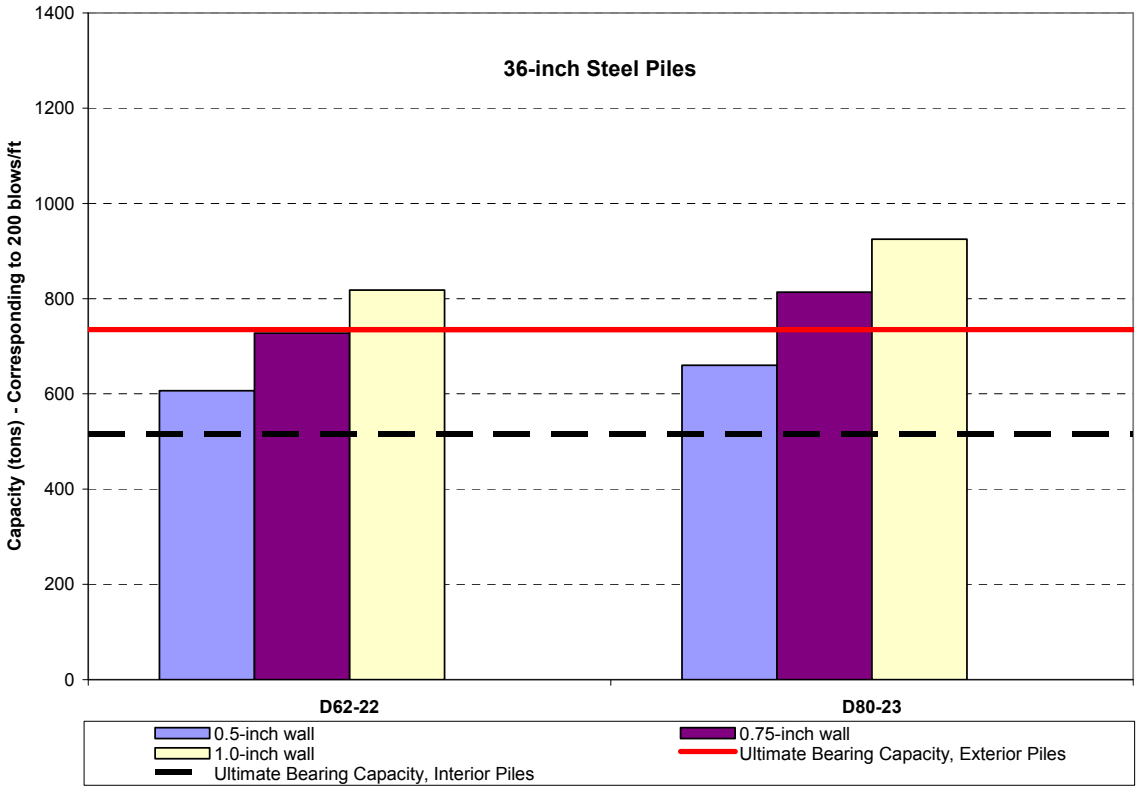
5.5.2.7 Pile Drivability

Although pile drivability is typically a construction issue, it is possible that the pile design could be governed primarily by the pile drivability rather than the recommended soil resistance values presented above.

We performed a wave equation analysis for piles (WEAP) for 24-, 30-, and 36-inch diameter, closed-end steel pipe piles using the GRL WEAP software (GRL Engineering 2005). We evaluated three pipe wall thicknesses and two hammers – Delmag 62-22 and Delmag 80-23. The results of our analyses indicated that because of damping effects caused by the length of pile, it may be difficult to demonstrate the required ultimate resistance; that is, significant energy loss would occur along the pile before each hammer impulse reaches the pile tip. The results of our WEAP analysis are shown on the graphs below for 24-, 30-, and 36-inch steel pile piles.




30-inch Steel Piles
Capacity (tons) - Corresponding to 200 blows/ft
1400
1200
1000
800
600
400
200
0
D62-22
D80-23
0.5-inch wall
0.75-inch wall
1.0-inch wall
Ultimate Bearing Capacity, Exterior Piles
Ultimate Bearing Capacity, Interior Piles


36-inch Steel Piles
Capacity (tons) - Corresponding to 200 blows/ft
1400
1200
1000
800
600
400
200
0
D62-22
D80-23
0.5-inch wall
0.75-inch wall
1.0-inch wall
Ultimate Bearing Capacity, Exterior Piles
Ultimate Bearing Capacity, Interior Piles

The capacities corresponding to 200 blows per foot shown on the graphs above reflect hard driving. According to the 2008 WSDOT Standard Specifications, the impact hammer needs to be selected based on 100 rather than 200 blows per foot. This issue needs to be further evaluated by the design team to assess the impact of pile installation on the pile design and layout.

Driving the piles to the ultimate capacities shown on the graphs above would result in compressive stresses on the steel piles. The driving stresses estimated by WEAP for 24-inch piles are presented in the table below. For 30- and 36-inch piles, the driving stresses should be less than the values presented in the table below.

DRIVING STRESSES (in kips per square inch)

Pile Diameter	Wall Thickness	D62-22	D80-23
24-inch	0.5	37	41
	0.75	35	39
	1.0	33	37

As shown on the above graph for the 24-inch-diameter piles, the ultimate bearing capacity for the piles can hardly be achieved using D80-23, which is probably the biggest hammer available regionally. However, it is important to note that excess pore water pressure generated during initial pile driving would likely result in less skin friction and possibly lower end bearing resistance during initial driving than that shown on Figure 22 (i.e., the piles may be easier to drive than implied by the WEAP analysis). Consequently, it may be possible to "seat" (i.e., 5 to 10 ft embedment) the piles in Soil Unit 4 using the D62-22 or D80-23 pile hammer. Based on the soil resistance recommendations presented in Section 5.5.2.2 the axial capacity of a well "seated" pile in Soil Unit 4 following excess water pressure dissipation (i.e., following soil-pile setup) may exceed the required maximum ultimate bearing capacity of 730 tons. However, it may not be possible to "verify" the post-soil setup pile capacity using dynamic testing because, even at 200 blows per foot, the wave equation analysis indicates lower axial capacities than the desired ultimate load as shown on the graph above. This is partly due to the loss of energy along the relatively long pile.

The WEAP results may seem inconsistent with other projects where 24-inch closed-end steel piles were driven 10 to 20 ft into glacial soils. For example, structures like Safeco Field in Seattle (Miner and Gurtowski 2000) and a segment of Interstate-90 (Hart Crowser 1986) are supported on 24-inch steel pipe piles driven with the closed end into glacial soils using a smaller hammer than a Delmag D80-23. The main difference between the proposed facility and other projects is that the subject site requires

longer piles (an average length of 120 ft) than those used for the other projects. The pile length at Safeco Field is less than 95 ft[12] and the piles supporting Interstate-90 are driven 70 to 90 ft[13]. The elastic deformation of long piles reduces driving energy transferred to the bottom of the piles.

To overcome the loss in energy, a solid mandrel inside the pipe pile is sometimes used to drive closed-end pipe piles. However, given the length of the piles, the use of a mandrel longer than 140 ft may not be practical. Another method of reducing energy loss is to fill part of the pile with concrete, increasing the pile stiffness, which in turn reduces energy loss. This, however, would be difficult and would require that splicing of longitudinal reinforcement occur simultaneously with splicing of pipe sections.

Comments on WEAP and Pile Testing Program

It has been our experience that WEAP results are sometimes conservative (i.e., underestimate capacity corresponding to blow counts). Therefore, for the subject site, where more than 1,600 long piles will be installed, relying on the WEAP results alone could be costly. Therefore, we recommend that WSDOT perform a pile testing program or at least a dynamic pile driving testing program. The results of the testing program could result in reducing the ultimate load required for design, and potentially the number of piles. It may also result in savings during site preparation because this cost will depend on the weight of the crane carrying the pile driving hammer.

5.5.2.8 Site Preparation Related to Pile Driving

The pile driving will be completed from the bottom of the excavation at approximately or below El. -17 ft (probably within Soil Unit 2B) at the West Basin and at approximately or below El. -13 ft (probably within Soil Unit 1) at the East Basin. Soil Unit 1 and Soil Unit 2B at these elevations are not suitable to support the pile driving crane. Therefore, we anticipate several feet of the existing soils at the bottom of excavation would need to be overexcavated and replaced with quarry spalls or other import structural fill that provides adequate support to the pile driving crane. The use of mats beneath the crane to further spread out the load may also be required.

---

[12] From pile driving testing program.
[13] From pile driving testing program.

5.5.3 SEISMIC LOADS

We understand that the current pile design may not account for seismic hazards (such as liquefaction, lateral spreading, and free field strains), and WSDOT may allow the piles to have large deflections and break during these seismic loadings.

The installation of piles would cause some densification of soils surrounding the piles, but not enough to mitigate liquefaction of Soil Unit 2B. This is mainly because the pile area compared to the tributary area for each pile (about 0.8 percent for 24-inch-diameter piles spaced 20 ft on center) is not sufficient for the needed densification. This is also because of the relatively high silt content of Soil Unit 2B. Liquefaction of Soil Unit 2B would cause settlement and consequently downdrag loads on piles, and lateral spreading would impose significant lateral loads on the piles.

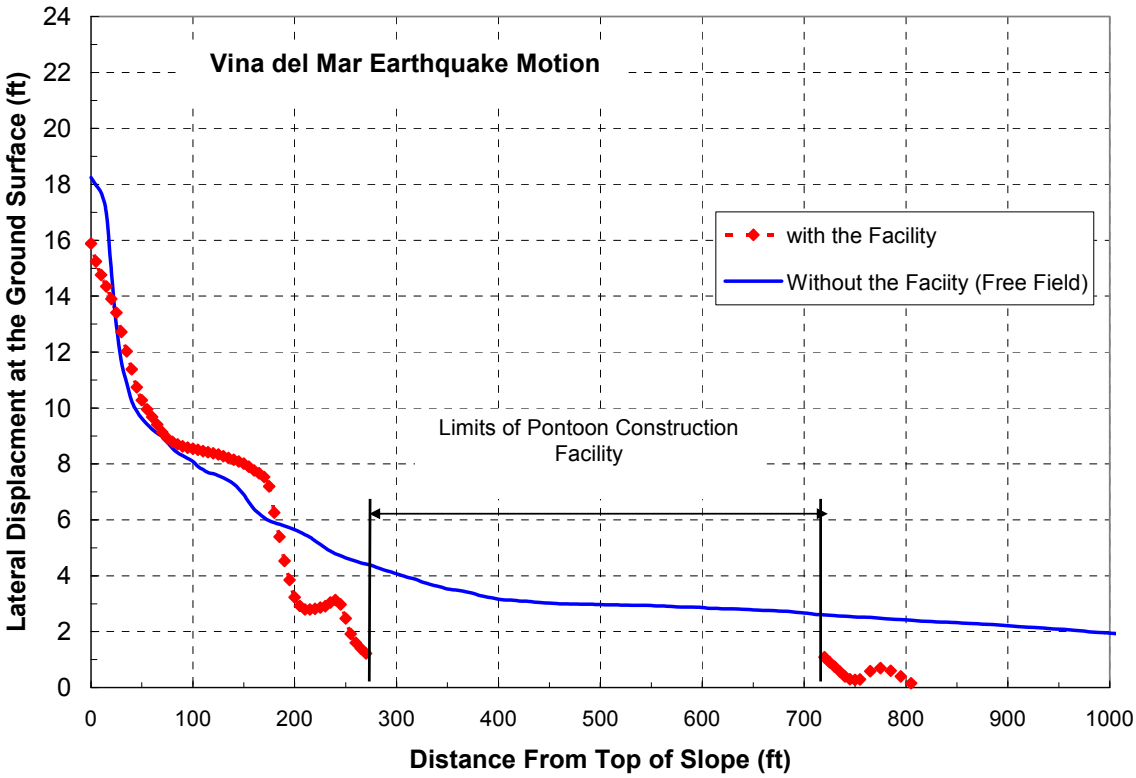
Liquefaction-induced settlement of Soil Unit 2B would cause downdrag on piles[14]. The estimated downdrag loads are 55, 68, and 82 tons on 24-, 30-, and 36-inch-diameter piles, respectively. Side friction within Soil Units 3 and 4 should still be considered in estimating the soil resistance to pile loads.

In addition to downdrag, our FLAC2D analysis performed for the seismic lateral earth pressure (refer to Section 5.5.1 Case I) indicates that the presence of piles would reduce the lateral deformations due to liquefaction as shown on the graph below. By limiting the soil deformations, the piles would be subjected to bending moments[15] as shown on Figure 25. In our opinion, the bending moments shown on Figure 25 need to be considered as residual rather than transient moments (i.e., the bending moments would not be reduced after the end of liquefaction). The analysis may need to be revised in the case of using different pile and slab design.

---

[14] Soil Unit 2A was not encountered within the facility footprint and, therefore, was not accounted for in the pile design. Additionally, Soil Unit 2A is not susceptible to liquefaction.

[15] Lateral analysis using software such as DFSAP is not required for this loading case.



5.5.4 CRANE FOUNDATIONS

Based on information provided by the design team, the foundation system for the crane foundations would consist of two rows of 24-inch piles, spaced about 33 ft apart. Along each row, piles will be spaced at 20 ft on center. The service lateral and axial loads per pile are 16 kips and 443 kips, respectively.

5.5.4.1 Axial Capacity

The axial capacity of the piles supporting the cranes would depend on the period between fill placement behind the perimeter retaining walls and the pile placement. Placing the fill behind the wall would cause time-dependent settlement of the underlying Soil Units 2 and 3 that may take a few months (probably up to 3 months) to complete. Placing the piles before the end of primary settlement would result in downdrag loads on the piles. Ideally, the crane piles should be placed after the end of primary settlement of Soil Unit 3.

We understand that the project construction schedule is still in progress and the timing of the installation of the piles in relation to fill placement has not been yet finalized. Therefore, this issue would need to be addressed at a later phase.

5.5.4.2 Lateral Capacity

The front row of piles for the crane foundations will be installed approximately 6 ft (about 3 times the pile diameter) from perimeter walls. As such, most of the lateral load acting on the front piles would be transferred to the perimeter walls. Therefore, we recommend the perimeter walls be designed assuming that the 16 kips lateral load would be acting at the top of the wall over a horizontal distance of approximately 8 ft (i.e., 2 kips/ft). We acknowledge that this is a conservative but simple way of analysis. If the crane lateral load controls the wall design, we recommend an advanced soil/structure analysis be performed to better assess the crane lateral load on the perimeter wall.

5.6 ALTERNATIVE II - ON-GRADE MAT FOUNDATIONS WITH MSE WALLS

This alternative consists of a mat foundation in lieu of deep pile foundations, and MSE walls in lieu of concrete walls along the basin perimeter. The top of the mat foundation for the East and West Basins under this design alternative will be at approximately El. -13 ft. The on-grade mat and the MSE walls will be founded directly on Soil Unit 2 or structural fill placed above Soil Unit 2. Compared to the deep foundation alternative, there is a higher risk of damages due to seismic loading. On the other hand, this alternative should be more economical, compared to the deep foundation option.

We completed engineering analyses, including a stability analysis using FLAC2D, for this alternative. The results of our analysis, which are presented in the draft version of this report (Landau Associates 2008b), indicate potential large deformations (up to several feet) of the MSE walls in the case of liquefaction. WSDOT reviewed our draft report and made a policy decision not to consider this option further. Therefore, the results of our engineering analyses for the MSE walls are not included in this report. Our recommendations for the mat foundation are presented below, assuming that a mat foundation with concrete walls can be used.

5.6.1 MAT FOUNDATION

The mat foundations should be founded directly on a drainage blanket (Landau Associates 2009) placed directly on Soil Unit 2. Soil Unit 1 encountered at the subgrade elevation should be overexcavated and replaced with quarry spalls as per Section 9-13.16 of the 2008 WSDOT Standard Specifications.

Separation geotextile (2008 WSDOT Standard Specifications Section 9-33, Table 3) should be placed between the quarry spalls and Soil Unit 2. The quarry spalls should be compacted to uniformly dense and unyielding conditions.

5.6.2 SUBGRADE REACTION MODULUS

The design of the mat foundations would depend partly on the vertical subgrade reaction modulus (K) of the soils. The subgrade reaction modulus is a time-dependent parameter that decreases with time before it stabilizes at the end of the primary settlement. Figure 26 presents two sets of K values at different locations within the footprint of the casting basin. The first set of values (Case 1) corresponds to the end of primary settlement (varies from 3 to 6 months) at each location. The second set of K values (Case 2) corresponds to approximately 4 months, which corresponds to the end of primary settlement at some locations within the facility, while settlement at other locations is still underway. The time-dependent analysis could be complex.

Our estimate of settlement rate (i.e., time to end of primary settlement) was based on the results of consolidation tests and *in-situ* testing (CPT dissipation tests). However, based on our experience and case histories, the actual settlement rate in the field can be faster than the rate estimated from laboratory testing. Adding to the complexity of the time-dependent analysis is that the live load application is also time dependent. Without knowing the sensitivity of the mat design to the K values, it is difficult for us to assess whether the use of the second set of K (Case 2) is warranted.

The K values presented on Figure 26 are based on our settlement analysis. At the subject site, the subsurface conditions are quite variable (e.g., wood debris, various soil lenses, etc.) and the zone of influence (probably 100 ft below the mat) is relatively large compared to typical projects. Our settlement analysis accounted for the results of the *in-situ* testing (SPTs, CPTs, and pressuremeter), laboratory testing (soil strength, soil consolidation), and used several analytical methods. The results of the settlement analysis were quite scattered in both test data as well as differing results depending on the method of analysis. We understand that the feasibility of the mat foundations may depend on K values (e.g., relatively low K values may prove that the mat foundations are not feasible).

Considering the above, we provide in this report our best estimate without a factor of safety. However, it is critical that the design team evaluate the sensitivity of the mat foundations to the K values and understand the assumptions (e.g., coupled versus uncoupled springs) included in the soil-structure analysis to be performed by the design team. Also, the design team should evaluate the consequences and potential remedial measures in case actual settlement exceeds estimated settlement.

Based on our discussion with the design team, we understand that the mat foundations will be analyzed using an uncoupled spring system, and the K values along the perimeter would be manually

increased to account for stress distribution within the soil mass. It is our opinion that increasing K values along the basin perimeter may not adequately capture the soil-structure interaction, and therefore, using a coupled-spring model may be warranted given the complexity of the analysis. We expect that using a coupled-spring model may result in a thinner mat.

5.6.2.1 Subgrade Disturbance and Mitigation Measures

Subgrade disturbance during construction will occur. The extent and degree of disturbance depends mainly on the construction method, particularly the dewatering method. For example, the use of a wet excavation method could have more impact on the subgrade due to disturbance as compared to a dry excavation method, resulting in lower K values. Equipment trafficking directly on subgrade could disturb the subgrade significantly. Therefore, we recommend that construction methods be used to limit the degree of subgrade disturbance. Examples of appropriate construction methods include:

- Excavation to the final subgrade elevation could be accomplished with excavators with a smooth-bladed bucket to limit disturbance from teeth on the excavator buckets
- Construction equipment should not be allowed to traffic directly over the exposed native soils at the base of the excavation at the final subgrade elevation
- The exposed subgrade should be protected soon after excavation by placement of a geotextile layer and a quarry spall gravel layer as recommended below.

Compaction of the native subgrade (i.e., Soil Unit 2) will not be practical or effective in restoring disturbed subgrade because of the high moisture content and fines content of the soils. Therefore, we recommend excavating and removing any disturbed subgrade soils and replacing them with quarry spalls that meet the requirements in Section 9-13.6 of the 2008 WSDOT Standard Specifications (WSDOT 2008b). We recommend that a separation geotextile be used between the base of the quarry spalls and the native subgrade.

The subgrade should be protected by at least 2 feet of quarry spalls as per Section 9-13.6 of the 2008 WSDOT Standard Specifications. If the selected construction method employs the use of heavy equipment or cranes operating on the quarry spall layer, it may be necessary to place a layer thicker than the recommended 2-foot minimum thickness to provide sufficient support or use temporary construction mats to better distribute the heavy equipment loads.

To account for subgrade disturbance, we recommend flooding the basin after the mat foundation has been constructed, but prior to the construction of the pontoons to reduce (but not to eliminate) settlement related to subgrade disturbance. Also, the flooding could help in detecting excessive settlement due to unexpected subsurface conditions (e.g., wood debris, thick layers of soft silt within Soil Unit 2, etc.).

Another mitigation measure that could be considered would be to use short timber piles (30 to 40 ft in length) driven below the base of the excavation to help transfer the mat foundation load deeper and bypass the potential zone of disturbance. This would increase the vertical K values of the soil by reducing the settlement of Soil Unit 2B.

5.7 MOORING DOLPHIN PILES

We understand that mooring dolphins could be installed in the Chehalis River adjacent to the site. Dolphin piles will be subjected to lateral loads only. The soil parameters presented in Tables 5a and 5b can be used in the lateral analyses using the LPILE and DFSAP software. Note that because of the different ground surface elevations at the mooring dolphin locations, the soil profile in Tables 5a and 5b starts from the existing ground surface at approximately El. 15 ft. The analysis should be based on the ground elevation at the location of each mooring dolphin. For example, for the mooring dolphin in the vicinity of Boring B-19 (Figure 3), the soil profile in the analysis should start from approximately El. -12 ft. Additionally, the analysis should account for the natural sloping ground surface and the sloping of the entrance channel side slopes.

In the case of liquefaction, our FLAC analysis predicts more than 25 ft of lateral spreading at the shoreline. This would result in significant deformations to the dolphin piles, probably rendering them useless afterward.

5.8 GATE FOUNDATIONS

A floating gate will be used between the casting basin structure and the entrance channel as shown on Figure 2. The gate will be subject to hydrostatic pressure corresponding to the river level. A riprap-lined channel will be constructed in front of the gate as shown on Figure 2.

We understand that the design of the gate structures, including the foundation recommendations, will be completed in a subsequent design phase. We also understand that gate foundations would depend on the type of foundations (piles or mat) and the seismic performance criteria for the gate structure. In the case of using deep piles, the recommendations for the piles supporting the casting basin are applicable to the gate piles. In the case of shallow foundations, the width of the foundations should be designed and/or the location of sheetpile cutoff wall (recommended based on our dewatering analysis) should be selected to reduce the uplift pressure on the base of the sill foundation.

5.9 BATCH PLANT FOUNDATIONS

According to the project design team, a concrete batch plant may be located at the project site. Plant components would include proportioning and mixing equipment, plus cement and fly-ash silos. Storage of fine and coarse aggregate would be located near the plant.

Depending on the depth and areal extent of aggregate storage, aggregate stockpiles could result in significant additional settlements. Stockpiles should be located away from buried utilities and other settlement sensitive improvements. If a batch plant is installed at the site, potential stockpile areas should be identified and the impacts due to additional settlement should be assessed.

According to the project design team, large lateral forces and overturning moments will be generated in the silo foundations due to wind loads. As a result, the silos may be founded on piles or a large, reinforced concrete mat foundation. Other more lightly-loaded plant components would likely be placed on shallow footings. If piles will be installed prior to dewatering, site grading, and other settlement-inducing activities (or before the consolidation settlement from these activities are complete), the piles should be designed to carry loads due to downdrag.

Since the details of the batch plant are subject to the planned equipment and configuration to be provided by the selected contractor, we assume that the detailed foundation design and aggregate storage impacts would be the responsibility of the contractor. However, for a preliminary-level design, the deep foundation parameters presented in Section 5.5.2.2 can be used by the design team.

5.10 SLOPE STABILITY

In previous design phases, we estimated the ability of the site soils to support temporary and permanent slopes at the project site. As the project design analysis has progressed and additional explorations have been completed, we have adjusted our estimates of the slope stability under various loading conditions. Our slope stability calculations in this and previous phases were made using the computer program SLIDE Version 5.0 (Rocscience, Inc. 2003). The present analyses include short-term and long-term slope stability estimates. The slope stability is initially influenced by the undrained soil shear strength reflective of soil conditions immediately following excavation (called rapid excavation in the tables below). Over a longer period of time, the soil strength is better represented by drained soil strength parameters (called long term in the tables below).

For permanent slopes, we estimated slope stability during earthquake shaking using pseudo static loads. We also estimated slope stability at these locations using residual (i.e., post-liquefaction) strengths in Soil Unit 2B under static and pseudo static loading conditions. The 2006 WSDOT GDM (WSDOT 2006) recommends a factor of safety of 1.25 for a cut slope. For seismic design, the WSDOT GDM

considers a factor of safety of 1.1 to be acceptable. These criteria were used in evaluating the slope stability under various conditions.

5.10.1 ARMORED SHORELINES

We evaluated the factor of safety against slope instability at two locations along the existing shoreline: 1) into the Hoquiam River at the east end of the project site, and 2) into the Chehalis River. The first location passes through a steep underwater slope along the river channel; both are located in areas vulnerable to sliding due to liquefaction of Soil Unit 2B. At both locations, we assumed a 3-ft thick layer of slope armor installed from elevation 19 ft down to -3 feet MLLW. We also assumed that site fill would be placed from the present ground surface (typically El. +13 to +14 ft) to El. +17 ft. Our estimate of the factors of safety against slope instability for various soil and loading conditions are summarized in the table below:

Location	Soil and Loading Conditions	Calculated Factor of Safety (minimum)
Chehalis River Shoreline	Static loads with rapid fill and slope armor placement	1.6
	Static loads with slow loading (drained soil strengths)	2.6
	Pseudo static earthquake loads of ½ PGA	0.9
	Liquefied Soil Unit 2B with pseudo static earthquake loads of ⅓ PGA (appropriate for long-duration earthquake)	0.3
	Liquefied Soil Unit 2B with static loads	0.6
Hoquiam River Shoreline	Static loads with rapid fill and slope armor placement	1.4
	Static loads with slow loading (drained soil strengths)	1.7
	Pseudo static earthquake loads of ½ PGA	0.9
	Liquefied Soil Unit 2B with pseudo static earthquake loads of ⅓ PGA (appropriate for long-duration earthquake)	0.4
	Liquefied Soil Unit 2B with static loads	0.6

The WSDOT GDM recommends a minimum factor of safety of 1.3 for embankment slopes not directly supporting structures. Under static loading conditions, the slope stability of the armored shoreline satisfies this factor of safety. During and following long-duration seismic loading, however, these slopes become significantly unstable and do not meet the criteria set forth in the WSDOT GDM for minimum factors of safety against slope instability resulting from pseudo static earthquake loads or following liquefaction. Liquefaction of Soil Unit 2B during and following a design level earthquake will produce very low factors of safety against slope movement and will likely result in a significant amount of lateral spreading. A detailed discussion of liquefaction and overall performance of the site during and following earthquake shaking is discussed in Sections 5.3.3.2 and 5.3.3.3.

5.10.2 ENTRANCE CHANNEL SLOPES

We evaluated the factor of safety for slopes along the sides of the entrance channel. We assumed that the channel sides will have slopes of 2 Horizontal to 1 Vertical (2H:1V) and applied the same slope armor and site fill assumptions as in the previous section. The entrance channel slopes are underlain mostly by Soil Unit 2A, which is not subject to widespread liquefaction. Our estimate of the factors of safety against slope instability for various conditions is summarized in the table below:

Soil and Loading Conditions	Calculated Factor of Safety (minimum)
Static loads with drained soil conditions*	1.58
Pseudo static earthquake loading of ½ PGA, undrained strength conditions**	0.99

*Slope stability computed at elevation -3.0 MLLW tide
** Slope stability computed at elevation +0.0 MLLW tide

Under static loading conditions, the slope stability of the entrance channel slopes satisfies the minimum factor of safety of 1.3, as recommended in the WSDOT GDM. During seismic loading, the slope becomes unstable and does not meet the minimum factor of safety criteria set forth in the WSDOT GDM. Also, in the case of lateral spreading (refer to Section 5.3.3.3), we expect significant deformations toward the entrance channel. It is our understanding that WSDOT is prepared to accept some deformation of these slopes during a design-level earthquake.

5.11 TEMPORARY AND PERMANENT DEWATERING

Temporary and permanent dewatering issues and related recommendations for drainage materials will be presented in a companion Dewatering Evaluation Report submitted under separate cover (Landau Associates 2009). The dewatering report also addresses potential ground surface settlement related to dewatering.

6.0 CIVIL DESIGN AND CONSTRUCTION CONSIDERATIONS

6.1 TEMPORARY CONSTRUCTION SLOPES

Temporary excavation slopes and temporary shoring are the responsibility of the contractor. All applicable local, state, and federal safety codes should be followed with respect to temporary excavations or shoring. Temporary excavations in excess of 4 ft should either be shored or sloped in accordance with Safety Standards for Construction Work, Part N, located in Chapter 296-155 of the Washington Administrative Code (WAC). In the absence of groundwater seepage, fill and alluvium encountered within the trench zone would be classified as a Type C soil per Chapter 296-155 WAC. The prescriptive maximum allowable excavation slope for Type C soils to depths less than 20 ft is 1½H:1V. If groundwater seepage is present, flatter slopes, temporary shoring, and/or dewatering may be required.

For planning and estimating purposes, we evaluated the factor of safety for a general temporary slope configuration needed for construction of the casting basin. This configuration uses a soil profile reflecting what we expect to be typical soil strength properties and soil unit thicknesses. Seismic loading was not considered for this temporary construction slope condition. Our estimate of the factors of safety against slope instability for various conditions is summarized in the table below:

Slope Inclination	Loading Conditions	Soil 2 Subunit	Factor of Safety (minimum)
Temp 1.5H:1V	Rapid Excavation	2A	1.18
Temp 1.5H:1V	Long Term	2A	1.37
Temp 1.5H:1V	Rapid Excavation	2B	1.18
Temp 1.5H:1V	Long Term	2B	1.28
Temp 1.75H:1V	Rapid Excavation	2A	1.29
Temp 1.75H:1V	Long Term	2A	1.44
Temp 1.75H:1V	Rapid Excavation	2B	1.29
Temp 1.75H:1V	Long Term	2B	1.55
Temp 2H:1V	Rapid Excavation	2A	1.41
Temp 2H:1V	Long Term	2A	1.73
Temp 2H:1V	Rapid Excavation	2B	1.41
Temp 2H:1V	Long Term	2B	1.60

These results indicate that temporary slopes of 1.5H:1V under rapid excavation conditions where undrained soil strength must be mobilized to resist soil movement do not satisfy the WSDOT criteria for minimum factor of safety. Our analyses indicate that slope inclinations of 1.75H:1V under rapid excavation conditions would have a calculated factor of safety above the minimum 1.25 criteria. Although site dewatering will be accomplished in advance of the planned temporary excavations, it has been our experience that there could be isolated lenses or pockets of water that could be present and as they are exposed in the side of the excavation would produce seepage immediately after excavation. The presence of seepage on the side of the temporary excavation could reduce the surficial stability of the

slope and result in localized shallow soil failures. With time, as the seepage from isolated zones dissipates and the soil strength is represented by the drained soil conditions, we expect the stability conditions to improve. For long-term loading conditions, where the drained soil strengths can be mobilized, the calculated factors of safety are in excess of 1.25 for all loading conditions. Given the above considerations, we recommend a temporary slope inclination around the casting basin of 1.75H:1V. The slope surface should be protected from the elements. Since soil and seepage conditions could be variable around the excavation perimeter, the contractor should be prepared to locally flatten the slope or provide a gravel blanket on the slope, if needed, to maintain temporary slope stability. The thickness of the gravel should be determined by the contractor, but is expected to be at least 6 inches.

6.2 SITE GRADING AND FILLING

According to the project design team, a gravel pad will be built around the casting basin and across most of the project site. The pad will serve as a platform for storage and staging of pontoon construction equipment and materials. The elevation of the top of the pad will range from 17 to 18 ft MLLW, approximately 3 to 4 ft higher than the existing ground surface in most locations. In general, a gravel pad grade elevation of +18 ft is planned in areas adjacent to the edge of the basin. The site grade will slope downward to an elevation of about +17 ft around the perimeter of the pad. More specific grading plans are not available at this design phase.

6.2.1 SUBGRADE PREPARATION AND GRADING

According to the project design team, the existing ground surface will be contoured to encourage drainage of infiltrated precipitation away from the basin perimeter and toward subgrade drain pipes or the site perimeter. We expect that differential settlements caused by placement of the construction pad due to variations in thickness of the fill or variability of subsurface conditions will result in some differential settlement of the contoured subgrade surface. Design of the contoured existing ground surface should consider this differential settlement potential.

Responsibility for equipment selection and grading methods will ultimately lie with the contractor. Overall site grading could probably be accomplished using scrapers, motor graders, bulldozers, or other large contouring equipment. However, because a large portion of the site has relatively loose or soft, moisture sensitive, near-surface soils with relatively high water contents, tracked equipment or low-tire pressure rubber-tired equipment may be the only practical way of grading the existing ground surface on the site. Ideally, grading and contouring of the existing ground surface should be accomplished during the dry season. Where grading occurs, exposed soil should be sealed using a

large, steel-drum roller to promote runoff of precipitation. During sealing, vibratory compaction energy should be applied only where the exposed grade consists of predominately sandy soil; static compaction should be employed where soil consisting predominantly of silt or silty sand is exposed.

Vegetation, soil, and other material removed during grading should be disposed of off site and not be reused as fill. At locations where the current site grades are favorable – that is, where the present ground surface promotes drainage of infiltrated stormwater without additional contouring – stripping of sod and topsoil is unnecessary. Prior to placement of site fill, all grass, brush, and other vegetation should be mowed close to the ground and clippings removed.

6.2.2 FILL SELECTION, PLACEMENT, AND COMPACTION

Soil generated from excavations at the site will be unsuitable for reuse as fill due to the soils' moisture sensitivity, gradation, and high *in-situ* water content. Unless there is a need for non-structural or landscape fill on the site, the excavated soils should be disposed of off site.

Granular fill will be imported to the site to build the gravel pad. According to an October 20, 2008 memorandum provided by WSDOT, the gravel pad could consist of several feet of quarry spalls capped with 1 ft of shoulder ballast. If a different material is selected for the gravel pad fill, it should consist of material meeting the requirements of Gravel Borrow in Section 9-03.14(1) or similar of the 2008 Washington State Department of Transportation (WSDOT) Standard Specifications (WSDOT 2008b). If wet weather construction is anticipated, then the amount of fines should be limited to 5 percent or less based on the fraction of the material passing a U.S. ¾-inch sieve. According to the project design team, material selection criteria for the gravel pad will also be based upon its ability to transmit infiltrated precipitation toward a subgrade drainage collection system. If a predominately gravel material with limited sand content is selected for use in the gravel pad, we recommend that a separation geotextile be used between the base of the gravel pad and the existing ground surface.

Fill should be placed and compacted in accordance with WSDOT Standard Specifications Section 2-03.3(14)C, Method B. If quarry spalls or other coarse materials are used for fill, they should be compacted to a firm and non-yielding conditions. However, the initial layer of fill placed on the site may need to be thicker (on the order of 12 inches or more) than subsequent layers in order to provide a reasonable working base for the construction equipment. This will require a modification of the Method B compaction layer thickness requirement. Use of a construction geotextile on top of the existing ground surface that provides separation and reinforcement functions should also be considered to enhance constructability above the moisture-sensitive, fine-grained soils. The construction geotextile would provide separation for the gravel fill layer above and provide some degree of reinforcement in order to facilitate fill placement and compaction with heavy equipment. Subsequent utility excavations would

require excavating through the gravel fill pad and the construction geotextile. Alternatively, a sand layer could be constructed immediately above the subgrade to provide separation of fine-grained soils from the gravel pad; however, the benefits of reinforcement gained from a construction geotextile at the bottom of the gravel layer would not be present.

In areas of the site where the gravel pad thickness is less than about 2.5 ft, or in areas subjected to particularly heavy construction loads, it may be appropriate to use a construction geotextile for subgrade stabilization. The construction geotextile should conform to WSDOT Standard Specifications Section 9-33, Table 3.

6.2.3 WET WEATHER CONSIDERATIONS

Earthwork-related construction will be influenced by weather conditions. Near-surface site soils generally contain a significant amount of fine sand and silt, making the existing soil highly sensitive to moisture. Site grading activities using moisture-sensitive soil should normally occur during the relatively warmer and drier period between about mid-summer to early fall. Completing these activities outside of this normal construction window could lead to a significant increase in construction costs due to weather-related delays, repair of disturbed areas, increased use of "all-weather" import fill materials, and increased disposal cost of disturbed and wet soil.

Because of the moisture sensitivity, unprotected site soil (in either a compacted or uncompacted state) will degrade quickly to a slurry-like consistency in the presence of water and construction traffic. If subgrade or fill soil becomes loosened or disturbed, additional excavation to expose undisturbed soil and replacement with properly compacted structural fill will be required. For wet weather construction, the contractor may reduce the potential for disturbance of site soil subgrades by performing the following:

- Protecting exposed subgrades from disturbance by construction activities by use of gravel working mats
- Using a trackhoe with a smooth-bladed bucket to limit disturbance of the subgrade during excavation
- Suspending earthwork and other construction activities that may damage subgrades during rainy days
- Limiting and/or prohibiting construction traffic over unprotected soil
- Providing designated haul roads for construction equipment
- Sloping excavated surfaces to promote runoff

- Sealing the exposed surface by rolling with a smooth drum compactor or rubber tire roller at the end of each working day and removing wet surface soil prior to commencement of filling each day.

6.3 SITE SETTLEMENT

We estimated settlements related to general site filling and due to dewatering for the casting basin excavation as discussed below.

6.3.1 SETTLEMENT DUE TO SITE FILLING

The magnitude of settlement at the project site is influenced by several factors, including depth of fill, fill density, the depths of compressible soils, and soil compressibility properties, such as consolidation indices and stress history for cohesive soils, and elastic moduli (Young's modulus and constrained modulus) for cohesionless soils. Compressibility of the wood debris layer is likely to be highly variable from location to location. Because of these uncertainties, our calculations may under- or over-predict actual settlements. Based upon our understanding of the site soil, we estimate that between 2 to 6 inches of consolidation settlement will occur due to construction of the 3 to 4 ft thick gravel pad. Around the edges of the gravel pad, settlement due to filling will likely be approximately half of that at the center of the gravel pad area.

Numerous logs were encountered within the upper 10 ft of Soil Unit 1 during test pit digging. Along the east half of the northern border and along the Hoquiam River, logs, large timbers, sawdust, or vertical timber piles were encountered in nearly all test pits. Large, near-surface areas of wood debris will likely create local zones of highly differential settlement during consolidation.

6.3.2 SETTLEMENT DUE TO BASIN EXCAVATION DEWATERING

Dewatering will be necessary for basin construction. Based upon the difference between the current groundwater table and our estimate of the steady-state groundwater surface during basin construction, we estimate that 2 to 8 inches of settlement will occur due to dewatering of the site. Maximum settlements will occur in areas with the greatest amount of groundwater drawdown. Areas of high drawdown coincide generally with the perimeter of the basin excavation. Dewatering-induced settlements should decrease with increasing distance from the basin excavation. Further discussion of the dewatering-induced settlements, including the likely lateral extent of the zone of influence from dewatering, is addressed in our dewatering evaluation report (Landau Associates 2009).

6.3.3 RATE OF SETTLEMENT

The rate of consolidation settlement following dewatering and site filling is highly dependent upon the presence and lateral continuity of sand interbeds and other layers that would serve to dissipate excess pore pressure. CPTs at the site suggest that most of the thickness of Soil Units 1 and 3 are uninterrupted by sand layers. We estimate the time required to achieve nearly complete consolidation settlement will be between 6 and 8 months.

We recommend that settlement and settlement rate be closely monitored during construction using settlement plates. These data may be helpful in determining when construction of utilities or other settlement-sensitive site improvements may proceed.

6.3.4 IMPACTS TO EXISTING STRUCTURES

Settlement caused by site filling and dewatering will likely impact structures near the northern border of the property. The structures most likely impacted by settlement as a result of activities at the project site include a stormwater pump station owned by the City of Hoquiam, railroad tracks owned by Puget Sound and Pacific Railroad, and poles supporting an overhead powerline.

According to the project design team, the pump station consists of a pump house, a below-grade surge tank, and its connection to an in-flowing municipal storm sewer. Incomplete as-built drawings indicate that the pump house is supported on timber piles which bear in Soil Unit 2. The surge tank also appears to be founded on timber piles bearing in Soil Unit 2. The 20-inch diameter ductile iron connecting storm sewer appears to have been placed in a trench and backfilled with conventional techniques. The gravel pad fill will be placed in close proximity to these existing structures and the dewatering zone of influence will extend to this area. These conditions will impose load on the underlying compressible soil and result in settlement of the ground surface and the existing structures.

The amount of settlement experienced by the components of the pump station will vary according to: 1) the component's foundation type, and 2) the component's proximity to the gravel pad fill. We estimate that the pump house and surge tank will settle on the order of 5 to 8 inches as a result of filling and dewatering at the project site. We estimate that the stormwater pipeline could settle 6 to 9 inches.

Components of the pump station that are pile-supported will experience downdrag as a result of settlement of Soil Unit 1. Depending on the capacity of the existing piles, the pile layout, and the proximity of the structure to the gravel pad fill, downdrag loads in the piles could vary, even for piles supporting the same structure. This could lead to substantial differential settlement and damage to the structure.

Sharp differential settlement contrasts will likely be experienced between shallowly-founded structures and deeply-founded structures. At these locations, rigid pipe connections, fittings, and other structural details may experience significant distress. According to the project design team, as-built drawings of the pump house do not indicate whether flexible connections are used between the pump house, surge tank, and storm sewer, nor the range of differential movements these connections can accommodate. Our field observations indicate that the pump house has settled a lesser amount than surrounding areas. The City of Hoquiam has not reported any substantial problems with the operation of the pump house during its history, which suggests that either flexible connections (of some sort) are in use or the magnitude of the differential settlement has not been sufficient to result in damage to the connections.

We recommend that the project design team obtain additional information, if possible, regarding the pump station's layout and foundations and the differential settlement tolerance of existing connections. WSDOT understands that part or all of this pump station may need to be replaced as a result of the expected settlement impacts from the filling and dewatering activities at the project site.

We expect that settlement of the Puget Sound and Pacific (PSP) railroad tracks due to filling at the project site will be less than approximately ¼-inch due to the distance of the tracks from the filled area. Much greater settlements will likely occur as a result of dewatering. Settlement of the PSP trackbed on the order of 1 to 2 inches will likely occur as a result of dewatering on the site. The railroad tracks should be surveyed on a routine basis until settlements due to site filling and dewatering are complete. WSDOT should confer with PSP railroad to determine the frequency of track surveying, settlement tolerances, and the costs of periodic track leveling, if necessary.

Eight poles carry overhead power lines along the northern property boundary. We assume that the poles derive their support by direct embedment in the soil or by a drilled shaft-type foundation. The power poles are expected to undergo some settlement due to site filling and dewatering. Tilting of the power poles due to differential settlement could occur, although it is difficult to estimate how much. Typical power pole foundations are not particularly sensitive to vertical settlement or even some tilt that could occur during filling. Prior to construction, the power utility owner should be contacted to discuss potential impacts of site activities and whether mitigation actions are appropriate.

6.3.5 IMPACTS TO CONSTRUCTION SEQUENCE

Differential settlements will occur due to variations in compressibility of the site soils and from stress effects near the edge of the site fill. Differential settlement will also occur as a result of the increased amount of groundwater dewatering drawdown near the basin excavation.

Sharp settlement contrasts are likely in the vicinity of large wood debris during consolidation. We understand from WSDOT that utilities will generally be placed above the wood layer, where it exists. As such, the presence of large wood objects below the utility trench subgrade may not be apparent at the time of utility installation. To the extent possible, utilities should be designed to accommodate some differential settlement.

We recommend that dewatering and site filling precede utility placement. This will allow the majority of differential settlements to occur prior to utility installation; the potential for change to pipe grades will be significantly reduced if the majority of settlements are allowed to occur prior to pipe installation.

6.3.6 INCREASING THE RATE OF SETTLEMENT

Soil Units 1, 2, and 3 will settle at different rates. Settlement in Soil Unit 2B (i.e., most of the site) will occur concurrently with site filling and dewatering. Settlement of Soil Units 1 and 3 will occur for several months following the end of site filling and after steady-state dewatering is achieved. We expect that Soil Units 1 and 3 will achieve 95-percent consolidation at around the same time. Because Soil Unit 1 will likely contribute approximately 50- to 75-percent of the total settlement at the site, we estimated the increase in the rate of settlement that would likely occur if wick drains were installed in Soil Unit 1. Wick drains would likely expedite consolidation settlements by several weeks and may not justify the expense of their installation.

6.4 UTILITIES

We understand from the design team that the project site will be served by industrial utilities plus site-specific utilities. These include:

- City of Hoquiam potable water service to the casting basin, batch plant, and office
- Onsite stormwater collection, conveyance, detention, and discharge
- Sanitary sewer service
- Conveyance and discharge of water from the casting basin dewatering system
- Conveyance, detention, and treatment of process water from the casting basin
- Electrical service.

6.4.1 UTILITY INSTALLATION SEQUENCE

As discussed above, we recommend that utilities be installed after the majority of consolidation settlement as a result of site filling and dewatering has occurred. In particular, installation of grade-sensitive utilities (including catch basins, gravity storm sewers, and gravity sanitary sewers) should be delayed until consolidation settlements caused by gravel pad construction and dewatering are complete. Installation of utilities within the area to be backfilled following construction of the basin walls should take place after consolidation due to the backfill is complete. Connection of these utilities to utilities beyond the wall backfill area should take place after consolidation due to wall backfilling and gravel pad construction is complete.

6.4.2 CONVENTIONAL UTILITIES

The following sections provide preliminary geotechnical recommendations for design and construction of new site utilities. Geotechnical recommendations are included for installation of new site utilities including construction dewatering, trench excavation and retention, horizontal directional drilling, pipe foundation support, pipe bedding and initial backfill, trench backfill and compaction criteria, and anticipated loads on pipes and utility vaults. Soil resistivity and pH tests were carried out to evaluate the soil resistivity in the application of buried underground utilities on the site. The results are presented in Appendix B.

The depths of specific utilities are unknown at the time this report was prepared; however, WSDOT anticipates the following:

- Stormwater conveyances will be between 2 and 5 ft below the finish grades
- Sanitary sewers will be a minimum of 5 ft below the finish grades and generally between 5 and 10 ft deep
- Water conveyances, including potable water, dewatering water, and process water, will be a minimum of 3 ft below finish grades and always above sanitary sewer lines
- Trenchless crossing beneath the PSP railroad tracks will be approximately 10 ft deep. This crossing will provide a connection to the City of Hoquiam municipal water utility.

6.4.3 UTILITY CONSTRUCTION DEWATERING

Groundwater was generally observed at about 3 to 6 ft below the present ground surface throughout the project site during previous and recent geotechnical explorations. Dewatering for the casting basin construction will lower the groundwater level significantly in close proximity to the casting

basin, with decreasing influence with distance away from the casting basin dewatering system. Any excavations extending below the groundwater table will require dewatering. It is expected that open sump pumping from the excavation where minor amounts of groundwater seepage is encountered in shallow excavations may be sufficient, assuming the trench walls remain stable. During test pit digging, we observed slight to heavy seepage in the layer of wood debris present across much of the site. Other soils exposed in test pit explorations exhibited slight seepage.

6.4.4 TRENCH AND EXCAVATION SUPPORT

Trench excavation should conform to the requirements of Section 7-08.3(1) of the 2008 WSDOT Standard Specifications. Actual trench configurations and maintenance of safe working conditions, including temporary excavation stability, should be the responsibility of the contractor. All applicable local, state, and federal safety codes should be followed. Temporary excavations in excess of 4 ft should either be shored or sloped in accordance with Safety Standards for Construction Work, Part N, located in Chapter 296-155 WAC. In the absence of groundwater seepage, fill and alluvium encountered within the trench zone would be classified as a Type C soil per Chapter 296-155 WAC. The prescriptive maximum allowable excavation slope for Type C soils is 1½H:1V. If groundwater seepage is present, flatter slopes, temporary shoring, and/or dewatering may be required.

Trench boxes should provide adequate support for shallow excavations, provided the trench is properly dewatered and settlement-sensitive structures and utilities are not situated immediately adjacent to the excavation. Trench boxes should meet the requirements in Safety Standards for Construction Work, Part N, located in Chapter 296-155 WAC.

Where a trench box is used to support excavations, one or both sides of the trench may cave against the box, especially if granular soil is present. Soil movement and disturbance due to caving may extend out on either side of the trench for a distance approximately equal to the depth of the trench. Caving can be reduced by routing stormwater away from the excavation and limiting vehicular traffic or vibrations next to the trench. Additional bracing or sheeting may be required where the near edge of the trench will be closer than 1.5 times the trench depth to settlement-sensitive utilities or structures. When the trench box is moved, precautions should be taken to minimize disturbance of the pipe, underlying bedding materials, and surrounding soil.

If bracing is needed to support the trench walls, the temporary bracing system should be designed by a structural engineer licensed in the State of Washington. Temporary shoring typically consists of steel plates with internal bracing. Temporary shoring may also be used in conjunction with sloped excavations. If sloped excavations are used in conjunction with trench boxes, the slopes should be sloped

no steeper than 1½H:1V. Surcharge loads on trench support systems due to construction equipment, stockpiled material, and vehicle traffic should be included in the design.

6.4.5 PIPE FOUNDATIONS, BEDDING, AND BACKFILL

We expect that excavation for the proposed utilities will typically be in medium dense to dense, gravel pad fill or in loose to medium dense/soft to medium stiff silty sand and sandy silt near the existing ground surface. Deeper excavations will encounter soft to very soft, wet silt and loose to very loose, wet sand. At much of the project site, small to large wood debris will be encountered where planned excavation depths exceed approximately 3 to 5 ft BGS. A heavy-duty hydraulic excavator with sufficient reach should be able to excavate the proposed trenches to the planned depths. Upon reaching the trench bottom, we recommend that a smooth-bladed bucket be used to clean the trench bottom of loose and/or disturbed soil. The final trench bottom should be firm and free of loose and disturbed soil.

In areas where the trench subgrade is planned to be no more than about 2 to 3 ft BGS (generally around 6 to 7 ft below the gravel pad finish elevation), we expect that gravel pad fill, medium dense sand, or medium stiff silt should provide adequate support for buried utilities, provided that the subgrade remains in a relatively undisturbed condition and is properly dewatered. If the trench subgrade is disturbed by construction traffic, the foundation soil should be overexcavated and replaced as discussed in the following paragraph.

Where very soft to soft silt and loose silty sand is anticipated at the pipe foundation elevation (i.e., greater than about 2 to 3 ft BGS), subgrade soil will be easily disturbed due to excavation and/or foot traffic during laying of the pipe and will generally provide poor foundation support for the pipeline. Wood debris will also provide a poor foundation. If exposed in the bottom of the trench, soft/loose soil and wood debris should be over-excavated until suitable foundation is reached or to a maximum depth of 2 ft. Individual logs or other large wood debris encountered during trenching should be removed to reduce the potential for development of localized shear stresses during backfilling. Removal and replacement of unsuitable foundation material should be in accordance with Section 7-08.3(1)A of the 2008 WSDOT Standard Specifications. The overexcavation should be backfilled with suitable foundation material to provide a firm trench bottom. Foundation material should meet the requirements for Class A Foundation Material in Section 9-03.12(1) of the 2008 WSDOT Standard Specifications, and should be thoroughly compacted by tamping with the excavator bucket to provide a firm trench bottom.

If suitable foundation material is not encountered within a depth of 2 ft below the pipe invert, a woven geotextile, meeting the requirements for Soil Separation in Table 3 in Section 9-33 of the 2008 WSDOT Standard Specifications, should be placed in the bottom of the trench prior to placement of the foundation material to provide separation between the trench bottom and the foundation material. The

geotextile should extend up the sides of the trench so that the foundation material can be encased within the geotextile, forming a "pillow" to lay the pipe on. The pipe should be bedded as recommended in the following section.

6.4.5.1 Bedding and Pipe Zone Backfill

To provide uniform support, the pipe should be bedded in accordance with Section 7-08.3(1)C of the 2008 WSDOT Standard Specifications. The bedding material should extend 6 inches below the invert of the pipe. For flexible pipes (welded steel pipes, PVC, HDPE), bedding material should consist of Gravel Backfill for Pipe Zone Bedding per the requirements of Section 9-03.12(3) of the 2008 WSDOT Standard Specifications. The bedding material should extend at least 6 inches above the crown of the pipe.

Pipe bedding material and pipe zone backfill should be brought up evenly around the pipe in relatively horizontal lifts not exceeding 6 inches, and worked under the haunches of the pipe by slicing with a shovel, vibration, or other approved procedures. Pipe zone backfill should be placed in accordance with Section 7-08.3(1)C of the 2008 WSDOT Standard Specifications.

6.4.5.2 Trench Backfill and Compaction

Except for trench spoils excavated from the gravel pad fill, we expect that excavated soils will be unsuitable for re-use as trench backfill. If gravel pad fill will be re-used for trench backfill, it should be separated from other trench spoils during excavation to prevent contamination with unsuitable soils.

Imported trench backfill should meet the requirements for Bank Run Gravel for Trench Backfill as contained in Section 9-03.19 of the 2008 WSDOT Standard Specifications. If wet weather construction is anticipated or groundwater seepage is present in the trench, then the amount of fines (material passing a U.S. No. 200 sieve) should be limited to 5 percent or less based on the fraction of the material passing a U.S. ¾-inch sieve. Backfill above the pipe zone should be placed and compacted in accordance with Section 7-08.3(3) of the 2008 WSDOT Standard Specifications.

6.4.5.3 Loads on Pipes

The soil load that will be imposed on a buried pipe is dependent on the soil and groundwater conditions, the type of pipe, the width of the trench, the height of bedding material around the pipe, the depth of cover over the pipe, the method of pipe placement, and the backfill conditions. We recommend assuming that the embankment condition will govern the soil load on the pipe. The embankment soil load, W_P (lbs/ft), acting on the pipe can be computed using the relationship (McGrath 1998):

$$W_P = VAF*W_{SP}$$

Where VAF = Variable Arching Factor
W_{SP} = Soil prism load (lbs/ft)

For flexible pipe, the variable arching factor (VAF) is typically taken as 1.0. For rigid pipe, the VAF is typically taken as 1.4. These values assume that the pipe is properly bedded with good side support. The soil prism load, W_{SP}, is given by:

$$W_{SP} = \gamma_S(H + 0.11B_C)B_C$$

Where γ_S = Soil unit weight in pounds per cubic ft
(assume 135 pcf for compacted import backfill)
H = Depth to top of pipe, in ft
B_C = Outside pipe diameter, in ft

Consideration should also be given to the effect of traffic loading on the pipe in those areas where the pipe will be installed beneath pavements or traffic areas. The live load, W_L (lbs/in), acting on a buried pipe from a truck (HS-22) crossing over the pipe can be computed using the relationship (AASHTO 1998):

$$W_L = 125*I_F*D/[(1.67+1.75*z)(0.83+1.75*z)]$$

Where D = Pipe diameter in inches
z = Depth to top of pipe in ft
I_F = Impact factor:
= 1.3 for z <= 1 ft
= 1.2 for 1 ft < z <= 2 ft

Trench widths are expected to be generally less than two pipe diameters. The modulus of soil reaction (E') of the trench walls will generally control pipe deflections computed using the Iowa Formula. Assuming good compaction of import structural fill around the side walls of the pipe and dredge fill composing the trench walls, we recommend using an E' value of 500 pounds per square inch (psi) for shallow installations.

6.4.5.4 Resistance to Lateral Loads

Lateral resistance to forces occurring at bends in the pipe will be resisted mainly by soil friction along the pipe. For a steel pipe in granular backfill, an ultimate interface friction angle of 18 degrees should be used. No factor of safety is included in the interface friction values. If thrust restraint (thrust

blocks) is being considered to resist lateral forces, a passive soil resistance, based on an equivalent fluid pressure of 90 pcf, may be used assuming submerged conditions. The value for the passive resistance has been reduced by a factor of 2.0 to limit lateral deflections to less than 1 percent of the embedded depth and to make it compatible with the movement required to mobilize the soil/pipe friction.

6.4.6 UTILITY TRENCH SETTLEMENTS

We estimate that up to approximately 0.5 inch of settlement will occur along trenches following backfilling. This is a result of replacing excavated native soils with denser granular backfill. Settlements of about 1.0 inch should be expected following backfilling of deep (i.e., up to 20 ft deep) trenches.

6.4.7 TRENCHLESS PIPE INSTALLATION

The conceptual utility design involves installing an 8-inch diameter water line (product pipe) beneath the PSP railroad and an industrial spur serving a lumber mill to provide municipal water service to the project site. The length of the proposed crossing is estimated to be approximately 300 ft and is planned to be installed using trenchless methods.

Based on conditions encountered in the explorations, it is our opinion that it is feasible to construct the proposed water service crossing using trenchless construction methods. However, large wood objects such as logs, dimension lumber, and timber piles are present at the site. These objects have the potential to become obstructions and deflect, bind, or cause drill refusal. Ground heave and the creation of voids are also possible if large wood debris is encountered during drilling. These issues should be considered during design and steps taken to limit the risk of encountering obstructions (e.g., lowering the alignment, exploring subsurface conditions, etc.). Due to the presence of wood debris encountered in explorations at both ends of the proposed alignment at depths of up to approximately 10 ft, we recommend that the crown of bore path be at least 10 ft below the existing ground surface.

Horizontal Directional Drilling (HDD) is a trenchless construction method that uses a drill to bore a hole in a shallow arc from the surface. The borehole is then reamed to remove the spoil and may be filled with bentonite slurry to maintain borehole stability. The pipeline is assembled above ground, pulled or pushed into the borehole and anchored. Impassable obstructions (wood, concrete, boulders, etc.) along the drill alignment require deviations resulting in poor line and grade and as such are not used for gravity sewers.

Pipe-jacking is a trenchless construction method used to install a casing by hydraulically pushing the pipe through the ground and removing the spoil through the pipe using an auger. This technique is typically advanced from a launching pit toward a receiving pit, by means of a rotating cutting head.

Spoils at the cutting face are removed to the back of the drive shaft by helically wound auger flights rotating in the steel casing. Significant jacking forces are necessary at the launching pit to advance the casing. These forces are usually provided by hydraulic jacks using reaction piles, deadman anchors, or other means for reaction. The equipment has limited steering capabilities and thus is suitable for only relatively straight alignments.

6.4.7.1 Launching and Receiving Excavations

Excavations will be necessary at both ends of the crossing to allow for trenchless construction. A sloped cut or braced excavation could be used for the excavation on the project site; at the north end of the crossing alignment, a braced cut will likely be necessary due to space limitations, an adjacent street, and utilities. We estimate that the launching and receiving excavations may need to be as deep as 15 ft in order to provide sufficient clearance below the wood layer; however, the actual depth needed will be dependent upon the contractor's equipment and operations. The length and width of the excavations will depend upon the contractor's space requirements.

The vertical stand-up time of soils exposed during exploratory test pit digging is generally quite short, especially below the groundwater table. Installation of temporary shoring methods such as top-down timber or concrete panel lagging are likely not feasible in these conditions. Methods which install positive ground support prior to excavation, such as soldier piles and driven steel plate lagging or braced sheet-pile walls should be used. These methods would also reduce dewatering requirements and the amount of dewatering settlement. Whichever shoring method is selected, the contractor should anticipate that large wood debris or other buried obstructions may be present below the ground surface. If a sloped excavation is used for a launching or receiving entry point, we recommend that the excavation sides be sloped or benched at an average inclination of no steeper than 2H:1V. Actual slopes may need to be flatter if warranted by the exposed soils.

6.4.7.2 Settlement Monitoring and Control Considerations

At the PSP crossing, ground surface settlement during construction will depend upon the trenchless method used. Negligible vertical surface settlements are expected to be reflected at the surface with the zone of influence of settlement extending about 10 to 15 ft beyond the centerline of the bore. The above settlement estimates assume good workmanship and face control during boring. If the boring face is not properly supported, and running/flowing conditions occur, surface settlements can be substantially greater. We recommend that the contractor implement an instrumentation program to

monitor ground surface settlement at the PSP railroad tracks during the trenchless crossing to confirm that the construction process is not resulting in loss of ground.

6.4.7.3 Obstruction Considerations

As discussed previously, borings at both ends of the trenchless crossing indicate a wood layer extending to a depth of up to 10 ft. Borings and test pits at the project site also show that logs up to 2.5 ft in diameter could be encountered within or above the wood layer. During test pit digging, we did not observe significant amounts of additional wood debris below the wood layer. Logs, timbers, and other large buried objects could cause refusal of the drill bit or the carrier pipe, or could heave the ground surface if encountered during drilling. These objects could also cause significant deflection from the planned alignment.

According to historical photographs acquired by the project archaeologist, a portion of the PSP mainline and a spur serving the project site were supported by trestles with timber pile foundations. In the photos, it is not obvious whether these trestles extended as far west of the Hoquiam River as the proposed trenchless crossing. Piles may also be present under the spur serving the lumber yard to the north of the project site. It is possible that timber piles are present throughout the area of the proposed crossing alignment. If present, timber piles could pose serious challenges to trenchless installation. These photographs should be further reviewed. Potholing along the proposed alignment could be undertaken to better assess the presence of these piles.

6.4.8 METHANE GAS

Methane gas was encountered during test pit explorations. The presence of methane gas is likely a product of decomposition of the wood layer. Hydrogen sulfide gas was also noted in some test pits. Methane gas concentrations measured in the test pits were below the lower explosive limit (LEL); however, when probing into the wood layer with a T-probe, our field personnel noted gas burbling from probe holes. At the probe holes, methane gas concentrations in excess of the LEL were noted. The gas likely dispersed quickly in the windy conditions at the site.

During construction, much larger areas of the wood layer will be exposed. This could result in more significant accumulations of methane, hydrogen sulfide, and other gasses. Gas levels in the excavations should be monitored to reduce explosion hazards and increase worker safety. Ultimately, safe excavation and utility installation practices are the responsibility of the contractor.

Following construction, vaults, catch basins, the HDD encasement pipe, and other underground openings have the potential to accumulate significant concentrations of methane gas. These

accumulations could exceed the LEL and create an explosion hazard. Venting of these structures may be necessary and they should be considered confined spaces. Backfilled trenches could act as gas conduits and allow transmission of gas to unexpected places. This issue could be more critical in paved areas, or other areas where construction creates a confining layer that does not allow the dissipation of any accumulated gases.

6.5 RAILROAD SPUR CONSTRUCTION

According to the design team, a rail spur may be constructed at the project site to provide access for delivery of construction materials via the PSP railroad. A rail yard is located adjacent to the western half of the northern project site property boundary. Portions of the yard appear to be in relatively poor condition and may require rehabilitation prior to routine use. The ground elevation of the yard is approximately +14 ft, roughly the same elevation as most of the project site. The proposed spur would need to cross a drainage ditch along the site boundary at a skew and climb to approximately elevation +17 ft to match the proposed site grade.

Crossing the ditch and reaching the project site grade could be accomplished using an embankment-and-culvert approach or with a pile-supported trestle. If an embankment and culvert are used, settlement in excess of what we described for general site filling earlier in this report would likely occur. Track settlement can be repaired with track leveling; however, multiple tracks would be affected and, because of the slow rate of consolidation, multiple leveling sessions could be necessary. A pile-supported bridge or trestle over the drainage ditch would reduce the potential for settlements at the rail yard, but could be more expensive than construction of an embankment fill plus periodic track leveling.

If a rail spur will be considered in later design, it should be designed in accordance with the 2007 American Railway Engineering and Maintenance-of-Way Association *Manual for Railway Engineering* (AREMA 2007). Additional lab testing, such as California Bearing Ratios, may be necessary to characterize the performance of the subgrade soils under track loads. The material used for the gravel pad fill would likely perform adequately as subballast. An appropriate depth of ballast would need to be placed above the gravel pad to support the rail ties. Alternatively, a portion of the gravel pad could be excavated and replaced with ballast.

6.6 MATERIAL STOCKPILING

Excavated soils or import structural fill should not be stockpiled within 200 ft of the perimeter walls of the casting basin so as to not induce settlement in the vicinity of the walls and downdrag loads on

piles. Also, the backfill materials should not be stockpiled within 100 ft of adjacent or settlement-sensitive structures or utilities, or within 50 ft of the crest of the slopes along the adjacent water bodies.

7.0 USE OF THIS REPORT

This report is for the exclusive use of HDR and WSDOT for specific application to the design phase of the proposed SR 520 Pontoon Construction Project on the IDD #1 site at the Port of Grays Harbor, Washington. The use of this report by others, or for purposes other than intended, is at the user's sole risk. The findings, conclusions, and recommendations presented herein are based on our understanding of the project, review of available geotechnical and geologic information in the project vicinity, and on subsurface conditions observed during explorations completed for this project.

Within the limitations of scope, schedule, and budget, the conclusions and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering principles and practices in the area at the time the report was prepared. We make no other warranty, either express or implied.

There may be some variation in subsurface soil and groundwater conditions at the site, and the nature and extent of the variations may not become evident until construction. Accordingly, a contingency for unanticipated conditions should be included in the project budget.

We appreciate the opportunity to provide geotechnical services on this project. As the project design progresses, we expect design refinements may require additional geotechnical consultation. We look forward to assisting you as the design progresses. If you have any questions or comments regarding the information contained in this report or if we may be of further service, please call.

LANDAU ASSOCIATES, INC.

Chad McMullen, P.E.
Project Engineer

Reda A. Mikhail, P.E.
Principal

REDA ANWAR MIKHAIL
STATE OF WASHINGTON
34822
REGISTERED
PROFESSIONAL ENGINEER
3/25/09

Dennis R. Stettler, P.E.
Principal

CTM/RAM/DRS/kes

8.0 REFERENCES

AASHTO. 2007a. *Proposed AASHTO Guide Specifications for LRFD Seismic Bridge Design, Subcommittee for Seismic Effects on Bridges, T-3.* American Association of State Highway and Transportation Officials. May.

AASHTO. 2007b. *LRFD Bridge Design Specifications.* American Association of State Highway and Transportation Officials.

AASHTO. 1998. *Standard Specifications for Highway Bridges.* Sixteenth Edition, with 1998 interim. America Association of State Highway and Transportation Officials.

AREMA. 2007. *Manual for Railway Engineering*. American Railway Engineering and Maintenance-of-Way Association.

BOAS. 2007. *Cultural Resource Study Report of the Port of Grays Harbor Industrial Development District Parcel No. 1, Hoquiam, Washington.* Boas. Inc. Prepared for the Washington State Department of Transportation. August.

FHWA. 2002. *Geotechnical Engineering Circular No. 5 – Evaluation of Soil and Rock Properties.* Federal Highway Administration. Report No. FHWA-IF-02-034.

GRL Engineering, Inc. 2005. GRLWEAP software, Version 2005-1.

Hart Crowser. 1986. *Subsurface Explorations and Design Phase Geotechnical Engineering, Study SR-90, Seattle Access, General Purpose and Transit/HOV Lanes, Seattle, Washington*. Volume III of III. Prepared for WSDOT and Henningson, Durham, and Richardson.

IDD package. 2006. Port of Grays Harbor Industrial Development District (IDD) No. 1. Topographic map of the site (which appeared to be completed sometime in 2005), a wetland report dated September 1997 prepared by Pentec Environmental, Inc, and some design drawings dated 1984. Received from the Washington State Department of Transportation.

Idriss, I.M. and R.W. Boulanger. 2008. *Soil Liquefaction During Earthquakes*, Earthquake Engineering Research Institute (EERI), MNO-12, 237 pp.

Itasca Consulting Group, Inc. 2008. FLAC-2D software, Version 6.

Itasca Consulting Group, Inc. 2006. FLAC 3D software, Version 3.1.

Kramer, S.L. 1996. *Geotechnical Earthquake Engineering.* Prentice Hall. Upper Saddle River, New Jersey. Pp. 653.

Landau Associates. 2009. Report: *Dewatering Evaluation Report WSDOT SR520 Pontoon Construction, Port of Grays Harbor, Washington*. Prepared for HDR Engineering, Inc. March.

Landau Associates. 2008a. *Technical Memorandum: Preliminary Evaluation – Timber Pile Option, SR 520 Pontoon Construction Project, Port of Grays Harbor, Washington*. Prepared for WSDOT. December 5.

Landau Associates. 2008b. Report: *Draft Geotechnical Design Study WSDOT SR520 Pontoon Construction Project, Grays Harbor, Washington*. Prepared for HDR. December 15.

Landau Associates. 2007a. Report: *Geotechnical Design Study WSDOT Special Projects Construction Site, Grays Harbor, Washington*. Prepared for WSDOT. March 29.

Landau Associates. 2007b. Report: *Dewatering Evaluation Report WSDOT Special Projects Construction Site, Grays Harbor, Washington*. Prepared for WSDOT. March 15.

Landau Associates. 2007c. Technical Memorandum: *Dewatering System Cost Estimate, WSDOT Special Projects Construction Site, Grays Harbor, Washington.* Prepared for WSDOT. March 15.

Landau Associates. 2006a. *Geotechnical and Hydrogeologic Study, Bridge Pontoon Construction Facility, Grays Harbor, Washington.* Prepared for WSDOT. May 31.

Landau Associates. 2006b. *Draft Preliminary Site Investigation, Washington State Department of Transportation Special Projects Construction Site, Port of Grays Harbor, Hoquiam, Washington.* Prepared for WSDOT. December 29.

Landau Associates. 2006c. *Radiocarbon Dating Report, WSDOT Special Projects Construction Site, Port of Grays Harbor, Hoquiam, Washington.* Prepared for WSDOT. September 5.

Logan, R.L. 1987. *Geologic Map of the Chehalis River and Westport Quadrangles, Washington.* Open File Report 87-8. Washington Division of Geology and Earth Resources Open File Report 87-8. Washington State Department of Natural Resources.

Luehring, R., Snortland, N., Steven, M., and Mejia, L. H. 2001. *Liquefaction Mitigation of a Silty Dam Foundation Using Vibro-Stone Columns and Drainage Wicks: a Case History at Salmon Lake Dam*. Bureau of Reclamation Water Operation and Maintenance Bulletin, No. 198, 1-15.

Lunne, T., P.K. Robertson, and J.J.M. Powell. 1997. *Cone Penetration Testing in Geotechnical Practice.* Spon Press. London, U.K.

Matasović, Neven, and Gustovo Ordóñez. 2007. *D-MOD2000*, GeoMotions, LLC, Computer Software.

McGrath, Timothy J. 1998. *Calculating Loads on Buried Culverts Based on Pipe Hoop Stiffness*. TRB Annual Meeting. Washington, D.C.

Meyerhof, G. G. 1976. *Bearing Capacity and Settlement of Pile Foundations*. Journal of the Geotechnical Engineering Division, ASCE, Vol. 102, No. GT3.

Miner, R F. and T.M. Gurtowski. 2000. *Driven Piles for Safeco Field.* The design & Installation of Higher Capacity Driven Piles. Presented by the Pile Driving Contractors Association, April 3 and 4, Annapolis, Maryland.

Ordóñez , G.A. 2000. Shake2000, Computer Software.

Pacific Earthquake Engineering Research Center. 2006. OpenSees Software, Version 1.7.3.

Rau, W.W. 1987. *Geologic Map of the Humptulips Quadrangle and Adjacent Areas. Grays Harbor County, Washington.* Geologic Map GM-33. Washington State Department of Natural Resources.

Rocscience, Inc. 2003. SLIDE Computer Slope Stability Program, Version 5.

Roger Lowe Associates. 1980. *Analysis of Surfacing Requirements, Industrial Development District No. 1, Port of Grays Harbor, Industrial Development District No. 1.* Prepared for the Port of Grays Harbor. March 11.

Roger Lowe Associates. 1978. *Surfacing and Grading Requirements, Industrial Development District No. 1, Port of Grays Harbor.* Prepared for the Port of Grays Harbor. May 16.

Roger Lowe Associates. 1976. *Dike Stability and Site Investigation, Port of Grays Harbor, Industrial Development District No. 1*. Prepared for the Port of Grays Harbor. December 23.

Seed, H.B, R.T. Wong, I.M. Idriss, and K. Tokimatsu. 1986. Moduli and damping factors for dynamic analyses of cohensionless soils. *Journal of Geotechnical Engineering*. ASCE, Vol. 112, No. GT11, pp. 1016-1032.

Tomlinson, M.J. 1986. *Foundation Design & Construction.* 5th Edition. John Wiley & Sons, Inc., New York, New York. Pp. 842.

USGS. 2002. *National Seismic Hazard Mapping Project*. http://earthquake.usgs.gov/hazmaps/. U.S. Geological Survey. Accessed in September 2008.

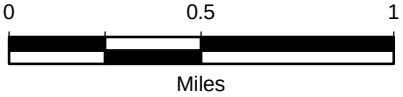
WSDOT. 2008a. *Geotechnical Design Manual, revised Chapter 6*. Washington State Department of Transportation. Publication M46-03. October.

WSDOT. 2008b. *Standard Specifications for Road, Bridge, and Municipal Construction*. Washington State Department of Transportation. Publication Number M41-10.

WSDOT. 2006. *Geotechnical Design Manual.* Washington State Department of Transportation. Publication Number M46-03.

Youd, T.L., C.M. Hansen, and S.F. Bartlett. 2002. *Revised Multilinear Regression Equations for Prediction of Lateral Spread Displacement.* ASCE Journal of Geotechnical and Geoenvironmental Engineering. Vol. 128. No. 12. Pp. 1007 – 1017.

Youd, T.L., I.M. Idriss, R.D. Andrus, I. Arango, G. Castro, J.T. Christian, R. Dobry, W.D.L. Finn, L.F. Harder, M.E. Hynes, K. Ishihara, J.P. Koester, S.S.C. Liao, W.F. Marcuson, G.R. Martin, J.K Mitchell, Y. Moriwaki, M.S. Power, P.K. Robertson, R.B. Seed, and K.H. Stockoe. 2001. "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils." *Journal of Geotechnical and Geoenvironmental Engineering*. 127(10): 817-833.

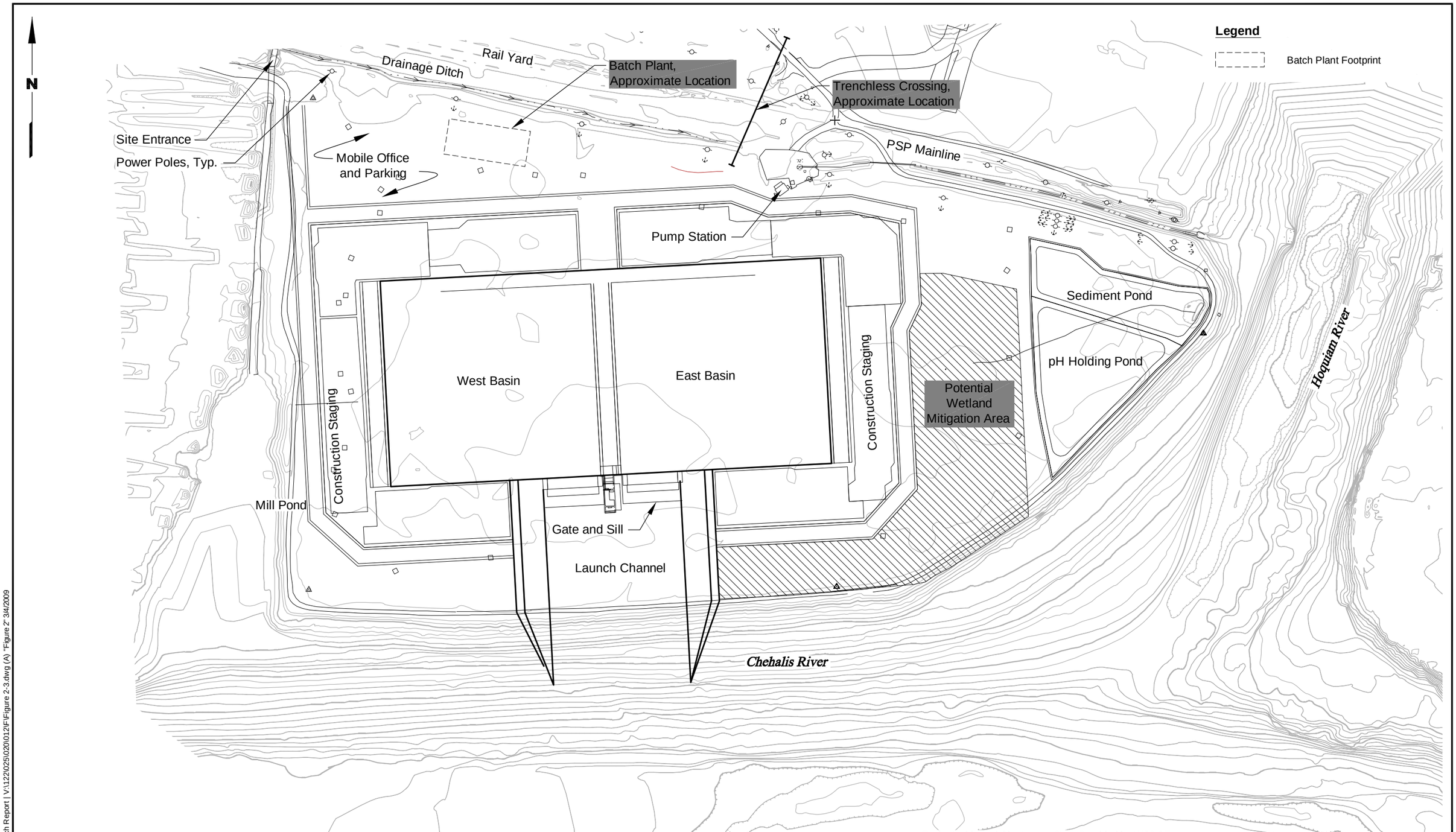


Data Source: ESRI 2008

Y:\Projects\122025\Mapdocs\Fig1.mxd 10/24/2008

LANDAU ASSOCIATES

SR520 Pontoon Construction Project Port of Grays Harbor, Washington	**Vicinity Map**	Figure 1



Topographic and Site Layout Data Provided by WSDOT

0 200 400
Scale in Feet

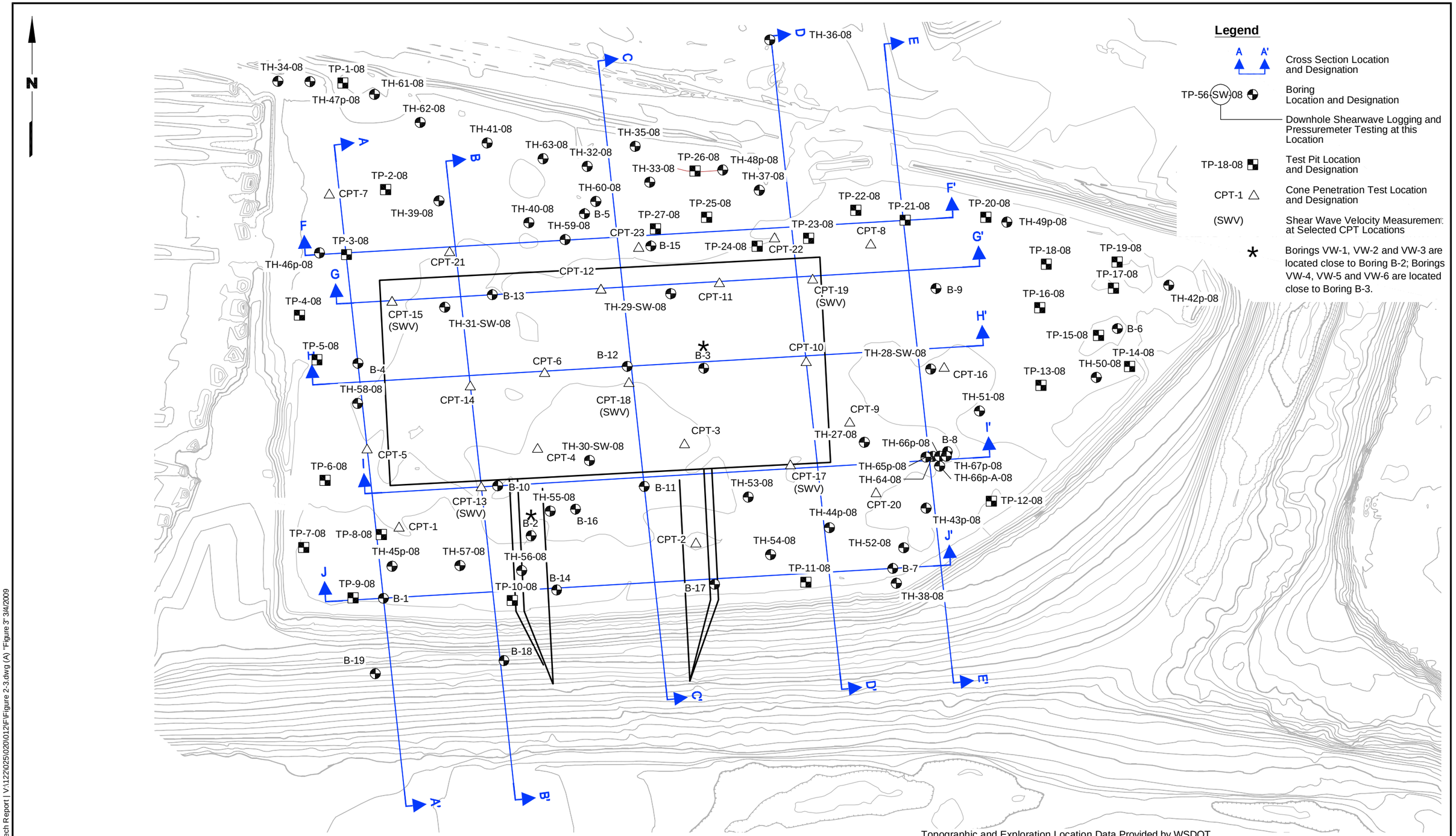
SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Site Layout

Figure
2

LANDAU ASSOCIATES

Geotech Report | V:\1220\025\020\012\F\Figure 2-3.dwg (A) "Figure 2" 3/4/2009

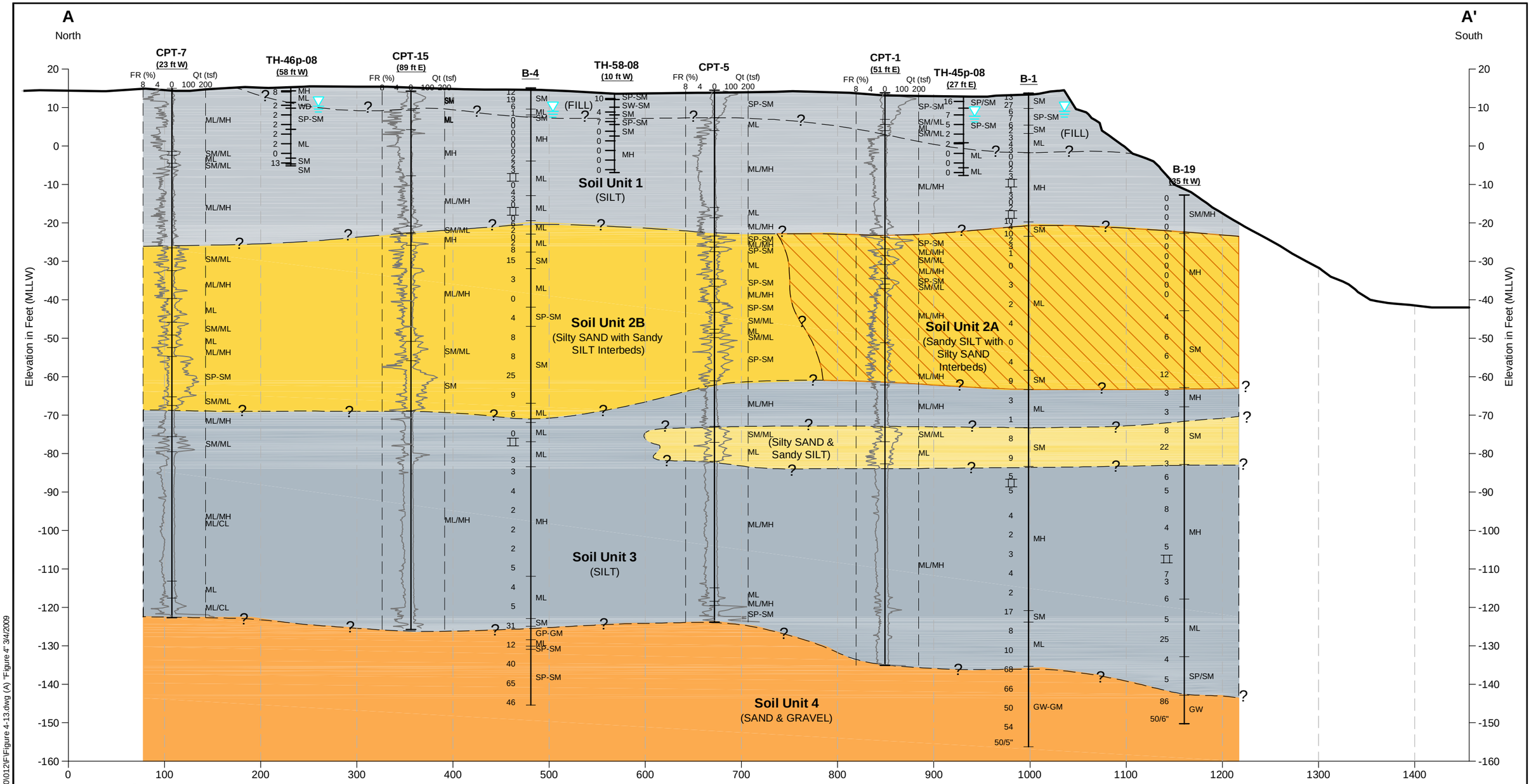


Topographic and Exploration Location Data Provided by WSDOT

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	**Site and Exploration Plan**	Figure 3

Geotech Report | V:\122\025\020\012\F\Figure 2-3.dwg (A) "Figure 3" 3/4/2009



Legend

B-2 (3 ft S) — Boring Number; Distance and Direction from Cross Section

Groundwater Elevation

ML — Unified Soil Classification Symbol

5 — Standard Penetration Test Blow Count (140 lb Hammer, 30" Drop)

? — Major Soil Unit Contact

? — Contact within the Same Soil Unit

Shelby Tube Sample (Pushed 24" with Rig Hydraulics)

CPT-4 — Cone Penetrometer Number

FR (%) Qt (tsf)

Friction Ratio — Cone Resistance

Note:

1. This cross section has been interpreted and generalized from project field data. Variations between this cross section and actual conditions may exist. The project boring logs and written report must be referenced for a proper understanding of the nature of the subsurface conditions.
2. Planned Casting Basin top of slab is approximately -13ft.

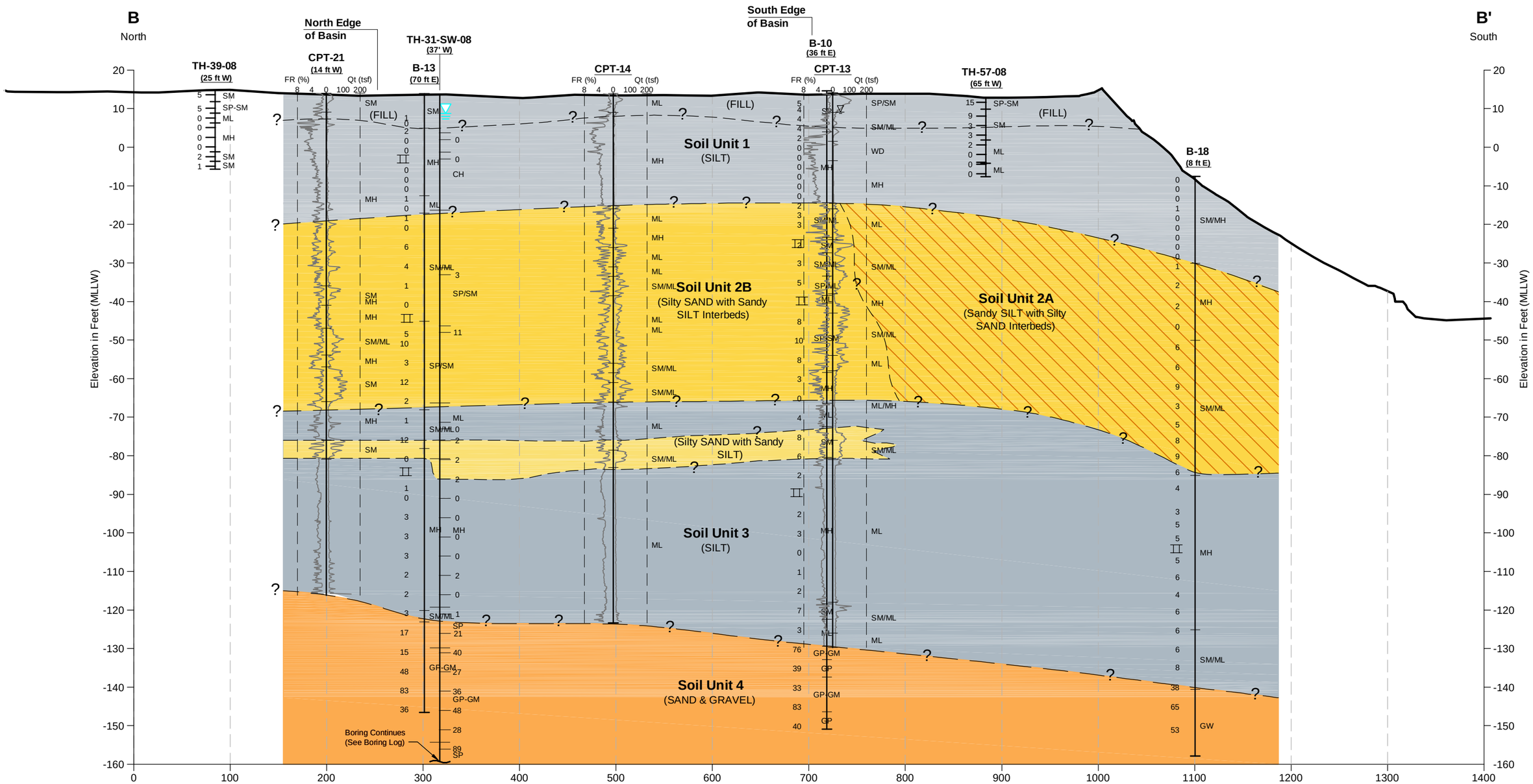
0 100 200

Scale in Feet
4x Vertical Exaggeration

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	Cross Section A-A'	Figure 4

Geotech Report | V:\122\025\020\012\F\Figure 4-13.dwg (A) "Figure 4" 3/4/2009



Legend

B-2 (3 ft S) — Boring Number; Distance and Direction from Cross Section

Groundwater Elevation

ML — Unified Soil Classification Symbol

5 — Standard Penetration Test Blow Count (140 lb Hammer, 30" Drop)

? — Major Soil Unit Contact

? — Contact within the Same Soil Unit

Shelby Tube Sample (Pushed 24" with Rig Hydraulics)

CPT-4 — Cone Penetrometer Number

FR (%) Qt (tsf)

Friction Ratio — Cone Resistance

Note:

1. This cross section has been interpreted and generalized from project field data. Variations between this cross section and actual conditions may exist. The project boring logs and written report must be referenced for a proper understanding of the nature of the subsurface conditions.

2. Planned Casting Basin top of slab is approximately -13ft.

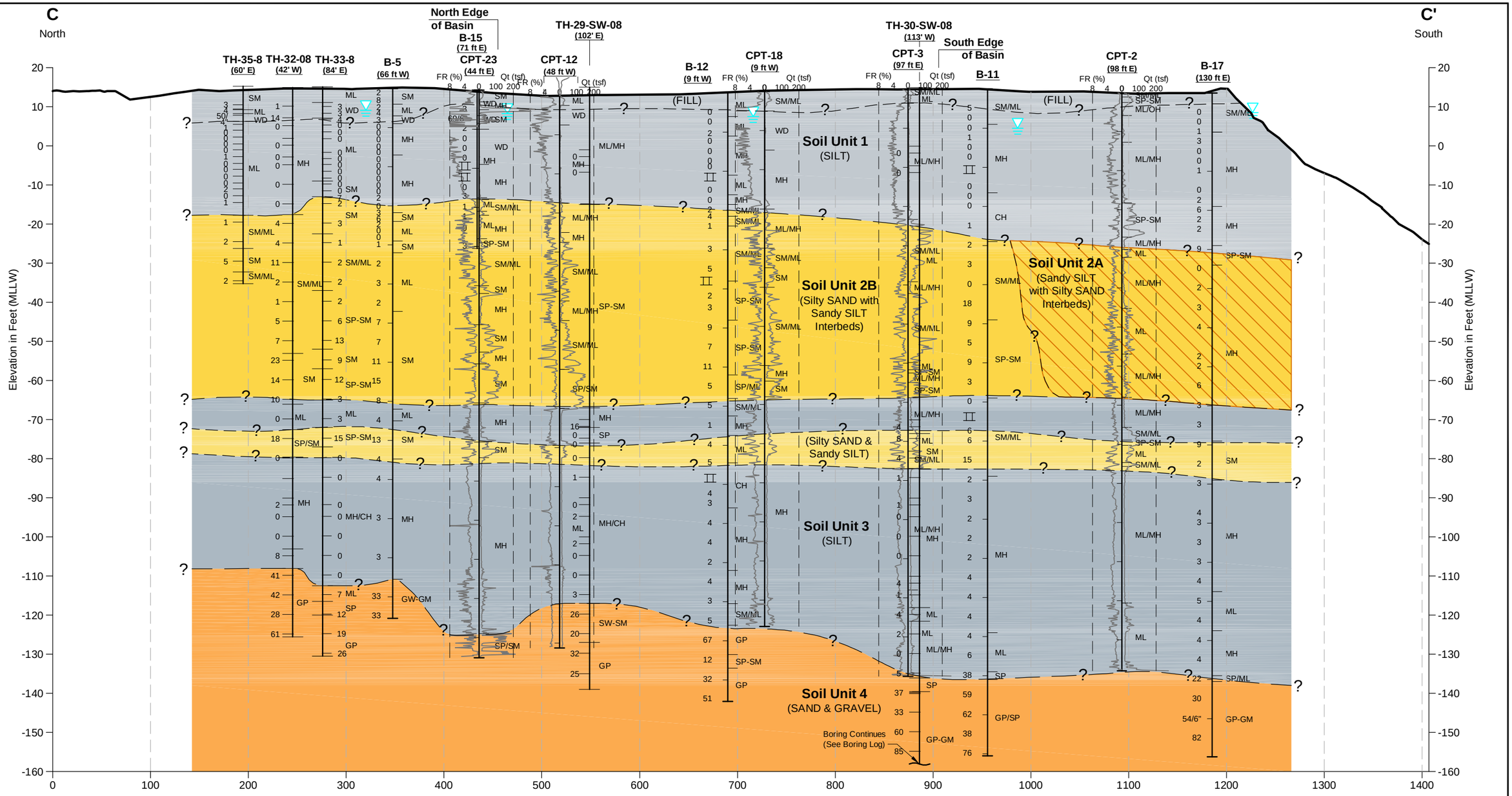
0 100 200

Scale in Feet
4x Vertical Exaggeration

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	Cross Section B-B'	Figure 5

Geotech Report | V:\122\025\020\012\F\Figure 4-13.dwg (A) "Figure 5" 3/4/2009



Legend

- **B-2** (3 ft S) — Boring Number; Distance and Direction from Cross Section
- Groundwater Elevation
- ML — Unified Soil Classification Symbol
- 5 — Standard Penetration Test Blow Count (140 lb Hammer, 30" Drop)
- Major Soil Unit Contact
- Contact within the Same Soil Unit
- Shelby Tube Sample (Pushed 24" with Rig Hydraulics)
- **CPT-4** — Cone Penetrometer Number
- FR (%) Qt (tsf) — Friction Ratio; Cone Resistance

Note:

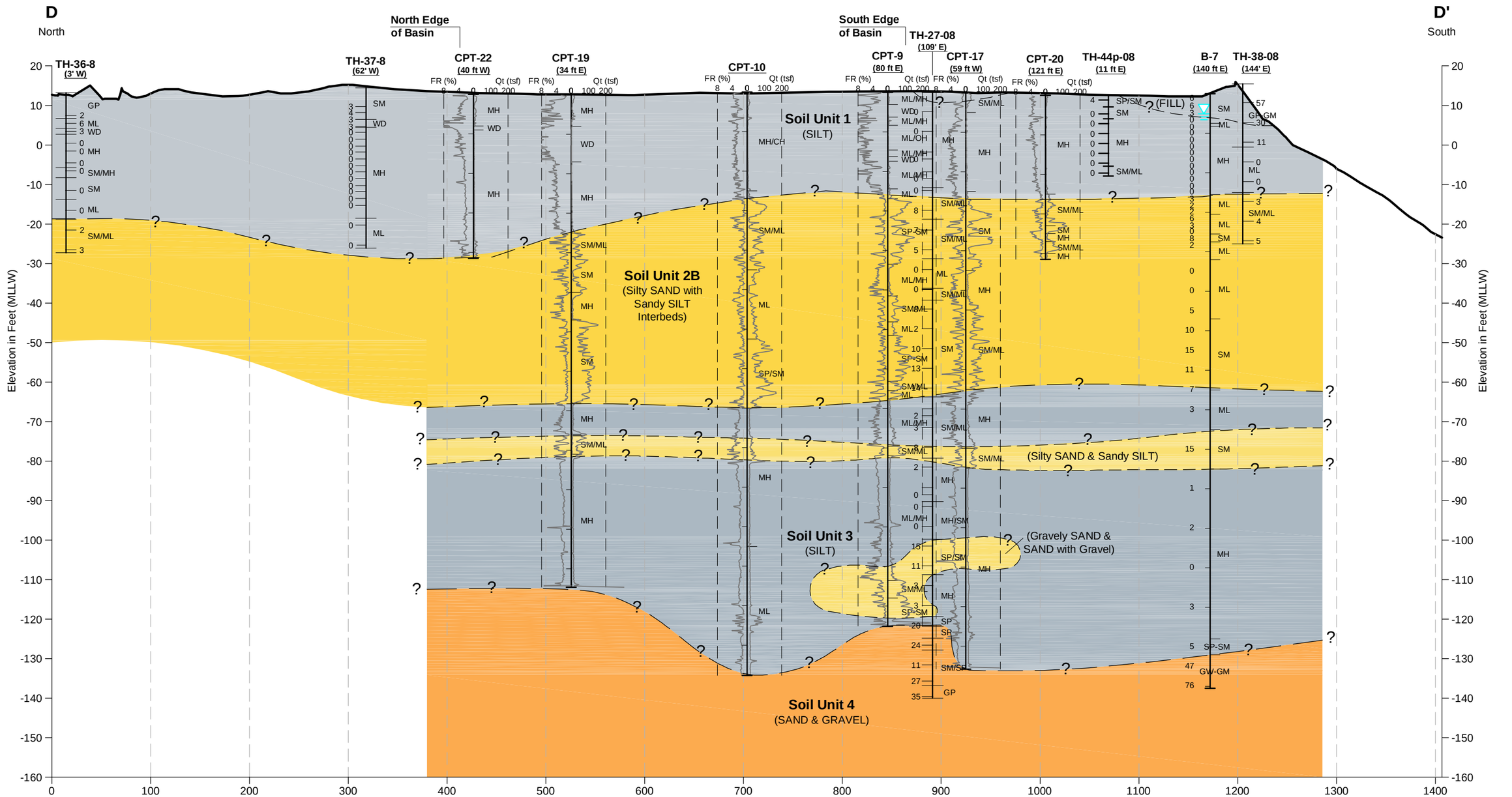
1. This cross section has been interpreted and generalized from project field data. Variations between this cross section and actual conditions may exist. The project boring logs and written report must be referenced for a proper understanding of the nature of the subsurface conditions.
2. Planned Casting Basin top of slab is approximately -13ft.

0 100 200
Scale in Feet
4x Vertical Exaggeration

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	**Cross Section C-C'**	Figure 6

Geotech Report | V:\122\025\020\012\F\Figure 4-13.dwg (A) "Figure 6" 3/4/2009



Legend

- B-2 (3 ft S) — Boring Number; Distance and Direction from Cross Section
- Groundwater Elevation
- ML — Unified Soil Classification Symbol
- 5 — Standard Penetration Test Blow Count (140 lb Hammer, 30" Drop)
- ? — Major Soil Unit Contact
- ? — Contact within the Same Soil Unit
- Shelby Tube Sample (Pushed 24" with Rig Hydraulics)

CPT-4 — Cone Penetrometer Number
FR (%) Qt (tsf)
Friction Ratio — Cone Resistance

Note:

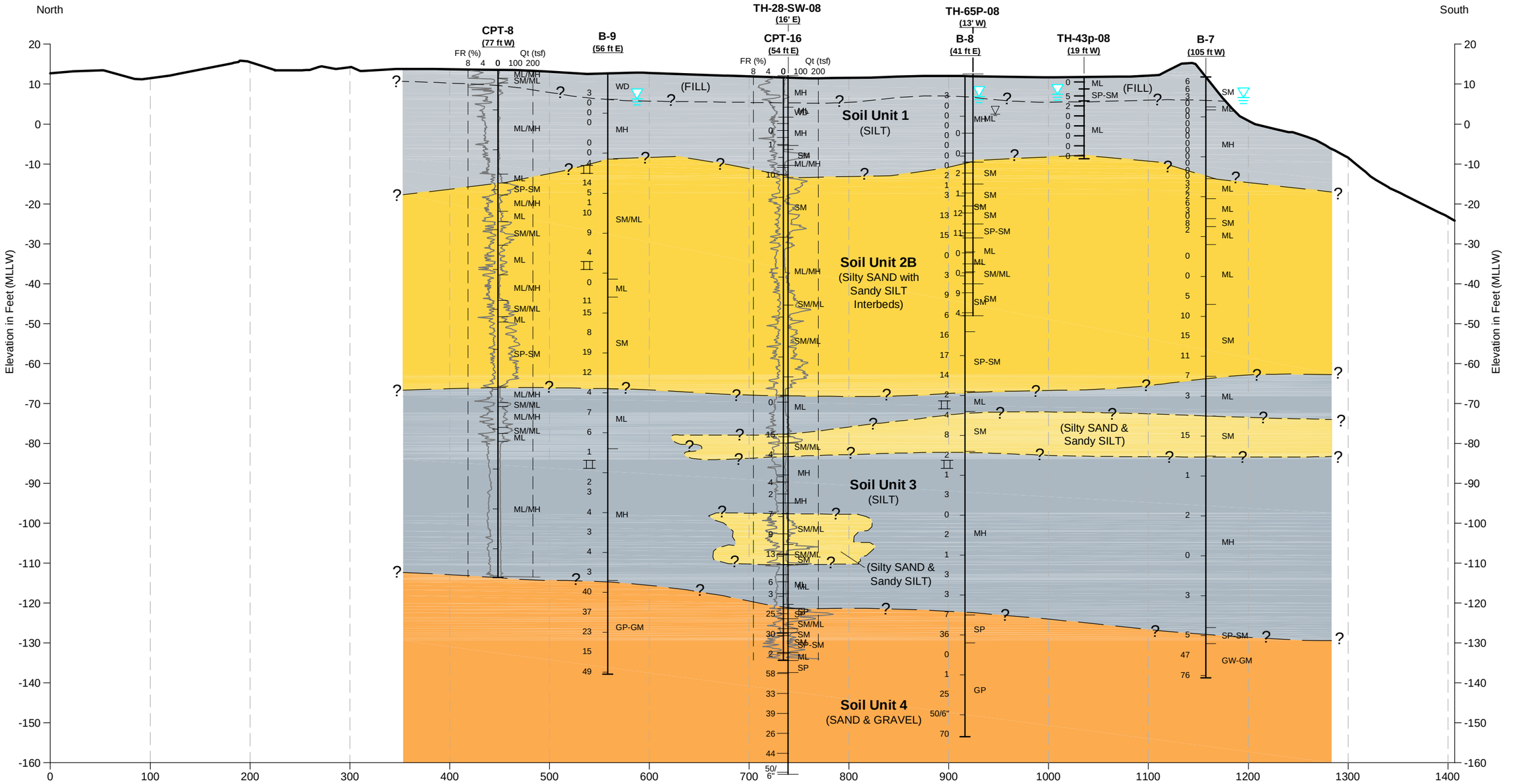
1. This cross section has been interpreted and generalized from project field data. Variations between this cross section and actual conditions may exist. The project boring logs and written report must be referenced for a proper understanding of the nature of the subsurface conditions.
2. Planned Casting Basin top of slab is approximately -13ft.

0 100 200
Scale in Feet
4x Vertical Exaggeration

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	Cross Section D-D'	Figure 7

Geotech Report | V:\122\025\020\012\F\Figure 4-13.dwg (A) "Figure 7" 3/4/2009



Legend

- B-2 (3 ft S) — Boring Number; Distance and Direction from Cross Section
- Groundwater Elevation
- ML — Unified Soil Classification Symbol
- 5 — Standard Penetration Test Blow Count (140 lb Hammer, 30" Drop)
- ? — Major Soil Unit Contact
- ? — Contact within the Same Soil Unit
- II — Shelby Tube Sample (Pushed 24" with Rig Hydraulics)
- CPT-4 — Cone Penetrometer Number
- FR (%) Qt (tsf) — Friction Ratio; Cone Resistance

Note:

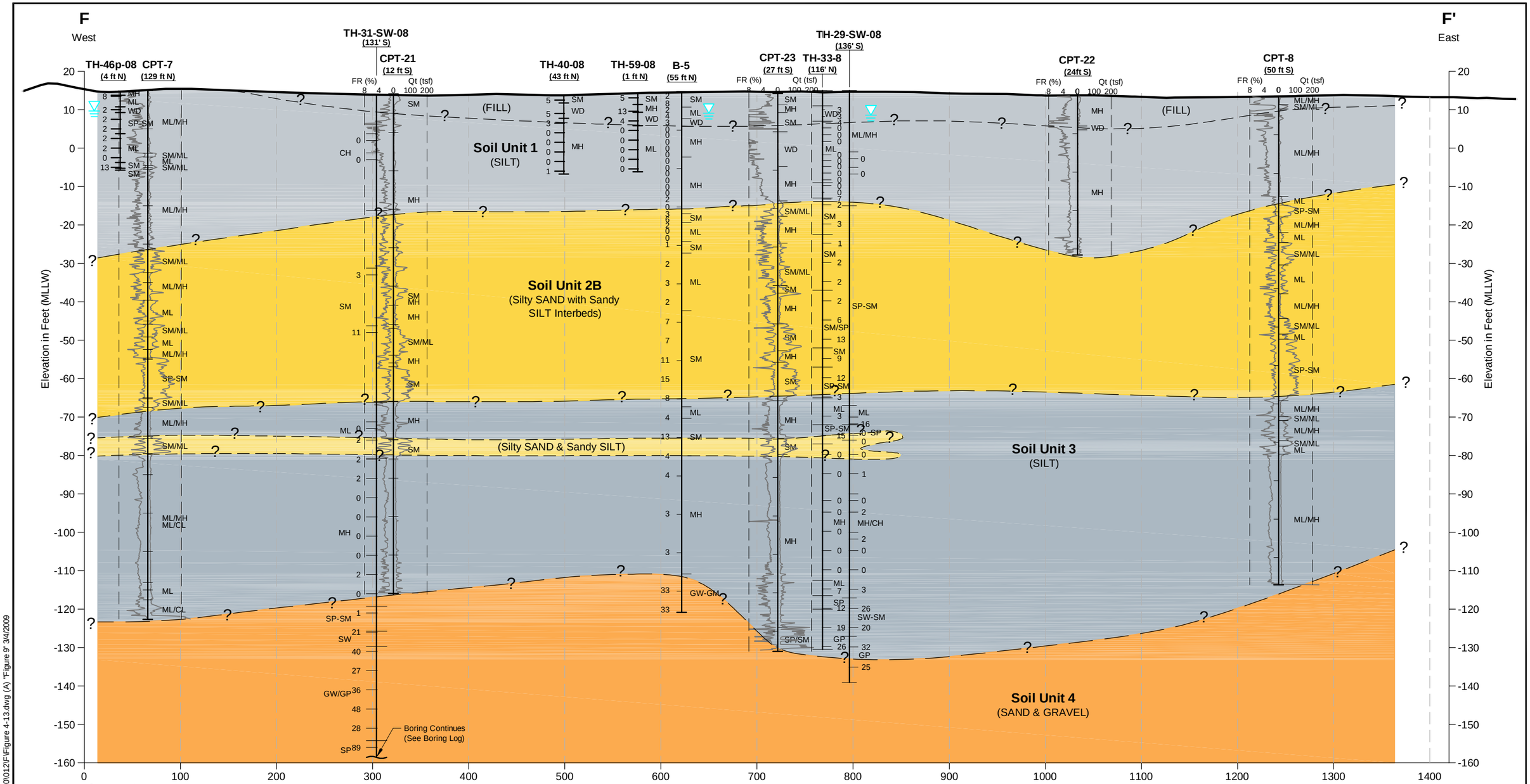
1. This cross section has been interpreted and generalized from project field data. Variations between this cross section and actual conditions may exist. The project boring logs and written report must be referenced for a proper understanding of the nature of the subsurface conditions.
2. Planned Casting Basin top of slab is approximately -13ft.

0 100 200
Scale in Feet
4x Vertical Exaggeration

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	Cross Section E-E'	Figure 8

Geotech Report | V:\122\025\020\012\F\Figure 4-13.dwg (A) "Figure 8" 3/4/2009



Legend

- **B-2** (3 ft S) — Boring Number; Distance and Direction from Cross Section
- Groundwater Elevation
- ML — Unified Soil Classification Symbol
- 5 — Standard Penetration Test Blow Count (140 lb Hammer, 30" Drop)
- ? — Major Soil Unit Contact
- ? — Contact within the Same Soil Unit
- II — Shelby Tube Sample (Pushed 24" with Rig Hydraulics)

CPT-4 — Cone Penetrometer Number

FR (%) Qt (tsf)

Friction Ratio — Cone Resistance

Note:

1. This cross section has been interpreted and generalized from project field data. Variations between this cross section and actual conditions may exist. The project boring logs and written report must be referenced for a proper understanding of the nature of the subsurface conditions.
2. Planned Casting Basin top of slab is approximately -13ft.

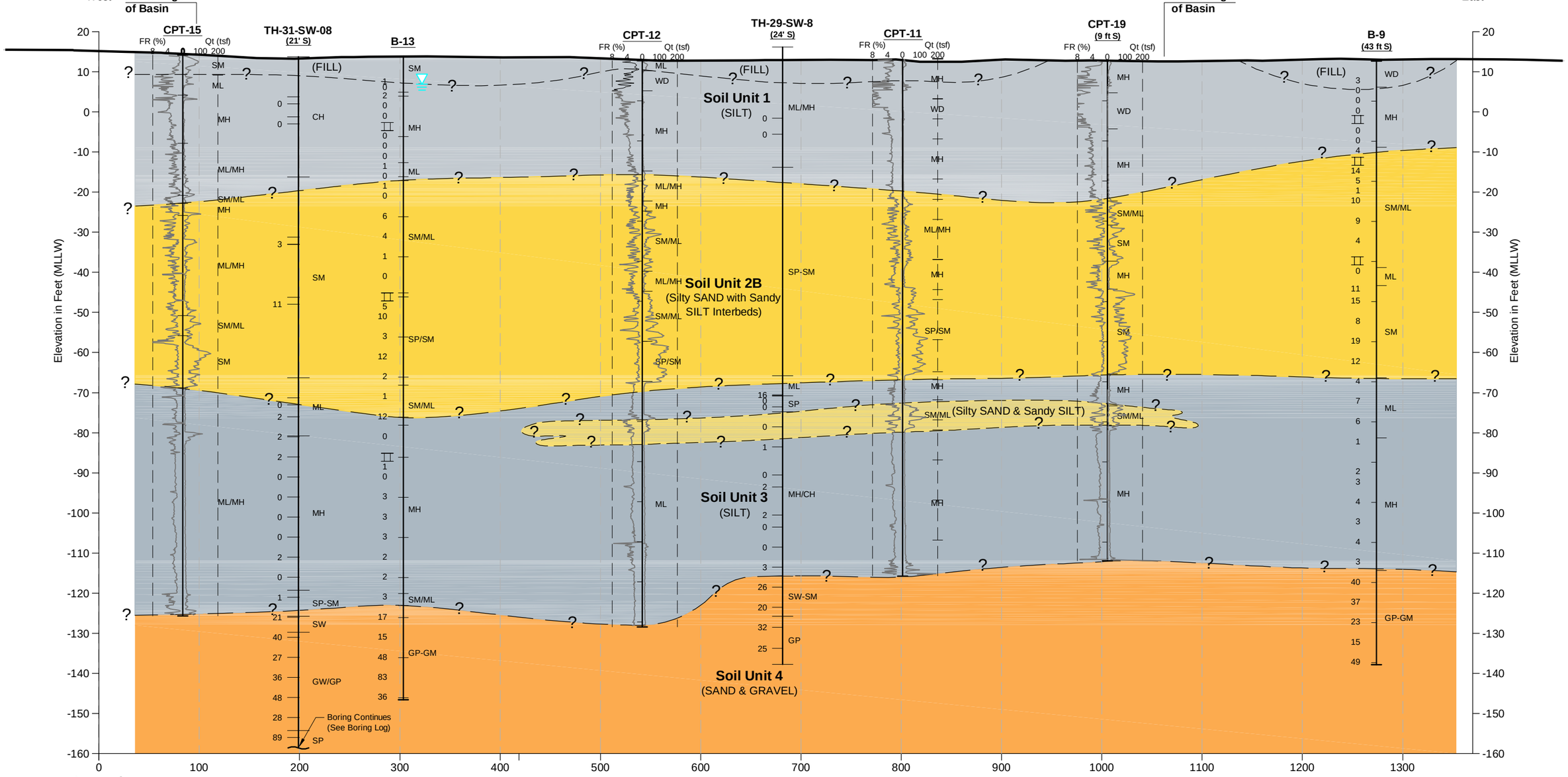
0 100 200

Scale in Feet
4x Vertical Exaggeration

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	**Cross Section F-F'**	Figure 9

Geotech Report | V:\122\025\020\012\F\Figure 4-13.dwg (A) "Figure 9" 3/4/2009



Legend

- B-2 (3 ft S) — Boring Number; Distance and Direction from Cross Section
- Groundwater Elevation
- ML — Unified Soil Classification Symbol
- 5 — Standard Penetration Test Blow Count (140 lb Hammer, 30" Drop)
- ? — Major Soil Unit Contact
- ? — Contact within the Same Soil Unit
- Shelby Tube Sample (Pushed 24" with Rig Hydraulics)

CPT-4 — Cone Penetrometer Number
FR (%) Qt (tsf)
Friction Ratio — Cone Resistance

Note:

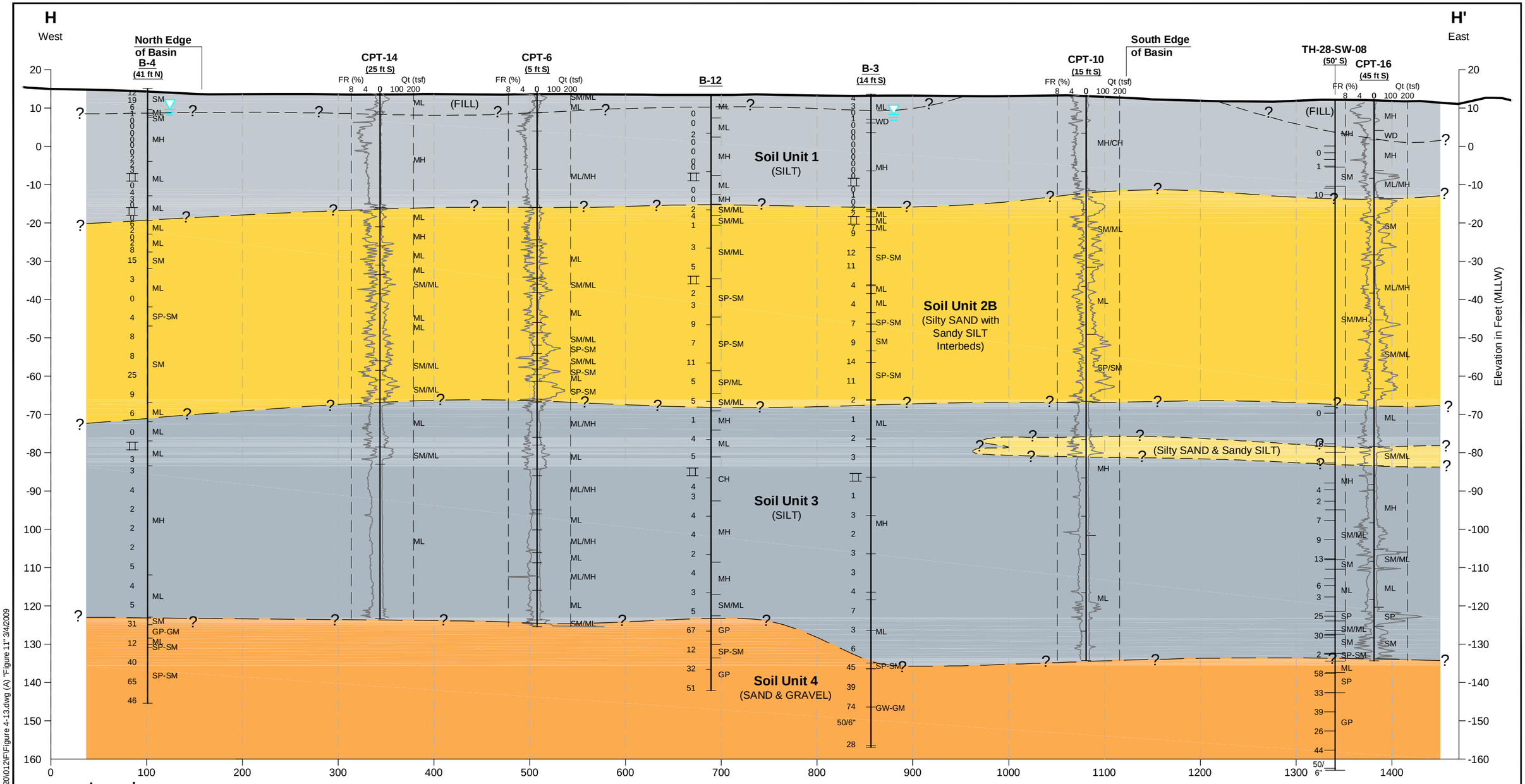
1. This cross section has been interpreted and generalized from project field data. Variations between this cross section and actual conditions may exist. The project boring logs and written report must be referenced for a proper understanding of the nature of the subsurface conditions.
2. Planned Casting Basin top of slab is approximately -13ft.

0 100 200
Scale in Feet
4x Vertical Exaggeration

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	Cross Section G-G'	Figure 10

Geotech Report | V:\122\025\020\012\F\Figure 4-13.dwg (A) "Figure 10" 3/4/2009



Legend

B-2 (3 ft S) — Boring Number; Distance and Direction from Cross Section

Groundwater Elevation

ML — Unified Soil Classification Symbol

5 — Standard Penetration Test Blow Count (140 lb Hammer, 30" Drop)

Major Soil Unit Contact

Contact within the Same Soil Unit

Shelby Tube Sample (Pushed 24" with Rig Hydraulics)

CPT-4 — Cone Penetrometer Number

FR (%) Qt (tsf) — Friction Ratio; Cone Resistance

Note:

1. This cross section has been interpreted and generalized from project field data. Variations between this cross section and actual conditions may exist. The project boring logs and written report must be referenced for a proper understanding of the nature of the subsurface conditions.
2. Planned Casting Basin top of slab is approximately -13ft.

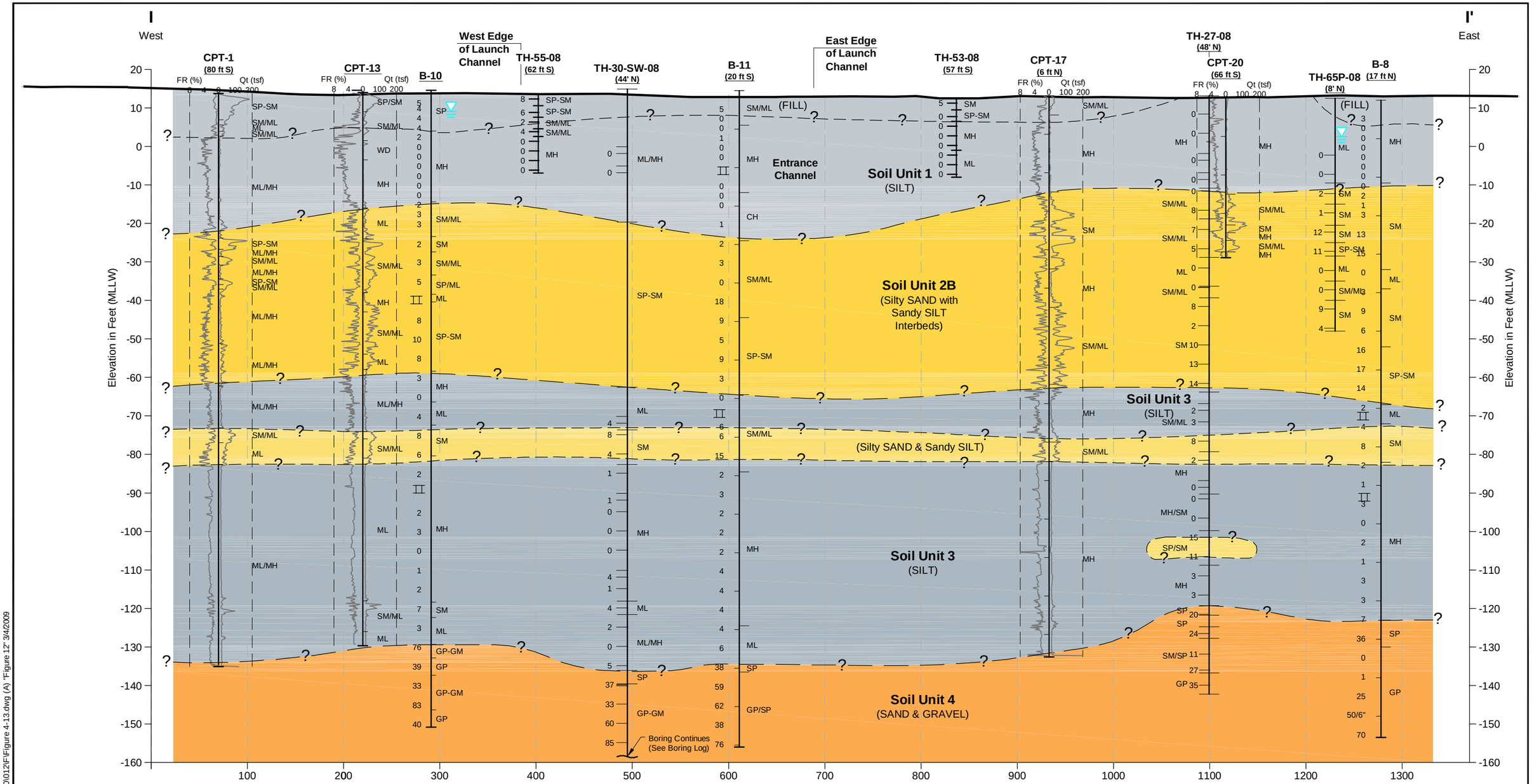
0 100 200

Scale in Feet
4x Vertical Exaggeration

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	Cross Section H-H'	Figure 11

Geotech Report | V:\122\025\020\012\F\Figure 4-13.dwg (A) "Figure 11" 3/4/2009



Legend

- **B-2** (3 ft S) — Boring Number; Distance and Direction from Cross Section
- Groundwater Elevation
- ML — Unified Soil Classification Symbol
- 5 — Standard Penetration Test Blow Count (140 lb Hammer, 30" Drop)
- ? — Major Soil Unit Contact
- ? — Contact within the Same Soil Unit
- Shelby Tube Sample (Pushed 24" with Rig Hydraulics)

CPT-4 — Cone Penetrometer Number

FR (%) Qt (tsf)

Friction Ratio — Cone Resistance

Note:

1. This cross section has been interpreted and generalized from project field data. Variations between this cross section and actual conditions may exist. The project boring logs and written report must be referenced for a proper understanding of the nature of the subsurface conditions.
2. Planned Casting Basin top of slab is approximately -13ft.

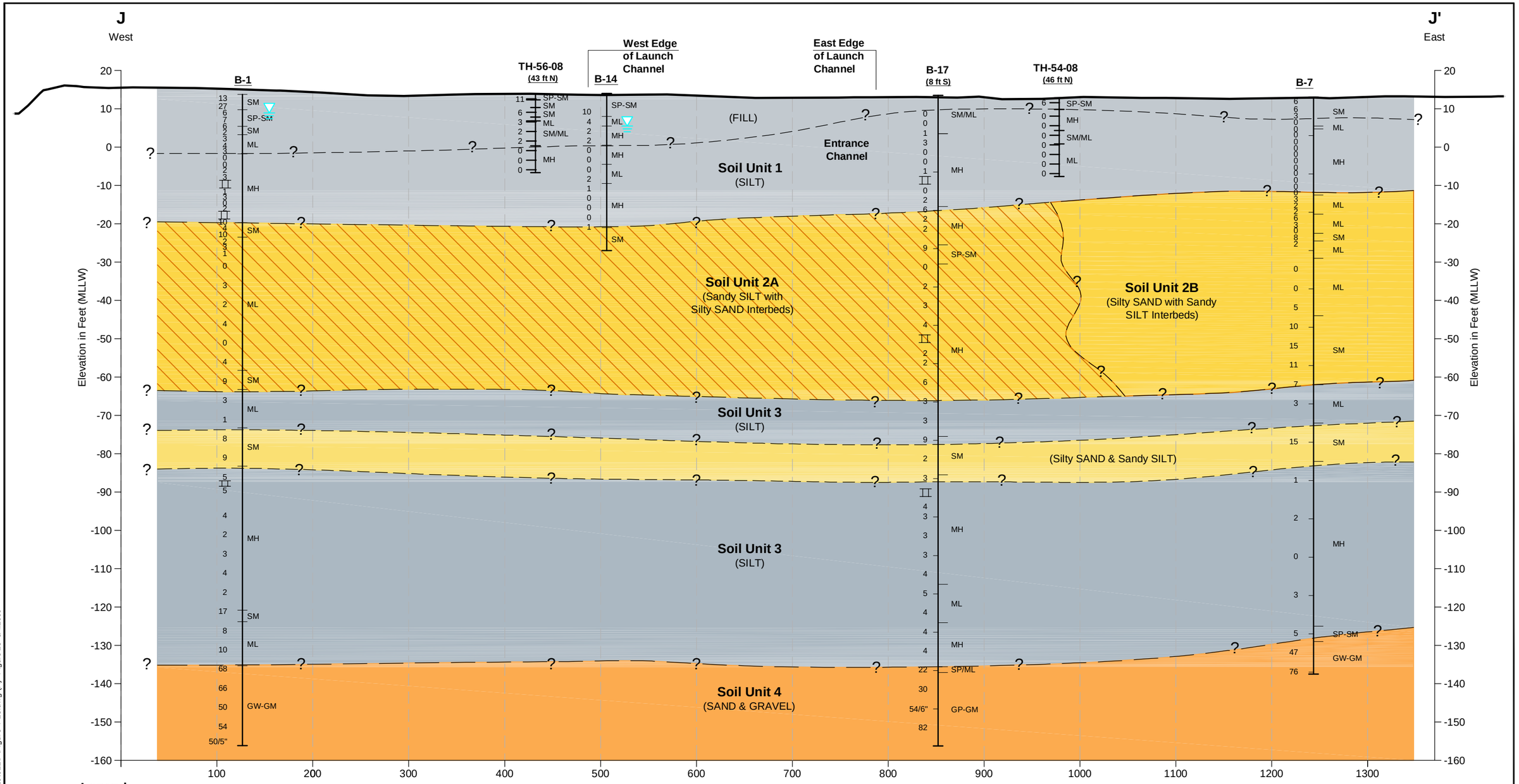
0 100 200

Scale in Feet
4x Vertical Exaggeration

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	**Cross Section I-I'**	Figure 12

Geotech Report | V:\122\025\020\012\F\Figure 4-13.dwg (A) "Figure 12" 3/4/2009



Legend

B-2 (3 ft S) — Boring Number; Distance and Direction from Cross Section

Groundwater Elevation

ML — Unified Soil Classification Symbol

5 — Standard Penetration Test Blow Count (140 lb Hammer, 30" Drop)

? — Major Soil Unit Contact

? — Contact within the Same Soil Unit

II — Shelby Tube Sample (Pushed 24" with Rig Hydraulics)

CPT-4 — Cone Penetrometer Number

FR (%) Qt (tsf)

Friction Ratio — Cone Resistance

Note:

1. This cross section has been interpreted and generalized from project field data. Variations between this cross section and actual conditions may exist. The project boring logs and written report must be referenced for a proper understanding of the nature of the subsurface conditions.

2. Planned Casting Basin top of slab is approximately -13ft.

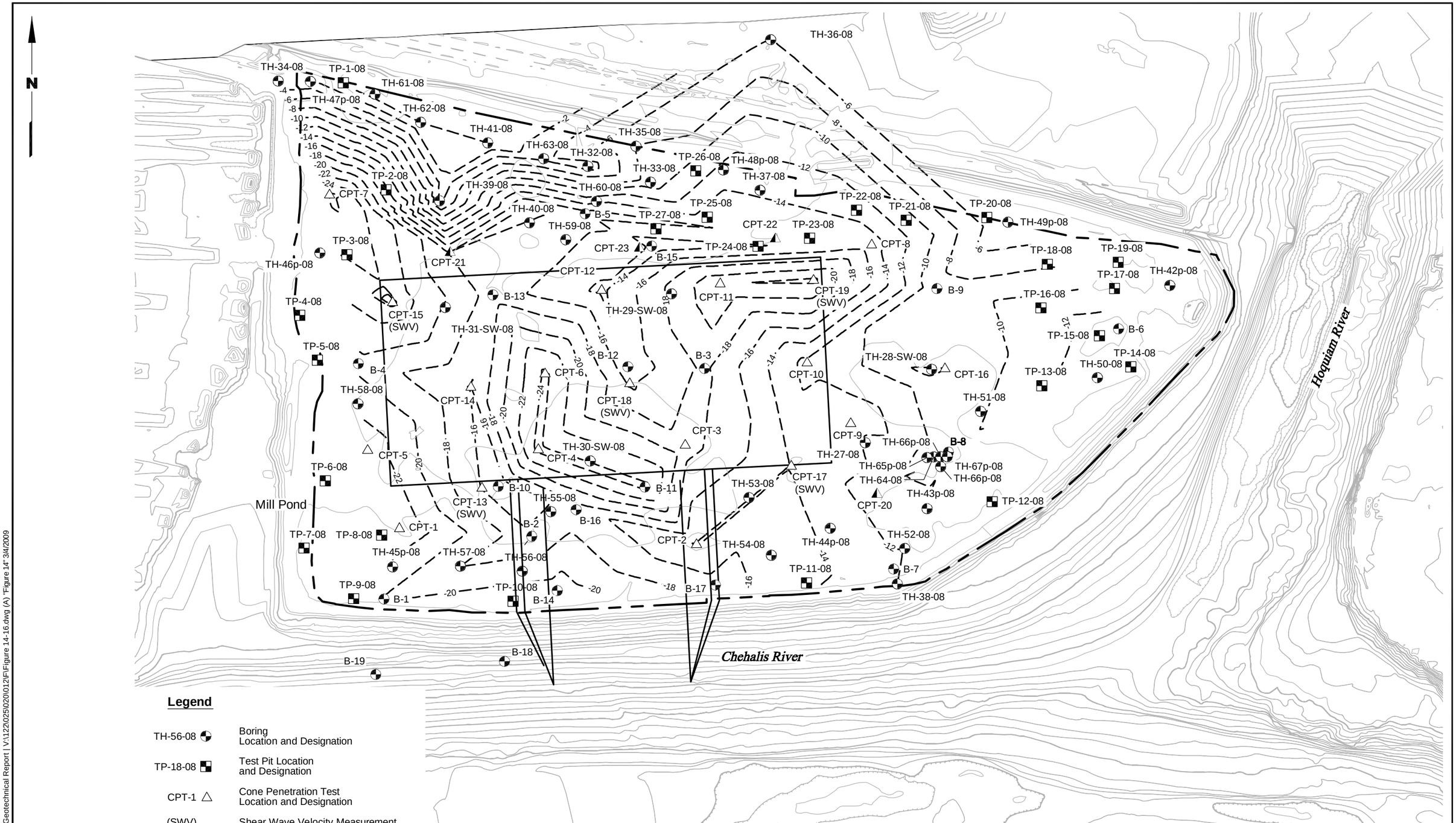
0 100 200

Scale in Feet
4x Vertical Exaggeration

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	**Cross Section J-J'**	Figure 13

Geotech Report | V:\122\025\020\012\F\Figure 4-13.dwg (A) "Figure 13" 3/4/2009



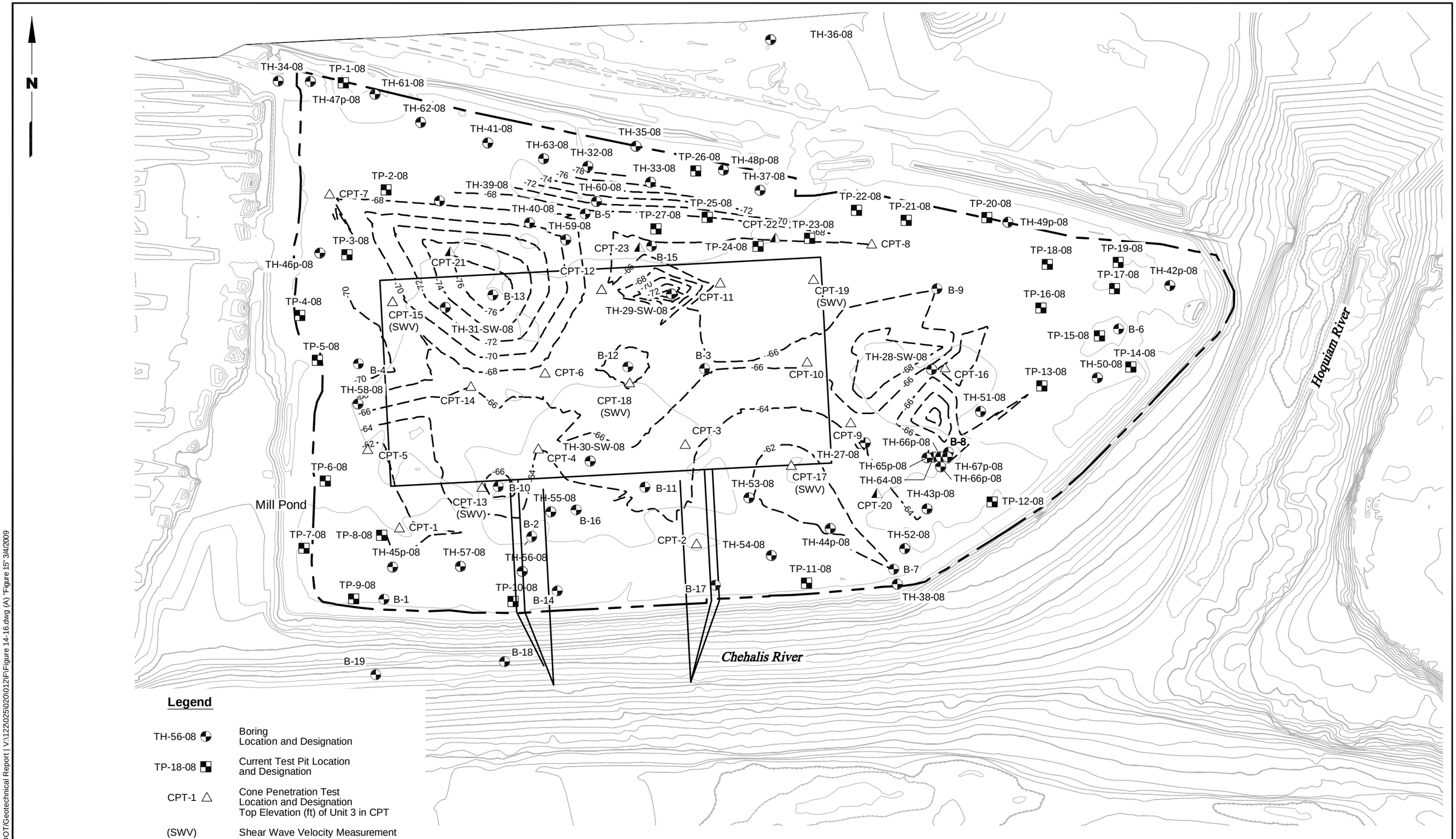
WSDOT/Geotechnical Report | V:\122\025\020\012\F\Figure 14-16.dwg (A) "Figure 14" 3/4/2009

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Top of Unit 2 Elevation Contour Map

Figure 14



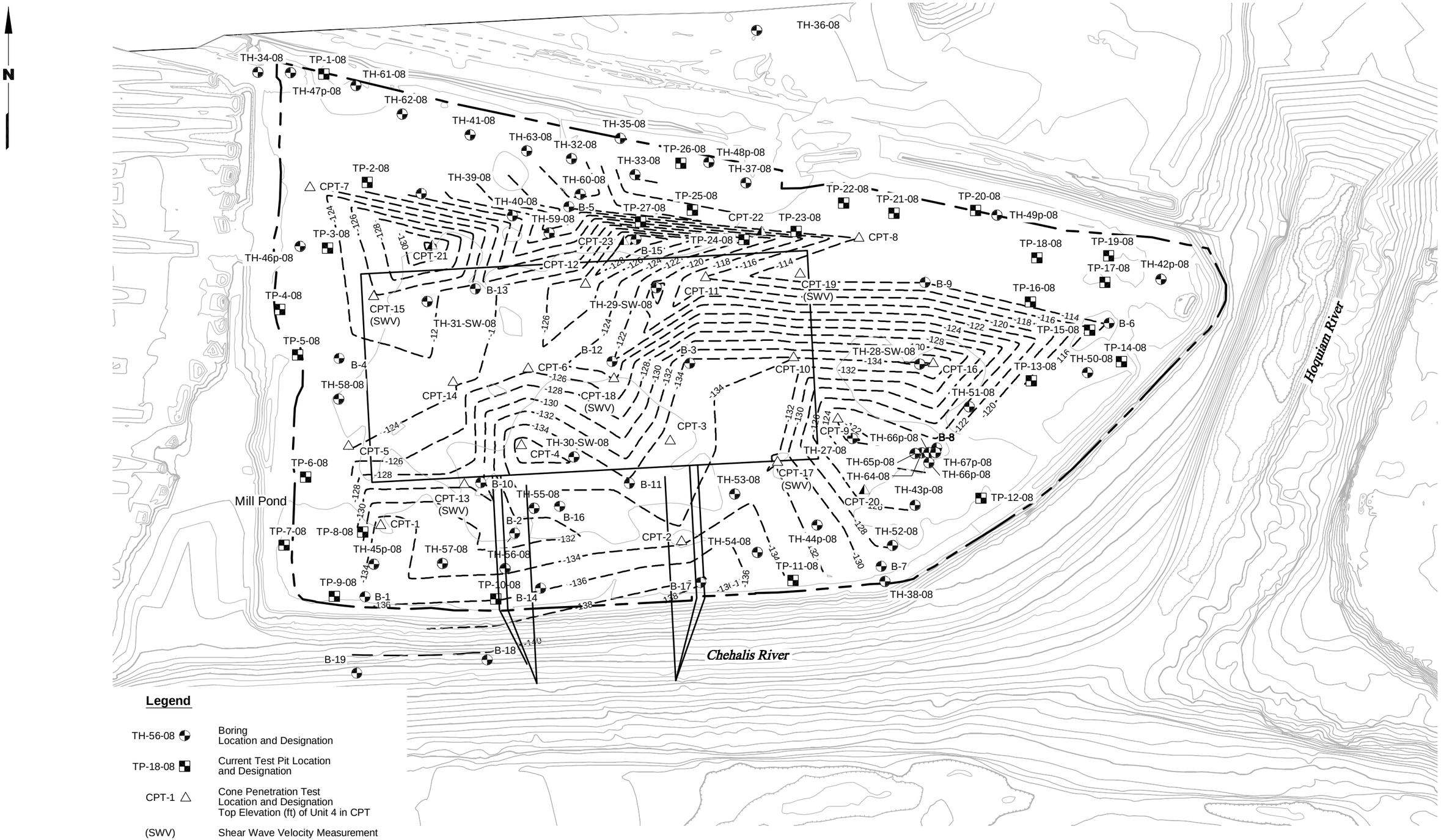
WSDOT/Geotechnical Report | V:\122\025\020\012\F\Figure 14-16.dwg (A) "Figure 15" 3/4/2009

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Top of Unit 3 Elevation Contour Map

Figure 15



Legend

TH-56-08	Boring Location and Designation
TP-18-08	Current Test Pit Location and Designation
CPT-1	Cone Penetration Test Location and Designation Top Elevation (ft) of Unit 4 in CPT
(SWV)	Shear Wave Velocity Measurement
-22	Interpreted Top of Unit 4 Elevation Contour

0 200 400
Scale in Feet

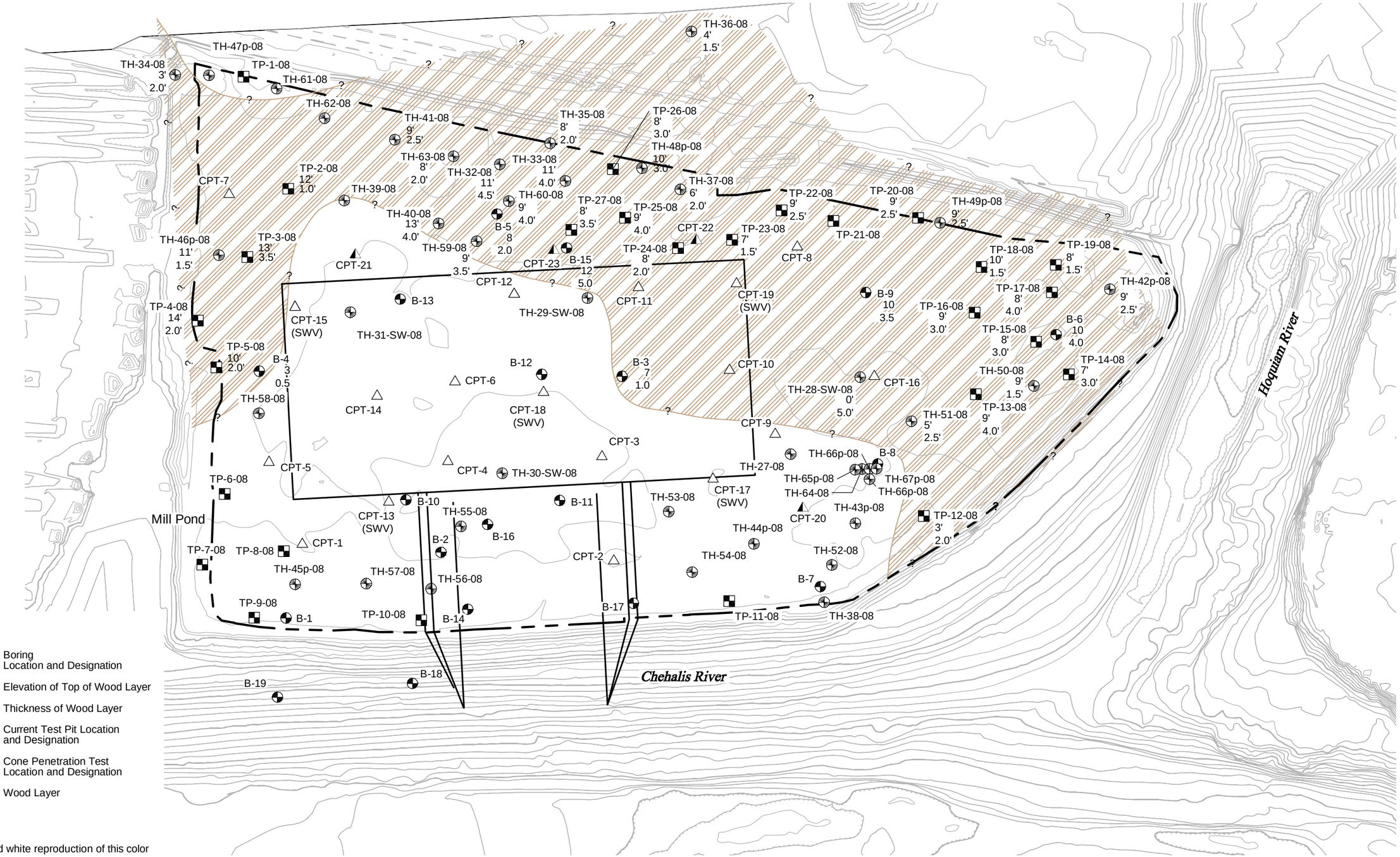
LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Top of Unit 4 Elevation Contour Map

Figure 16

WSDOT/Geotechnical Report | V:\122\025\020\012\F\Figure 14-16.dwg (A) "Figure 16" 3/4/2009



Legend

TH-56-08	Boring Location and Designation
8	Elevation of Top of Wood Layer
2.5	Thickness of Wood Layer
TP-18-08	Current Test Pit Location and Designation
CPT-1	Cone Penetration Test Location and Designation
	Wood Layer

Note

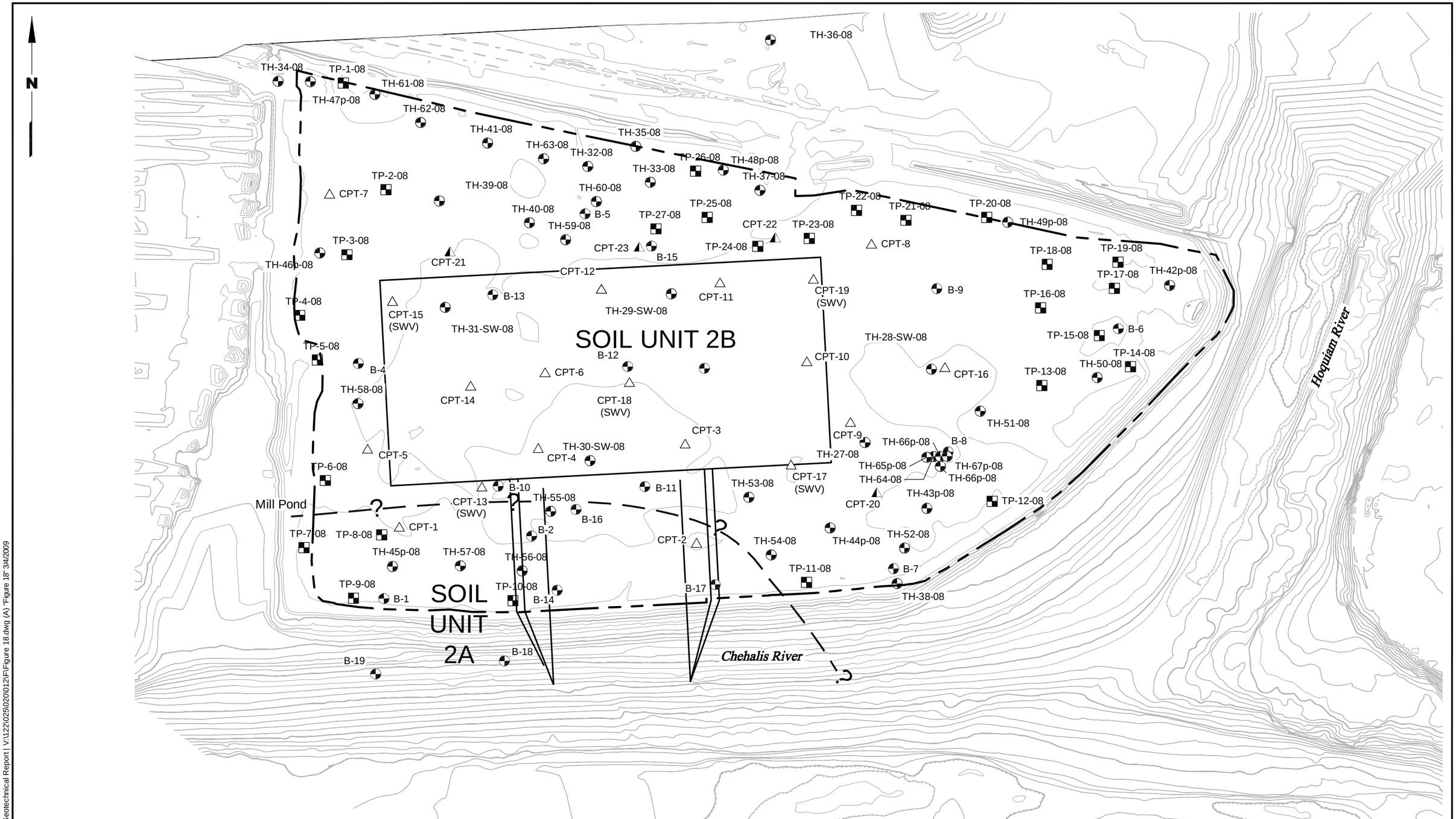
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 200 400
Scale in Feet

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	**Approximate Extent of Shallow Wood Layer**	Figure 17

WSDOT/Geotechnical Report | V:\122\025\020\012\F\Figure 17.dwg (A) "Figure 17" 3/4/2009



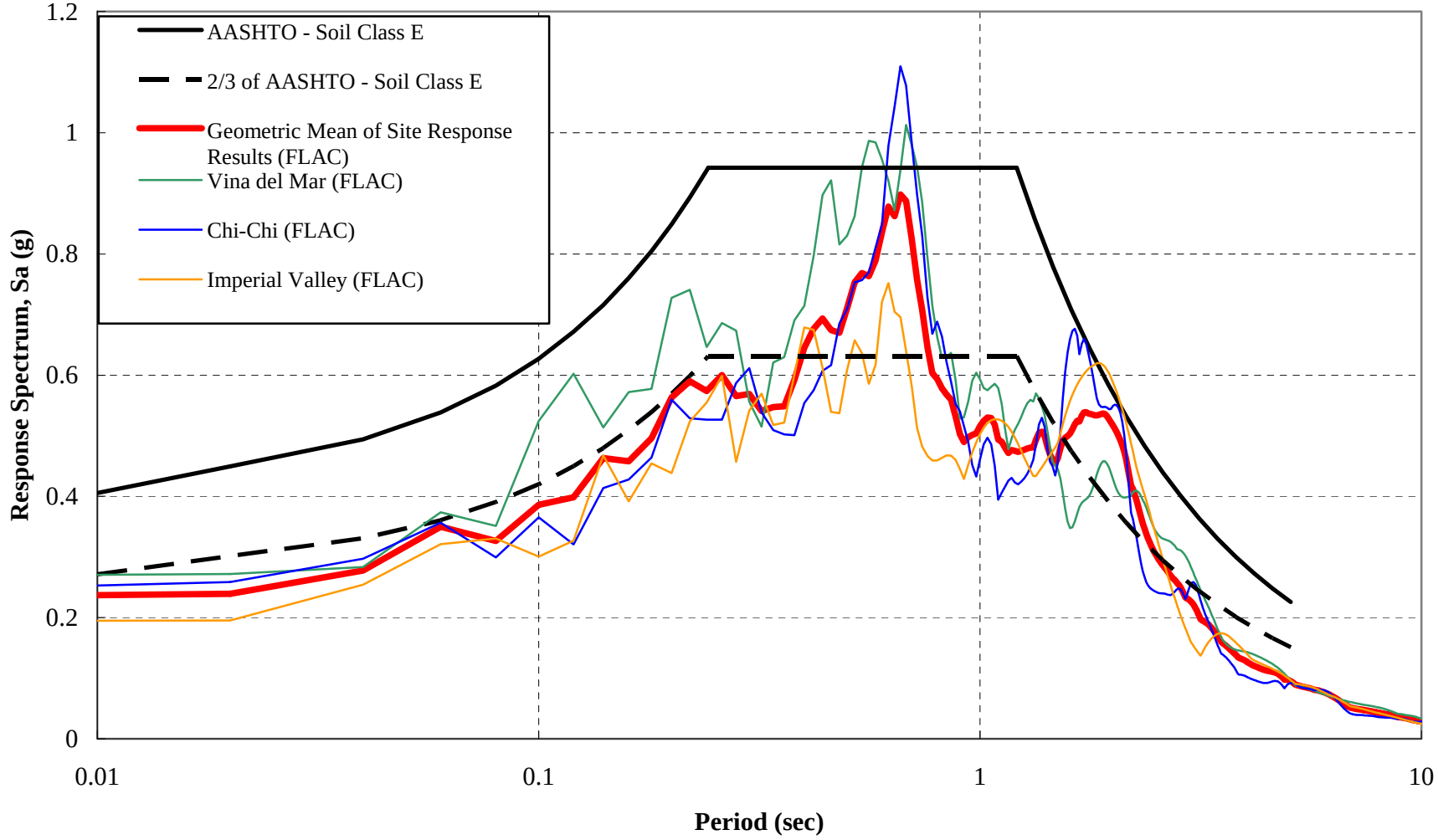
WSDOT/Geotechnical Report | V:\122\025\020\012\F\Figure 18.dwg (A) "Figure 18" 3/4/2009

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Approximate Extent of Areas A and B

Figure 18

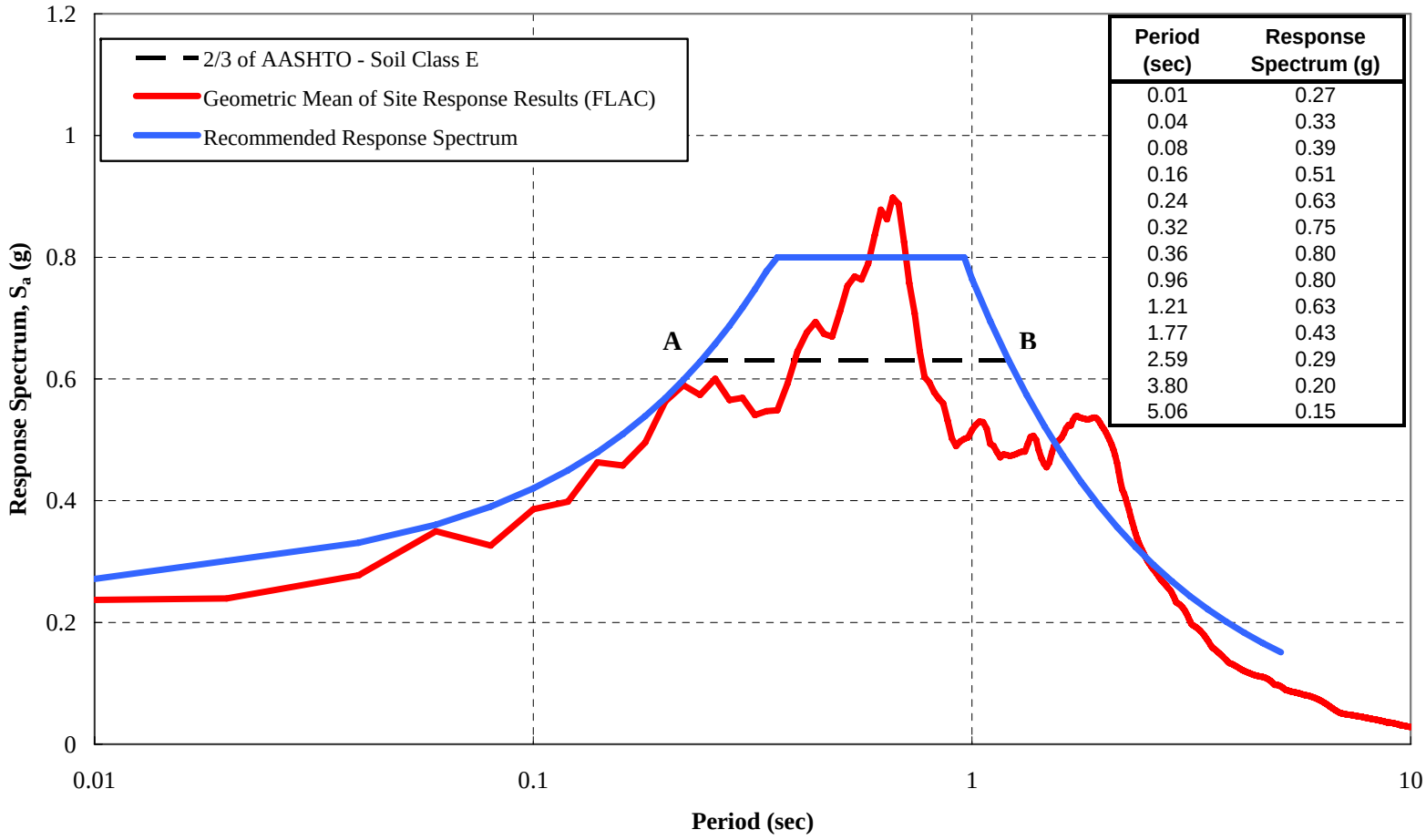


Note: Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	**Site-Specific Site Response Results and AASHTO Spectra**	Figure 19

Recommended Response Spectrum
Grays Harbor Pontoon Construction
FLAC Analysis



Period (sec)	Response Spectrum (g)
0.01	0.27
0.04	0.33
0.08	0.39
0.16	0.51
0.24	0.63
0.32	0.75
0.36	0.80
0.96	0.80
1.21	0.63
1.77	0.43
2.59	0.29
3.80	0.20
5.06	0.15

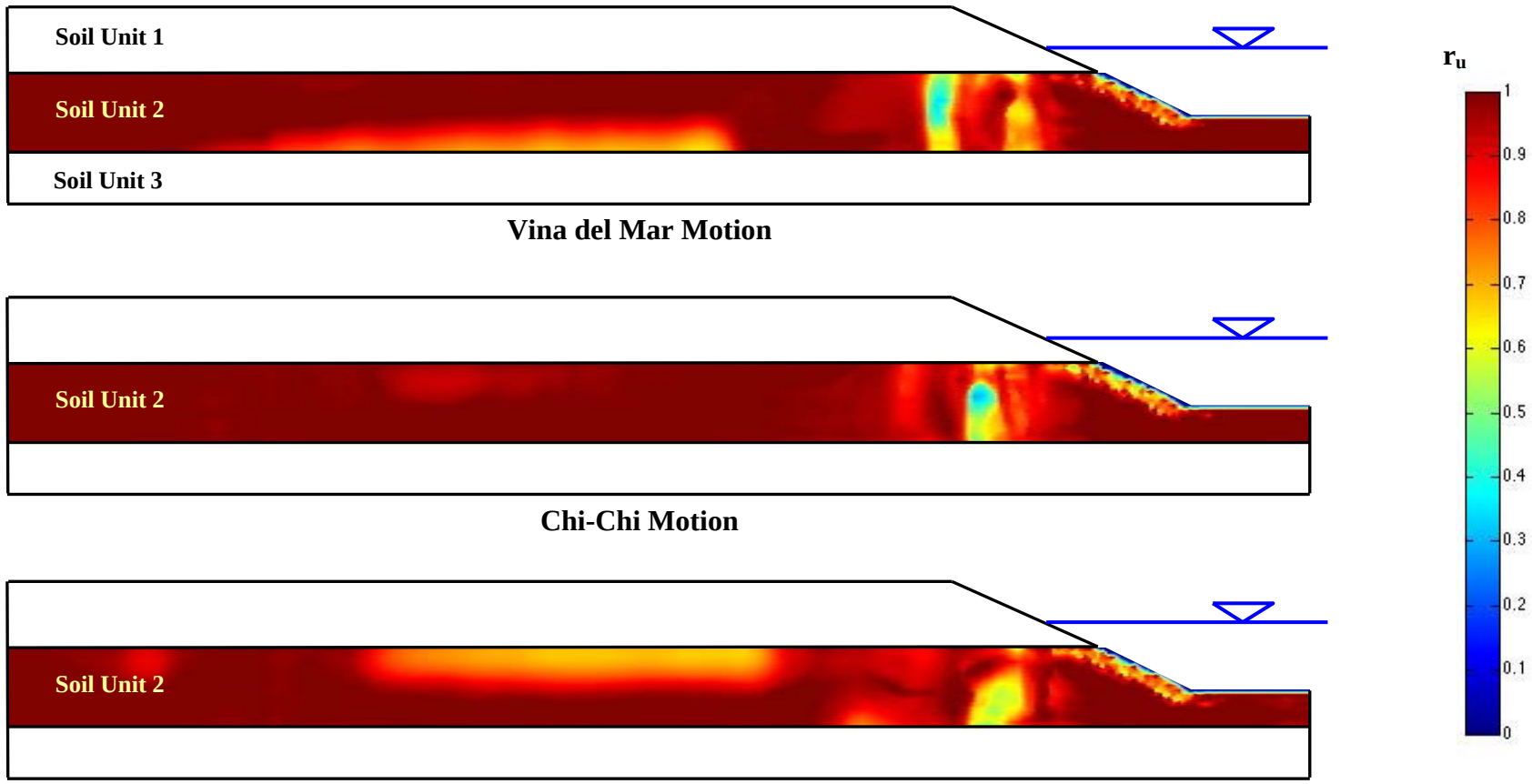
Notes: 1) Recommended response spectrum overlays the 2/3 of AASHTO curve except between Point A and Point B.
2) Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

LANDAU ASSOCIATES

SR 520 Pontoon
Construction Project
Port of Grays Harbor, Washington

Recommended Design Spectrum

Figure
20



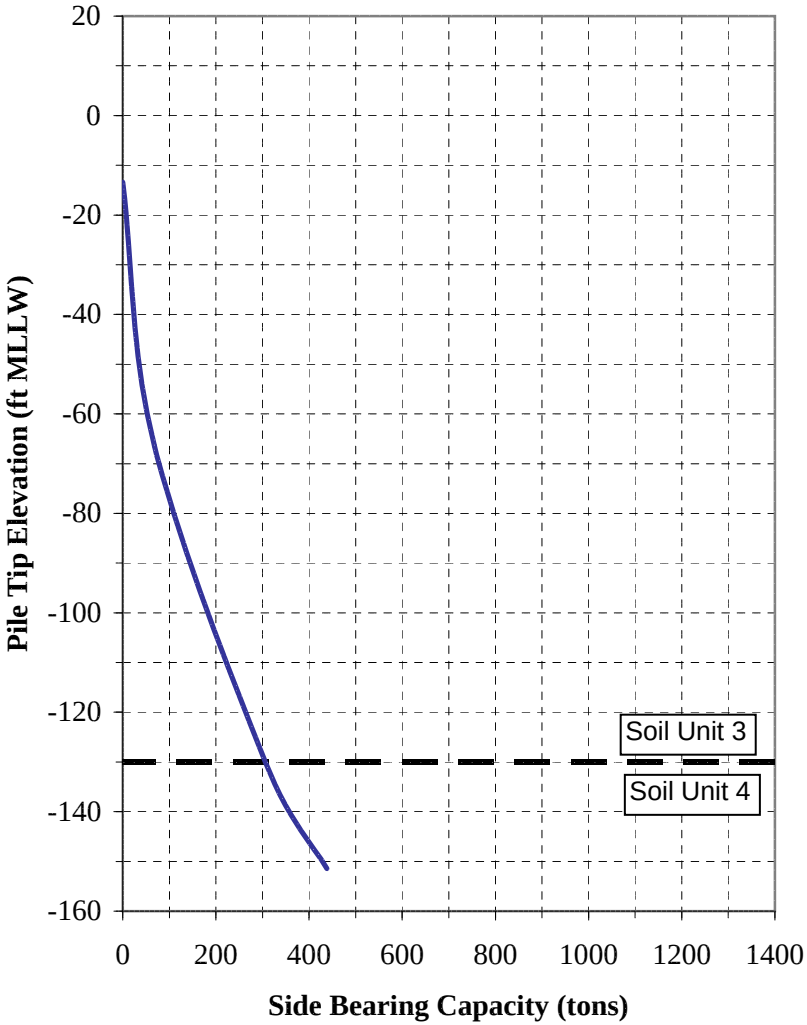
Notes: 1) Excess pore water pressure ratio r_u is defined in terms of initial vertical effective stress. Refer to Appendix E for further discussion.

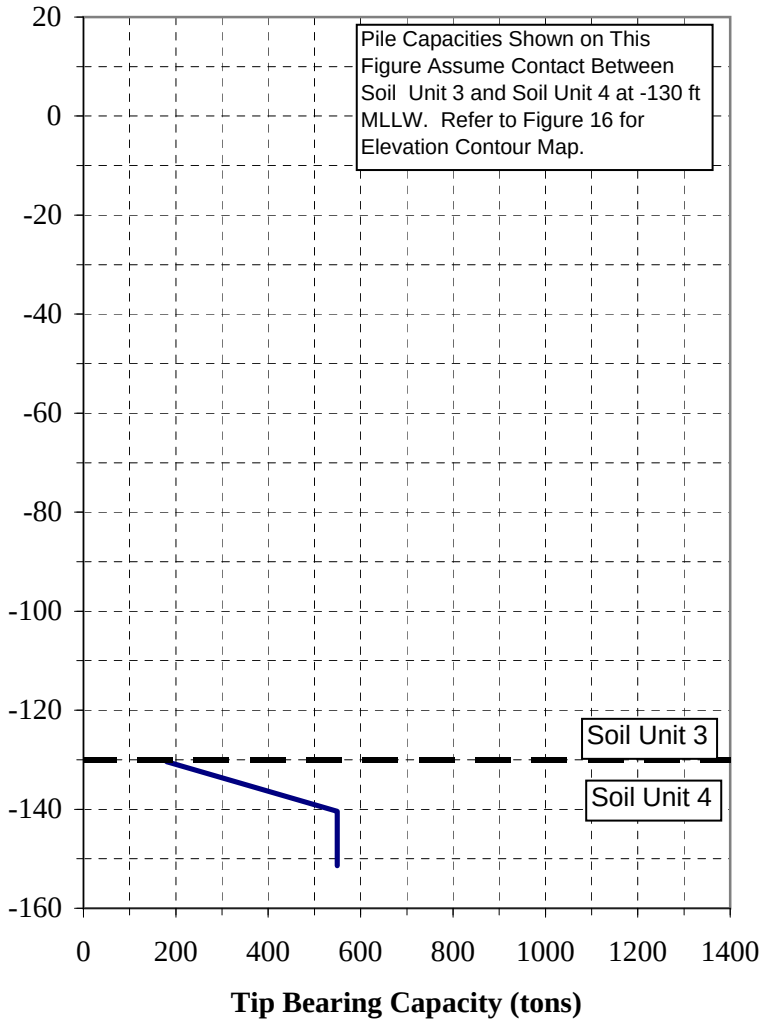
2) The values shown on the figure correspond to maximum r_u values and do not necessarily occur at the same time. Refer to Appendix E for further discussion.

3) Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	**Extent of Liquefaction 1,000-Year Event – Three Earthquake Motions**	Figure 21



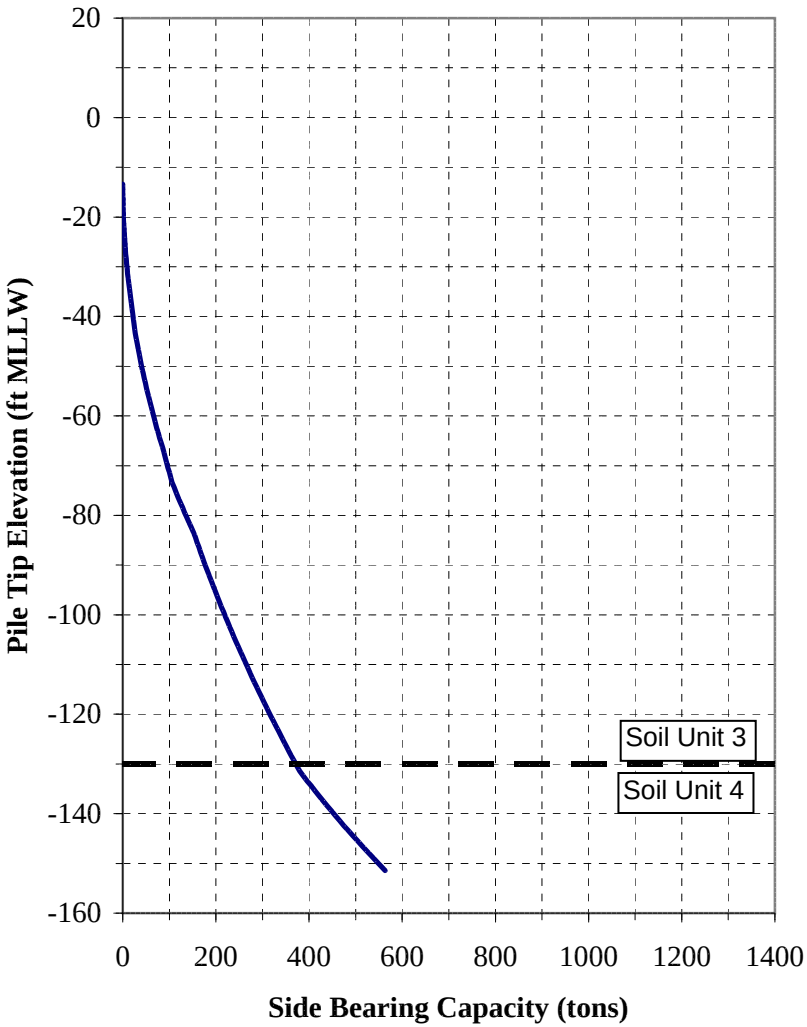


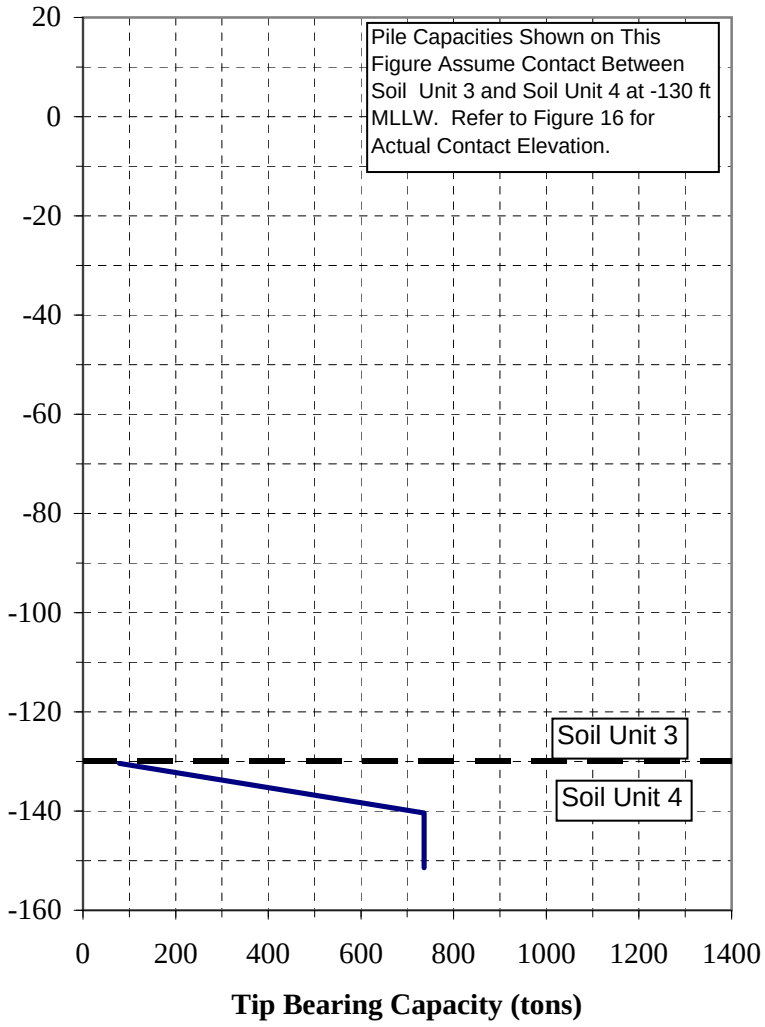
LANDAU ASSOCIATES

SR 520 Pontoon
Construction Project
Port of Grays Harbor, Washington

Ultimate Bearing Capacity of Driven 24-inch Steel Piles

Figure
22



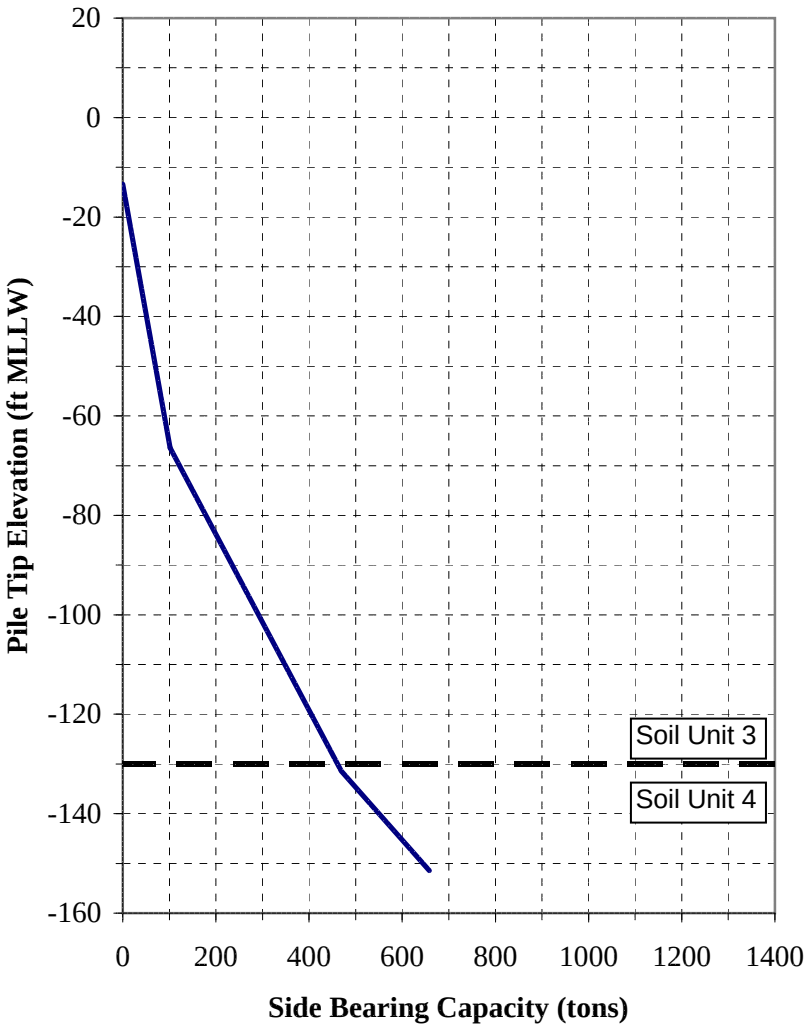


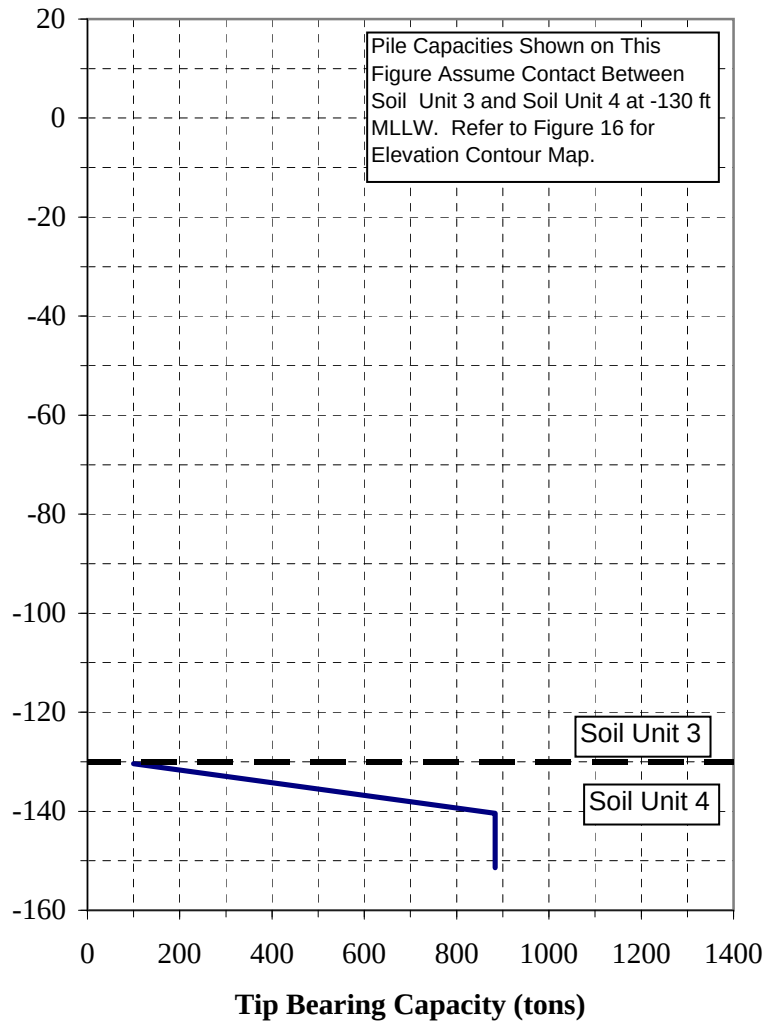
LANDAU ASSOCIATES

SR 520 Pontoon
Construction Project
Port of Grays Harbor, Washington

Ultimate Bearing Capacity of Driven 30-inch Steel Piles

Figure
23





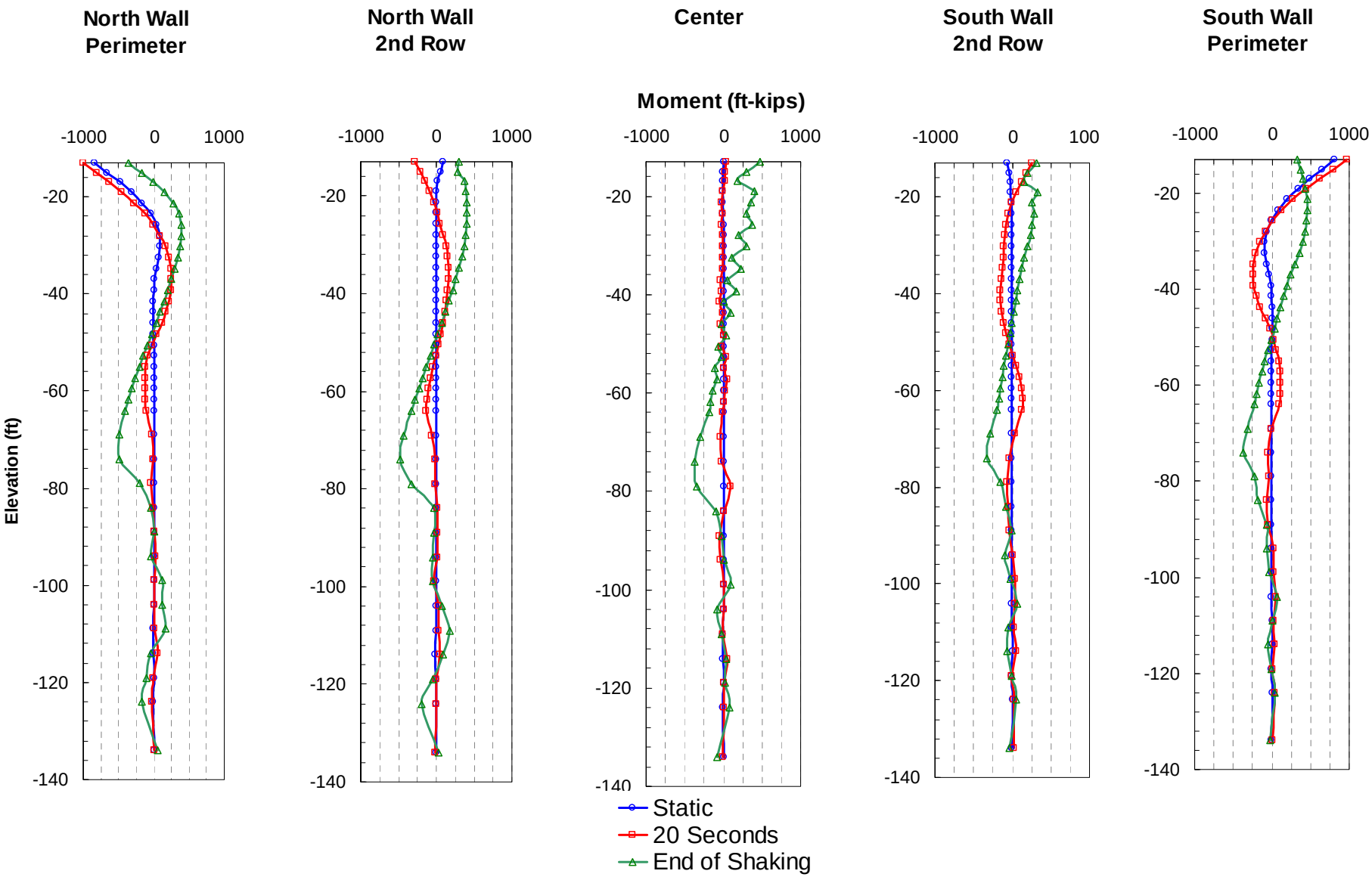
LANDAU ASSOCIATES

SR 520 Pontoon Construction Project

Port of Grays Harbor, Washington

Ultimate Bearing Capacity of Driven 36-inch Steel Piles

Figure 24



LANDAU ASSOCIATES

SR 520 Pontoon
Construction Project
Port of Grays Harbor, Washington

Bending Moments on Piles Due to Lateral Spreading

Figure
25

Casting Basin

Case 1 - K at end of primary settlement

K=9 kcf	10	9.5	11	11
11	11	9	11	9.5
12	10	9.5	9	9

Entrance Channel

N

Case 2 - K during the process of primary settlement

K=10 kcf	11	11.5	11	11
11	12	10	12	12
13	12	11	11.5	10.5

Entrance Channel

Casting Basin

Notes:

1- K values are in kips per cubic foot (kcf)

2- The subgrade reaction modulus (K) is a time-dependent parameter that decreases with time until it stabilizes at the end of primary settlement. Case 1 values correspond to end of primary settlement, which may take several months to occur. Case 2 values present a "snapshot" of K values during the settlement process (i.e., before the end of primary settlement)

3- Effect of the gate/sill loading is not included

4- K values are based on the following:

- The top of the East Basin and West Basin floor is at El. -13 ft
- The site will be flooded prior to the construction of the pontoons
- No stone columns
- The K values are based on uniform load over an infinite surface (i.e., the effect of stress distribution is not accounted for)
- The K estimate is based on uniform stress less than 2000 psf
- Settlement due to subgrade disturbance is not accounted for (flooding the facility should reduce the effect of subgrade disturbance).

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Vertical Subgrade Reaction Modulus (K)

Figure 26

TABLE 1
SUMMARY OF MEASURED SOIL PROPERTIES FROM IN SITU AND LABORATORY TESTS
SR 520 PONTOON CONSTRUCTION PROJECT
PORT OF GRAYS HARBOR, WASHINGTON

Interpreted Soil Unit		SPT	CPT		Index Testing					Grain Size Testing			Consolidation							Strength			
		N-Value N (blows/ft)	Tip Resistance (tsf)	Friction Ratio (%)	Water Content Wn (%)	Liquid Limit LL (%)	Plastic Limit PL (%)	Plasticity Index PI (%)	Wet Unit Weight (pcf)	% Gravel	% Sand	% Fines	Young's Modulus * (PMT basis) E_{pmt} (ksf)	Compression Index Cc	Recompression Index Cr	Over-consolidation Ratio	Coefficient of Consolidation in Compression Zone Cv (ft^2/day)	Coefficient of Consolidation in Recompression Zone Cv (ft^2/day)	Horizontal Coefficient of Consolidation in SILT Ch (ft^2/day)	UU Undrained Shear Strength Su (tsf)	VST Undrained Shear Strength Su (tsf)	CU Consolidated Undrained Shear Strength c' (psf)	CU Consolidated Undrained Shear Strength ϕ' (degrees)
Unit 1	Count	567	4321	4321	530	99	99	99	39	76	76	76	16	7	7	7	21	22	29	15	8	6	6
	Maximum	69	330.5	35.3	228	108	58	50	109	21	97	99	689	0.75	0.08	2.4	3.4	4.2	21.1	0.54	0.6	250	34
	Minimum	0	0.1	0.2	6	38	25	5	93	0	0	0	77	0.48	0.03	1.3	0.1	0.4	0.2	0.12	0.2	150	29
	Average *	2	10.5	3.6	60	67	40	27	101	1	43	43	172	0.64	0.05	1.8	0.7	1.9	5.5	0.27	0.4	200	31
	Std. Dev.	5	18.6	2.4	22	13	5	10	3	4	36	32	167	0.09	0.02	0.4	1.0	1.2	5.0	0.13	0.1	NA	NA
Unit 2A	Count	80	537	537	67	9	9	9		15	15	15									1		
	Maximum	22	167.8	1.7	112	91	54	42		0	89	86									0.9		
	Minimum	0	6.9	0.1	30	34	29	4		0	14	11									0.9		
	Average	4	28.9	0.6	52	59	40	20		0	56	44									0.9		
	Std. Dev.	4	24.7	0.3	15	18	8	11		0	22	22									NA		
Unit 2B	Count	254	5745	5745	208	8	8	8		51	51	51	40								5		
	Maximum	25	184.5	61.5	74	65	37	28		1	86	75	2030								1.6		
	Minimum	0	0.4	0.1	26	36	26	8		0	0	4	230								0.5		
	Average *	6	44.1	2.5	43	46	32	15		0	46	31	829								1.0		
	Std. Dev.	5	34.4	4.6	11	10	4	7		0	34	19	543								0.4		
Unit 3	Count	255	78	3453	241	49	49	49	32	6	6	6	93	9	9	9	30	29	20	15	10	3	3
	Maximum	76	286.2	12.0	99	108	64	52	111	0	76	58	6320	0.87	0.12	1.6	2.6	4.2	6.7	1.68	1.3	775	30
	Minimum	0	4.7	0.1	8	34	25	4	88	0	42	24	460	0.47	0.03	1.1	0.1	0.7	0.4	0.48	0.4	575	26
	Average *	5	22.9	2.4	55	65	37	27	100	0	59	41	1109	0.66	0.06	1.4	0.8	2.3	2.7	1.00	0.9	675	28
	Std. Dev.	8	22.1	0.8	15	18	8	13	5	0	15	15	1094	0.14	0.03	0.2	0.6	1.0	1.7	0.41	0.3	NA	NA
Unit 4	Count	130			61	1	1	1		15	15	15											
	Maximum	112			46	35	28	7		64	50	10											
	Minimum	0			3	35	28	7		40	30	4											
	Average	49			12	35	28	7		50	43	6											
	Std. Dev.	24			8	0	0	0		6	6	2											

* NOTE: Young's Modulus values determined from pressuremeter testing (PMT) are highly influenced by soil type, presence of interbeds, and other factors. For PMT-derived modulus values, the harmonic mean of the data set is reported instead of the (arithmetic) average.

TABLE 2
SOIL PROPERTIES FOR DESIGN
SR 520 PONTOON CONSTRUCTION PROJECT
PORT OF GRAYS HARBOR, WASHINGTON

Soil Unit	Material Type	Soil Unit Weight (pcf)	Undrained Shear Strength (psf)	Effective Friction Angle (degrees)	Effective Cohesion (psf)	Consolidation Properties				Large Strain Elastic Modulus[(a)] (psf)	Low-Strain Shear Modulus [(b)] (ksf)	Average Shear Wave Velocity (fps)	$N_{1,60,cs}$ (blows/ft)
						c_c	c_r	OCR	c_v (ft^2/day)				
Unit 1	SAND	115	NA	31	0	NA	NA	NA	NA	150	293	300	NA
Unit 1	SILT	105	400 (top) to 800 (bottom)	31	100	0.64	0.05	1.8	0.7 (compression) 2.0 (recompression)				NA
Unit 2A	SILT	105	1,400	31	150	NA	NA	NA	NA	NM	893	500	NA
Unit 2B	SAND	115	NA	31	0	NA	NA	NA	NA	900			11
Unit 3	SILT	105	1,750	30	400	0.66	0.1	1.4	2.3 (recompression)	1000	800 (Upper 50 ft)	500	NA
											1,800 (10 ft)	750	
Unit 4	GRAVEL	140	NA	38	0	NA	NA	NA	NA	NM	4,300 (Upper 20 ft)	1000	NA
											6,800 (20 ft)	1250	
											9,780 (60 ft)	1500	
											13,300 (50 ft)	1750	
											17,400 (Lower 10 ft)	2000	

Notes:

(a) Approximate values based on the harmonic average of the pressuremeter testing

(b) Shear Modulus value for the upper 160 ft of Soil Unit 4 are presented, otherwise considered rock with G_{max} = 27,175 ksf.

NA = Not analyzed.

NM = Not measured

TABLE 3
EARTH PRESSURES RECOMMENDATIONS
SR 520 PONTOON CONSTRUCTION PROJECT
PORT OF GRAYS HARBOR, WASHINGTON

Material	WSDOT Standard Specifications	Fill Placement and Degree of Compaction	Assumed friction Angle (degrees)	Assumed Total Weight (γ_t) (pcf)	Assumed Angle of Friction Between Soil & Wall (Degrees)	Static At-Rest Earth Pressure Coefficient, K_0	Static Active Earth Pressure Coefficient, K_a	Seismic Active Earth Pressure Coefficient, K_{ae}	Passive Earth Pressure Coefficient, K_p
Gravel Backfill for Walls or Gravel Borrow	9-03.12(2) or 9-03.14(1)	Method B (Section 2-03.3 (14)C, 2006 WSDOT Standard Specifications)	36	135	15	0.41	0.24	0.60 (north wall) 0.57 (other walls)	7.0
Select Borrow	9-03.14(2)		34	125	15	0.44	0.26	Not Evaluated	6.0
Common Borrow	9-03.14(3)		30	1105	10	0.50	0.30		4.0

Assumptions:

1) Free drainage behind walls (i.e., no hydrostatic pressures).
2) Seismic Coefficient K_{ae} is based on the FLAC2D analysis (refer to Section 5.5.1 in the main text of the report)
3) Seismic pressure based on Vina del Mar earthquake motion.

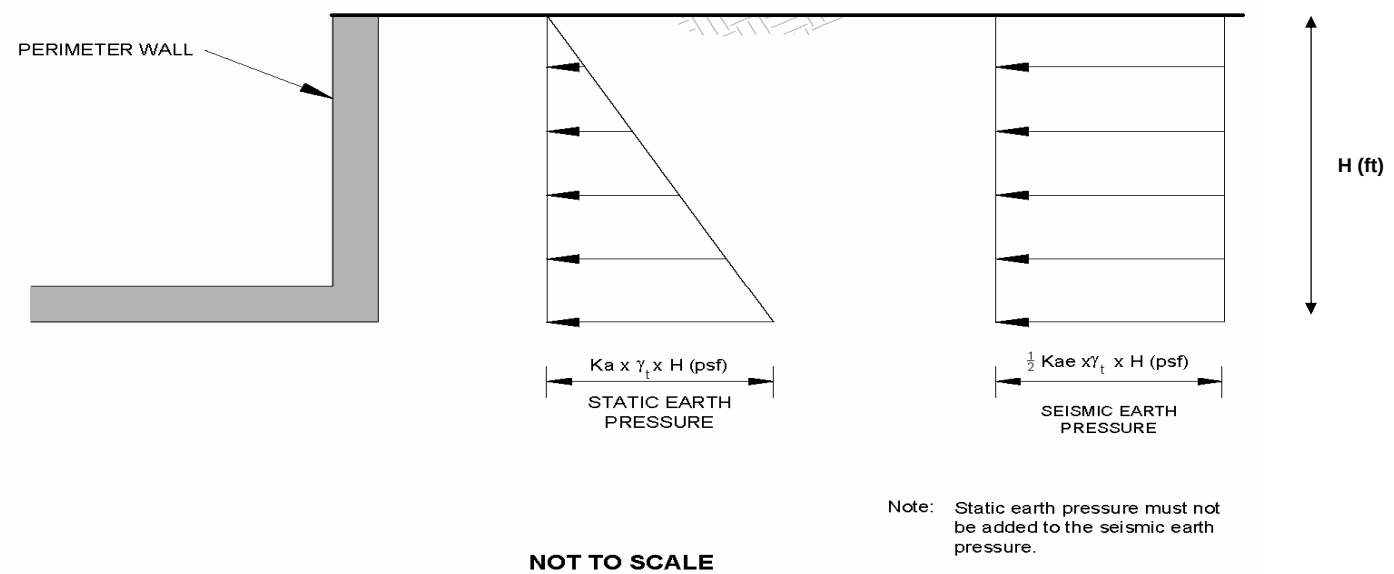


TABLE 4A
LPILE DESIGN INPUT PARAMETERS, 1,000 YEAR EARTHQUAKE
SR 520 PONTOON CONSTRUCTION PROJECT
PORT OF GRAYS HARBOR, WASHINGTON

Area A

Soil Unit	Layer	Soil Type	Soil Type (p-y curve model)	Layer Thickness (ft)	Btm. Elev. (ft)	Effective Unit Weight (pcf)	Friction Angle (deg)	Soil Modulus, k pci	ε_{50} (%)	Undrained Cohesion (psf)
1	1	Clay	Soft Clay (Matlock)	35.0*	-21.0	41			1.5	750
2A	2	Sand	API Sand (O'Neill)	7.0	-28.0	51	31	20		
2A	3	Clay	Soft Clay (Matlock)	33.0	-61.0	41			0.6	1400
2A	4	Sand	API Sand (O'Neill)	5.0	-66.0	51	31	20		
2A	5	Clay	API Sand (O'Neill)	10.0	-76.0	41			0.5	1750
2A	6	Sand	API Sand (O'Neill)	10.0	-86.0	51	31	20		
3	7	Clay	API Sand (O'Neill)	48.0	-134.0	41			0.5	1750
4	8	Sand	Soft Clay (Matlock)	20.0	-154.0	76	38	125		

Area B

Soil Unit	Layer	Soil Type	Soil Type (p-y curve model)	Layer Thickness (ft)	Btm. Elev. (ft)	Effective Unit Weight (pcf)	Friction Angle (deg)	Soil Modulus, k pci	ε_{50} (%)	Undrained Cohesion (psf)
1	1	Clay	Soft Clay (Matlock)	37.0*	-23.0	41			1.5	750
2B	2	Sand	API Sand (O'Neill)	15.0	-38.0	51	31	20		
2B	3	Clay	Soft Clay (Matlock)	7.0	-45.0	41			0.6	1400
2B	4	Sand	API Sand (O'Neill)	5.0	-50.0	51	31	20		
2B	5	Sand	API Sand (O'Neill)	5.0	-55.0	51	31	20		
2B	6	Sand	API Sand (O'Neill)	5.0	-60.0	51	31	20		
2B	7	Sand	API Sand (O'Neill)	8.0	-68.0	51	31	20		
3	8	Clay	Soft Clay (Matlock)	60.0	-128.0	41			0.6	1750
4	9	Sand	API Sand (O'Neill)	20.0	-148.0	76	38	125		

*Layer thickness of Soil Unit 1 will vary depending on the ground elevation of the pile location. Thickness shown is for the maximum ground elevation, +14 MLLW

TABLE 4B
DFSAP DESIGN INPUT PARAMETERS, 1,000 YEAR EARTHQUAKE
SR 520 PONTOON CONSTRUCTION PROJECT
PORT OF GRAYS HARBOR, WASHINGTON

Area A

Soil Unit	Layer	Soil Type	Layer Thickness (ft)	Btm. Elev. (ft)	Effective Unit Weight (pcf)	Friction Angle (deg)	ε_{50} (%)	Liq.	Soil Cohesion (psf)	s_u at Top of Layer (psf)	s_u at Bottom of Layer (psf)	Rock Comp. Stgth (psf)	SPT Corrected Blowcounts $N_{1(60)}$	Fines Content (%)	Angularity
1	1	Clay	35.0*	-21.0	41		1.500			750	750				
2A	2	Sand	7.0	-28.0	51	31	0.750								
2A	3	Clay	33.0	-61.0	41		0.750			1400	1400				
2A	4	Sand	5.0	-66.0	51	31	0.750								
2A	5	Clay	10.0	-76.0	41		0.750			1750	1750				
2A	6	Sand	10.0	-86.0	51	31	0.750								
3	7	Clay	48.0	-134.0	41		0.750			1750	1750				
4	8	Sand	20.0	-154.0	76	38	0.015								

Area B

Soil Unit	Layer	Soil Type	Layer Thickness (ft)	Btm. Elev. (ft)	Effective Unit Weight (pcf)	Friction Angle (deg)	ε_{50} (%)	Liq.	Soil Cohesion (psf)	s_u at Top of Layer (psf)	s_u at Bottom of Layer (psf)	Rock Comp. Stgth (psf)	SPT Corrected Blowcounts $N_{1(60)}$	Fines Content (%)	Angularity
1	1	Clay	37.0*	-23.0	41		1.500			750	750				
2B	2	Sand	15.0	-38.0	51	31	0.600								
2B	3	Clay	7.0	-45.0	41		0.750			1400	1400				
2B	4	Sand	5.0	-50.0	51	31	0.600								
2B	5	Sand	5.0	-55.0	51	31	1.500								
2B	6	Sand	5.0	-60.0	51	31	0.600								
2B	7	Sand	8.0	-68.0	51	31	0.600								
3	8	Clay	60.0	-128.0	41		0.750			1750	1750				
4	9	Sand	20.0	-148.0	76	38	0.015								

*Layer thickness of Soil Unit 1 will vary depending on the ground elevation of the pile location. Thickness shown is for the maximum ground elevation, +14 MLLW

TABLE 5A
LPILE DESIGN INPUT PARAMETERS
MOORING DOLPHINS
SR 520 PONTOON CONSTRUCTION
PORT OF GRAYS HARBOR, WASHINGTON

Soil Unit	Layer	Soil Type	Soil Type (p-y curve model)	Layer Thickness (ft)	Btm. Elev. (ft)	Effective Unit Weight (pcf)	Friction Angle (deg)	Soil Modulus, k pci	ε_{50} (%)	Undrained Cohesion (psf)	s_u at Bottom of Layer (psf)
1	1	Clay	Soft Clay (Matlock)	35.0*	-21.0	41			1.5	750	
2A	2	Sand	API Sand (O'Neill)	7.0	-28.0	51	31	20			750
2A	3	Clay	Soft Clay (Matlock)	33.0	-61.0	41			0.6	1400	
2A	4	Sand	API Sand (O'Neill)	5.0	-66.0	51	31	20			1400
2A	5	Clay	API Sand (O'Neill)	10.0	-76.0	41			0.5	1750	
2A	6	Sand	API Sand (O'Neill)	10.0	-86.0	51	31	20			1750
3	7	Clay	API Sand (O'Neill)	48.0	-134.0	41			0.5	1750	
4	8	Sand	Soft Clay (Matlock)	20.0	-154.0	76	38	125			1750

*Layer thickness of Soil Unit 1 will vary depending on the ground elevation of the pile location. Thickness shown is for the maximum ground elevation, +14 MLLW

TABLE 5B
DFSAP DESIGN INPUT PARAMETERS
MOORING DOLPHINS
SR 520 PONTOON CONSTRUCTION
PORT OF GRAYS HARBOR, WASHINGTON

Soil Unit	Layer	Soil Type	Layer Thickness (ft)	Btm. Elev. (ft)	Effective Unit Weight (pcf)	Friction Angle (deg)	ε_{50} (%)	Liq.	Soil Cohesion (psf)	s_u at Top of Layer (psf)	s_u at Bottom of Layer (psf)	Rock Comp. Stgth (psf)	SPT Corrected Blowcounts $N_{1(60)}$	Fines Content (%)	Angularity
1	1	Clay	35.0*	-21.0	41		1.000			750	750				
2A	2	Sand	7.0	-28.0	51	31	0.750	No							
2A	3	Clay	33.0	-61.0	41		0.750			1400	1400				
2A	4	Sand	5.0	-66.0	51	31	0.750	No							
2A	5	Clay	10.0	-76.0	41		0.750			1750	1750				
2A	6	Sand	10.0	-86.0	51	31	0.750	No							
3	7	Clay	48.0	-134.0	41		0.750			1750	1750				
4	8	Sand	20.0	-154.0	76	38	0.015	No							

*Layer thickness of Soil Unit 1 will vary depending on the ground elevation of the pile location. Thickness shown is for the maximum ground elevation, +14 MLLW

APPENDIX A

Field Explorations

APPENDIX A
FIELD EXPLORATIONS

Subsurface conditions within the limits of the project area were explored during the current (phase II design) phase and during two earlier field exploration efforts. Exploration for the current phase also included one offsite boring (TH-36-08) to obtain subsurface information for a proposed utility crossing beneath railroad tracks near the northern boundary of the project site.

Exploration for earlier phases occurred in 2006. Previous explorations included 20 geotechnical borings (designated borings B-1 through B-20), 6 borings installed as monitoring wells with vibrating wire pressure transducers (designated as VW-1 through VW-6), and 23 cone penetration tests (CPTs) (designated CPT-1 through CPT-23). The results of the previous explorations are included in the appendices of our previous reports (Landau Associates 2006, 2007) and the boring and CPT logs for previous explorations are also included in this appendix.

The current exploration program included drilling and sampling a total of 42 exploratory boring locations (designated TH-27-08 through TH-67-08) and 28 test pits (designated TP-1-08 through TP-27-08). Because of refusal due to a very large log encountered in test pit TP-18-08, an additional test pit (TP-18A-08) was excavated nearby. At some boring locations, multiple borings were drilled within close proximity for pressuremeter testing and shearwave suspension logging, or to obtain additional samples. The locations of all explorations are shown on Figure 3. Where multiple borings or test pits were made in close proximity, only one location is indicated on the figure.

The field exploration program was coordinated and monitored by a geotechnical engineer or engineering geologist from our staff, who also obtained representative soil samples, maintained a detailed record of the observed subsurface soil and groundwater conditions, and described the soil encountered by visual and textural examination. Soil samples were taken to our laboratory for further examination and testing. Each representative soil type observed in our explorations was described using the soil classification system shown on Figure A-1, in general accordance with the American Society for Testing and Materials (ASTM) D2488, *Standard Recommended Practice for Description of Soils (Visual-Manual Procedure).*

The exploration logs represent our interpretation of subsurface conditions identified during the field exploration program. The stratigraphic contacts shown on the individual logs represent the approximate boundaries between soil types; actual transitions may be more gradual. The soil and groundwater conditions depicted are only for the specific date and locations reported and are not necessarily representative of other locations and times. A further discussion of the soil and groundwater conditions observed is contained in the text of this report.

Exploration locations were initially located in the field using a hand-held global positioning system (GPS) unit and later surveyed by the Washington State Department of Transportation (WSDOT). Locations shown on the report figures and the coordinates on the exploration logs indicate the surveyed locations of the explorations. Elevations shown on the exploration logs represent surveyed values.

EXPLORATORY BORINGS

Borings were advanced to depths ranging from about 20 to 250 ft below the existing ground surface (BGS). Most of the borings were advanced with WSDOT track- or truck-mounted drill rigs using mud rotary drilling techniques and a wire-line casing advancer system. Two offshore borings were advanced by WSDOT with mud rotary drilling methods using skid-mounted drilling equipment on a barge. Boring TH-64-08 was advanced by Boart Longyear (under contract to Landau Associates) using rotosonic techniques. Logs of the exploratory borings are presented on Figures A-2 through A-69.

Disturbed samples of the soil encountered from the borings were obtained at frequent intervals using a 1.5-inch inside-diameter (ID) Standard Penetration Test (SPT) split-spoon sampler. Select samples were also obtained during previous phases of the project for chemical analyses using a 2.0-inch ID modified California sampler. The sampler was driven up to 18 inches (or a portion thereof) into the undisturbed soil ahead of the drill bit with a 140-pound (lb) automatic hammer falling a distance of approximately 30 inches. The number of blows required to drive the sampler for the final 12 inches (or portion thereof) of soil penetration is noted on the boring logs adjacent to the appropriate sample notation. According to recent dynamic measurements conducted by WSDOT, the average efficiency of autohammers within the WSDOT drilling fleet is approximately 76 percent (Miner 2007). Samples collected in this manner were taken to our laboratory for further examination and index tests. A discussion of laboratory test procedures and the laboratory test results are presented in Appendix B.

Relatively undisturbed samples of fine-grained soil encountered in the borings were obtained by advancing a 3-inch outside-diameter (OD), thin-walled tube. During the preliminary 2006 exploration phase, the relatively undisturbed samples were obtained by pushing a 3-inch OD, thin-walled tube into the undisturbed soil ahead of the drill bit. The tube was advanced approximately 24 inches using the drill rig hydraulics. During the second phase of 2006 exploration, the 3-inch OD tubes were pushed using the aforementioned techniques in Soil Unit 1, Soil Unit 2A, and Soil Unit 2B. However, the 3-inch OD tubes were advanced into Soil Unit 3 using a hydraulic piston. The tubes for the most recent exploration phase were advanced using the piston sampler. The samples from offshore explorations B-18 and B-19 were obtained by pushing 1.75-inch OD, thin-walled tubes. After removal of the tube from the borehole, the ends of the tube were capped and sealed. Samples collected in this manner were taken to our laboratory

for further examination and testing. A discussion of laboratory test procedures and the laboratory test results are presented in Appendix B.

Following completion of drilling and sampling of selected borings, piezometers consisting of either 2-inch-diameter PVC pipe with 0.010-inch machine-slotted screens (i.e., standpipe piezometers) or vibrating-wire piezometers (VWPs) were installed. Piezometers were installed in the following borings:

Boring	Total Depth	Piezometer Type
VW-1	40	VWP
VW-2	40	VWP
VW-3	40	VWP
VW-4	40	VWP
VW-5	40	VWP
VW-6	40	VWP
TH-42P-08	20.5	Standpipe
TH-43P-08	20.5	Standpipe
TH-44P-08	20.5	Standpipe
TH-45P-08	20.5	Standpipe
TH-46P-08	20.5	Standpipe
TH-47P-08	20.5	Standpipe
TH-49P-08	20.5	Standpipe
TH-66P-08	20	Standpipe
TH-65P-08	60.5	VWP
TH-66P-A-08	60.5	VWP
TH-67P-08	60.5	VWP

For standpipe piezometers, the screened interval was backfilled with clean sand and a bentonite seal was placed above the backfill. For VWPs, a tremied bentonite grout was placed to the planned depth of the vibrating-wire device. The device was then placed and held at the planned depth by attachment to ¾-inch diameter PVC pipe extending to the ground surface. In some VWP installations, VWPs were placed at multiple depths. For each piezometer, a lockable aboveground monument was installed to help protect the standpipe or VWP readout wires. One boring (TH-64-08) was installed by rotosonic drilling methods and used as an extraction well for pump testing. Pump testing results are presented in a separate report.

At borings TH-28-08 through TH-31-08, *in situ* pressuremeter testing was conducted at depths of up to 140 feet (ft) using a self-boring pressuremeter. Also at these borings, *in situ* shearwave suspension logging was conducted from the ground surface to depths of up to 230 ft to help estimate the seismic response of site soils. A discussion of these *in situ* test procedures and test results are presented in Appendix C of this report.

EXPLORATORY TEST PITS

Shallow subsurface soil and groundwater conditions at the project site were further explored by excavating 28 test pits at the locations shown on Figure 3. Test pits were excavated by a tracked excavator under subcontract to Landau Associates to depths ranging from approximately 8.5 to 18.5 ft BGS. Tabulated logs of the test pits are presented on Figures A-70 through A-97. Wood waste, wood debris, and logs were encountered in some of the test pits. Photographs showing some of the wood waste and debris are included as Figures A-98 through A-101.

CONE PENETRATION TEST PROGRAM

The field exploration program included a CPT program to provide an overview of the subsurface soil conditions at the project site. The CPT program consisted of advancing 23 CPT soundings (CPT-1 through CPT-23) at the locations illustrated on Figure 3 of this report. The CPT soundings were advanced to depths ranging from about 41 to 152 ft BGS using truck-mounted CPT equipment. The CPT soundings were completed by WSDOT drilling crews.

At each CPT sounding location, a four-channel electronic cone was pushed at a rate of between 1 to 2 centimeters (cm) per second. The cone was used to simultaneously record tip resistance, sleeve friction, pore pressure, and inclination every 5 cm. Electrical energy was used to transmit the data to a receiver located at the ground surface. Upon completion of testing, the CPT soundings were abandoned in general accordance with the requirements of WAC 173-160.

WSDOT reduced the collected CPT data and plotted tip resistance, sleeve friction, friction ratio (sleeve friction divided by tip resistance), and pore water pressure as a function of sounding depth. WSDOT then used published correlations (Robertson and Campanella 1983) to estimate soil behavior types and Standard Penetration Test values at each interval where data were recorded (i.e., approximately every 2 inches). CPT logs produced by WSDOT are presented at the end of this appendix.

During the advancement of the CPT soundings, WSDOT drill crews performed 59 pore water dissipation tests. A discussion of the CPT dissipation tests and test results are presented in Appendix C of this report. WSDOT drill crews also performed shear wave velocity tests in the upper 80 ft of five of the CPT soundings. A discussion of the shear wave velocity tests and test results are presented in Appendix C of this report.

REFERENCES

Landau Associates. 2006a. *Geotechnical and Hydrogeologic Study, Bridge Pontoon Construction Facility, Grays Harbor, Washington.* Prepared for WSDOT. May 31.

Landau Associates. 2007a. Report: *Geotechnical Design Study WSDOT Special Projects Construction Site, Grays Harbor, Washington*. Prepared for WSDOT. March 29.

Miner. 2007. Letter Report: *Standard Penetration Test Energy Measurements, Washington State Department of Transportation Drilling Rigs, RMDT Job No. 06F11*. Prepared for the Washington State Department of Transportation. Robert Miner Dynamic Testing, Inc. April 20.

Robertson, P.K. and R.G. Campanella. 1983. *Interpretation of Cone Penetration Tests, Part I: Sand.* Canadian Geotechnical Journal. Volume 20. pp. 718-733.

Soil Classification System

MAJOR DIVISIONS			GRAPHIC SYMBOL	USCS LETTER SYMBOL[1]	TYPICAL DESCRIPTIONS[2][3]
COARSE-GRAINED SOIL (More than 50% of material is larger than No. 200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/clay mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through No. 4 sieve)	CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than No. 200 sieve size)	SILT AND CLAY (Liquid limit less than 50)			ML	Inorganic silt and very fine sand; rock flour; silty or clayey fine sand or clayey silt with slight plasticity
				CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
				OL	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid limit greater than 50)			MH	Inorganic silt; micaceous or diatomaceous fine sand
				CH	Inorganic clay of high plasticity; fat clay
				OH	Organic clay of medium to high plasticity; organic silt
	HIGHLY ORGANIC SOIL			PT	Peat; humus; swamp soil with high organic content

OTHER MATERIALS	GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
PAVEMENT		AC or PC	Asphalt concrete pavement or Portland cement pavement
ROCK		RK	Rock (See Rock Classification)
WOOD		WD	Wood, lumber, wood chips
DEBRIS		DB	Construction debris, garbage

NOTES:

1. USCS letter symbols correspond to symbols used by the Unified Soil Classification System and ASTM classification methods. Dual letter symbols (e.g., SP-SM for sand or gravel) indicate soil with an estimated 5-15% fines. Multiple letter symbols (e.g., ML/CL) indicate borderline or multiple soil classifications.
2. Soil descriptions are based on the general approach presented in the *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*, outlined in ASTM D 2488. Where laboratory index testing has been conducted, soil classifications are based on the *Standard Test Method for Classification of Soils for Engineering Purposes*, as outlined in ASTM D 2487.
3. Soil description terminology is based on visual estimates (in the absence of laboratory test data) of the percentages of each soil type and is defined as follows:

Primary Constituent:	> 50% - "GRAVEL," "SAND," "SILT," "CLAY," etc.
Secondary Constituents:	> 30% and ≤ 50% - "very gravelly," "very sandy," "very silty," etc.
	> 15% and ≤ 30% - "gravelly," "sandy," "silty," etc.
Additional Constituents:	> 5% and ≤ 15% - "with gravel," "with sand," "with silt," etc.
	≤ 5% - "trace gravel," "trace sand," "trace silt," etc., or not noted.

1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ SCS WSDOT 1OF2

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Soil Classification System and Key

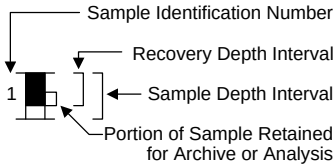
Figure A-1 (1 of 2)

Drilling and Sampling Key

SAMPLER TYPE

Code	Description
a	3.25-inch O.D., 2.42-inch I.D. Split Spoon
b	2.00-inch O.D., 1.50-inch I.D. Split Spoon
c	Shelby Tube
d	Grab Sample
e	Single-Tube Core Barrel
f	Double-Tube Core Barrel
g	Other - See text if applicable
1	300-lb Hammer, 30-inch Drop
2	140-lb Hammer, 30-inch Drop
3	Pushed
4	Rotosonic
5	Air Rotary (Rock)
6	Wash Rotary (Rock)
7	Other - See text if applicable

SAMPLE NUMBER & INTERVAL



Field and Lab Test Data

Code	Description
PP = 1.0	Pocket Penetrometer, tsf
TV = 0.5	Torvane, tsf
PID = 100	Photoionization Detector VOC screening, ppm
W = 10	Moisture Content, %
D = 120	Dry Density, pcf
-200 = 60	Material smaller than No. 200 sieve, %
GS	Grain Size - See separate figure for data
AL	Atterberg Limits - See separate figure for data
VST	Vane Shear Test
GT	Other Geotechnical Testing
CA	Chemical Analysis

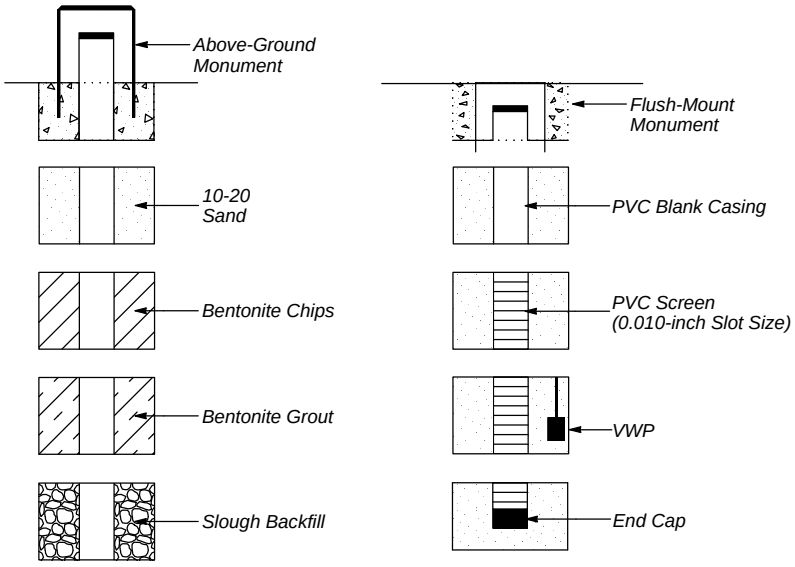
Groundwater

▽ Approximate water elevation at time of drilling (ATD).

▼ Approximate water elevation at other time(s). When multiple water levels are obtained other than ATD, only a representative range is shown. See text for additional information.

Note: Groundwater levels can fluctuate due to precipitation, seasonal conditions, and other factors.

Well Log Graphics



1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ SCS WSDOT 2OF2

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Soil Classification System and Key

Figure A-1 (2 of 2)

B- 1

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 13.7 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
0	S-1	b2	13		SM	Brown silty, fine SAND (medium dense, moist) **(SOIL UNIT 1)**
	S-2	b2	27	W = 18		
5	S-3	b2	6		SP-SM	Brown, fine to medium SAND with silt (loose, wet) - 1" interbed of sandy SILT at 5.5'
	S-4	b2	7	W = 29 GS		
	S-5	b2	6	W = 26	SM	Dark gray silty, fine SAND (loose, wet)
10	S-6	b2	2			
	S-7	b2	3	W = 51	ML	Dark gray SILT with sand (medium stiff, wet)
	S-8	b2	4			
15	S-9	b2	3	W = 49		
	S-10	b2	0	W = 56 AL	MH	Dark gray, clayey SILT with organics (medium stiff, wet)
	S-11	b2	0			
20	S-12	b2	2	W = 55		
	S-13	b2	3			
	S-14	c3		W = 53 AL GT		
25	S-15	b2	1	W = 57 AL VST		- disturbed sample, blow count not representative
	S-16A S-16B	b2	3	W = 62 AL		
	S-17	b2	0	W = 48		- 1/4" organic interbed at 28.6'
30	S-18	b2	2	W = 54		
	S-19	c3		W = 59 AL		
	S-20	b2	10	W = 63	SM	Gray, very silty, fine SAND (loose, wet) **(SOIL UNIT 2A)**
35	S-21	b2	4	W = 43 GS		
	S-22	b2	10	W = 33		- grades medium dense
	S-23	b2	2		ML	Gray SILT with sand and silty, SAND interbeds (1/8" thick) (medium stiff to stiff, wet)
40	S-24	b2	3	W = 47		

WELL DETAIL

LL = 80

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 1

Figure A-2
(1 of 5)

B- 1

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 13.7 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description
40	S-25	b2	1			ML	Gray SILT with sand and silty, SAND interbeds (1/8" thick) (medium stiff to stiff, wet)
45	S-26	b2	0	W = 43			- 1" thick interbed of very silty, fine SAND interbeds in sample
50	S-27	b2	3				- 2" thick interbed of very silty, fine SAND at 50.0'
55	S-28	b2	2	W = 54 AL			
60	S-29	b2	4				- 1" thick interbed of silty, fine to medium SAND at 60.3'
65	S-30	b2	0	W = 52			
70	S-31	b2	4	W = 46			
						SM	Gray, very silty, fine to medium SAND with wood and 1/4" thick interbedded SILT (loose, wet)
75	S-32	b2	9	W = 44			
						ML	Gray SILT with sand and very silty, SAND interbeds (1/8" thick) (stiff to very stiff, wet) **(SOIL UNIT 3)**
80	S-33	b2	3	W = 51			

WELL DETAIL

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 1

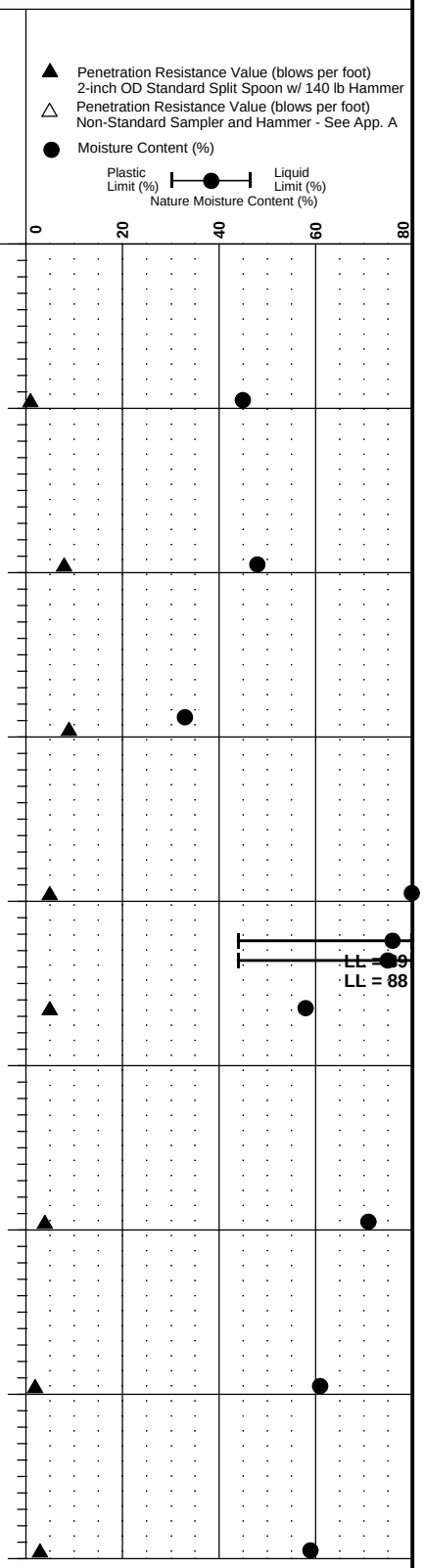
Figure A-2
(2 of 5)

B- 1

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 13.7 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
80				AL	ML	Gray SILT with sand and very silty, SAND interbeds (1/8" thick) (stiff to very stiff, wet) **(SOIL UNIT 3)**
85	S-34	b2	1	W = 45		- grades very soft, more massive
					SM	Gray, very silty, fine SAND with 1/8" thick interbedded sandy SILT (loose, wet)
90	S-35	b2	8	W = 48 GS		
						- grades silty
95	S-36	b2	9	W = 33		
					MH	Gray-brown, clayey SILT with abundant organics (stiff to very stiff, wet)
100	S-37	b2	5	W = 80		
	S-38	c3		W = 76 AL GT		
	S-39	b2	5	W = 75 AL VST W = 58		- disturbed sample, blow count not representative
105						
110	S-40	b2	4	W = 71		
115	S-41	b2	2	W = 61		
120	S-42	b2	3	W = 59		- grades trace organics

WELL DETAIL



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 1

Figure A-2
(3 of 5)

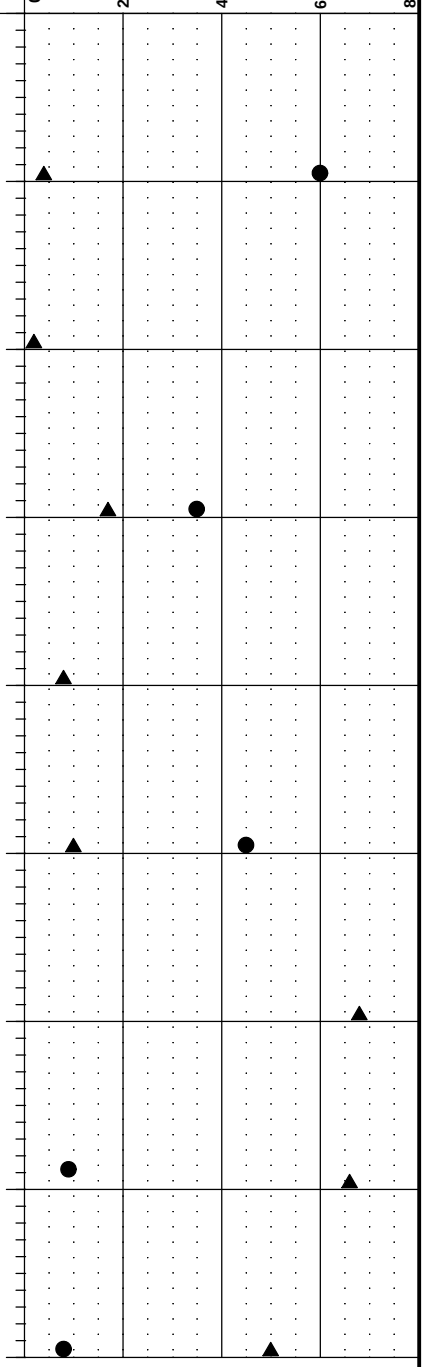
B- 1

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 13.7 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
120					MH	Gray-brown, clayey SILT with abundant organics (stiff to very stiff, wet)
125	S-43	b2	4	W = 60		
130	S-44	b2	2			
135	S-45	b2	17	W = 35	SM	Gray, very silty, fine SAND (medium dense, wet)
					ML	Gray SILT with trace organics (stiff to very stiff, wet)
140	S-46	b2	8			
145	S-47	b2	10	W = 45		
150	S-48	b2	68		GW-GM	Gray, very sandy, GRAVEL with silt (very dense, wet) **(SOIL UNIT 4)**
155	S-49	b2	66	W = 9		
160	S-50	b2	50	W = 8		

WELL DETAIL

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

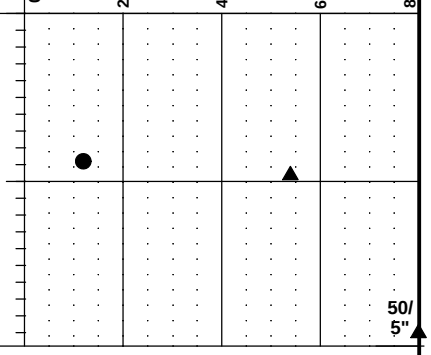
Log of Boring B- 1

Figure A-2
(4 of 5)

B- 1

SAMPLE DATA					SOIL PROFILE			WELL DETAIL
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 104'; 3.5" below Driller (Lic.#): WSDOT - R. Shepherd (2710) Ground Elevation (ft): 13.7 (MLLW)	
160				GS		GW-GM	Gray, very sandy, GRAVEL with silt (very dense, wet) **(SOIL UNIT 4)**	
165	S-51	b2	54	W = 12				
170	S-52	b2	50/5"					

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)



Boring Completed 01/26/06
Total Depth of Boring = 169.9 ft.
WSDOT Job #: XL 2672
Start Card #: R 68277
Ecology Well#: AKK-294

Point located at State Plane Coordinates:
North: 614830.43
East: 795611.67
Township: 17N
Range: 10W
Section: 11
Inspector: BAB (Landau Associates)

Completed 01/30/06
Elevation at Top of Casing = 16.00 ft.
Total Depth of = 40.0 ft.

175
180
185
190
195
200

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 1

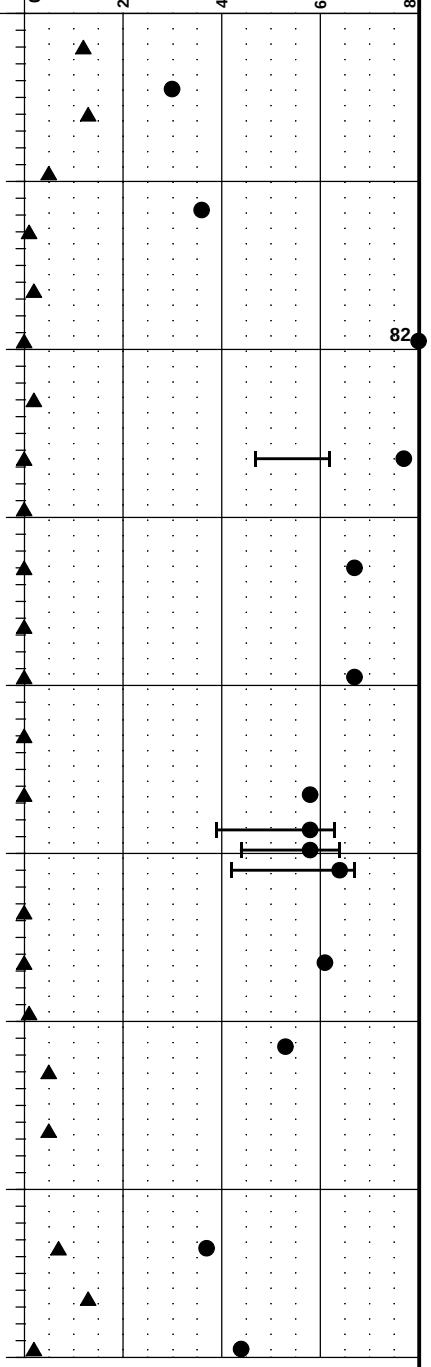
Figure A-2
(5 of 5)

B- 2

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 14.2 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Description
0	S-1	b2	12	PID=0.0	SP-SM	Red-brown, fine to medium SAND with silt (medium dense, wet) **(SOIL UNIT 1)**
	S-2	b2	13	W = 30	SM	Dark gray, very silty, fine SAND with wood debris (loose, wet)
5	S-3	b2	5			
	S-4	b2	1	W = 36		- grades very loose
	S-5	b2	2			
10	S-6	b2	0	W = 82	MH	Dark gray, clayey SILT with sand and organics (medium stiff, wet)
	S-7	b2	2			
	S-8	b2	0	W = 77 AL		- two 1/4" to 1/2" interbedded sandy SILT in sample
15	S-9	b2	0			
	S-10	b2	0	W = 67		
	S-11	b2	0			
20	S-12	b2	0	W = 67		
	S-13	b2	0			
	S-14	b2	0	W = 58		
25	S-15	c3		W = 58 AL W = 58 AL GT		
	S-16	b2	0	W = 64 AL		
	S-17	b2	0	W = 61		
30	S-18	b2	1			
	S-19	b2	5	W = 53	ML	Gray SILT with interbeds (1/4" to 1/2" thick) of very silty, fine SAND (medium stiff to stiff, wet)
	S-20	b2	5		SM	**(SOIL UNIT 2A)** Gray silty, fine SAND (loose, wet)
35	S-21	c3				
	S-22	b2	7	W = 37 GS		- 1/4" interbedded SILT in sampler
	S-23	b2	13			- grades medium dense
40	S-24	b2	2	W = 44	ML	



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 2

Figure A-3 (1 of 5)

B- 2

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 14.2 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description
40						ML	Gray, sandy SILT with interbedded (1/4" to 1" thick) of SILT (medium stiff to stiff, wet)
45	S-25	b2	2	W = 46 AL			
50	S-26	b2	2	W = 52			
55	S-27	b2	0	W = 57			
						ML	Gray, very sandy SILT (medium stiff to stiff, wet)
60	S-28	b2	4	W = 52 GS			- 3" thick interbed of SILT with sand at 59.75'
						MH	Gray, clayey SILT with sand and organics (medium stiff to stiff, wet)
65	S-29	b2	4	W = 53			- 1" thick interbed of very silty, fine SAND at 64.8', abundant organics at 65.2'
70	S-30	b2	4	W = 62 AL			- 4" thick interbed of very silty, fine SAND at 69.9'
75	S-31	b2	2	W = 53			- 3" thick interbed of very silty, fine SAND at 74' - 3" thick interbed of very silty, fine SAND at 75.3'
						ML	Gray SILT with interbeds (1/8" thick) of sandy SILT (stiff to very stiff, wet) **(SOIL UNIT 3)**
80	S-32	b2	0	W = 56			

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 2

Figure A-3 (2 of 5)

B- 2

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 14.2 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
80					ML	Gray SILT with interbeds (1/8" thick) of sandy SILT (stiff to very stiff, wet) **(SOIL UNIT 3)**
85	S-33	b2	0	W = 47 AL		
					SM	Gray, very silty, fine SAND (medium dense, wet)
90	S-34	b2	11	W = 30		
95	S-35	b2	10			
					MH	Gray, clayey SILT with abundant organics (stiff to very stiff, wet)
100	S-36	b2	4	W = 73		
	S-37	c3		GT		
	S-38	b2	3	VST W = 78		- sample disturbed, blow counts not representative
105						
110	S-39	b2	2	W = 60		- grades trace organics
115	S-40	b2	6	W = 64		
120	S-41	b2	3			

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 2

Figure A-3
(3 of 5)

B- 2

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 14.2 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
120					MH	Gray, clayey SILT with abundant organics (stiff to very stiff, wet)
125	S-42	b2	4	W = 57 AL		
					ML	Gray SILT with sand (stiff to very stiff, wet)
130	S-43	b2	6	W = 48		
135	S-44	b2	5	W = 39		
140	S-45	b2	6	W = 40		
145	S-46	b2	49	W = 8		
					GW-GM	Gray, very sandy, GRAVEL with silt (very dense, wet) **(SOIL UNIT 4)**
150	S-47	b2	62	W = 8		
155	S-48	b2	49	W = 9		- grades very dense
160	S-49	b2	65	W = 7		

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 2

Figure A-3
(4 of 5)

B- 2

SAMPLE DATA					SOIL PROFILE				
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 104'; 3.5" below Driller (Lic.#): WSDOT - R. Shepherd (2710) Ground Elevation (ft): 14.2 (MLLW)	WELL DETAIL	
160				GS		GW-GM	Gray, very sandy, GRAVEL with silt (very dense, wet) **(SOIL UNIT 4)**		
165	S-50	b2	82						82

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)
0 20 40 60 80

Boring Completed 02/02/06
Total Depth of Boring = 165.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68278
Ecology Well#: AKK-295

Point located at State Plane Coordinates:
North: 614967.42
East: 795935.00
Township: 17N
Range: 10W
Section: 11
Inspector: BAB (Landau Associates)

Completed 02/02/06
Elevation at Top of Casing = 16.15 ft.
Total Depth of = 50.0 ft.

170 175 180 185 190 195 200

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 2

Figure A-3
(5 of 5)

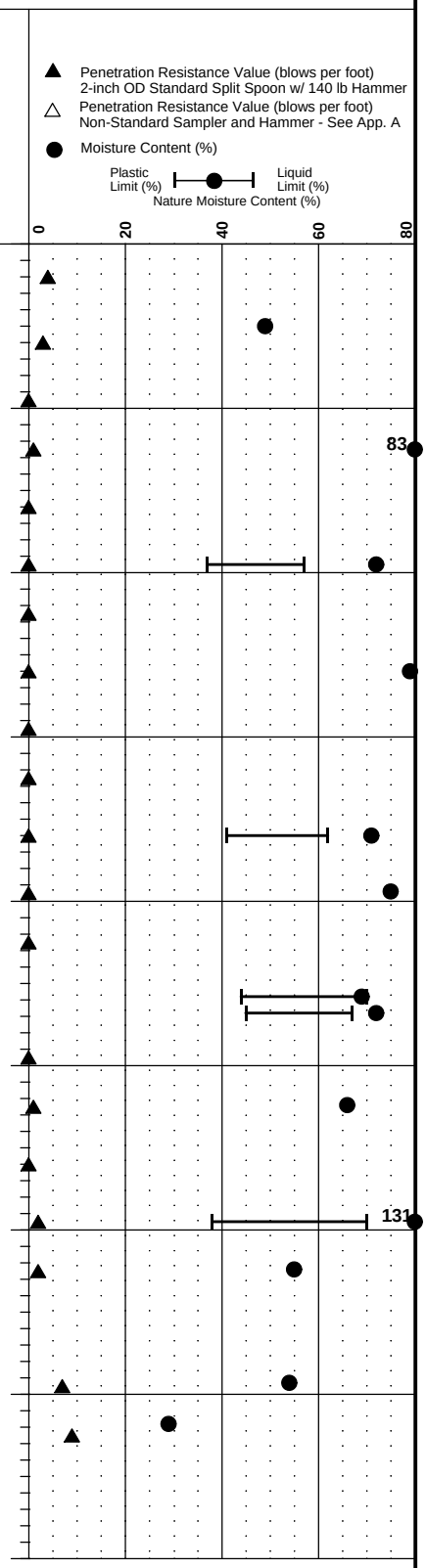
B- 3

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.6 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
0	S-1	b2	4	PID=0.0		ML	Gray and light brown, sandy SILT with interbedded silty, fine SAND (soft, wet) **(SOIL UNIT 1)**
	S-2	b2	3	PID=0.0 W = 49			- grades with SAND
5	S-3	b2	0	PID=0.0			- grades with trace sand, very soft
	S-4	b2	1	PID=0.0 W = 83		WD	Wood debris and grass
	S-5	b2	0			MH	Dark gray, clayey SILT with interbedded sand and organics (medium stiff, wet)
10	S-6	b2	0	W = 72 AL			
	S-7	b2	0				
	S-8	b2	0	W = 79			
15	S-9	b2	0				
	S-10	b2	0				
	S-11	b2	0	W = 71 AL			
20	S-12	b2	0	W = 75			
	S-13	b2	0				
	S-14	c3		W = 69 AL			
25	S-15	b2	0	W = 72 AL VST			- disturbed sample, blow count not representative
	S-16	b2	1	W = 66			
	S-17	b2	0				
30	S-18	b2	2	W = 131 AL			- 2.5" interbed of wood at 30'
	S-19	b2	2	W = 55		ML	Brown SILT with interbedded fine organics and 1/2" interbed of fine to coarse SAND (medium stiff, wet)
	S-20	c3				ML	Gray SILT with silty, fine SAND interbeds (medium stiff to stiff, wet)
35	S-21	b2	7	W = 54		ML	**(SOIL UNIT 2B)** Gray, sandy SILT with interbeds (2" thick) of silty, fine SAND; non-platic (medium stiff to stiff, wet)
	S-22	b2	9	W = 29		SP-SM	Gray, fine SAND with silt (loose, wet)
40							

WELL DETAIL



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 3

Figure A-4 (1 of 5)

B- 3

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.6 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
40	S-23	b2	12	W = 31 GS	SP-SM	Gray, fine SAND with silt (loose, wet) - grades medium dense, interbedded fine SAND with silt in sample,
45	S-24	b2	11	W = 34		
50	S-25A S-25B	b2	4	W = 48		- interbedded fine sandy SILT in sample
					ML	Gray to light-brown SILT with sand and trace shells (medium stiff to stiff, wet)
					ML	Gray and light brown SILT with interbeds (1/4" thick) of fine SAND with silt (medium stiff to stiff, wet)
55	S-26	b2	4	W = 50		
					SP-SM	Gray, fine SAND with silt and scattered organics and interbeds (1/4" thick) of SILT (loose, wet)
60	S-27	b2	7	W = 36		
					SM	Gray, very silty, fine SAND (loose, wet)
65	S-28	b2	9	W = 52 GS		
					SP-SM	Gray, fine SAND with silt and scattered organics and interbeds (1/4" thick) of SILT (medium dense, wet)
70	S-29	b2	14	W = 26		
75	S-30	b2	11	W = 37		
80	S-31A	b2	2	W = 71		- abundant wood debris in sample

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 3

Figure A-4 (2 of 5)

B- 3

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.6 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Moisture Content (%)
80	S-31B			W = 55		ML	Gray SILT with interbeds (1/32" to 1/16") of silty, fine SAND (stiff to very stiff, wet) **(SOIL UNIT 3)**	
85	S-32	b2	1	W = 53 AL				
90	S-33	b2	2	W = 43			- grades medium stiff	
						MH	Gray, clayey SILT with scattered organics (medium stiff to very stiff, wet)	
95	S-34	b2	3	W = 65				
100	S-35	c3		W = 74 AL				LL = 92
105	S-36	b2	1	VST W = 58			- disturbed sample, blow count not representative	
110	S-37	b2	3	W = 69 AL				
115	S-38	b2	2	W = 68				
120	S-39	b2	3	W = 55				

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 3

Figure A-4
(3 of 5)

B- 3

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.6 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
120						MH	Gray, clayey SILT with scattered organics (medium stiff to very stiff, wet)
125	S-40	b2	3	W = 60			
130	S-41	b2	4	W = 52 AL			
						ML	Gray SILT with sand and interbedded silty, fine SAND (stiff to very stiff, wet)
135	S-42	b2	7	W = 36			
140	S-43	b2	3	W = 40 AL			
145	S-44	b2	6				- no recovery, cuttings and drill action indicate same as above.
150	S-45A S-45B	b2	45	W = 24		SP-SM	Gray, fine to medium SAND with silt (dense, wet)
							(SOIL UNIT 4)
						GW-GM	Gray, very sandy, GRAVEL with silt (dense, wet)
155	S-46	b2	39	W = 9 GS			
160	S-47	b2	74	W = 7			- grades very dense

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

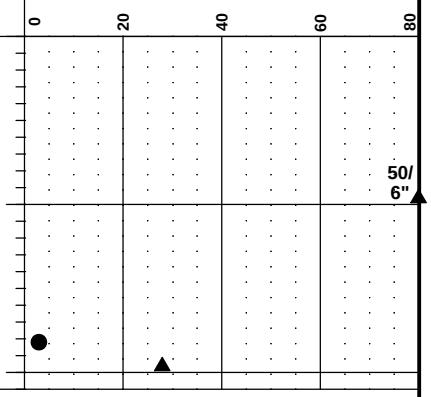
Log of Boring B- 3

Figure A-4
(4 of 5)

B- 3

SAMPLE DATA					SOIL PROFILE			WELL DETAIL
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 104'; 3.5" below Driller (Lic.#): WSDOT - V. Johnson (2532) Ground Elevation (ft): 13.6 (MLLW)	
160						GW-GM	Gray, very sandy, GRAVEL with silt (dense, wet)	
165	S-48	b2	50/ 6"					
170	S-49	b2	28	W = 3			- grades medium dense	

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)



Boring Completed 01/31/06
Total Depth of Boring = 170.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68279
Ecology Well#: AKK-296

Point located at State Plane Coordinates:
North: 615334.27
East: 796312.78
Township: 17N
Range: 10W
Section: 11
Inspector: BEC (Landau Associates)

Completed 01/31/06
Elevation at Top of Casing = 15.18 ft.
Total Depth of = 43.5 ft.

175
180
185
190
195
200

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 3

Figure
A-4
(5 of 5)

B- 4

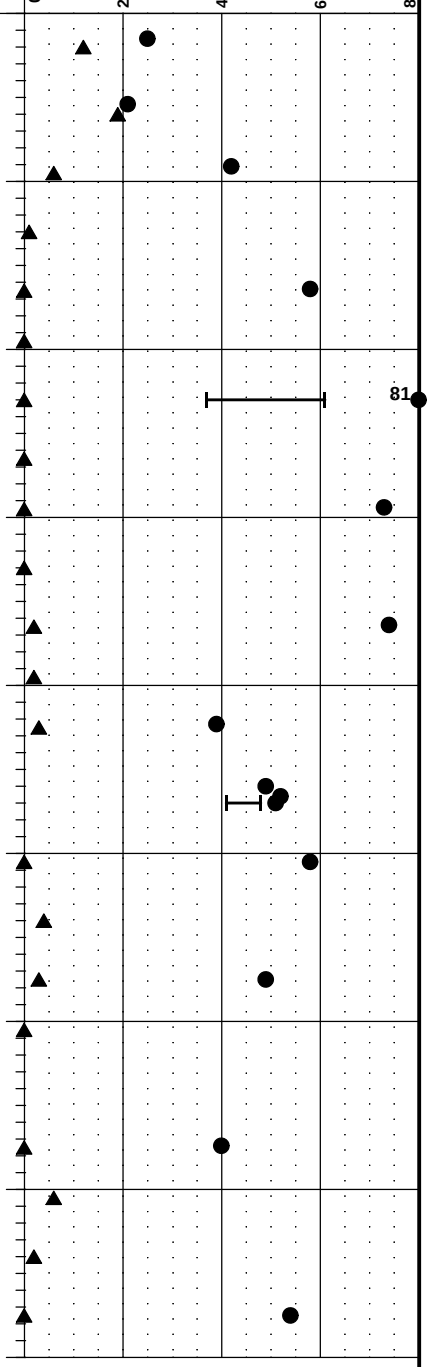
Drilling Method: Mud Rotary
Casing: 4.5" upper 96'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 15.1 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
0	S-1	b2	12	PID=0.0 W = 25	SM	Brown silty, fine SAND with abundant organics (loose, wet) **(SOIL UNIT 1)**
	S-2	b2	19	PID=0.0 W = 21		- grades trace organics - grades medium dense
5	S-3	b2	6	PID=0.0 W = 42		- fine organic interbeds (1/4" to 3/4" thick) in sample
	S-4	b2	1	PID=0.0	ML	Dark gray to black, sandy SILT with trace organics (medium stiff, wet)
					SM	Dark gray silty, fine SAND (loose, wet)
	S-5	b2	0	W = 58	MH	Dark gray, clayey SILT with sand and abundant organics (medium stiff, wet)
10	S-6	b2	0	PID=0.0		
	S-7	b2	0	PID=0.0 W = 81 AL		- 6" thick wood and grass interbed at 12'
	S-8	b2	0	PID=0.0		
15	S-9	b2	0	PID=0.0 W = 73		- 1/32" to 1/16" interbedded silty, fine SAND with trace organics in sample
	S-10	b2	0			
	S-11	b2	2	W = 74		
20	S-12	b2	2		ML	Dark gray SILT with sand and trace shells (medium stiff, wet)
	S-13	b2	3	W = 39		
	S-14	c3		W = 49 W = 52 GT		
25	S-15	b2	0	W = 51 AL VST		- disturbed sample, blow count not representative
	S-16	b2	4	W = 58		
	S-17	b2	3	W = 49	ML	Gray SILT with thin interbedded silty, fine SAND or sandy SILT (medium stiff, wet)
30	S-18	b2	0			
	S-19	c3		PID=0.0		
	S-20	b2	0	W = 40		
35	S-21	b2	6		ML	Gray SILT with thin interbedded silty, fine SAND or sandy SILT (medium stiff to stiff, wet)
	S-22	b2	2			**(SOIL UNIT 2B)** - interbed thickness increases from 1/8" to 1/4"
	S-23	b2	0	W = 54 GS	ML	
40						

Graphic Symbol

WELL DETAIL

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 4

Figure A-5
(1 of 5)

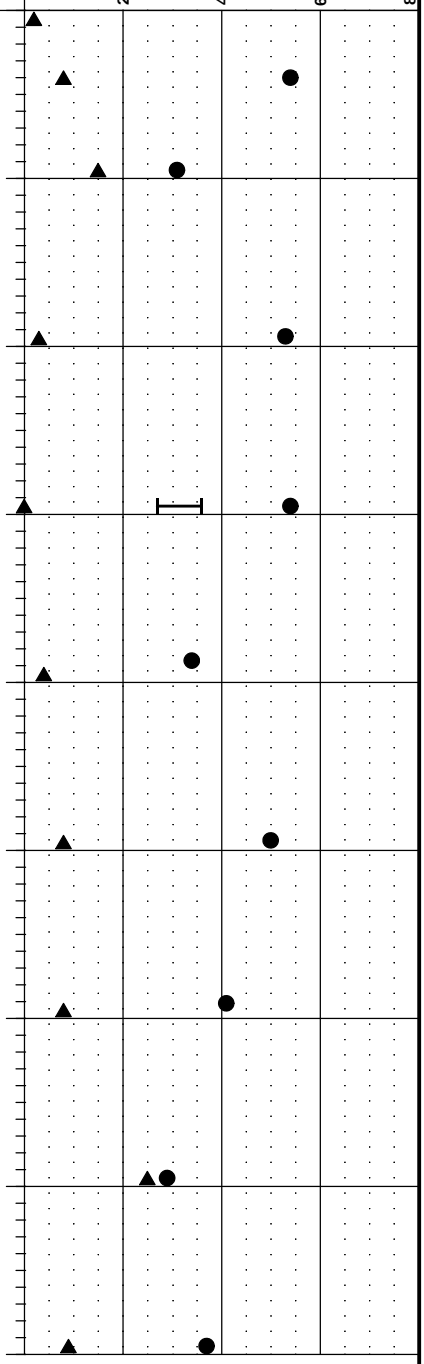
B- 4

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4.5" upper 96'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 15.1 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Description
40	S-24	b2	2		ML	Gray, sandy SILT with 1/16" to 1/8" thick interbedded silty, fine SAND (medium stiff to stiff, wet)
	S-25A S-25B	b2	8	W = 54		
					SM	Gray silty, fine SAND with 1/16" to 1/8" thick interbedded SILT (medium dense, wet)
45	S-26	b2	15	W = 31 GS		
					ML	Gray SILT with 1/32" to 1/16" thick interbedded silty, fine SAND and trace shells (medium stiff to stiff, wet)
50	S-27	b2	3	W = 53		
55	S-28	b2	0	W = 54 AL		
					SP-SM	Gray, fine SAND with silt (very loose to loose, wet)
60	S-29	b2	4	W = 34		
					SM	Gray, very silty, fine SAND with 1/32" to 1/16" thick interbedded SILT and organics (loose, wet)
65	S-30	b2	8	W = 50		
70	S-31	b2	8	-200=38 W = 41		
75	S-32	b2	25	W = 29 GS		- grades silty, medium dense
80	S-33	b2	9	W = 37		- grades very silty, loose

WELL DETAIL



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 4

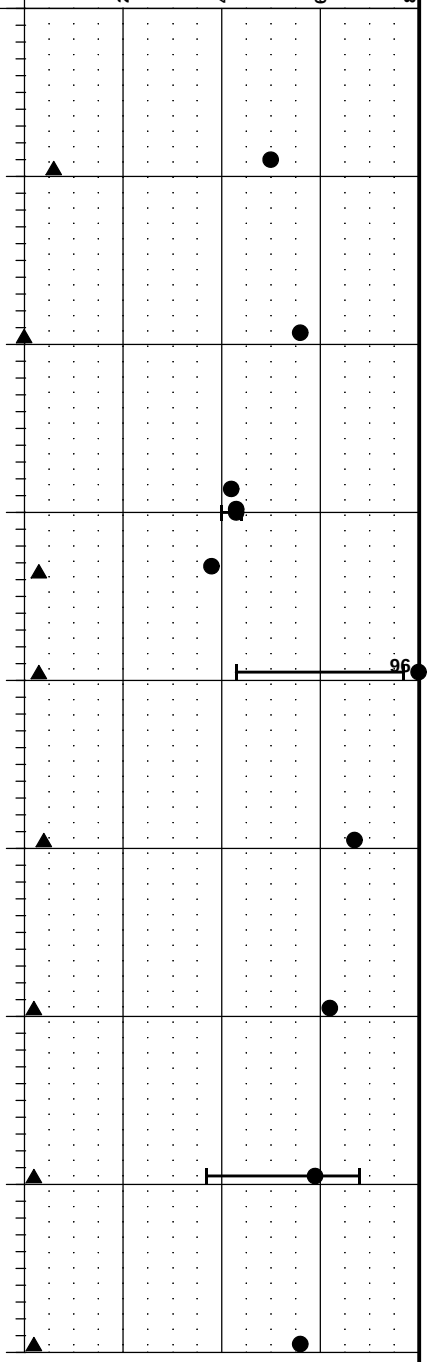
Figure A-5 (2 of 5)

B- 4

Drilling Method: Mud Rotary
Casing: 4.5" upper 96'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 15.1 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
80				GS	SM	Gray, very silty, fine SAND with 1/32" to 1/16" thick interbedded SILT and organics (loose, wet)
					ML	Gray SILT with trace organics and 1/32" to 1/16" thick interbedded silty, fine SAND (medium stiff to stiff, wet)
85	S-34	b2	6	W = 50		
					ML	Gray SILT with scattered fine organics (stiff to very stiff, wet) **(SOIL UNIT 3)**
90	S-35	b2	0	W = 56		
					ML	Gray, sandy SILT with organics (stiff to very stiff, wet)
95	S-36	c3		W = 42 W = 43 W = 43 AL		
	S-37	b2	3	VST W = 38		- disturbed sample, blow count not representative
					MH	Gray, clayey SILT with abundant organics (stiff to very stiff, wet)
100	S-38	b2	3	W = 96 AL		
105	S-39	b2	4	W = 67		
110	S-40	b2	2	W = 62		- grades trace organics
115	S-41	b2	2	W = 59 AL		- grades trace lamination
120	S-42	b2	2	W = 56		- grades massive



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 4

Figure A-5 (3 of 5)

B- 4

Drilling Method: Mud Rotary
Casing: 4.5" upper 96'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 15.1 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
120					MH	Gray, clayey SILT with abundant organics (stiff to very stiff, wet)
125	S-43	b2	5	W = 65		- grades with abundant organics
					ML	Gray SILT with thin interbedded sandy SILT (stiff to very stiff, wet)
130	S-44	b2	4	W = 50 AL		
135	S-45	b2	5			
					SM	Dark gray silty, fine SAND (medium dense, wet)
140	S-46	b2	31			**(SOIL UNIT 4)**
					GP-GM	Gray, sandy, GRAVEL with silt (dense, wet)
					ML	Gray SILT with sand and trace wood; massive (very stiff, wet)
145	S-47	b2	12	W = 46 AL		
					SP-SM	Gray, fine SAND with silt (medium dense, wet)
					SP-SM	Gray, very gravelly, fine to coarse SAND with silt (dense, wet)
150	S-48	b2	40			
155	S-49	b2	65	W = 9 GS		- grades very dense
160	S-50	b2	46			- grades dense

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 4

Figure A-5
(4 of 5)

B- 4

SAMPLE DATA					SOIL PROFILE			WELL DETAIL
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 96'; 3.5" below Driller (Lic.#): WSDOT - R. Shepherd (2710) Ground Elevation (ft): 15.1 (MLLW)	

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├─●─┤ Liquid Limit (%)
Nature Moisture Content (%)
0 20 40 60 80

160
165
170
175
180
185
190
195
200

Boring Completed 01/23/06
Total Depth of Boring = 160.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68280
Ecology Well#: AKK-297

Point located at State Plane Coordinates:
North: 615344.86
East: 795555.95
Township: 17N
Range: 10W
Section: 11
Inspector: BEC (Landau Associates)

Completed 01/24/06
Elevation at Top of Casing = 15.92 ft.
Total Depth of = 49.3 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 4

Figure
A-5
(5 of 5)

B- 5

Drilling Method: Mud Rotary
Casing: 4.5" upper 70'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 15.0 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
0	S-1	b2	2		SM	Red-brown silty, fine to medium SAND with roots (loose, wet) **(SOIL UNIT 1)**
	S-2	b2	8	W = 43		- grades very silty, gray
5	S-3	b2	2	W = 47 GS	ML	Gray SILT with sand (medium stiff, wet)
	S-4	b2	4	W = 58 GS		- grades sandy with trace organics
	S-5	b2	3		WD	- no recovery, wood in shoe
10	S-6	b2	0	W = 85	MH	Gray, clayey SILT with trace organics (medium stiff, wet)
	S-7	b2	0			
	S-8	b2	0	W = 69		
15	S-9	b2	0	W = 84 AL		
	S-10	b2	0	W = 70		- grades with organics
	S-11	b2	0		MH	Gray, clayey SILT with interbedded silty, fine SAND (medium stiff, wet)
20	S-12	b2	0	W = 73		
	S-13	b2	0			
	S-14	b2	0	W = 62		
25	S-15	b2	0			
	S-16	b2	0	W = 66		
	S-17	b2	2			- grades with trace shells and organics
30	S-18	b2	0	W = 70		
	S-19	b2	3		SM	Gray silty, SAND with thin interbedded sandy SILT (loose, wet) **(SOIL UNIT 2B)**
	S-20	b2	6	-200=33 W = 39		
35	S-21	b2	2		ML	Gray, sandy SILT with 1/32" to 1/16" thick interbedded silty, fine SAND and trace organics (medium stiff to stiff, wet)
	S-22	b2	0	W = 55		
	S-23	b2	0			
40	S-24	b2	1	-200=32 W = 41	SM	

Moisture Content (%): 85, 84

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 5

Figure A-6
(1 of 4)

B- 5

Drilling Method: Mud Rotary
Casing: 4.5" upper 70'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 15.0 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—— Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
40					SM	Gray silty, fine SAND with thin interbedded SILT (very loose, wet)
					ML	Light-brown SILT with thin interbedded silty, SAND (medium stiff to stiff, wet)
45	S-25	b2	2	W = 63		
50	S-26	b2	3	W = 45		
55	S-27	b2	2	W = 50 AL		- grades trace organics
					SM	Gray silty, fine SAND with trace organics and shells and thin interbedded SILT (loose, wet)
60	S-28	b2	7	W = 38		
65	S-29	b2	7	W = 30 GS		- 1.5' of heave removed from bottom of hole prior to sampling at 64'
70	S-30	b2	11	W = 33		- 1.5' of heave removed from bottom of hole prior to sampling at 69' - grades medium dense
75	S-31	b2	15	W = 35		
80	S-32	b2	8	W = 43		- grades loose

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 5

Figure A-6
(2 of 4)

B- 5

Drilling Method: Mud Rotary
Casing: 4.5" upper 70'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 15.0 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
80					SM	Gray silty, fine SAND with trace organics and shells and thin interbedded SILT (loose, wet)
					ML	Gray SILT with thin interbedded fine SAND and trace shells (stiff to very stiff, wet)
						(SOIL UNIT 3)
85	S-33	b2	4	W = 48	SM	Gray silty, fine SAND with interbedded SILT (loose, wet)
90	S-34	b2	13	W = 34 GS		- grades medium dense
95	S-35A S-35B	b2	4	W = 45 W = 99	MH	Light-brown to gray, clayey SILT with interbedded sand and organics (stiff to very stiff, wet)
100	S-36	b2	4	W = 68		- grades massive
105						
110	S-37	b2	3	W = 70 AL		
115						
120	S-38	b2	3	W = 64		- grades trace organics

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 5

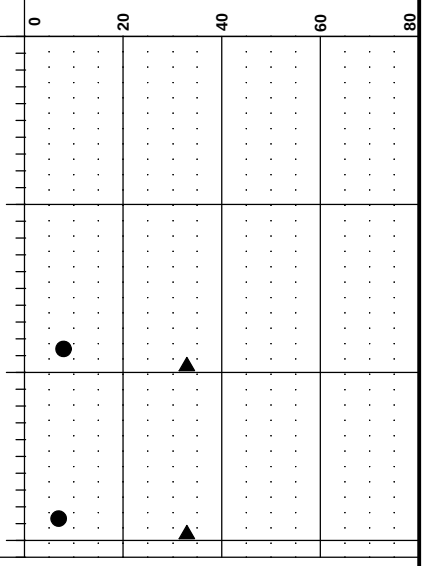
Figure A-6
(3 of 4)

B- 5

SAMPLE DATA					SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 70'; 3.5" below Driller (Lic.#): WSDOT - V. Johnson (2532) Ground Elevation (ft): 15.0 (MLLW)
120						MH	Light-brown to gray, clayey SILT with interbedded sand and organics (stiff to very stiff, wet)
125						GW-GM	Gray, sandy, GRAVEL with silt (dense, wet) **(SOIL UNIT 4)** - drill action indicates SAND from 127.5' to 129'
130	S-39	b2	33	W = 8			
135	S-40	b2	33	W = 7			

WELL DETAIL

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)



Boring Completed 02/01/06
Total Depth of Boring = 135.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68279
Ecology Well#: AKK-298

Point located at State Plane Coordinates:
North: 615672.55
East: 796051.74
Township: 17N
Range: 10W
Section: 11
Inspector: BEC (Landau Associates)

Completed 02/02/06
Elevation at Top of Casing = 16.64 ft.
Total Depth of = 48.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 5

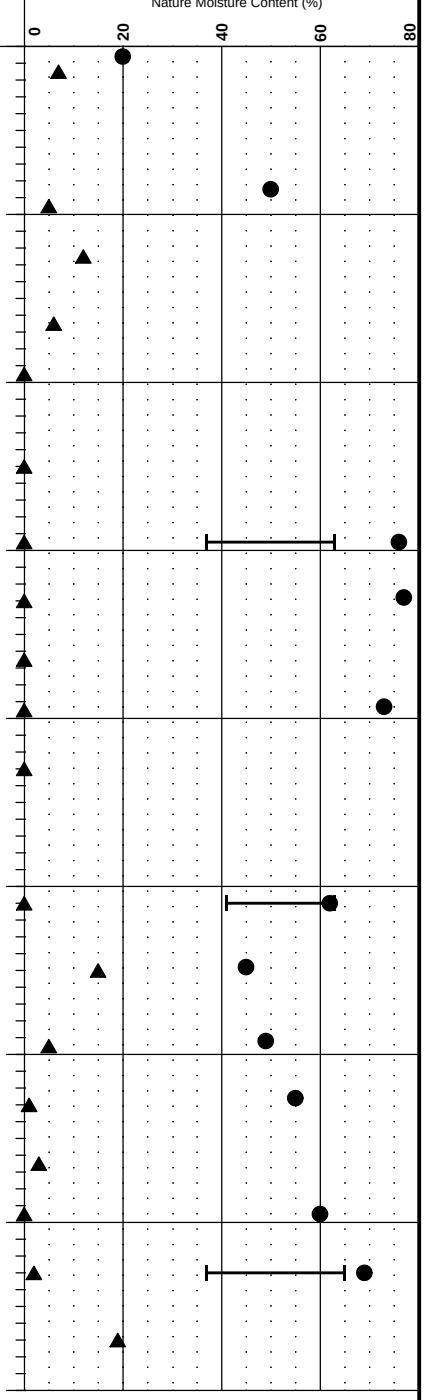
Figure A-6
(4 of 4)

B- 6

Drilling Method: Mud Rotary
Casing: 4.5" upper 96'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 14.5 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
0	S-1A, S-1B	b2	7	PID=0.0 W = 20	SM	Red-brown silty to very silty, fine SAND (loose, moist) **(SOIL UNIT 1)**
	S-2	b2	5	PID=0.0 W = 50		- grades trace shells
5					WD	Wood debris
		b2	12	PID=0.0	ML	Gray to brown SILT with 1" thick interbed of sawdust (medium stiff, wet)
					WD	Wood debris
	S-3	b2	6	PID=0.0		
10	S-4	b2	0	PID=0.0	MH	Dark gray, clayey SILT with organics (medium stiff, wet)
	S-5	b2	0			
15	S-6	b2	0	PID=0.0 W = 76 AL		- grades with sand and trace organics and shells
	S-7	b2	0	PID=0.0 PID=0.0 W = 77		
	S-8	b2	0			
20	S-9	b2	0	W = 73	MH	Dark gray, clayey SILT with sand and organics (medium stiff, wet)
	S-10	b2	0			
	S-11	c3				
25	S-12	b2	0	W = 62 AL		
	S-13	b2	15	W = 45		
					SM	Gray silty, fine SAND with organics and trace shell fragments (medium dense, wet) **(SOIL UNIT 2B)**
30	S-14	b2	5	W = 49		-grades loose
	S-15	b2	1	W = 55	MH	Gray, clayey SILT with sand, shells, and organics (medium stiff to stiff, wet)
	S-16	b2	3			
35	S-17	b2	0	W = 60		
	S-18	b2	2	W = 69 AL		- 1 to 2" thick interbedded silty, fine SAND with trace shells
					SM	Gray silty, fine SAND with trace shells and organic layers (medium dense, wet)
40	S-19	b2	19			

WELL DETAIL



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 6

Figure A-7
(1 of 4)

B- 6

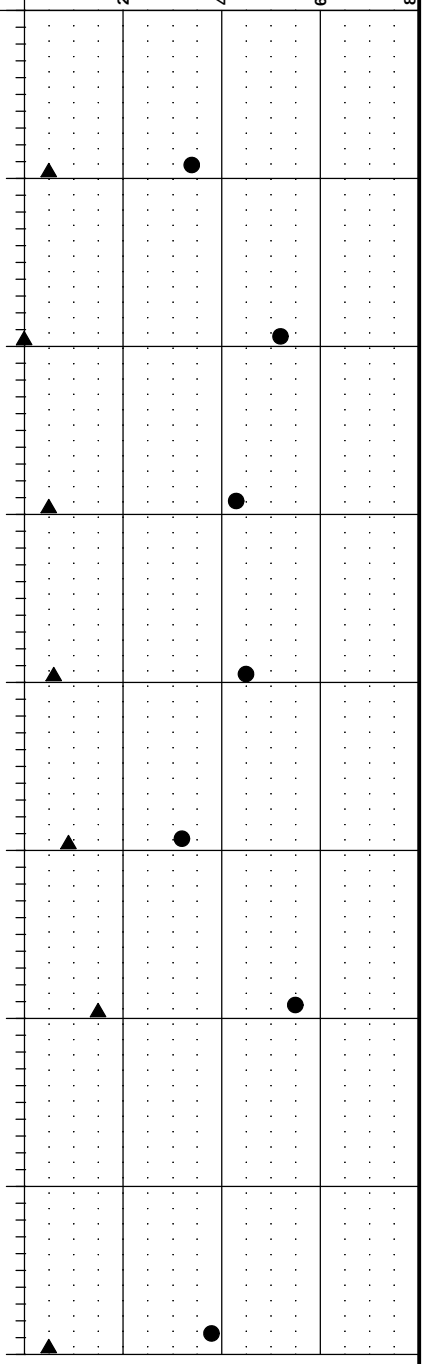
SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4.5" upper 96'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 14.5 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Description
40					SM	Gray silty, fine SAND with trace shells and organic layers (medium dense, wet)
45	S-20	b2	5	W = 34		- 1 to 2" thick interbedded SILT, grades loose
					ML	Gray SILT with trace shell fragments and organics (medium stiff to stiff, wet)
50	S-21	b2	0	W = 52		
					SM	Gray, very silty, fine SAND with 1/4" to 2" thick interbedded SILT (loose, wet)
55	S-22	b2	5	W = 43		
60	S-23	b2	6	W = 45 GS		- 1/32" to 1/16" thick interbedded SILT
65	S-24	b2	9	W = 32		
70	S-25	b2	15	W = 55		- grades medium dense
75						
80	S-26A	b2	5	W = 38		

WELL DETAIL



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 6

Figure A-7
(2 of 4)

B- 6

Drilling Method: Mud Rotary
Casing: 4.5" upper 96'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 14.5 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Moisture Content (%)
80	S-26B			W = 73		ML	Gray SILT with trace organics (stiff to very stiff, wet) **(SOIL UNIT 3)**	
85	S-28	b2	2	W = 52				
90	S-29	b2	5	W = 50 AL				
						ML	Gray SILT with thin interbedded fine sandy SILT (stiff to very stiff, wet)	
95	S-30	c3						
	S-31	b2	5	W = 73		MH	Gray, clayey SILT with sand and organics (stiff to very stiff, wet)	
100	S-32	b2	6	W = 75				
105	S-33	b2	2	W = 57			- grades wet	
110	S-34	b2	4	W = 59 AL				
115	S-35	b2	3	W = 65			- grades with organics	
120	S-36	b2	3	W = 61				

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

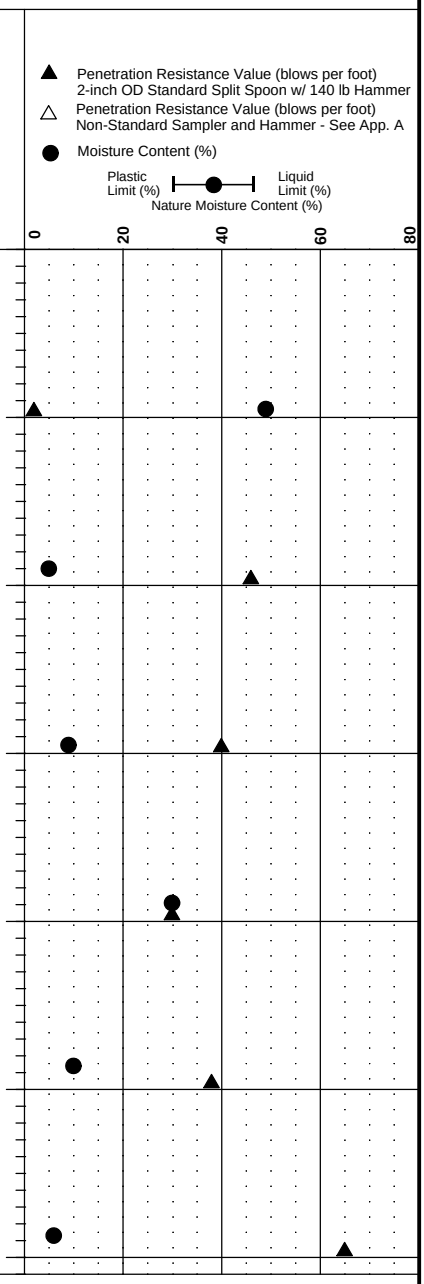
Log of Boring B- 6

Figure A-7 (3 of 4)

B- 6

SAMPLE DATA					SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 96'; 3.5" below Driller (Lic.#): WSDOT - R. Shepherd (2710) Ground Elevation (ft): 14.5 (MLLW)
120						MH	Gray, clayey SILT with sand and organics (stiff to very stiff, wet)
125	S-37	b2	2	W = 49			
130	S-38	b2	46	W = 5		GW-GM	Dark gray, very sandy, GRAVEL with silt (dense, wet) **(SOIL UNIT 4)**
135	S-39	b2	40	W = 9 GS			
140	S-40	b2	30	W = 30		SP-SM	Black, fine SAND with silt and thin interbedded fine to medium sandy, GRAVEL (medium dense to dense, wet)
145	S-41	b2	38	W = 10		GW-GM	Dark gray, very sandy, GRAVEL with silt (dense, wet)
150	S-42	b2	65	W = 6			- grades very dense
155							
160							

WELL DETAIL



Boring Completed 01/20/06
Total Depth of Boring = 150.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68281
Ecology Well#: AKK-299

Point located at State Plane Coordinates:
North: 615420.96
East: 797218.25
Township: 17N
Range: 10W
Section: 11
Inspector: BEC (Landau Associates)

Completed 01/20/06
Elevation at Top of Casing = 15.98 ft.
Total Depth of = 48.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

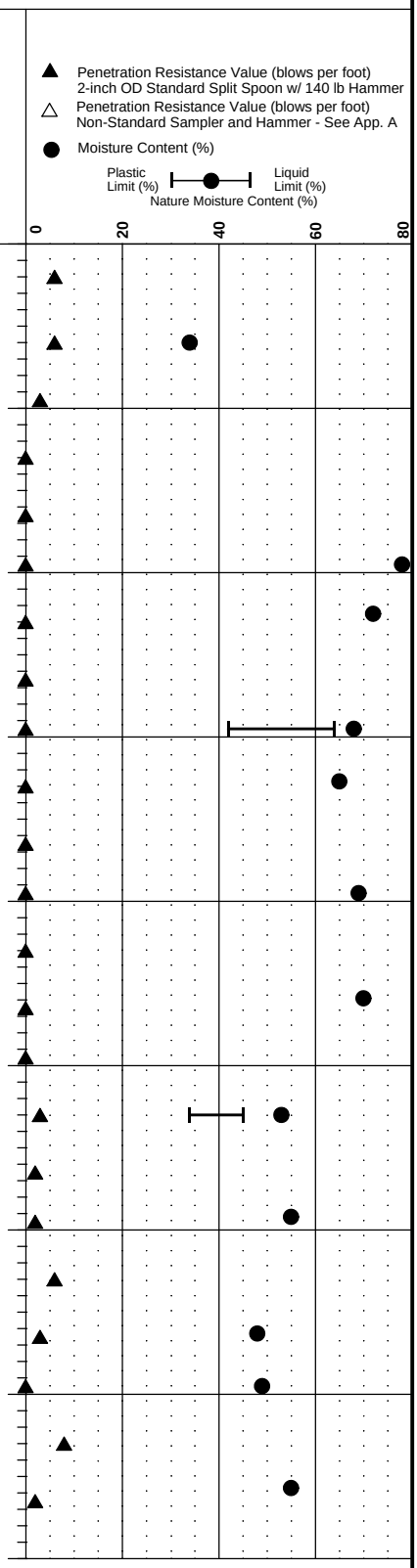
B- 7

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4.5" upper 74'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 13.0 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Description
0	S-1	b2	6		SM	Light brown silty, fine SAND (loose, wet) **(SOIL UNIT 1)**
	S-2	b2	6	W = 34 GS		
5	S-3	b2	3			
	S-4	b2	0			- grades very loose
	S-5	b2	0		ML	Dark gray, sandy SILT (medium stiff, wet)
					MH	Dark gray, clayey SILT with sand (medium stiff, wet)
10	S-6	b2	0	W = 78 GS		
	S-7	b2	0	W = 72		- grades with abundant organics and wood
	S-8	b2	0			
15	S-9	b2	0	W = 68 AL		
	S-10	b2	0	W = 65		
	S-11	b2	0			- grades with interbedded silty, SAND, organics, and wood
20	S-12	b2	0	W = 69		
	S-13	b2	0			
	S-14	b2	0	W = 70		
25	S-15	b2	0			- grades increasing wood
	S-16	b2	3	W = 53 AL	ML	Dark gray SILT with sand and interbedded silty, fine SAND (medium stiff to stiff, wet) **(SOIL UNIT 2B)**
	S-17	b2	2			
30	S-18	b2	2	W = 55		
	S-19	b2	6		ML	Dark gray, very sandy SILT with interbedded silty, SAND (medium stiff to stiff, wet)
	S-20	b2	3	W = 48		
35	S-21	b2	0	W = 49 GS		
	S-22	b2	8		SM	Dark gray, very silty, fine SAND (loose, wet)
	S-23	b2	2	W = 55	ML	Dark gray, very sandy SILT with interbedded silty, SAND (medium stiff to stiff, wet)
40						

WELL DETAIL



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 7

Figure A-8 (1 of 4)

B- 7

Drilling Method: Mud Rotary
Casing: 4.5" upper 74'; 3.5" below
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 13.0 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
40					ML	Dark gray, very sandy SILT with interbedded silty, SAND (medium stiff to stiff, wet)
					ML	Dark gray SILT with sand and trace organics (medium stiff to stiff, wet)
45	S-24	b2	0	W = 48		
50	S-25	b2	0	W = 47 AL		
55	S-26	b2	5	W = 46		- grades with 1/8" to 1/4" thick interbedded fine SAND with silt
					SM	Gray silty, fine SAND with thin interbedded SILT (medium dense, wet)
60	S-27	b2	10	W = 38		
65	S-28	b2	15	W = 36		
70	S-29	b2	11	W = 35 GS		
75	S-30	b2	7	W = 58		
					ML	Gray SILT with sand; massive (stiff to very stiff, wet) **(SOIL UNIT 3)**
80	S-31	b2	3	W = 48		

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

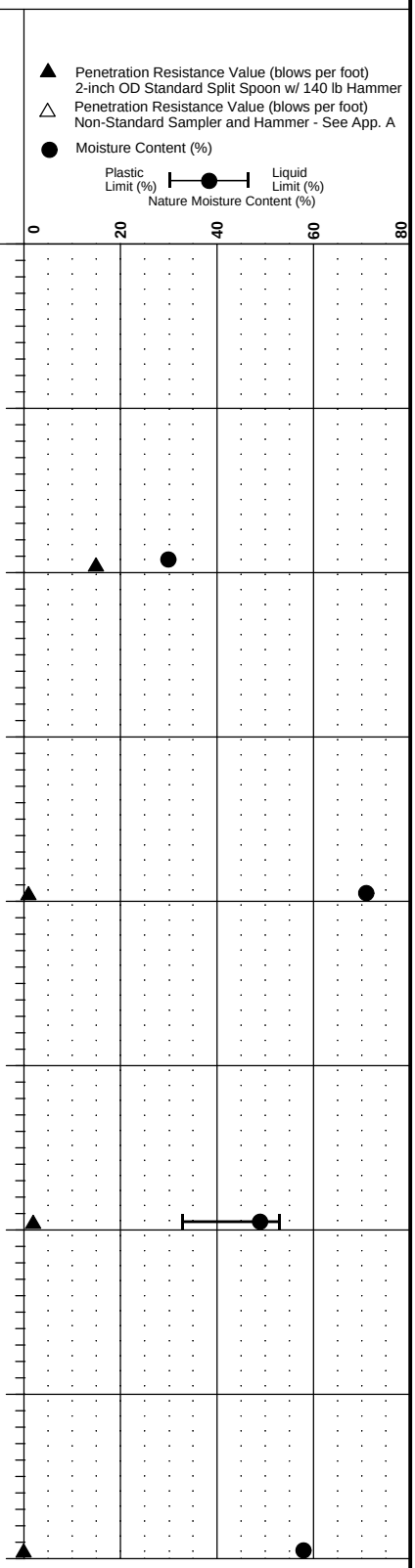
Log of Boring B- 7

Figure A-8
(2 of 4)

B- 7

SAMPLE DATA					SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 74'; 3.5" below Driller (Lic.#): WSDOT - R. Shepherd (2710) Ground Elevation (ft): 13.0 (MLLW)
80						ML	Gray SILT with sand; massive (stiff to very stiff, wet) **(SOIL UNIT 3)**
85						SM	Gray silty, fine SAND with trace interbedded SILT (medium dense, wet)
90	S-32	b2	15	W = 30			
95						MH	Gray, clayey SILT with abundant organics (stiff to very stiff, wet)
100	S-33	b2	1	W = 71			
105							
110	S-34	b2	2	W = 49 AL			- grades trace organics
115							
120	S-35	b2	0	W = 58			

WELL DETAIL



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

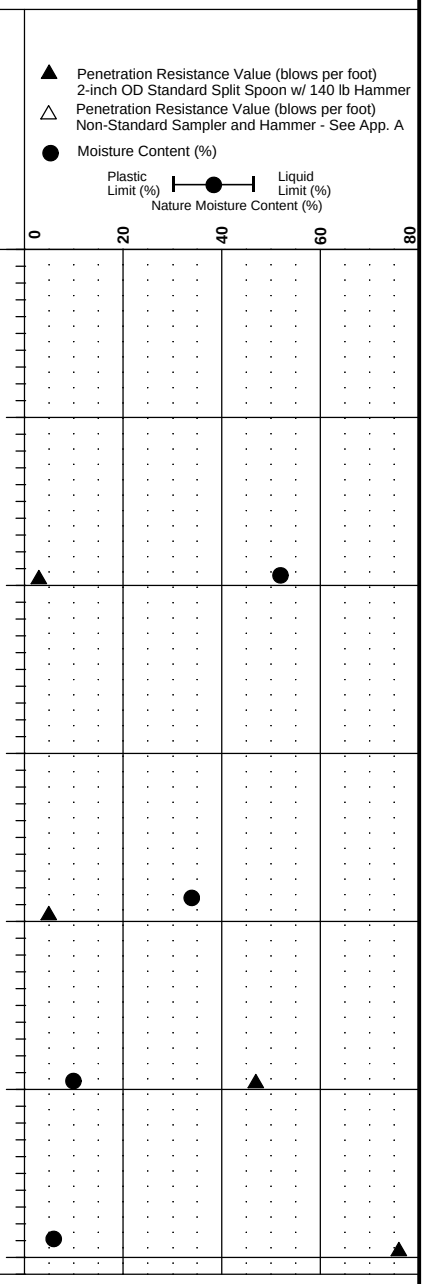
Log of Boring B- 7

Figure A-8
(3 of 4)

B- 7

SAMPLE DATA					SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 74'; 3.5" below Driller (Lic.#): WSDOT - R. Shepherd (2710) Ground Elevation (ft): 13.0 (MLLW)
120						MH	Gray, clayey SILT with abundant organics (stiff to very stiff, wet)
125							
130	S-36	b2	3	W = 52			
135							
140	S-37	b2	5	W = 34		SP-SM	Gray, fine SAND with silt and trace wood debris (loose, wet)
145	S-38	b2	47	W = 10 GS		GW-GM	Gray, very sandy, GRAVEL with silt (dense, wet) **(SOIL UNIT 4)**
150	S-39	b2	76	W = 6			- grades very dense
155							
160							

WELL DETAIL



Boring Completed 02/07/06
Total Depth of Boring = 150.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68282
Ecology Well#: AKK-300

Point located at State Plane Coordinates:
North: 614895.96
East: 796726.40
Township: 17N
Range: 10W
Section: 11
Inspector: BEC (Landau Associates)

Completed 02/07/06
Elevation at Top of Casing = 14.53 ft.
Total Depth of = 40.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 7

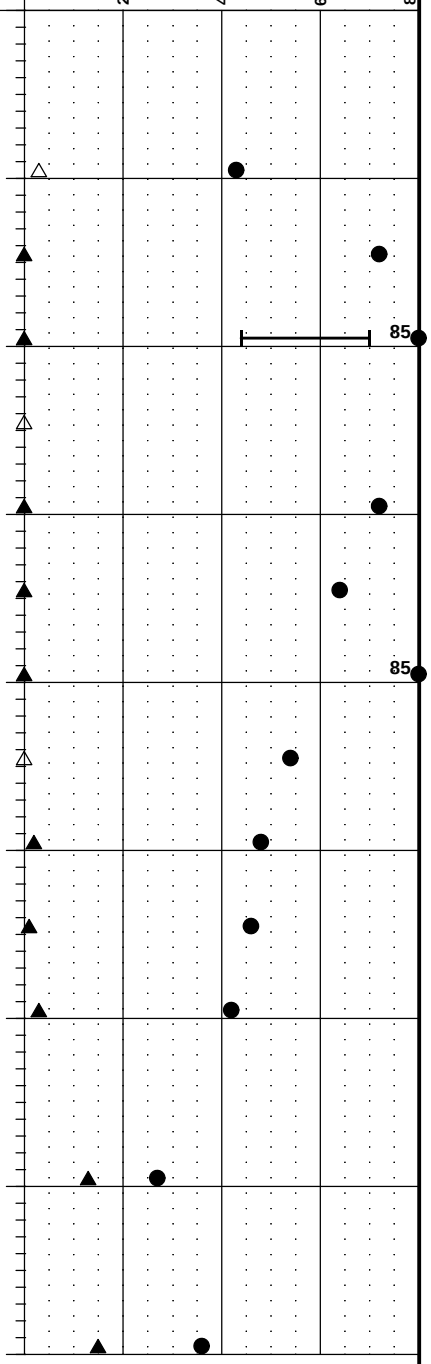
Figure
A-8
(4 of 4)

B- 8

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 12.3 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0						MH	Dark gray, clayey SILT with sand and some organics (very soft/wet) **(SOIL UNIT 1)**	
5	S-1	g2	3	PID=0.0 CA W = 43				▼
	S-2	b2	0	PID=0.0 W = 72				
10	S-3	b2	0	PID=0.0 W = 85 AL				
	S-4	g2	0	PID=0.0 CA				
15	S-5	b2	0	PID=0.0 W = 72				
	S-6	b2	0	PID=0.0 W = 64			- with sandy interbeds	
20	S-7	b2	0	PID=0.0 W = 85				
	S-8	g2	0	PID=0.0 CA W = 54		SM	Dark gray, very silty, fine to medium SAND with organics (very loose, wet) **(SOIL UNIT 2B)**	
25	S-9	b2	2	PID=0.0 W = 48 GS				
	S-10	b2	1	PID=0.0 W = 46				
30	S-11	b2	3	PID=0.0 W = 42		SM	Dark gray silty, fine SAND (very loose to medium dense, wet)	
35	S-12	b2	13	PID=0.0 W = 27				
40	S-13	b2	15	PID=0.0				



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 8

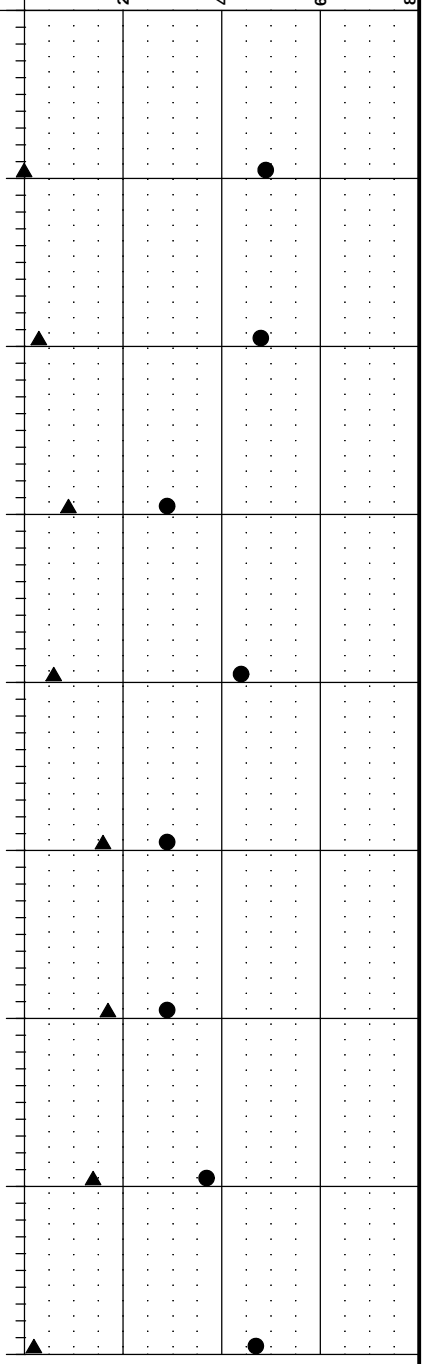
Figure A-9
(1 of 5)

B- 8

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 12.3 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description	Groundwater
40				W = 36	SM	Dark gray silty, fine SAND (very loose to medium dense, wet)	
45	S-14	b2	0	PID=0.0 W = 49 GS	ML	Dark gray, very sandy SILT (very soft, wet)	
50	S-15	b2	3	PID=0.0 W = 48	SM/ ML	Dark gray silty to very silty, fine to medium SAND with thin interbedded silt (very loose to loose and soft, wet)	
55	S-16	b2	9	PID=0.0 W = 29			
60	S-17	b2	6	PID=0.0 W = 44 GS			
65	S-18	b2	16	PID=0.0 W = 29	SP-SM	Dark gray, fine to medium SAND with silt (medium dense, wet)	
70	S-19	b2	17	PID=0.0 W = 29			
75	S-20	b2	14	PID=0.0 W = 37		- becomes silty	
80	S-21	b2	2	PID=0.0	ML	Dark gray SILT (very soft, wet)	



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

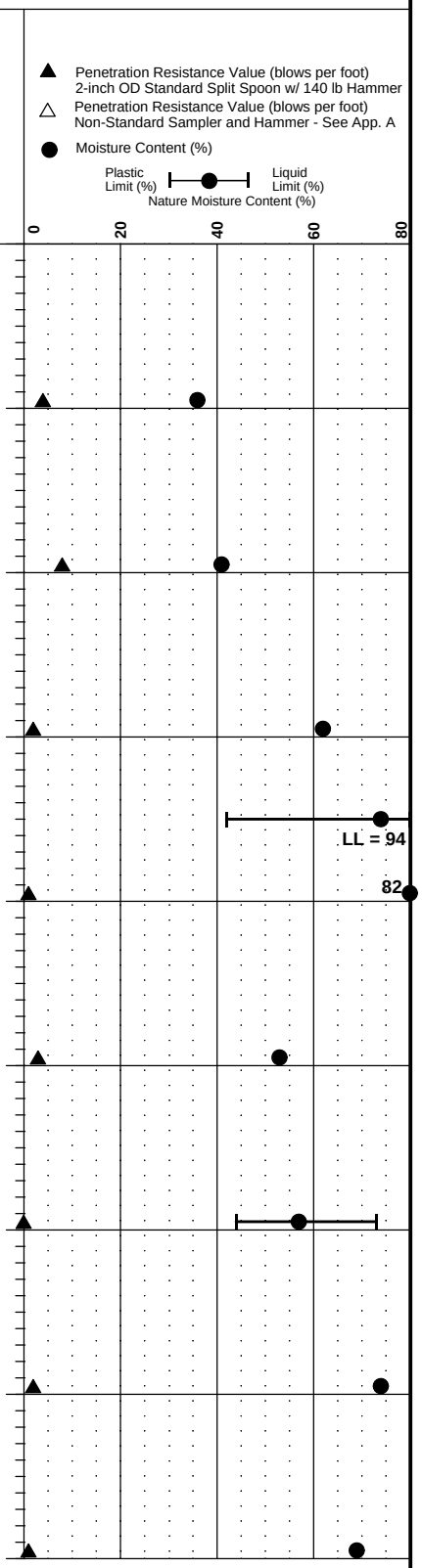
Log of Boring B- 8

Figure A-9
(2 of 5)

B- 8

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 12.3 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
80				W = 47		ML	**(SOIL UNIT 3)** Dark gray SILE (very soft, wet)	
	S-22	c7						
85	S-23	b2	4	PID=0.0 VST W = 36		SM	Dark gray silty, fine SAND with interbedded silt (loose, wet)	
90	S-24	b2	8	PID=0.0 W = 41				
95	S-25	b2	2	PID=0.0 W = 62		MH	Dark gray, clayey SILT with sand to trace sand and abundant organics (very soft to soft, wet)	
	S-26	c7		GT W = 74 AL				
100	S-27	b2	1	PID=0.0 VST W = 82				
105	S-28	b2	3	PID=0.0 W = 53			- with trace organics	
110	S-29	b2	0	PID=0.0 W = 57 AL			- with trace organics	
115	S-30	b2	2	PID=0.0 W = 74			- with trace organics	
120	S-31	b2	1	PID=0.0				



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

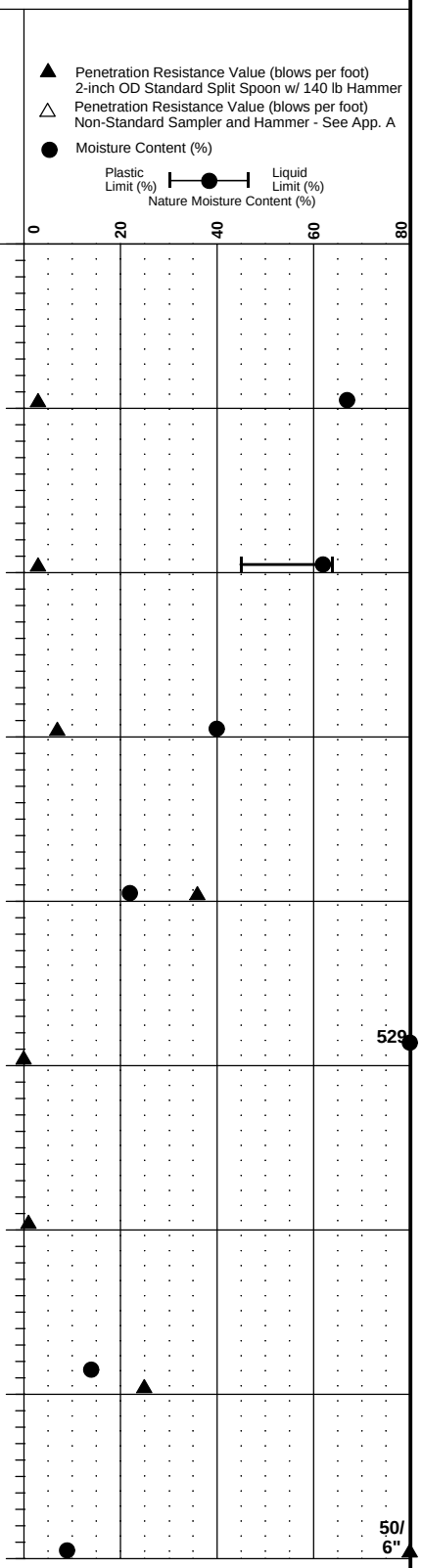
Log of Boring B- 8

Figure A-9
(3 of 5)

B- 8

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 12.3 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description	Groundwater
120				W = 69	MH	Dark gray, clayey SILT with sand to trace sand and abundant organics (very soft to soft, wet)	
125	S-32	b2	3	PID=0.0 W = 67			
130	S-33	b2	3	PID=0.0 W = 62 AL		- with trace organics	
135	S-34	b2	7	PID=0.0 W = 40	SP	Dark gray to gray, fine to medium SAND with trace silt and trace gravel (loose to dense, wet) **(SOIL UNIT 4)**	
140	S-35	b2	36	PID=0.0 W = 22			
145	S-36	b2	0	PID=0.0 W = 529	WD	Brown, decomposed WOOD (very loose, wet)	
150	S-37	b2	1	PID=0.0			
155	S-38	b2	25	PID=0.0 W = 14	GP	Gray, fine to coarse GRAVEL with sand (loose to very dense, wet)	
160	S-39	b2	50/	PID=0.0			



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

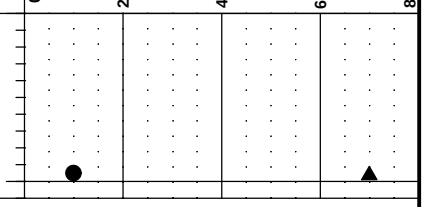
Log of Boring B- 8

Figure A-9
(4 of 5)

B- 8

SAMPLE DATA					SOIL PROFILE			
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 99'; 3.5" below Driller (Lic.#): WSDOT - D. Henderson (2742) Ground Elevation (ft): 12.3 (MLLW)	Groundwater
160			6"	W = 9		GP	Gray, fine to coarse GRAVEL with sand (loose to very dense, wet)	
165	S-40	b2	70	PID=0.0 W = 10				

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)



Boring Completed 07/20/06
Total Depth of Boring = 165.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: NA

Point located at State Plane Coordinates:
North: 615152.18
East: 796845.08
Township: 17N
Range: 10W
Section: 11
Inspector: JJB & BAB

170
175
180
185
190
195
200

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 8

Figure
A-9
(5 of 5)

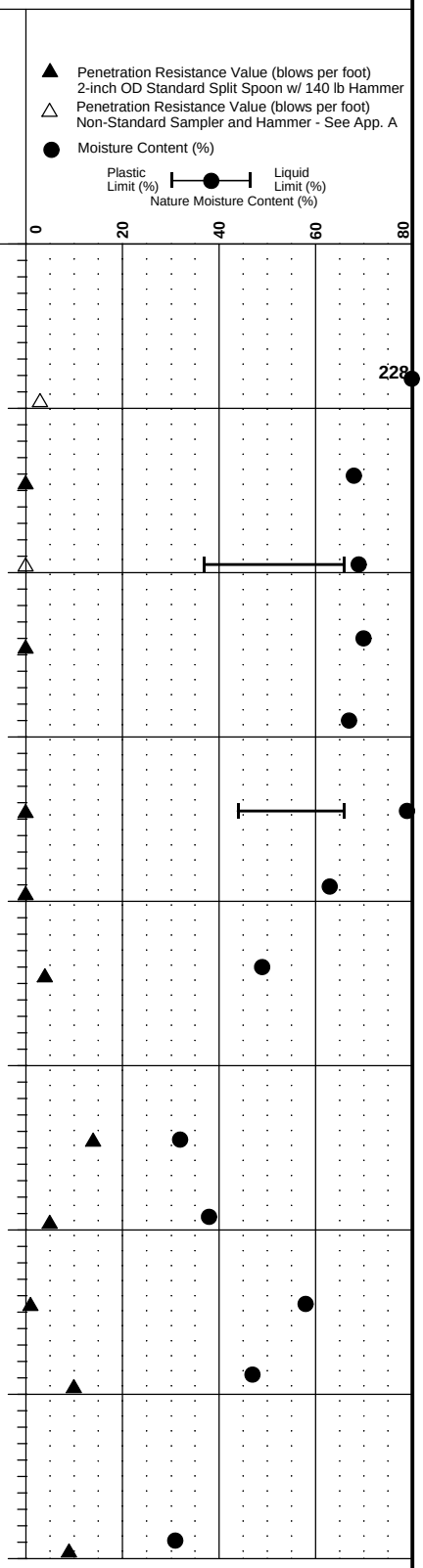
B- 9

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.1 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
0						SM/ ML	Dark gray to brown, very silty, fine SAND to very sandy SILT (loose and soft, moist to wet) **(SOIL UNIT 1)**
						WD	Dark brown to black decomposed WOOD debris (soft, wet)
5	S-1	g2	3	PID=0.0 W = 228			
	S-2	b2	0	PID=0.0 W = 68		MH	Gray to dark gray, clayey SILT with trace sand and fine organics (very soft, wet)
10	S-3	g2	0	PID=0.0 CA W = 69 AL			
	S-4	b2	0	PID=0.0 W = 70			- becomes interbedded with very silty, fine SAND and trace wood
15	S-5	g2		W = 67			
	S-6	b2	0	PID=0.0 CA W = 79 AL			
20	S-7	b2	0	PID=0.0 W = 63			
	S-8	b2	4	PID=0.0 W = 49		SM/ ML	Gray to dark gray, very silty, fine SAND to very sandy SILT with interbedded SILT and fine organics (very loose to medium dense, wet) **(SOIL UNIT 2B)**
25	S-9	c3					
	S-10	b2	14	PID=0.0 VST W = 32			
30	S-11	b2	5	PID=0.0 W = 38			
	S-12	b2	1	PID=0.0 W = 58 GS			
35	S-13	b2	10	PID=0.0 W = 47			- with shell fragments
40	S-14	b2	9	PID=0.0 W = 31			

WELL DETAIL



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 9

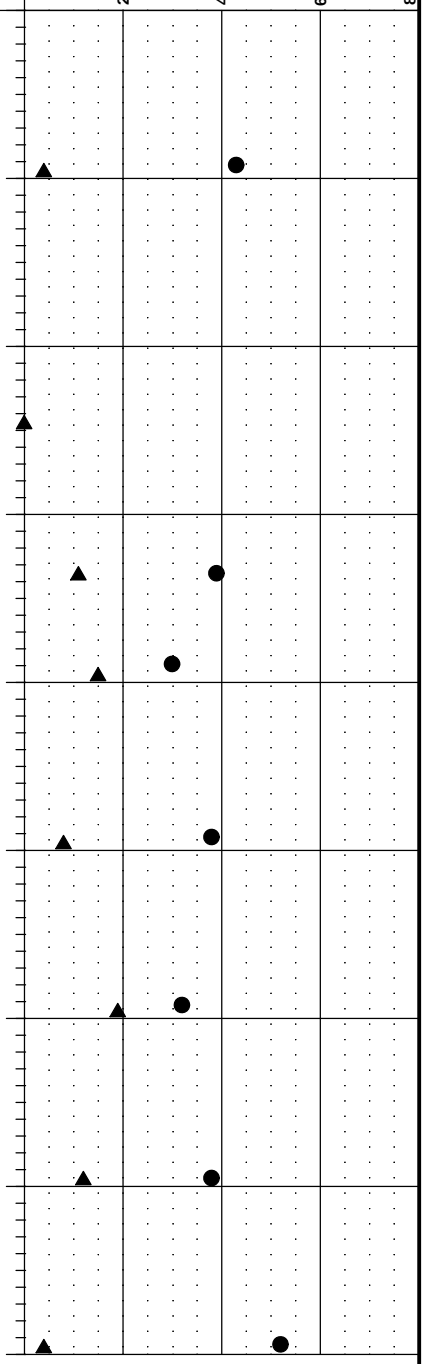
Figure A-10
(1 of 4)

B- 9

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.1 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description	Well Detail
40						SM/ ML	Gray to dark gray, very silty, fine SAND to very sandy SILT with interbedded SILT and fine organics (very loose to medium dense, wet) **(SOIL UNIT 2B)**	
45	S-15	b2	4	PID=0.0 W = 43				
50	S-16	c3						
	S-17	b2	0	PID=0.0 VST		ML	Gray SILT with interbedded silty, fine SAND to fine SAND with silt	
55								
	S-18	b2	11	PID=0.0 W = 39 GS		SM	Gray to dark gray, silty, fine SAND with interbedded SILT and fine organics (very loose to medium dense, wet)	
60	S-19	b2	15	PID=0.0 W = 30				
65	S-20	b2	8	PID=0.0 W = 38				
70	S-21	b2	19	PID=0.0 W = 32				
75	S-22	b2	12	PID=0.0 W = 38 GS				
80	S-23	b2	4	PID=0.0		ML		



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 9

Figure A-10
(2 of 4)

B- 9

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.1 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
80				W = 52	ML	Gray to light brown interbedded SILT and silty, fine SAND with zones of fine organics (soft to medium stiff, wet) **(SOIL UNIT 3)**
85	S-24	b2	7	PID=0.0 W = 48	SP-SM	Light brown and gray, fine SAND with silt and thin interbedded SILT (loose, wet)
90	S-25	b2	6	PID=0.0 W = 44	ML	Gray to light brown SILT with interbedded fine sandy SILT and trace organics (medium stiff, wet)
95	S-26	b2	1	PID=0.0 W = 61	MH	Light brown to gray SILT with scattered fine organics (very soft, wet)
100	S-27	c7		GT W = 59 AL		
	S-28	b2	2	PID=0.0 VST W = 51 AL		
105	S-29	b2	3	PID=0.0 W = 51		
110	S-30	b2	4	PID=0.0 W = 54		
115	S-31	b2	3	PID=0.0 W = 67		
120	S-32	b2	4	PID=0.0		

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B- 9

Figure A-10
(3 of 4)

B- 9

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.1 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
120				W = 76	MH	Light brown to gray SILT with scattered fine organics (very soft, wet) - becomes laminated
125	S-33	b2	3	PID=0.0 W = 55		
130	S-34	b2	40	PID=0.0 W = 8	GP-GM	Gray, sandy GRAVEL with silt and coarse sand (dense, wet) **(SOIL UNIT 4)**
135	S-35	b2	37	PID=0.0 W = 8 GS	SP-SM	Gray, very gravelly, fine to coarse SAND (dense, wet)
140	S-36	b2	23	PID=0.0 W = 9	GP-GM	Gray, sandy GRAVEL with silt and trace organics (medium dense to dense, wet)
145	S-37	b2	15	PID=0.0 W = 5		
150	S-38	b2	49	PID=0.0 W = 10		
155						
160						

Boring Completed 07/18/06
Total Depth of Boring = 150.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: ALP-751

Point located at State Plane Coordinates:
North: 615509.29
East: 796821.82
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

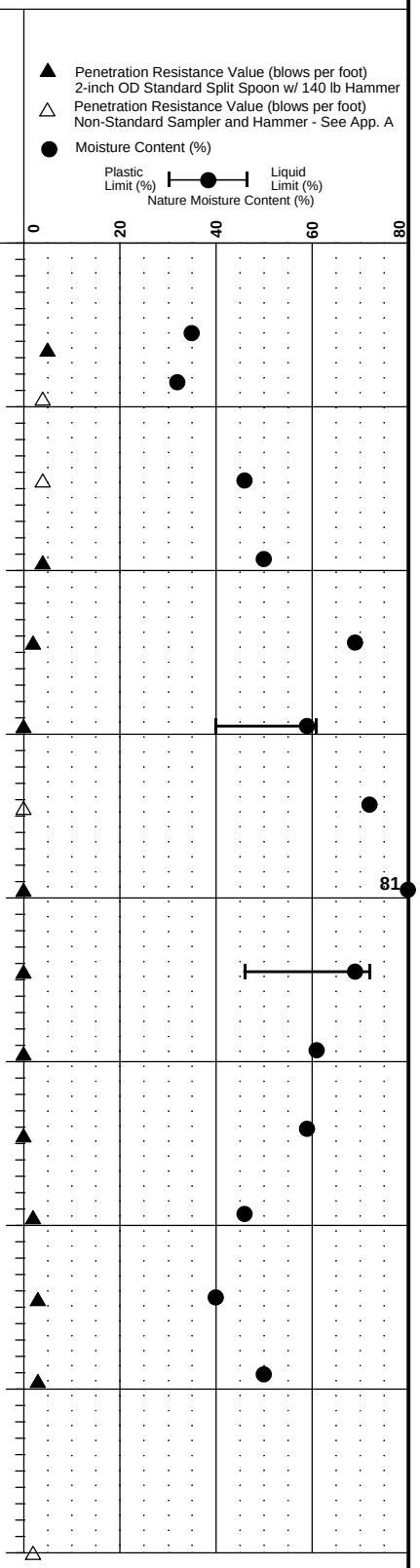
Log of Boring B- 9

Figure A-10
(4 of 4)

B-10

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 14.6 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0						SP	Gray, fine SAND with silt, wood, and some fine organics (loose, moist to wet) **(SOIL UNIT 1)**	
	S-1	b2	5	PID=0.0 W = 35				
	S-2	g2	4	PID=0.0 CA W = 32				▼
	S-3	g2	4	PID=0.0 CA W = 46 GS				
							- thin interbedded fine organics and trace wood	
10	S-4	b2	4	PID=0.0 W = 50				
						MH	Dark gray to gray, clayey SILT with trace organics (very soft to soft, wet)	
	S-5	b2	2	PID=0.0 W = 69				
15	S-6	b2	0	PID=0.0 W = 59 AL				
	S-7	g2	0	PID=0.0 CA W = 72				
20	S-8	b2	0	PID=0.0 W = 81				
	S-9	b2	0	PID=0.0 W = 69 AL				
25	S-10	b2	0	PID=0.0 W = 61			- with trace shells	
	S-11	b2	0	PID=0.0 W = 59				
30	S-12	b2	2	PID=0.0 W = 46		SM/ ML	Gray silty to very silty, fine SAND with interbedded sandy SILT to SILT (very loose to soft, wet) **(SOIL UNIT 2B)**	
	S-13	b2	3	PID=0.0 W = 40			- with some shells	
35	S-14	b2	3	PID=0.0 W = 50			- with decomposed wood and some shells	
40						SM	Gray, fine SAND with silt and trace very thin lamination of sandy SILT (very loose, wet)	



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-10

Figure A-11
(1 of 5)

B-10

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 14.6 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—— Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater
40	S-15	c3	2			SM	Gray, fine SAND with silt and trace very thin lamination of sandy SILT (very loose, wet)	
						SM/ ML	Gray silty, fine SAND with some shells and interbedded sandy SILT with trace organics (loose, wet)	
45	S-16	b2	3	PID=0.0 W = 38 GS				
						SP/ ML	Gray, fine SAND with silt and occasional very thin interbedded light brown SILT (loose, wet)	
50	S-17	b2	5	PID=0.0 W = 48				
						ML	Gray, sandy SILT (soft, wet)	
55	S-18	c3				SP-SM	Gray, fine SAND with silt to trace silt (loose to medium dense, wet)	
							- occasional very thin interbedded brown SILT	
60	S-19	b2	8	PID=0.0 W = 37				
65	S-20	b2	10	PID=0.0 W = 44 GS			- trace shells	
70	S-21	b2	8	PID=0.0 W = 31				
						MH	Light brown, clayey SILT with interbedded silty, fine SAND and occasional thin interbedded fine organics (very soft to soft, wet)	
75	S-22	b2	3	PID=0.0 W = 62				
80	S-23	b2	0	PID=0.0 W = 54				

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-10

Figure A-11
(2 of 5)

B-10

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 14.6 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description	Groundwater
80				AL	MH		
					ML	Light brown to gray, clayey SILT with trace sand (soft to medium stiff, wet) **(SOIL UNIT 3)**	
85	S-24	b2	4	PID=0.0 W = 47			
					SM	Gray silty, fine SAND with thin interbedded light brown to gray, SILT and thin interbedded fine organics (loose, wet)	
90	S-25	b2	8	PID=0.0 W = 41			
95	S-26	b2	6	PID=0.0 W = 47		- trace wood fragments	
					MH	Light brown to gray, clayey SILT with scattered fine organics (very soft to soft, wet)	
100	S-27	b2	2	PID=0.0 W = 61			
105	S-28	c3		GT VST W = 53 AL			
110	S-29	b2	2	PID=0.0 W = 60			
115	S-30	b2	3	PID=0.0 W = 77		- scattered fine organics and trace interbedded fine organics	
120	S-31	b2	0	PID=0.0			

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-10

Figure A-11
(3 of 5)

B-10

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 14.6 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
120				W = 54	MH	Light brown to gray, clayey SILT with scattered fine organics (very soft to soft, wet)
125	S-32	b2	1	PID=0.0 W = 70		
130	S-33	b2	2	PID=0.0 W = 59		- trace shells
135	S-34	b2	7	PID=0.0 W = 33	SM	Gray silty to very silty, fine SAND with interbedded SILT with sand (loose, wet)
140	S-35	b2	3	PID=0.0 W = 36	ML	Light brown, sandy SILT with thin interbedded silty, fine SAND (soft, very loose, wet)
145	S-36	b2	76	PID=0.0	GP-GM	Light brown, sandy GRAVEL with silt (very dense, wet) **(SOIL UNIT 4)**
150	S-37	b2	39	PID=0.0 W = 9 GS	GP	Gray, very sandy (medium to coarse), GRAVEL with trace silt (dense, wet)
155	S-38	b2	33	PID=0.0 W = 11	GP-GM	Gray, sandy to very sandy, GRAVEL with silt to trace silt (dense to very dense, wet)
160	S-39	b2	83	PID=0.0		- with sand and trace silt

Groundwater

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

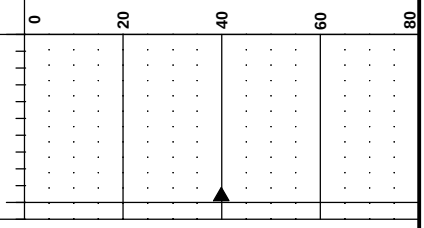
Log of Boring B-10

Figure A-11
(4 of 5)

B-10

SAMPLE DATA					SOIL PROFILE			
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 99'; 3.5" below Driller (Lic.#): WSDOT - V. Johnson (2532) Ground Elevation (ft): 14.6 (MLLW)	Groundwater
160						GP	Gray, sandy, medium to coarse GRAVEL (dense, wet)	
165	S-40	b2	40	PID=0.0				

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)



Boring Completed 07/05/06
Total Depth of Boring = 165.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: NA

Point located at State Plane Coordinates:
North: 615083.21
East: 795865.83
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

170
175
180
185
190
195
200

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-10

Figure
A-11
(5 of 5)

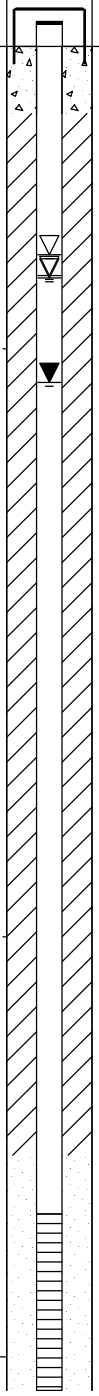
B-11

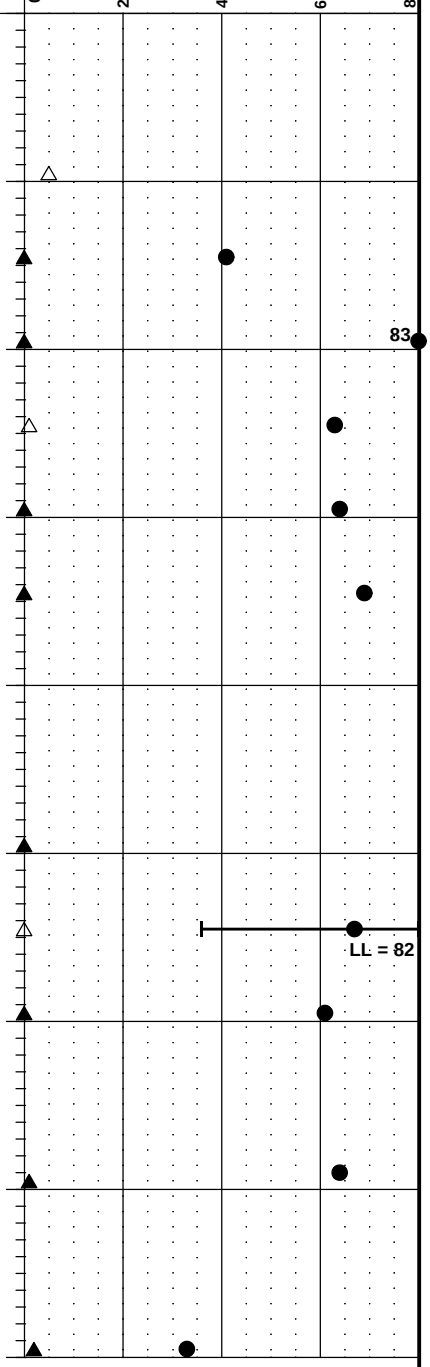
Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 14.55 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
0					SM/ ML	Dark gray silty, fine to medium SAND with organics (very loose to loose, wet) **(SOIL UNIT 1)**
5	S-1	g2	5	PID=0.0 CA		
	S-2	b2	0	PID=0.0 W = 41		
10	S-3	b2	0	PID=0.0 W = 83 GS	MH	Dark gray SILT with sand and organics (very soft, wet)
	S-4	g2	1	PID=0.0 CA W = 63		
15	S-5	b2	0	PID=0.0 W = 64		
	S-6	b2	0	PID=0.0 W = 69		
20						
	S-7	c3				
25	S-7B	b2	0	PID=0.0 VST		
	S-8	g2	0	PID=0.0 W = 67 AL	CH	Dark gray silty CLAY with interbedded fine SAND, shells, and fine organics (very soft, wet)
30	S-9	b2	0	PID=0.0 W = 61		
35	S-10	b2	1	PID=0.0 W = 64		- with shell fragments
40	S-11	b2	2	PID=0.0		

WELL DETAIL





Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-11

Figure A-12
(1 of 5)

B-11

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 14.55 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
40				W = 33	SM/ ML	Dark gray silty, fine SAND with interbedded sandy SILT with shell fragments (very loose to medium dense, wet) **(SOIL UNIT 2B)**
45	S-12	b2	3	PID=0.0 W = 34 GS		
50	S-13	b2	0	PID=0.0 W = 53		
55	S-14	b2	18	PID=0.0 W = 32		- with interbedded SILT
60	S-15	b2	9	PID=0.0 W = 35	SP-SM	Dark gray silty, fine SAND with organics (very loose to loose, wet)
65	S-16	b2	5	PID=0.0 W = 39		
70	S-17	b2	9	PID=0.0 W = 32 GS		
75	S-18	b2	3	PID=0.0 W = 27		
80	S-19	b2	0	PID=0.0 W = 46		

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-11

Figure A-12
(2 of 5)

B-11

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 14.55 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Moisture Content (%)
80						SM/ ML	Dark gray, very silty, fine SAND with scattered organics and interbedded sandy SILT (loose to medium dense, wet) **(SOIL UNIT 3)**	
85	S-20	c7		W = 24				
	S-21	b2	6	PID=0.0 VST				
90	S-22	b2	6	PID=0.0 W = 40 GS				
95	S-23	b2	15	PID=0.0 W = 38				
100	S-24	b2	2	PID=0.0 W = 61 AL		MH	Dark gray, clayey SILT with scattered fine organics (very soft to medium stiff, wet)	
105	S-25	b2	3	PID=0.0 W = 59				
110	S-26	b2	2	PID=0.0 W = 51				
115	S-27	b2	2	PID=0.0 W = 56				
120	S-28	b2	2	PID=0.0				

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

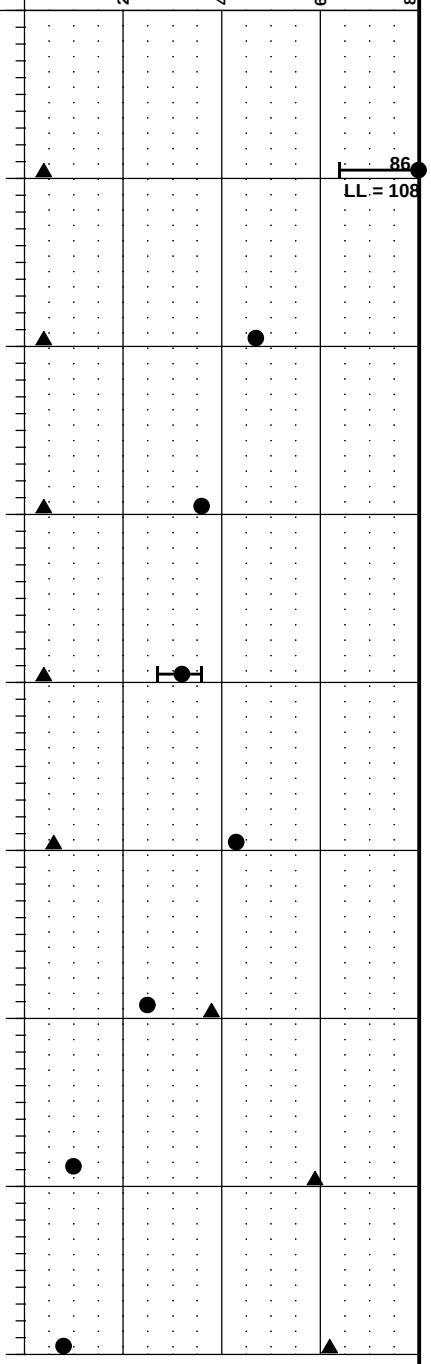
Log of Boring B-11

Figure A-12
(3 of 5)

B-11

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 14.55 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
120				W = 58	MH	Dark gray, clayey SILT with scattered fine organics (very soft to medium stiff, wet)
125	S-29	b2	4	PID=0.0 W = 86 AL		
130	S-30	b2	4	PID=0.0 W = 47		
135	S-31	b2	4	PID=0.0 W = 36		- becomes interbedded with to medium SAND
140	S-32	b2	4	PID=0.0 W = 32 AL	ML	Dark gray SILT with scattered organics (soft to medium stiff, wet)
145	S-33	b2	6	PID=0.0 W = 43		- approximately 6" of decomposed wood
150	S-34	b2	38	PID=0.0 W = 25	SP	Dark gray, fine to medium SAND (dense, wet)
						(SOIL UNIT 4)
					GP/ SP	Dark gray to gray, very sandy, fine to coarse GRAVEL (dense to very dense, wet)
155	S-35	b2	59	PID=0.0 W = 10		
160	S-36	b2	62	PID=0.0 W = 8		



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

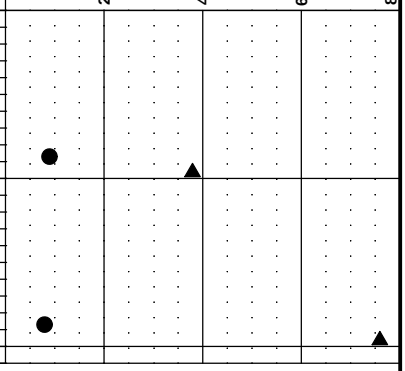
Log of Boring B-11

Figure A-12
(4 of 5)

B-11

SAMPLE DATA					SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 99'; 3.5" below Driller (Lic.#): WSDOT - D. Henderson (2742) Ground Elevation (ft): 14.55 (MLLW)
160				GS		GP/ SP	Dark gray to gray, very sandy, fine to coarse GRAVEL (dense to very dense, wet)
165	S-37	b2	38	PID=0.0 W = 9			
170	S-38	b2	76	PID=0.0 W = 8			- becomes silty

WELL DETAIL



Boring Completed 07/18/06
Total Depth of Boring = 170.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: ALP-752

Point located at State Plane Coordinates:
North: 615072.14
East: 796183.26
Township: 17N
Range: 10W
Section: 11
Inspector: JJB

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-11

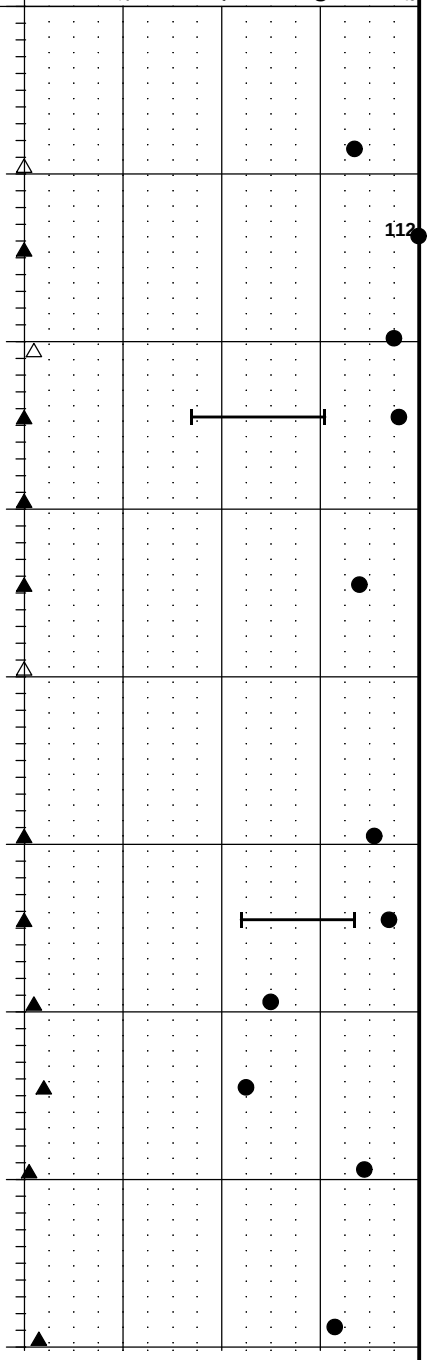
Figure
A-12
(5 of 5)

B-12

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.8 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%) — Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater
0						ML	Gray, sandy SILT with some wood (very soft, wet) **(SOIL UNIT 1)**	
5	S-1	g2	0	PID=0.0 CA W = 67				
	S-2	b2	0	PID=0.0 W = 112		ML	Gray to light brown SILT with some fine organics (very soft to soft, wet)	
10	S-3	g2	2	PID=0.0 CA W = 75				
	S-4	b2	0	PID=0.0 W = 76 AL		MH	Dark gray to black, clayey SILT with trace shells and fine organics (very soft, wet)	
15	S-5	b2	0	PID=0.0			- becoming gray	
	S-6	b2	0	PID=0.0 W = 68			- with interbedded SILT with sand	
20	S-7	g2	0	PID=0.0 CA				
	S-8	c3				ML	Gray SILT with trace fine organics (very soft, wet)	
25	S-9	b2	0	PID=0.0 VST W = 71				
	S-10	b2	0	PID=0.0 W = 74 AL		MH	Gray to light brown, clayey SILT with trace wood (very soft, wet)	
30	S-11	b2	2	PID=0.0 W = 50		SM/ ML	Gray to dark gray, sandy SILT to SILT with sand and interbedded SILT with some fine organics and wood (soft, wet) **(SOIL UNIT 2B)**	
	S-12	b2	4	PID=0.0 W = 45 GS		SM/ ML	Gray to light brown, very silty, fine SAND with interbedded sandy SILT to SILT with some shells, and organics (very loose to loose and very soft to soft, wet)	
35	S-13	b2	1	PID=0.0 W = 69		SM/ ML	Gray to light brown SILT with interbedded silty, fine SAND to fine SAND with silt, trace shells, and fine organics (soft and very loose, wet)	
40	S-14	b2	3	PID=0.0 W = 63			- with interbedded SILT and SAND and trace shells	



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-12

Figure A-13
(1 of 4)

B-12

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.8 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater
						SM/ ML	Gray to light brown SILT with interbedded silty, fine SAND to fine SAND with silt, trace shells, and fine organics (soft and very loose, wet)	
45	S-15	b2	5	PID=0.0 W = 48			- interbedded fine SAND	
						SP-SM	Gray, fine SAND with trace silt (very loose, wet)	
50	S-16	c3						
	S-17	b2	2	PID=0.0 VST W = 34			- with silt	
55	S-18	b2	3	PID=0.0 W = 50			- with thin interbedded SILT and trace interbedded fine organics	
						SP-SM	Gray, fine SAND with silt to trace silt and thin interbedded light brown SILT and trace small wood (loose to medium dense, wet)	
60	S-19	b2	9	PID=0.0 W = 40				
65	S-20	b2	7	PID=0.0 W = 40			- trace thin laminated fine organics	
70	S-21	b2	11	PID=0.0 W = 33 GS			- becomes silty with trace thin laminated fine organics	
						SP/ ML	Light brown SILT with thin interbedded fine SAND with trace silt to with silt, and trace thin lamination of fine organics, and fine shells (loose and medium stiff, wet)	
75	S-22	b2	5	PID=0.0 W = 55				
						SM/ ML	Gray to light brown, fine SAND with silt to trace silt and thin interbedded SILT, trace wood, shells, and fine organics	
80	S-23	b2	5	PID=0.0				

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-12

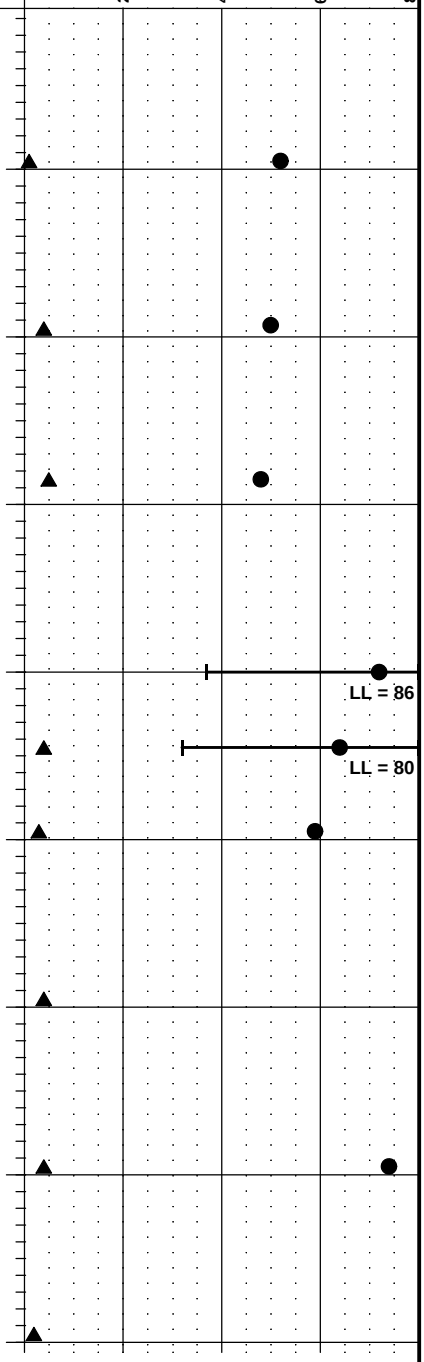
Figure A-13
(2 of 4)

B-12

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.8 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description	Groundwater
					SM/ ML	Gray to light brown, fine SAND with silt to trace silt and thin interbedded SILT, trace wood, shells, and fine organics	
					MH	Gray, clayey SILT with trace sand (very soft, wet) **(SOIL UNIT 3)**	
85	S-24	b2	1	PID=0.0 W = 52			
					ML	Gray, sandy SILT with thin interbedded silty to very silty, fine SAND (soft to medium stiff, wet)	
90	S-25	b2	4	PID=0.0 W = 50			
	S-26A	b2	5	PID=0.0 W = 48		- with some thin lamination of fine organics	
95	S-26B	b2		PID=0.0	CH	Light brown, silty CLAY with scattered fine organics (soft to medium stiff, wet)	
100	S-27	c3		GT W = 72 AL			
	S-28	b2	4	PID=0.0 VST W = 64 AL			
105	S-29	b2	3	PID=0.0 W = 59			
					MH	Light brown, clayey SILT with scattered organics and trace decomposed wood (soft, wet)	
110	S-30	b2	4	PID=0.0			
115	S-31	b2	4	PID=0.0 W = 74			
120	S-32	b2	2	PID=0.0			



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-12

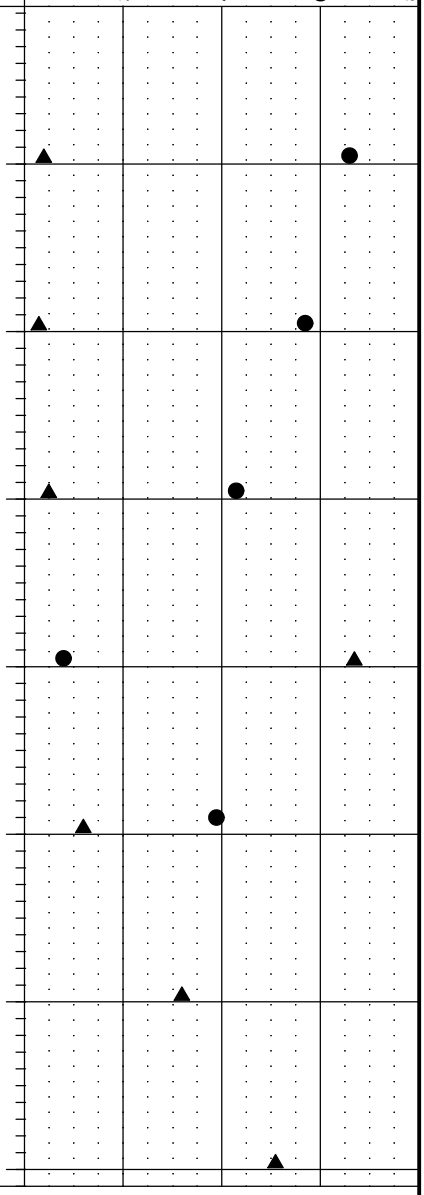
Figure A-13
(3 of 4)

B-12

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.8 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
						MH		
						MH	Light brown SILT with scattered fine organics, and trace shell fragments (soft to medium stiff, wet)	
125	S-33	b2	4	PID=0.0 W = 66				
130	S-34	b2	3	PID=0.0 W = 57				
						SM/ ML	Gray, silty to very silty, fine SAND and interbedded fine sandy SILT with trace organics (loose and medium stiff, wet)	
135	S-35	b2	5	PID=0.0 W = 43				
						GP	Gray, very sandy GRAVEL with trace silt (very dense, wet) **(SOIL UNIT 4)**	
140	S-36	b2	67	PID=0.0 W = 8 GS				
						SP-SM	Gray, fine SAND with silt and trace organics (medium dense, wet)	
145	S-37	b2	12	PID=0.0 W = 39				
						GP	Gray, sandy GRAVEL (dense to very dense, wet)	
150	S-38	b2	32	PID=0.0			- Gravelly SAND	
155	S-39	b2	51	PID=0.0				
160								



Boring Completed 07/11/06
Total Depth of Boring = 155.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: NA

Point located at State Plane Coordinates:
North: 615340.75
East: 796147.04
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

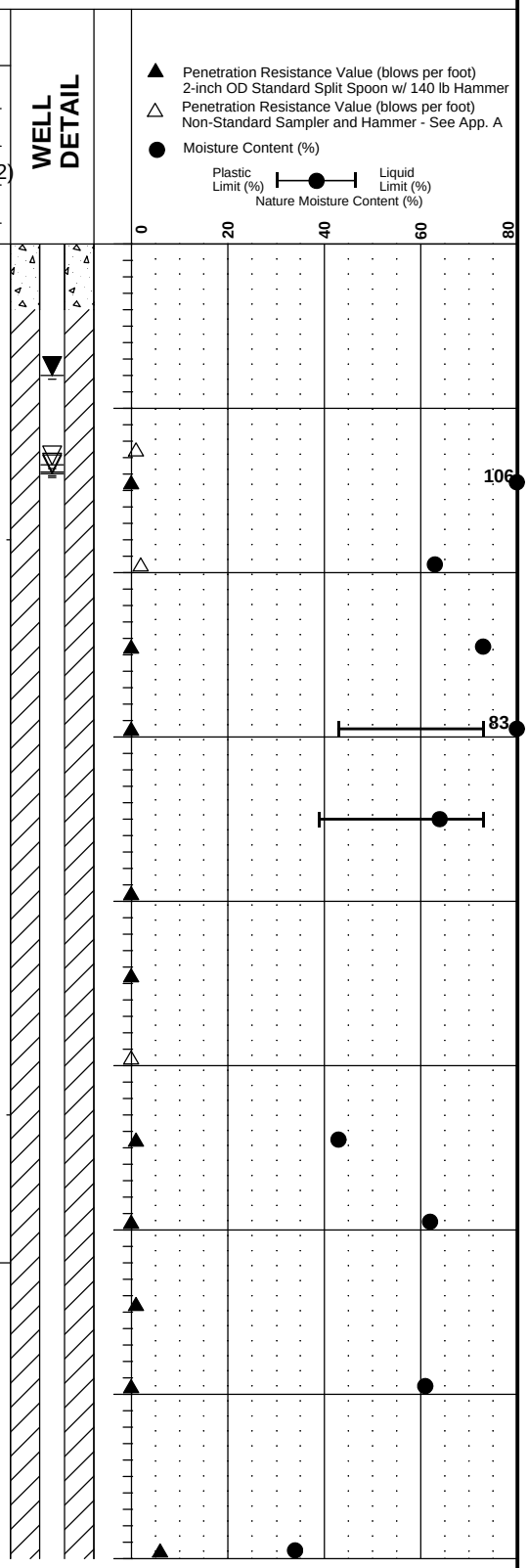
Log of Boring B-12

Figure A-13
(4 of 4)

B-13

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 13.9 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
0					SM	Dark gray silty, fine to medium SAND with organics (very loose, wet) **(SOIL UNIT 1)**
5	S-1	g2	1	PID=0.0 CA		
	S-2	b2	0	PID=0.0 W = 106		
				PID=0.0 CA	MH	Dark gray, clayey SILT with sand and fine organics (very soft, wet)
10	S-3	g2	2	W = 63 GS		
	S-4	b2	0	PID=0.0 W = 73		
15	S-5	b2	0	PID=0.0 W = 83 AL		
	S-6	c3		GT W = 64 AL		
20	S-6B	b2	0	PID=0.0 VST		
	S-7	b2	0	PID=0.0		
25	S-8	g2	0	PID=0.0 CA		- wood fiber layer
	S-9	b2	1	PID=0.0 W = 43	ML	Dark gray, sandy SILT with trace shells (very soft, wet)
30	S-10	b2	0	PID=0.0 W = 62 GS		
	S-11	b2	1	PID=0.0	SM/ ML	Dark gray silty, fine SAND with trace shells and interbedded fine sandy SILT and organics (very loose to loose, wet) **(SOIL UNIT 2B)**
35	S-12	b2	0	PID=0.0 W = 61		
40	S-13	b2	6	PID=0.0		



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-13

Figure A-14
(1 of 5)

B-13

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 13.9 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
40				W = 34	SM/ ML	Dark gray silty, fine SAND with trace shells and interbedded fine sandy SILT and organics (very loose to loose, wet) **(SOIL UNIT 2B)**
45	S-14	b2	4	PID=0.0 W = 36 GS		
50	S-15	b2	1	PID=0.0		
55	S-16	b2	0	PID=0.0 W = 47		
60	S-17	c3			SP/ SM	Dark gray, fine to medium SAND with silt and interbedded light brown, clayey SILT with trace organics (very loose to medium dense, wet)
	S-17B	b2	5	PID=0.0 VST		
65	S-18	b2	10	PID=0.0 W = 39 GS		
70	S-19	b2	3	PID=0.0 W = 54		
75	S-20	b2	12	PID=0.0 W = 35		
80	S-21	b2	2	PID=0.0		

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-13

Figure A-14
(2 of 5)

B-13

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 13.9 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
80				W = 58	SP/ SM	
					SM/ ML	Dark gray, very silty, fine SAND with organics and interbedded sandy SILT (very loose to medium dense, wet)
85	S-22	b2	1	PID=0.0 W = 43		
90	S-23	b2	12	PID=0.0 W = 43 GS		
					MH	Dark gray SILT with shells, scattered organics, and interbedded fine to medium SAND (very soft to soft, wet) **(SOIL UNIT 3)**
95	S-24	b2	0	PID=0.0		
100	S-25	c7		GT W = 71 AL		
	S-25B	b2	1	PID=0.0 VST		
105	S-26	b2	0	PID=0.0 W = 60		
110	S-27	b2	3	PID=0.0 W = 58 AL		
115	S-28	b2	3	PID=0.0 W = 65		
120	S-29	b2	3	PID=0.0		

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-13

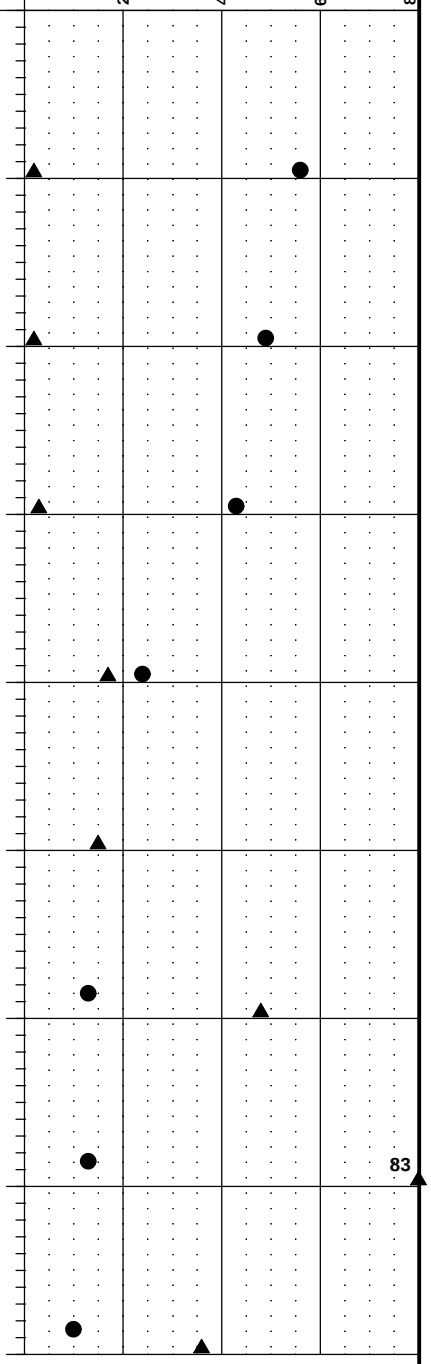
Figure A-14
(3 of 5)

B-13

Drilling Method: Mud Rotary
Casing: 4.5" upper 99'; 3.5" below
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 13.9 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
120				W = 50	MH	Dark gray SILT with shells, scattered organics, and interbedded fine to medium SAND (very soft to soft, wet) **(SOIL UNIT 3)**
125	S-30	b2	2	PID=0.0 W = 56		
130	S-31	b2	2	PID=0.0 W = 49		
135	S-32	b2	3	PID=0.0 W = 43 GS	SM/ ML	Dark gray, very sandy SILT (soft, wet)
140	S-33	b2	17	PID=0.0 W = 24	GP-GM	Gray, sandy, fine to coarse GRAVEL with silt (medium dense to very dense, wet) **(SOIL UNIT 4)**
145	S-34	b2	15	PID=0.0		
150	S-35	b2	48	PID=0.0 W = 13		
155	S-36	b2	83	PID=0.0 W = 13		
160	S-37	b2	36	PID=0.0 W = 10		

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-13

Figure A-14
(4 of 5)

B-13

SAMPLE DATA					SOIL PROFILE			WELL DETAIL
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 99'; 3.5" below Driller (Lic.#): WSDOT - D. Henderson (2742) Ground Elevation (ft): 13.9 (MLLW)	

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)
0 20 40 60 80

160
165
170
175
180
185
190
195
200

Boring Completed 07/13/06
Total Depth of Boring = 160.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: ALP-753

Point located at State Plane Coordinates:
North: 615499.21
East: 795853.58
Township: 17N
Range: 10W
Section: 11
Inspector: JJB

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

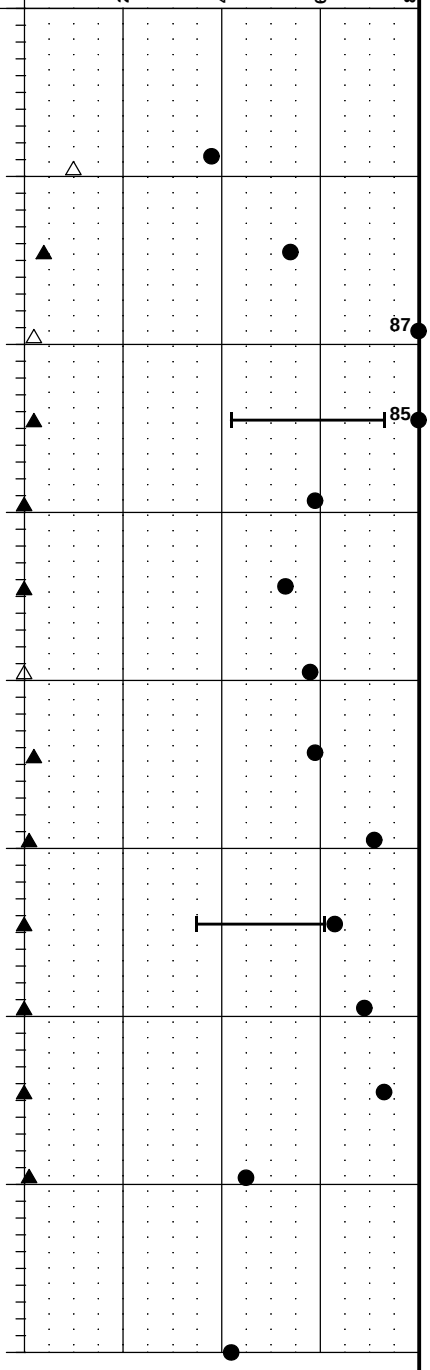
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

B-14

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - R. Shepherd (2710)
Ground Elevation (ft): 14 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Description	Groundwater
0					SP-SM	Gray, fine SAND with trace silt to with silt (loose to medium dense, moist to wet) **(SOIL UNIT 1)**	
5	S-1	g2	10	PID=0.0 CA W = 38			
					ML	Gray, very sandy SILT and thin interbedded SILT with sand and trace organics (soft to medium stiff, wet)	
	S-2	b2	4	PID=0.0 W = 54 GS			
					MH	Gray to light brown, clayey SILT with occasional thin interbedded fine organics (very soft to soft, wet)	▼
10	S-3	g2	2	PID=0.0 CA W = 87			
	S-4	b2	2	PID=0.0 W = 85 AL			
					MH	Gray, clayey SILT with occasional fine organics and thin interbedded gray SILT with sand (very soft, wet)	
15	S-5	b2	0	PID=0.0 W = 59			
	S-6	b2	0	PID=0.0 W = 53			
					ML	Gray, very sandy SILT and interbedded SILT with sand and organics (very soft to soft, wet)	
20	S-7	g2	0	PID=0.0 CA W = 58 GS			
	S-8	b2	2	PID=0.0 W = 59			
					MH	Gray to light brown SILT with occasional thin lamination of wood and fine organics and thin interbedded silty, fine SAND (very soft, wet)	
25	S-9	b2	1	PID=0.0 W = 71			
	S-10	b2	0	PID=0.0 W = 63 AL			
30	S-11	b2	0	PID=0.0 W = 69			
	S-12	b2	0	PID=0.0 W = 73			
35	S-13A S-13B	b2	1	PID=0.0 W = 45 PID=0.0			
					SM	Gray silty, fine SAND (very loose, wet) **(SOIL UNIT 2A)**	
40						- grading to SILT with sand	



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-14

Figure A-15 (1 of 2)

B-14

SAMPLE DATA					SOIL PROFILE				
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" Driller (Lic.#): WSDOT - R. Shepherd (2710) Ground Elevation (ft): 14 (MLLW)	Groundwater	
40	S-14	c7		W = 42		SM	- very silty, fine SAND and interbedded sandy SILT		

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├●┤ Liquid Limit (%)
Nature Moisture Content (%)
0 20 40 60 80

Boring Completed 07/07/06
Total Depth of Boring = 41.0 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: NA

Point located at State Plane Coordinates:
North: 614849.00
East: 795991.00
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

45 50 55 60 65 70 75 80

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

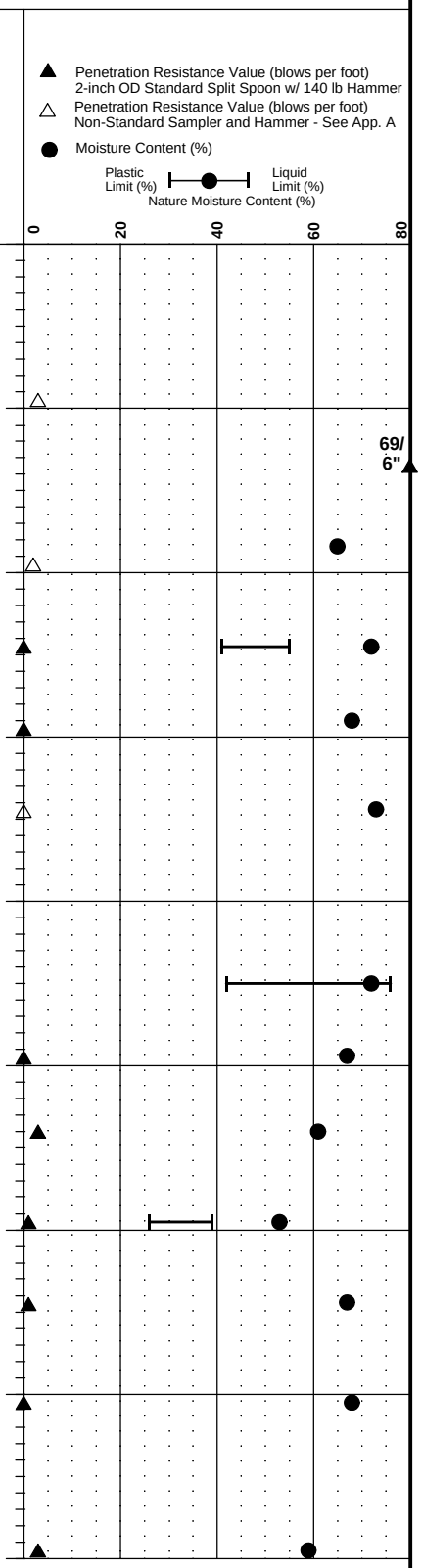
Log of Boring B-14

Figure A-15
(2 of 2)

B-15

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 14.6 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0						PT	Grass (Sod) (thickness: 0.5 ft)	
						SP-SM	**(SOIL UNIT 1)** Gray, fine SAND with silt (very loose, moist)	
						WD	Brown, WOOD and fine organics (sawdust) with silt.	
5	S-1	g2	3	PID=0.0				
	S-2	b2	69/ 6"	PID=0.0		WD	WOOD (log) (thickness: 28 in)	
				PID=0.0 CA W = 65		MH	Dark gray SILT with wood and organics (very soft to soft, wet)	
10	S-3	g2	2					
	S-4	b2	0	PID=0.0 W = 72 AL				
15	S-5	b2	0	PID=0.0 W = 68				
	S-6	g2	0	PID=0.0 CA W = 73			- trace shells	
20	S-7	c3						
	S-8	c3		GT W = 72 AL				
25	S-9	b2	0	PID=0.0 VST W = 67			- with thin lamination and fine organics trace shells (very soft, wet)	
	S-10A	b2	3	PID=0.0 W = 61				
	S-10B	b2				ML	Gray, clayey SILT with interbedded sand and fine organics (very soft, wet) **(SOIL UNIT 2B)**	
30	S-11	b2	1	PID=0.0 W = 53 AL			- interbedded silty, fine sand	
	S-12	b2	1	PID=0.0 W = 67		ML	Gray to light brown SILT with interbedded silty, fine SAND and trace organics (very soft, wet)	
35	S-13	b2	0	PID=0.0 W = 68				
						SP-SM		
40	S-14	b2	3	PID=0.0 W = 59				



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-15

Figure A-16 (1 of 2)

B-15

SAMPLE DATA				SOIL PROFILE			
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" Driller (Lic.#): WSDOT - V. Johnson (2532) Ground Elevation (ft): 14.6 (MLLW)
40				GS			Gray, fine SAND with silt and thin interbedded light brown SILT with trace sand and little fine organic matter; very loose, wet

Groundwater

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)
0 20 40 60 80

Boring Completed 07/11/06
Total Depth of Boring = 40.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: NA

Point located at State Plane Coordinates:
North: 616004.88
East: 796196.16
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

45 50 55 60 65 70 75 80

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-15

Figure A-16 (2 of 2)

B-16

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 14.7 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description	Groundwater
0					SP-SM	Gray, fine SAND with silt (very loose, moist to wet) **(SOIL UNIT 1)**	
5	S-1	g2	3	PID=0.0 CA			▼
	S-2	b2	0	PID=0.0 W = 72 GS	SM/ML	Dark gray to black SILT and interbedded silty to very silty, fine SAND with some fine organics and wood (very soft/very loose, wet)	
10	S-3	b2	1	PID=0.0 W = 45			
	S-4	g2	4	PID=0.0 CA W = 64	MH	Dark gray and light brown, SILT and interbedded sandy SILT with trace organics (very soft to soft, wet)	
15	S-5	b2	2	PID=0.0 W = 59 AL			
	S-6	c3					
20	S-7	c3		GT W = 70 AL			
	S-8	b2	0	PID=0.0 VST W = 66			
25	S-9	g2	1	PID=0.0 CA W = 61			
	S-10	b2	0	PID=0.0 W = 65 AL			
30	S-11	b2	1	PID=0.0 W = 62			
	S-12	b2	14	PID=0.0 W = 37 GS	SP-SM	Gray, fine SAND with silt and trace organics and fine wood fragments (loose to medium dense, wet) **(SOIL UNIT 2A)**	
35	S-13	b2	5	PID=0.0 W = 47	ML	Light brown SILT with interbedded fine SAND with silt (soft, wet)	
40	S-14	b2	4	PID=0.0			

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-16

Figure A-17
(1 of 2)

B-16

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 14.7 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
40				W = 44		ML	Light brown SILT with interbedded fine SAND with silt (soft, wet)	
45	S-15	b2	4	PID=0.0 W = 40		SP-SM	Gray, fine SAND with silt and trace organics (very loose to loose, wet)	
50	S-16	b2	2	PID=0.0 W = 47 GS		ML	- Gray to light brown, very sandy SILT with interbedded fine sandy SILT to silty, fine SAND and trace shell fragments (very soft/very loose, wet)	
55	S-17	c3		PID=0.0				

Boring Completed 07/19/06
Total Depth of Boring = 56.0 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: NA

Point located at State Plane Coordinates:
North: 615027.96
East: 796031.88
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-16

Figure A-17
(2 of 2)

B-17

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 12.2 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
0					SM	Gray silty to very silty, fine SAND with wood fragments (very loose, wet) **(SOIL UNIT 1)**
5	S-1	g2	0	PID=0.0 CA		
	S-2	b2	0	PID=0.0 W = 58 GS	SM/ ML	Dark gray, very sandy SILT to very silty, fine SAND with wood fragments (very soft to very loose, wet)
10	S-3	b2	1	PID=0.0 W = 66	MH	Dark gray, clayey SILT with some wood fragments (very soft to soft, wet)
	S-4	g2	3	PID=0.0 CA W = 47		
15	S-5	b2	0	PID=0.0 W = 61 AL		
	S-6	b2	0	PID=0.0 W = 74		- with trace SAND
20	S-7	g2	1	PID=0.0 CA W = 70		
	S-8	c3		GT W = 66 AL		
25	S-9	b2	0	PID=0.0 VST W = 46		
	S-10	b2	2	PID=0.0 W = 50		
30	S-11	b2	6	PID=0.0 W = 45	MH	Gray, clayey SILT to sandy SILT with interbedded silty, fine SAND (loose and very soft, wet) **(SOIL UNIT 2A)**
	S-12	b2	2	PID=0.0 W = 56 AL		
35	S-13	b2	2	PID=0.0 W = 50		
40	S-14	b2	9	PID=0.0 W = 32		Gray, fine SAND with silt (loose, wet)

Groundwater

Moisture Content (%): 0, 20, 40, 60, 80

LL = 84

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-17

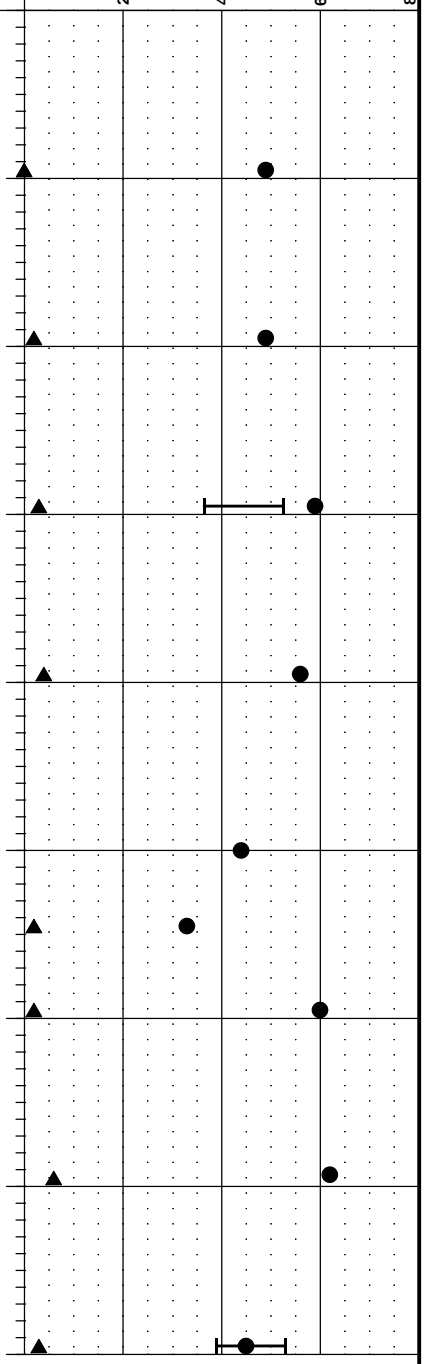
Figure A-18
(1 of 5)

B-17

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 12.2 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
40				GS		SP-SM	Gray, fine SAND with silt (loose, wet)	
45	S-15	b2	0	PID=0.0 W = 49		MH	Light brown to gray, SILT to SILT with sand and occasional interbedded silty, fine SAND with trace small shell and trace organics (very soft to medium stiff, wet)	
50	S-16	b2	2	PID=0.0 W = 49				
55	S-17	b2	3	PID=0.0 W = 59 AL				
60	S-18	b2	4	PID=0.0 W = 56				
65	S-19	c3		W = 44			- Sample taken for potential C14 testing at 64 ft BGS	
	S-20	b2	2	PID=0.0 VST W = 33				
70	S-21	b2	2	PID=0.0 W = 60			- 1/2" zone of fine organic debris, sample taken for potential C14 testing	
75	S-22	b2	6	PID=0.0 W = 62			- thin interbedded fine organic debris	
80	S-23	b2	3	PID=0.0 W = 45				



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-17

Figure A-18
(2 of 5)

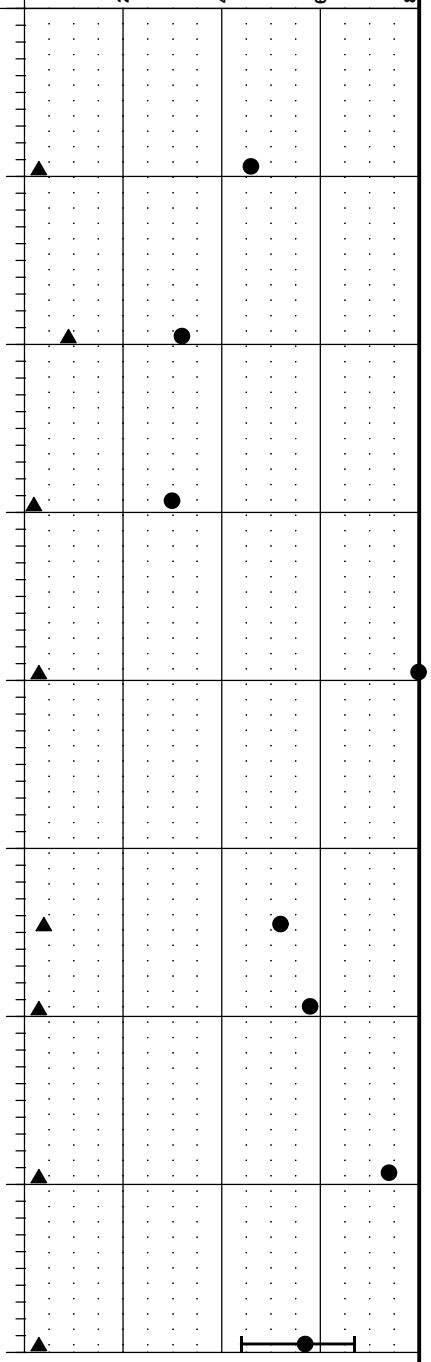
B-17

SAMPLE DATA | **SOIL PROFILE**

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 12.2 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—— Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description	Groundwater
80				AL		MH	Light brown to gray, SILT to SILT with sand and occasional interbedded silty, fine SAND with trace small shell and trace organics (very soft to medium stiff, wet)	
85	S-24	b2	3	PID=0.0 W = 46				
90	S-25	b2	9	PID=0.0 W = 32 GS		SM	Gray, silty, fine SAND with interbedded sandy SILT (very loose to loose, wet) - Sample taken for potential C14 testing at 89 ft BGS	
95	S-26	b2	2	PID=0.0 W = 30				
100	S-27	b2	3	PID=0.0 W = 80		MH	Light brown, clayey SILT with scattered organics (soft, wet) **(SOIL UNIT 3)** - Sample taken for potential C14 testing at 99 ft BGS	
105	S-28	c3						
	S-29	b2	4	PID=0.0 VST W = 52				
110	S-30	b2	3	PID=0.0 W = 58				
115	S-31	b2	3	PID=0.0 W = 74				
120	S-32	b2	3	PID=0.0 W = 57				



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-17

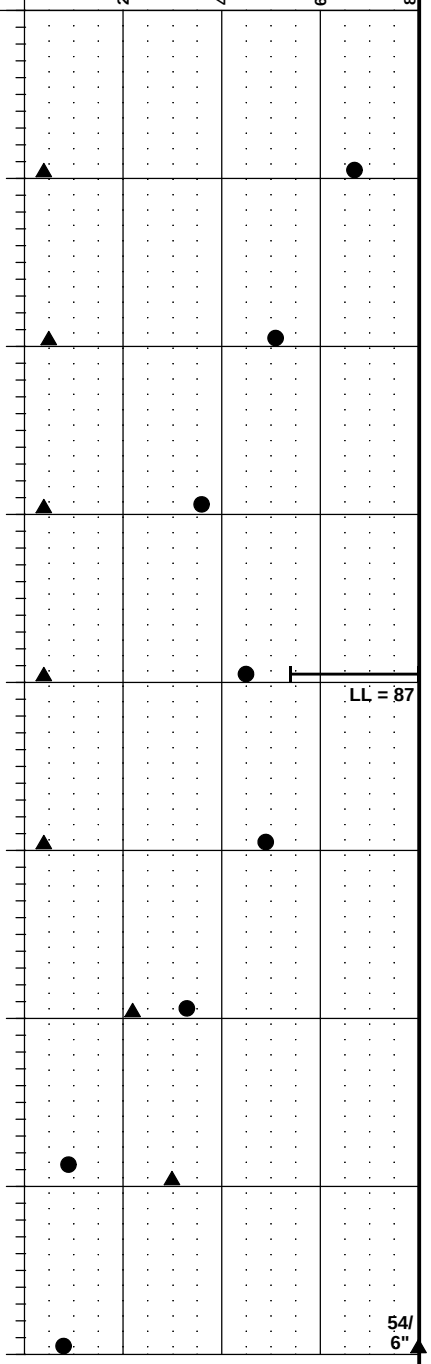
Figure A-18
(3 of 5)

B-17

Drilling Method: Mud Rotary
Casing: 4.5" upper 104'; 3.5" below
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 12.2 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater
120				AL		MH	Light brown, clayey SILT with scattered organics (soft, wet) **(SOIL UNIT 3)**	
125	S-33	b2	4	PID=0.0 W = 67				
						ML	Light brown to gray, sandy SILT with interbedded silty, fine SAND (soft to medium stiff, wet)	
130	S-34	b2	5	PID=0.0 W = 51				
135	S-35	b2	4	PID=0.0 W = 36				
						MH	Light brown SILT with trace scattered brown organics (soft, wet)	
140	S-36	b2	4	PID=0.0 W = 45 AL				
145	S-37	b2	4	PID=0.0 W = 49				
						SP/ ML	Gray, fine SAND with silt to trace silt and fine interbedded sandy SILT (medium dense, wet)	
150	S-38	b2	22	PID=0.0 W = 33				
						GP-GM	Gray,very gravelly, fine to coarse SAND (medium dense to very dense, wet) **(SOIL UNIT 4)**	
155	S-39	b2	30	PID=0.0 W = 9				
160	S-40	b2	54/	PID=0.0 W = 8				



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-17

Figure A-18
(4 of 5)

B-17

SAMPLE DATA					SOIL PROFILE				
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" upper 104'; 3.5" below Driller (Lic.#): WSDOT - V. Johnson (2532) Ground Elevation (ft): 12.2 (MLLW)	Groundwater	
160			6"	GS		GP-GM	Gray,very gravelly, fine to coarse SAND (medium dense to very dense, wet) **(SOIL UNIT 4)**		
165	S-41	b2	82	PID=0.0 W = 8					82
170	S-42	b2	50/ 2.5"	PID=0.0 W = 10					50/ 2.5"

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)
0 20 40 60 80

Boring Completed 07/21/06
Total Depth of Boring = 169.8 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: NA

Point located at State Plane Coordinates:
North: 614866.66
East: 796341.67
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

175
180
185
190
195
200

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

B-18

Drilling Method: Mud Rotary
Casing: 3.5"
Driller (Lic.#): WSDOT - K. Cooper (2552)
Ground Elevation (ft): -7.6 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater	Moisture Content (%)
0	S-1	g2	0	PID=0.0 CA W = 60		SM/ MH	Dark gray, very sandy SILT with organics and shells (very soft, wet) **(SOIL UNIT 1)**		
	S-2	b2	0	PID=0.0 W = 64 AL			- with shells		
5	S-3	g2	0	PID=0.0 CA					
	S-4	b2	1	PID=0.0 W = 75					
10	S-5	b2	0	PID=0.0 W = 61 GS					
	S-6	b2	0	PID=0.0 W = 64					
15	S-7	b2	0	PID=0.0 W = 76 AL					LL = 86
	S-8	b2	0	PID=0.0 W = 102					102
20	S-9	b2	0	PID=0.0 W = 86					86
	S-10	b2	1	PID=0.0 W = 82 AL		MH	Gray, sandy SILT with shells and interbedded fine SAND (very soft , wet) **(SOIL UNIT 2A)**		82 LL = 91
25	S-11	b2	2	PID=0.0 W = 51 GS					
30	S-12	b2	2	PID=0.0 W = 54 AL					
35	S-13	b2	0	PID=0.0 W = 63 GS					
40									

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-18

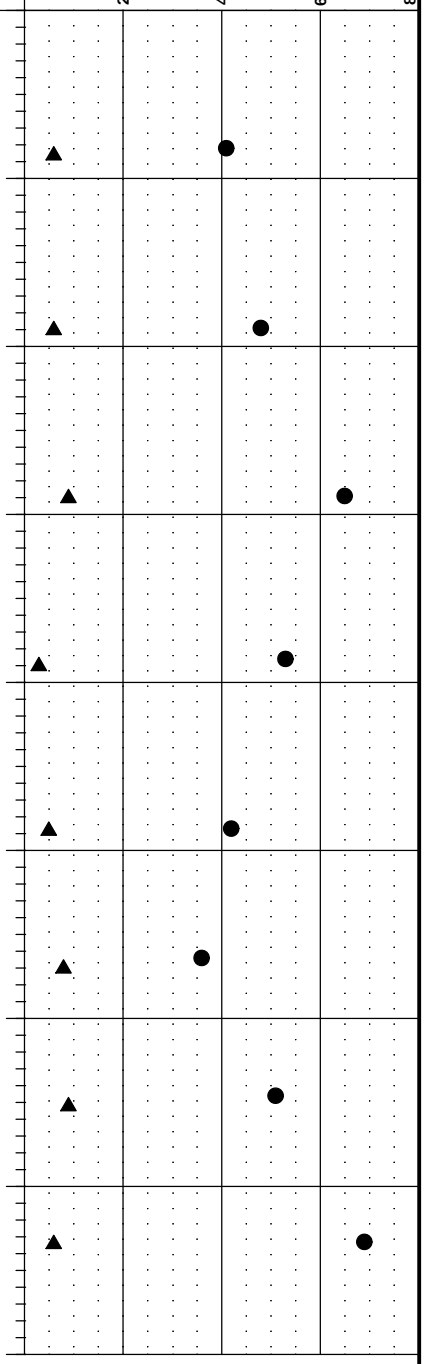
Figure A-19
(1 of 4)

B-18

Drilling Method: Mud Rotary
Casing: 3.5"
Driller (Lic.#): WSDOT - K. Cooper (2552)
Ground Elevation (ft): -7.6 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater
40						MH		
						SM/ ML	Dark gray, very sandy SILT to silty, fine SAND with organics and interbedded sandy SILT (very soft to stiff and very loose to loose , wet)	
45	S-14	b2	6	PID=0.0 W = 41				
50	S-15	b2	6	PID=0.0 W = 48 GS				
55	S-16	b2	9	PID=0.0 W = 65				
60	S-17	b2	3	PID=0.0 W = 53				
65	S-18	b2	5	PID=0.0 W = 42				
70	S-19	b2	8	PID=0.0 W = 36				
75	S-20	b2	9	PID=0.0 W = 51				
	S-21	b2	6	PID=0.0 W = 69		MH	Dark gray, clayey SILT with mottled organics (soft to medium stiff, wet) **(SOIL UNIT 3)**	
80								



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

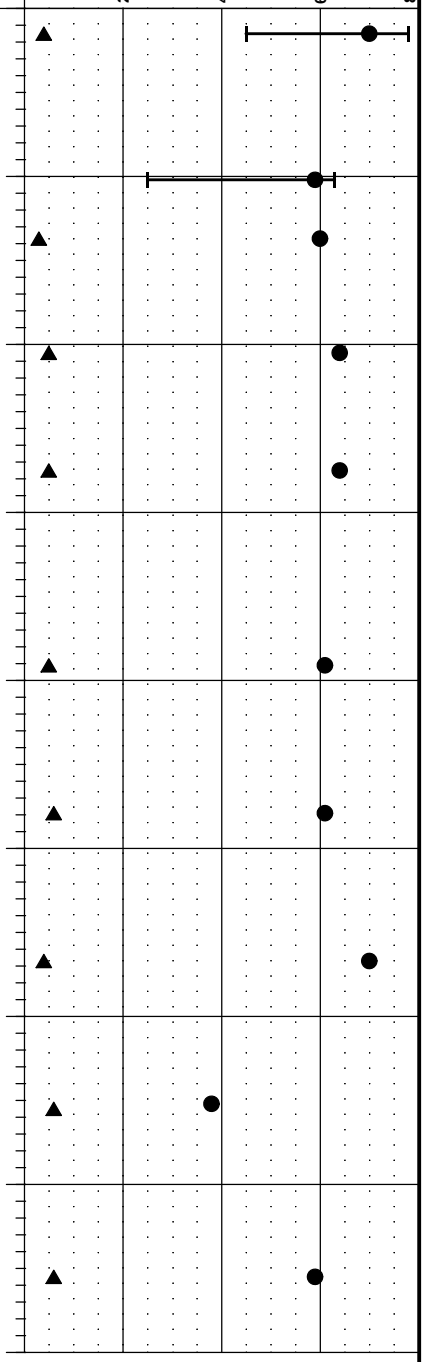
B-18

SAMPLE DATA | **SOIL PROFILE**

Drilling Method: Mud Rotary
Casing: 3.5"
Driller (Lic.#): WSDOT - K. Cooper (2552)
Ground Elevation (ft): -7.6 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater
80	S-22	b2	4	PID=0.0 W = 70 AL		MH	Dark gray, clayey SILT with mottled organics (soft to medium stiff, wet) **(SOIL UNIT 3)**	
85	S-23	c3		GT W = 59 AL				
	S-24	b2	3	PID=0.0 W = 60			- with shells	
90	S-25	b2	5	PID=0.0 W = 64				
	S-26	b2	5	PID=0.0 W = 64				
95								
100	S-27	b2	5	PID=0.0 W = 61				
	S-28	b2	6	PID=0.0 W = 61				
105								
	S-29	b2	4	PID=0.0 W = 70				
110						SM/ ML	Gray, very silty, fine SAND to very sandy SILT (loose, wet)	
	S-30	b2	6	PID=0.0 W = 38				
115								
	S-31	b2	6	PID=0.0 W = 59			- with shells	
120								

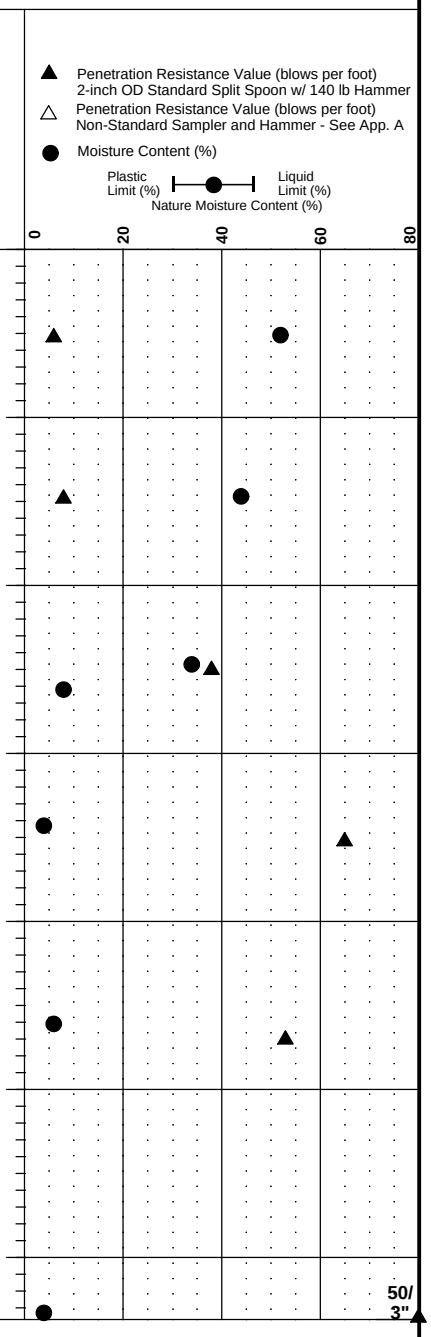


Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

B-18

SAMPLE DATA					SOIL PROFILE			
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 3.5" Driller (Lic.#): WSDOT - K. Cooper (2552) Ground Elevation (ft): -7.6 (MLLW)	Groundwater
120						SM/ ML	Gray, very silty, fine SAND to very sandy SILT (loose, wet)	
	S-32	b2	6	PID=0.0 W = 52				
125								
	S-33	b2	8	PID=0.0 W = 44				
130								
	S-34A S-34B	b2	38	PID=0.0 W = 34 W = 8 GS		GW	Gray, sandy, fine to coarse GRAVEL with silt (dense to very dense, wet) **(SOIL UNIT 4)**	
135								
	S-35	b2	65	PID=0.0 W = 4				
140								
	S-36	b2	53	PID=0.0 W = 6				
145								
150								
	S-37	b2	50/ 3"	PID=0.0 W = 4				
155								
160								



Boring Completed 09/26/06
Total Depth of Boring = 151.9 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: NA

Point located at State Plane Coordinates:
North: 614702.80
East: 795873.74
Township: 17N
Range: 10W
Section: 11
Inspector: JJB

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-18

Figure
A-19
(4 of 4)

B-19

Drilling Method: Mud Rotary
Casing: 3.5"
Driller (Lic.#): WSDOT - K. Cooper (2552)
Ground Elevation (ft): -12.8 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater	Moisture Content (%)
0	S-1	g2	0	PID=0.0 CA W = 87		SM/ MH	Dark gray, sandy SILT to very silty, fine SAND with silt interbeds (very soft, wet) **(SOIL UNIT 1)**		87
	S-2	b2	0	PID=0.0 W = 89 GS					89
5	S-3	g2	0	PID=0.0 CA W = 81					81
	S-4	b2	0	PID=0.0 W = 88 AL					88, LL = 87
10	S-5	b2	0	PID=0.0 W = 55		MH	Dark gray, sandy to very sandy SILT with organics (very soft to very loose, wet) **(SOIL UNIT 2A)**		
	S-6	b2	0	PID=0.0 W = 81 GS					81
15	S-7	b2	0	PID=0.0 W = 78 AL					LL = 87
	S-8	b2	0	PID=0.0 W = 84					84
20	S-9	b2	0	PID=0.0 W = 93					93
	S-10	b2	0	PID=0.0 W = 92			- with wood		92
25	S-11	b2	0	PID=0.0 W = 112					112
30	S-12	b2	4	PID=0.0 W = 41 GS		SM	Gray, very silty, fine SAND with interbedded light brown SILT (loose, wet)		
35	S-13	b2	6	PID=0.0 W = 49					
40									

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-19

Figure A-20
(1 of 4)

B-19

Drilling Method: Mud Rotary
Casing: 3.5"
Driller (Lic.#): WSDOT - K. Cooper (2552)
Ground Elevation (ft): -12.8 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater	Moisture Content (%)
40	S-14	b2	6	PID=0.0 W = 60		SM	Gray, very silty, fine SAND with interbedded light brown SILT (loose, wet) - with wood		
45	S-15	b2	12	PID=0.0 W = 69					
50	S-16	b2	3	PID=0.0 W = 57		MH	Gray, SILT with sand and organics (soft, wet) **(SOIL UNIT 3)**		
55	S-17	b2	3	PID=0.0 W = 44		SM	Gray, silty, fine SAND with interbedded organics (very loose to medium dense, wet)		
60	S-18	b2	8	PID=0.0 W = 46 GS					
65	S-19	b2	22	PID=0.0 W = 35					
70	S-20	b2	3	PID=0.0 W = 99		MH	Gray SILT with abundant mottled organics (soft to medium stiff, wet)		99
75	S-21	b2	6	PID=0.0 W = 77					
80	S-22	b2	5	PID=0.0 W = 54					

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-19

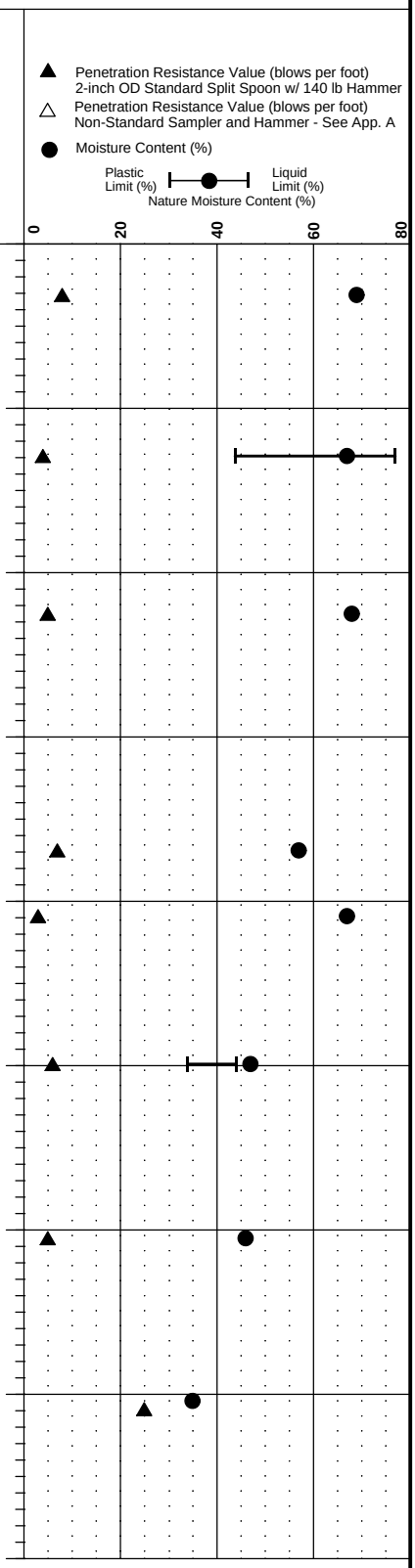
Figure A-20
(2 of 4)

B-19

Drilling Method: Mud Rotary
Casing: 3.5"
Driller (Lic.#): WSDOT - K. Cooper (2552)
Ground Elevation (ft): -12.8 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
80	S-23	b2	8	PID=0.0 W = 69	MH	Gray SILT with abundant mottled organics (soft to medium stiff, wet)
85	S-24	b2	4	PID=0.0 W = 67 AL		
90	S-25	b2	5	PID=0.0 W = 68		
95	S-26	c3				
	S-27	b2	7	PID=0.0 W = 57		
100	S-28	b2	3	PID=0.0 W = 67		
105	S-29	b2	6	PID=0.0 W = 47 AL	ML	Gray, sandy SILT to SILT with sand (medium stiff to very stiff, wet)
110	S-30	b2	5	PID=0.0 W = 46		
115	S-31	b2	25	PID=0.0 W = 35		
120						

Groundwater



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

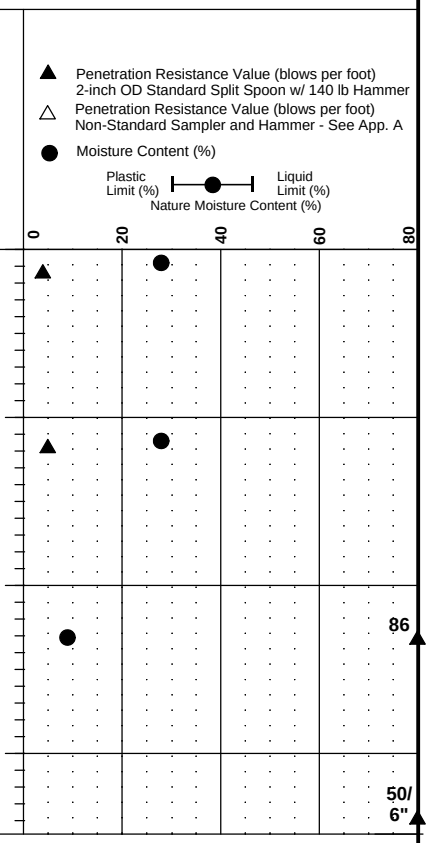
SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-19

Figure A-20
(3 of 4)

B-19

SAMPLE DATA					SOIL PROFILE			
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 3.5" Driller (Lic.#): WSDOT - K. Cooper (2552) Ground Elevation (ft): -12.8 (MLLW)	Groundwater
120	S-32	b2	4	PID=0.0 W = 28		SP/ SM	Gray, fine SAND with silt (loose to medium dense, wet)	
125	S-33	b2	5	PID=0.0 W = 28				
130	S-34	b2	86	PID=0.0 W = 9 GS		GW	Gray, sandy, fine to coarse GRAVEL with silt (very dense, wet) **(SOIL UNIT 4)**	
135	S-35	b2	50/ 6"	PID=0.0				
140								
145								
150								
155								
160								



Boring Completed 09/27/06
Total Depth of Boring = 137.4 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: NA

Point located at State Plane Coordinates:
North: 614664.00
East: 795594.00
Township: 17N
Range: 10W
Section: 11
Inspector: JJB

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-19

Figure
A-20
(4 of 4)

B-20

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 14 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater	Nature Moisture Content (%)
0						ML	Dark gray, clayey SILT with interspersed organics (wet, soft) **(SOIL UNIT 1)**	Entered to clean the log	
15	S-1	g2	0	PID=0.0 C14					△
25	S-2	g2	0	PID=0.0 C14		ML	Dark gray, clayey SILT with sand and trace organics (wet, soft to medium stiff)		△
	S-2	g2	1	PID=0.0					△
35	S-3	g2	6	PID=0.0 C14					△

Boring Completed 07/21/06
Total Depth of Boring = 35.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: NA

Point located at State Plane Coordinates:
North: 615469.00
East: 795640.00
Township: 17N
Range: 10W
Section: 11
Inspector: JJB

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring B-20

Figure A-21

VW- 1

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 13.9 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
0					ML	Dark gray, very sandy SILT with shells and trace wood **(SOIL UNIT 1)**
15	S-1	d2	0	PID=0.0 C14		
					SM/ ML	Dark gray, very sandy SILT with trace organics (soft, wet) - Sample taken for potential C14 testing at 19 ft BGS VWP @ 20' - S/N: 86391 -
20	S-2	b2	0	PID=0.0 W = 63 -200 = 67		
25	S-3	d2	0	PID=0.0 C14		
					SM/ ML	Dark gray, fine SAND with interbedded SILT and medium SAND (soft, wet)
30	S-4	b2	1	PID=0.0		
					SM/ ML	Dark gray, very silty, fine to medium SAND to very sandy SILT (very loose to soft, wet) **(SOIL UNIT 2A)**
35	S-5	d2	2	PID=0.0 C14		
40	S-6	b2	1	PID=0.0		

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring VW- 1

Figure A-22 (1 of 2)

VW- 1

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
40						SM/ ML	Dark gray, very silty, fine to medium SAND to very sandy SILT (very loose to soft, wet) **(SOIL UNIT 2A)**
45	S-7	b2	0	PID=0.0 W = 49 -200 = 49			VWP @ 44' - S/N: 86714 -

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 13.9 (MLLW)

WELL DETAIL

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

0 20 40 60 80

Boring Completed 07/21/06
Total Depth of Boring = 45.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: ALP-754

Point located at State Plane Coordinates:
North: 614950.43
East: 795944.33
Township: 17N
Range: 10W
Section: 11
Inspector: JJB

50 55 60 65 70 75 80

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring VW- 1

Figure A-22 (2 of 2)

VW- 2

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 14.0 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├─●─┤ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
0						ML	Gray and dark gray SILT with interbedded sandy SILT with trace organics (very soft, wet) **(SOIL UNIT 1)**
15	S-1	b2	1	PID=0.0			
						ML	Light brown SILT with trace sand and scattered interbedded fine organics (very soft, wet) VWP @ 20' - S/N: 86715 -
20	S-2	b2	0	PID=0.0			
						MH	Dark gray grading to gray, clayey SILT with occasional thin interbedded fine organics (very soft, wet)
25	S-3	b2	0	PID=0.0			
						ML	Gray SILT with occasional interbedded silty, fine sand (very soft, wet)
30	S-4	b2	0	PID=0.0			
						SM/ ML	Gray silty, fine SAND with interbedded SILT (1/4" to 2" thickness) with occasional thin interbedded fine organics (very loose, wet) **(SOIL UNIT 2A)**
35	S-5	b2	3	PID=0.0			
						SM/ ML	Gray to light brown silty, fine SAND with interbedded SILT with thin interbedded fine organics (very loose, wet)
40	S-6	b2	2	PID=0.0 W = 48			

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring VW- 2

Figure A-23 (1 of 2)

VW- 2

SAMPLE DATA					SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" Driller (Lic.#): WSDOT - V. Johnson (2532) Ground Elevation (ft): 14.0 (MLLW)
40				-200 = 43		SM/ ML	Gray to light brown silty, fine SAND with interbedded SILT with thin interbedded fine organics (very loose, wet)
						SM/ ML	VWP @ 40.5' - S/N: 86716 - Gray and light brown SILT with thin interbedded fine SAND and occasional shells (very soft, wet)
45	S-7	b2	0	PID=0.0			

WELL DETAIL

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├●┤ Liquid Limit (%)
Nature Moisture Content (%)

0 20 40 60 80

Boring Completed 07/25/06
Total Depth of Boring = 45.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: ALP-755

Point located at State Plane Coordinates:
North: 614959.50
East: 795969.55
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

50 55 60 65 70 75 80

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring VW- 2

Figure A-23 (2 of 2)

VW- 3

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 14.0 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description
0						ML	Gray to dark gray SILT with trace organics (very soft, wet) **(SOIL UNIT 1)**
15	S-1	b2	1	PID=0.0			
20	S-2	b2	0	PID=0.0 W = 66 -200 = 66		SM/ ML	Gray to light brown, very sandy SILT with interbedded fine SAND with thin interbedded fine organics (very soft, wet) VWP @ 20' - S/N: 86712 -
25	S-3	b2	0	PID=0.0		SM/ ML	Gray, light brown SILT with thin interbedded silty, fine SAND (1/16" to 1/4" thickness) with thin interbedded fine organics (twigs and wood debris) (1/16" to 1/4" thickness)
30	S-4	b2	0	PID=0.0		ML	Light brown SILT with very thin lamination of fine SAND with silt (1/32" to 1/16" thickness) and trace organics; small sand filled structure (very soft, wet) **(SOIL UNIT 2A)**
35	S-5	b2	0	PID=0.0			-less interbedded silty, fine SAND trace shell fragments
40	S-6	b2	2	PID=0.0		SM/ ML	

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring VW- 3

Figure A-24 (1 of 2)

VW- 3

SAMPLE DATA					SOIL PROFILE			WELL DETAIL
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" Driller (Lic.#): WSDOT - V. Johnson (2532) Ground Elevation (ft): 14.0 (MLLW)	
40						SM/ ML	Gray to light brown SILT with interbedded silty, fine SAND to fine SAND with silt (1/8" to 2" thickness) and shells (very sift to soft, very loose, wet)	
							VWP @ 40' - S/N: 86713 -	
						ML	Light brown SILT with occasional thin interbedded silty, fine SAND with trace shell fragments (very soft, wet)	
45	S-7	b2	1	PID=0.0				

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

0 20 40 60 80

Boring Completed 07/24/06
Total Depth of Boring = 45.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: ALP-756

Point located at State Plane Coordinates:
North: 614957.76
East: 795989.70
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

50 55 60 65 70 75 80

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring VW- 3

Figure A-24 (2 of 2)

VW- 4

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.5 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├●┤ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description	Moisture Content (%)
0						ML	Light brown SILT with trace sand and trace organics **(SOIL UNIT 1)**	
15	S-1	b2	0	PID=0.0				
20	S-2	b2	0	PID=0.0		ML	Dark brown SILT with thin interbedded (1/16" to 1/4") silty, fine SAND with occasional thin interbedded fine organics (very soft, wet) VWP @ 20' - S/N: 85487 -	
25	S-3	b2	0	PID=0.0		ML	Light brown SILT with some thin lamination and some thin interbedded fine organics (very soft, wet)	
30	S-4	b2	4	PID=0.0		SM/ ML	Mottled dark gray and gray, sandy SILT with abundant wood (decomposed dark brown and light gray to light brown, less weathered) with angular siltstone (1/4" diameter) (soft to medium stiff, wet)	
35	S-5	b2	2	PID=0.0		SM/ ML	Light brown to gray SILT with some thin lamination and thin interbedded (1/8" to 1/2" thickness) silty, fine SAND (very soft, wet) **(SOIL UNIT 2B)**	
40	S-6	b2	17	PID=0.0		SP-SM	Gray, fine SAND with silt and trace shells (medium dense, wet)	

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

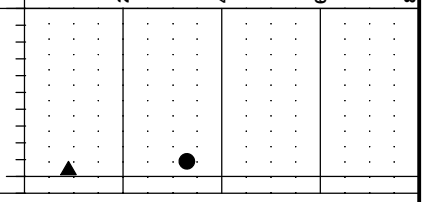
Log of Boring VW- 4

Figure A-25 (1 of 2)

VW- 4

SAMPLE DATA					SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4.5" Driller (Lic.#): WSDOT - V. Johnson (2532) Ground Elevation (ft): 13.5 (MLLW)
40						SP-SM	Gray, fine SAND with silt and trace shells (medium dense, wet)
						SM	Gray silty, fine SAND and interbedded SILT and some fine interbedded fine organics and trace shell fragments (loose, wet)
45	S-7	b2	9	PID=0.0 W = 33 -200 = 16			VWP @ 43.3' - S/N: 85488 -

WELL DETAIL



Boring Completed 07/25/06
Total Depth of Boring = 45.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: ALP-757

Point located at State Plane Coordinates:
North: 615324.92
East: 796313.01
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring VW- 4

Figure
A-25
(2 of 2)

VW- 5

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.7 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description
0						ML	Light brown to gray, SILT with trace sand with occasional thin interbedded fine organics (very soft, wet) **(SOIL UNIT 1)**
5							
10							
15	S-1	b2	0	PID=0.0			
20	S-2	b2	0	PID=0.0			- gray, trace organics VWP @ 20' - S/N: 85489 -
25	S-3	b2	0	PID=0.0		SM/ ML	Gray to light brown SILT with occasional very thin interbedded (1/32" to 1/8" thickness) silty, fine SAND to fine SAND with silt and trace very thin interbedded fine organics (very soft, wet)
30	S-4	b2	1	PID=0.0			
35	S-5	b2	2	PID=0.0			- with SAND and SILT interbeds (1/8" to 3/4" thickness) (very soft to soft, wet)
40	S-6	b2	14	PID=0.0 W = 34		SM	Gray silty, fine SAND and trace shell fragments (medium dense, wet) **(SOIL UNIT 2B)**

WELL DETAIL

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring VW- 5

Figure A-26 (1 of 2)

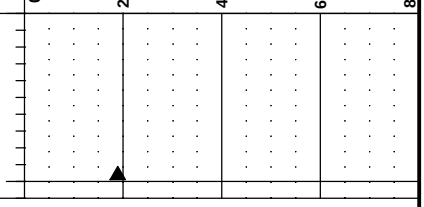
VW- 5

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
40				-200 = 18		SM	Gray silty, fine SAND and trace shell fragments (medium dense, wet) **(SOIL UNIT 2B)** VWP @ 40' - S/N: 85491 -
45	S-7	b2	19	PID=0.0			- dark gray, with zones of some shell fragments

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - V. Johnson (2532)
Ground Elevation (ft): 13.7 (MLLW)

WELL DETAIL

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)



Boring Completed 07/26/06
Total Depth of Boring = 45.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: ALP-758

Point located at State Plane Coordinates:
North: 615332.31
East: 796348.04
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring VW- 5

Figure A-26 (2 of 2)

VW- 6

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 13.9 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
0						SM/ ML	Dark gray, very sandy SILT with organics to silty, fine SAND with organics **(SOIL UNIT 1)**
5							
10							
15	S-1	g2	1	PID=0.0 C14			
20	S-2	b2	0	PID=0.0 W = 64 -200 = 69			- Sample taken for potential C14 testing at 19 ft BGS VWP @ 20 ' - S/N: 85486 -
25	S-3	g2	0	PID=0.0 C14			
30	S-4	b2	2	PID=0.0		SM/ WD SM	Gray, fine to medium SAND and WOOD - Potential C14 sample taken at 30 ft BGS Gray, fine to medium SAND with trace silt **(SOIL UNIT 2B)**
35	S-5	g2	4	PID=0.0 C14			
40	S-6	b2	11	PID=0.0		SM/ ML	Gray, fine to medium SAND with interbedded SILT

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring VW- 6

Figure A-27 (1 of 2)

VW- 6

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
40						SM/ ML	Gray, fine to medium SAND with interbedded SILT
						SM	Dark gray, fine to medium SAND with shell
45	S-7	b2	1	PID=0.0			VWP @ 44' - S/N: 85490 -

Drilling Method: Mud Rotary
Casing: 4.5"
Driller (Lic.#): WSDOT - D. Henderson (2742)
Ground Elevation (ft): 13.9 (MLLW)

WELL DETAIL

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├●┤ Liquid Limit (%)
Nature Moisture Content (%)

0 20 40 60 80

Boring Completed 07/20/06
Total Depth of Boring = 45.5 ft.
WSDOT Job #: XL 2672
Start Card #: R 68407
Ecology Well#: ALP-759

Point located at State Plane Coordinates:
North: 615333.71
East: 796368.40
Township: 17N
Range: 10W
Section: 11
Inspector: JJB

50 55 60 65 70 75 80

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring VW- 6

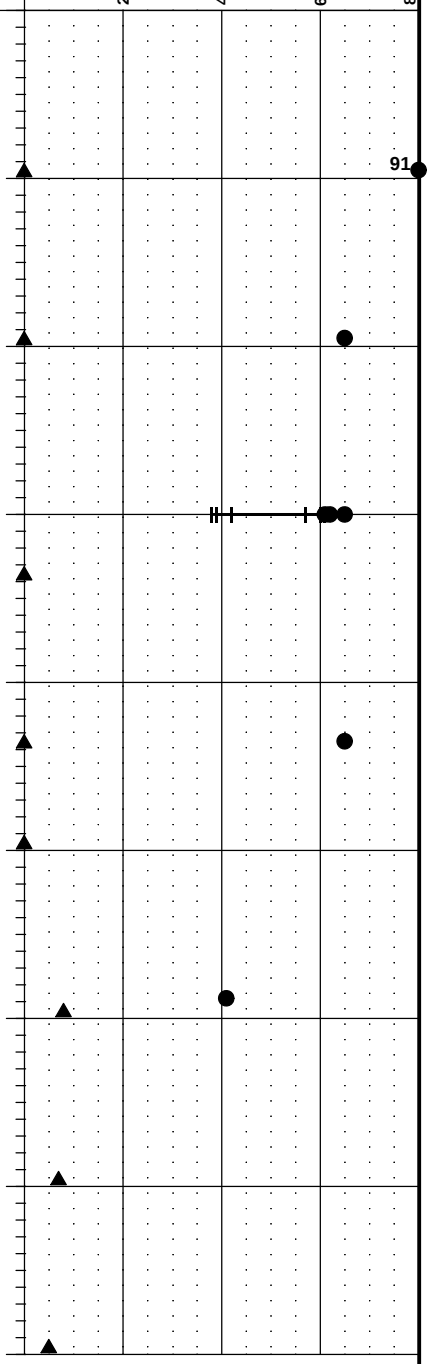
Figure A-27 (2 of 2)

TH-27-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.2 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0						MH	Gray, SILT with trace sand and trace interbedded fine organics (very soft, wet) **(SOIL UNIT 1)**	
5	S-1	b2	0	W = 91			-Black	
10	S-2	b2	0	W = 65				
15	S-3	c3		GT W = 61 AL				
	S-4	b2	0	W = 65 AL W = 62 AL			- fine SAND with silt and interbedded silty, fine SAND with organics	
20	S-5	c3						
	S-6	b2	0	W = 65				
25	S-7	b2	0			SM/ ML	Gray brown, fine sandy SILT grading to silty, fine SAND to fine SAND with silt and fine organics (very soft and very loose to loose, wet) **(SOIL UNIT 2B)**	
30	S-8	b2	8	W = 41				
35	S-9	b2	7			SM/ ML	Gray, fine SAND with silt and thin (1/8 to 3/4 inch) interbedded light brown, SILT with trace sand (loose, wet)	
40	S-10	b2	5					



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-27-08

Figure A-28 (1 of 5)

TH-27-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.2 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater
40						SM/ ML	Gray, fine SAND with silt and thin (1/8 to 3/4 inch) interbedded light brown, SILT with trace sand (loose, wet)	
						ML	Gray brown, SILT with sand with trace thin (1/8 to 1/4 inch) interbedded silty, fine SAND (very soft, wet)	
45	S-11	b2	0	W = 50				
50	S-12A S-12B	b2	0			SM/ ML	Gray, silty, fine SAND with thin (1/8 to 1/4 inch) interbedded SILT (very loose, wet)	
						SM	Gray brown, silty, fine SAND with thin (1/8 to 1 inch) interbedded SILT (loose to medium dense, wet)	
55	S-13	b2	8	W = 36 GS				
60	S-14	b2	2					
65	S-15	b2	10	W = 41			- thin fine organics interbeds	
70	S-16	b2	13					
75	S-17	b2	14				- trace shells and interbedded fine organics	
80						SM/ ML		

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-27-08

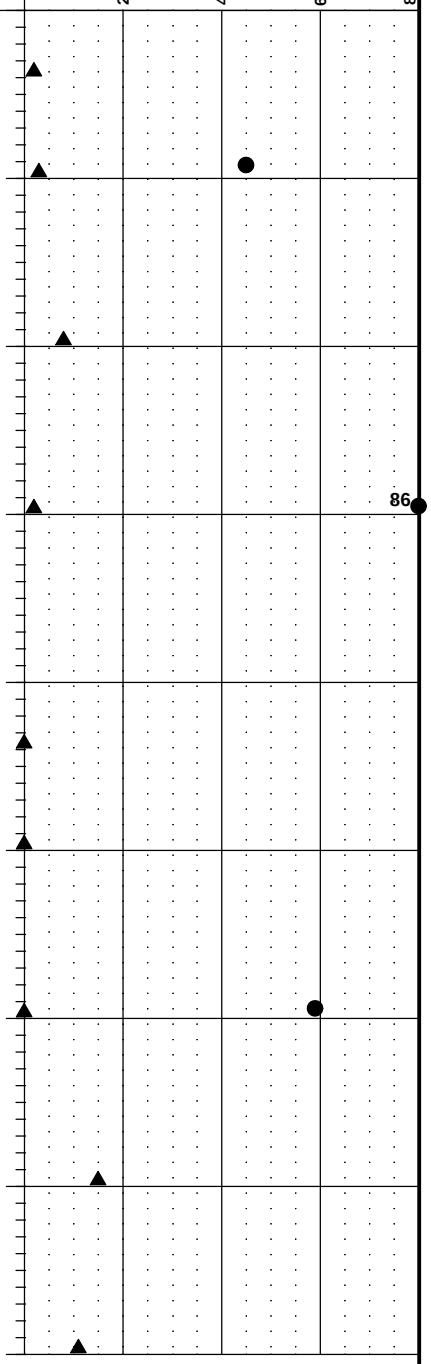
Figure A-28
(2 of 5)

TH-27-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.2 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
80	S-18	c3				SM/ ML	Gray brown, SILT with trace sand and thin (1/16 to 1/2 inch) interbedded silty, fine SAND (very soft to stiff, wet) **(SOIL UNIT 3)**	
	S-19	b2	2					
85	S-20	b2	3	W = 45				
90	S-21	b2	8					
						MH	Gray brown, SILT with scattered fine organics (very soft to soft, wet)	
95	S-22	b2	2	W = 86			- abundant scattered fine organics	
100	S-23	c3		GT				
	S-24	b2	0				- trace scattered fine organics	
						SM/ MH	Gray brown, SILT with scattered fine organics and thin (1/8 to 1 inch) interbedded silty, fine SAND to fine SAND with silt (very soft, wet)	
105	S-25	b2	0					
110	S-26	b2	0	W = 59				
						SP/ SM	Gray, silty, fine SAND with trace thin (1/4 inch) interbedded SILT and trace organics (medium dense, wet)	
115	S-27	b2	15					
120	S-28	b2	11				- grading to fine SAND with trace silt	



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-27-08

Figure A-28
(3 of 5)

TH-27-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.2 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description	Groundwater
120						SP/ SM	Gray, silty, fine SAND with trace thin (1/4 inch) interbedded SILT and trace organics (medium dense, wet)	
						MH	Gray brown, SILT with scattered fine organics and occasional thin (1/8 to 1/2 inch) interbedded fine SAND with silt (soft, wet)	
125	S-29	b2	3	W = 59				
130	S-30	b2	3					
						SP	Gray, fine to medium SAND with trace coarse sand with light brown, SILT interbed (3/4 inch) (medium dense, wet)	
135	S-31	b2	20				**(SOIL UNIT 4)**	
						SP	Gray, gravelly, fine to medium SAND (medium dense, wet)	
						SW/ SP	Gray, fine to medium SAND with interbedded gravelly, fine to coarse SAND (medium dense, wet)	
140	S-32	b2	24					
						SM/ ML	Gray, very silty, fine SAND and fine sandy SILT with thin interbedded fine organics grading to fine to medium SAND (medium dense, wet)	
145	S-33	b2	11					
150	S-34	b2	27					
						GP	Gray, gravelly, fine to medium SAND with silt (medium dense, wet) grading to fine to medium sandy GRAVEL (dense, wet)	
155	S-35	b2	35					
160								

Boring Completed 08/27/08
Total Depth of Boring = 155.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615172.41
East: 796666.23
Township: 17N
Range: 10W
Section: 11

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-27-08

Figure A-28
(4 of 5)

TH-27-08

SAMPLE DATA | **SOIL PROFILE**

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.2 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├─●─┤ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Groundwater	0	20	40	60	80
160												
165												
170												
175												
180												
185												
190												
195												
200												

Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

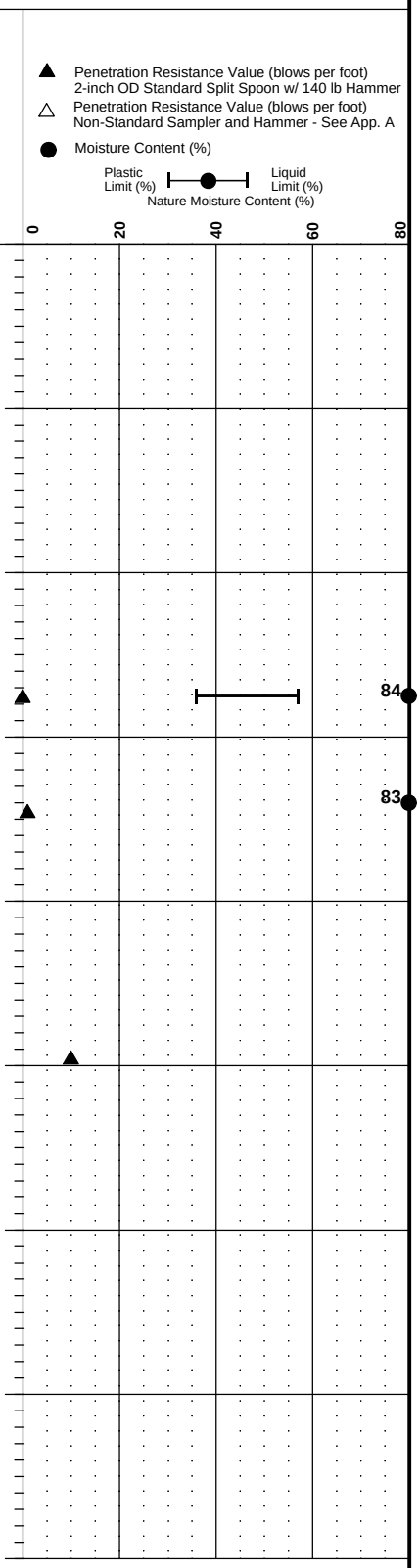
TH-28-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 12.05 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description
0						MH	Gray, SILT with trace sand to with sand and interbedded fine organics (very soft, wet) **(SOIL UNIT 1)**
10	S-1	c3					-12 to 17 feet roots and wood debris (chips)
	S-2	b2	0	W = 84 AL			
15	S-3	c3					
	S-4A S-4b	b2	1	W = 83			
						SM	Gray, fine SAND with silt and interbedded silty, fine SAND with organics (loose, wet)
20	S-5	c3				SM/ MH	Gray brown, SILT with trace sand to with sand and interbedded silty, fine SAND (soft to stiff, wet) **(SOIL UNIT 2B)**
25	S-6	b2	10				
30							
35							
40							

WELL DETAIL



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-28-SW-08

Figure A-29
(1 of 5)

TH-28-SW-08

SAMPLE DATA				SOIL PROFILE			WELL DETAIL
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4" ID (HW) Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710 Ground Elevation (ft): 12.05 (MLLW)
40						SM/ MH	Gray brown, SILT with trace sand to with sand and interbedded silty, fine SAND (soft to stiff, wet) **(SOIL UNIT 2B)**
45							
50							
55							
60							
65							
70							
75							
80							

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├─●─┤ Liquid Limit (%)
Nature Moisture Content (%)

0 20 40 60 80

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-28-SW-08

Figure A-29
(2 of 5)

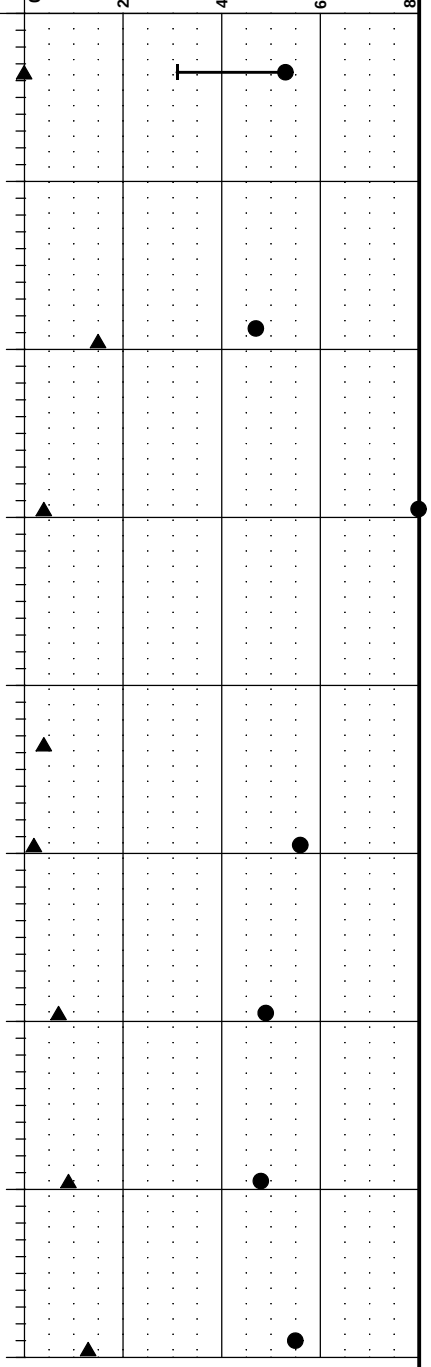
TH-28-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 12.05 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description
80	S-7	c3				SM/ MH	Gray brown, SILT with trace sand to with sand and interbedded silty, fine SAND (soft to stiff, wet) **(SOIL UNIT 2B)**
	S-8	b2	0	W = 53 AL			
85							
90	S-9A S-9B	b2	15	W = 47			
						MH	Gray brown, SILT with scattered fine organics (soft to medium stiff, wet) **(SOIL UNIT 3)**
95	S-10	b2	4	W = 80			
100	S-11	c3					
	S-12	b2	4				- trace scattered fine organics
105	S-13	b2	2	W = 56			- trace shell fragments and fine organics
						SM/ ML	Gray brown, SILT with thin (1/8 to 1/4 inch) interbedded silty, fine SAND (medium stiff to stiff and medium dense, wet)
110	S-14	b2	7	W = 49			
115	S-15	b2	9	W = 48			- trace shell fragments and fine organics
120	S-16A	b2	13	W = 55			

WELL DETAIL

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-28-SW-08

Figure A-29 (3 of 5)

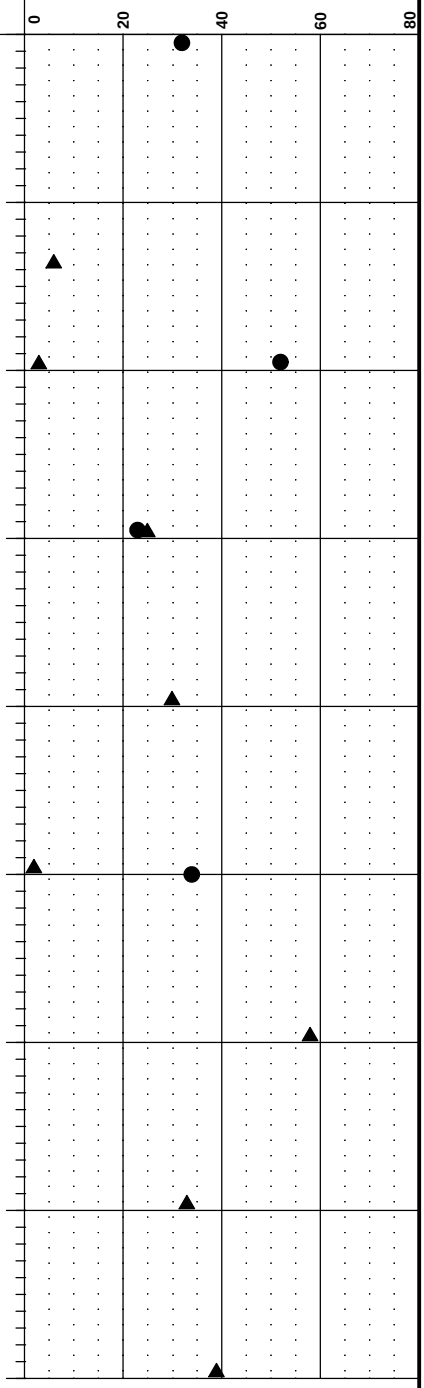
TH-28-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 12.05 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
120	S-16B			W = 32	SM	Gray, fine SAND with silt and occasional thin (1/4 inch) interbedded SILT
					ML	Gray brown, SILT with trace thin (1/8 to 1/4 inch) interbedded fine SAND with silt with trace shell fragments (soft to medium stiff, wet)
125	S-17	c3				
	S-18	b2	6			
130	S-19	b2	3	W = 52		
					SP	Dark gray, fine to medium SAND with trace thin (1/4 inch) interbedded fine organics and wood debris (medium dense, wet)
135	S-20	b2	25	W = 23		
					SM	Dark gray, fine to medium SAND with silt (very loose to dense, wet)
140	S-21A, S-21B, S-21c	b2	30		SP-SM	Dark gray, fine to coarse and fine to medium SAND with trace silt to with silt (dense to loose, wet)
145	S-22A, S-22B	b2	2	W = 34	ML	Gray brown, SILT with trace sand (very soft to soft, wet)
					SP	Gray, fine to medium SAND with gravel (very dense, wet) **(SOIL UNIT 4)**
150	S-23	b2	58		GP	Gray, medium to coarse sandy, GRAVEL (dense to very dense, wet)
155	S-24	b2	33			
160	S-25	b2	39			

WELL DETAIL

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-28-SW-08

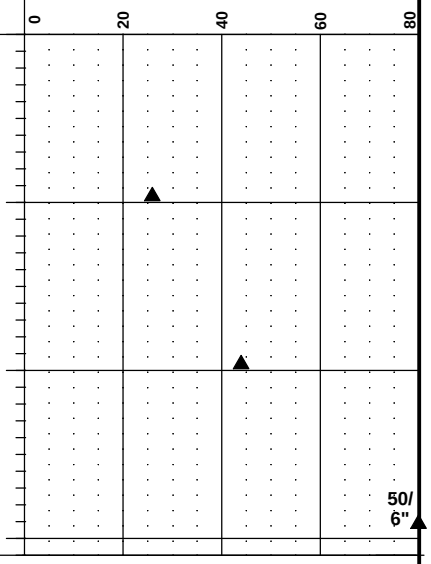
Figure A-29
(4 of 5)

TH-28-SW-08

SAMPLE DATA					SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4" ID (HW) Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710 Ground Elevation (ft): 12.05 (MLLW)
160						GP	Gray, medium to coarse sandy, GRAVEL (dense to very dense, wet)
165	S-26	b2	26				
170	S-27	b2	44				
175	S-28	b2	50/ 6"				
180							
185							
190							
195							
200							

WELL DETAIL

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├●┤ Liquid Limit (%)
Nature Moisture Content (%)



Boring Completed 08/18/08
Total Depth of Boring = 175.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615326.78
East: 796801.72
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-28-SW-08

Figure
A-29
(5 of 5)

TH-29-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 15.96 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├─●─┤ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater	Moisture Content (%)
0						ML/ MH	Gray to dark gray, clayey SILT with sand to trace of fine sand (very soft, wet), includes fine mica flakes and occasional fine organic fibers **(SOIL UNIT 1)**		
5									
10									
15	S-1	c3		GT W = 84 AL					84
	S-2	b2	0	W = 84					84
20	S-3	c3		GT					
	S-4	b2	0	W = 80					80
25									
30						SP-SM	- contact estimated based upon CPT-11, CPT-12a, and CPT-12b **(SOIL UNIT 2B)** (as based upon nearby explorations)		
35									
40									

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

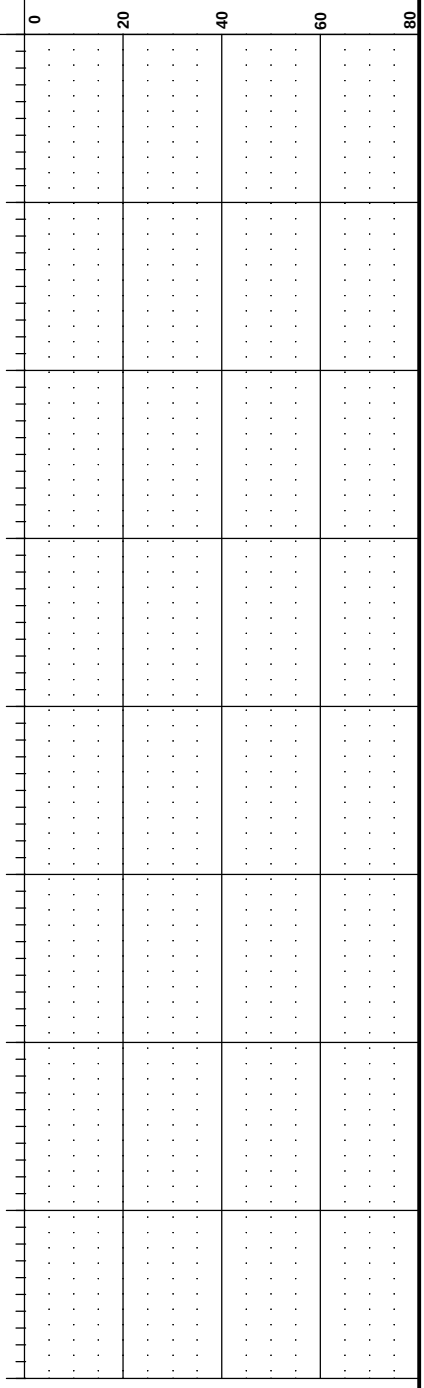
Log of Boring TH-29-SW-08

Figure A-30 (1 of 4)

TH-29-SW-08

SAMPLE DATA				SOIL PROFILE			
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4" ID (HW) Driller (Lic.#): WSDOT - D. Henderson Lic # 2742 Ground Elevation (ft): 15.96 (MLLW)	Groundwater
40						SP-SM	**(SOIL UNIT 2B)** (as based upon nearby explorations)	
45								
50								
55								
60								
65								
70								
75								
80								

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├─●─┤ Liquid Limit (%)
Nature Moisture Content (%)



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

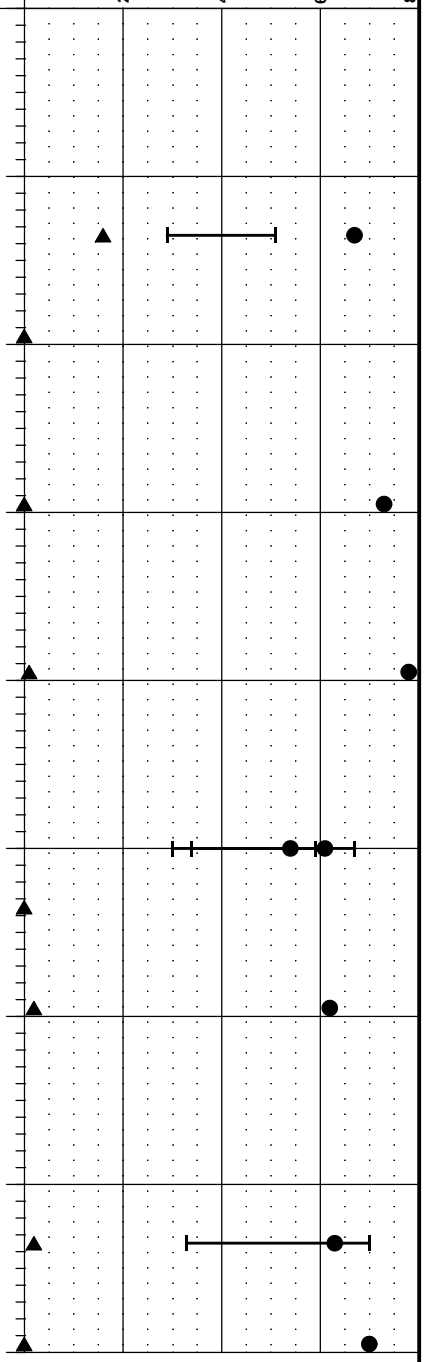
TH-29-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 15.96 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
80					SP-SM	- driller reports softer ground and easier drilling at 82 feet BGS
					MH	Gray, clayey SILT with sand to trace of fine sand, (medium stiff, wet) **(SOIL UNIT 3)**
85	S-5	c3				
	S-6A S-6B	b2	16	W = 67 AL	SP	Gray, fine SAND with trace silt (very loose to medium dense), includes scattered thin layers of silty, fine sand
90	S-7	b2	0			
					MH/CH	Dark gray to dark gray-brown, clayey SILT (very soft to soft, damp to wet), scattered to numerous fine organics throughout
95	S-8	b2	0	W = 73		
100	S-9	b2	1	W = 78		
105	S-10	c3		GT W = 54 AL		
	S-11	b2	0	W = 61 AL		
110	S-12	b2	2	W = 62		
					CH	Dark gray to dark gray-brown, silty CLAY (very soft to soft, wet), scattered to numerous organics throughout
115	S-13	c3				
	S-14	b2	2	W = 63 AL		
120	S-15	b2	0	W = 70		

Groundwater



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-29-SW-08

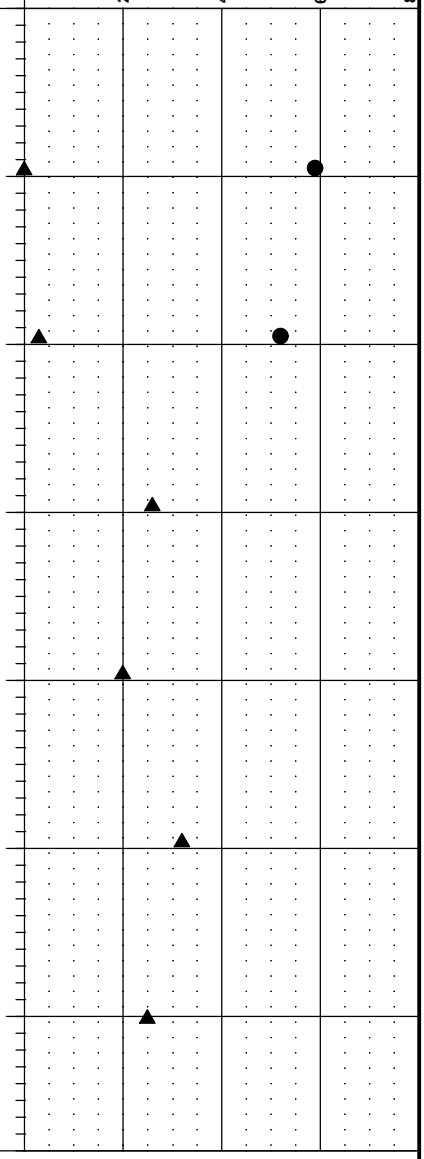
Figure A-30
(3 of 4)

TH-29-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 15.96 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description	Groundwater
120						CH	Dark gray to dark gray-brown, silty CLAY (very soft to soft, wet), scattered to numerous organics throughout	
125	S-16	b2	0	W = 59				
130	S-17	b2	3	W = 52			- sample includes a trace of fine sand	
						SW-SM	Gray, very fine gravelly SAND to SAND with gravel, with silt to trace of silt (medium dense, wet) **(SOIL UNIT 4)**	
135	S-18	b2	26					
140	S-19	b2	20					
						GP	Gray, sandy to very sandy GRAVEL with trace silt (medium dense to dense, wet)	
145	S-20	b2	32					
150	S-21	b2	25				- casing advancer un-retrievable due to mechanical problem with advancer; no bottom sample.	
155								
160								



Boring Completed 08/21/08
Total Depth of Boring = 154.0 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615491.33
East: 796240.04
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-29-SW-08

Figure A-30
(4 of 4)

TH-30-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.93 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
0						ML/ MH	Gray, SILT with trace sand and with trace organics (very soft, wet) **(SOIL UNIT 1)**
15	S-1	c3		GT W = 63 AL			
	S-2	b2	0				
20	S-3	c3					
	S-4	b2	0				
30						SP-SM	**(SOIL UNIT 2B)** (as based upon nearby borings)

WELL DETAIL

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-30-SW-08

Figure A-31
(1 of 7)

TH-30-SW-08

SAMPLE DATA				SOIL PROFILE			WELL DETAIL
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4" ID (HW) Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710 Ground Elevation (ft): 14.93 (MLLW)
40						SP-SM	**(SOIL UNIT 2B)** (as based upon nearby borings)
45							
50							
55							
60							
65							
70							
75							
80							

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

0 20 40 60 80

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

TH-30-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.93 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
80					ML	Gray and gray-brown SILT with trace sand (soft to medium stiff, wet) **(SOIL UNIT 3)**
85	S-5	c3		GT W = 51 AL		
	S-6	b2	4			
					SM	Gray and gray brown, very silty, fine SAND with interbedded fine sandy SILT (loose to very loose, wet)
90	S-7	b2	8	W = 42		
95	S-8	b2	4	W = 50		
					MH	Gray brown, SILT with varying amounts of scattered fine organics and trace shells (very soft to soft, wet)
100	S-9	b2	1			
105	S-10	c3		GT W = 59 AL		
	S-11	b2	1			- trace thin (1/16 to 1/8 inch) interbedded fine SAND with silt
110	S-12	b2	0			
115	S-13	b2	0			
120	S-14	b2	0			- decreasing scattered fine organics

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-30-SW-08

Figure A-31
(3 of 7)

TH-30-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.93 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
120						MH	Gray brown, SILT with varying amounts of scattered fine organics and trace shells (very soft to soft, wet)
125	S-15	c3		GT W = 71 AL			
	S-16	b2	4				- with trace thin (1/16 inch) interbedded silty, fine SAND Gray brown, SILT with scattered fine organics (very soft, moist to wet)
130	S-17	b2	1				
						ML	Gray brown, sandy SILT (soft to medium stiff, wet)
135	S-18	b2	4	W = 37			
						ML/ MH	Gray brown, SILT with trace organics (very soft to medium stifft, wet)
140	S-19	b2	2	W = 47			
145	S-20	b2	0	W = 44			
150	S-21	b2	5	W = 41			
						SP	Gray, gravelly to very gravelly, fine and medium SAND (dense, wet) **(SOIL UNIT 4)**
155	S-22A S-22B S-22c	b2	37			GP-GM	Brown, fine to coarse sandy GRAVEL with trace silt to with silt and medium to coarse sandy GRAVEL (dense to very dense, wet)
160	S-23	b2	33				

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-30-SW-08

Figure A-31
(4 of 7)

TH-30-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.93 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├●┤ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Moisture Content (%)
160						GP-GM	Brown, fine to coarse sandy GRAVEL with trace silt to with silt and medium to coarse sandy GRAVEL (dense to very dense, wet)	
165	S-24	b2	60					
170	S-25	b2	85					85
175	S-26	b2	63					
180	S-27	b2	96				- grading very sandy (fine to coarse)	96
185	S-28	b2	90					90
190	S-29	b2	92					92
195	S-30	b2	35					
200	S-31	b2	101/					101/ 11"

WELL DETAIL

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-30-SW-08

Figure A-31
(5 of 7)

TH-30-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.93 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Moisture Content (%)
200			11"			GP-GM	Brown, fine to coarse sandy GRAVEL with trace silt to with silt and medium to coarse sandy GRAVEL (dense to very dense, wet)	
205	S-32	b2	79			SP	Light brown, fine SAND with trace silt (very dense, wet)	
210	S-33	b2	50/ 6"			GP/ GM	Gray, medium to coarse sandy GRAVEL with trace silt to fine to coarse sandy GRAVEL with silt (dense to very dense, wet)	50/ 6"
215	S-34	b2	67					
220	S-35	b2	39				- sandy less gravel 222 to 223.5 feet	
225	S-36	b2	42					
230	S-37	b2	93					93
235	S-38	b2	83					83
240	S-39	b2	90/					90/ 10"

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

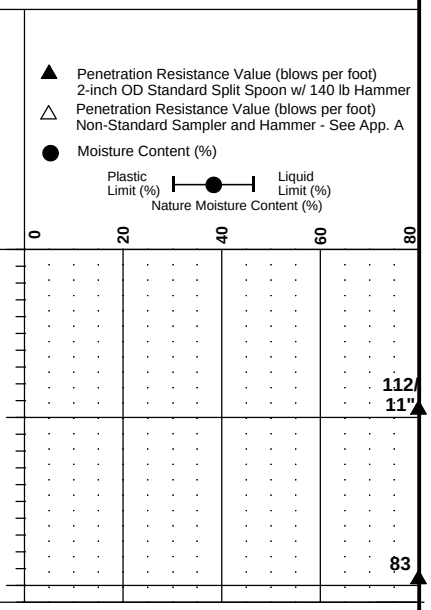
Log of Boring TH-30-SW-08

Figure A-31
(6 of 7)

TH-30-SW-08

SAMPLE DATA					SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4" ID (HW) Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710 Ground Elevation (ft): 14.93 (MLLW)
240			10"			GP/ GM	Gray, medium to coarse sandy GRAVEL with trace silt to fine to coarse sandy GRAVEL with silt (dense to very dense, wet)
245	S-40	b2	112/ 11"				
250	S-41	b2	83				

WELL DETAIL



Boring Completed 08/11/08
Total Depth of Boring = 250.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615132.66
East: 796062.95
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

255
260
265
270
275
280

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-30-SW-08

Figure
A-31
(7 of 7)

TH-31-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.75 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
0						CH	Gray, CLAY with trace sand and with trace shells (very soft to soft, wet) **(SOIL UNIT 1)**
10	S-1	c3					
	S-2	b2	0				
15	S-3	c3		GT W = 72 AL			
	S-4	b2	0				
30						SM	Gray and gray brown, interbedded fine SAND with silt and very sandy SILT with varying amounts of organics and shells (very loose to medium dense and very soft to soft, wet) **(SOIL UNIT 2B)**

WELL DETAIL

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-31-SW-08

Figure A-32 (1 of 6)

TH-31-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.75 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description	Well Detail
40						SM	Gray and gray brown, interbedded fine SAND with silt and very sandy SILT with varying amounts of organics and shells (very loose to medium dense and very soft to soft, wet) **(SOIL UNIT 2B)**	
45	S-5	c3						
	S-6A S-6B	b2	3	W = 32 GS W = 46 GS				
50								
55								
60	S-7	c3						
	S-8	b2	11	W = 30 -200 = 14				
65								
70								
75								
80								

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-31-SW-08

Figure A-32 (2 of 6)

TH-31-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.75 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Nature Moisture Content (%)
80						CH	Gray brown, CLAY with occasional tin (1/16 inch) interbedded fine SAND and trace shells (very soft to soft, wet) **(SOIL UNIT 3)**	
85	S-9	c3		GT W = 53 AL				●
	S-10	b2	0					▲
90	S-11	b2	2	W = 55				●
95	S-12	b2	2			MH	Gray brown, SILT with varying amounts of scattered fine organics and trace shells (very soft to soft, wet)	▲
100	S-13	b2	2	W = 65				●
105	S-14	b2	0					▲
110	S-15	b2	0	W = 70				●
115	S-16	b2	0					▲
120	S-17	b2	0	W = 48		ML		●

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-31-SW-08

Figure A-32
(3 of 6)

TH-31-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.75 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
120				AL		ML	Gray brown, SILT with scattered organics (very soft to soft, wet) trace thin (1/8 to 1/4 inch) interbedded silty, fine SAND
125	S-18	b2	2				
130	S-19	b2	0	W = 53			
135	S-20	b2	1			SP-SM	Gray, fine SAND with silt and wood debris (very loose, wet) **(SOIL UNIT 4)**
140	S-21	b2	21	W = 13		SW	Gray, fine to coarse SAND with trace gravel and with some wood debris (medium dense, wet)
145	S-22	b2	40			GW/GP	Gray, very sandy GRAVEL with trace silt and wood debris (medium dense to dense, wet)
150	S-23	b2	27	W = 10 GS			
155	S-24	b2	36				
160	S-25	b2	48				

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-31-SW-08

Figure A-32
(4 of 6)

TH-31-SW-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.75 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description	Moisture Content (%)
160					GW/ GP	Gray, very sandy GRAVEL with trace silt and wood debris (medium dense to dense, wet)	
165	S-26	b2	28				
					SP	Gray, gravelly, fine to medium SAND with coarse sand (very dense, wet)	
170	S-27	b2	89	W = 19			89
					GP	Gray, (medium to coarse and fine to medium) sandy to very sandy GRAVEL (very dense, wet)	
175	S-28	b2	70				
180	S-29	b2	87			- grading very sandy (fine to coarse)	87
185	S-30	b2	98				98
190	S-31	b2	62				
					SP	Gray, fine SAND (medium dense to dense, wet)	
195	S-32	b2	25				
200	S-33	b2	41			- grading with gravel (dense, wet)	

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-31-SW-08

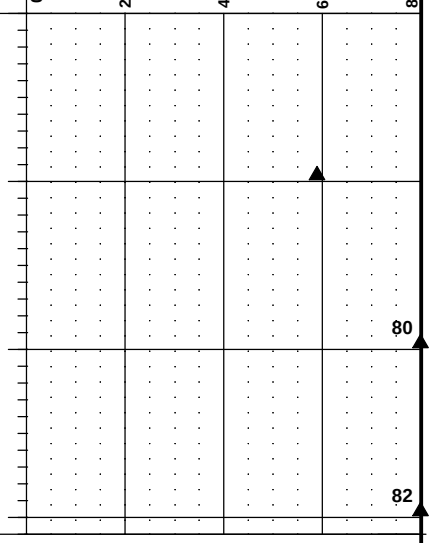
Figure A-32
(5 of 6)

TH-31-SW-08

SAMPLE DATA					SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4" ID (HW) Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710 Ground Elevation (ft): 13.75 (MLLW)
200						SP	
						GP-GM	Brown, fine to coarse sandy GRAVEL with trace silt to with silt (very dense, wet)
205	S-34	b2	59				
						GP	Gray, medium to coarse sandy GRAVEL with trace silt (very dense, wet)
210	S-35	b2	80				
215	S-36	b2	82				

WELL DETAIL

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)



Boring Completed 07/28/08
Total Depth of Boring = 215.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615468.30
East: 795746.16
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-31-SW-08

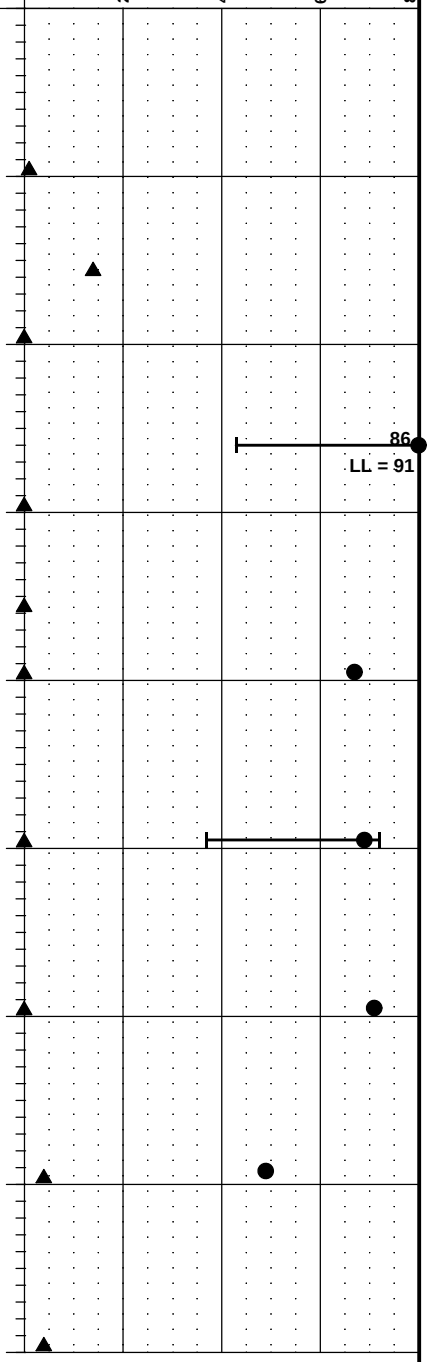
Figure
A-32
(6 of 6)

TH-32-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 14.94 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0						MH	Gray brown, SILT with trace sand and some fine organics (very soft to soft, wet) **(SOIL UNIT 1)**	
							- log approximate 6 diameter encountered	
5	S-1	b2	1	PID=0				
	S-2	b2	14	PID=0			- log approximately 4 diameter encountered	
10	S-3	b2	0	PID=0				
	S-4	c3		GT W = 86 AL				
15	S-5	b2	0	PID=0				
	S-6	b2	0	PID=0				
							- silty, fine SAND interbeds	
20	S-7	b2	0	PID=0 W = 67			- wood and shells	
25	S-8	b2	0	PID=0 W = 69 AL				
30	S-9	b2	0	PID=0 W = 71				
35	S-10	b2	4	W = 49		SM/ ML	Gray brown, SILT with sand and interbedded silty, fine SAND (soft to medium stiff and loose to medium dense, wet) **(SOIL UNIT 2B)**	
40	S-11	b2	4					



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-32-08

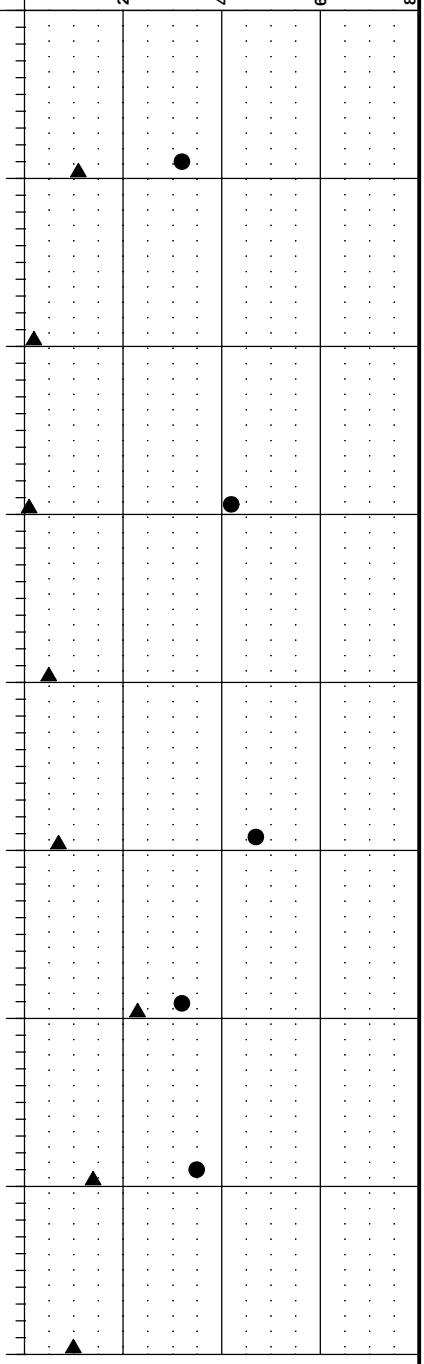
Figure A-33 (1 of 4)

TH-32-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 14.94 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
40						SM/ ML	Gray brown, SILT with sand and interbedded silty, fine SAND (soft to medium stiff and loose to medium dense, wet) **(SOIL UNIT 2B)** - shells	
45	S-12	b2	11	W = 32				
50	S-13	b2	2					
55	S-14	b2	1	W = 42			- decomposed wood fragments	
60	S-15	b2	5					
65	S-16	b2	7	W = 47				
70	S-17	b2	23	W = 32		SM	Gray, silty, fine SAND to fine SAND with silt and occasional thin (1/8 to 1/4 inch) interbedded light brown, SILT (loose to medium dense, wet)	
75	S-18	b2	14	W = 35			- decomposed wood debris	
80	S-19	b2	10				- trace shells	



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-32-08

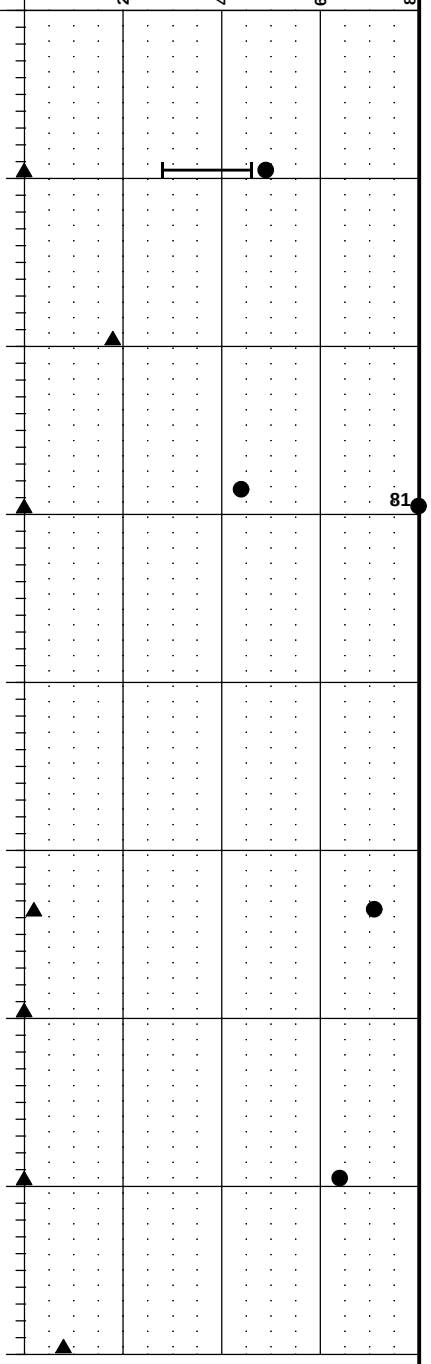
Figure A-33
(2 of 4)

TH-32-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 14.94 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description	Groundwater
80						SM		
						ML	Gray brown, SILT with thin (1/32 to 1/16 inch) interbedded fine SAND with silt and trace organics (very soft, wet) **(SOIL UNIT 3)**	
85	S-20	b2	0	W = 49 AL				
						SP/ SM	Gray, fine SAND with silt grading to silty, fine SAND and trace shell fragments and occasional interbedded SILT (medium dense, wet)	
90	S-21	b2	18					
95	S-22A S-22B	b2	0	W = 44 W = 81		MH	Light brown, SILT with scattered fine organics (very soft to soft, wet)	
100	S-23	c3						
105	S-24	c3						
	S-25	b2	2	W = 71				
110	S-26	b2	0					
115	S-27	b2	0	W = 64				
						SM/ ML	Light brown, SILT with scattered fine organics grading to fine SAND with silt (medium stiff to stiff and loose, wet)	
120	S-28	b2	8					



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-32-08

Figure A-33
(3 of 4)

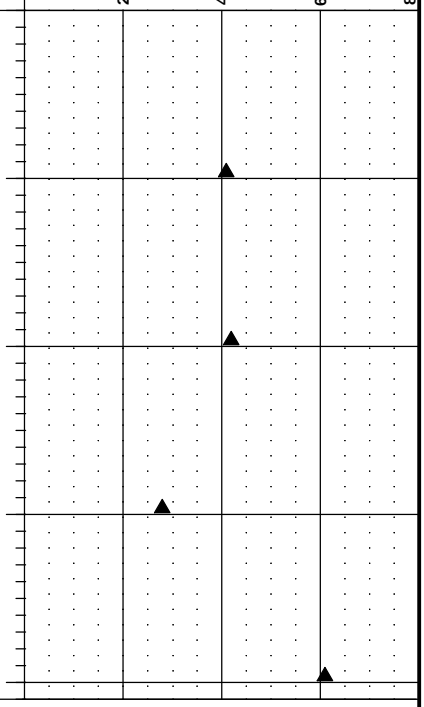
TH-32-08

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 14.94 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├●┤ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description	Groundwater
120						SM/ ML	- trace thin (1/16 to 1/8 inch) interbedded fine SAND with silt Light brown, SILT with scattered fine organics grading to fine SAND with silt (medium stiff to stiff and loose, wet)	
						GP	Gray, very sandy to sandy GRAVEL (medium dense to very dense, wet) **(SOIL UNIT 4)**	
125	S-29	b2	41					
130	S-30	b2	42					
135	S-31	b2	28					
140	S-32	b2	61					
145								
150								
155								
160								



Boring Completed 08/29/08
Total Depth of Boring = 140.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615777.36
East: 796064.14
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-32-08

Figure A-33
(4 of 4)

TH-33-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 15.00 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater
0						ML	Gray, SILT with trace sand and trace interbedded fine organics (very soft to soft, wet) **(SOIL UNIT 1)**	
5	S-1	g2	3	PID=0		WD	- Wood; at 4.5 feet approximately 6 inch diameter log; at 6 feet milled Lumber	
	S-2	g2	3	PID=0				
	S-3	g2	4	PID=0		ML	Gray, SILT with trace sand and trace interbedded fine organics (very soft to soft, wet)	
10	S-4	g2	0	PID=0			- scattered wood debris and scattered shell fragments	
	S-5	g2	0	PID=0 W = 72				
	S-6	g2	0	PID=0				
15	S-7	c3		GT				
	S-8	g2	0	PID=0			- trace shell fragments	
	S-9	g2	0	PID=0				
20	S-10	g2	0	PID=0				
	S-11A S-11B	g2	0	PID=0 W = 68 W = 64				
	S-12	g2	0	PID=0				
25	S-13	g2	0	PID=0 W = 51		SM	Dark gray to black, very silty, fine SAND with trace shells (very loose, wet)	
	S-14	g2	0	PID=0				
	S-15	g2	7	PID=0		SM	Gray, very silty, fine SAND to fine SAND with silt and occasional thin (1/2 inch) interbedded light brown, SILT (very loose loose, wet) **(SOIL UNIT 2B)**	
30	S-16	g2	2	PID=0 W = 42 GS				
35	S-17	b2	3	W = 33			- trace wood (twig 1/2 diameter)	
						SM/ ML	Gray brown, SILT and fine SAND with silt (very soft to soft and very loose, wet)	
40	S-18	b2	1					

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-33-08

Figure A-34 (1 of 4)

TH-33-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 15.00 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater
40						SM/ ML	Gray brown, SILT and fine SAND with silt (very soft to soft and very loose, wet)	
45	S-19	b2	2	W = 59				
50	S-20	b2	2					
						SP-SM	Gray, fine SAND with silt and thin (1/16 to 1 inch) interbedded light brown, very silty, fine SAND with trace decomposed wood debris (loose to medium dense, wet)	
55	S-21	b2	2	W = 39				
60	S-22	b2	6	W = 39 GS				
65	S-23	b2	13	W = 38				
						SM	Gray, silty, fine SAND with organics (loose, wet)	
70	S-24	b2	9					
						SP-SM	Gray, fine SAND with silt and trace thin (1/8 inch) interbedded light brown, SILT and trace decomposed wood debris and fine organics (medium dense, wet)	
75	S-25	b2	12	W = 39				
80	S-26A	b2	3					

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-33-08

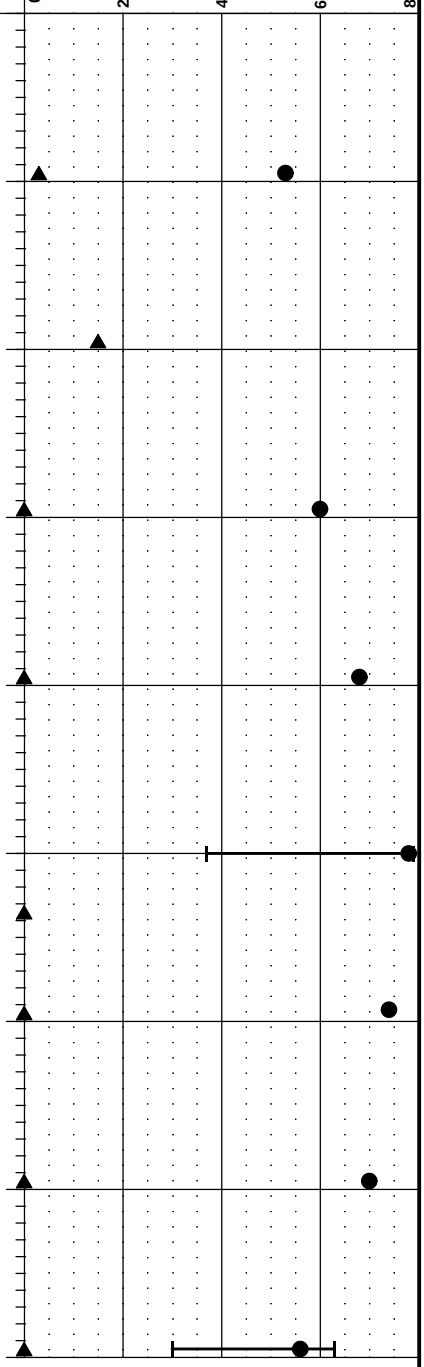
Figure A-34
(2 of 4)

TH-33-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 15.00 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater
80	S-26B					ML	Gray brown, SILT with thin (1/2 to 3/4 inch) interbedded fine SAND with silt and trace organics (soft, wet) **(SOIL UNIT 3)**	
85	S-27	b2	3	W = 53				
						SP-SM	Gray, fine SAND with trace silt and occasional thin (1/4 inch) light brown, SILT (very loose to medium dense, wet)	
90	S-28	b2	15					
						MH	Gray brown, SILT with trace scattered fine organics (very soft, wet)	
95	S-29	b2	0	W = 60				
100	S-30	b2	0	W = 68				
105	S-31	c3		GT W = 78 AL				
	S-32	b2	0					
110	S-33	b2	0	W = 74				
115	S-34	b2	0	W = 70				
						CH	Gray brown, CLAY with trace scattered fine organics (very soft, wet)	
120	S-35	b2	0	W = 56				



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-33-08

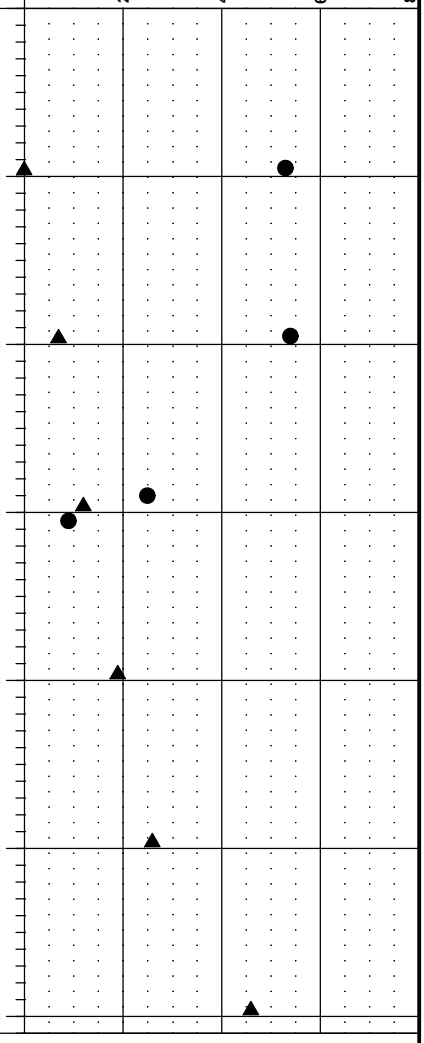
Figure A-34 (3 of 4)

TH-33-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 15.00 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater
120				AL		CH	Gray brown, CLAY with trace scattered fine organics (very soft, wet)	
125	S-36	b2	0	W = 53			- trace thin (1/32 to 1/16 inch) interbedded fine SAND	
						ML	Light brown, SILT with thin (1/16 to 1/2 inch) interbedded fine SAND with trace silt (medium stiff, wet)	
130	S-37	b2	7	W = 54				
						SP	Gray, fine to medium SAND with trace silt and gravel (medium dense, wet) **(SOIL UNIT 4)**	
135	S-38A S38B	b2	12	W = 25 W = 9		GP	Gray, fine to medium to medium to coarse sandy GRAVEL with trace silt (medium dense, wet)	
140	S-39A S-39B	b2	19				- interbedded Gray brown, SILT	
145	S-40	b2	26					
150	S-41	b2	46					
155								
160								



Boring Completed 09/03/08
Total Depth of Boring = 150.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615744.46
East: 796202.86
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

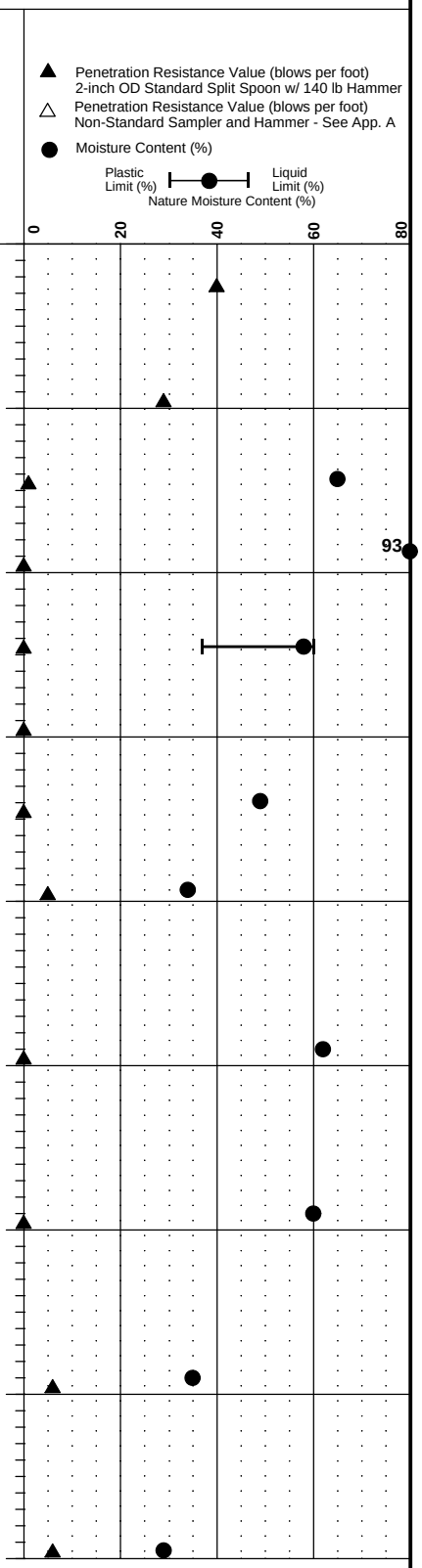
Log of Boring TH-33-08

Figure A-34
(4 of 4)

TH-34-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 16.54 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Profile	Groundwater
0	S-1	b2	40		GP	Gray, sandy GRAVEL (medium dense to dense, moist) **(GRANULAR ROAD MATERIAL)**	
5	S-2	b2	29				
	S-3	b2	1	W = 65	ML	Black to dark gray, SILT with sand and fine organics (very soft, wet) **(SOIL UNIT 1)**	
10	S-4	b2	0	W = 93			
	S-5	b2	0	W = 58 AL	MH	Gray, SILT with sand and trace organics (very soft, wet)	
15	S-6	b2	0		WD	Dark brown, WOOD (wood chips and fine organics) with silt and fine sand (very soft, wet)	
	S-7	b2	0	W = 49	ML	Gray brown, SILT with sand to trace sand (very soft, wet)	
20	S-8	b2	5	W = 34	SM	Dark gray, silty, fine SAND (loose, wet)	
25	S-9	b2	0	W = 62	SM/ ML	Gray brown, interbedded silty, fine SAND, fine SAND with silt, and fine sandy SILT with scattered interbeds of fine organics (very soft and very loose, wet)	
30	S-10	b2	0	W = 60			
35	S-11	b2	6	W = 35	SP/ SM	Dark gray, fine to medium SAND with thin (1/4 to 1/8 inch) interbedded brown, SILT and occasional fine organics and trace shells (loose, wet) **(SOIL UNIT 2B)**	
40	S-12	b2	6	W = 29		- with trace coarse sand and no silt	



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

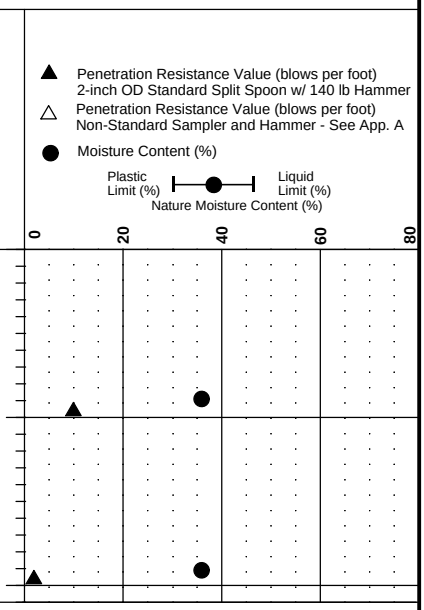
Log of Boring TH-34-08

Figure A-35 (1 of 2)

TH-34-08

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description	Groundwater
40				-200 = 9		SP/ SM	interbeds	
						SP-SM	Gray, fine SAND with silt with thin (1/8 inch) interbedded SILT with shells and trace organics (loose to medium dense, wet)	
45	S-13	b2	10	W = 36				
						ML	Gray brown, SILT with thin (1/8 to 1/2 inch) interbedded fine SAND with silt (very soft to soft, wet)	
50	S-14	b2	2	W = 36				

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 16.54 (MLLW)



Boring Completed 07/02/08
Total Depth of Boring = 50.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615963.06
East: 795380.79
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

55
60
65
70
75
80

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-34-08

Figure
A-35
(2 of 2)

TH-35-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 15.21 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0						SM	Mottled brown, reddish brown, and gray, silty, fine SAND to fine SAND with silt (very loose, wet) **(SOIL UNIT 1)**	
5	S1	g2	3	PID=0 W = 47				
	S2A S2B	g2	4	PID=0		ML	Dark brown, SILT with trace sand with abundant fine organics (soft, wet)	
	S3	g2	50/4"	PID=0		WD	Wood	
10	S4	g2	1	PID=0 W = 71		ML	Dark gray, SILT with trace sand (very soft to soft, wet)	
	S5	g2	0	PID=0				
	S6	g2	0	PID=0 W = 70			- grading to black, and occasional silty, fine SAND interbeds	
15	S7	g2	0	PID=0			- trace shells 14 to 29 feet	
	S8	g2	0	PID=0 W = 74			- grading to gray brown	
	S9	g2	1	PID=0			- wood approximately 2" diameter	
20	S10	g2	0	PID=0			- wood approximately 3" diameter	
	S11	g2	0	PID=0				
	S12	g2	0	PID=0 W = 54				
25	S13	g2	0	PID=0			- interbedded fine sandy SILT	
	S14	g2	2	PID=0				
	S15	g2	0	PID=0			- grading to SILT with sand and very fine sandy SILT with decomposed wood debris and twigs	
30	S16	g2	1	PID=0 W = 54				
35	S17	b2	1	PID=0 W = 70		SM/ML	Gray brown, SILT with thin (1/2 to 1/16 inch) interbedded fine SAND with silt and trace shell and fragments and fine organics (very soft to soft, wet) **(SOIL UNIT 2B)**	
40	S18	b2	2	PID=0				

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-35-08

Figure A-36 (1 of 2)

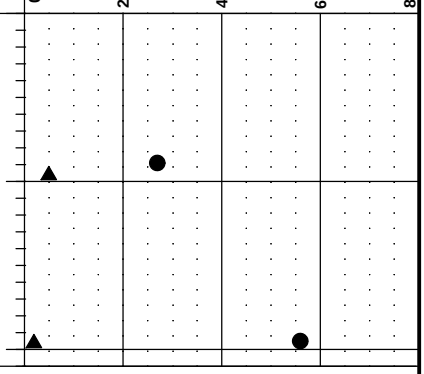
TH-35-08

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
40				W = 46	SM/ ML	
					SM	Gray, fine SAND with silt and thin (1/4 to 1/8 inch) interbedded light brown, SILT with some shells (loose, wet)
45	S19	b2	5	PID=0 W = 27		
					SM/ ML	Gray brown, interbedded SILT with trace sand and gray, silty, fine SAND with trace shells (very soft to soft and very loose, wet)
50	S20	b2	2	PID=0 W = 56		

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 15.21 (MLLW)

Groundwater

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)



Boring Completed 09/09/08
Total Depth of Boring = 50.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615859.47
East: 796176.13
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

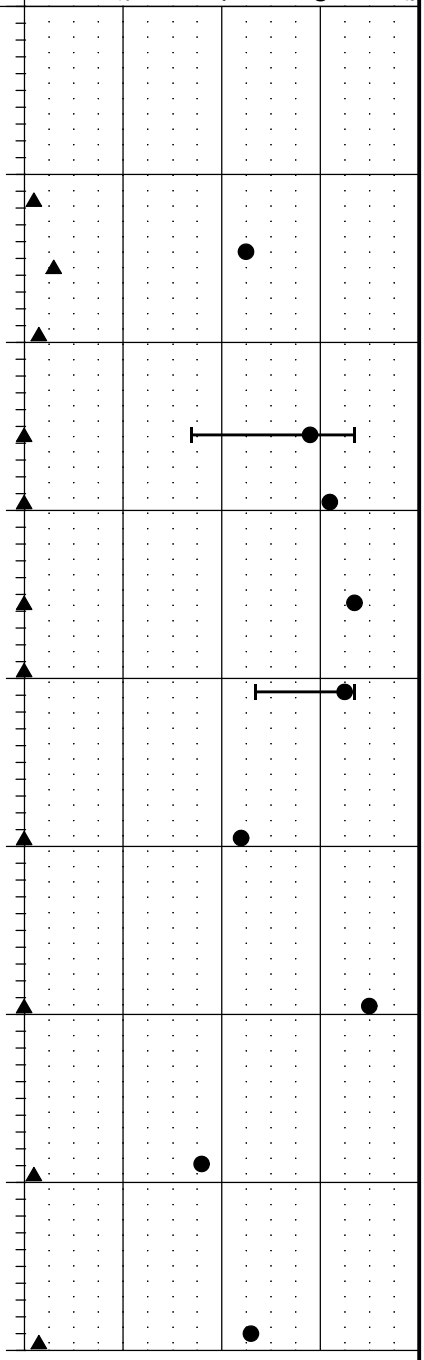
Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

TH-36-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 13.25 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0						GP	Dark gray, fine to medium sandy GRAVEL with petroleum like odor (very loose, wet) **(ROAD FILL MATERIAL)**	
5	S1	b2	2					
	S2	b2	6	W = 45		ML	Dark gray, SILT with wood with petroleum like odor (soft to medium stiff, wet) **(SOIL UNIT 1)**	
10	S3	b2	3	GT		WD	Wood with petroleum like odor	
						MH	Gray brown, SILT (very soft, wet)	
	S4	b2	0	W = 58 AL				
15	S5	b2	0	CA W = 62				
	S6	b2	0	W = 67				
20	S7	b2	0	W = 65 AL		SM/ MH	- with trace thin (1/32 to 1/16 inch) interbedded fine SAND with silt (very soft, wet) Gray brown, SILT with sand and interbedded silty, fine SAND (very soft and very loose, wet)	
						SM	Gray brown, silty, fine SAND with medium sand and some shell fragments and some thin interbedded SILT (very loose, wet)	
25	S8	b2	0	W = 44				
						ML	Gray brown, fine sandy SILT with some thin (1/2 to 1/4 inch) interbedded fine SAND with silt and some fine organics and trace shells (very soft, wet)	
30	S9	b2	0	W = 70				
						SM/ ML	Dark gray, interbedded fine SAND with silt and SILT (soft and very loose, wet) **(SOIL UNIT 2B)**	
35	S10	b2	2	W = 36				
40	S11	b2	3	W = 46				



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-36-08

Figure A-37 (1 of 2)

TH-36-08

SAMPLE DATA					SOIL PROFILE				
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4" ID (HW) Driller (Lic.#): WSDOT - D. Henderson Lic # 2742 Ground Elevation (ft): 13.25 (MLLW)	Groundwater	

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├─●─┤ Liquid Limit (%)
Nature Moisture Content (%)
0 20 40 60 80

40
45
50
55
60
65
70
75
80

Boring Completed 09/08/08
Total Depth of Boring = 40.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 616057.66
East: 796460.29
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

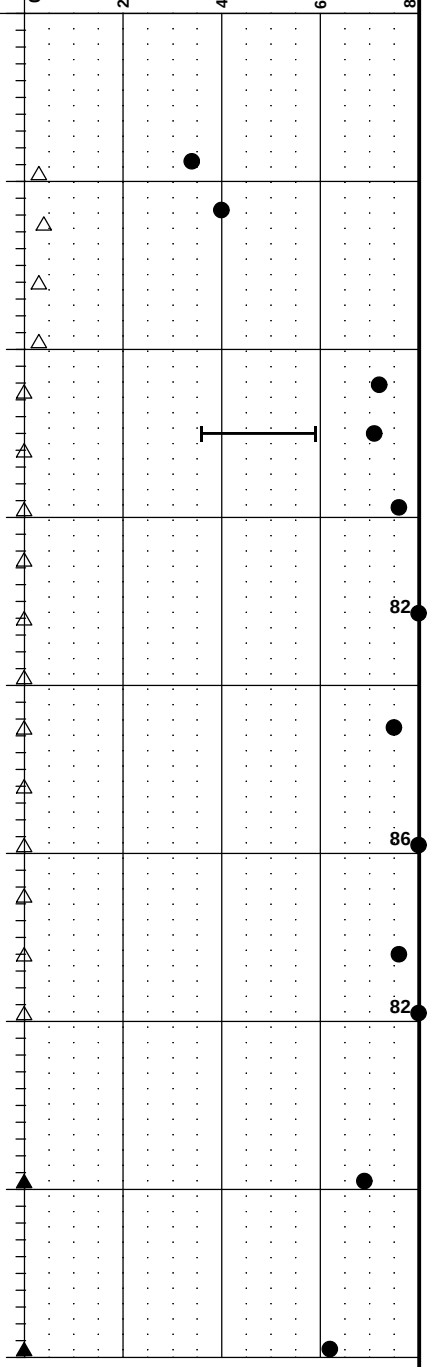
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

TH-37-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 14.43 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0						SP-SM	Gray and light reddish brown, gravelly, fine SAND with silt and wood debris and coal fragments at 5 feet (very loose to loose, wet) **(SOIL UNIT 1)**	
5	S1	g2	3	PID=0 W = 34 GS				
	S2	g2	4	PID=0 W = 40				
	S3A S3B	g2	3	PID=0			- grading to dark gray, very sandy SILT with organics	
						WD	Wood and decomposed sawdust	
10	S4	g2	3	PID=0				
	S5	g2	0	PID=0 W = 72		MH	Dark gray grading to gray brown, SILT with trace sand and trace organics, with some wood at 11 feet (very soft, wet)	
	S6	g2	0	PID=0 W = 71 AL				
15	S7	g2	0	PID=0 W = 76				
	S8	g2	0	PID=0				
	S9	g2	0	PID=0 W = 82			- shell fragments	
20	S10	g2	0	PID=0				
	S11	g2	0	PID=0 W = 75			- occasional fine sandy SILT interbeds	
	S12	g2	0	PID=0				
25	S13	g2	0	PID=0 W = 86				
	S14	g2	0	PID=0				
	S15	g2	0	PID=0 W = 76				
30	S16	g2	0	PID=0 W = 82				
35	S17	b2	0	PID=0 W = 69		ML	Gray brown, SILT with occasional thin (1/4 to 1/8 inch) interbedded fine SAND with silt (very soft, wet)	
40	S18	b2	0	PID=0			- increasing interbedded fine SAND with	



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-37-08

Figure A-38 (1 of 2)

TH-37-08

SAMPLE DATA				SOIL PROFILE			
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4" ID (HW) Driller (Lic.#): WSDOT - D. Henderson Lic # 2742 Ground Elevation (ft): 14.43 (MLLW)
40				W = 62			silt

Groundwater

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)

Plastic Limit (%) ├─●─┤ Liquid Limit (%)
Nature Moisture Content (%)

0 20 40 60 80

Boring Completed 09/09/08
Total Depth of Boring = 40.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615724.44
East: 796434.54
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

45 50 55 60 65 70 75 80

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-37-08

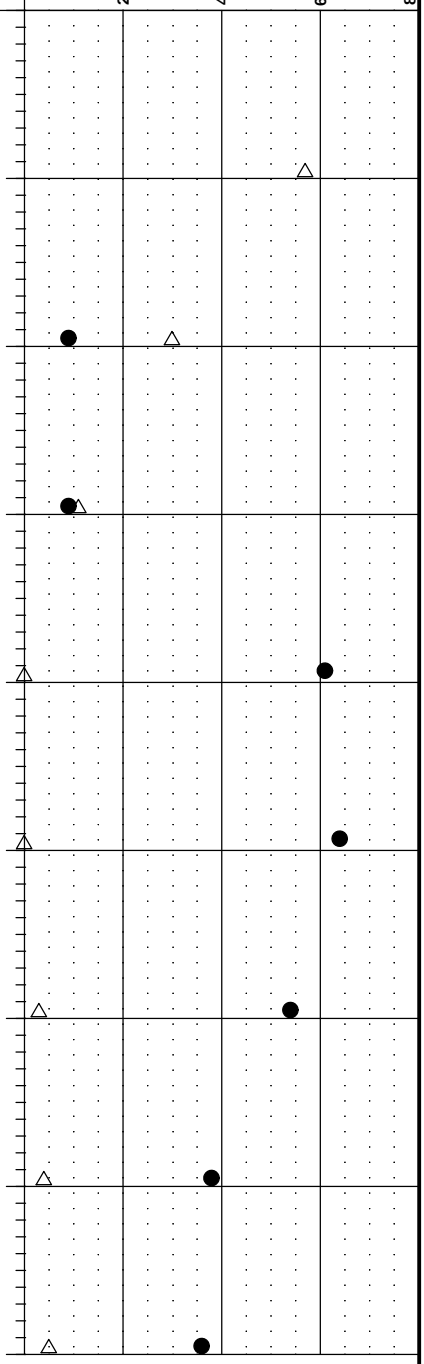
Figure A-38
(2 of 2)

TH-38-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 15.46 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0						GP-GM	Dark gray brown, fine to coarse GRAVEL with sand and trace silt to sandy GRAVEL (very dense to medium dense, moist to wet) **(DIKE FILL)**	
5	S-1	g2	57					
10	S-2	g2	30	W = 9 GS				
15	S-3	g2	11	W = 9 GS				
						ML	Gray to dark gray, SILT with trace sand and interbedded SILT with sand (very soft, wet) **(SOIL UNIT 1)**	
20	S-4	g2	0	W = 61				
25	S-5	g2	0	W = 64				
						SM/ML	Gray, fine SAND with silt to very sandy SILT and thin (1/8 to 1/4 inch) interbedded light brown, SILT (very loose and soft, wet) **(SOIL UNIT 2B)**	
30	S-6	g2	3	W = 54 -200 = 66				
35	S-7	g2	4	W = 38 -200 = 38			- grading to very silty, fine SAND (very loose to loose, wet0	
40	S-8	g2	5	W = 36			- less interbedded SILT with sand and with	



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-38-08

Figure A-39 (1 of 2)

TH-38-08

SAMPLE DATA					SOIL PROFILE				
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4" ID (HW) Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710 Ground Elevation (ft): 15.46 (MLLW)	Groundwater	
40				-200 = 23			organics and shells		

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├─●─┤ Liquid Limit (%)
Nature Moisture Content (%)
0 20 40 60 80

Boring Completed 07/15/08
Total Depth of Boring = 40.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 614863.83
East: 796734.54
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

45 50 55 60 65 70 75 80

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-38-08

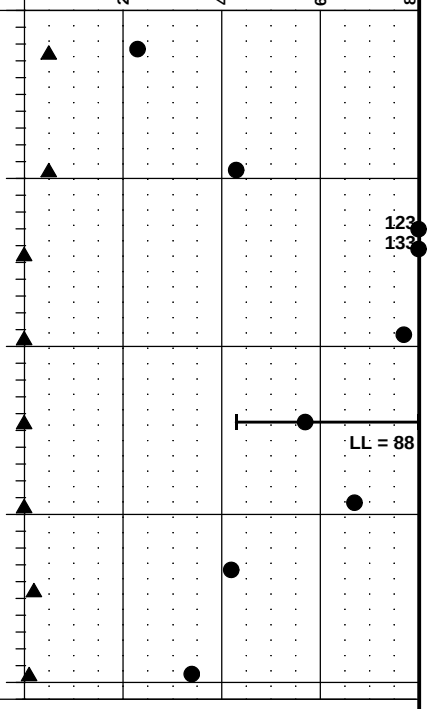
Figure A-39
(2 of 2)

TH-39-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.95 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0	S-1	b2	5	W = 23		SM	Mottled reddish brown and gray, silty, fine SAND with roots (loose, moist to wet) **(SOIL UNIT 1)**	
5	S-2	b2	5	W = 43 -200 = 44		SP-SM	Gray, very silty, fine SAND (loose, wet)	
	S-3	b2	0	W = 123 W = 133		ML	Dark gray and brown, fine sandy SILT with interbedded partially decomposed wood (very soft, wet)	
10	S-4	b2	0	W = 77		MH	Dark gray to black, SILT with occasional fine organics and wood (very soft, wet)	
	S-5	b2	0	W = 57 AL				
15	S-6	b2	0	W = 67			- with interbedded fine sandy SILT	
	S-7	b2	2	W = 42		SM	Dark gray, fine sandy silt with interbedded SILT (very soft, wet)	
20	S-8	b2	1	W = 34 -200 = 13		SM	Dark gray, fine SAND with silt (loose, wet) **(SOIL UNIT 2B)**	



Boring Completed 06/26/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615701.26
East: 795733.46
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-39-08

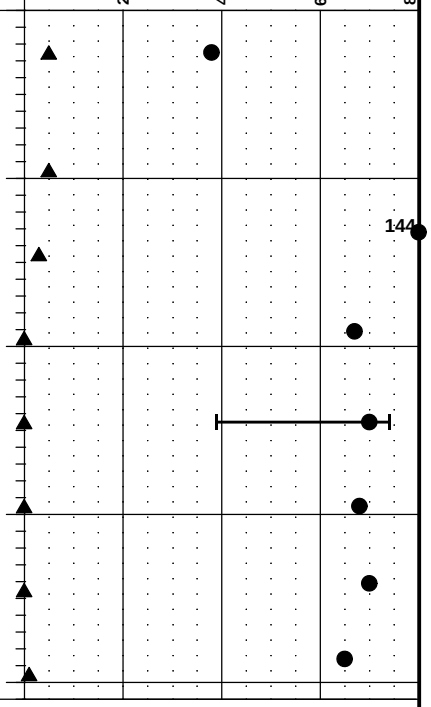
Figure A-40

TH-40-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.59 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description	Groundwater
0	S-1	b2	5	W = 38 GS		SM	Mottled reddish brown and gray brown, silty, fine SAND and fine SAND with silt (loose, moist to wet)	
						WD	**(SOIL UNIT 1)** Dark brown, WOOD (medium stiff, wet)	
5	S-2	b2	5					
	S-3	b2	3	W = 144		MH	Dark gray, SILT with wood and fine organics (very soft to soft, wet)	
10	S-4	b2	0	W = 67				
	S-5	b2	0	W = 70 AL			- no wood and trace organics	
15	S-6	b2	0	W = 68			- becoming with SAND interbeds and trace shells	
	S-7	b2	0	W = 70				
20	S-8	b2	1	W = 65				



Boring Completed 07/01/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615653.37
East: 795930.23
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-40-08

Figure A-41

TH-41-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.84 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0	S-1	b2	7	W = 26		SP-SM	Reddish brown, fine SAND with silt and fine to medium SAND with silt grading to with coarse sand and fine gravel (loose, moist)	
						ML	**(SOIL UNIT 1)** Gray, SILT with trace organics and fine sandy SILT with increasing decomposed wood (very soft, wet)	
5	S-2	b2	1	W = 67				
	S-3	b2	2			WD	WOOD and gray SILT with trace sand (very soft to soft, wet)	
						ML	Gray, SILT and interbedded SILT with sand (very soft, wet)	
10	S-4	b2	0	W = 76				
	S-5	b2	0	W = 74				
15	S-6A	b2	3	W = 66				
	S-6B			W = 28		SM	Gray, silty, fine SAND with organics (very loose, wet)	
	S-7	b2	3	W = 48			- with interbedded SILT with sand	
20	S-8	b2	4	W = 39 -200 = 13		SM	Gray, fine SAND with silt (very loose, wet) **(SOIL UNIT 2B)**	
25								
30								
35								
40								

Boring Completed 06/30/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615827.95
East: 795838.92
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-41-08

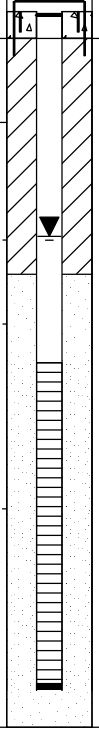
Figure A-42

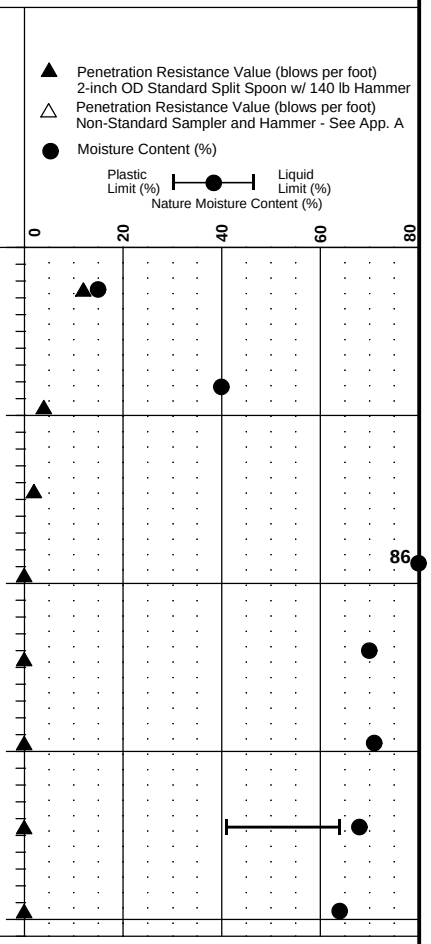
TH-42P-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.73 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Profile
0	S-1	b2	12	W = 15 GS	SM	Reddish brown, silty, fine to medium SAND with gravel and fine SAND with silt and with crushed rock and roots (medium dense, moist)
					SM	**(SOIL UNIT 1)** Gray, silty, fine SAND with abundant brick and concrete debris (loose, wet)
5	S-2	b2	4	W = 40		
	S-3	b2	2		WD	WOOD debris with sandy SILT (very soft to soft, wet)
10	S-4	b2	0	W = 86	ML	Dark gray to black, SILT with trace sand and with wood (very soft, wet)
	S-5	b2	0	W = 70		
						- becoming gray brown
15	S-6	b2	0	W = 71	MH	Gray brown, SILT with trace sand and interbedded fine sandy SILT and trace organic interbeds and trace shell fragments (very soft, wet)
	S-7	b2	0	W = 68 AL		
20	S-8	b2	0	W = 64		- with thin interbeds of wood chips

WELL DETAIL





Boring Completed 07/02/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: APJ-618

Point located at State Plane Coordinates:
North: 615516.36
East: 797330.78
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Total Depth of Piezometer = 20.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-42P-08

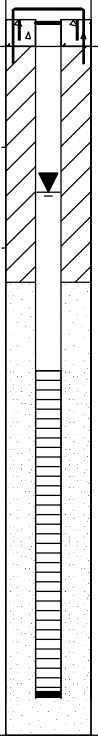
Figure A-43

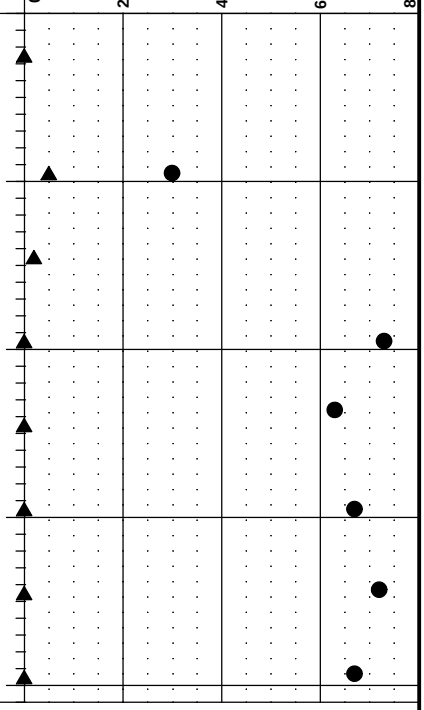
TH-43P-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 12.01 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile
0	S-1	b2	0			ML	Reddish brown and light brown, SILT with trace sand with roots (very soft, wet) **(SOIL UNIT 1)**
5	S-2	b2	5	W = 30 GS		SP-SM	Dark gray, fine SAND with silt (loose, wet)
	S-3	b2	2			ML	Dark gray, SILT with sand and wood (very soft to soft, wet)
10	S-4	b2	0	W = 73 GS			
	S-5	b2	0	W = 63			
15	S-6	b2	0	W = 67			- with very thin (1/32 inch) silty, fine SAND interbeds with some scattered fine organics and trace shell fragments
	S-7	b2	0	W = 72			
20	S-8	b2	0	W = 67			

WELL DETAIL





Boring Completed 06/25/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: APJ-620

Point located at State Plane Coordinates:
North: 615028.32
East: 796799.64
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Total Depth of Piezometer = 20.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-43P-08

Figure A-44

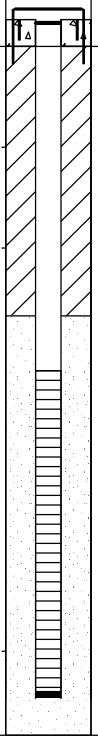
TH-44P-08

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.24 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
0	S-1	b2	4	W = 41		SP/ SM	Reddish brown, fine SAND with silt and silty, fine SAND with roots (very loose to loose, moist to wet) **(SOIL UNIT 1)**
5	S-2	b2	0	W = 43 GS		SM	Dark gray, very silty, fine SAND with roots (very loose, wet)
	S-3	b2	0	W = 99		MH	Dark gray, SILT with wood (very soft, wet)
10	S-4	b2	0	W = 83 AL			
	S-5	b2	0	W = 69			- with interbedded SILT with sand
15	S-6	b2	0	W = 70			
	S-7	b2	0	W = 75			- becoming gray brown
20	S-8	b2	0	W = 63 -200 = 68		SM/ ML	Gray brown,very sandy SILT with thin interbedded silty, fine SAND with some fine organics (very soft and very loose, wet)
25							
30							
35							
40							

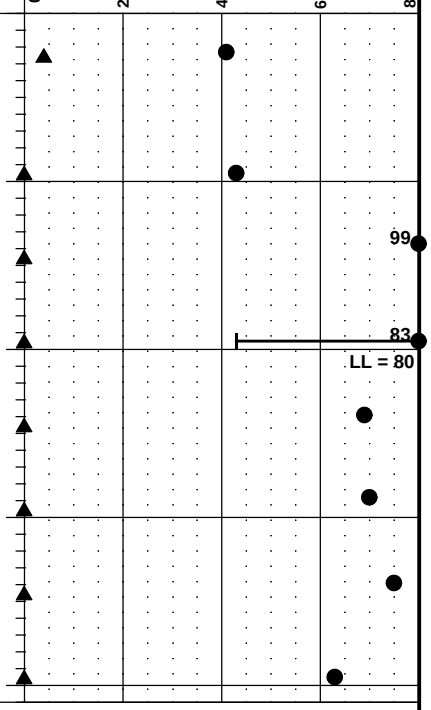
WELL DETAIL



Penetration Resistance Value (blows per foot) / Moisture Content (%)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)

Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)



Boring Completed 06/24/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: APJ-619

Point located at State Plane Coordinates:
North: 614985.55
East: 796588.13
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Total Depth of Piezometer = 20.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-44P-08

Figure A-45

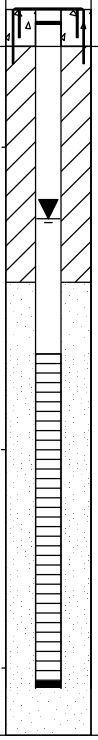
TH-45P-08

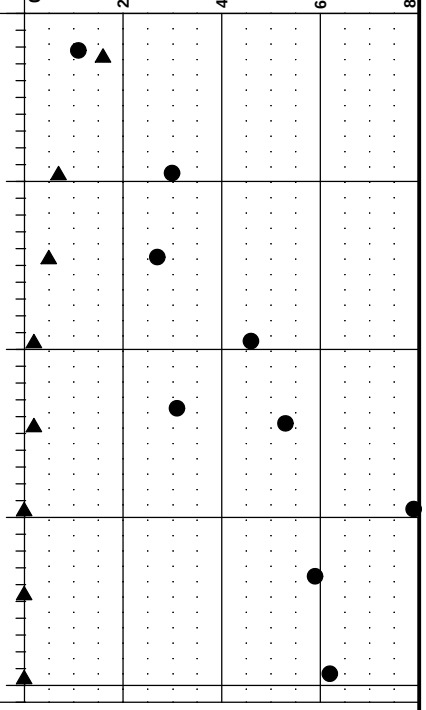
SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.21 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description
0	S-1	b2	16	W = 11		SP/ SM	Reddish brown, silty, fine SAND and interbed fine SAND with silt (medium dense, moist) **(SOIL UNIT 1)**
						SP-SM	Light brown to gray, fine SAND (very loose to loose, wet)
5	S-2	b2	7	W = 30 -200 = 11			
	S-3	b2	5	W = 27 -200 = 6			
10	S-4	b2	2	W = 46 -200 = 31			- grading to very silty and trace organics
	S-5B S-5A	b2	2	W = 31 W = 53			- trace shell fragments
						ML	Dark gray to gray brown, SILT with partially decomposed wood (very soft to soft, wet)
15	S-6	b2	0	W = 79			- with abundant thin (1/16 to 1/4 inch) interbedded fine organics
	S-7	b2	0	W = 59			- with thin (less then 1/4 inch) silty, fine SAND
20	S-8	b2	0	W = 62		ML	Dark gray, SILT with trace sand (very soft, wet)

WELL DETAIL





Boring Completed 06/26/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: APJ-606

Point located at State Plane Coordinates:
North: 614901.05
East: 795630.92
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Total Depth of Piezometer = 20.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-45P-08

Figure A-46

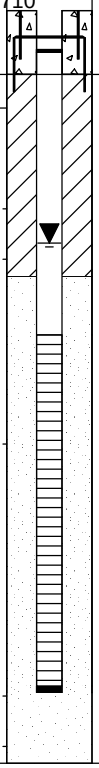
TH-46P-08

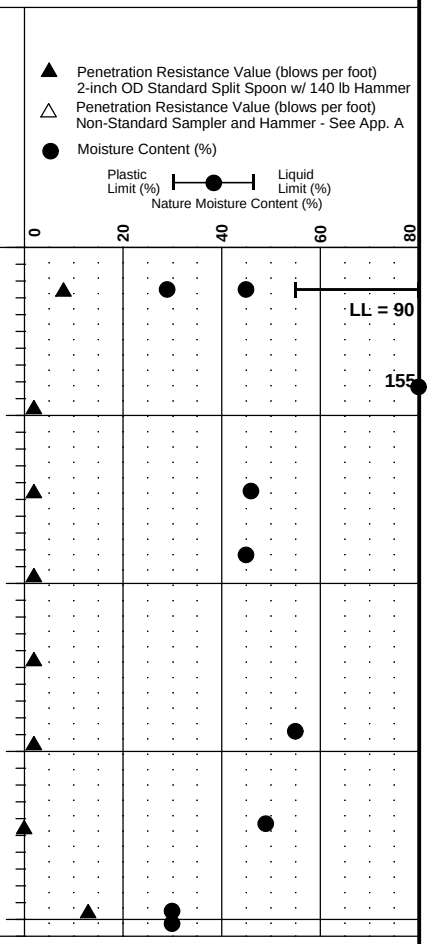
SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 15.41 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description
0	S-1A S-1B	b2	8	W = 45 AL W = 29		MH ML	Reddish brown, gravelly, fine sandy SILT with wood and roots (medium stiff to stiff, moist) **(SOIL UNIT 1)**
				W = 155		WD	Dark brown, SILT with gravel and abundant wood and fine organics (medium stiff, wet) Brown, WOOD with sandy SILT (very soft to soft, wet)
5	S-2	b2	2			SP-SM	Dark gray, very silty, fine SAND withtrace organics (very loose, wet)
	S-3	b2	2	W = 46 GS			
	S-4	b2	2	W = 45			
10	S-5	b2	2			ML	Gray, SILT with organics (very soft to soft, wet)
	S-6	b2	2	W = 55			- wIth trace sand and fine organics
15	S-7	b2	0	W = 49			- with thin (less than 1/4 inch) interbedded silty, fine SAND
						SM	Gray, very silty, fine SAND (medium dense, wet)
20	S-8A S-8B	b2	13	W = 30 -200 = 4 W = 30 -200 = 16		SM	Gray, silty, fine SAND (medium dense, wet)
25							
30							
35							
40							

WELL DETAIL





Boring Completed: 06/26/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: APJ-607

Point located at State Plane Coordinates:
North: 615587.31
East: 795471.93
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Total Depth of Piezometer = 20.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-46P-08

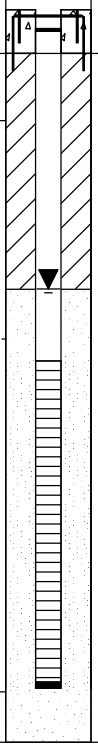
Figure A-47

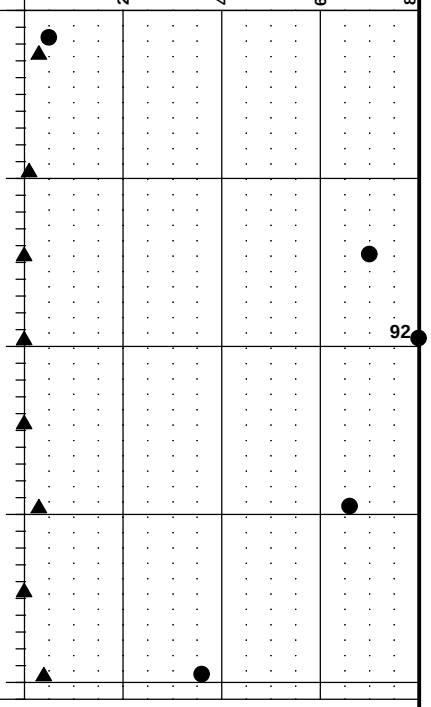
TH-47P-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 16.67 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile
0	S-1	b2	3	W = 5		GP-GM	Gray and brown, sandy GRAVEL with silt (very loose, moist) **(CRUSHED ROAD MATERIAL)**
						ML	Gray brown, sandy, clayey SILT with gravel and wood and trace organics (very soft, moist to wet) **(SOIL UNIT 1)**
5	S-2	b2	1				
	S-3	b2	0	W = 70 GS			
						ML	Gray brown, SILT with increasing interbedded fine organics and wood (very soft to soft, wet)
10	S-4	b2	0	W = 92			
	S-5	b2	0				- with thin interbedded silty, fine SAND and less organics and no wood
15	S-6	b2	3	W = 66			- with sand to trace sand and trace organics
	S-7	b2	0				
20	S-8	b2	4	W = 36 -200 = 15		SM	Gray, fine SAND with silt (very loose to loose, wet) **(SOIL UNIT 2B)**
25							
30							
35							
40							

WELL DETAIL





Boring Completed 07/02/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: APJ-609

Point located at State Plane Coordinates:
North: 615962.27
East: 795451.18
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Total Depth of Piezometer = 20.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-47P-08

Figure A-48

TH-48-08

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 15.01 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
0					SM	Gray grading to light brown, very silty, fine SAND with abundant wood debris (very loose, wet) **(SOIL UNIT 1)**
5	S1	g2	3	PID=12.7 W = 61 GS		
	S2	g2	19	PID=0.4	WD	Wood
	S3	g2	5	PID=0	MH	Gray brown, SILT with trace sand and trace organics (very soft, wet)
10	S4	g2	0	PID=0		
	S5	g2	1	PID=0		- wood
	S6	g2	1	PID=0 CA W = 62		- interbedded silty, fine SAND - wood chips 4" thickness
15	S7	c3		W = 56 AL GT		
	S8	g2	0	PID=0 W = 64		
20	S9	c3				
25						
30						
35						
40						

Groundwater: ▼

Moisture Content (%): 0, 20, 40, 60, 80

Boring Completed 09/09/08
Total Depth of Boring = 21.0 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615768.75
East: 796354.45
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-48-08

Figure A-49

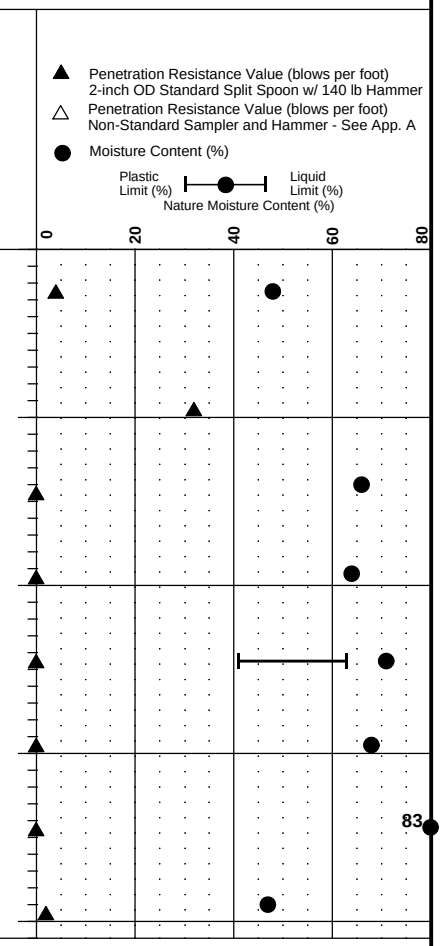
TH-49P-08

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.22 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
0	S-1	b2	4	W = 48 GS		ML	Reddish brown, gravellly, sandy, clayey SILT (soft to medium stiff, wet)
							(SOIL UNIT 1)
						ML	Mottled black, brown, and light brown, gravelly, fine sandy SILT with coal slag (loose, wet)
5	S-2	b2	32			WD	WOOD (log approximately 2 1/4 feet diameter) (hard, wet)
	S-3	b2	0	W = 66		MH	Dark gray to gray brown, SILT with trace sand to with sand (very soft, wet)
10	S-4	b2	0	W = 64			- becoming with interbedded silty, fine SAND and trace shells
	S-5	b2	0	W = 71 AL			- trace organics
15	S-6	b2	0	W = 68			- trace shells
	S-7	b2	0	W = 83		SM/ ML	Gray brown, SILT with sand and interbedded very silty, fine SAND with abundant decomposed wood (very soft and very loose, wet)
20	S-8	b2	2	W = 47			- with trace organics

WELL DETAIL



Boring Completed 07/01/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: APJ-616

Point located at State Plane Coordinates:
North: 615654.64
East: 796976.42
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Total Depth of Piezometer = 20.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of the report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

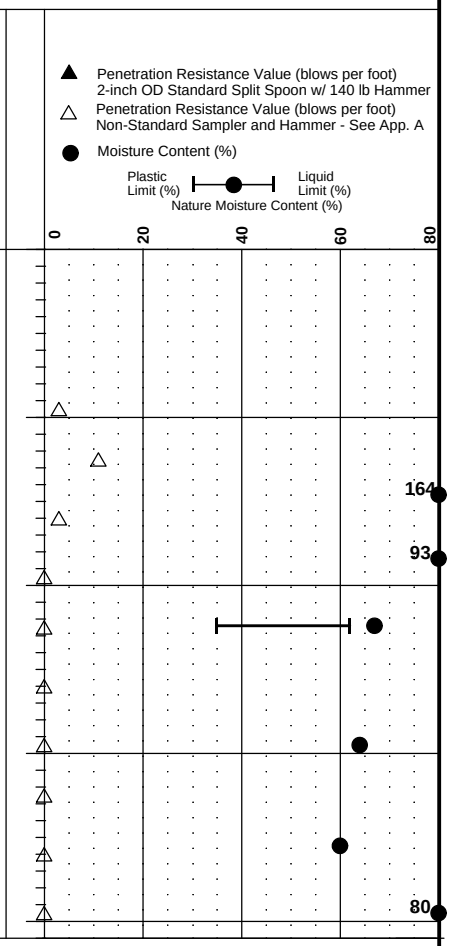
Log of Boring TH-49P-08

Figure A-50

TH-50-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - D. Henderson Lic # 2742
Ground Elevation (ft): 13.60 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0						SM/ ML	Mottled reddish brown and gray brown, fine sandy SILT with organics with oyster shells at 4 feet (very soft to soft, wet) **(SOIL UNIT 1)**	
5	S1	g2	3	PID=0		WD	Sawdust strong Hydrogen Sulfide odor	
	S2	g2	11	PID=0		SM/ ML	Mottled black and dark brown, fine sandy SILT with abundant organics (sawdust), wood, and shells, with Hydrogen Sulfide odor (stiff, wet)	
	S3	g2	3	PID=0 W = 164		MH	Gray brown, SILT with trace sand and fine organics (very soft, wet)	
10	S4	g2	0	PID=0 W = 93			- with some wood	
	S5	g2	0	PID=0 W = 67 AL			- trace shells and thin fine organics interbeds	
	S6	g2	0	PID=0				
15	S7	g2	0	PID=0 W = 64				
	S8	g2	0	PID=0				
	S9	g2	0	PID=0 W = 60			- grading to fine sandy SILT	
20	S10	g2	0	PID=0 W = 80				



Boring Completed 09/10/80
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615314.54
East: 797173.10
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-50-08

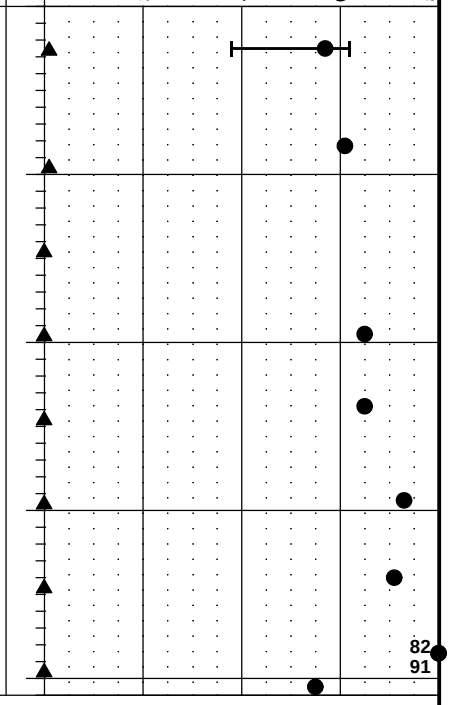
Figure A-51

TH-51-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 12.18 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0	S-1	b2	1	W = 57 AL		MH	Reddish brown and gray, SILT with roots (very soft, wet) **(SOIL UNIT 1)**	
5	S-2	b2	1	W = 61		ML	Dark gray, SILT with sand and some organics (very soft, wet)	
	S-3	b2	0				-with partially decomposed wood	
10	S-4	b2	0	W = 65			-with scattered fine organics and interbedded very thin (1/32 inch) silty, fine SAND	
	S-5	b2	0	W = 65		ML	Gray brown, SILT with occasional thin (1/16 to 1/8 inch) interbedded fine organics (very soft, wet)	
15	S-6	b2	0	W = 73			- trace shell fragments	
	S-7	b2	0	W = 71			- dark gray	
20	S-8A S-8B S-8C	b2	0	W = 82 W = 91 W = 55			- with shells	



Boring Completed 06/25/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615240.99
East: 796916.64
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-51-08

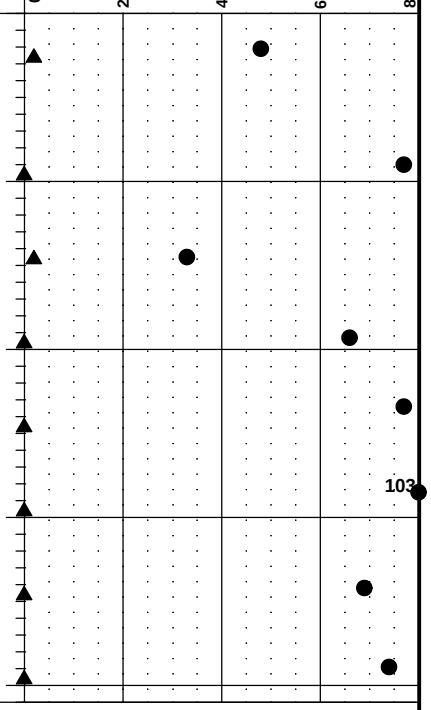
Figure A-52

TH-52-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 12.59 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description	Groundwater
0	S-1	b2	2	W = 48	SM/ ML	Reddish brown, interbedded silty, fine SAND and fine sandy SILT (very soft to soft and very loose, wet) **(SOIL UNIT 1)**	
5	S-2	b2	0	W = 77	ML	Light gray brown to dark gray to black, SILT (very soft, wet)	
	S-3	b2	2	W = 33 -200 = 17	SM	Dark gray, silty, fine SAND (very loose, wet)	
10	S-4	b2	0	W = 66	ML/ CL	Gray brown to dark gray, clayey SILT to silty CLAY (very soft, wet)	
	S-5	b2	0	W = 77	ML	Dark gray, SILT (very soft, wet)	
15	S-6	b2	0	W = 103			
	S-7	b2	0	W = 69		- Dark gray grading to gray brown, with scattered fine organics	
20	S-8	b2	0	W = 74		- with sand	



Boring Completed 06/24/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 614941.54
East: 796750.80
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-52-08

Figure A-53

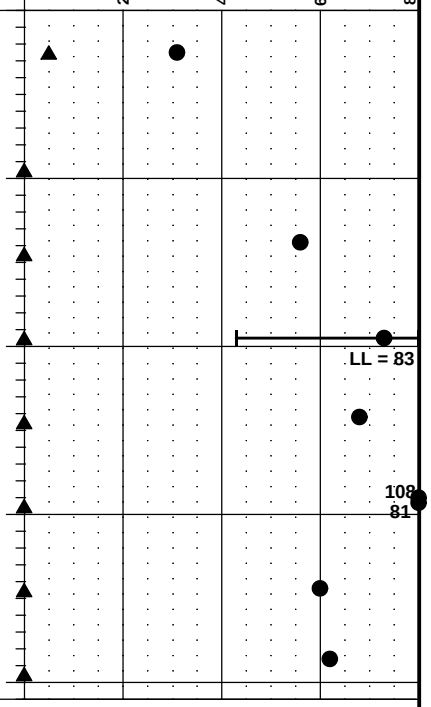
TH-53-08

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.06 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description	Groundwater
0	S-1	b2	5	W = 31 GS		SM	Reddish brown, silty, fine SAND to fine SAND with silt (loose, moist to wet) **(SOIL UNIT 1)**	
5	S-2	b2	0			SP-SM	Dark gray, fine SAND with silt (very loose, wet)	
	S-3	b2	0	W = 56		MH	Dark gray, SILT with occasional interbedded silty, fine SAND with wood debris and trace plastic debris (very soft, wet)	
10	S-4	b2	0	W = 73 AL				
	S-5	b2	0	W = 68				
15	S-6	b2	0	W = 108 W = 81		ML	Gray brown, SILT with trace sand and thin (1/16 to 1/8 inch) interbedded silty, fine SAND with some trace scattered fine organics (very soft, wet) - wood chips and trace shell fragments	
	S-7	b2	0	W = 60				
20	S-8	b2	0	W = 62			- increasing thickness of silty, fine SAND interbeds	



Boring Completed 06/24/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615052.57
East: 796410.33
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-53-08

Figure A-54

TH-54-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.23 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater	Moisture Content (%)
0	S-1	b2	6	W = 27		SP-SM	Reddish brown, fine SAND with silt (loose, wet) **(SOIL UNIT 1)**		
5	S-2	b2	0	W = 85 AL		MH	Dark gray to black, clayey SILT with trace sand and trace fine organics (very soft, wet)		85
	S-3	b2	0	W = 97 GS					97
10	S-4	b2	0	W = 84		SM/ML	Dark gray, silty, fine SAND and fine sandy SILT interbeds with abundant wood chips (very soft and very loose, wet)		84
	S-5	b2	0	W = 61		ML	Gray brown and Dark gray, SILT with trace wood debris with trace thin interbedded silty, fine SAND with some fine organics (very soft, wet)		
15	S-6	b2	0	W = 70					
	S-7	b2	0	W = 59					
20	S-8	b2	0	W = 58			- some scattered shell fragments		

Boring Completed 06/24/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 614926.49
East: 796459.21
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-54-08

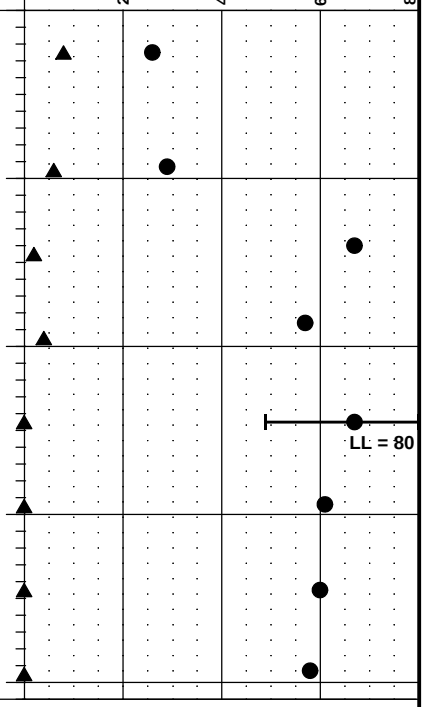
Figure A-55

TH-55-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.51 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0	S-1	b2	8	W = 26 GS		SP-SM	Light brown, fine SAND with silt (loose, moist) **(SOIL UNIT 1)**	
5	S-2	b2	6	W = 29		SP-SM	Dark gray, fine SAND with silt to trace silt (loose, moist to wet)	
	S-3	b2	2	W = 67		SM/ML	Dark gray, interbedded silty, fine SAND and SILT with sand and trace interbedded fine organics (very soft to soft, wet)	
10	S-4	b2	4	W = 57		SM/ML	Dark gray, fine SAND with silt and fine sandy SILT and wood (very loose to loose and soft to medium stiff, wet)	
	S-5	b2	0	W = 67 AL		MH	Dark gray, SILT with trace sand with shell fragments and scattered fine organics (very soft, wet)	
15	S-6	b2	0	W = 61				
	S-7	b2	0	W = 60			- with thin interbedded fine sandy SILT	
20	S-8	b2	0	W = 58				



Boring Completed 06/24/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615021.90
East: 795976.96
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-55-08

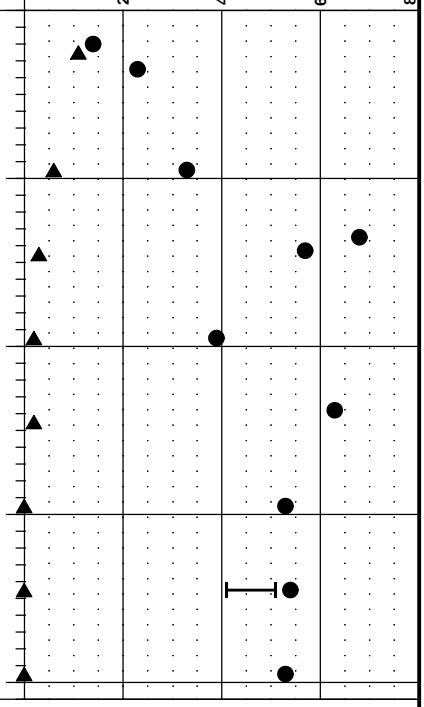
Figure A-56

TH-56-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.36 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0	S-1A, S-1B	b2	11	W = 14, W = 23		SP-SM	Reddish brown, fine to medium SAND with silt (medium dense, moist)	
						SM	**(SOIL UNIT 1)** Reddish brown, silty, fine SAND (medium dense, moist)	
5	S-2	b2	6	W = 33, GS		SM	Dark gray, silty, fine SAND with trace shell fragments (loose, wet)	
	S-3B, S-3A	b2	3	W = 68, W = 57		ML	Dark gray, SILT with wood (soft, wet)	
						SM/ML	Dark gray, very silty, fine SANDto sandy SILT with wood (very loose, wet)	
10	S-4	b2	2	W = 39, GS			- becoming with partially decomposed wood debris	
	S-5	b2	2	W = 63				
15	S-6	b2	0	W = 53		MH	Dark gray, SILT and trace sand with trace scattered fine organics and shell fragments (very soft, wet)	
	S-7	b2	0	W = 54, AL				
20	S-8	b2	0	W = 53			- with thin (1/8 to 1/2 inch) interbedded silty, fine SAND	



Boring Completed 06/25/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 614891.68
East: 795914.48
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-56-08

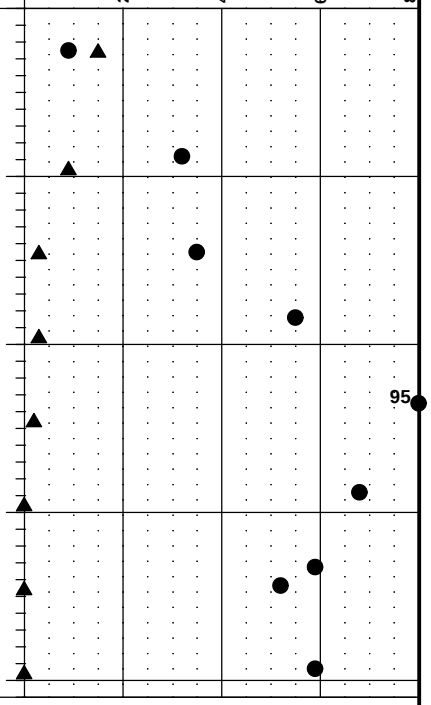
Figure A-57

TH-57-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 13.57 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0	S-1	b2	15	W = 9 GS		SP-SM	Reddish brown, fine SAND with silt and coarse gravel (medium dense, moist) **(SOIL UNIT 1)**	
5	S-2	b2	9	W = 32		SM	Dark gray, fine to medium SAND with silt and interbedded fine SAND with silt (loose to very loose, wet)	
	S-3	b2	3	W = 35 GS				
10	S-4	b2	3	W = 55				
	S-5	b2	2	W = 95		ML	Dark gray, SILT with sand and abundant partially decomposed wood and fine organics (very soft to soft, wet)	
15	S-6	b2	0	W = 68				
	S-7B	b2	0	W = 59			- dark gray SILT	
	S-7A			W = 52		ML	Dark gray, SILT with sand to trace sand with scattered fine organics (very soft, wet)	
20	S-8	b2	0	W = 59			- with thin (1/8 inch) interbedded silty, fine SAND	
25								
30								
35								
40								



Boring Completed 06/25/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 614902.61
East: 795779.40
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-57-08

Figure A-58

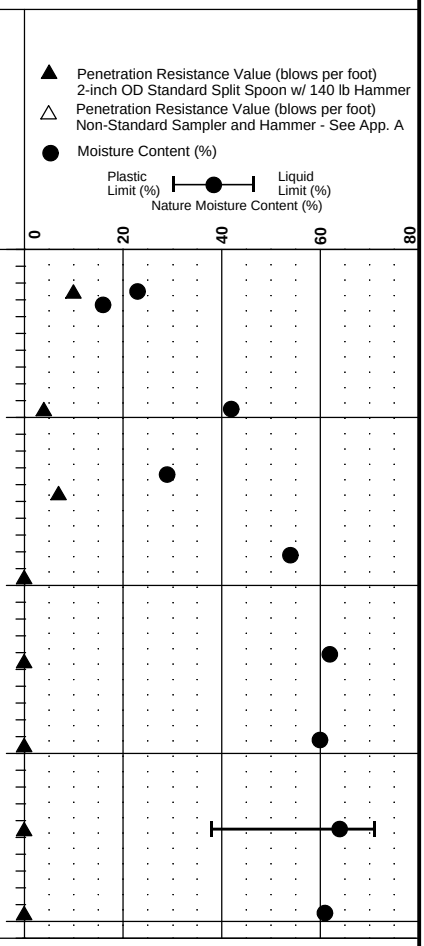
TH-58-08

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.75 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
0	S-1A S-1B	b2	10	W = 23 GS W = 16 GS	SP-SM	Reddish brown, fine to medium SAND with silt and some roots (loose to medium dense, moist to wet)
					SW-SM	**(SOIL UNIT 1)** Reddish brown, fine to medium SAND with trace silt (loose to medium dense, wet)
5	S-2	b2	4	W = 42 -200 = 34	SM	Dark gray to black, very silty, fine SAND with gravel and wood (very loose to loose, wet)
	S-3	b2	7	W = 29	SP-SM	Dark gray to black, fine SAND with silt (loose, wet)
10	S-4	b2	0	W = 54	SM	Dark gray to black, silty, fine SAND with abundant wood (very loose, wet)
	S-5	b2	0	W = 62	MH	Dark gray, SILT with sand and scattered fine organics and trace shell fragments (very soft, wet)
15	S-6	b2	0	W = 60		
	S-7	b2	0	W = 64 AL		
20	S-8	b2	0	W = 61		

Groundwater



Boring Completed 06/24/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615257.60
East: 795555.28
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-58-08

Figure A-59

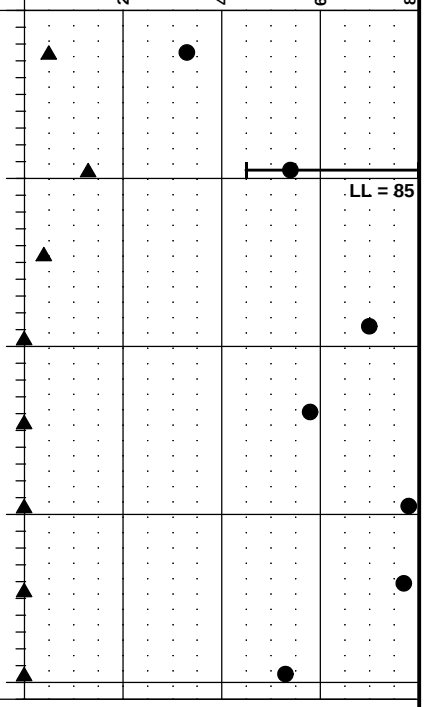
TH-59-08

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.48 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description	Groundwater
0	S-1	b2	5	W = 33 GS		SM	Reddish brown, silty, fine SAND with wood and roots (loose, moist) **(SOIL UNIT 1)**	
						MH	Dark gray, SILT with trace organics and wood (stiff, wet)	
5	S-2	b2	13	W = 54 AL		WD	Dark brown, partially decomposed WOOD (soft, wet)	
	S-3	b2	4					
						ML	Gray brown, SILT with trace sand with scattered fine organics (very soft, wet)	
10	S-4	b2	0	W = 70				
	S-5	b2	0	W = 58				
15	S-6	b2	0	W = 78				
	S-7	b2	0	W = 77				
20	S-8	b2	0	W = 53			- with interbedded SILT with sand and trace shells	



Boring Completed 07/01/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615616.35
East: 796009.60
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

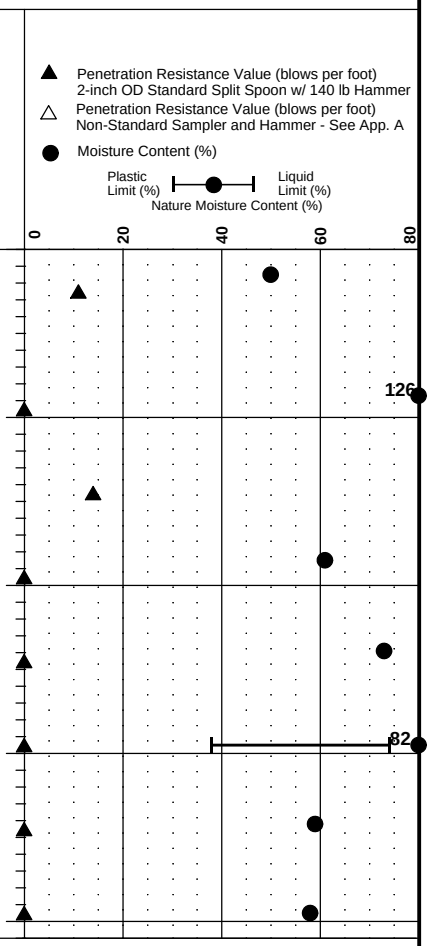
Log of Boring TH-59-08

Figure A-60

TH-60-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.43 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Groundwater
0	S-1A S-1B	b2	11	W = 50		ML	Dark gray and brown, fine sandy SILT with abundant roots (stiff, wet)	
						SM/ ML	**(SOIL UNIT 1)** Reddish brown grading to gray, silty, fine SAND with tine sandy SILT (medium dense and very soft, wet)	
5	S-2	b2	0	W = 126			- with abundant organics and partially decomposed wood	
	S-3	b2	14					
10	S-4	b2	0	W = 61		MH	Gray brown and Dark gray, SILT with trace sand and with organics (very soft, wet)	
	S-5	b2	0	W = 73			- trace shells	
15	S-6	b2	0	W = 82 AL			- trace shells and few fine organics	
	S-7	b2	0	W = 59				
20	S-8	b2	0	W = 58				
25								
30								
35								
40								



Boring Completed 07/01/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615699.90
East: 796076.78
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-60-08

Figure A-61

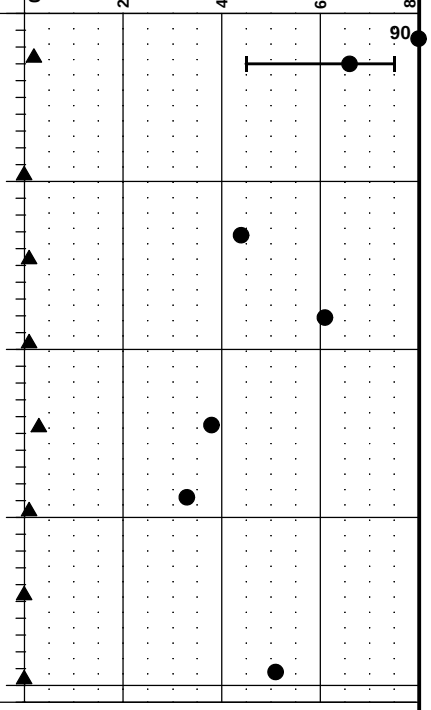
TH-61-08

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 12.11 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Description	Groundwater
0	S-1A S-1B	b2	2	W = 90 W = 66 AL	ML/ OL MH	Dark brown, SILT with sand and abundant fine organics and roots (very soft to soft, wet) **(SOIL UNIT 1)** Mottled reddish brown and gray, SILT with trace sand (very soft to soft, wet)	
5	S-2	b2	0				
	S-3	b2	1	W = 44 -200 = 0	SP	Gray, fine SAND with scattered interbedded fine organics (very loose, wet)	
10	S-4	b2	1	W = 61	ML	Gray, very sandy SILT to very silty, fine SAND (very soft and very loose, wet)	
	S-5	b2	3	W = 38 -200 = 29	SM	Gray, silty, fine SAND to fine SAND with silt (very loose, wet) **(SOIL UNIT 2B)**	
15	S-6	b2	1	W = 33			
	S-7	b2	0				
20	S-8	b2	0	W = 51			



Boring Completed 06/30/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615934.39
East: 795592.31
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-61-08

Figure A-62

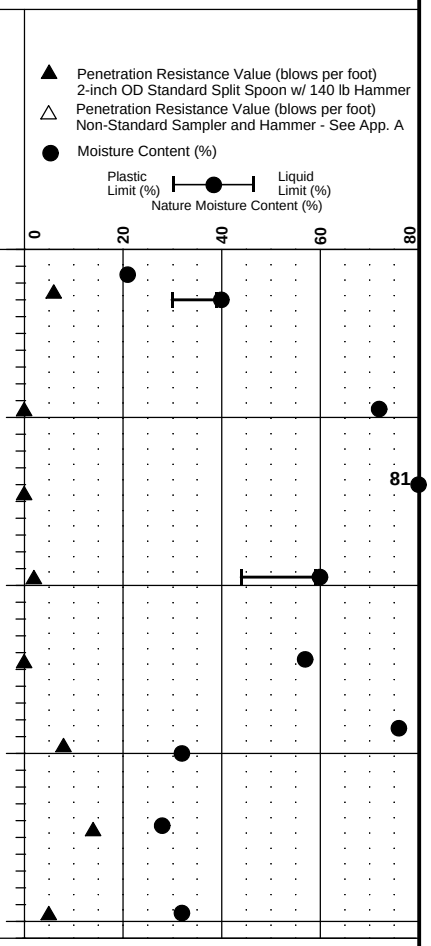
TH-62-08

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.44 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
0	S-1A S-1B	b2	6	W = 21 W = 40 AL	SM / ML	Reddish brown, silty, fine SAND (loose, moist to wet) **(SOIL UNIT 1)**
					MH	Reddish brown, SILT with interbedded fine sand to fine sandy SILT (medium stiff, wet)
5	S-2	b2	0	W = 72 GS		Gray, clayey SILT with trace sand and scattered fine organics (very soft, wet)
	S-3	b2	0	W = 81		
10	S-4	b2	2	W = 60 AL	MH	Gray, SILT with sand and interbeds of abundant wood and shell fragments (very soft to soft, wet)
	S-5	b2	0	W = 57		
15	S-6A S-6B	b2	8	W = 76 W = 32	ML / SM	Brown, fine sandy SILT with abundant scattered fine organics (medium stiff to stiff, wet)
						Gray, silty, fine SAND with trace scattered fine organics (loose, wet) **(SOIL UNIT 2B)**
	S-7	b2	14	W = 28	SP-SM	Gray, fine SAND with silt (medium dense, wet)
20	S-8	b2	5	W = 32 -200 = 12		

Groundwater



Boring Completed 06/30/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615872.87
East: 795692.29
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-62-08

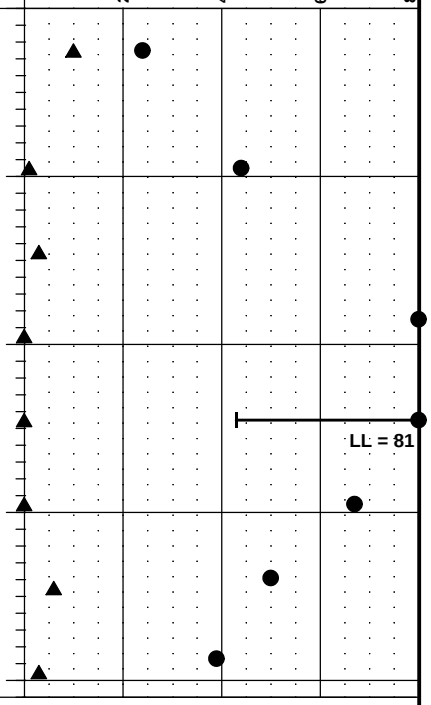
Figure A-63

TH-63-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 14.85 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description	Groundwater
0	S-1	b2	10	W = 24 GS	SM	Reddish brown, silty, fine SAND with trace gravel (loose to medium dense, moist to wet) **(SOIL UNIT 1)**	
5	S-2	b2	1	W = 44 GS	ML	Gray, fine sandy SILT with decomposed wood (very soft, wet)	
	S-3	b2	3		WD	Brown, partially decomposed WOOD (soft, wet)	
10	S-4	b2	0	W = 80	ML	Gray brown, SILT with sand and some wood and scattered fine organics (very soft, wet)	
	S-5	b2	0	W = 80 AL	MH	Gray to dark gray, SILT with scattered fine organics and trace shell fragments (very soft, wet)	
15	S-6	b2	0	W = 67			
	S-7	b2	6	W = 50	ML	Gray brown, SILT with sand grading to fine sandy SILT with trace shells and fine organics (medium stiff, wet)	
20	S-8	b2	3	W = 39	SM	Gray, silty, fine SAND with some decomposed wood and fine organics (very loose, wet) **(SOIL UNIT 2B)**	



Boring Completed 07/01/08
Total Depth of Boring = 20.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: N/A

Point located at State Plane Coordinates:
North: 615793.41
East: 795961.23
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

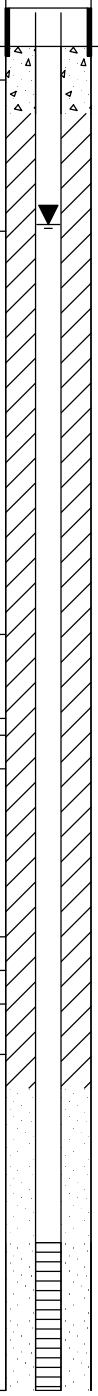
Log of Boring TH-63-08

Figure A-64

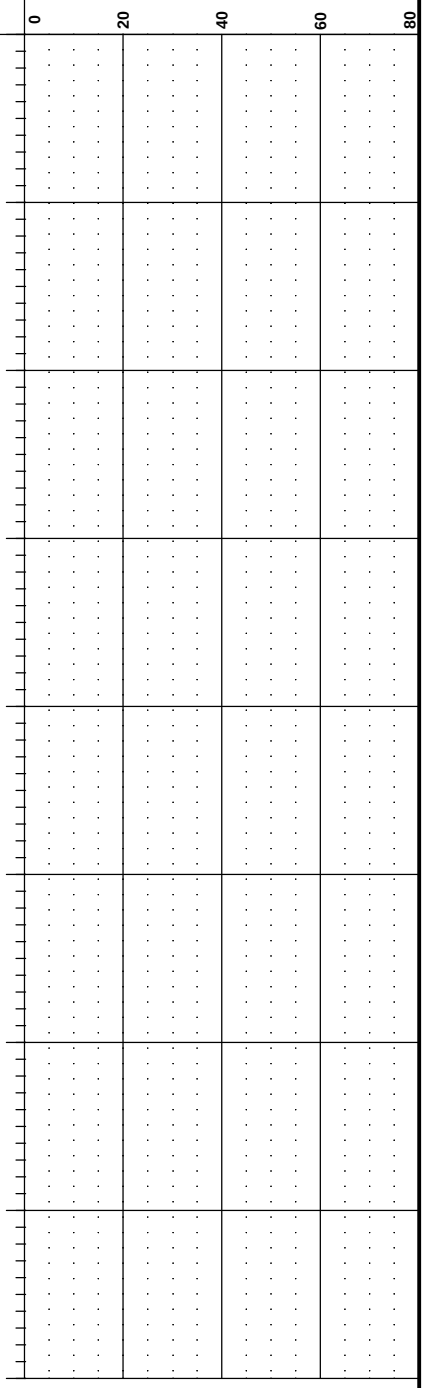
TH-64-08

SAMPLE DATA				SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Rotosonic Casing: 8" dia. cased Driller (Lic.#): Boart Longyear Inc. Ground Elevation (ft): 12.25 (MLLW)
0						ML	Brown, SILT with sand (soft, wet)
						SM	**(SOIL UNIT 1)** Gray, silty, fine SAND (soft, wet)
5						ML	Gray, SILT with sand and trace organics and trace shell fragments (soft, wet)
10							-increasing fine sand -decreasing fine sand
15						ML	Gray, SILT with trace sand, trace shells, and trace organics with occasional sand interbeds (soft, wet)
20						SM/ ML	Gray, silty, fine SAND to fine sandy SILT (soft, wet)
						ML	Gray, SILT with trace sand (soft, wet)
						SM	Gray, silty, fine SAND with trace organics (soft, wet) **(SOIL UNIT 2A)** -Increasing fine sand
25						ML	Gray, SILT with SAND interbeds (soft, wet)
						SM	Gray, silty, fine SAND (soft, wet)
						ML	Gray, fine sandy SILT with silty, fine SAND interbeds (soft, wet)
30						SM	Gray, very silty, fine SAND with trace organics and with SILT interbeds (soft, wet) -no silt interbeds
35							
40							

WELL DETAIL



▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├─●─┤ Liquid Limit (%)
Nature Moisture Content (%)



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-64-08

Figure
A-65
(1 of 2)

TH-64-08

SAMPLE DATA				SOIL PROFILE			WELL DETAIL
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Rotosonic Casing: 8" dia. cased Driller (Lic.#): Boart Longyear Inc. Ground Elevation (ft): 12.25 (MLLW)
40						ML	Gray, SILT with sand and trace organics and trace shell fragments and interbedded, silty, fine SAND (soft and wet)
45						ML	Gray, fine sandy SILT (soft and wet)
50						SM	Gray, silty, fine SAND (soft and wet)
						SM	Gray, fine to medium SAND with silt and trace coarse sand (soft and wet)
55							
60							
65							
70							
75							
80							

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)

Plastic Limit (%) ├─●─┤ Liquid Limit (%)
Nature Moisture Content (%)

0 20 40 60 80

Boring Completed 07/29/08
Total Depth of Boring = 55.6 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: BAJ-222

Point located at State Plane Coordinates:
North: 615141.51
East: 796813.97
Township: 17N
Range: 10W
Section: 11
Inspector: AJF

Total Depth of Well = 55.6 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

TH-65P-08

SAMPLE DATA | **SOIL PROFILE**

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 12.51 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ●—● Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Description
0					ML	Gray brown, SILT with trace sand and interbedded fine sandy SILT and trace organic interbeds and trace shell fragments (very soft, wet) **(SOIL UNIT 1)**
15	S-1	b2	0	W = 74		
20	S-2	b2	0	W = 89		
					SM	Gray, very silty, fine SAND with occasional interbedded fine sandy SILT some fine organics (very loose, wet)
25	S-3	b2	2	W = 50 -200 = 43		
					SM	Gray,very silty, fine SAND with interbedded silty, fine SAND and with occasional thin (1/4 to 1/8 inch) interbedded SILT with sand (very loose, wet) **(SOIL UNIT 2B)**
30	S-4	b2	1	W = 43 -200 = 36		
					SM	Gray, silty, fine SAND with trace organics and occasional thin (1/8 inch) interbedded SILT (medium dense, wet)
35	S-5	b2	12	W = 32		
					SP-SM	Gray, fine SAND with silt and trace shells (medium dense, wet)
40	S-6	b2	11	W = 54		

WELL DETAIL

Moisture Content (%): 89

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-65P-08

Figure A-66 (1 of 2)

TH-65P-08

SAMPLE DATA / SOIL PROFILE

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - R. Shepherd Lic # 2710
Ground Elevation (ft): 12.51 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ⊢●⊣ Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Description
40					ML	Gray, SILT with sand and occasional thin (1/8 inch) interbedded silty, fine SAND and fine SAND with silt with trace organics and shells (very soft, wet)
45	S-7	b2	0	W = 49		
					SM/ ML	Gray, fine sandy SILT with interbedded silty, fine SAND and fine SAND with silt (very soft and very loose, wet)
50	S-8	b2	0	W = 51		
					SM	Gray, silty, fine SAND with some partially decomposed wood and thin (1/8 to 1/2 inch) interbedded light brown SILT (loose, wet)
55	S-9	b2	9	W = 41		
60	S-10	b2	4	W = 40 -200 = 23		
65						
70						
75						
80						

WELL DETAIL

Boring Completed 07/15/08
Total Depth of Boring = 60.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: APJ-613

Point located at State Plane Coordinates:
North: 615140.14
East: 796799.42
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Total Depth of Piezometer = 60.5 ft.

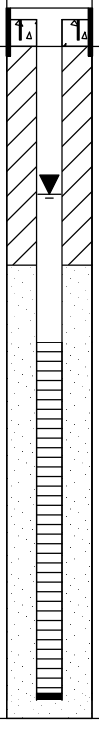
Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

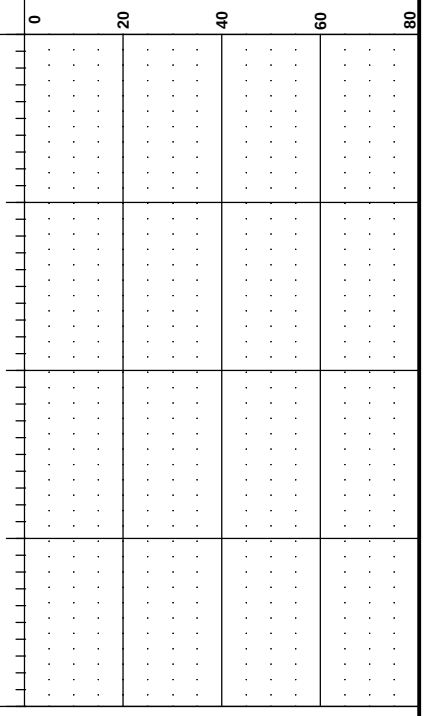
TH-66P-08

SAMPLE DATA				SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Drilling Method: Mud Rotary Casing: 4" ID (HW) Driller (Lic.#): WSDOT - J. Fetterly Lic # 2507 Ground Elevation (ft): 12.07 (MLLW)
0						ML	Gray, SILT with trace sand and trace organics (very soft, wet) **(SOIL UNIT 1)** (inferred from TH-66P-A-08) (no samples collected from this boring)
5							
10							
15							
20							- with occasional thin (1/8 inch) interbedded fine organics and trace shells
25							
30							
35							
40							

WELL DETAIL



▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) ├─●─┤ Liquid Limit (%)
Nature Moisture Content (%)



Boring Completed 07/16/08
Total Depth of Boring = 20.0 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: APJ-614

Point located at State Plane Coordinates:
North: 615141.80
East: 796829.34
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Total Depth of Piezometer = 20.0 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-66P-08

Figure
A-67

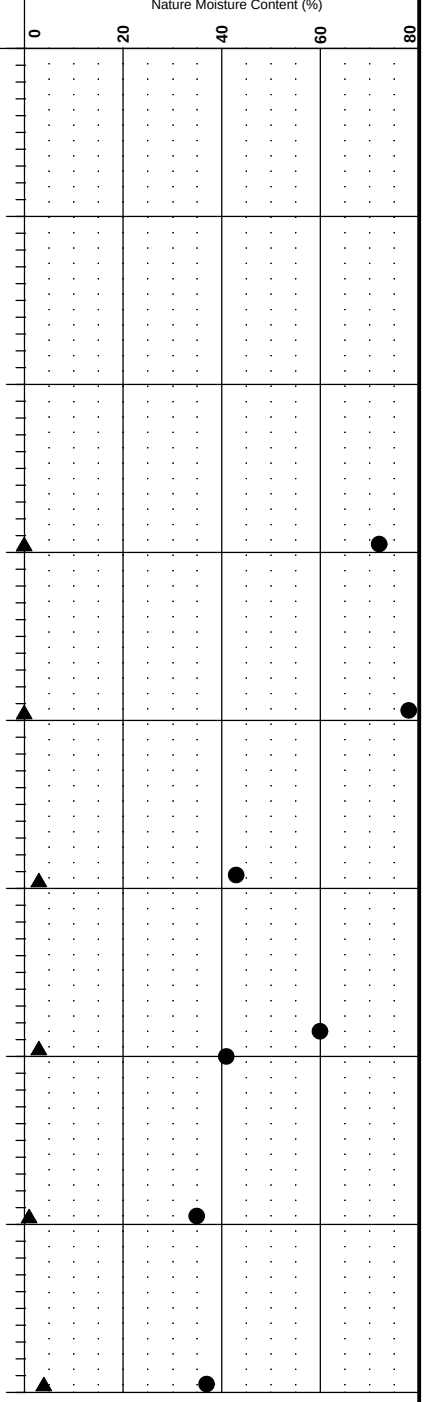
TH-66P-A-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - J. Fetterly Lic # 2507
Ground Elevation (ft): 12.10 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Soil Description
0						ML	Gray, SILT with trace sand and trace organics (very soft, wet) **(SOIL UNIT 1)**
15	S-1	b2	0	W = 72			
20	S-2	b2	0	W = 78			- with occasional thin (1/8 inch) interbedded fine organics and trace shells
						SM	Gray, silty, fine SAND with trace partially decomposed wood and thin interbedded fine organics and trace shells (very loose, wet)
25	S-3	b2	3	W = 43			
						ML	Gray brown, SILT with trace to with sand and shells (soft, wet)
30	S-4A S-4B	b2	3	W = 60 W = 41		SM	Gray, silty, fine SAND with silt and thin (1/4 to 1/8 inch) interbedded light brown, SILT with shells (very loose to loose, wet) **(SOIL UNIT 2B)**
35	S-5	b2	1	W = 35 -200 = 18			
40	S-6	b2	4	W = 37			

WELL DETAIL



Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-66P-A-08

Figure A-68
(1 of 2)

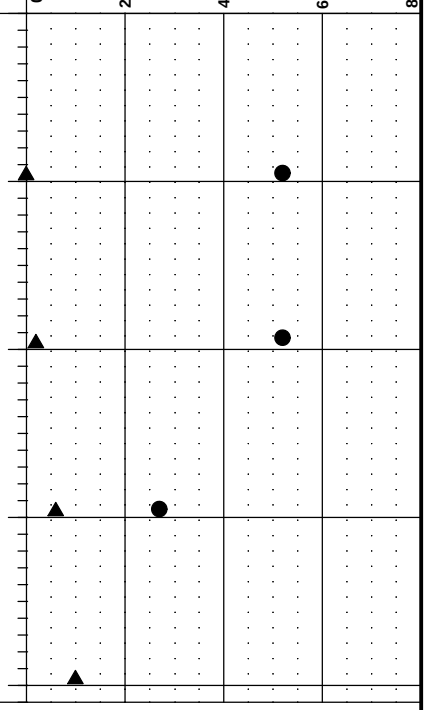
TH-66P-A-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - J. Fetterly Lic # 2507
Ground Elevation (ft): 12.10 (MLLW)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	USCS Symbol	Soil Description
40				-200 = 17	SM	
					ML	Gray brown, SILT with sand to trace sand and occasional thin (1/4 inch) silty, fine SAND with some fine organics and trace partially decomposed wood and shells (very soft, wet)
45	S-7	b2	0	W = 52		
					SM/ ML	Gray and light brown, thin (1/16 to 1/4 inch) silty, fine SAND and SILT with occasional thin (1 inch) interbedded fine SAND with silt (very soft to soft and very loose, wet)
50	S-8	b2	2	W = 52		
					SP	Gray, fine to medium SAND with trace silt and trace decomposed wood (loose, wet)
55	S-9	b2	6	W = 27 -200 = 4		
					SM/ ML	Gray and light brown, thin (1/16 to 1/4 inch) silty, fine SAND and SILT with occasional thin (1 inch) interbedded fine SAND with silt (very soft to soft and very loose, wet)
					SP-SM	Gray, fine SAND with silt to trace silt with occasional thin (1/8 to 1/4 inch) light brown, SILT (loose to medium dense, wet)
60	S-10	b2	10			
65						
70						
75						
80						

WELL DETAIL

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Nature Moisture Content (%) — Liquid Limit (%)



Boring Completed 07/16/08
Total Depth of Boring = 60.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: APJ-622

Point located at State Plane Coordinates:
North: 615133.80
East: 796829.34
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Total Depth of Piezometer = 60.5 ft.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-66P-A-08

Figure A-68 (2 of 2)

TH-67P-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - J. Fetterly Lic # 2507
Ground Elevation (ft): 11.94 (MLLW)

▲ Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
△ Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
● Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
0						MH	Gray brown and dark gray, SILT with occasional thin (l/8 inch) interbedded fine SAND with silt and occasional fine organics (very soft to soft, wet) **(SOIL UNIT 1)**
15	S-1	c3					
	S-2	c3		GT W = 64 AL			
	S-3	b2	0	W = 65 AL			
25	S-4	b2	3	W = 57			- with interbedded fine organics and trace shells
						CL	Gray brown and dark gray, CLAY (medium stiff, wet)
30	S-5A S-5B	2 b2	8	W = 56 AL		SM	Gray, silty, fine SAND and fine SAND with silt and thin (1/16 to 1/8 inch) light brown, SILT with shells (loose, wet)
35	S-6	b2	8	W = 27		SP-SM	Gray, fine SAND with silt to trace silt (loose, wet) **(SOIL UNIT 2B)**
40	S-7	b2	7	W = 31			- trace shell fragments and fine organics

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-67P-08

Figure A-69 (1 of 2)

TH-67P-08

Drilling Method: Mud Rotary
Casing: 4" ID (HW)
Driller (Lic.#): WSDOT - J. Fetterly Lic # 2507
Ground Elevation (ft): 11.94 (MLLW)

Penetration Resistance Value (blows per foot) 2-inch OD Standard Split Spoon w/ 140 lb Hammer
Penetration Resistance Value (blows per foot) Non-Standard Sampler and Hammer - See App. A
Moisture Content (%)
Plastic Limit (%) — Liquid Limit (%)
Nature Moisture Content (%)

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	Test Data	Graphic Symbol	USCS Symbol	Description
40						SP-SM	
						ML	Gray brown, SILT with trace sand with occasional very thin (1/32 inch) interbedded silty, fine SAND and trace shell fragments (very soft, wet)
45	S-8	b2	0	W = 52 AL			
						SM/ML	Gray and light brown, interbedded thin (1/16 to 1/4 inch) silty, fine SAND to fine SAND with silt and SILT (very soft to soft and very loose, wet)
50	S-9	b2	2	W = 52			
						SP	Dark gray, fine to medium SAND with trace silt grading to fine SAND with silt and occasional thin (1/16 inch) interbedded light brown, SILT with trace shell and wood fragments (loose, wet)
55	S-10	b2	8	W = 43			
60	S-11A S-11B	b2	8	W = 29 W = 38		SM/ML	Gray brown and light brown, silty, fine SAND with occasional thin interbedded fine sandy SILT (loose, wet)
65							
70							
75							
80							

Boring Completed 07/16/08
Total Depth of Boring = 60.5 ft.
WSDOT Job #: XL 2672
Start Card #: Unknown
Ecology Well#: APJ-615

Point located at State Plane Coordinates:
North: 615142.12
East: 796843.91
Township: 17N
Range: 10W
Section: 11
Inspector: BEC

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SOIL BORING LOG W/ WELL 80

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Boring TH-67P-08

Figure A-69 (2 of 2)

TP-01-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 11.70 (MLLW) Excavated By: Chinook Exc. and Land Dev.	
0					ML	Mottled brown and gray clayey SILT (soft, moist to wet), numerous small plant roots in upper foot, occasional small wood debris. **(SOIL UNIT 1)**	
	1	d	W = 72				
					ML/ CL	Gray clayey SILT/silty SLAY (soft, wet), occasional small wood debris to 2 inches. - 10-inch diameter log in sidewall from approximately 3.5 to 5 feet. - becomes less plastic with depth.	Slight Seepage
	2	d	W = 75				
5							
	3	d	W = 79				
10							
15							
20							
25							

Test Pit Completed 07/21/08
Total Depth of Test Pit = 10.5 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615959.42
East: 795523.10
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-01-08

Figure A-70

TP-02-08

Excavation Method: Tracked Excavator

Ground Elevation (ft): 15.01 (MLLW)

Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	NOTES/GROUNDWATER
0	1	d	W = 25		ML	Mottled gray and brown, clayey, fine sandy SILT (medium stiff, wet)(sandier in upper foot, numerous small wood debris, with gravel in bottom foot) **(SOIL UNIT 1)**	
					ML	Dark gray, sandy SILT with sawdust (medium stiff, wet). Numerous pieces of decaying dimension lumber.	Slight Seepage
5	2	d	CA W = 54		ML	Gray, clayey SILT with sand (soft to medium stiff, wet)	
10					ML	- small broken shells and buried marsh grass at approximately 13 feet. Gray, clayey SILT (soft, moist to wet), numerous small broken shells.	
15	3	d	W = 64				
20							
25							

Test Pit Completed 07/21/08
Total Depth of Test Pit = 16.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615725.72
East: 795616.80
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-02-08

Figure A-71

TP-03-08

Excavation Method: Tracked Excavator

Ground Elevation (ft): 15.15 (MLLW)

Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Soil Profile	Notes/Groundwater
0					SP-SM	Brown, fine SAND with silt to trace silt, numerous grass roots (loose, moist).	
					ML/CL	**(SOIL UNIT 1)** Mottled gray and brown clayey SILT, scattered fine wood debris (loose, moist)	
					SM	Dark gray, silty, gravelly SAND, numerous fine to large wood debris, including occasional logs to 20" in diameter.	
5					ML	Gray, fine sandy SILT with trace clay	Moderate Seepage
10	1	d	W = 51				
15							
20							
25							

Test Pit Completed 07/21/08
Total Depth of Test Pit = 12.5 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615583.50
East: 795531.18
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-03-08

Figure A-72

TP-04-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 14.54 (MLLW) Excavated By: Chinook Exc. and Land Dev.	
0					SM	Brown, silty, fine SAND (loose, moist) **(SOIL UNIT 1)**	
					ML	Dark gray sandy silt w/ abundant cedar shake spalls (soft, moist to wet)	
					SP-SM	Gray, fine SAND with silt (loose, wet). Significant caving and slumping of test pit sides below 3 feet.	Rapid Seepage
5	1	d	W = 31 GS				
10						- small broken shells and fine roots at 11.5	
15							
20							
25							

Test Pit Completed 07/21/08
Total Depth of Test Pit = 12.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615450.87
East: 795428.17
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-04-08

Figure A-73

TP-05-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 15.82 (MLLW) Excavated By: Chinook Exc. and Land Dev.	
0					SP-SM	Brown, fine to medium SAND with silt to trace of silt (medium dense, moist) with trace wood debris. **(SOIL UNIT 1)**	
	1	d	W = 19				
	2	d	W = 40 GS		SM	Gray, very silty, fine SAND (medium dense, moist to damp), scattered wood debris (small limbs).	
5							Slight Seepage
						- pocket of dark brown, decayed sawdust between 6 and 8 feet in one corner of test pit.	
10						- pocket of dark brown, decayed sawdust between 10 and 12 feet in one corner of test pit.	
					ML	Gray SILT with sand (soft to medium stiff, moist to damp), occasional shells.	
	3	d	W = 51				
15							
20							
25							

Test Pit Completed 07/21/08
Total Depth of Test Pit = 14.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615353.20
East: 795466.49
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-05-08

Figure
A-74

TP-06-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 14.61 (MLLW) Excavated By: Chinook Exc. and Land Dev.
0					SP	Brown, fine SAND with trace silt (medium dense, moist) **(SOIL UNIT 1)**
	1	d	W = 17			
	2	d	CA W = 16 GS		SP	Gray, fine to medium SAND with trace silt and gravel (medium dense, moist), occasional wood debris near upper contact.
5						Moderate Seepage
	3	d	W = 44			
10	4	d	W = 56		ML	Gray, clayey SILT with sand. 1-inch layer of marsh grass at 11 feet
15						
20						
25						

Test Pit Completed 07/21/08
Total Depth of Test Pit = 12.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615089.39
East: 795483.92
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-06-08

Figure A-75

TP-07-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 14.11 (MLLW) Excavated By: Chinook Exc. and Land Dev.
0					SP	Brown, fine SAND with trace silt (medium dense to dense, moist) **(SOIL UNIT 1)**
	1	d	W = 11		SP	Gray, fine SAND with trace silt (medium dense to dense, moist)
					SP	Brown, fine to medium SAND with trace silt (medium dense, moist).
5	2	d	W = 12 GS			
					SM	Gray, fine SAND with silt (loose to medium dense, wet).
						Moderate Seepage
10	3	d	W = 41 GS			
15						
20						
25						

Test Pit Completed 07/21/08
Total Depth of Test Pit = 10.5 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 614942.21
East: 795437.30
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-07-08

Figure A-76

TP-08-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 13.72 (MLLW) Excavated By: Chinook Exc. and Land Dev.	
0					SP-SM	Brown, fine SAND with silt to trace of silt (medium dense, moist) **(SOIL UNIT 1)**	
					SP	Gray, fine SAND, occasional layers with silt (medium dense, damp to wet). Occasional wood debris below 8 feet. Test pit caves rapidly below 3 feet.	
5							Slight Seepage
10							
15							
20							
25							

Test Pit Completed 07/21/08
Total Depth of Test Pit = 9.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 614970.36
East: 795607.17
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-08-08

Figure
A-77

TP-09-08

Excavation Method: Tracked Excavator

Ground Elevation (ft): 14.12 (MLLW)

Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	NOTES/GROUNDWATER
0					SP-SM	Brown, fine SAND with silt (medium dense to dense, moist). **(SOIL UNIT 1)** - occasional wood debris	
	1	d	W = 13				
	2	d	W = 27		SP	- several thin pockets of gray fine sand at 3.5 feet. Gray, fine SAND with trace silt (medium dense, moist to damp).	
5					SP-SM	Brown, fine SAND with silt (medium dense to dense, moist).	
					SP-SM	Gray, fine SAND with silt (medium dense, moist to damp).	Moderate Seepage
	3	d	W = 38 GS				
10							
15							
20							
25							

Test Pit Completed 07/22/08
Total Depth of Test Pit = 12.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 614831.63
East: 795545.63
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-09-08

Figure A-78

TP-10-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 13.78 (MLLW) Excavated By: Chinook Exc. and Land Dev.
0					SP-SM	Brown, fine SAND with silt to trace silt (medium dense, moist). **(SOIL UNIT 1)**
	1	d	W = 33 GS		SP	Gray, fine SAND with trace silt (loose to medium dense, wet), 1-inch seam of organic-rich sand at 3.5 feet.
5						Moderate Seepage
10						
	2	d	W = 59 GS		ML	Gray, SILT with sand (soft to medium stiff, wet), abundant wood debris from 11.5 to 12.5.
15						
20						
25						

Test Pit Completed 07/22/08
Total Depth of Test Pit = 13.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 614826.17
East: 795894.18
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-10-08

Figure A-79

TP-11-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 13.19 (MLLW) Excavated By: Chinook Exc. and Land Dev.	
0					SM	Brown, fine SAND with silt to silty (loose, moist), occasional wood debris to 3-inch diameter. **(SOIL UNIT 1)**	
	1	d	W = 90 GS		ML	Dark gray, sandy, SILT (medium stiff, damp), numerous fine organic fibers, medium plasticity.	
5							Slight Seepage
					SM	Brown, silty, gravelly SAND (dense, damp), gravel consists of quarry spalls to 3 inches. Top contact slopes from 3 ft to 8.5 ft BGS over distance of 15 ft (2.75H:1V); depth shown is midway along test pit wall. **(DIKE STRUCTURE)**	
10							
15							
20							
25							

Test Pit Completed 07/22/08
Total Depth of Test Pit = 8.5 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 614866.22
East: 796536.36
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-11-08

Figure
A-80

TP-12-08

Excavation Method: Tracked Excavator
Ground Elevation (ft): 11.86 (MLLW)
Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	NOTES/GROUNDWATER
0					ML	Mottled brown and light gray sandy SILT to SILT with sand (soft to medium stiff, moist), abundant small roots, occasional wood debris. **(SOIL UNIT 1)**	
	1	d	W = 53				
					MH/ CH	Dark gray, clayey SILT/silty CLAY (soft, moist), occasional wood debris.	
	2	d	W = 96				
5					SP-SM	Gray SAND with silt (loose, wet) - pocket of gray, decaying sawdust at 6 feet.	
					ML	Gray, SILT with sand to sandy SILT (soft to medium stiff, damp to wet) - stacked dimensioned lumber from 9 to 11 feet. Strong Hydrogen Sulfide odor.	Slight Seepage
10							
15	3	d	W = 63 GS		ML	Gray, SILT with sand to sandy SILT (soft to medium stiff, wet), scattered fine broken shells and layer of marsh grass at 15 feet.	
20							
25							

Test Pit Completed 07/22/08
Total Depth of Test Pit = 16.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615043.62
East: 796942.31
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-12-08

Figure A-81

TP-13-08

Excavation Method: Tracked Excavator
Ground Elevation (ft): 13.24 (MLLW)
Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	NOTES/GROUNDWATER
0					ML	Brown, SILT with sand (medium stiff, moist). **(SOIL UNIT 1)**	
					GP-GM	Gray, GRAVEL with silt and sand (dense, moist), pit run used for work yard	
					ML	Gray, SILT with sand (medium stiff, moist)	
5					DB	Brown, dimensioned lumber debris with pockets of silty sand and sandy silt. Includes approximately 1 foot of small, charred wood debris at top of unit.	Moderate Seepage
10					ML	Gray to dark gray, fine sandy SILT (soft, DAMP)	
15	1	d	W = 63		ML	Gray to dark gray, fine sandy SILT (soft, DAMP), thin layer of marsh grass at top of unit.	
20							
25							

Test Pit Completed 07/22/08
Total Depth of Test Pit = 17.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615297.23
East: 797050.94
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

TP-14-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 13.47 (MLLW) Excavated By: Chinook Exc. and Land Dev.	
0					ML	Mottled gray and brown, fine sandy SILT (medium stiff, moist), scattered small roots **(SOIL UNIT 1)** - scattered concrete and brick debris around 2 feet.	
	1	d					
	2	d			SM	Dark brown, silty SAND with occasional ash and charred wood debris (loose, damp)	
5					WD	Dark brown, decaying fine wood debris (very loose, wet), mostly sawdust and wood chips. - methane above LEL at surface of pile (disperses quickly). Strong Hydrogen Sulfide odor.	Moderate Seepage
	3	d					
					ML	Gray SILT with sand (soft, damp), occasional wood debris throughout unit.	
10							
15							
	4	d					
20							
25							

Test Pit Completed 07/22/08
Total Depth of Test Pit = 18.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615338.51
East: 797245.28
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-14-08

Figure A-83

TP-15-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 14.42 (MLLW) Excavated By: Chinook Exc. and Land Dev.	
0					ML	Mottled brown and gray sandy SILT and SILT with sand (medium stiff to stiff, moist) **(SOIL UNIT 1)**	
					GP-GM	Gray, GRAVEL with sand and silt (dense, moist), angular (pit run or quarry spalls placed for working surface).	
					SM	- 30-inch log encountered in corner of test pit at 4 feet.	
5					SP-SM	Light brown, silty SAND (dense, moist)	
						Brown, fine SAND with silt (medium dense, damp)	
					WD	Dark brown, decaying sawdust and wood chips, occasional larger wood debris.	
					ML	Dark gray, fine sandy SILT (medium stiff, damp), occasional pockets of decaying sawdust.	Slight Seepage
10							
15							
20							
25							

Test Pit Completed 07/22/08
Total Depth of Test Pit = 16.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615406.58
East: 797176.90
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

TP-16-08

Excavation Method: Tracked Excavator

Ground Elevation (ft): 13.52 (MLLW)

Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	NOTES/GROUNDWATER
0					SM	Brown, very silty, fine SAND (medium dense to dense, moist), numerous roots to 3/16" in upper 1.5 feet. **(SOIL UNIT 1)**	
	1	d	W = 21 GS				
					DB	White and light gray, coarsely broken oyster shells with silt and fine sand, (loose, moist)	
5	2	d	W = 356		WD	Dark brown, decaying WOOD with silt (loose, wet), mostly cedar shake spalls and cut ends of small dimensioned lumber.	Moderate Seepage
					ML/ MH	Gray, clayey SILT with sand (soft, damp), occasional pockets of fine wood debris (sawdust) throughout unit	
10							
	3	d	W = 66 AL				
15							
20							
25							

Test Pit Completed 07/22/08
Total Depth of Test Pit = 18.5 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615467.33
East: 797048.55
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-16-08

Figure A-85

TP-17-08

Excavation Method: Tracked Excavator

Ground Elevation (ft): 14.48 (MLLW)

Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	NOTES/GROUNDWATER
0					SM	Brown, silty, fine SAND (medium dense, moist), abundant roots to 3/16" diameter	
	1	d	W = 6 GS		SP	**(SOIL UNIT 1)** Brown, fine to medium SAND with trace silt (loose to medium dense, moist), occasional fine roots	
					ML	Mottled gray and brown, clayey SILT and SILT with sand	
	2	d	W = 42		SM	Gray, silty, fine SAND (medium dense, moist), occasional wood debris at top, numerous oyster shells from 5 to 10 feet.	
5							Slight Seepage
						- vertical timber pile encountered in corner of test pit from approximately 6 to 10 feet BGS	
10					ML	Gray, fine sandy SILT with clay (soft, moist), occasional dark gray pockets of clayey silt, occasional fine organics.	
15							
	3	d	W = 64 AL				
20							
25							

Test Pit Completed 07/22/08
Total Depth of Test Pit = 18.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615509.74
East: 797209.63
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-17-08

Figure A-86

TP-18-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 13.10 (MLLW) Excavated By: Chinook Exc. and Land Dev.	
0					ML/ MH	Brown, clayey SILT with trace sand (medium dense, moist), scattered small roots. **(SOIL UNIT 1)**	
	1	d	W = 41			- becomes mottled gray and brown below 2 feet	
					DB	White to light gray, large broken oyster shells with silt and sand (loose, wet), several large logs and other wood debris. Moved to TP-18A to negotiate digging below 8.5 feet.	
5					ML	Gray, sandy SILT (soft, wet)	Rapid Seepage

Test Pit Completed 07/22/08
Total Depth of Test Pit = 8.5 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615561.58
East: 797072.54
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

10
15
20
25

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-18-08

Figure
A-87

TP-18A-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 13.10 (MLLW) Excavated By: Chinook Exc. and Land Dev.	
0					ML	Brown, very snady SILT (medium dense, moist), scattered small roots. **(SOIL UNIT 1)**	
					DB	White to light gray, large broken oyster shells with silt and sand (loose, wet), several large logs and other wood debris	
					WD	Dark gray to black, wood debris with silt and sand (loose, wet), mostly cedar shake spalls and dimensioned lumber cut-offs.	Rapid Seepage
5					SM/ ML	Gray, silty, fine SAND/fine sandy SILT (loose/soft, damp to wet)	
10	1	d	W = 61				
15							
20							
25							

Test Pit Completed 07/22/08
Total Depth of Test Pit = 13.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615541.58
East: 797072.54
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

TP-19-08

Excavation Method: Tracked Excavator

Ground Elevation (ft): 14.36 (MLLW)

Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	NOTES/GROUNDWATER
0	1	d	W = 8		SP-SM	Brown, fine SAND with trace silt (with silt in upper foot)(loose, moist), scattered roots in upper foot. **(SOIL UNIT 1)**	
	2	d	W = 36 GS		SM	Mottled brown and gray, silty SAND (medium stiff, moist)	
5					SM	Gray, silty SAND (medium dense, wet), numerous oyster shells below 5 feet.	Moderate Seepage
					WD	Dark gray to black, WOOD debris with silt and sand (loose, wet), mostly short dimensioned lumber cut-offs.	
					ML/MH	Dark gray, clayey SILT with sand (very soft to soft, damp)	
10	3	d	W = 58 AL				
	4	d	W = 66		ML	Dark gray, fine sandy SILT (medium stiff, wet), numerous small shells.	
15							
20							
25							

Test Pit Completed 07/22/08
Total Depth of Test Pit = 14.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615567.00
East: 797217.66
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-19-08

Figure A-89

TP-20-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 13.08 (MLLW) Excavated By: Chinook Exc. and Land Dev.	
0					ML/ MH	Brown, clayey SILT with sand (medium stiff, moist) **(SOIL UNIT 1)**	
					GM	Dark brown, sandy, silty GRAVEL (loose, moist), abundant roots to 1/4" diameter.	
					WD	Dark brown to black, WOOD (loose, wet), mostly dimensioned lumber. **TRESTLE DEBRIS** - two vertical timber piles exposed in test pit sidewalls from 2 to 6 feet BGS.	Rapid Seepage
5					ML/ MH	Dark gray, clayey SILT with trace sand (very soft to soft, damp), includes scattered broken shells.	
	1	d	W = 72 AL				
10							
15							
20							
25							

Test Pit Completed 07/23/08
Total Depth of Test Pit = 12.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615665.07
East: 796930.34
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-20-08

Figure A-90

TP-21-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 14.40 (MLLW) Excavated By: Chinook Exc. and Land Dev.	
0	1	d	W = 44		ML	Mottled gray-brown SILT with clay and trace sand (soft to medium stiff, moist), scattered fine roots	Groundwater not encountered.
					SM	**(SOIL UNIT 1)** - scattered concrete and brick rubble from 0.5 to 3.0 feet Dark brown, silty SAND (medium dense, moist), including concrete and brick rubble	
	2	d	W = 23		SP	Gray, fine SAND with trace silt (medium dense, moist), becomes darker gray with depth	
5					ML/ MH	Dark gray, clayey SILT (very soft, moist), numerous organic fibers and broken shells	
	3	d	W = 76				
10							
15							
20							
25							

Test Pit Completed 07/23/08
Total Depth of Test Pit = 9.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615658.91
East: 796754.01
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

TP-22-08

SAMPLE DATA			SOIL PROFILE			NOTES/GROUNDWATER
Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	Excavation Method: Tracked Excavator Ground Elevation (ft): 13.40 (MLLW) Excavated By: Chinook Exc. and Land Dev.	
0	1	d	W = 64 AL		ML	Mottled gray-brown, clayey SILT with trace sand (soft to medium stiff, moist), abundant small roots in upper foot **(SOIL UNIT 1)**	
					SP-SM	Brown, fine SAND with silt (loose, moist), numerous roots in upper 3", occasional roots throughout	
5					ML/OL	Dark gray to black, organic SILT (very soft, damp), numerous small fibers and occasional wood debris, fragments of porcelain dishware throughout - 20" diameter log located at 5 feet	Moderate Seepage
					ML/MH	Dark gray, clayey SILT (very soft, damp) - numerous small shells in bedded layers	
10	2	d	W = 104				

Test Pit Completed 07/23/08
Total Depth of Test Pit = 10.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615680.71
East: 796645.63
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

15
20
25

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

TP-23-08

Excavation Method: Tracked Excavator
Ground Elevation (ft): 13.41 (MLLW)
Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	NOTES/GROUNDWATER
0	1	d	W = 84 AL		ML/ MH	Mottled gray-brown, fine sandy, clayey, SILT, grading downward to SILT with sand (soft to medium stiff, moist), numerous small roots in upper foot **(SOIL UNIT 1)**	Groundwater not encountered.
	2	d	W = 45		ML	Gray, SILT with trace sand (soft to medium stiff, moist), occasional roots near top contact - abundant dimensioned lumber debris from 6.0 to 7.5 feet	
5	3	d	W = 74 AL		ML/ MH	Dark gray, clayey SILT with trace sand (very soft, damp), occasional small broken shells and decayed organic fibers	
10							
15							
20							
25							

Test Pit Completed 07/23/08
Total Depth of Test Pit = 10.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615619.34
East: 796542.76
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

TP-24-08

Excavation Method: Tracked Excavator

Ground Elevation (ft): 14.18 (MLLW)

Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	NOTES/GROUNDWATER
0					ML	Mottled gray-brown, clayey SILT with trace sand (soft, moist), numerous roots in upper foot **(SOIL UNIT 1)**	
	1	d	W = 60				
					ML	Gray, SILT with sand and clay (soft, damp), occasional wood debris, becomes more plastic with depth	
	2	d	W = 48				
5						- concrete slab debris between 3.5 and 5.0 feet	
	3	d	W = 53			- numerous pieces of dimensioned lumber in probe hole, strong Hydrogen Sulfide odor **- methane detected in test pit**	Moderate Seepage
					ML/ MH	Gray to dark gray, clayey SILT with occasion sandy SILT lamination (very soft to soft, damp), scattered organic fibers and roots	
10							
	4	d	W = 61				
15							
20							
25							

Test Pit Completed 07/23/08
Total Depth of Test Pit = 14.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615601.87
East: 796430.06
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-24-08

Figure A-94

TP-25-08

Excavation Method: Tracked Excavator

Ground Elevation (ft): 14.52 (MLLW)

Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	NOTES/GROUNDWATER
0					ML	Mottled brown and gray, SILT with trace sand (loose, moist), scattered small plant roots in upper 1.5 feet **(SOIL UNIT 1)**	
	1	d	W = 61 GS				
	2	d	W = 58 AL		ML	Gray, clayey SILT (very soft to soft, moist), scattered fine organic fibers and small wood debris	
5					ML/ MH	Gray, clayey SILT with sand (very soft, damp to wet)	
					WD	- abundant dimensioned lumber between 5.5 and 9.5 feet (appears to be stacked) with strong Hydrogen Sulfide smell **- methane at 20ppm (>LEL) immediately around T-probe penetration**	Moderate Seepage
10					ML	Dark gray, SILT with sand and clay (very soft, damp), scattered shells and organic fibers	
	3	d	W = 54				
15							
20							
25							

Test Pit Completed 07/23/08
Total Depth of Test Pit = 14.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615665.36
East: 796319.13
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-25-08

Figure A-95

TP-26-08

Excavation Method: Tracked Excavator
Ground Elevation (ft): 15.10 (MLLW)
Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	NOTES/GROUNDWATER
0					ML	Mottled gray-brown, sandy SILT, with clay (medium stiff, moist), occasional roots to 1.5 feet **(SOIL UNIT 1)**	
	1	d	W = 43 AL				
	2	d	W = 24		SP	Gray, fine SAND with trace silt (medium dense, damp).	
5					ML	Dark gray, sandy SILT (soft, damp to wet), abundant dimensioned lumber below 7.0 feet, strong Hydrogen Sulfide odor **- methane up to 10ppm next to T-probe hole**	Rapid Seepage
10					ML	Dark gray, SILT with sand and clay (very soft, damp), scattered small shells and small organic fibers	
15	3	d	W = 57 AL				
20							
25							

Test Pit Completed 07/23/08
Total Depth of Test Pit = 15.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615766.60
East: 796293.87
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Log of Test Pit TP-26-08

Figure A-96

TP-27-08

Excavation Method: Tracked Excavator

Ground Elevation (ft): 15.27 (MLLW)

Excavated By: Chinook Exc. and Land Dev.

Depth (ft)	Sample Number & Interval	Sampler Type	Test Data	Graphic Symbol	USCS Symbol	SOIL PROFILE	NOTES/GROUNDWATER
0					ML/ MH	Mottled brown and gray, clayey, sandy SILT (medium stiff, moist), scattered roots in upper foot **(SOIL UNIT 1)**	
	1	d	W = 42 AL				
	2	d	W = 38		ML	Gray, sandy SILT (soft, moist), numerous fine organics, becomes darker gray with depth	
	3	d	W = 43		ML/ OL	Dark gray to black, sandy SILT, with clay (soft, damp), abundant fine organics and fire-brick debris	
5						- abundant dimensioned lumber debris from 7.0 to 10.5 feet	Moderate Seepage
10					ML/ MH	Dark gray to gray, clayey SILT with sand (soft, damp), scattered broken shells and marsh grass	
	4	d	W = 55 AL				
15							
20							
25							

Test Pit Completed 07/23/08
Total Depth of Test Pit = 14.0 ft.
WSDOT Job #: XL 2672

Point located at State Plane Coordinates:
North: 615640.14
East: 796207.20
Township: 17N
Range: 10W
Section: 11
Inspector: CTM

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ WSDOT SINGLE TEST PIT LOG

Test Pit TP-15-08

Test Pit TP-26-08

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Test Pit Photographs Showing Wood

Figure
A-98

Test Pit
TP-4-08

Test Pit
TP-20-08

1/2/09 \\Edmdata\projects\122\025\020\FileRm\R\Geotech Report\Final Report\Appendices\App_A\Fig A-99.doc

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	**Test Pit Photographs Showing Wood**	Figure A-99

Test Pit
TP-20-08

Test Pit
TP-20-08

1/2/09 \\Edmdata\projects\122\025\020\FileRm\R\Geotech Report\Final Report\Appendices\App_A\Fig A-100.doc

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	**Test Pit Photographs Showing Wood**	Figure A-100

Test Pit
TP-22-08

Test Pit
TP-25-08

1/2/09 \\Edmdata\projects\122\025\020\FileRm\R\Geotech Report\Final Report\Appendices\App_A\Fig A-101.doc

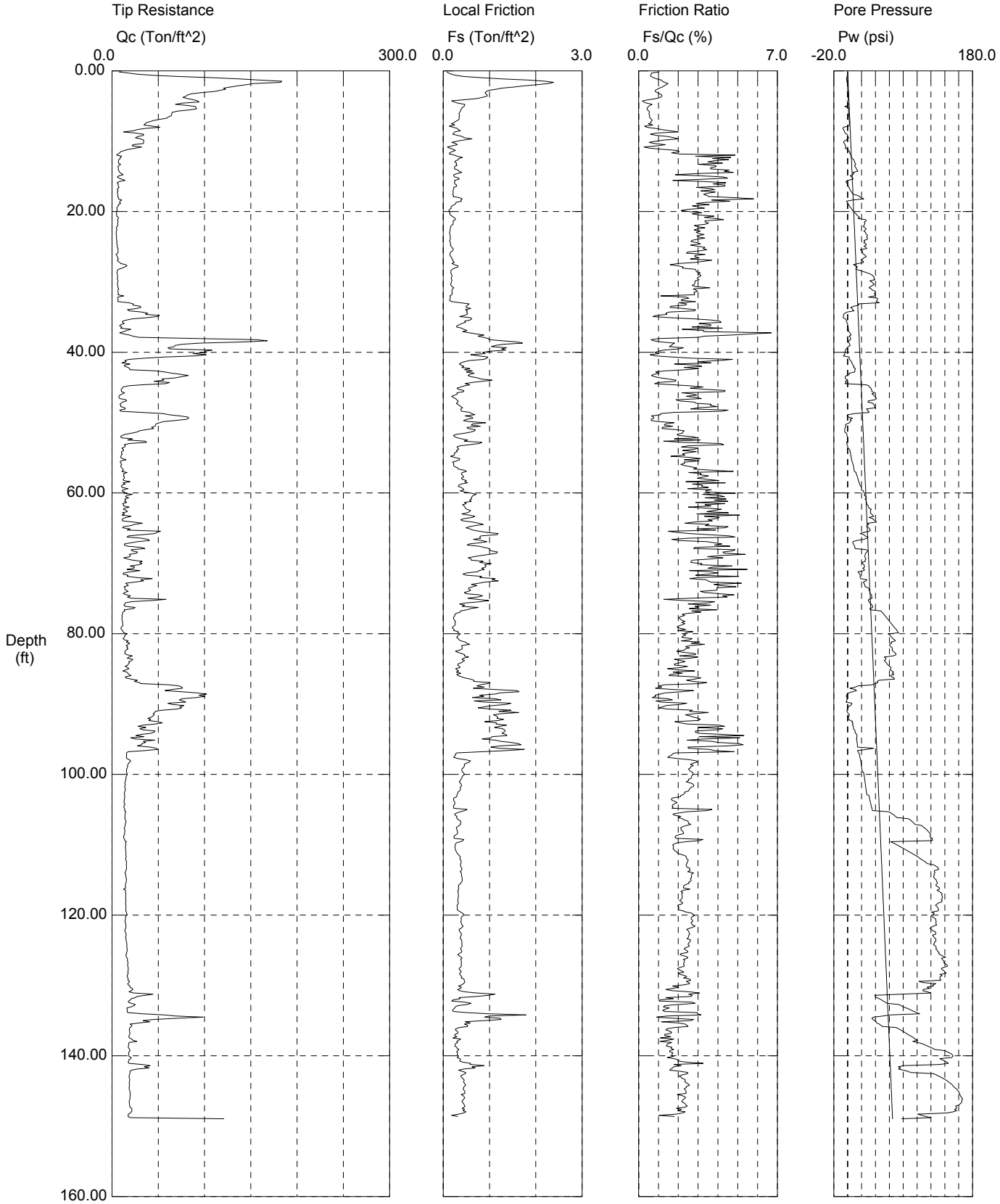
LANDAU ASSOCIATES

SR 520 Pontoon Construction Project Port of Grays Harbor, Washington	**Test Pit Photographs Showing Wood**	Figure A-101

WSDOT GEOTECH DIVISION

Operator: Brian Hilts
Sounding: CPT-1
Elevation: 0

CPT Date/Time: 01-21-06 13:19
Location: CPT-1-06
Job Number: XL-2344



Maximum Depth = 148.95 feet

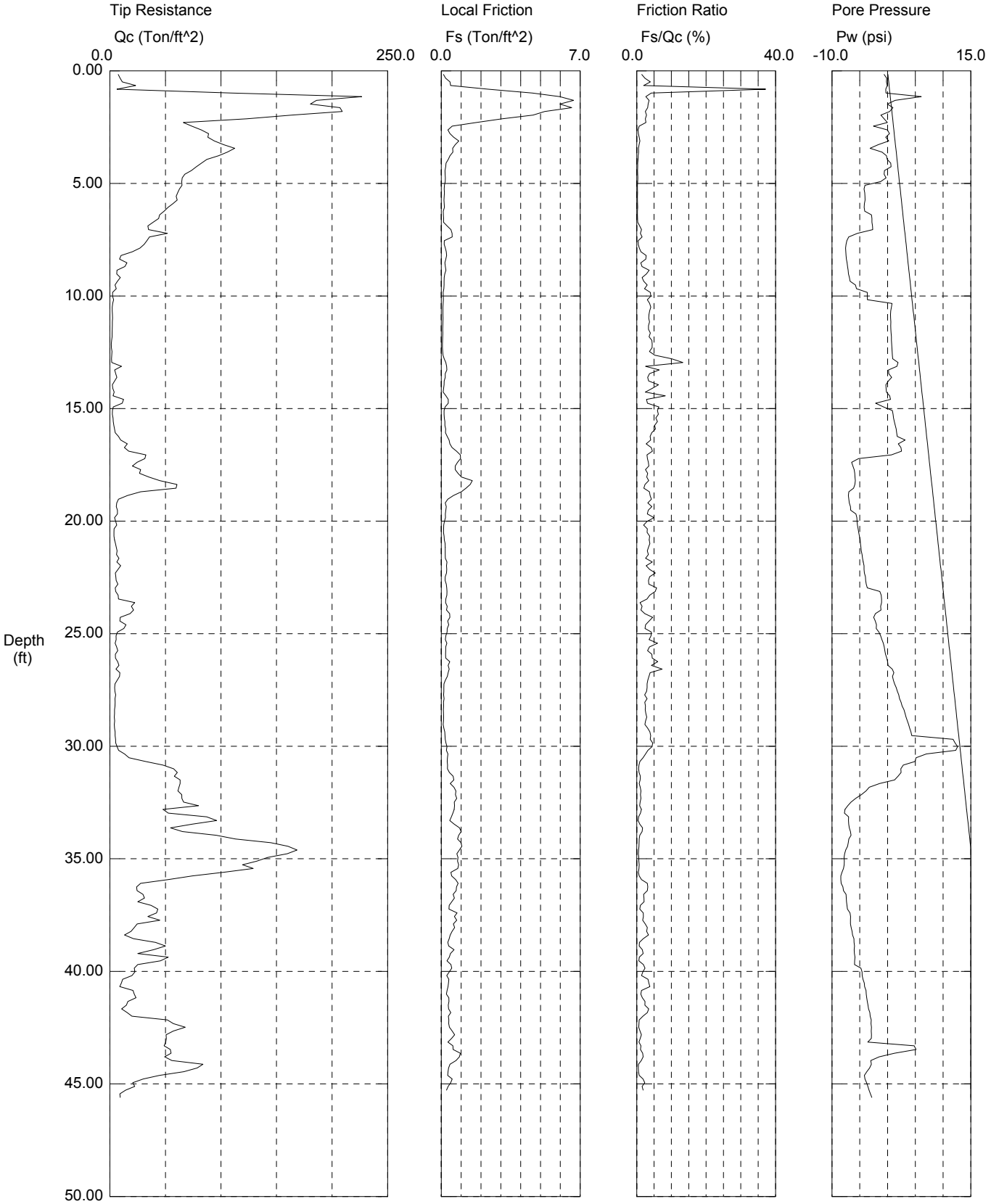
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator: Vince Johnson
Sounding: CPT-2
Elevation: 0

CPT Date/Time: 01-18-06 07:51
Location: CPT-2-06
Job Number: XL-2344



Maximum Depth = 45.60 feet

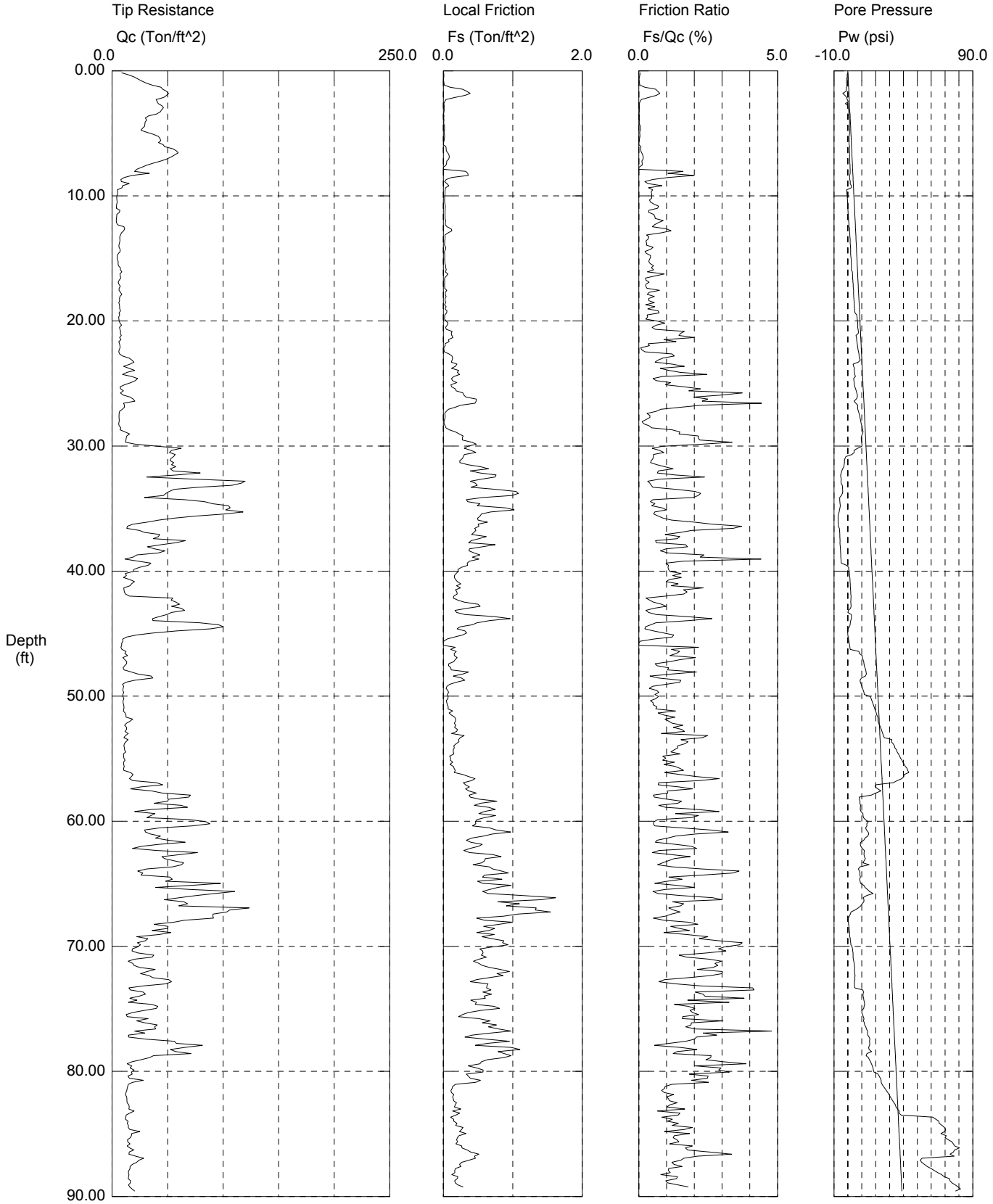
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim, WA

WSDOT GEOTECH DIVISION

Operator: Vince Johnson
Sounding: CPT-2A
Elevation: 0

CPT Date/Time: 01-18-06 09:14
Location: 9.7' W OF CPT-2
Job Number: XL-2344



Maximum Depth = 89.57 feet

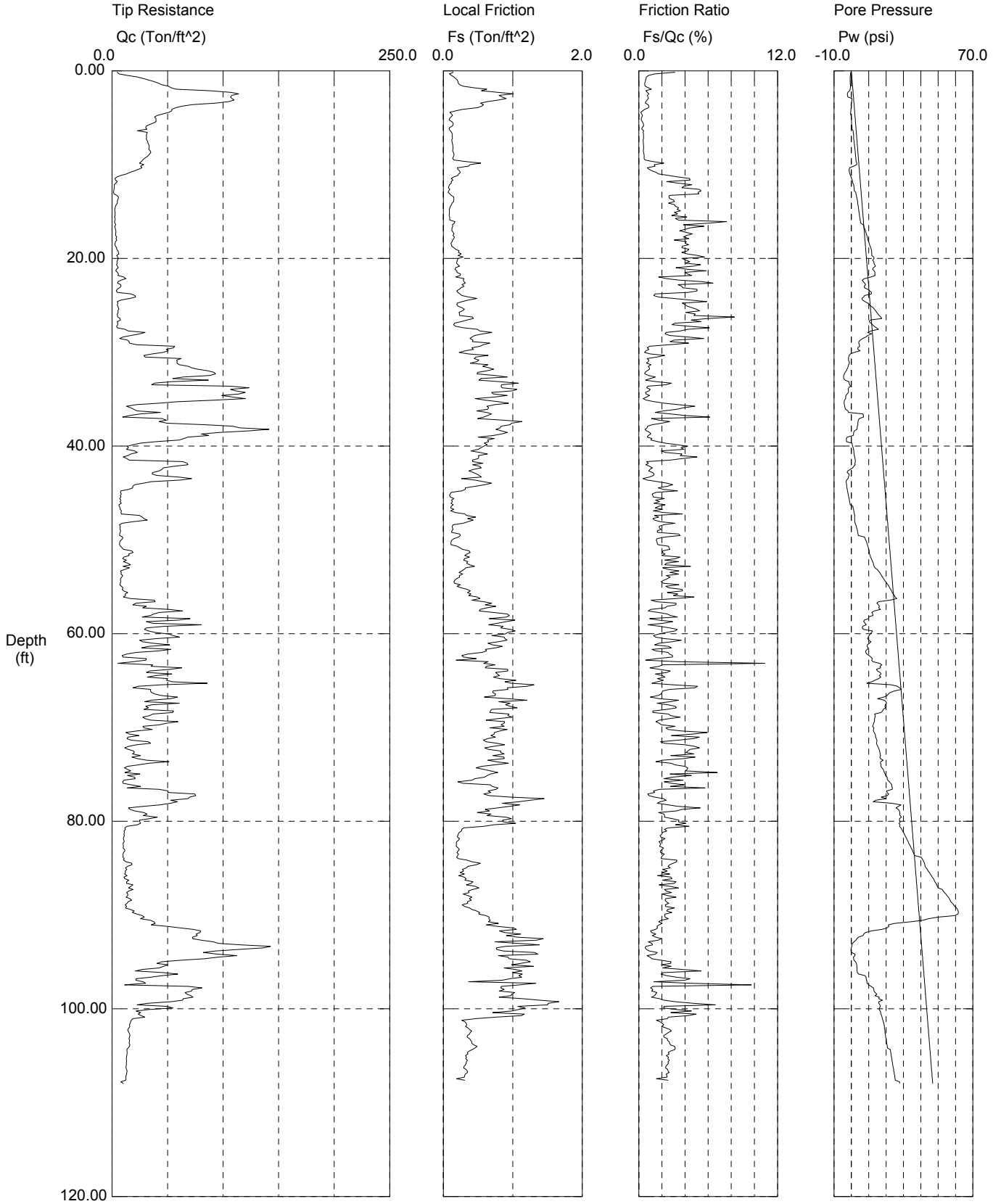
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim, WA

WSDOT GEOTECH DIVISION

Operator: Vince Johnson
Sounding: CPT-2B
Elevation: 0

CPT Date/Time: 01-18-06 11:10
Location: 9.7' E of CPT-2
Job Number: XL-2344



Maximum Depth = 107.94 feet

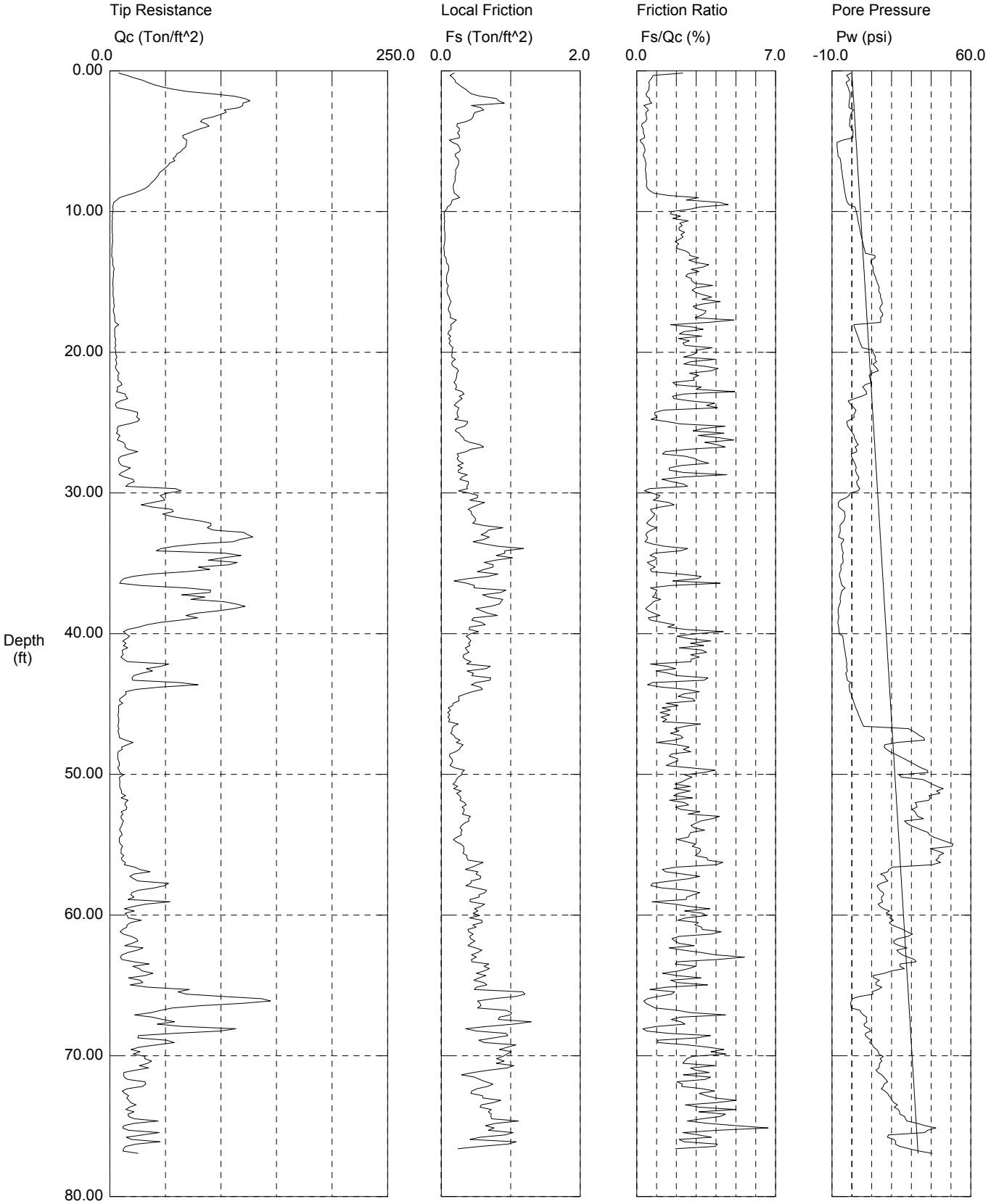
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator: Vince Johnson
Sounding: CPT-2C
Elevation: 0

CPT Date/Time: 01-18-06 13:57
Location: 22.8' E of CPT-2
Job Number: XL-2344



Maximum Depth = 76.94 feet

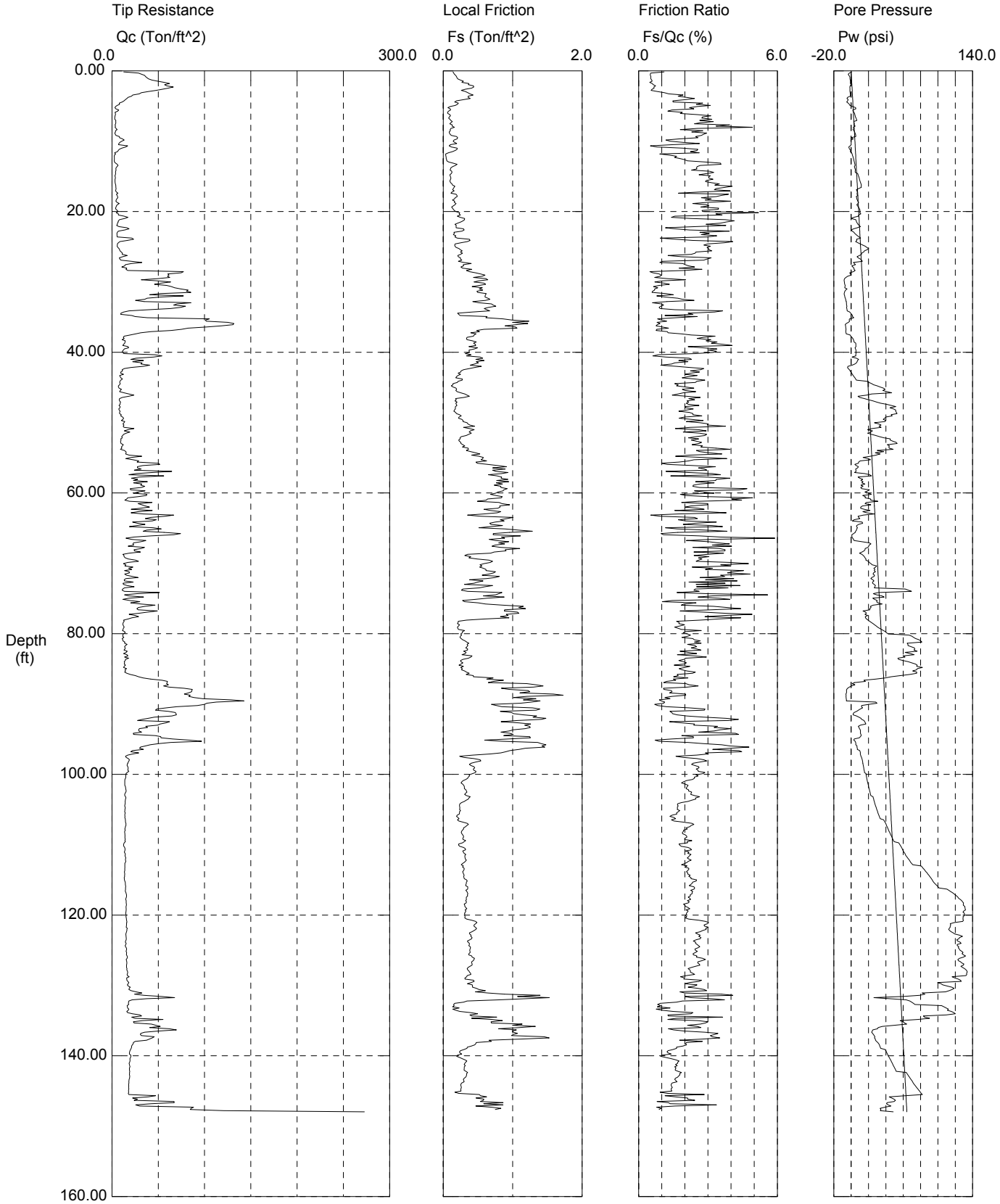
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator: Brian Hilts
Sounding: CPT-2D
Elevation: 0

CPT Date/Time: 01-23-06 13:19
Location: CPT-2D-06
Job Number: XL-2344



Maximum Depth = 147.97 feet

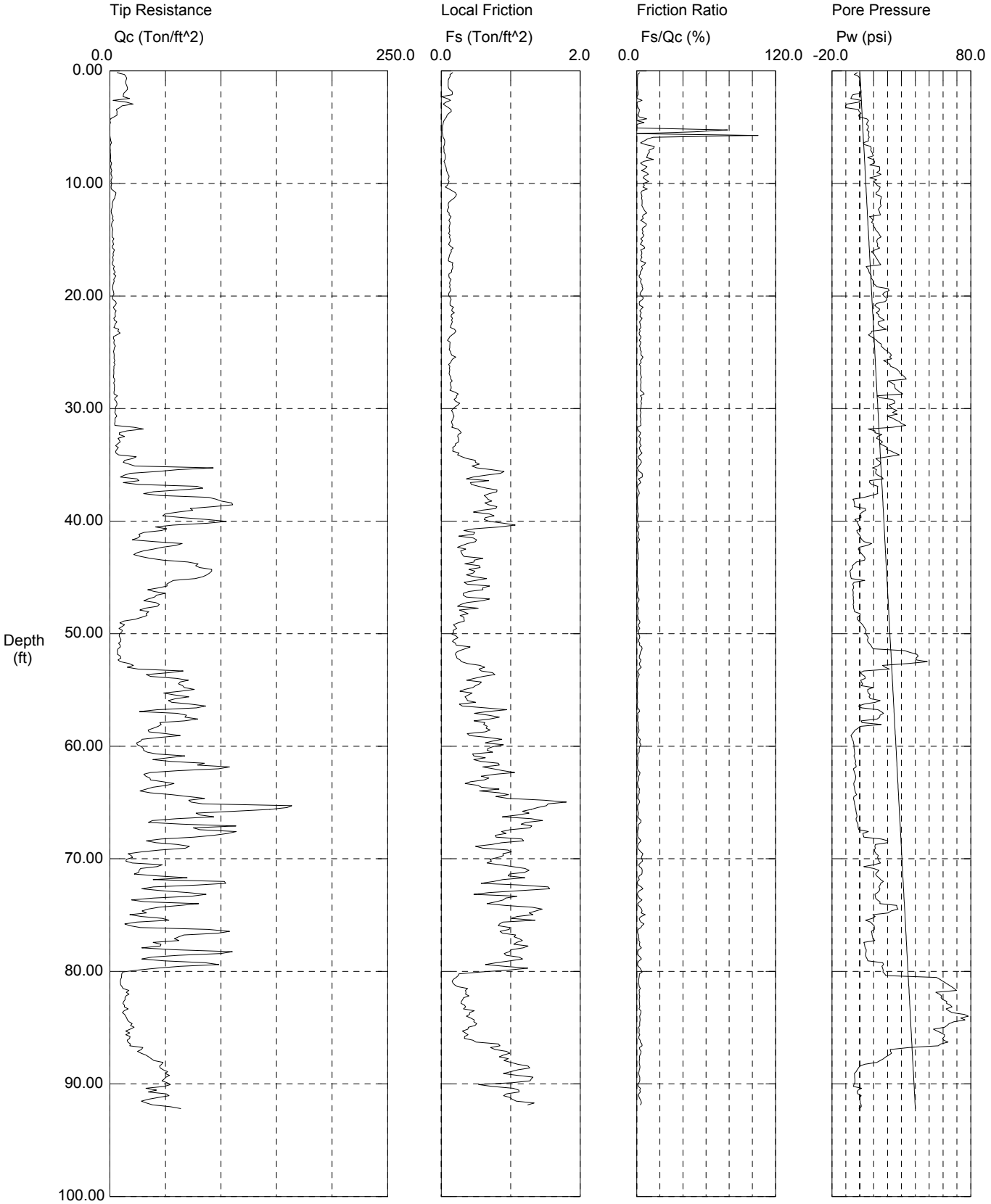
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator: Brian Hilts
Sounding: CPT-3
Elevation: 0

CPT Date/Time: 01-19-06 08:16
Location: CPT-3-06
Job Number: XL-2344



Maximum Depth = 92.19 feet

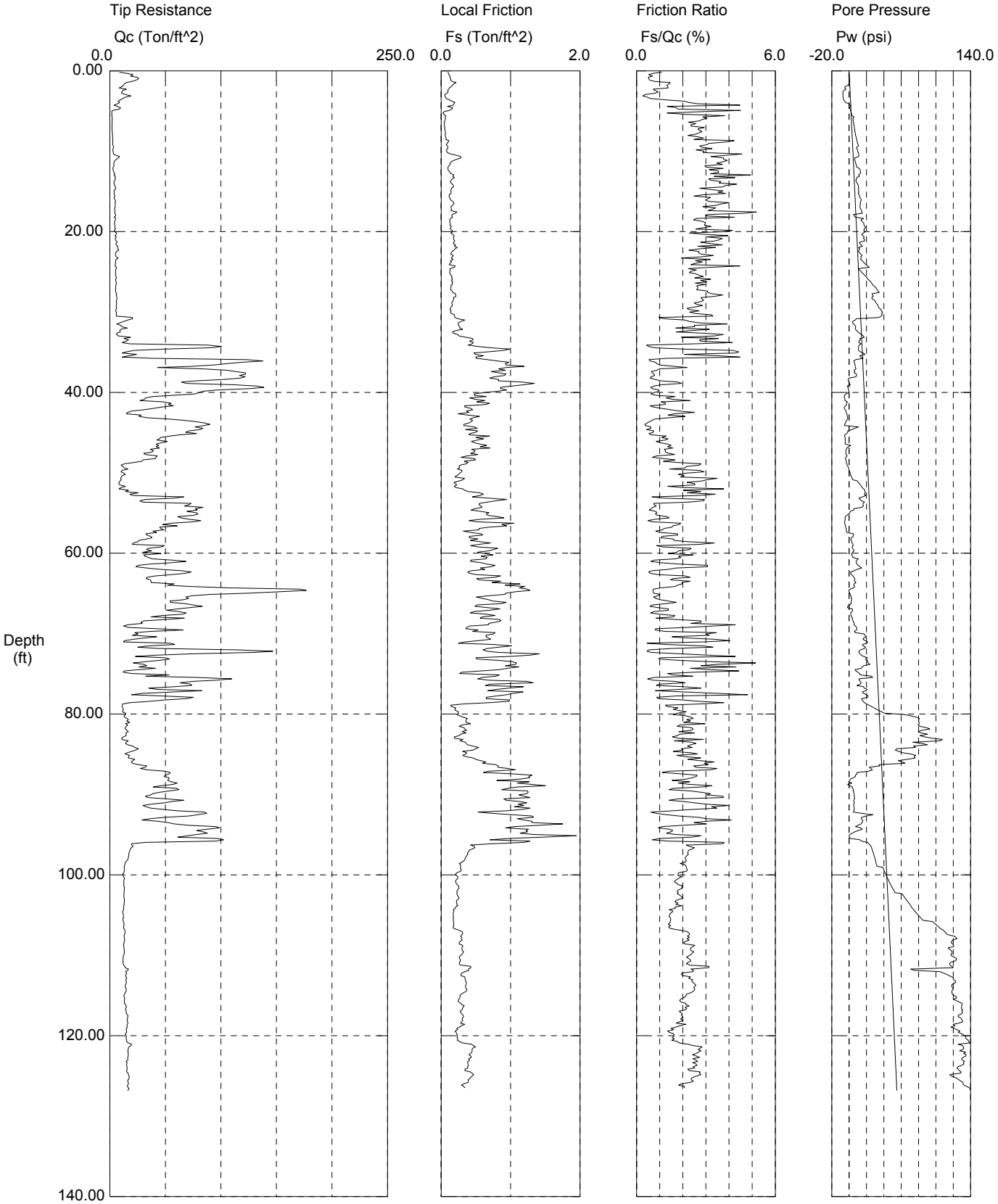
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator: Brian Hilts
Sounding: CPT-3A
Elevation: 0

CPT Date/Time: 01-19-06 11:40
Location: 9' E of CPT-3
Job Number: XL-2344



Maximum Depth = 126.80 feet

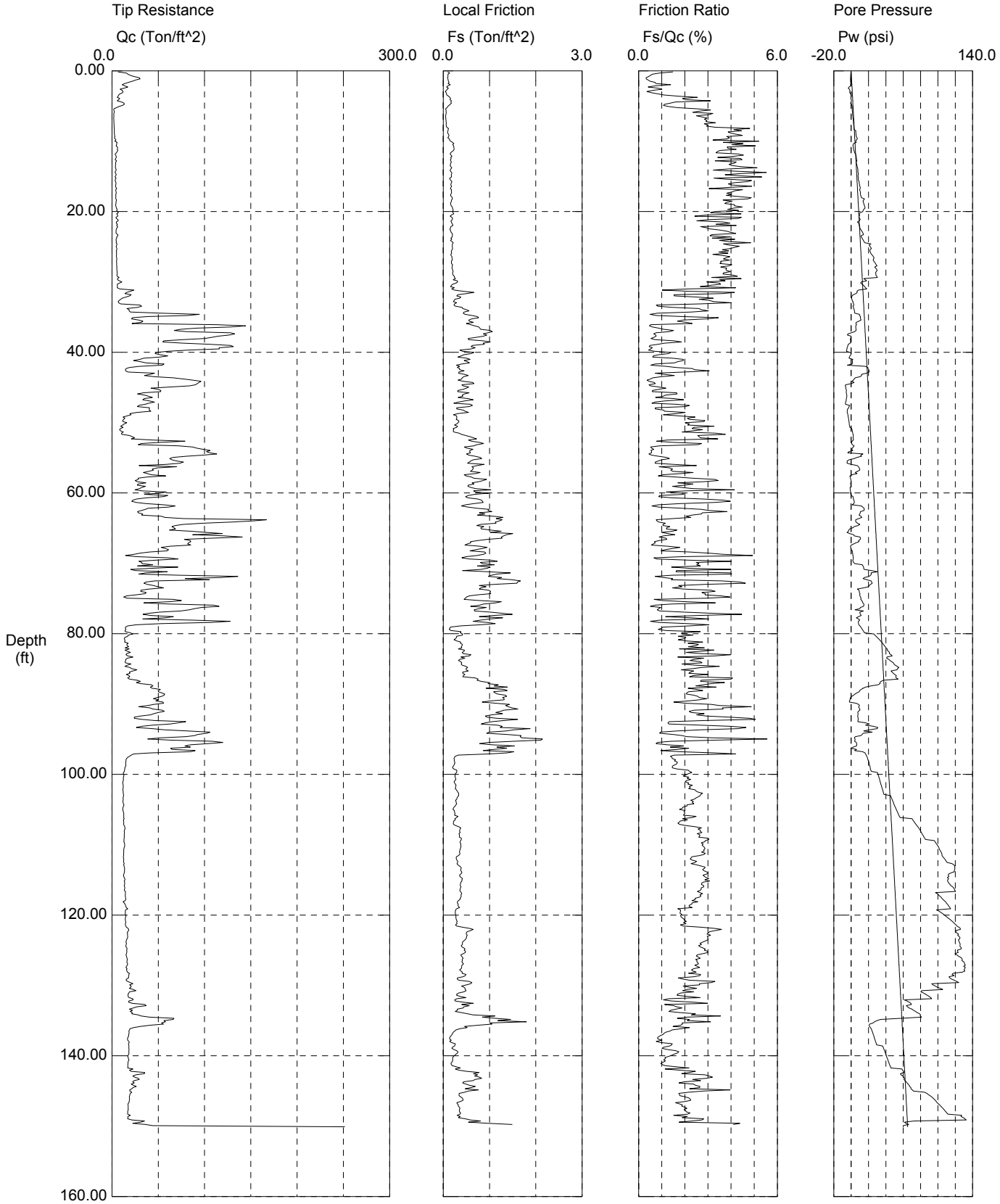
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator: Brian Hilts
Sounding: CPT-3B
Elevation: 0

CPT Date/Time: 01-20-06 08:45
Location: 8.9' E of CPT-3
Job Number: XL-2344



Maximum Depth = 150.10 feet

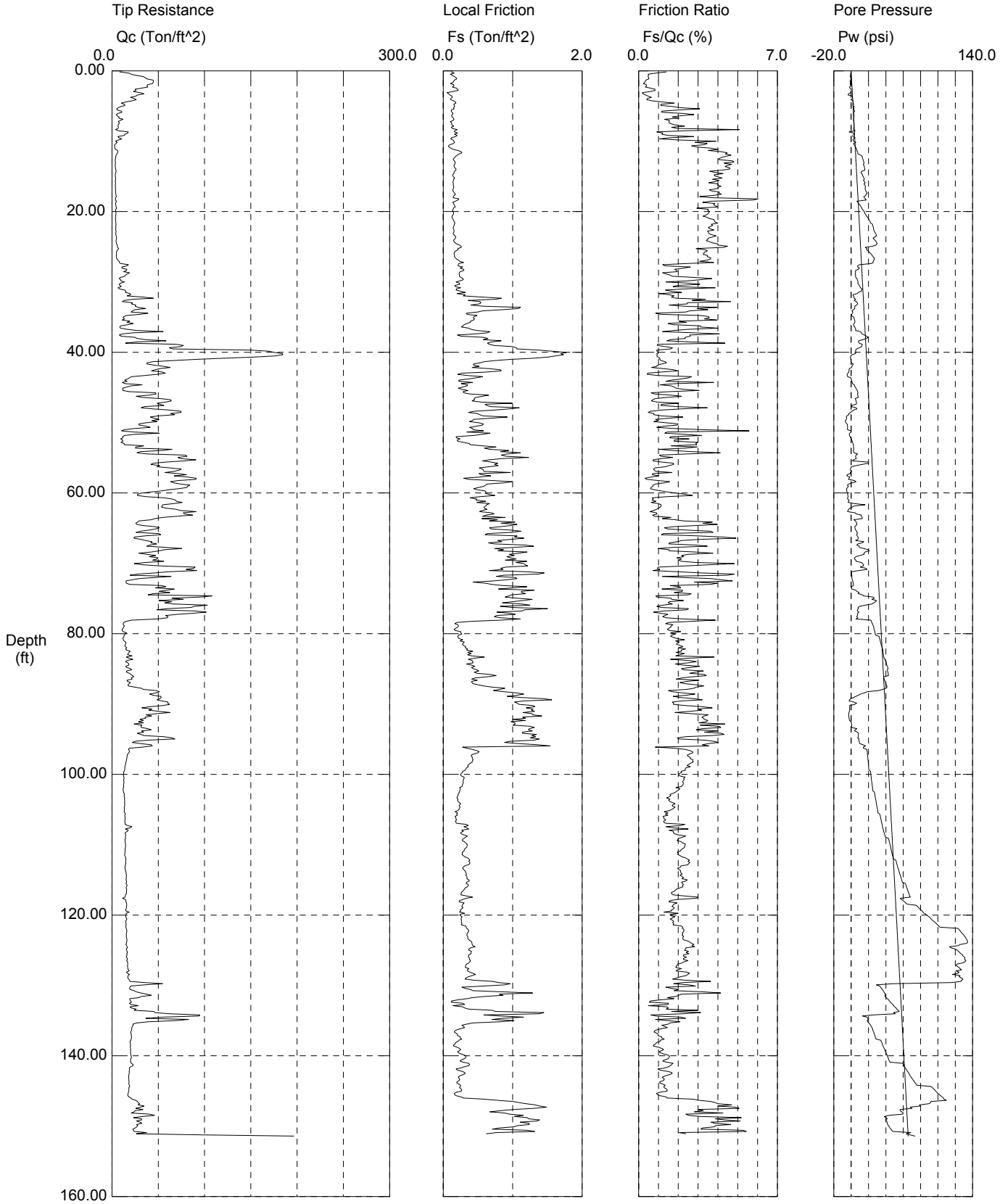
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator: Brian Hilts
Sounding: CPT-4
Elevation: 0

CPT Date/Time: 01-21-06 09:12
Location: CPT-4-06
Job Number: XL-2344



Maximum Depth = 151.41 feet

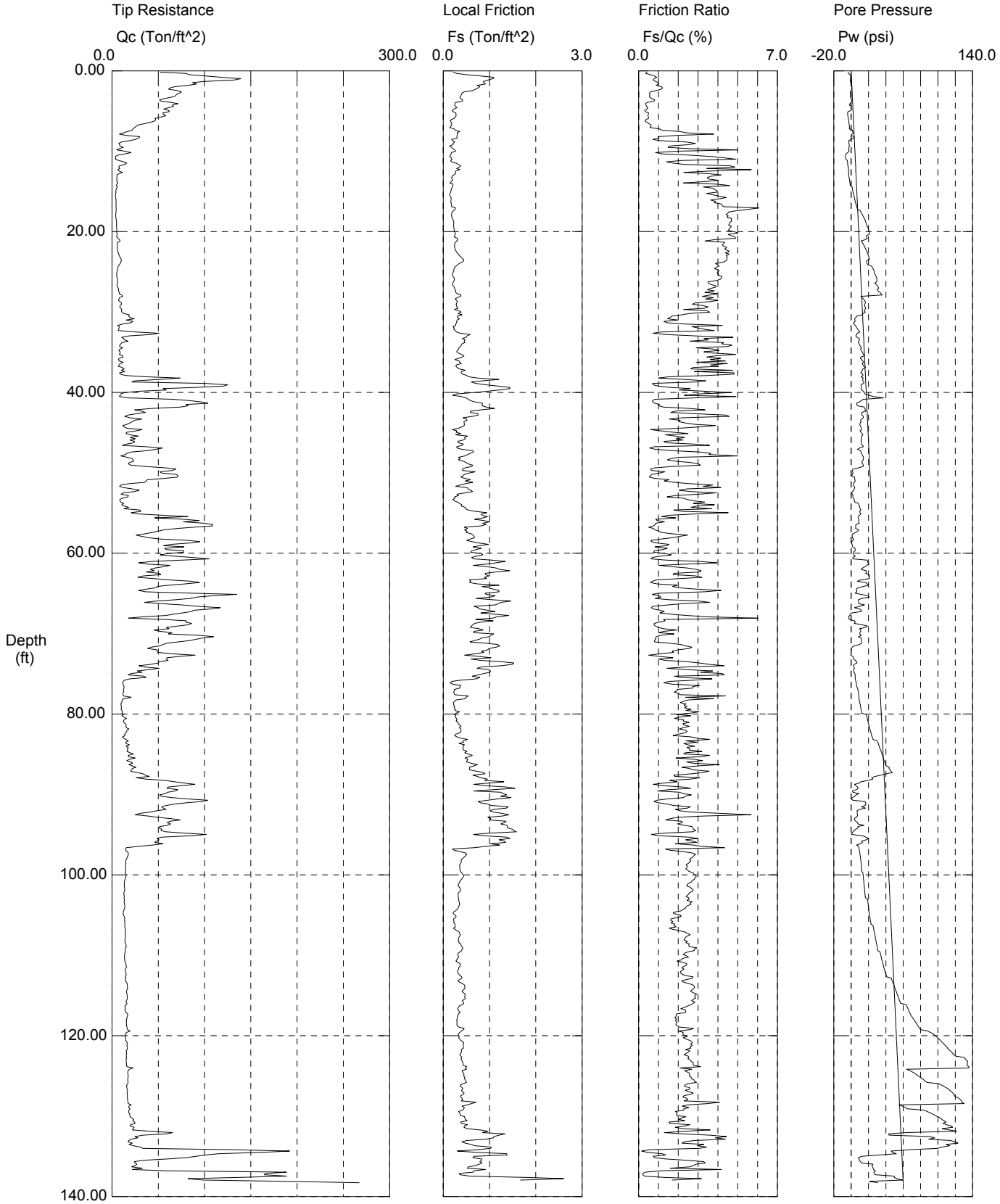
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator: Brian Hilts
Sounding: CPT-5
Elevation: 0

CPT Date/Time: 01-22-06 09:24
Location: CPT-5-06
Job Number: XL-2344



Maximum Depth = 138.29 feet

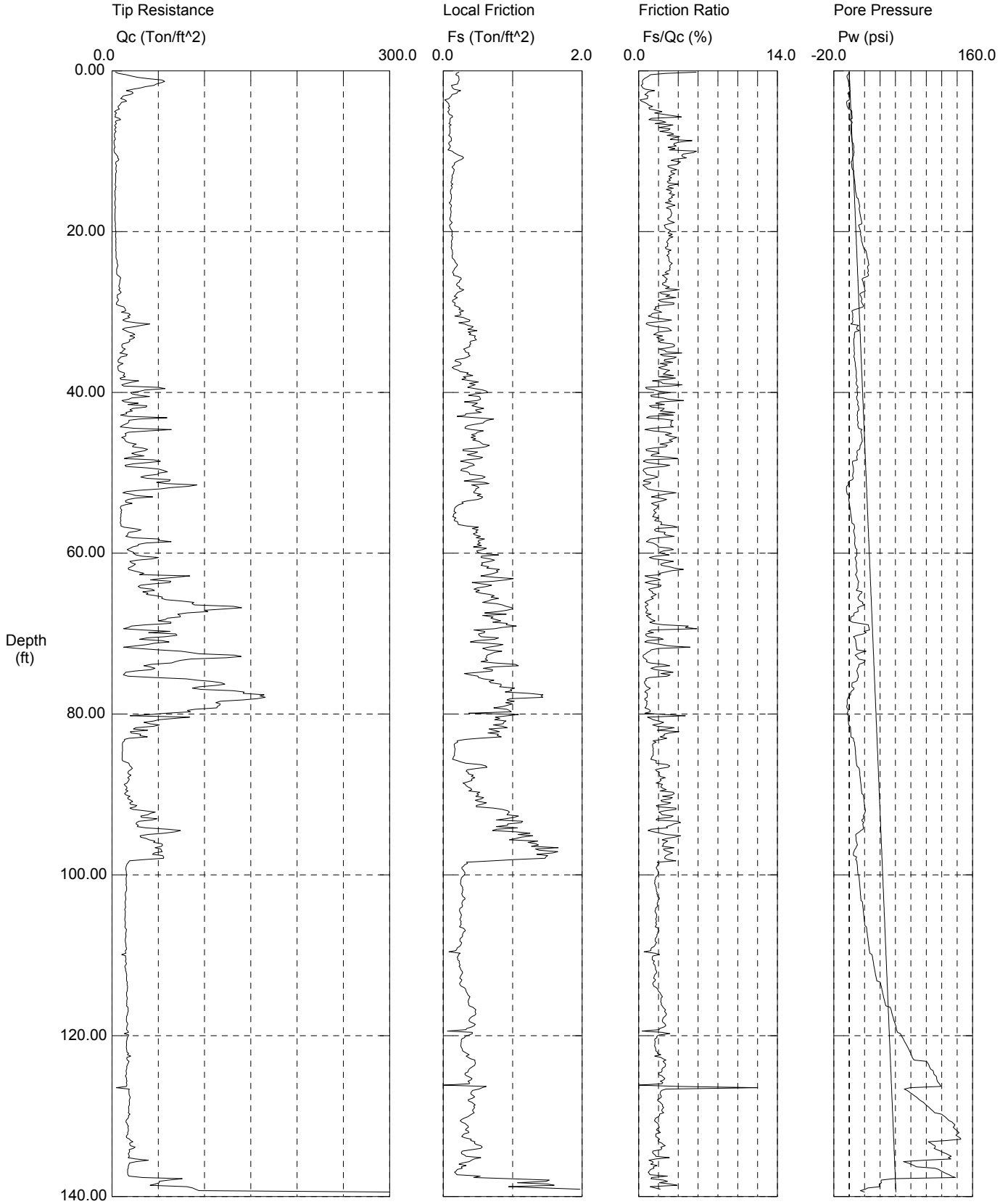
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator: Vince Johnson
Sounding: CPT-6
Elevation: 0

CPT Date/Time: 01-20-06 13:18
Location: CPT-6-06
Job Number: XL-2344



Maximum Depth = 139.44 feet

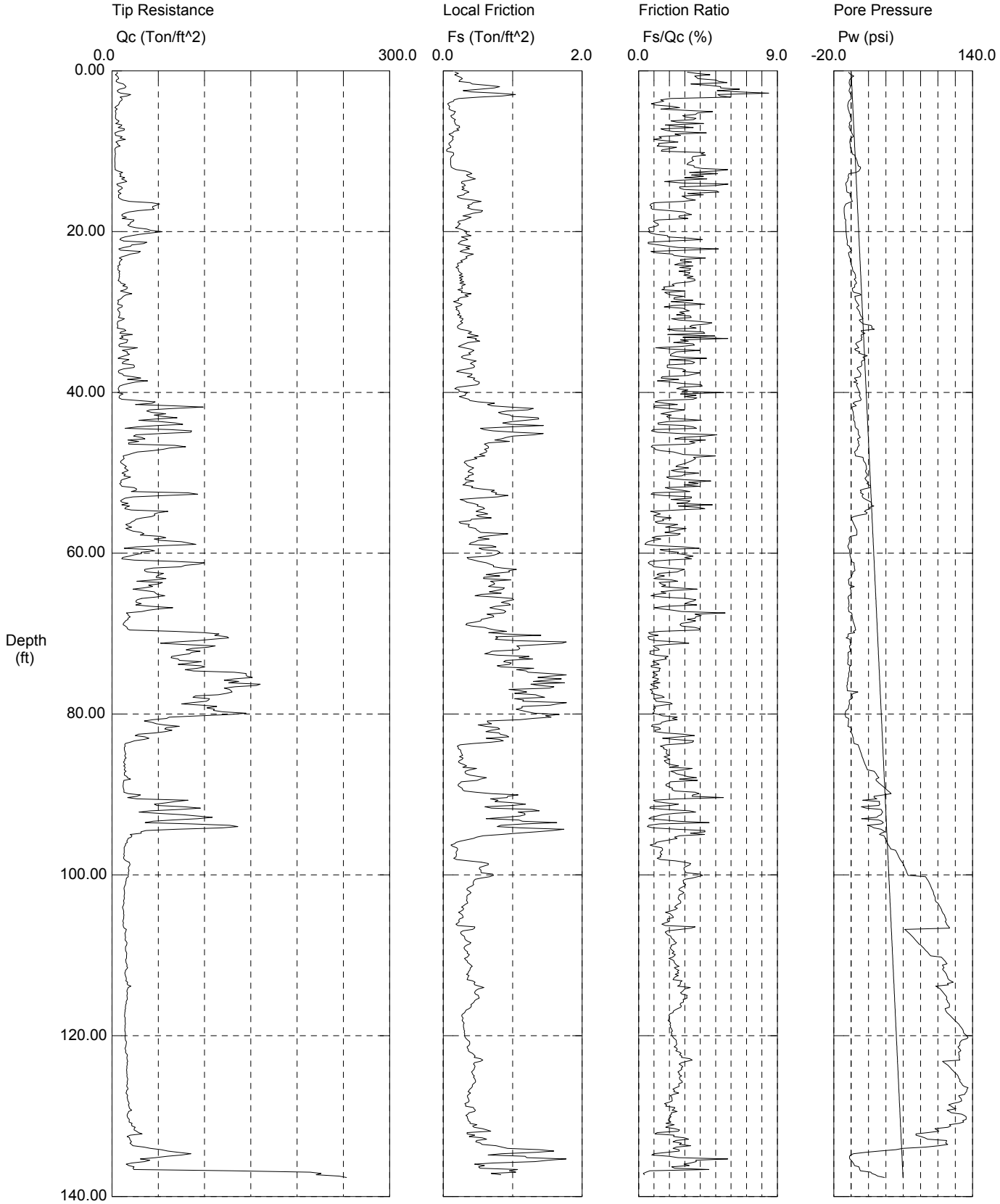
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator: Brian Hilts
Sounding: CPT-7
Elevation: 0

CPT Date/Time: 01-23-06 07:55
Location: CPT-7-06
Job Number: XL-2344



Maximum Depth = 137.63 feet

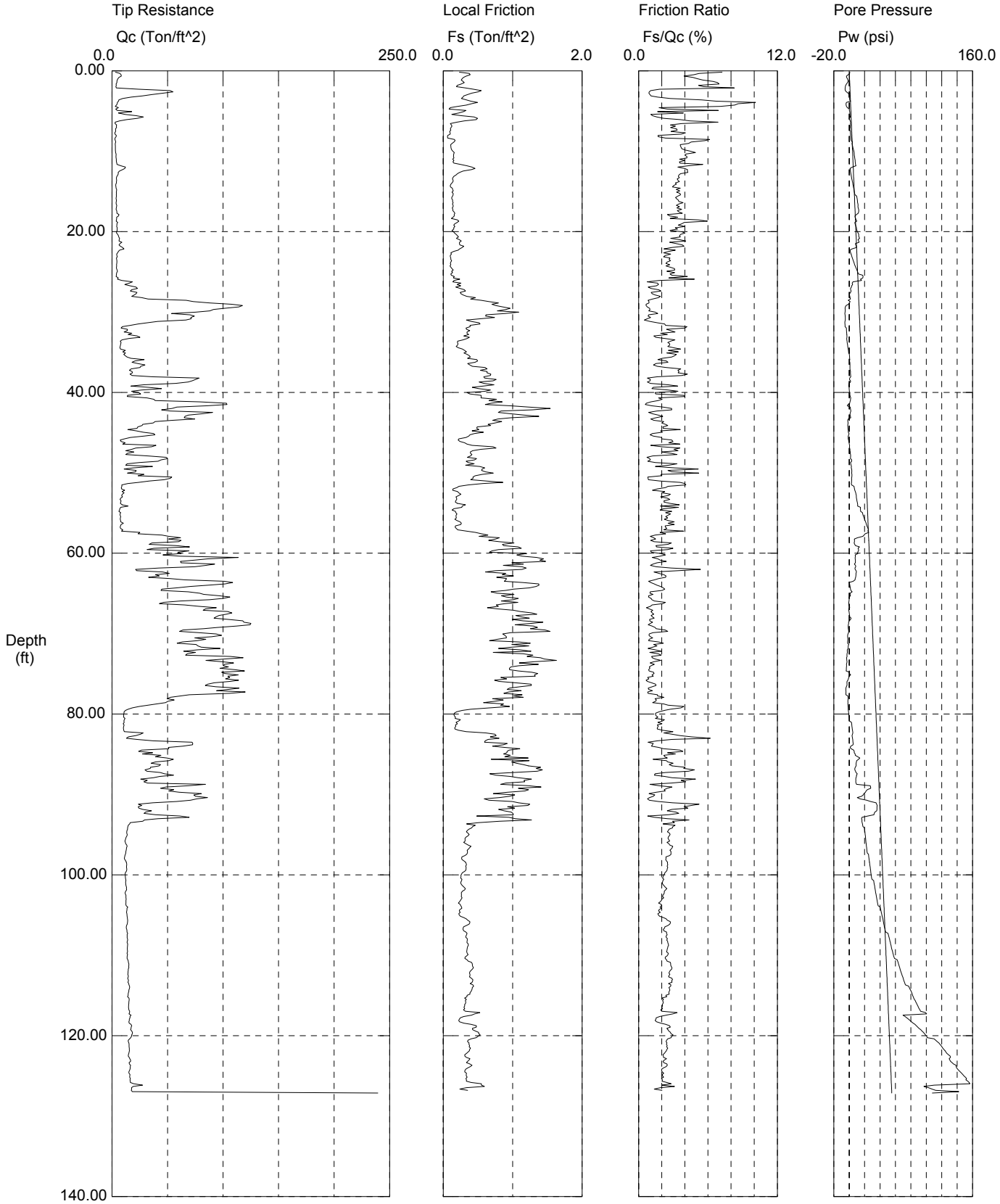
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator: Brian Hilts
Sounding: CPT-8
Elevation: 0

CPT Date/Time: 01-24-06 15:24
Location: CPT-8-06
Job Number: XL-2344



Maximum Depth = 127.13 feet

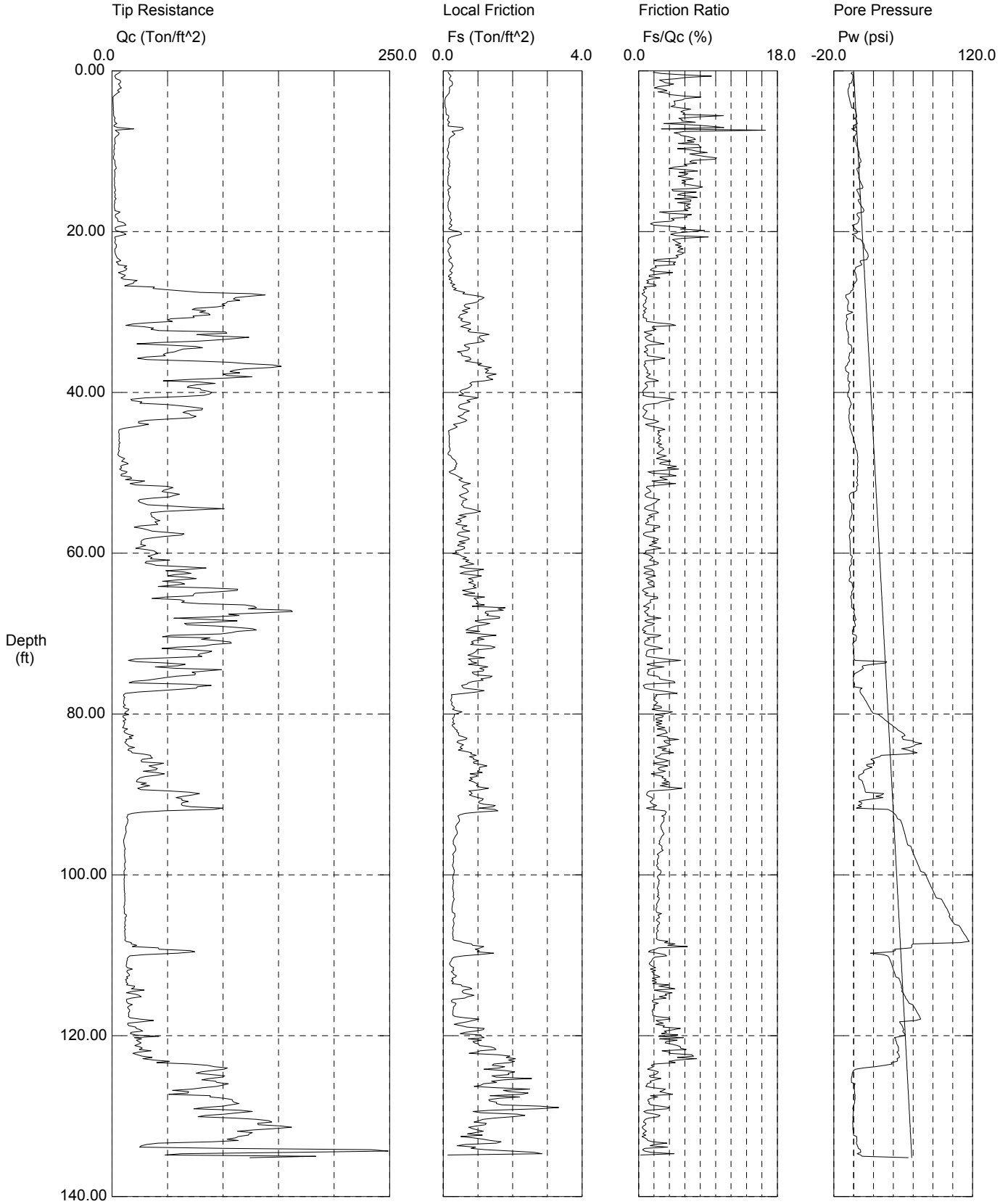
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator: Brian Hilts
Sounding: CPT-9
Elevation: 0

CPT Date/Time: 01-24-06 09:32
Location: CPT-9-06
Job Number: XL-2344



Maximum Depth = 135.17 feet

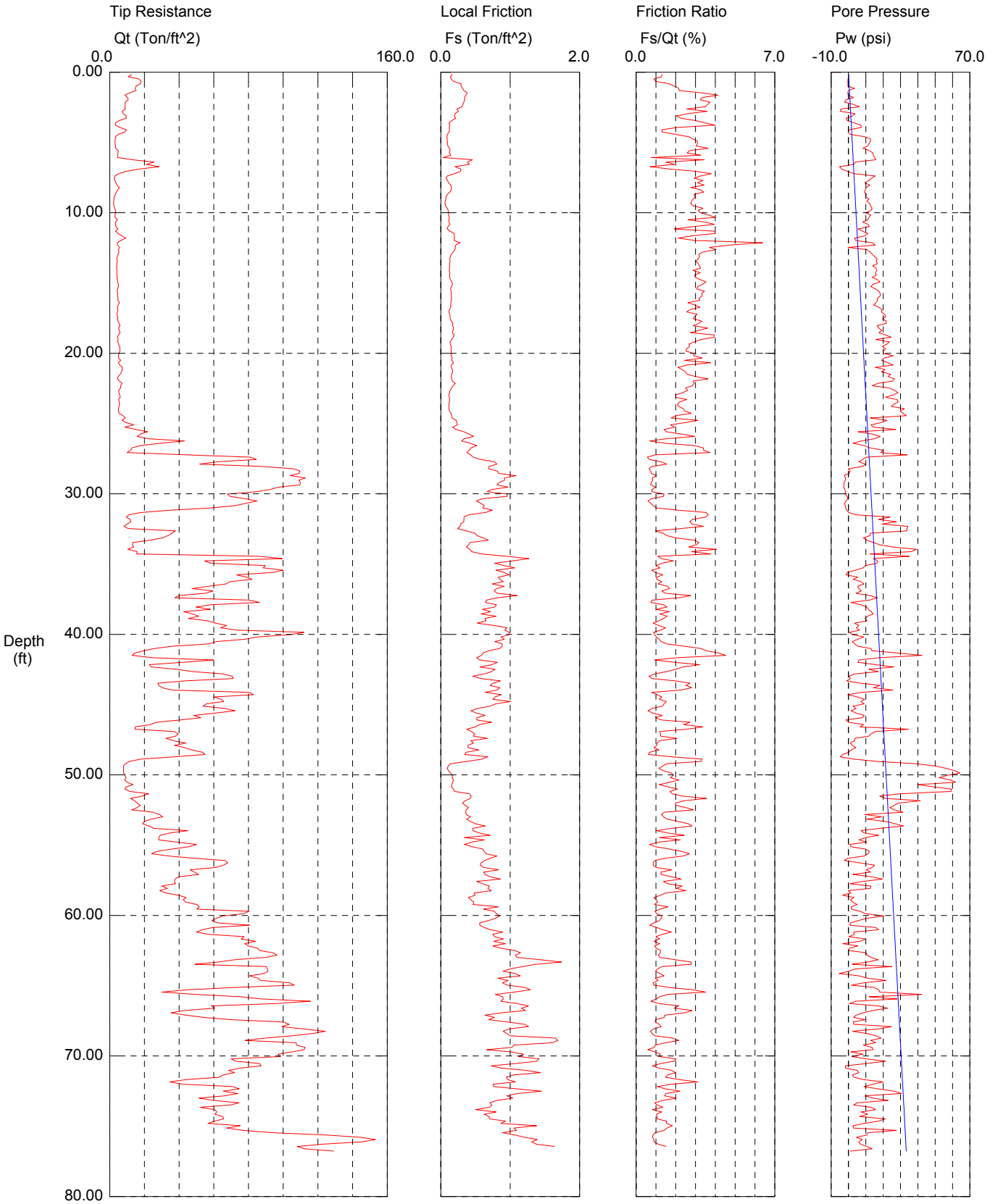
Depth Step = 0.16 feet

SR 520 Bridge Pontoon Const. Site Invesigation
Grays Harbor - Hoquaim WA

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-10-06
Elevation: UNKNOWN

CPT Date/Time: 07-19-06 08:15
Location: CPT-10-06
Job Number: XL-2672



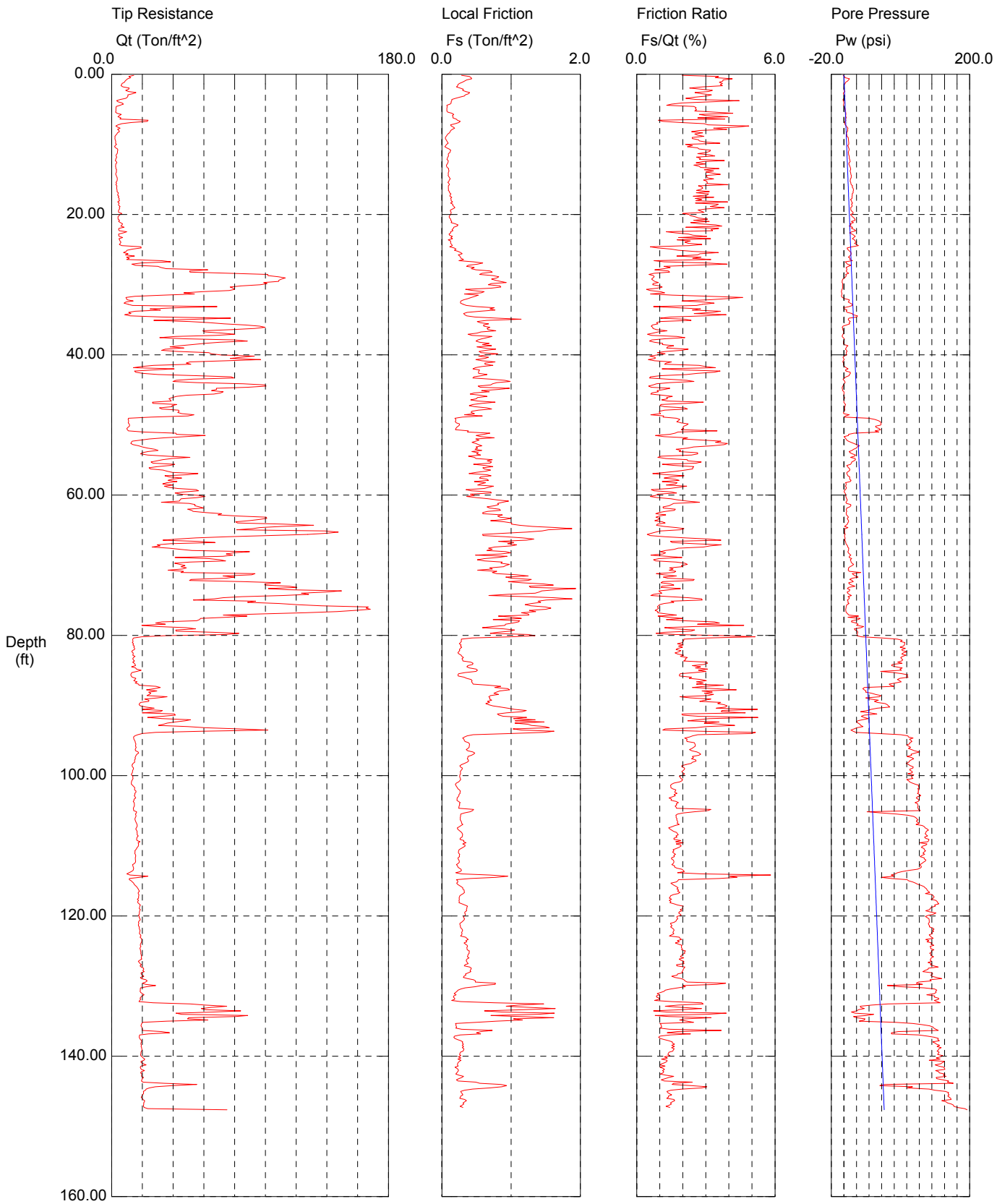
Maximum Depth = 76.77 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-10a-06
Elevation: UNKNOWN

CPT Date/Time: 07-19-06 10:34
Location: CPT-10A-06
Job Number: XL-2672



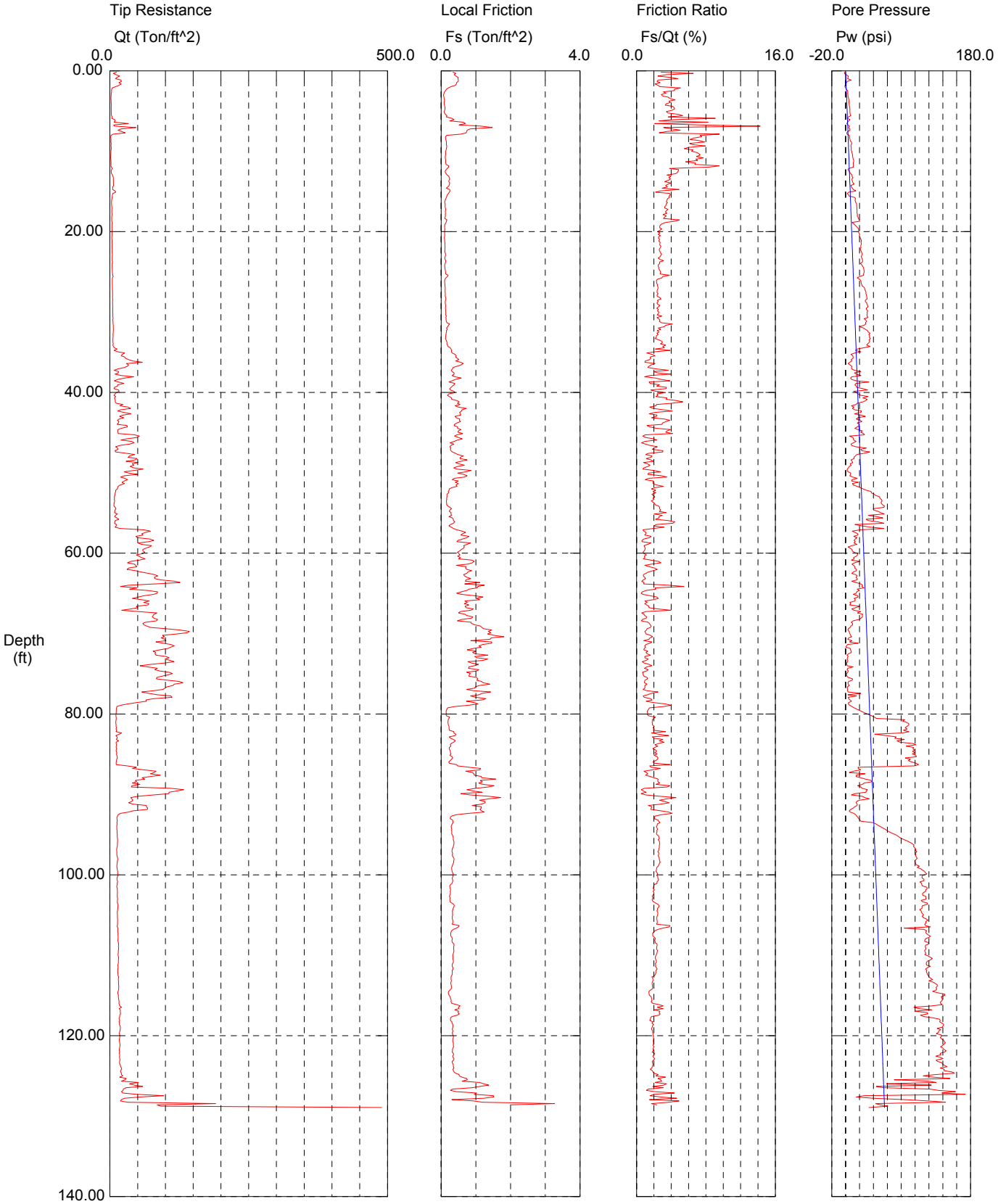
Maximum Depth = 147.64 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-11-06
Elevation: UNKNOWN

CPT Date/Time: 07-18-06 10:58
Location: CPT-11-06
Job Number: XL-2672



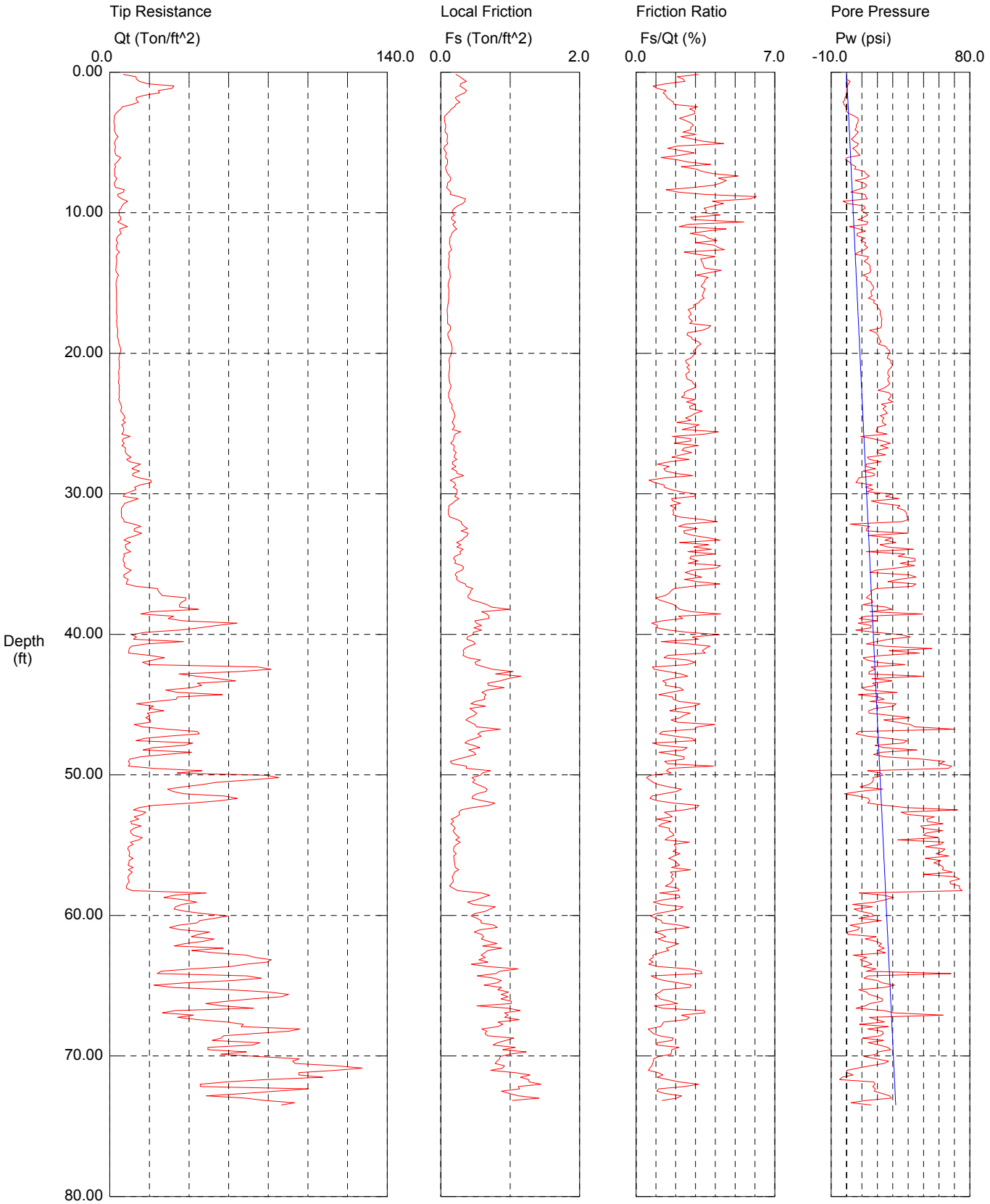
Maximum Depth = 128.94 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-12-06
Elevation: Unknown

CPT Date/Time: 07-13-06 08:13
Location: CPT-12-06
Job Number: XL-2672



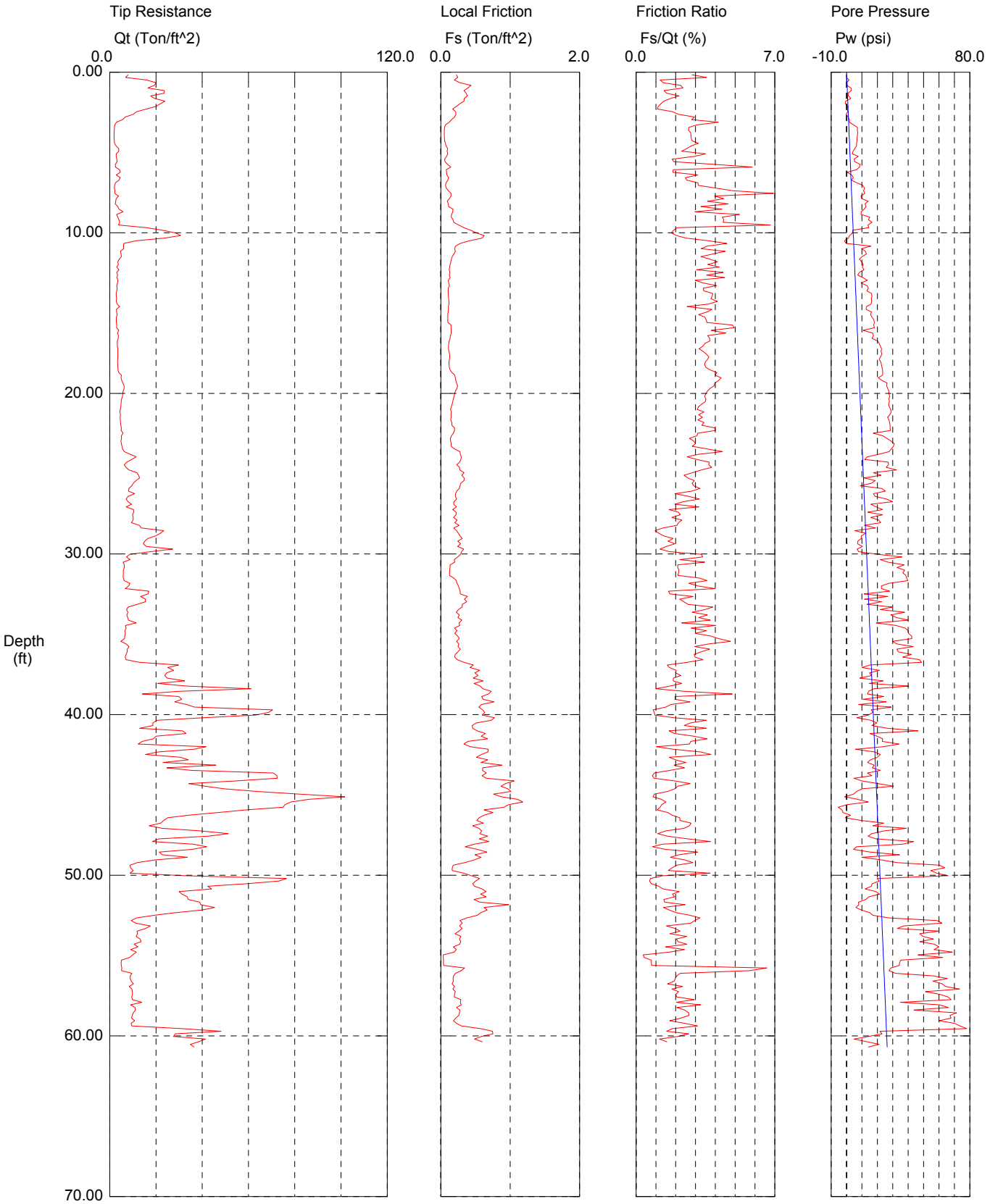
Maximum Depth = 73.49 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT12a-06
Elevation: Unknown

CPT Date/Time: 07-13-06 14:19
Location: CPT-12A-06
Job Number: XL-2672



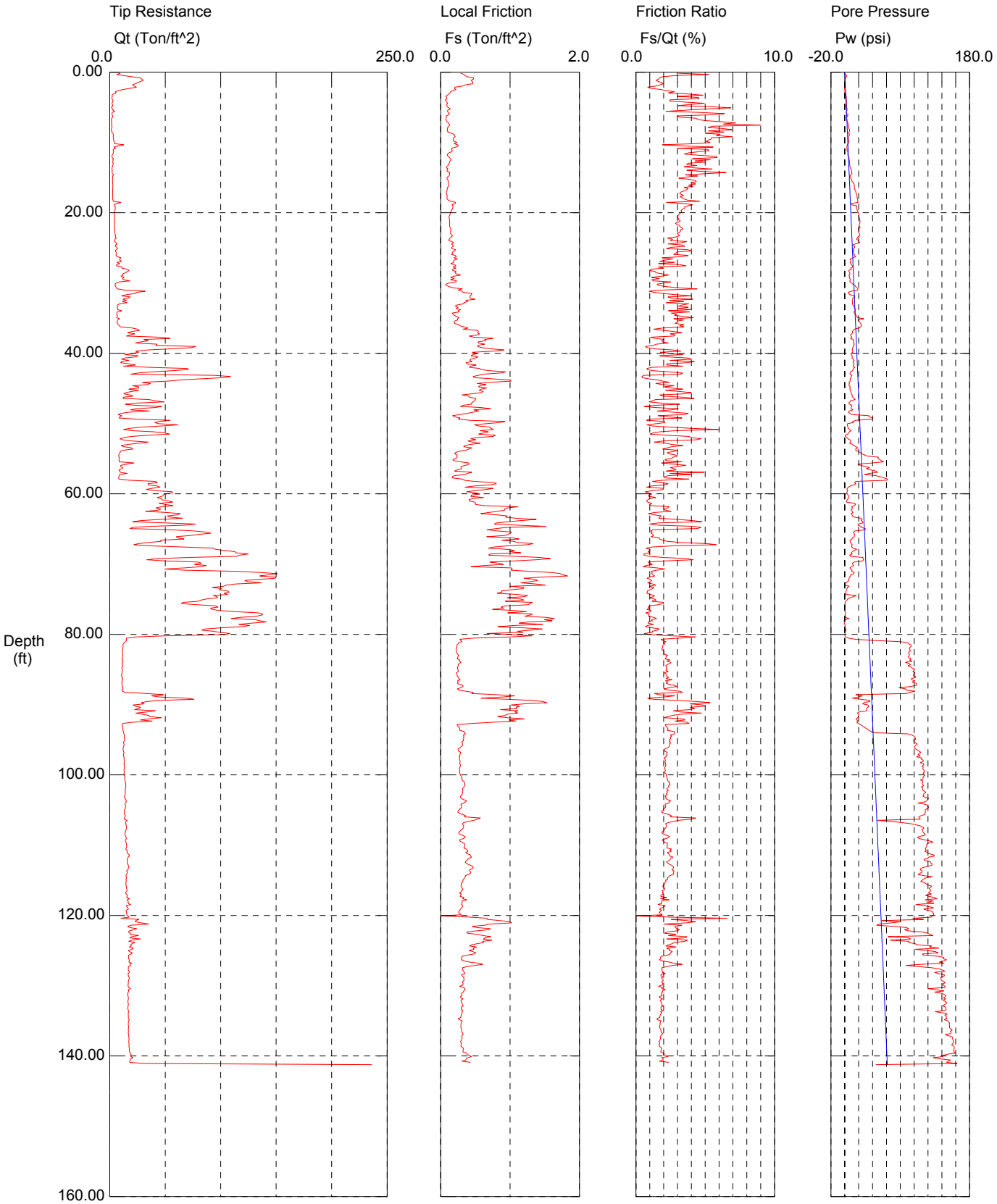
Maximum Depth = 60.70 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-12b-06
Elevation: UNKNOWN

CPT Date/Time: 07-26-06 13:16
Location: CPT-12B-06
Job Number: XL-2672



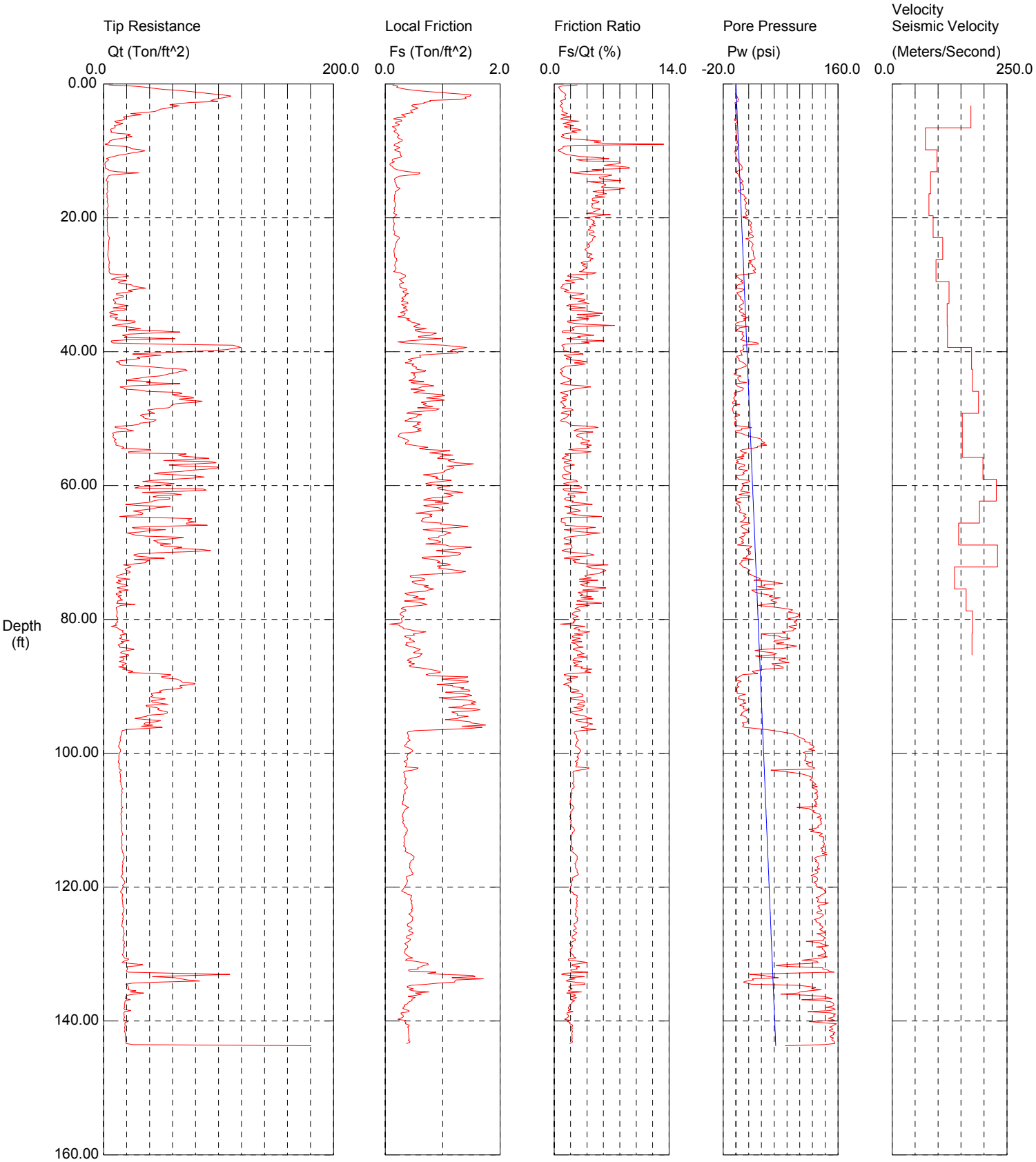
Maximum Depth = 141.24 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Danny Henderson
Sounding: CPT-13-06
Elevation: Unknown

CPT Date/Time: 08-01-06 08:54
Location: CPT-13-06
Job Number: XL-2672



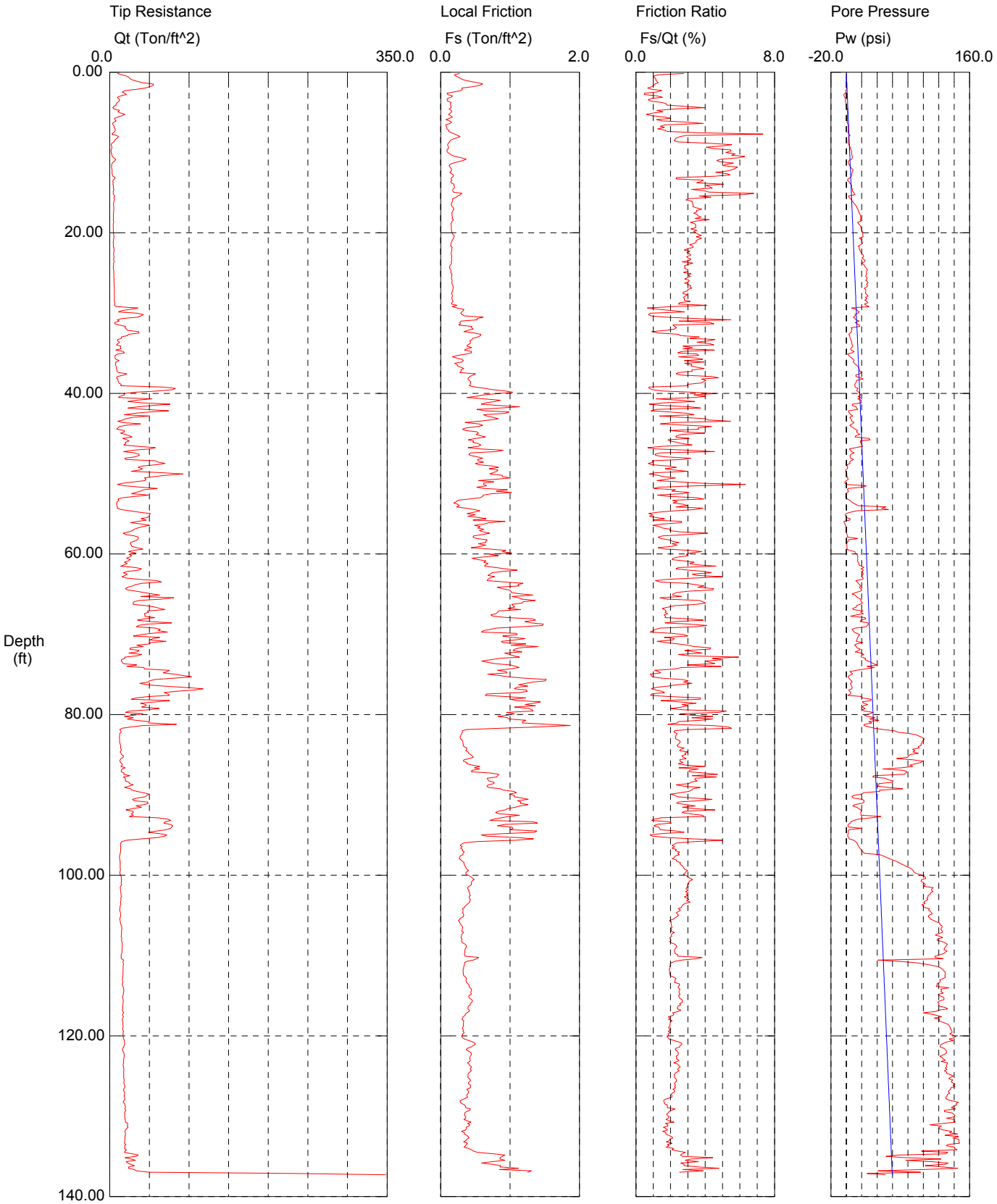
Maximum Depth = 143.70 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-14-06
Elevation: UNKNOWN

CPT Date/Time: 07-27-06 12:18
Location: CPT-14-06
Job Number: XL-2672



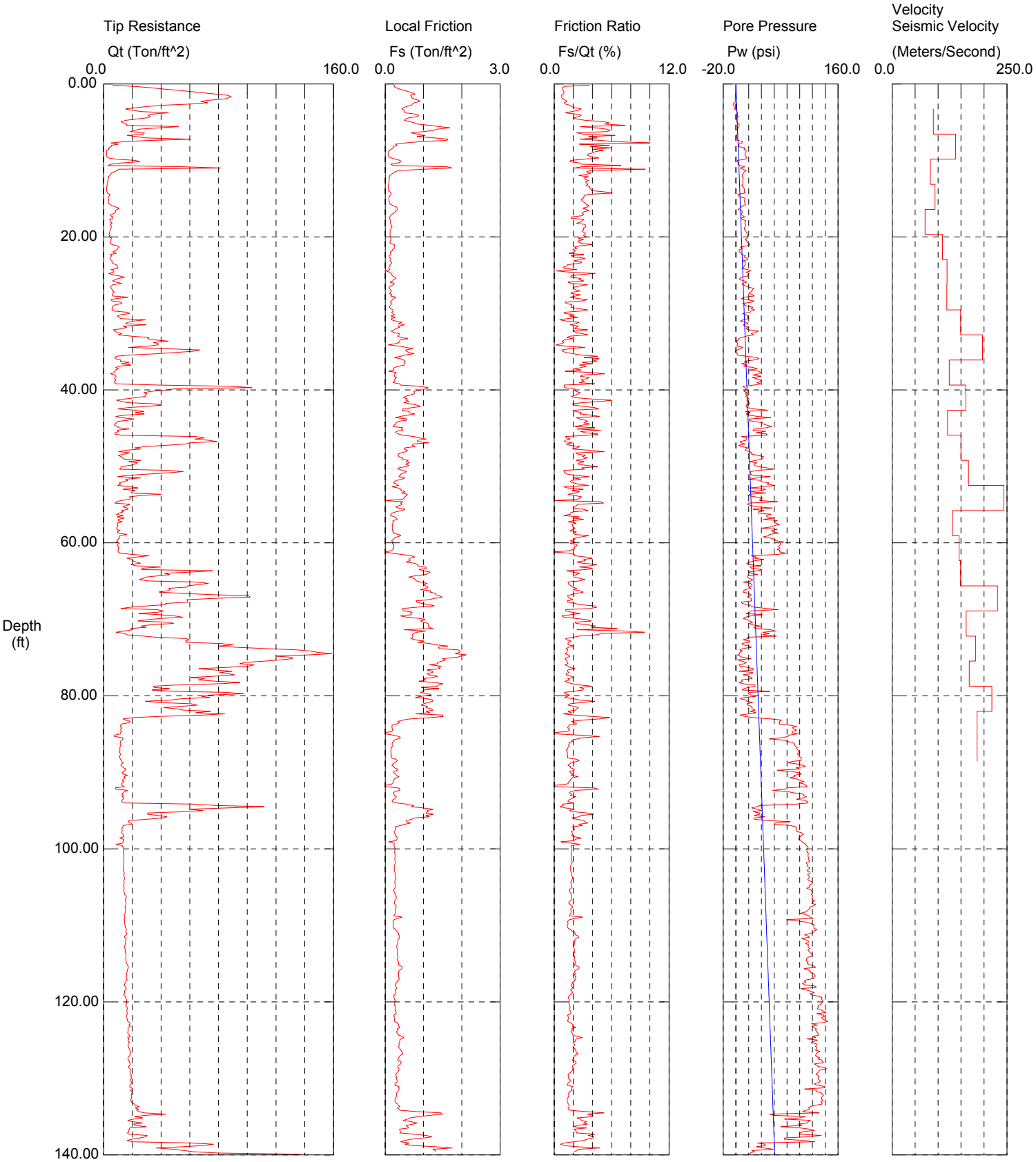
Maximum Depth = 137.30 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-15-06
Elevation: Unknown

CPT Date/Time: 07-31-06 13:36
Location: CPT-15-06
Job Number: XL-2672



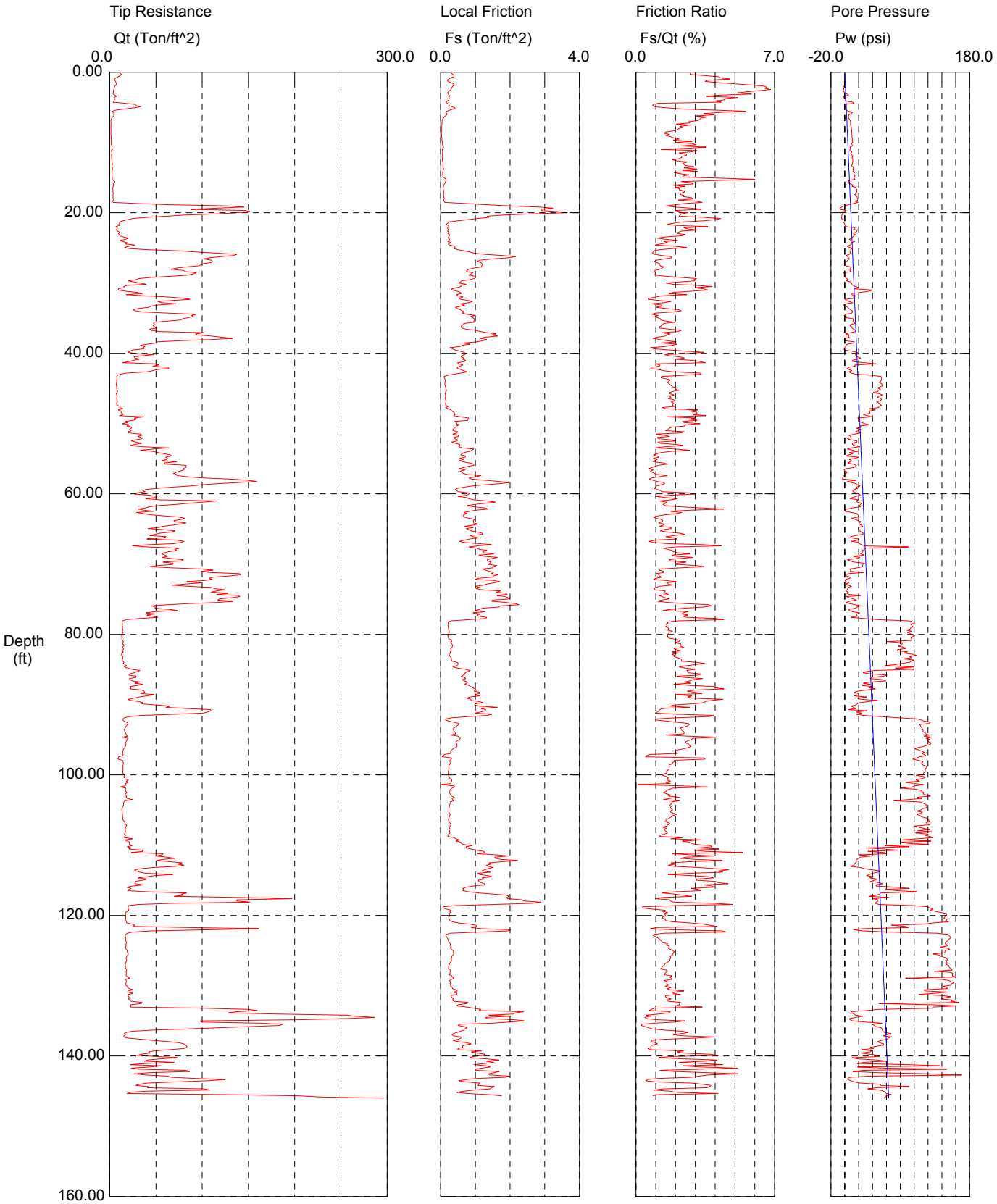
Maximum Depth = 139.93 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-16-06
Elevation: UNKNOWN

CPT Date/Time: 07-19-06 15:12
Location: CPT-16-06
Job Number: XL-2672



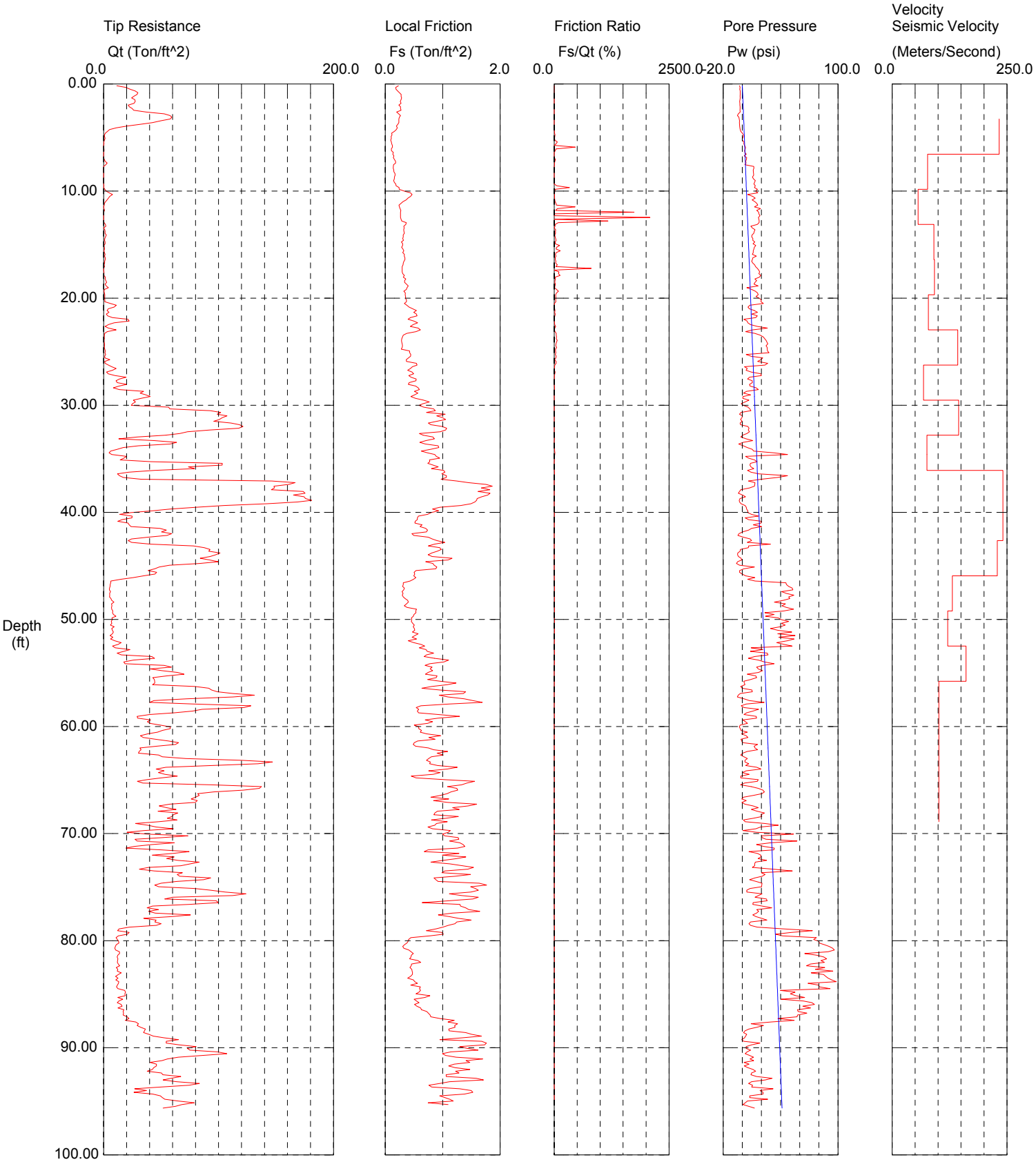
Maximum Depth = 146.00 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-17-06
Elevation: Unknown

CPT Date/Time: 07-25-06 13:28
Location: CPT-17-06
Job Number: XL-2672



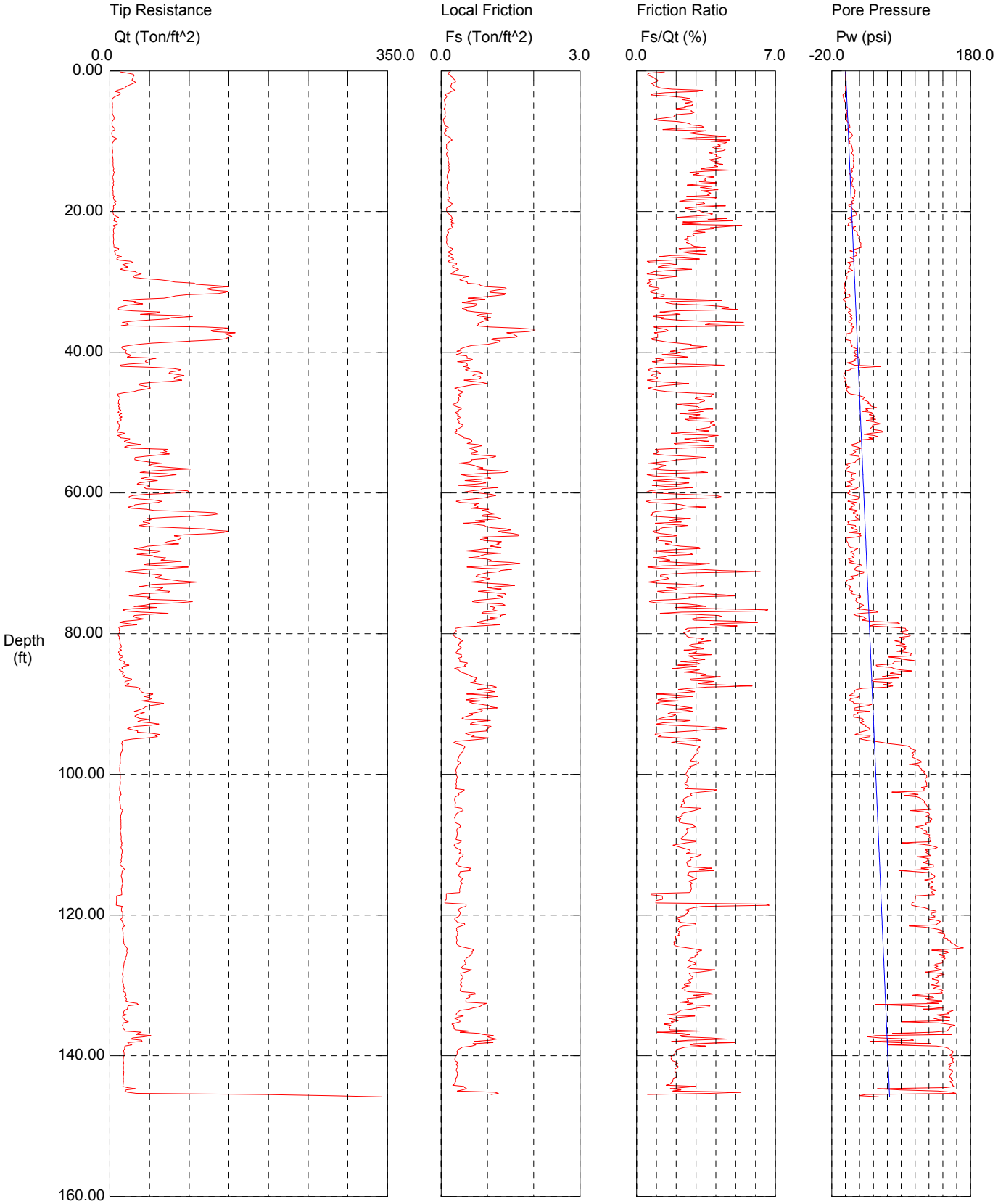
Maximum Depth = 95.64 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT17a-06
Elevation: Unknown

CPT Date/Time: 07-26-06 07:46
Location: CPT-17A-06
Job Number: XL-2672



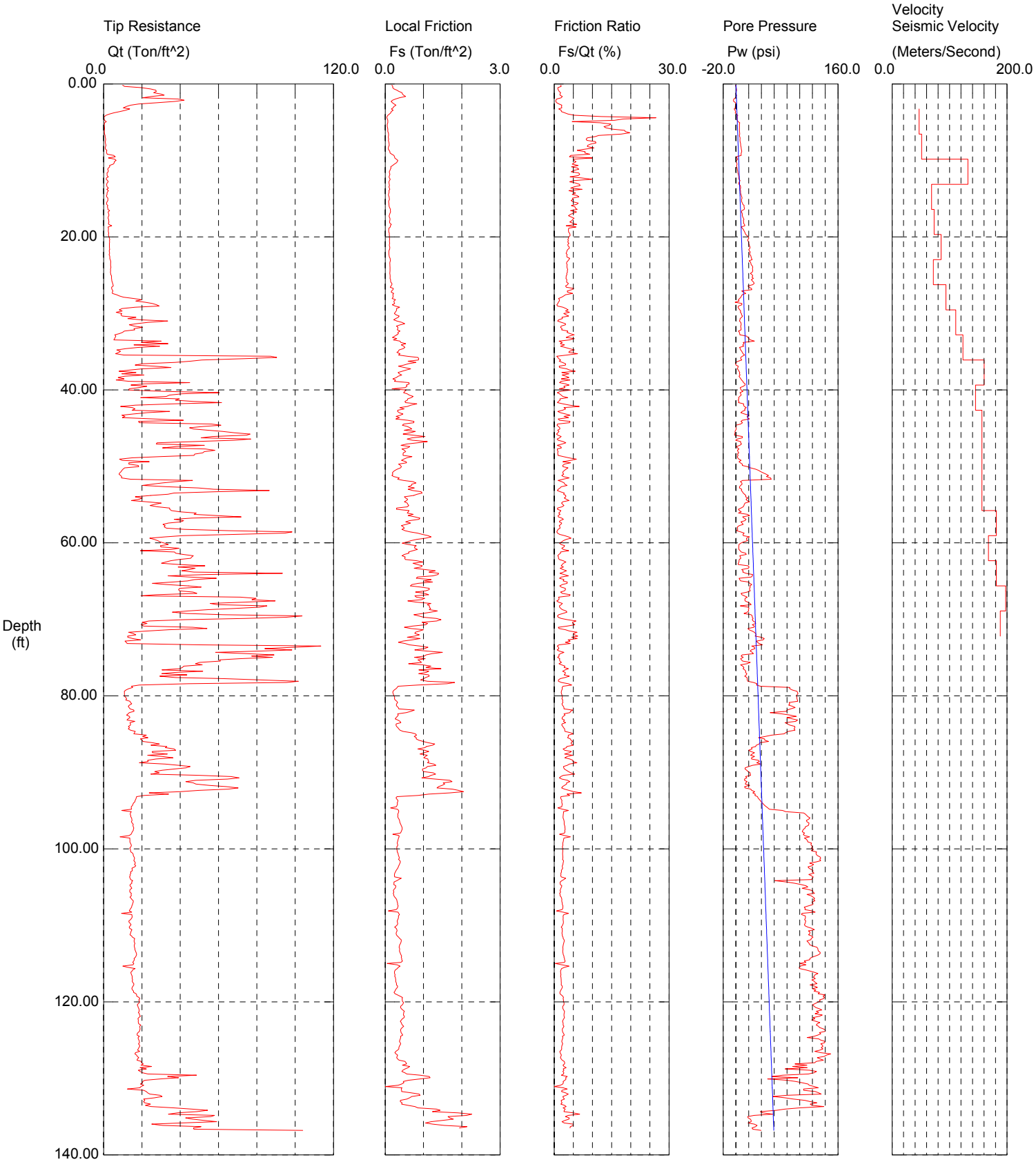
Maximum Depth = 145.83 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-18-06
Elevation: Unknown

CPT Date/Time: 07-27-06 08:55
Location: CPT-18-06
Job Number: XL-2672



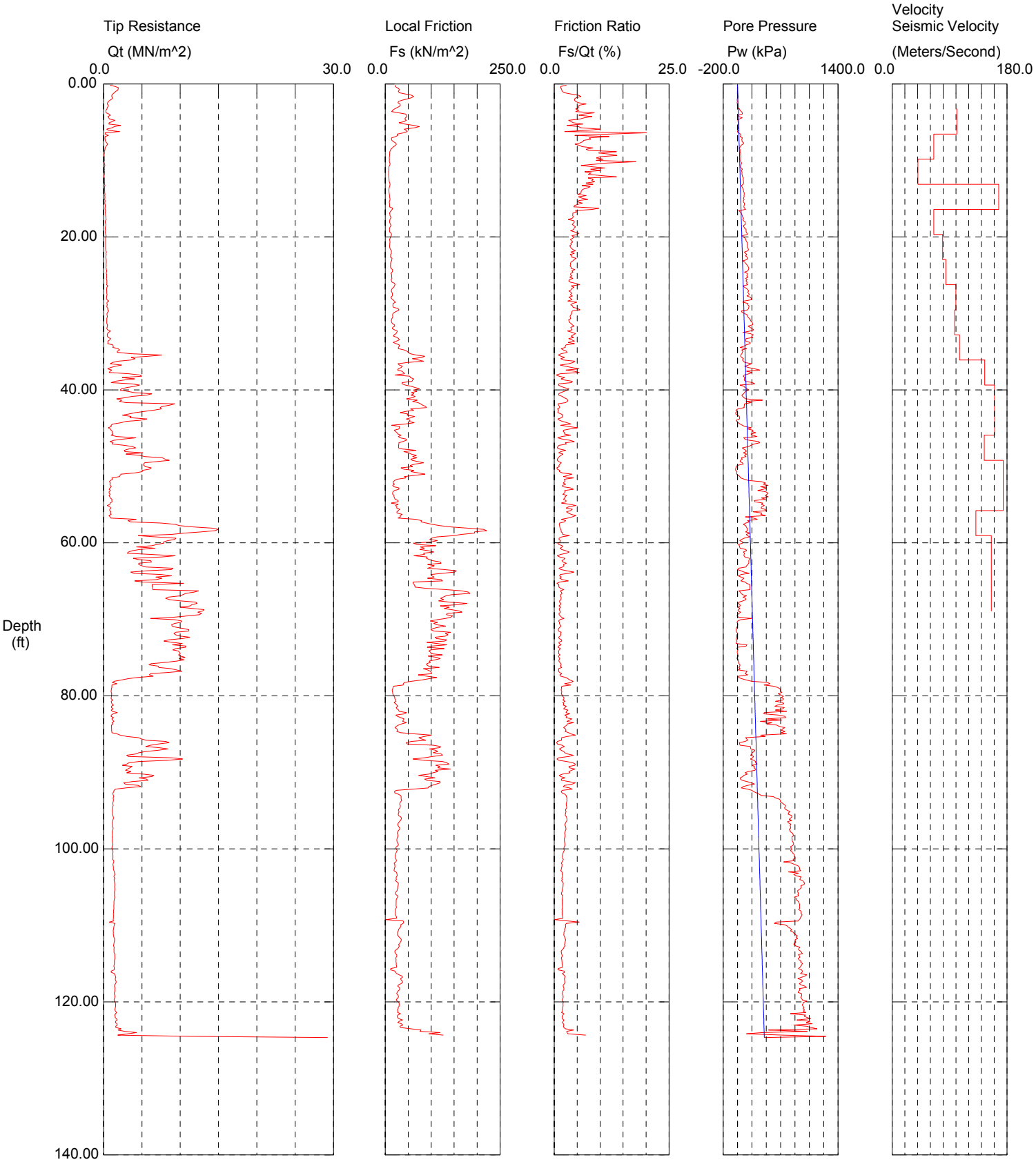
Maximum Depth = 136.81 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-19-06
Elevation: Unknown

CPT Date/Time: 07-25-06 08:10
Location: CPT-19-06
Job Number: XL-2672



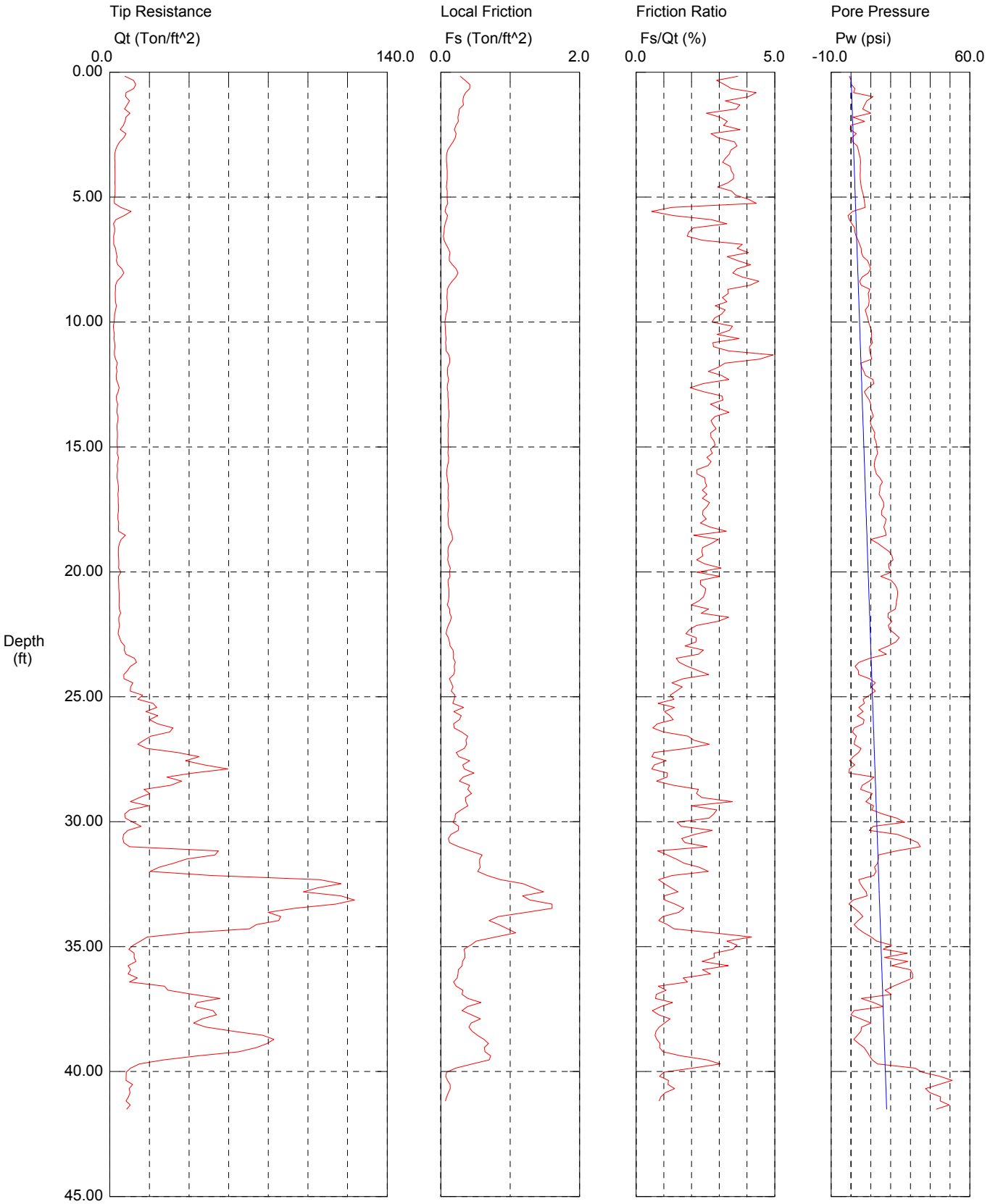
Maximum Depth = 124.67 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-20-06
Elevation: UNKNOWN

CPT Date/Time: 07-26-06 11:15
Location: CPT-20-06
Job Number: XL-2672



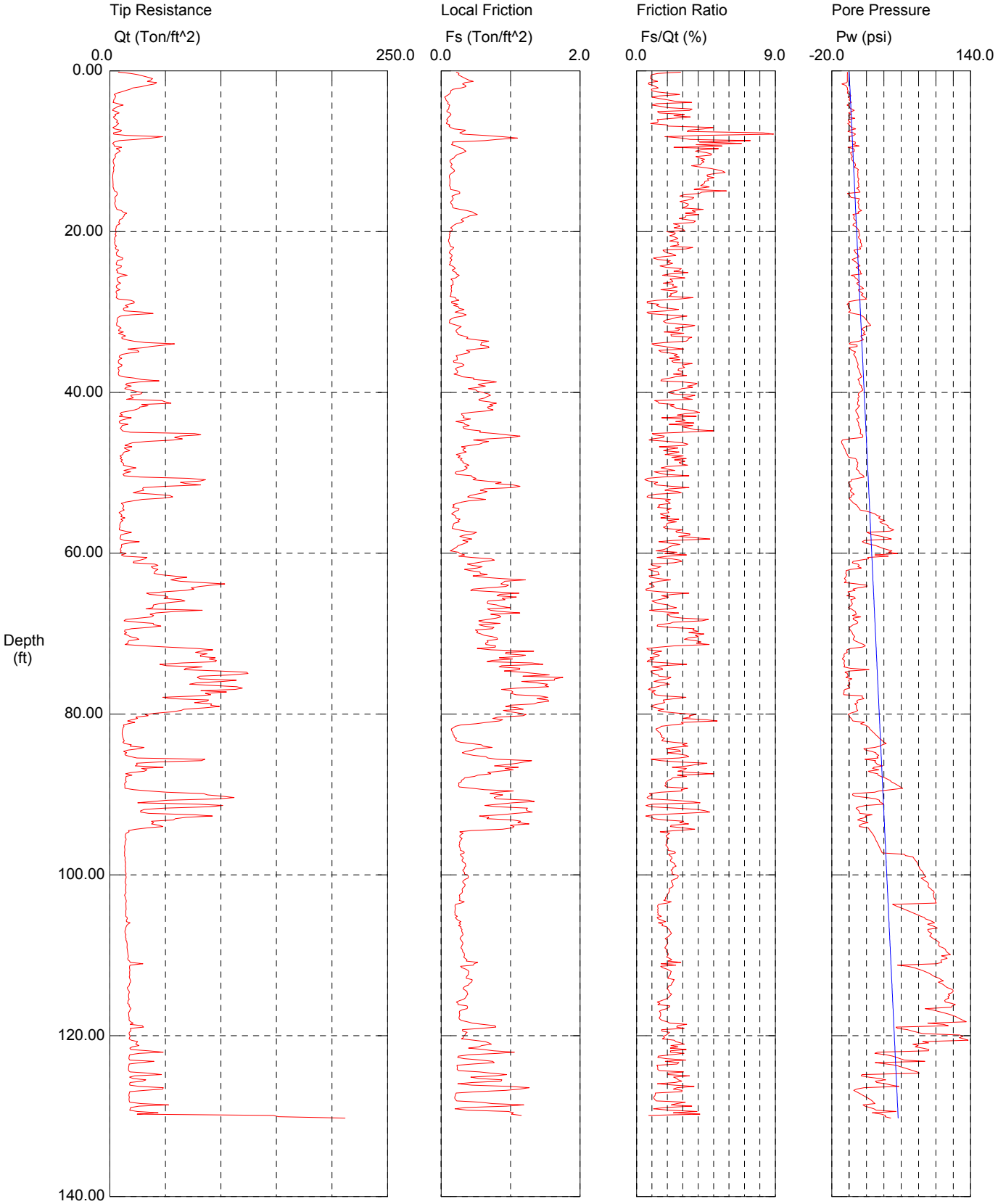
Maximum Depth = 41.50 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-21-06
Elevation: Unknown

CPT Date/Time: 07-12-06 12:21
Location: CPT-21
Job Number: XL-2672



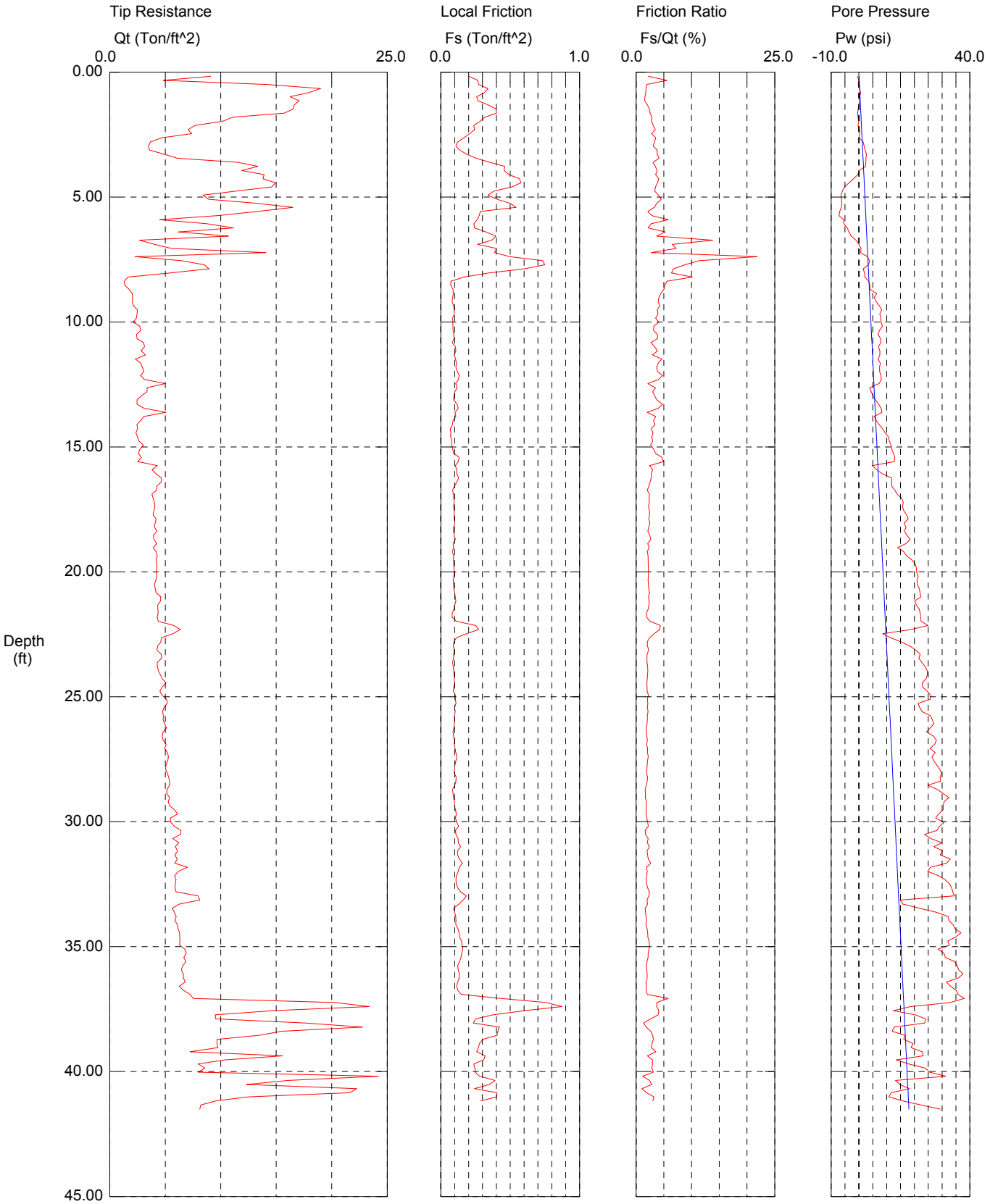
Maximum Depth = 130.25 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-22-06
Elevation: UNKNOWN

CPT Date/Time: 07-18-06 14:55
Location: CPT-22-06
Job Number: XL-2672



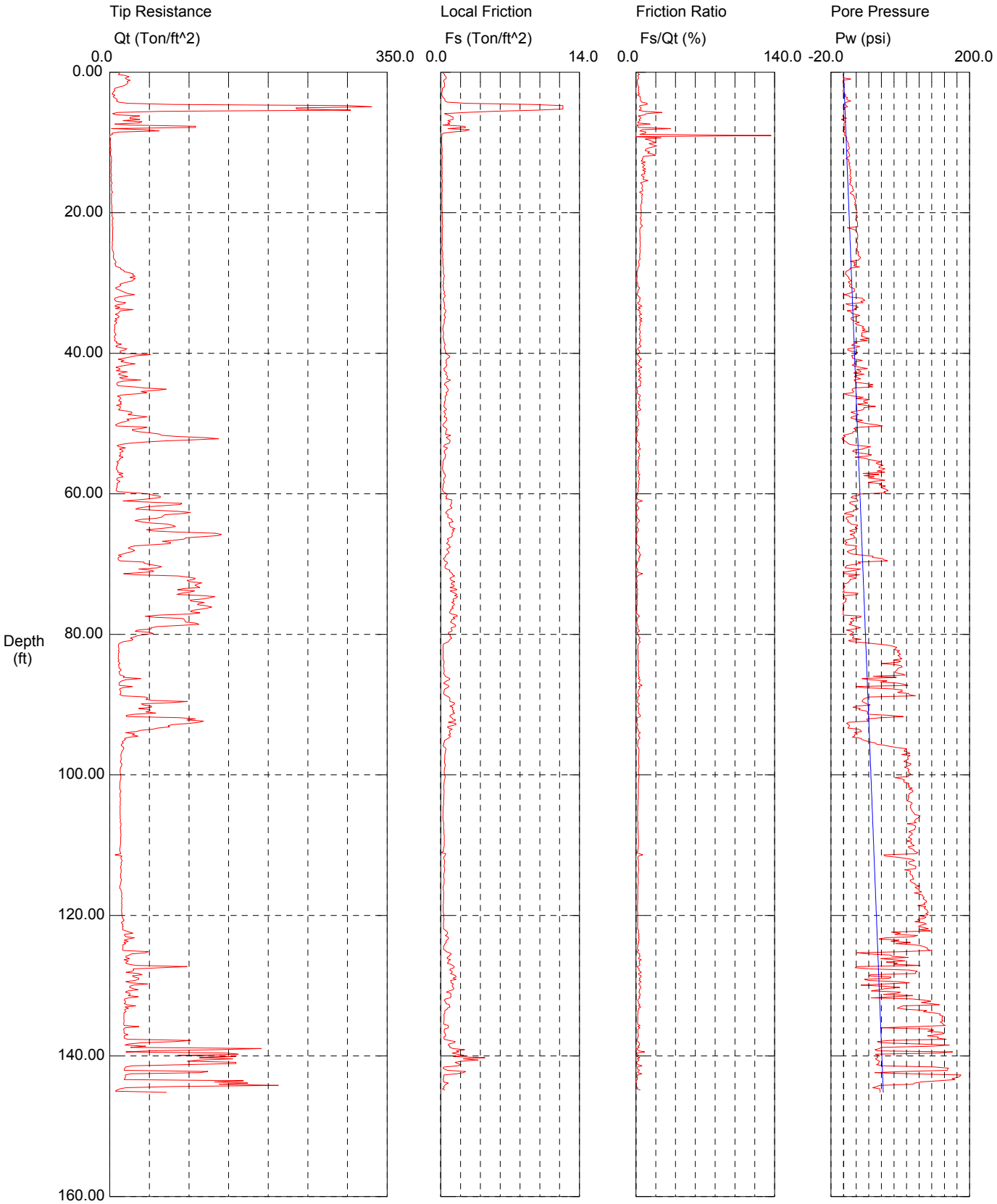
Maximum Depth = 41.50 feet

Depth Step = 0.16 feet

WSDOT Geotechnical Division

Operator: Brian Hilts
Sounding: CPT-23-06
Elevation: Unknown

CPT Date/Time: 07-14-06 08:49
Location: CPT-23-06
Job Number: XL-2672



Maximum Depth = 145.18 feet

Depth Step = 0.16 feet

APPENDIX B

Geotechnical Laboratory Testing

APPENDIX B
GEOTECHNICAL LABORATORY TESTING

Geotechnical laboratory testing performed on soil samples obtained during the current and previous exploration phases consisted of:

- Index tests (natural moisture content determinations, grain size analyses, Atterberg limit determinations)
- Triaxial unconsolidated undrained compression strength tests
- Triaxial consolidated undrained compression strength tests
- One-dimensional consolidation tests
- pH and resistivity tests.

Summaries of geotechnical laboratory testing of site soils for samples obtained during previous exploration phases are included in previous reports (Landau Associates 2006, 2007) and laboratory data obtained during those phases are included in this appendix.

The tests were performed on selected samples to aid in soil classification and to estimate the engineering characteristics of site soils. Geotechnical laboratory testing was performed in general accordance with American Society for Testing and Materials (ASTM) standard test procedures, which are described below. The samples were checked against the field log descriptions, which were updated where appropriate, in general accordance with ASTM D2487, *Standard Test Method for Classification of Soils for Engineering Purposes*.

Summary statistics for laboratory tests are presented by soil unit in Table 1 of the report text.

NATURAL MOISTURE CONTENT

Natural moisture content determinations were performed on selected soil samples recovered from the borings and test pits in general accordance with ASTM D2216. The results of these tests are plotted at the respective sample depth on the exploration logs, and are also indicated in the column labeled "Test Data" on the summary boring and test pit logs in Appendix A.

SIEVE ANALYSES

Grain size analyses were performed on representative soil samples obtained from the explorations in accordance with ASTM D422 to provide an indication of the grain size distribution. Samples selected for grain size analyses are designated with a "GS" in the column labeled "Test Data" on the summary logs

in Appendix A. The results of the grain size analyses are presented by soil unit (Soil Unit 1, Soil Unit 2B, etc.) on Figures B-1 through B-25 in the form of grain size distribution curves.

FINES CONTENT

The fines content (the percentage of material passing the U.S. Standard No. 200 sieve) of selected soil samples obtained from our exploratory borings was determined in general accordance with ASTM D1140 test procedures. The test results are shown at the respective sample depth in the column labeled "Test Data" on the summary boring logs in Appendix A.

ATTERBERG LIMITS

Atterberg limit determinations were performed on representative soil samples obtained from the explorations in general accordance with ASTM D4318 to determine the liquid limit (LL), plastic limit (PL), and plasticity index (PI). The results of the Atterberg limit determinations are presented by soil unit on Figures B-26 through B-43 in this appendix. Samples on which Atterberg limit determinations were completed are designated by "AL" in the column labeled "Test Data" and are shown graphically on the summary boring logs.

TRIAXIAL UNCONSOLIDATED UNDRAINED COMPRESSION TEST

Triaxial unconsolidated undrained (UU) testing was performed on selected fine-grained soil samples obtained from Soil Units 1 and 3 to estimate undrained (short-term) strength. The testing was performed at the Soil Technology, Inc. laboratory in general accordance with ASTM D2850 test procedure. Samples on which this test (or other advanced laboratory tests) was completed are designated by "GT" in the column labeled "Test Data" on the summary logs. The test results are presented in reports by Soil Technology, Inc., which are included in this appendix.

TRIAXIAL CONSOLIDATED UNDRAINED COMPRESSION TEST

Triaxial consolidated undrained (CU) testing was performed on selected fine-grained soil samples obtained from Soil Units 1 and 3 to estimate undrained strength. The testing was performed at the Soil Technology, Inc. laboratory in general accordance with ASTM D2850 test procedure. Samples on which this test (or other advanced laboratory tests) was completed are designated by "GT" in the column labeled "Test Data" on the summary logs. The test results are presented in reports by Soil Technology, Inc., which are included in this appendix.

ONE-DIMENSIONAL CONSOLIDATION TEST

The consolidation characteristics of selected fine-grained soil samples obtained from Soil Units 1 and 3 were determined at the Soil Technology, Inc. laboratory in general accordance with ASTM D2435 test procedures. Samples on which this test (or other advanced laboratory tests) was completed are designated by "GT" in the column labeled "Test Data" on the summary logs. The test results are presented in a report by Soil Technology, Inc., which is included in this appendix.

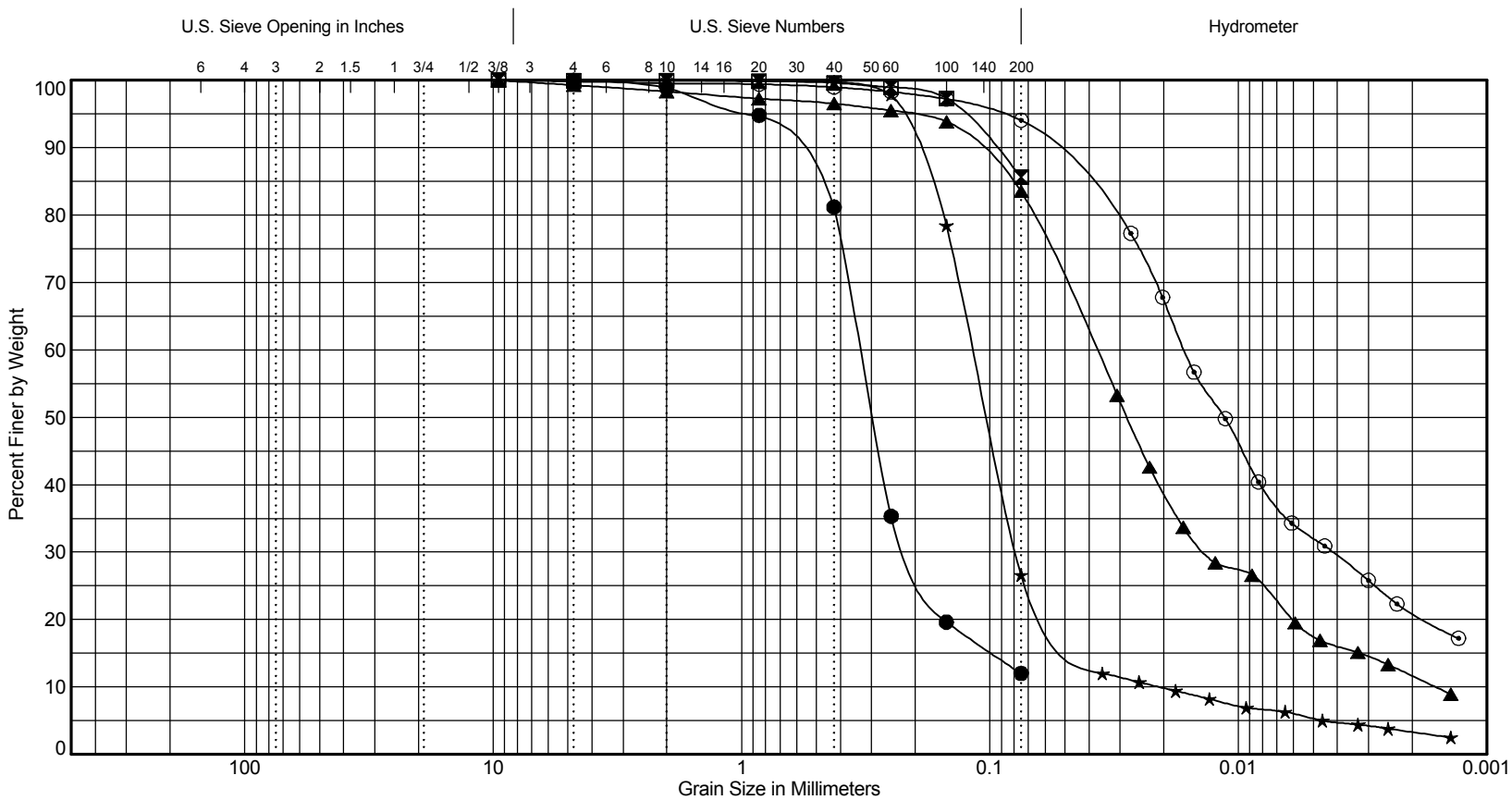
SOIL pH AND RESISTIVITY TESTING

Soil samples were selected from test pit explorations and from previous borings and subjected to pH and resistivity testing at the Soil Technology, Inc. laboratory. pH tests were accomplished in general accordance with ASTM D4972. Resistivity tests were accomplished in general accordance with ASTM G57. A tabular summary of these results is presented in reports by Soil Technology, Inc., included in this appendix.

REFERENCES

Landau Associates. 2007. Report: *Geotechnical Design Study WSDOT Special Projects Construction Site, Grays Harbor, Washington*. Prepared for WSDOT. March 29.

Landau Associates. 2006. *Geotechnical and Hydrogeologic Study, Bridge Pontoon Construction Facility, Grays Harbor, Washington.* Prepared for WSDOT. May 31.



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

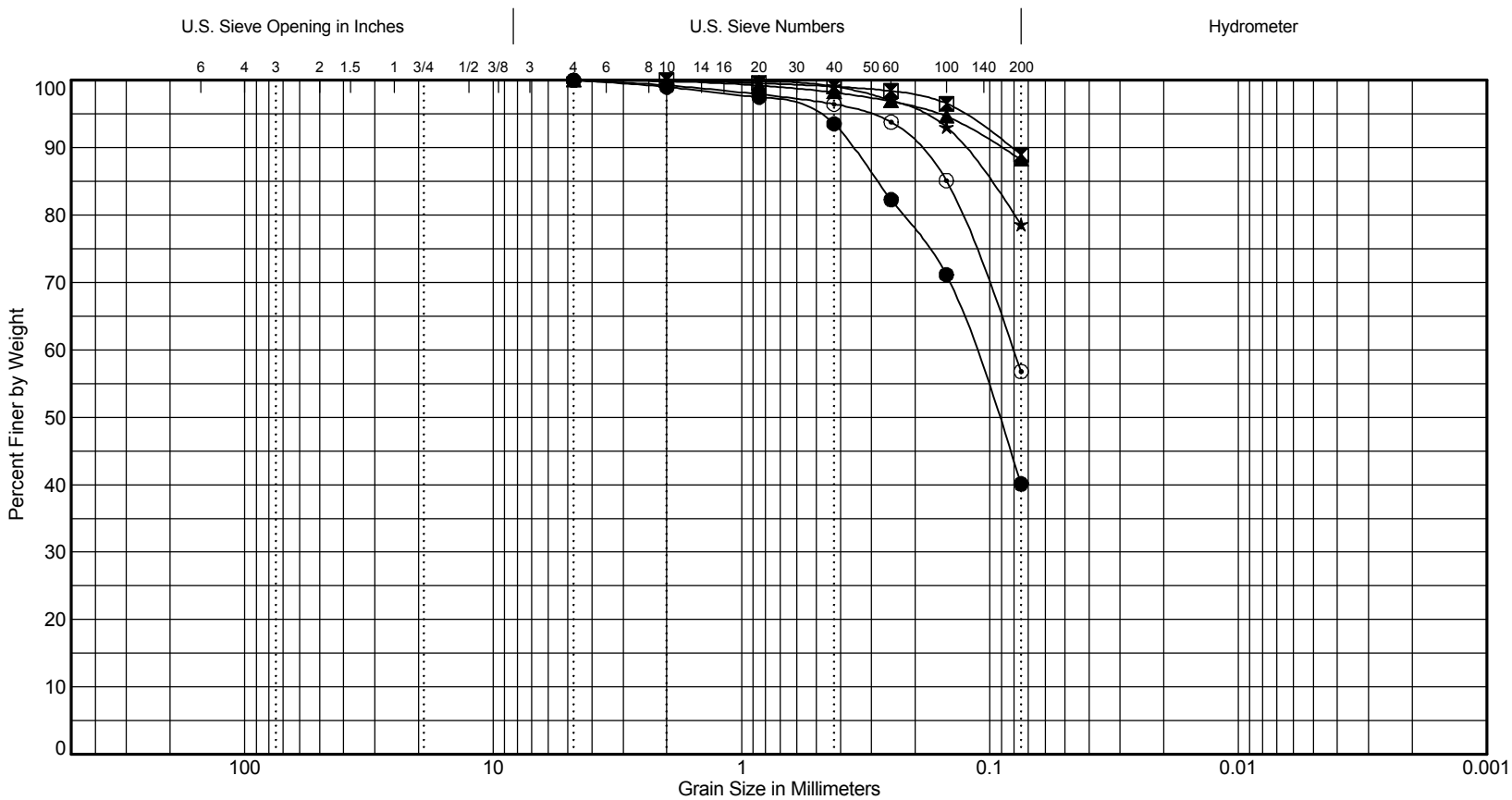
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 1	S-4	5.5	29	Fine to medium SAND with silt	SP-SM
⊠	B- 5	S-3	4.0	47	SILT with fine sand	ML
▲	B- 5	S-4	5.5	58	Sandy SILT	ML
★	B- 7	S-2	2.0	34	Silty, fine SAND	SM
⊙	B- 7	S-6	9.0	78	Clayey SILT with fine sand	MH

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 1

Figure
B-1



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

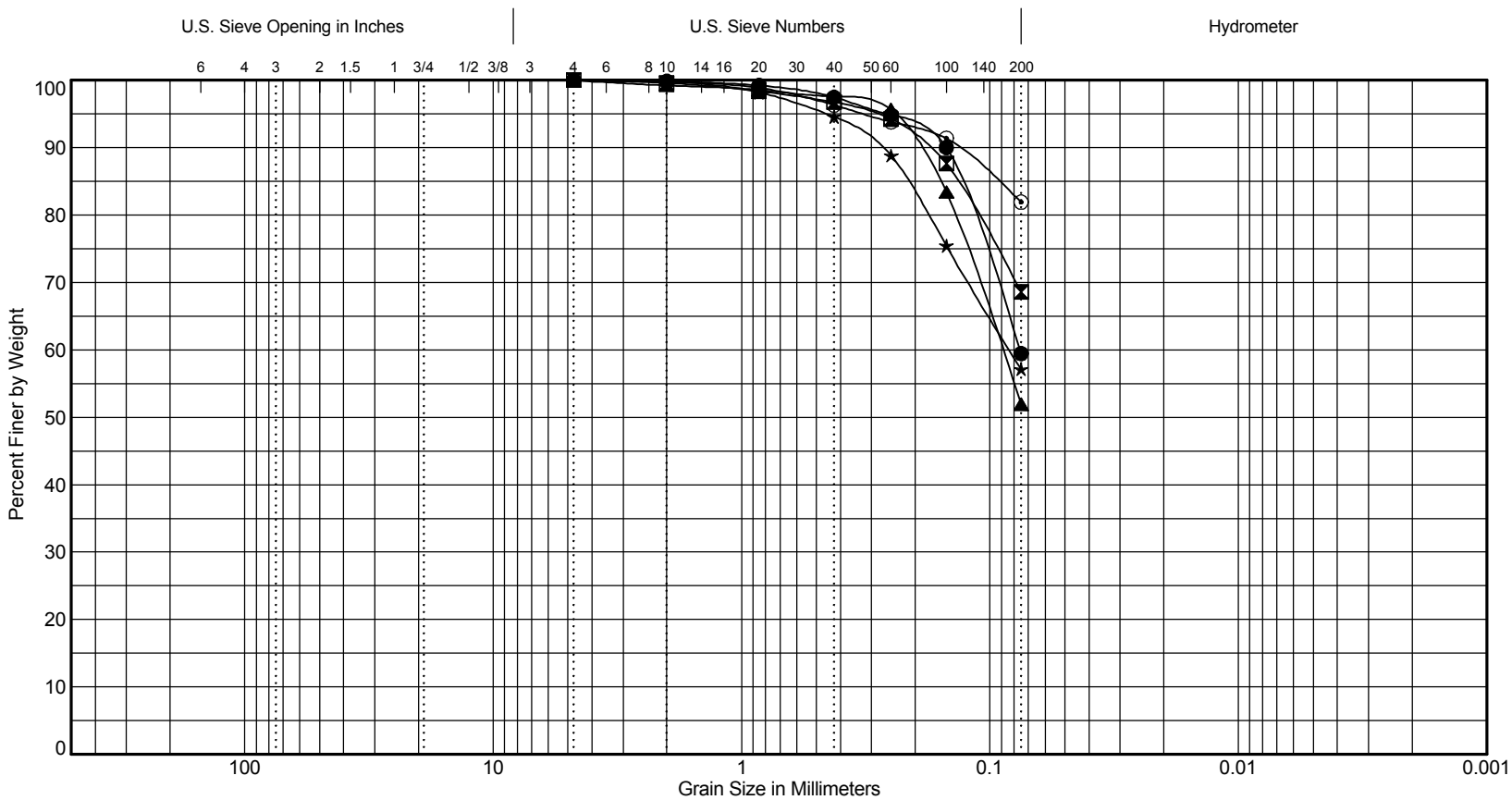
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-10	S-3	6.5	46	Very silty, fine SAND	SM
⊠	B-11	S-3	9.0	83	SILT with fine sand	ML
▲	B-13	S-3	9.0	63	SILT with fine sand	ML
★	B-13	S-10	29.0	62	Sandy SILT	ML
⊙	B-14	S-2	6.5	54	Very sandy SILT	ML

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 1

Figure
B-2



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

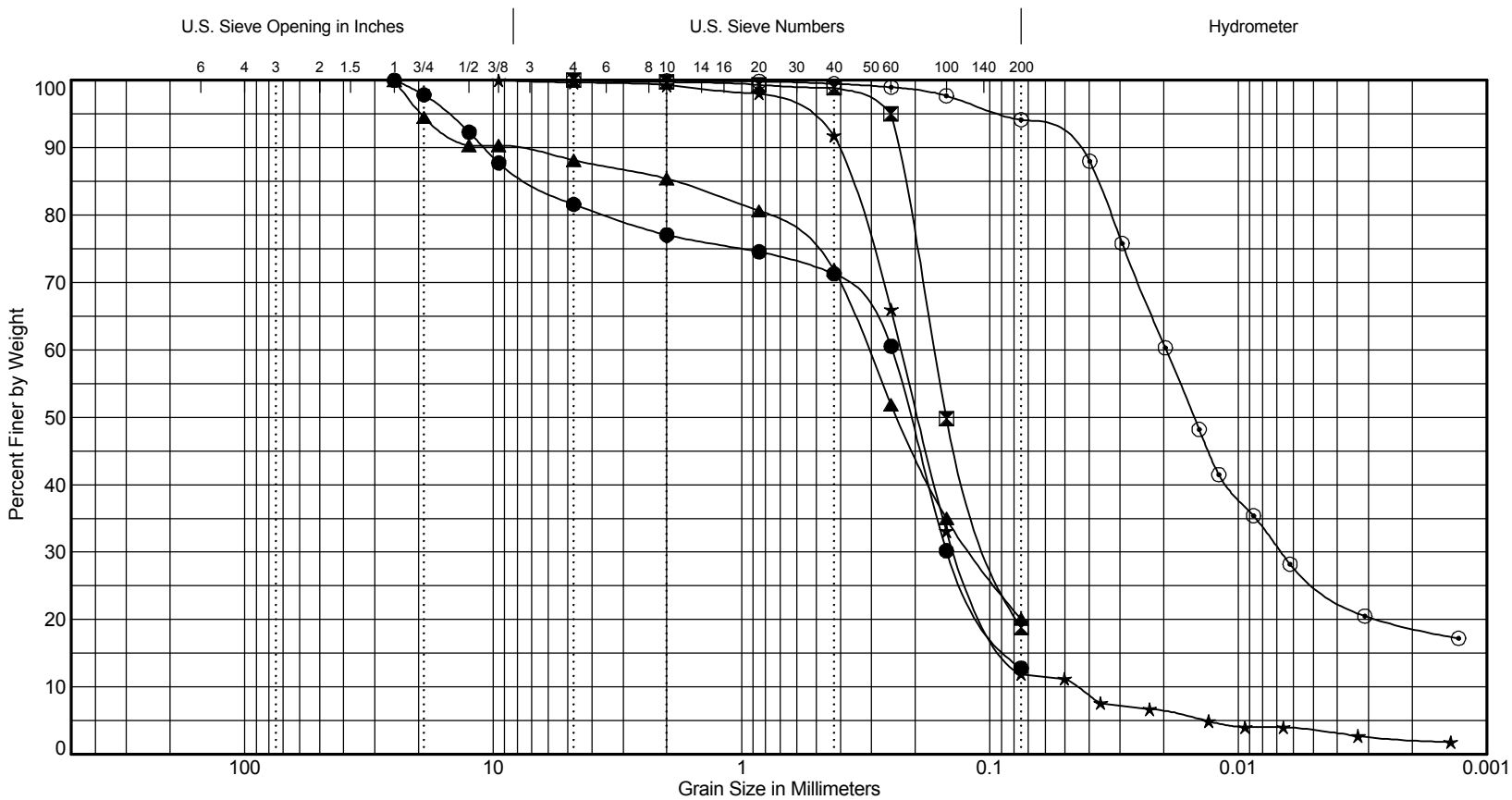
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-14	S-7	19.0	58	Very sandy SILT	ML
⊠	B-16	S-2	6.5	72	Very sandy SILT	ML
▲	B-17	S-2	6.5	58	Very sandy SILT	ML
★	B-18	S-5	10.0	61	Very sandy SILT	ML
⊙	B-19	S-2	2.5	89	Sandy SILT	ML

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 1

Figure
B-3



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

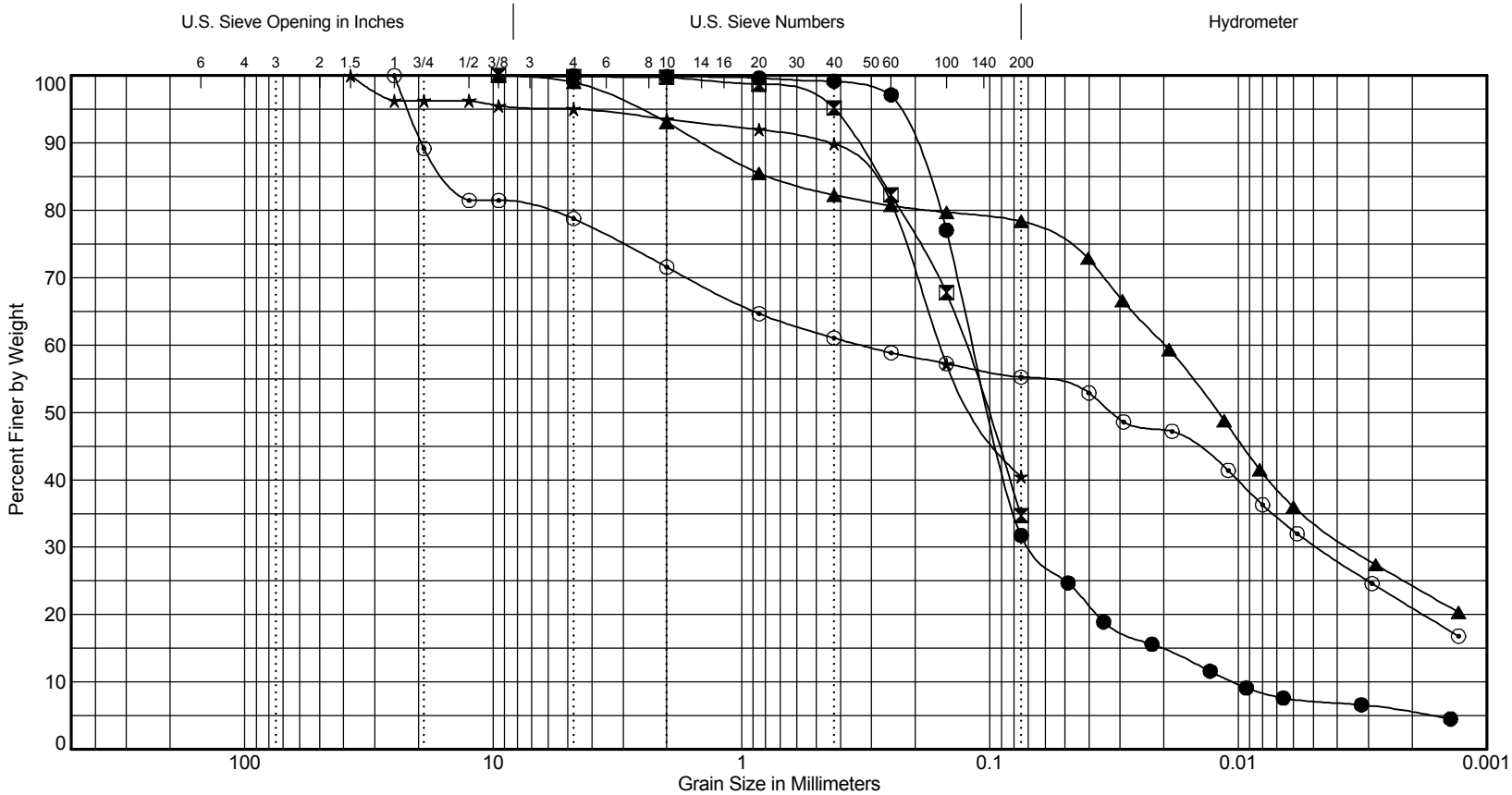
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TH-37-08	S-1	4.0	34	Gravelly, fine SAND with silt	SP-SM
⊠	TH-40-08	S-1	0.5	38	Silty, fine SAND	SM
▲	TH-42P-08	S-1	0.5	15	Silty, fine to medium SAND with fine gravel	SM
★	TH-43P-08	S-2	4.0	30	Fine SAND with silt	SP-SM
⊙	TH-43P-08	S-4	9.0	73	SILT with sand	ML/MH

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 1

Figure
B-4



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

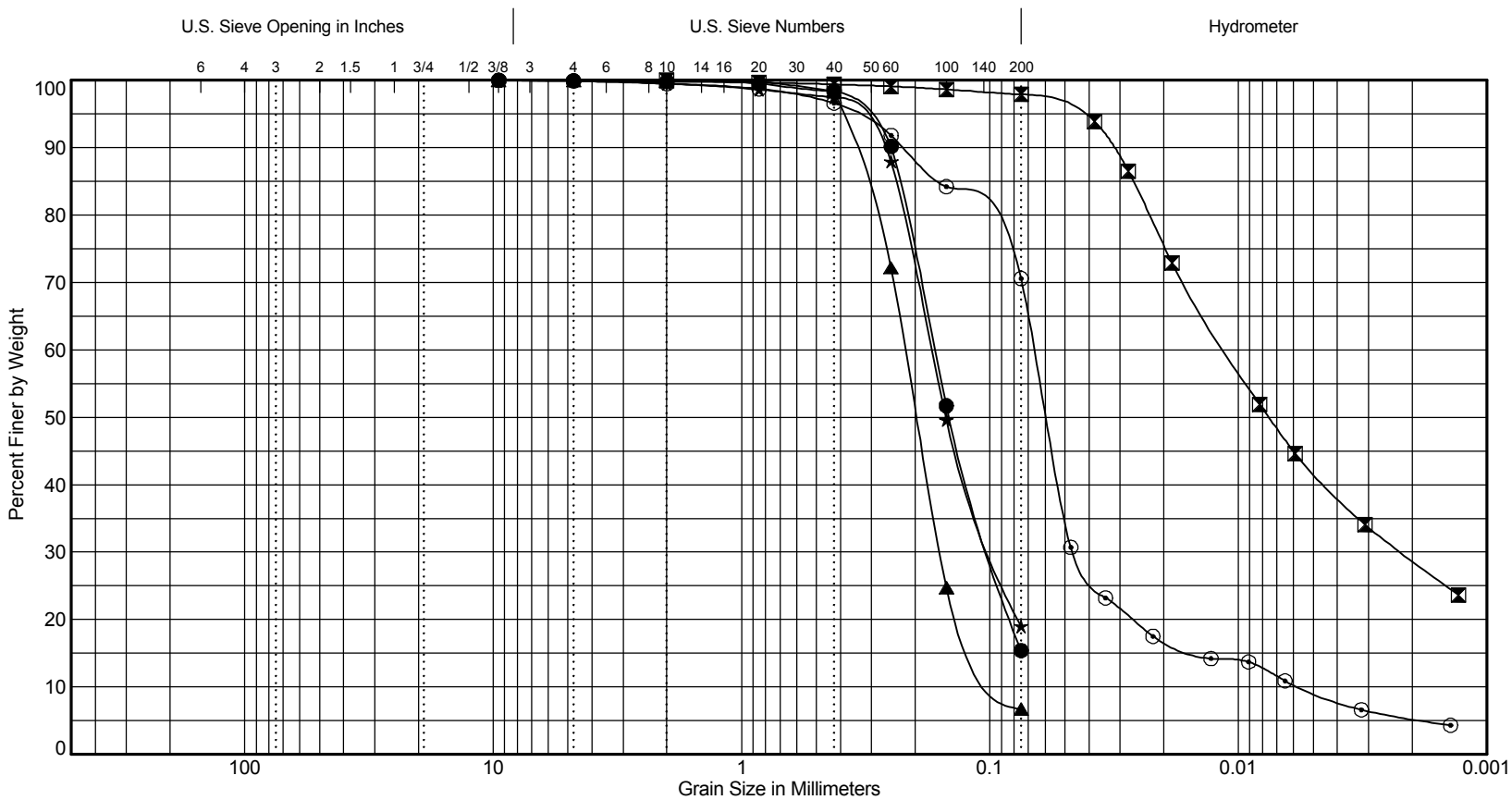
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TH-44P-08	S-2	4.0	43	Very silty, fine SAND	SM
⊠	TH-46P-08	S-3	6.5	46	Very silty, fine SAND	SM
▲	TH-47P-08	S-3	6.5	70	Sandy, clayey SILT with trace fine gravel	ML
★	TH-48-08	S-1	4.0	61	Very silty, fine SAND	SM
⊙	TH-49P-08	S-1	0.5	48	Sandy and gravelly, clayey SILT	ML

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 1

Figure
B-5



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

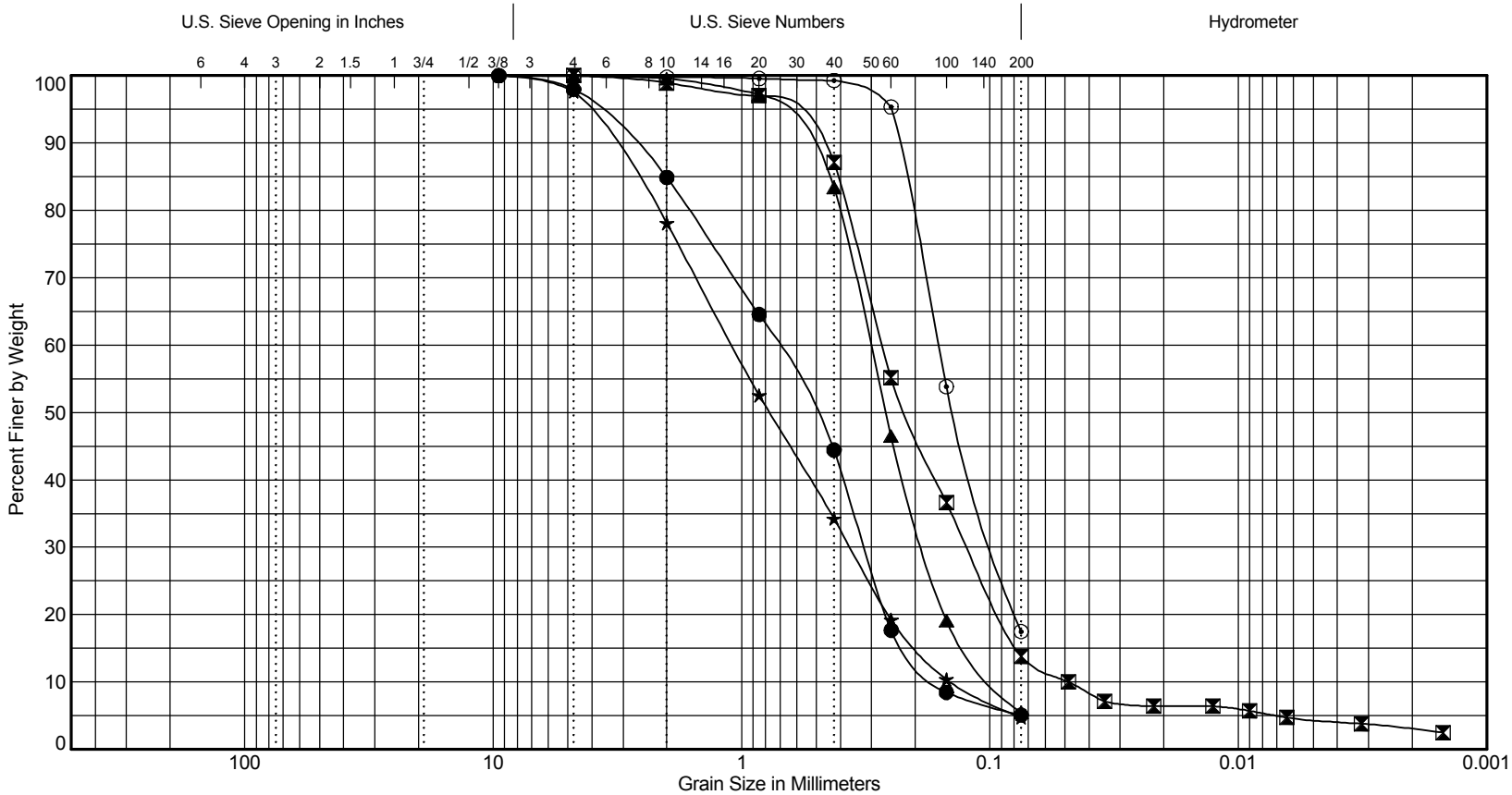
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TH-53-08	S-1	0.5	31	Silty, fine SAND	SM
⊠	TH-54-08	S-3	6.5	97	Clayey SILT with trace sand	MH
▲	TH-55-08	S-1	0.5	26	Fine SAND with silt	SP-SM
★	TH-56-08	S-2	4.0	33	Silty, fine SAND	SM
⊙	TH-56-08	S-4	9.0	39	Sandy SILT with trace clay	ML

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 1

Figure
B-6



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

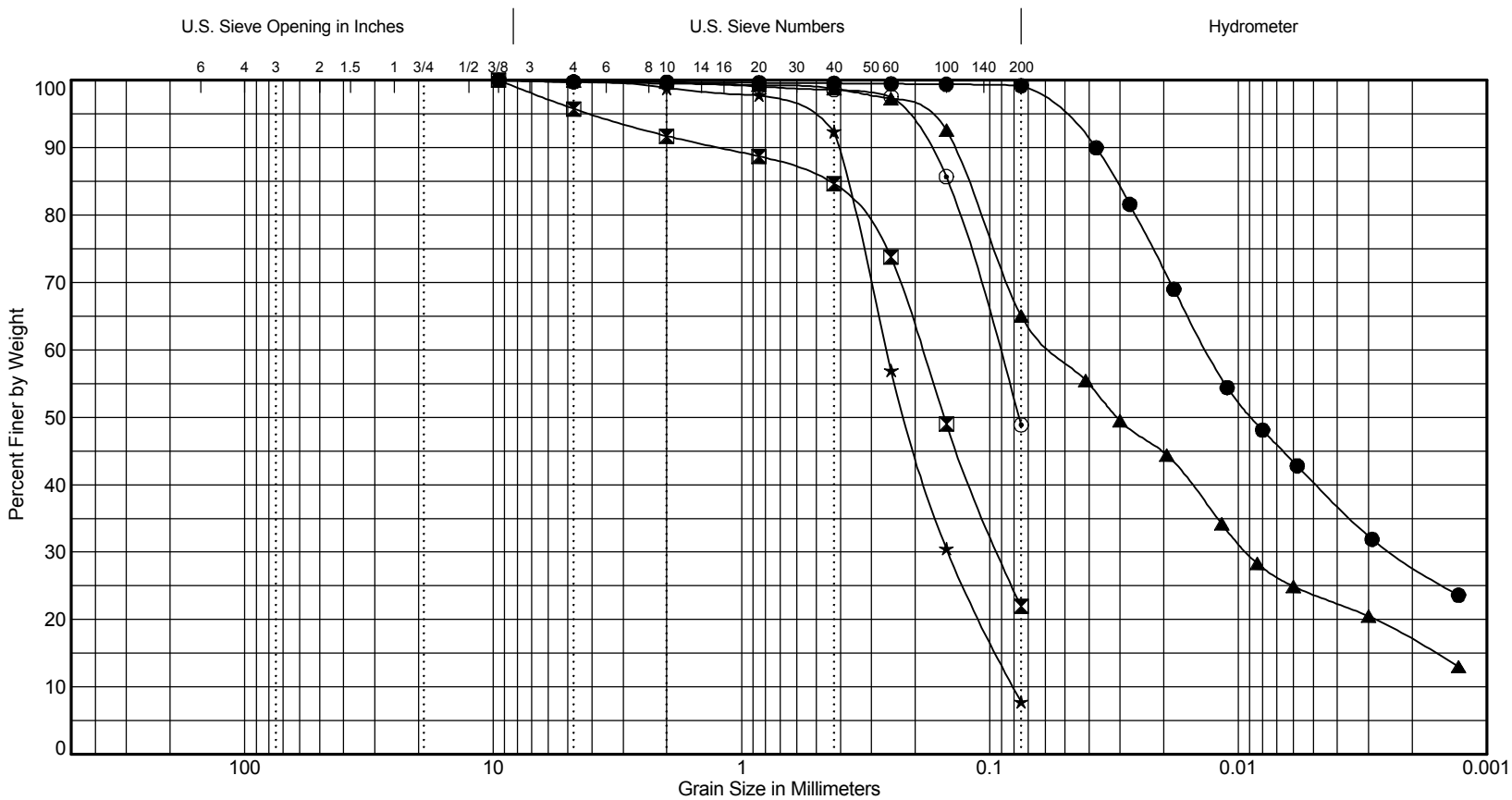
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TH-57-08	S-1	0.5	9	Fine to coarse SAND with silt and trace gravel	SM
⊠	TH-57-08	S-3	6.5	35	Fine to medium SAND with silt	SP-SM
▲	TH-58-08	S-1A	0.5	23	Fine to medium SAND with silt	SP-SM
★	TH-58-08	S-1B	1.5	16	Fine to coarse SAND with trace silt and gravel	SP
⊙	TH-59-08	S-1	0.5	33	Silty, fine SAND	SM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 1

Figure
B-7



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

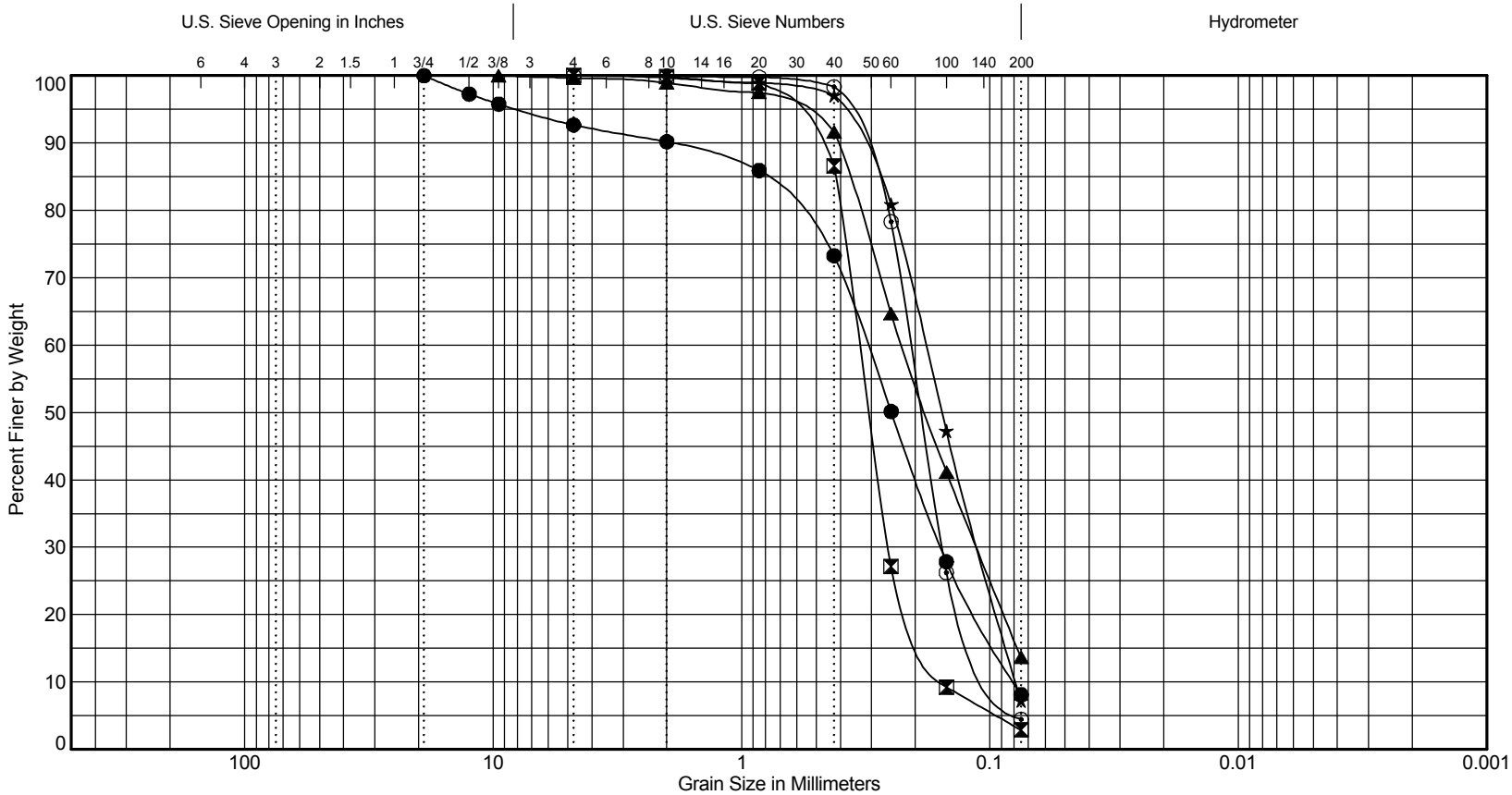
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TH-62-08	S-2	4.0	72	Clayey SILT with trace sand	MH
⊠	TH-63-08	S-1	0.5	24	Silty, fine SAND with trace gravel	SM
▲	TH-63-08	S-2	4.0	44	Very sandy SILT	ML
★	TP-04-08	S-1	6.0	31	Fine SAND with silt	SP-SM
⊙	TP-05-08	S-2	3.5	40	Very silty, fine SAND	SM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 1

Figure
B-8



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

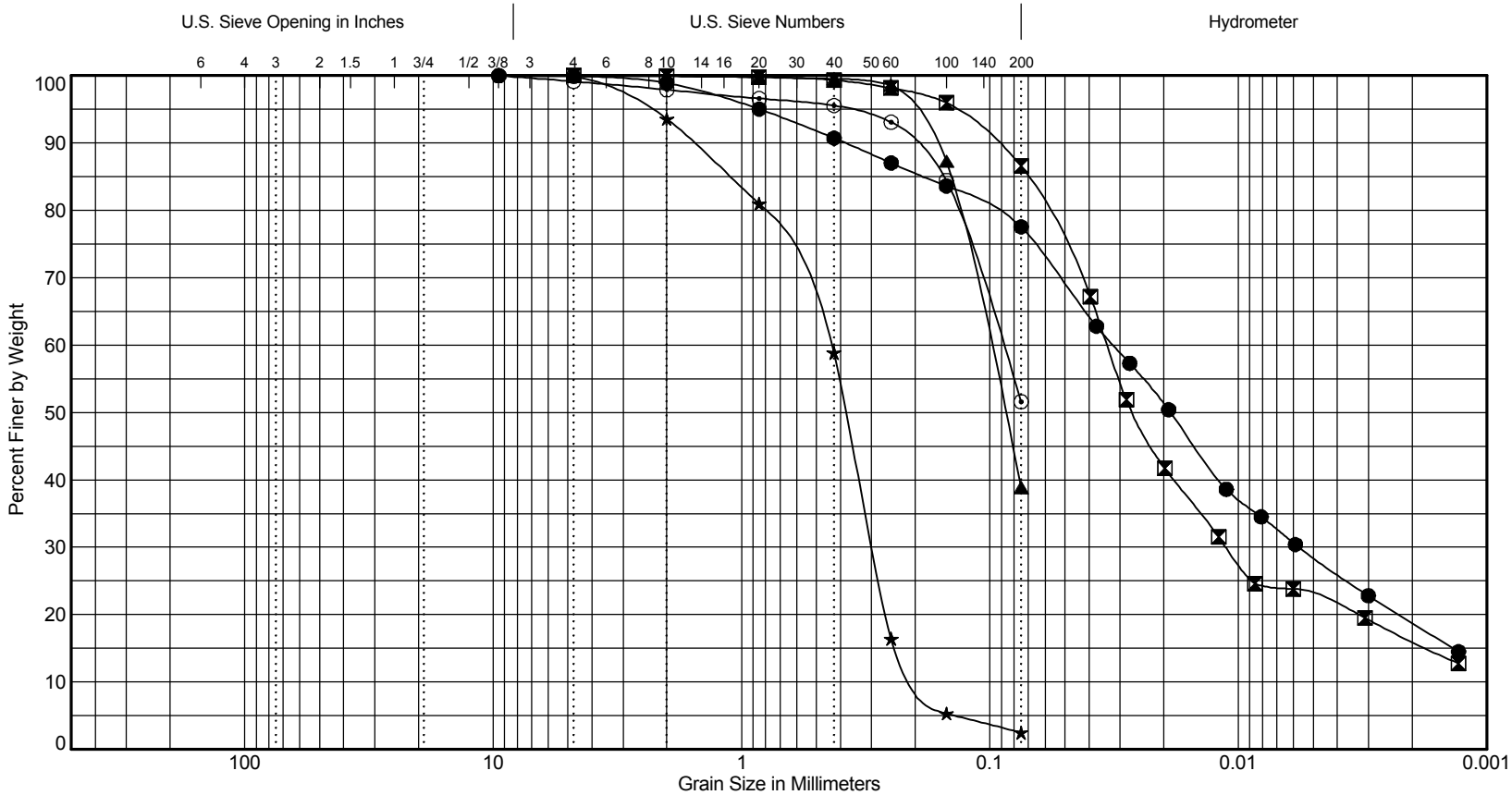
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TP-06-08	S-2	3.5	16	Fine to medium SAND with silt and gravel	SP-SM
⊠	TP-07-08	S-2	4.5	12	Fine to medium SAND with trace silt	SP
▲	TP-07-08	S-3	10.0	41	Fine SAND with silt	SM
★	TP-09-08	S-3	8.5	38	Fine SAND with silt	SP-SM
⊙	TP-10-08	S-1	3.0	33	Fine SAND with trace silt	SP

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 1

Figure
B-9



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

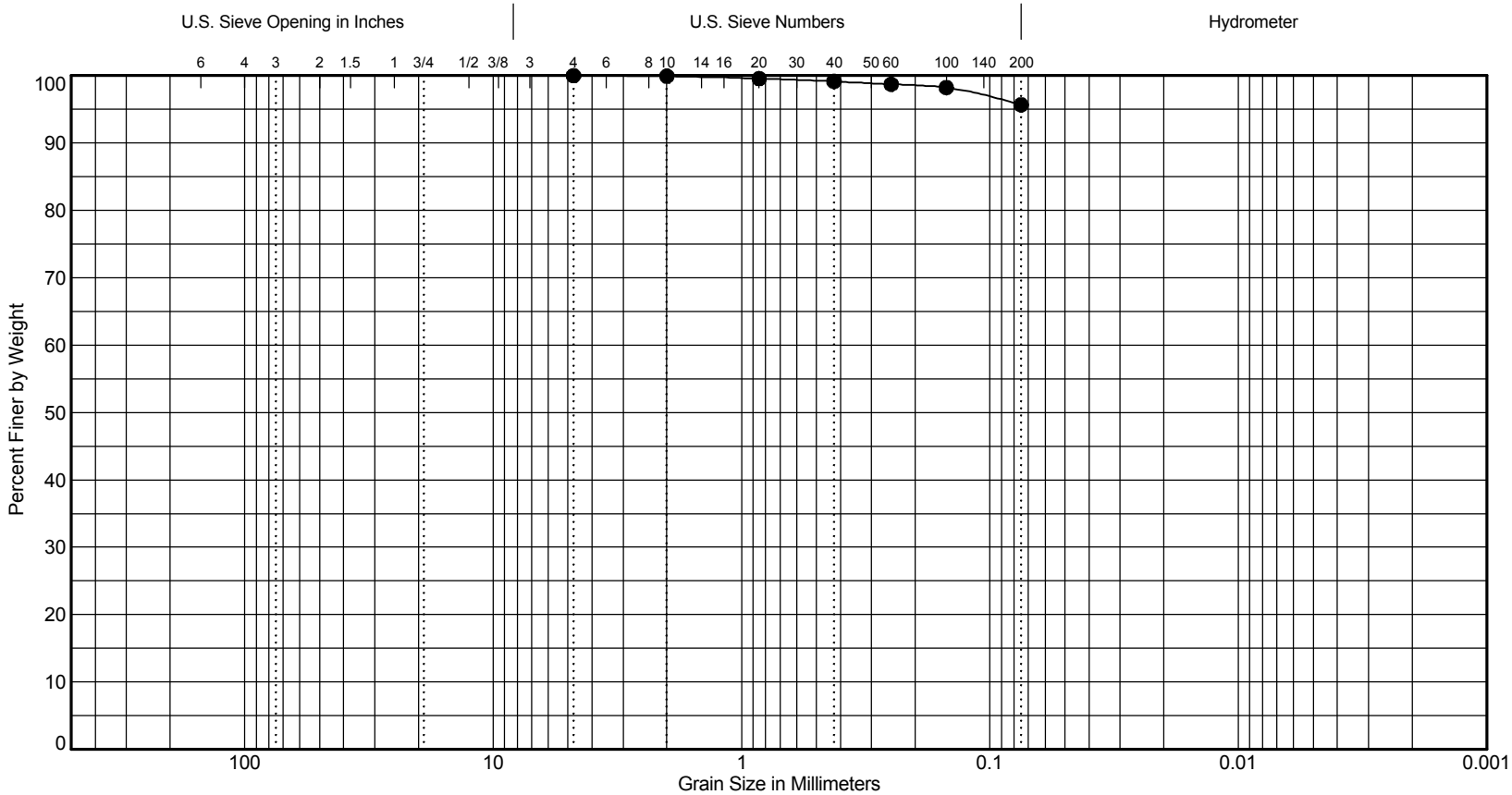
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TP-11-08	S-1	3.5	90	Sandy SILT	ML
⊠	TP-12-08	S-3	15.0	63	SILT with sand	ML
▲	TP-16-08	S-1	2.0	21	Very silty, fine SAND	SM
★	TP-17-08	S-1	1.0	6	Fine to medium SAND with trace silt	SP
⊙	TP-19-08	S-2	3.0	36	Very sandy SILT	ML

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 1

Figure
B-10



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

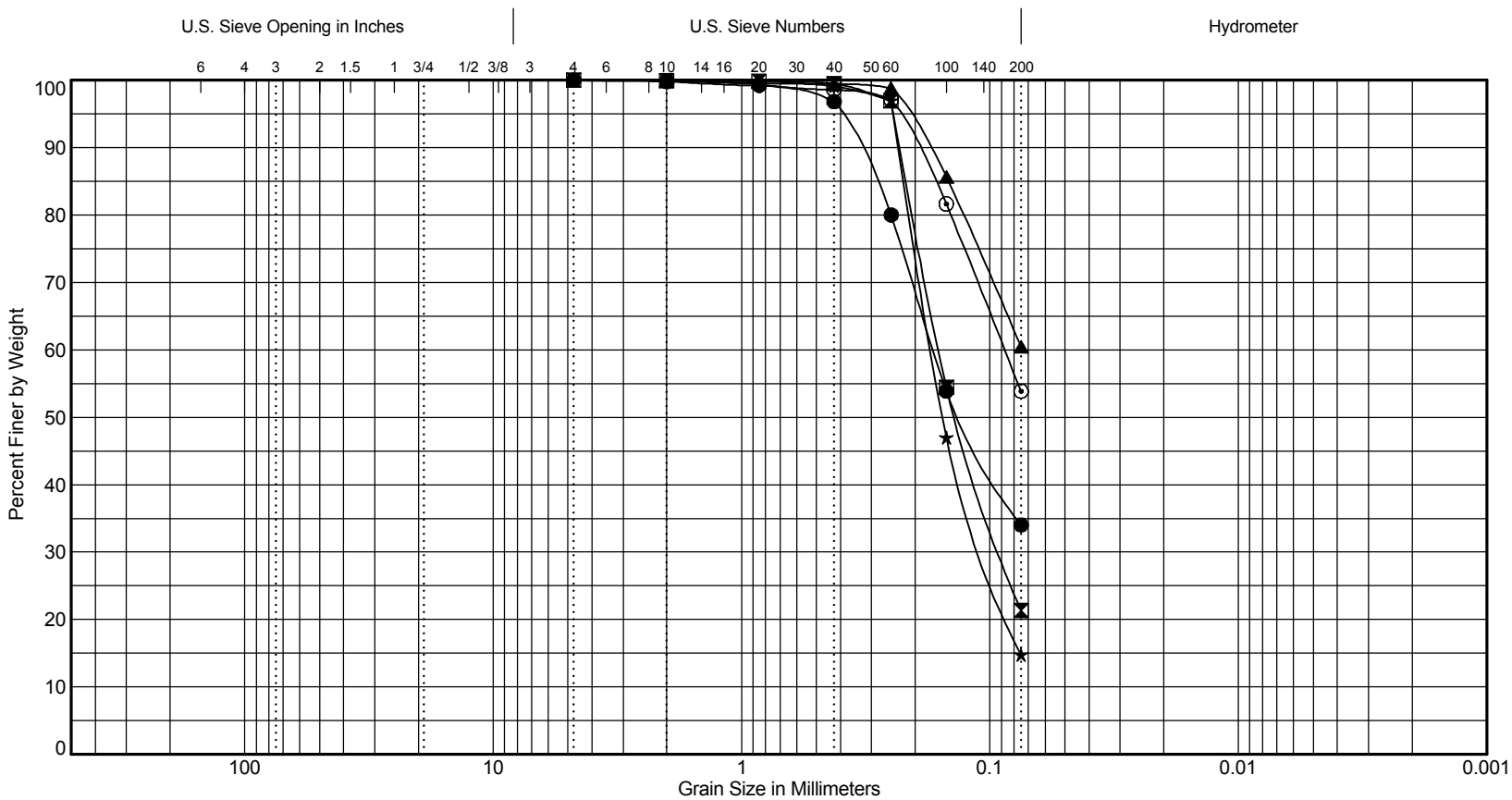
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TP-25-08	S-1	1.5	61	SILT with trace sand	ML

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 1

Figure
B-11



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

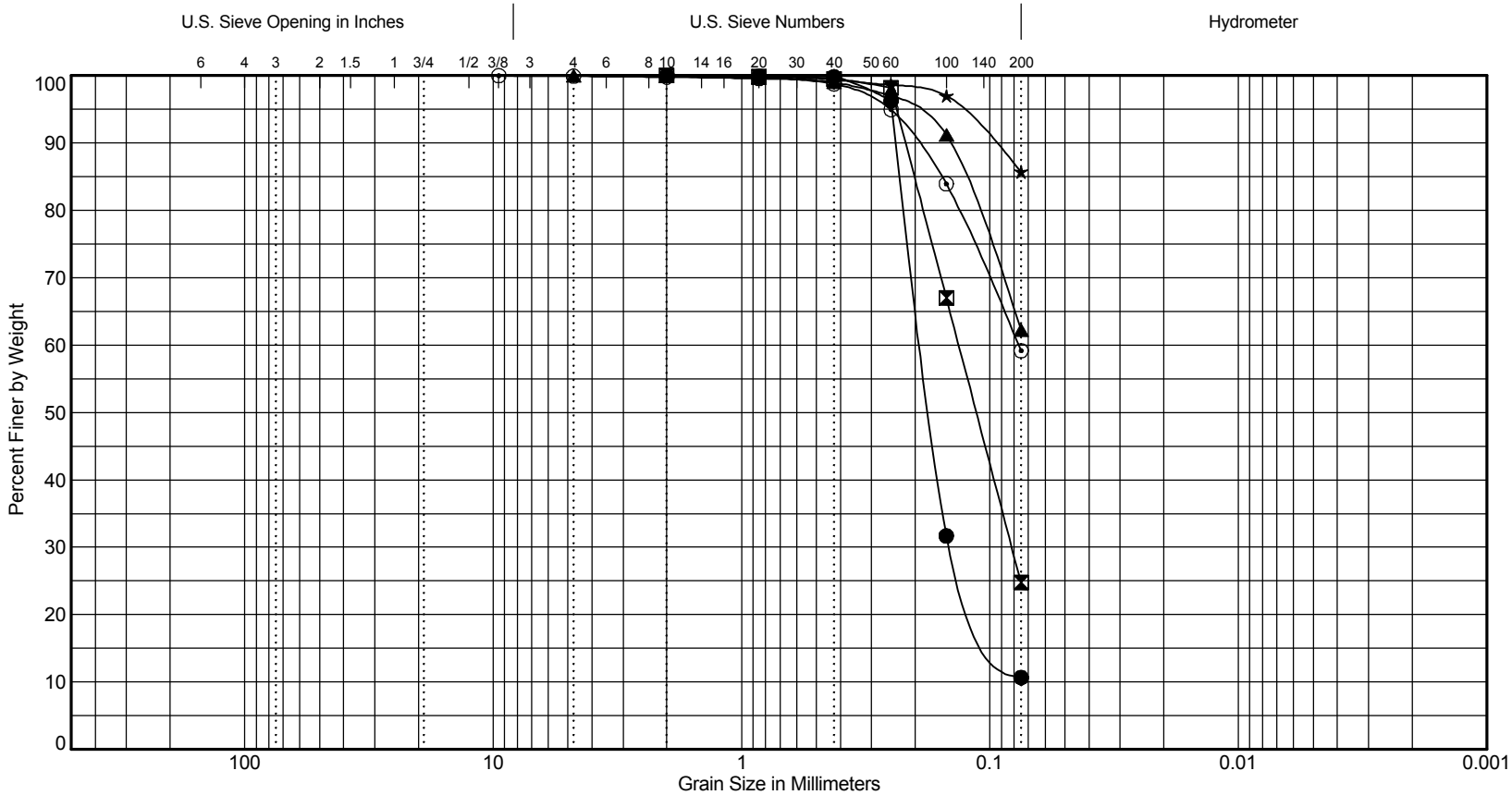
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 1	S-21	34.0	43	Very silty, fine SAND	SM
⧗	B- 2	S-22	36.0	37	Silty, fine SAND	SM
▲	B- 2	S-28	59.0	52	Very sandy SILT	ML
★	B-16	S-12	31.6	37	Fine SAND with silt	SP-SM
⊙	B-16	S-16	49.0	47	Very sandy SILT	ML

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 2A

Figure
B-12



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

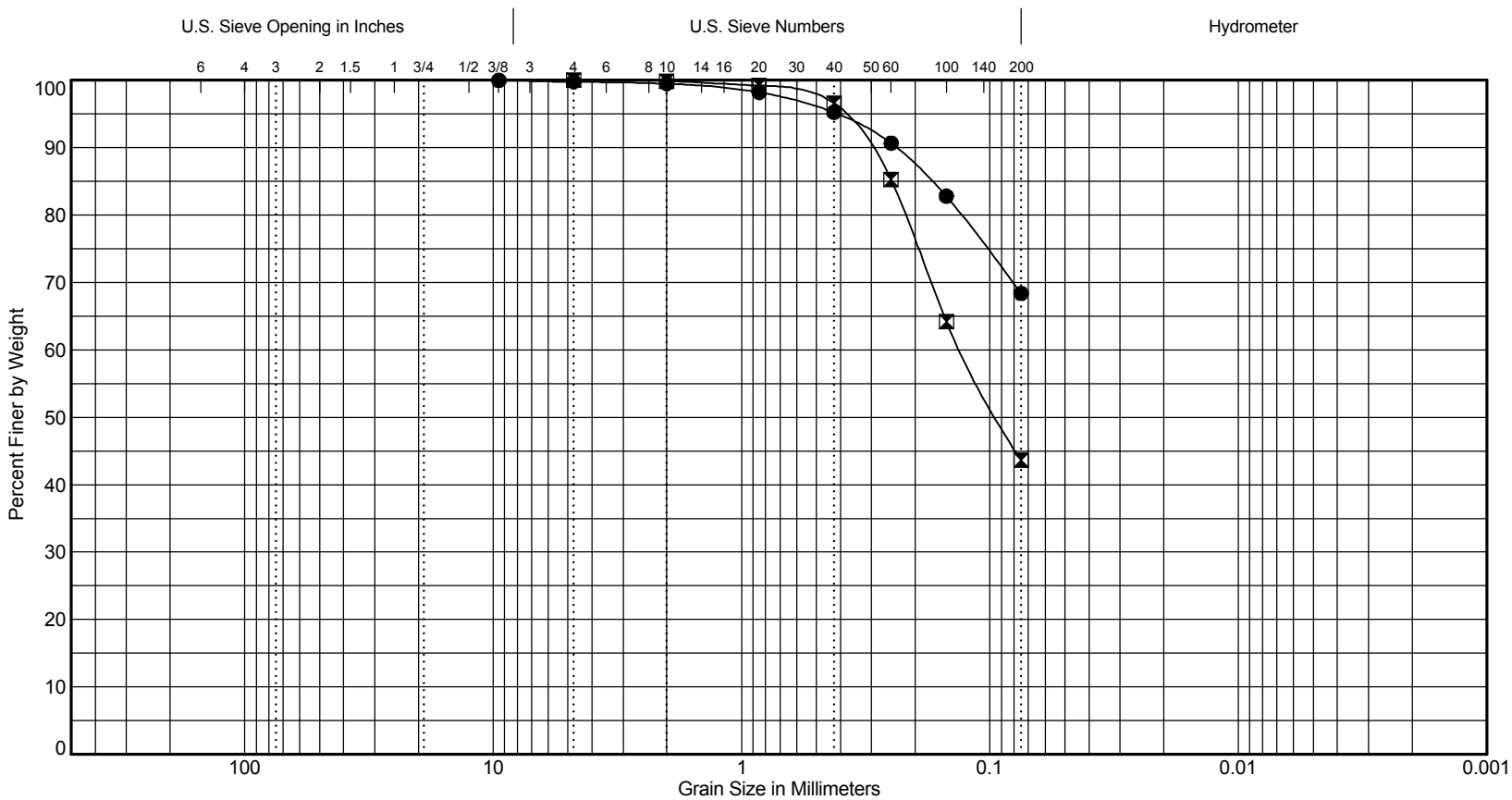
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-17	S-14	39.0	32	Fine SAND with silt	SP-SM
⊠	B-17	S-25	89.0	32	Silty, fine SAND	SM
▲	B-18	S-11	27.4	51	Very sandy SILT	ML
★	B-18	S-13	38.2	63	Sandy SILT	ML
⊙	B-18	S-15	48.7	48	Very sandy SILT	ML

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 2A

Figure
B-13



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

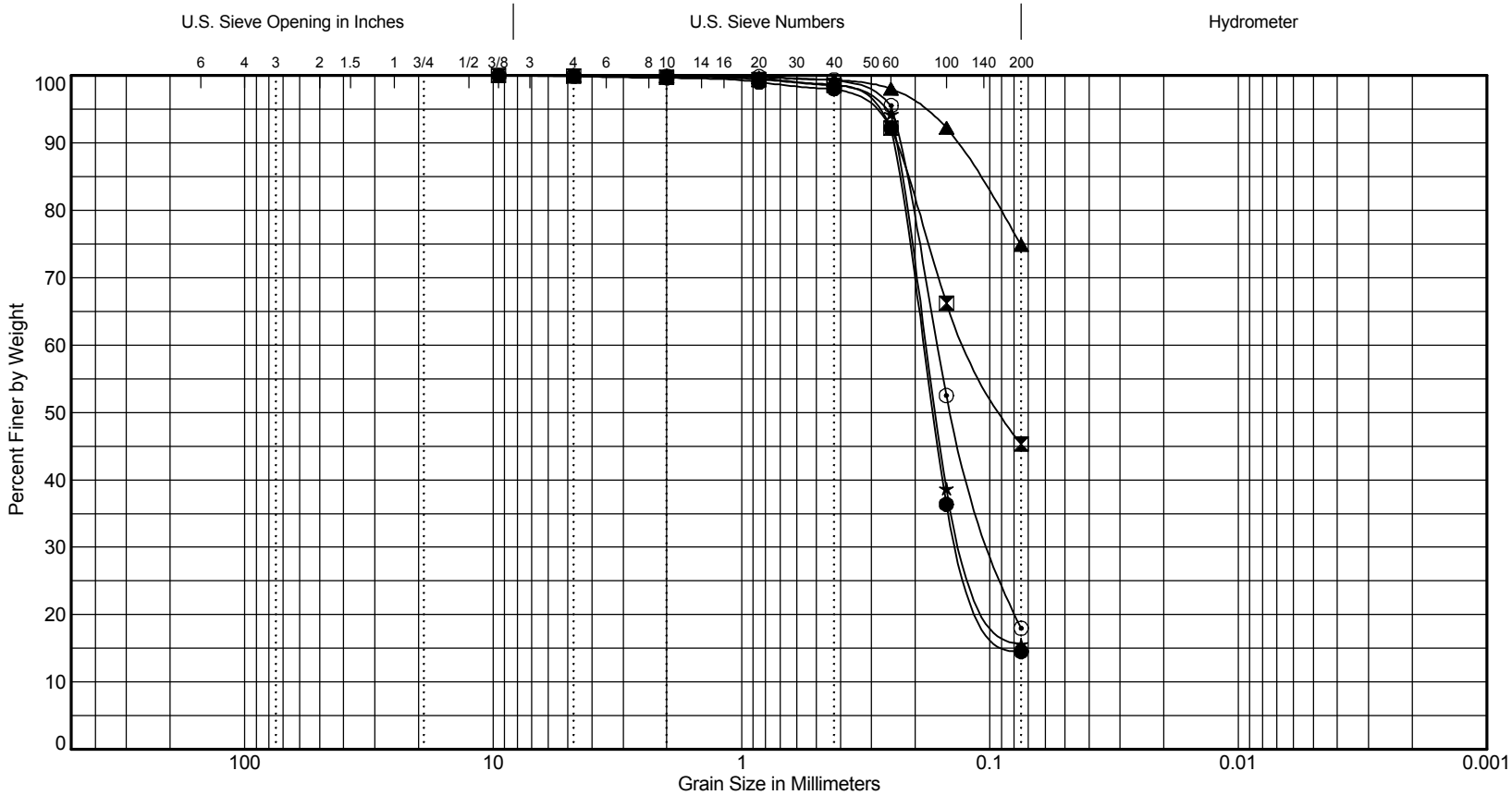
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-19	S-6	12.5	81	Very sandy SILT	ML
⧗	B-19	S-12	30.9	41	Very silty, fine SAND	SM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 2A

Figure
B-14



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

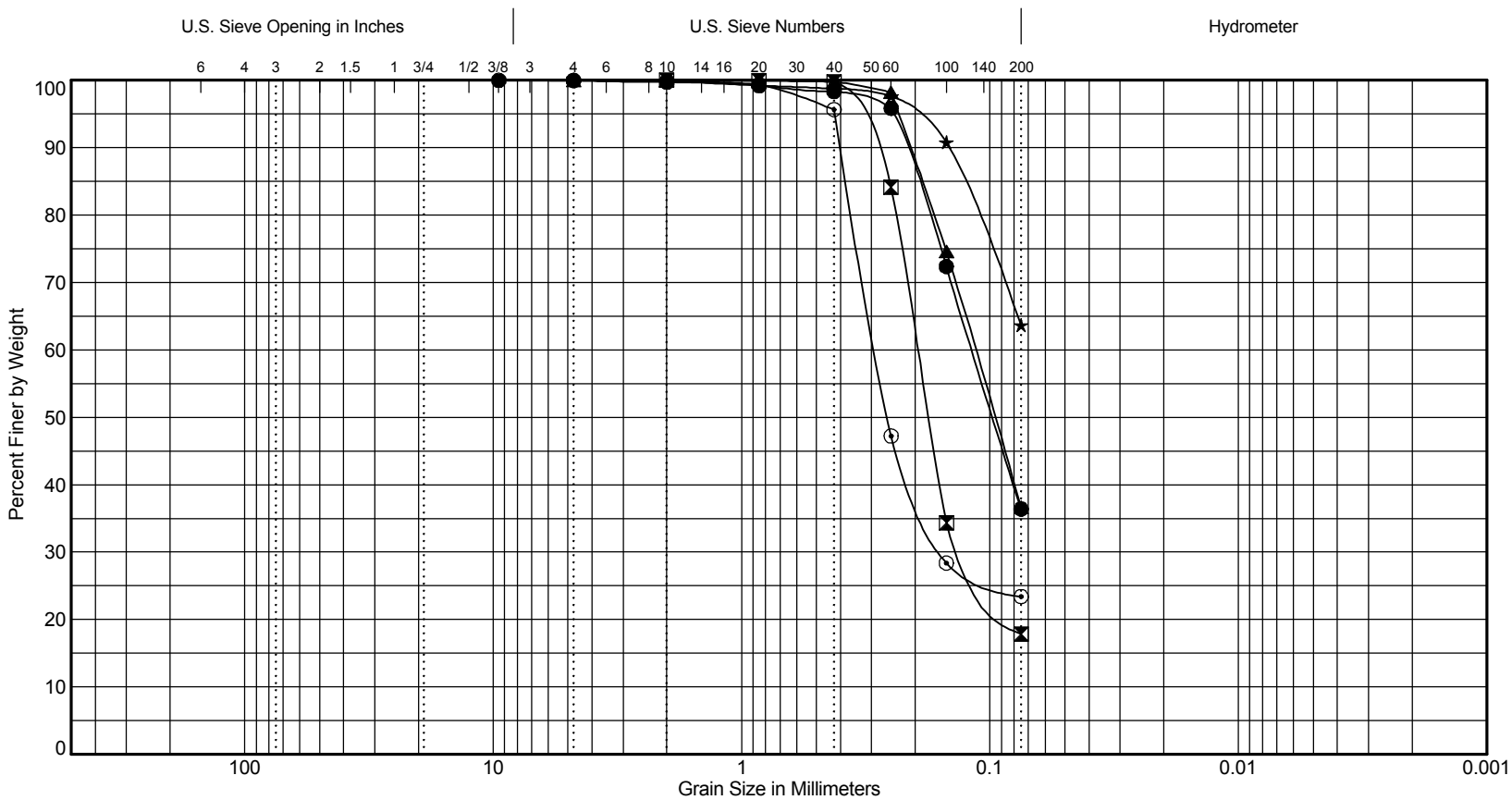
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 3	S-23	40.5	31	Fine SAND with silt	SP-SM
⊠	B- 3	S-28	64.0	52	Very silty, fine SAND	SM
▲	B- 4	S-23	38.0	54	Sandy SILT	ML
★	B- 4	S-26	44.0	31	Silty, fine SAND	SM
⊙	B- 4	S-32	74.0	29	Silty, fine SAND	SM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 2B

Figure
B-15



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

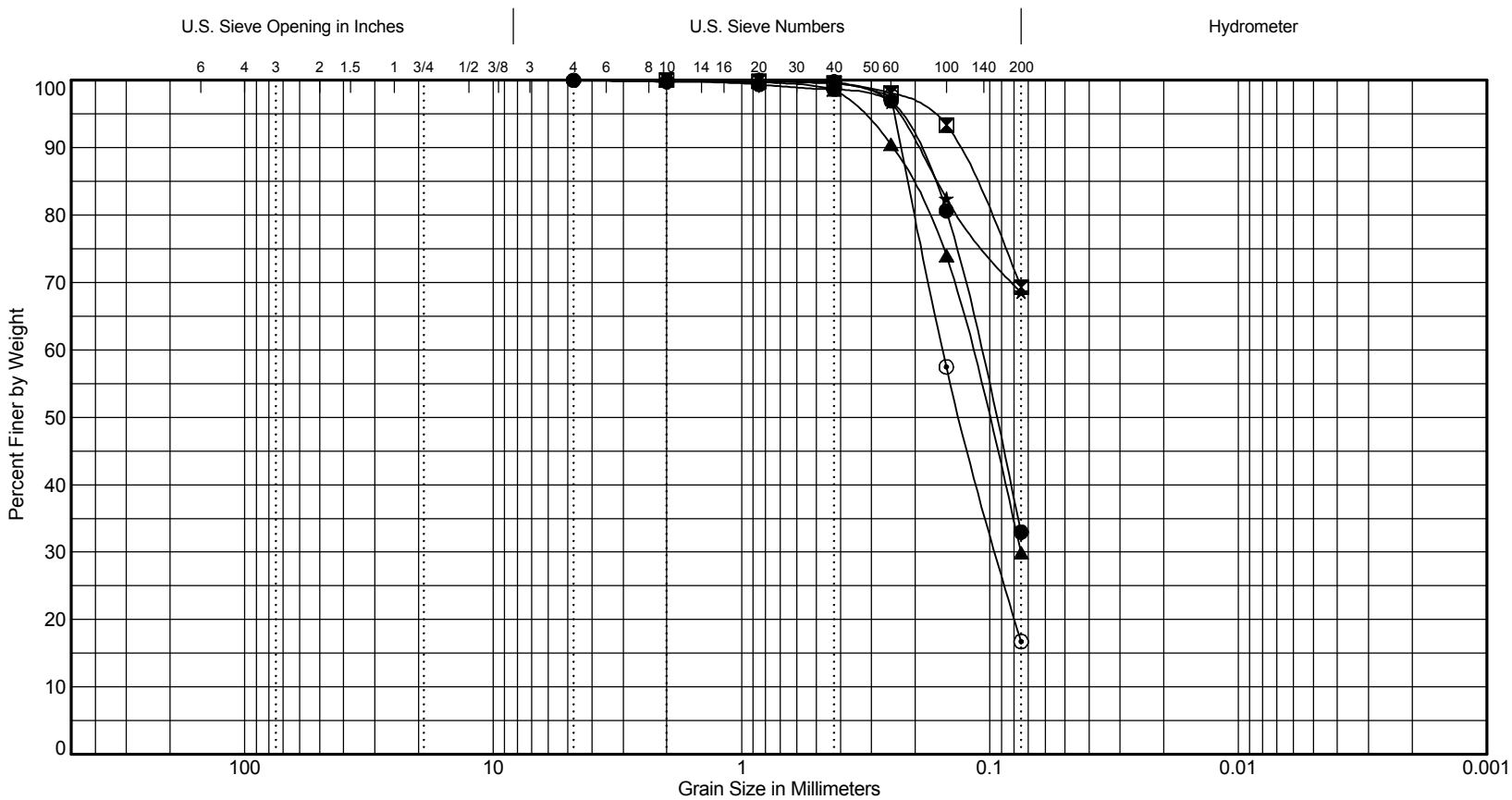
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 4	S-33	79.0	37	Very silty, fine SAND	SM
⊠	B- 5	S-29	64.0	30	Silty, fine SAND	SM
▲	B- 6	S-23	59.0	45	Very silty, fine SAND	SM
★	B- 7	S-21	34.0	49	Very sandy SILT	ML
⊙	B- 7	S-29	69.0	35	Silty, fine SAND	SM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 2B

Figure
B-16



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

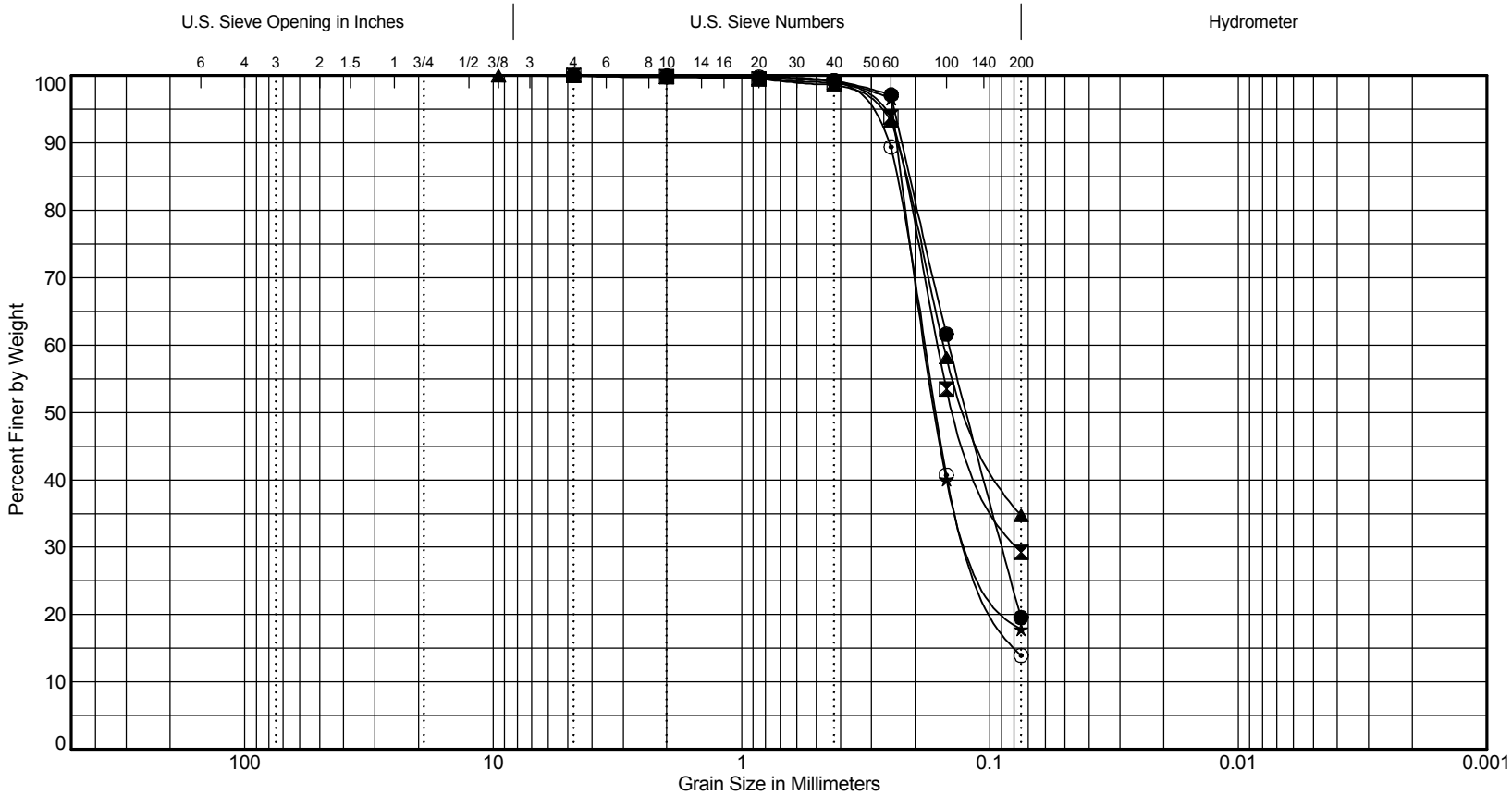
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 8	S-9	24.0	48	Very silty, fine SAND	SM
⊠	B- 8	S-14	44.0	49	Very sandy SILT	ML
▲	B- 8	S-17	59.0	44	Very silty, fine SAND	SM
★	B- 9	S-12	31.5	58	Very sandy SILT	ML
⊙	B- 9	S-18	56.0	39	Silty, fine SAND	SM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 2B

Figure
B-17



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

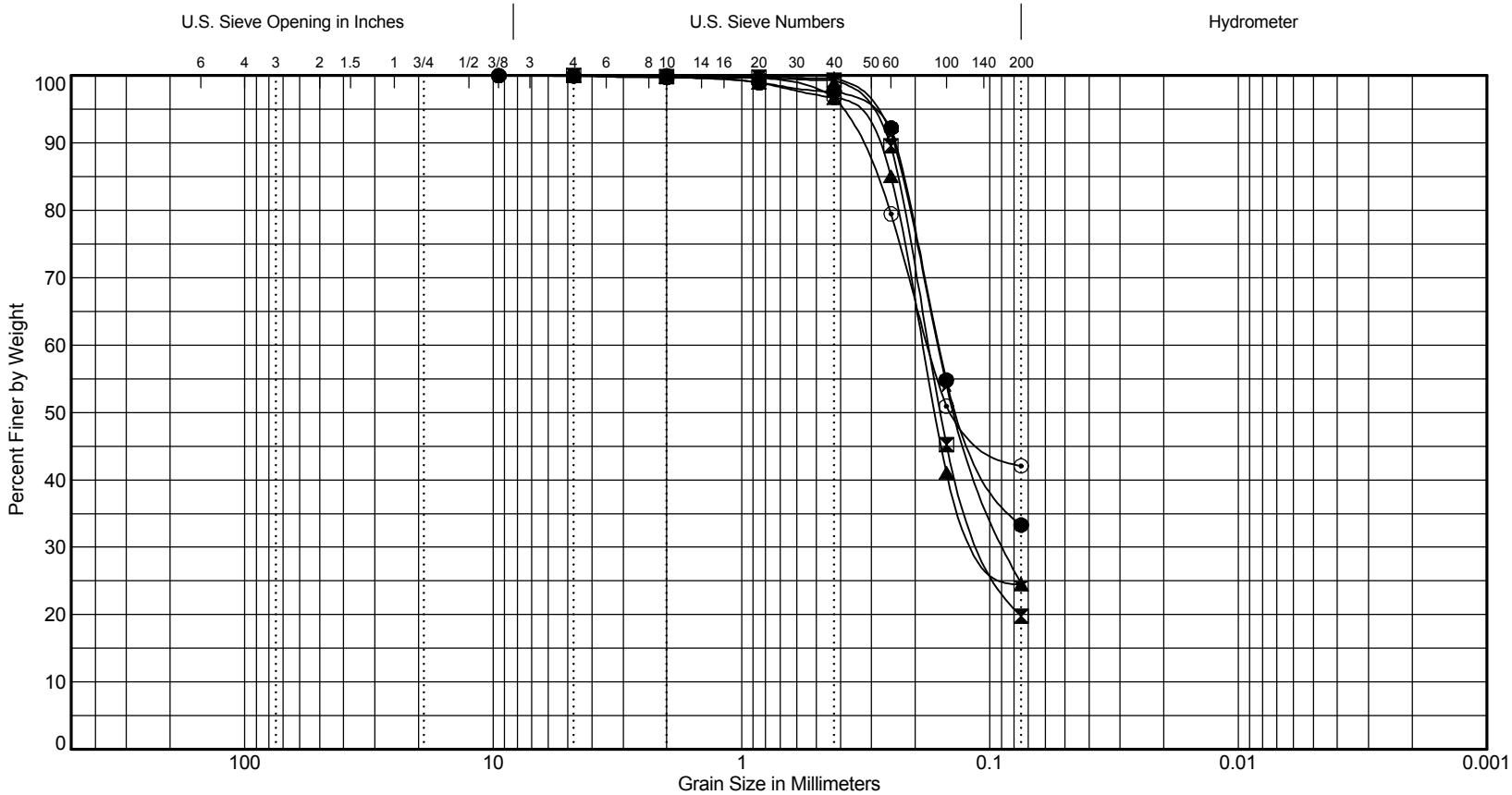
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 9	S-22	74.0	38	Silty, fine SAND	SM
⊠	B-10	S-16	44.0	38	Silty, fine SAND	SM
▲	B-10	S-20	64.0	44	Very silty, fine SAND	SM
★	B-11	S-12	44.0	34	Silty, fine SAND	SM
⊙	B-11	S-17	69.0	32	Silty, fine SAND	SM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 2B

Figure
B-18



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

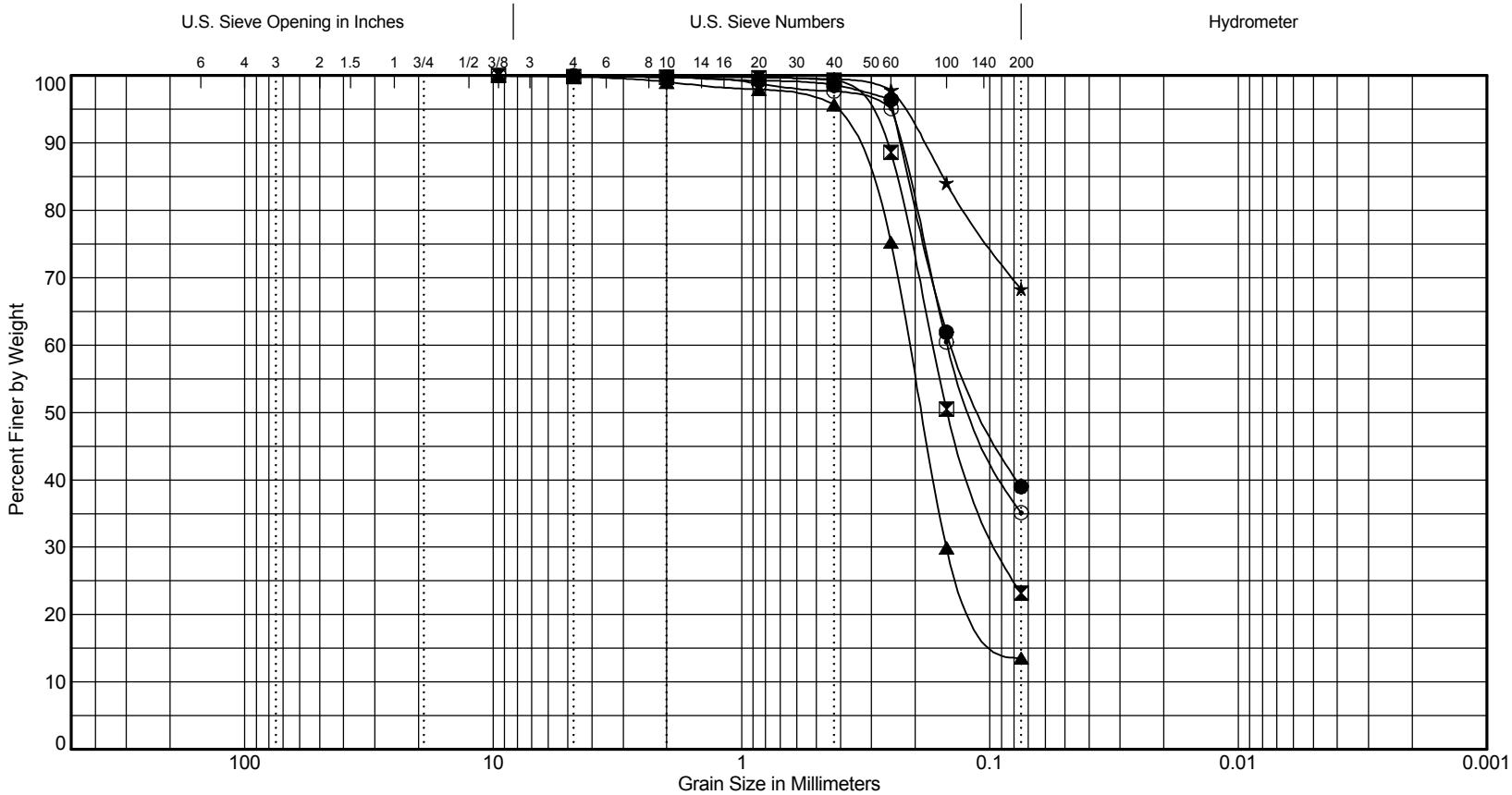
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-12	S-12	31.5	45	Very silty, fine SAND	SM
⊠	B-12	S-21	69.0	33	Silty, fine SAND	SM
▲	B-13	S-14	44.0	36	Silty, fine SAND	SM
★	B-13	S-18	64.0	39	Silty, fine SAND	SM
⊙	B-13	S-23	89.0	43	Very silty, fine SAND	SM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 2B

Figure
B-19



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

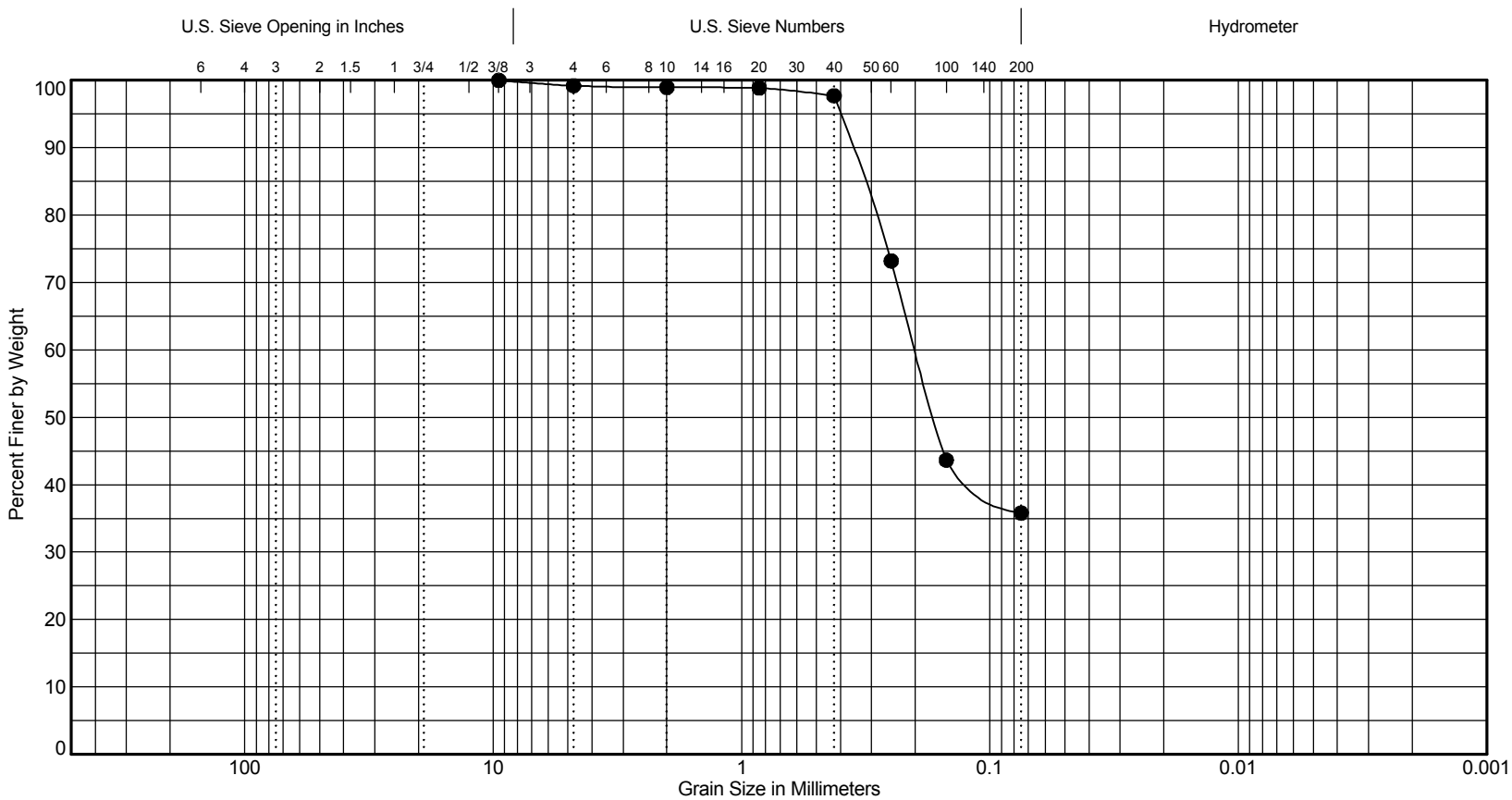
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-15	S-14	39.0	59	Very silty, fine SAND	SM
⊠	TH-27-08	S-13	54.0	36	Silty, fine SAND	SM
▲	TH-31-SW-08	S-6A	46.0	32	Fine SAND with silt	SM
★	TH-31-SW-08	S-6B	46.8	46	Very sandy SILT	ML
⊙	TH-33-08	S-16	29.0	42	Very silty, fine SAND	SM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 2B

Figure
B-20



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

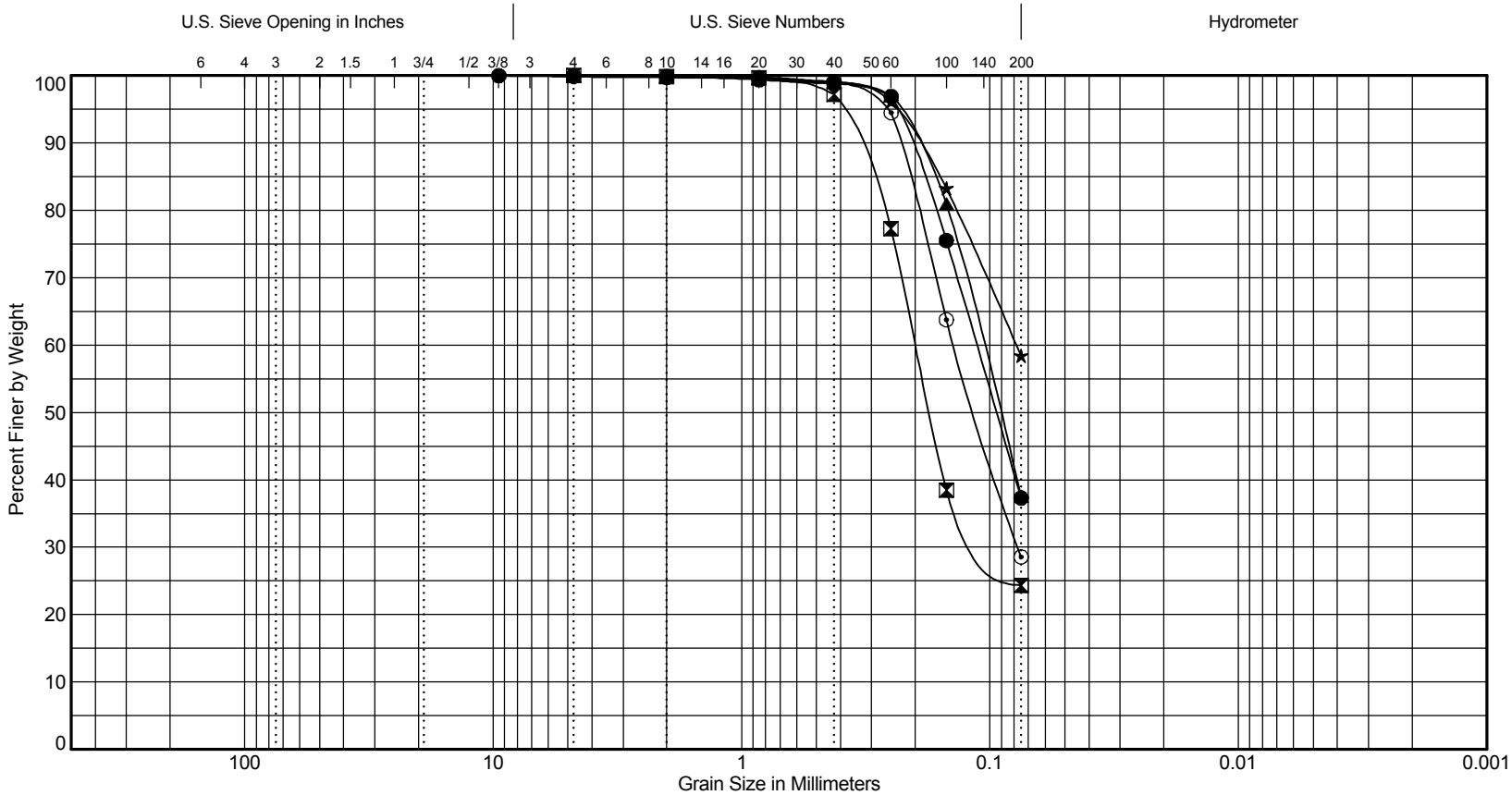
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TH-33-08	S-22	59.0	39	Very silty, fine SAND	SM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 2B

Figure
B-21



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

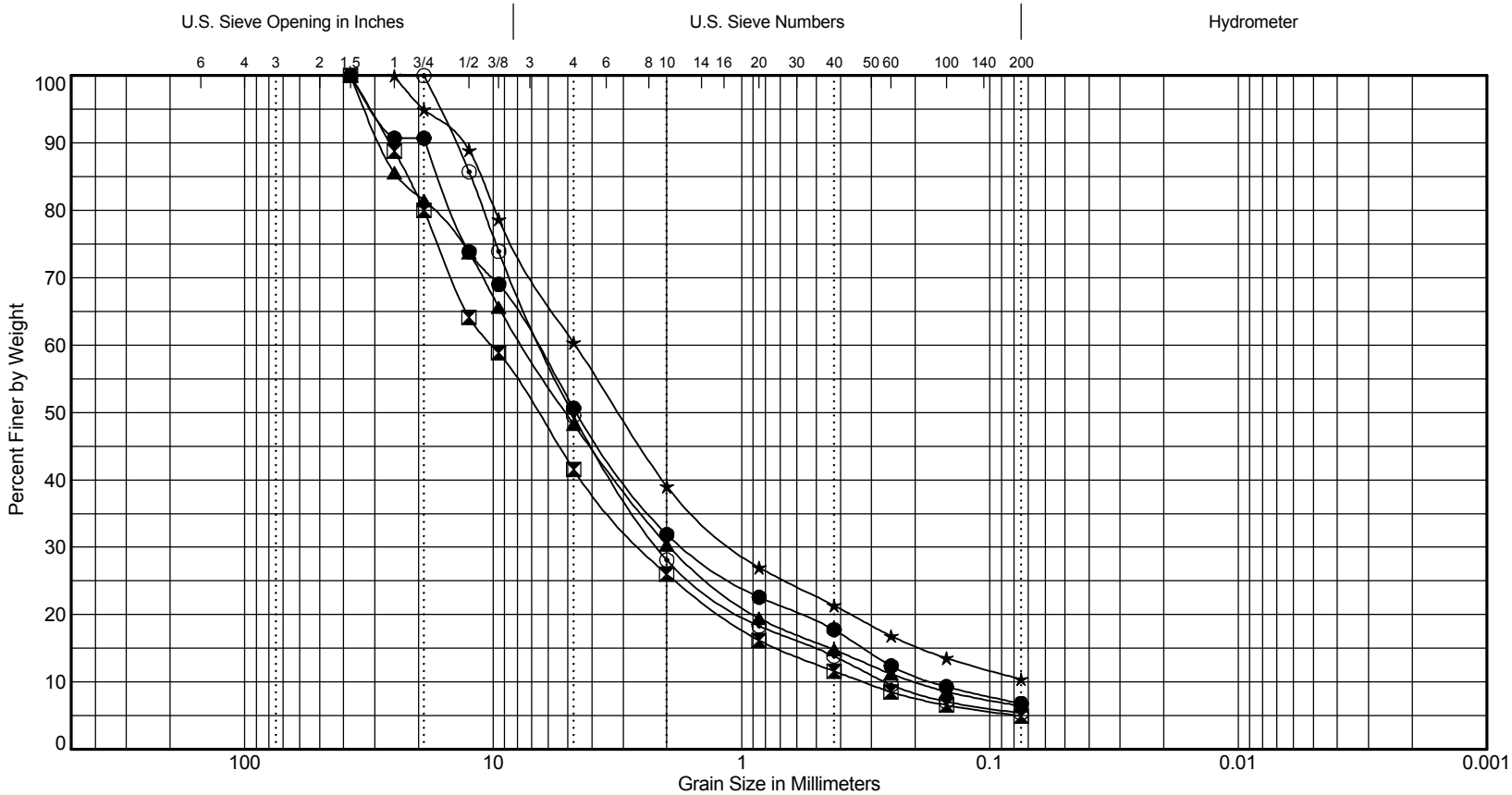
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 1	S-35	89.0	48	Very silty, fine SAND	SM
⊠	B- 5	S-34	89.0	34	Silty, fine SAND	SM
▲	B-11	S-22	89.0	40	Very silty, fine SAND	SM
★	B-13	S-32	134.0	43	Very sandy, SILT	ML
⊙	B-19	S-18	60.4	46	Silty, fine SAND	SM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 3

Figure
B-22



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

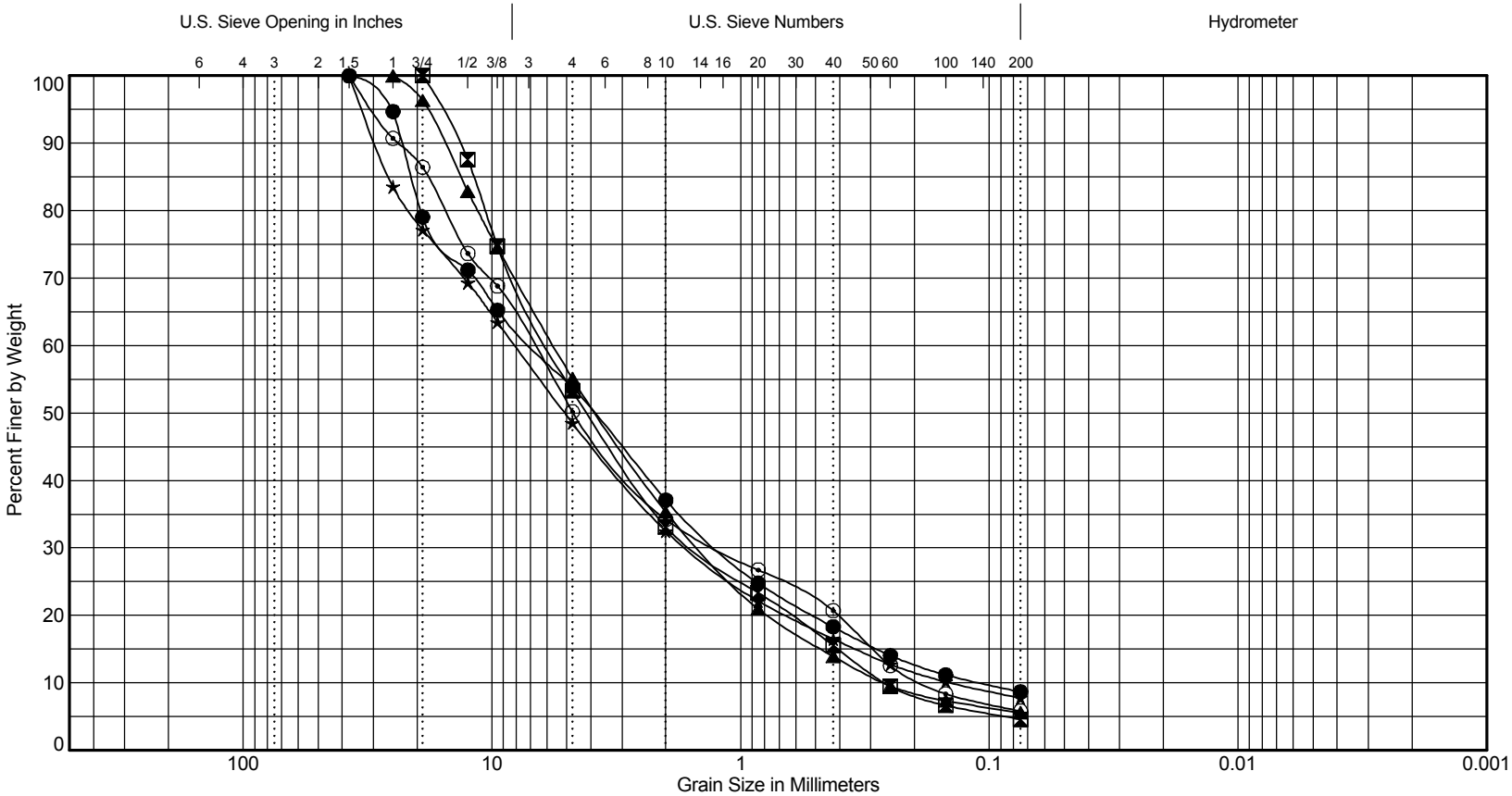
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 1	S-50	159.0	8	Very sandy, GRAVEL with silt	GW-GM
⊠	B- 2	S-49	159.0	7	Very sandy, GRAVEL with silt	GW-GM
▲	B- 3	S-46	154.0	9	Very sandy, GRAVEL with silt	GW-GM
★	B- 4	S-49	154.0	9	Very gravelly, fine to coarse SAND with silt	SP-SM
⊙	B- 6	S-39	134.0	9	Very sandy, GRAVEL with silt	GW-GM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 4

Figure
B-23



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

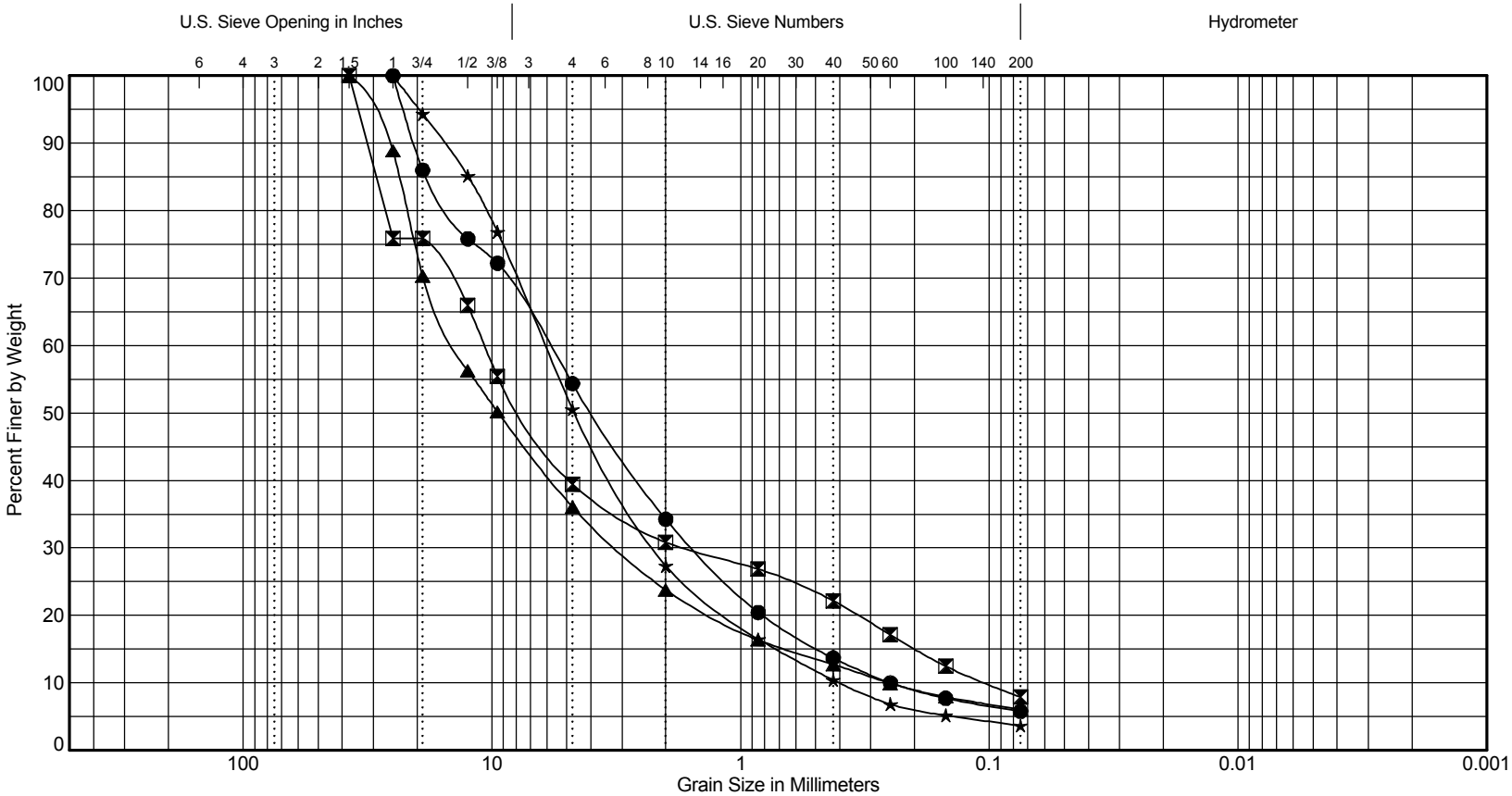
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 7	S-38	144.0	10	Very sandy, GRAVEL with silt	GW-GM
⊠	B- 9	S-35	134.0	8	Very gravelly, fine to coarse SAND	SW
▲	B-10	S-37	149.0	9	Very gravelly, fine to coarse SAND with silt	SW-SM
★	B-11	S-36	159.0	8	Very sandy, fine to coarse GRAVEL with silt	GW-GM
⊙	B-12	S-36	139.0	8	Very sandy, GRAVEL with silt	GW-GM

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 4

Figure
B-24



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

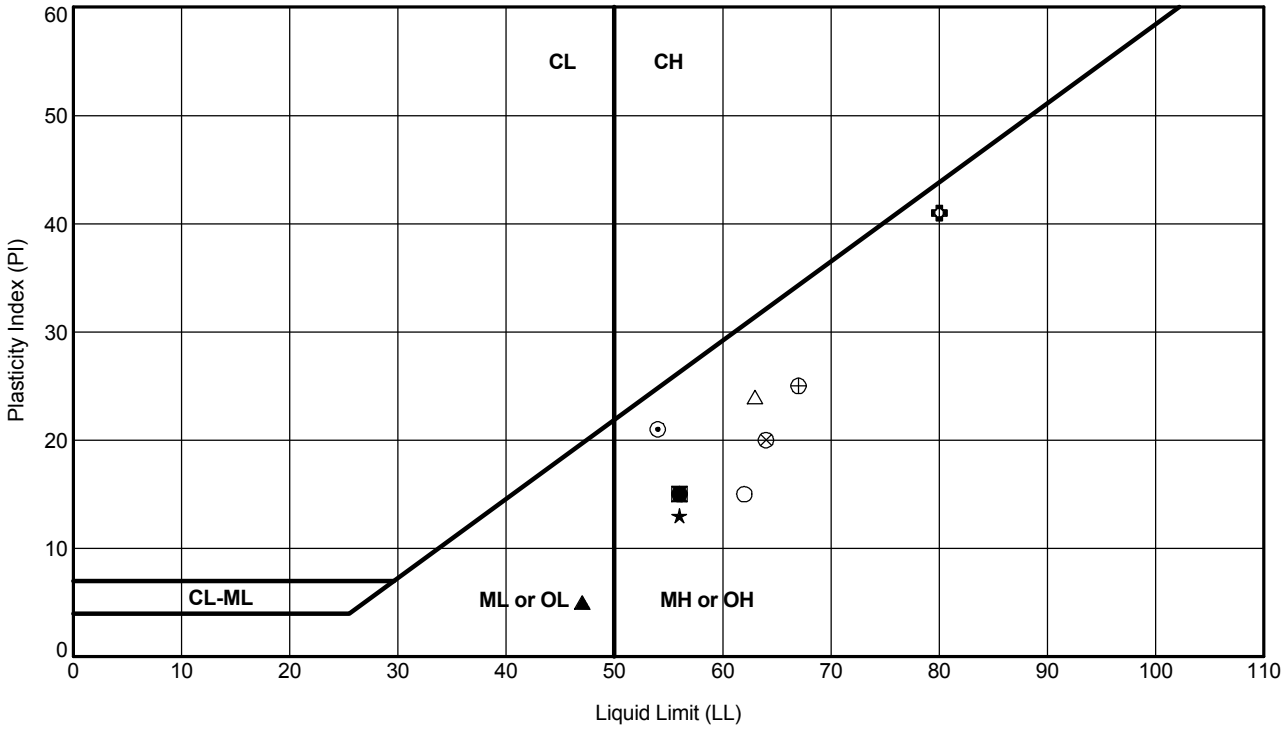
Symbol	Exploration Number	Sample Number	Depth (ft)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-17	S-40	159.0	8	Very gravelly, fine to coarse SAND with silt	SW-SM
⊠	B-18	S-34B	133.1	8	Sandy, fine to coarse GRAVEL with silt	GW-GM
▲	B-19	S-34	130.8	9	Sandy, fine to coarse GRAVEL with silt	GW-GM
★	TH-31-SW-08	S-23	149.0	10	Very sandy, fine GRAVEL with trace silt	GW

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Grain Size Distribution
Soil Unit 4

Figure
B-25



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 1	S-10	15.5	56	41	15	56	Clayey, SILT with organics	MH
⊠	B- 1	S-10	15.5	56	41	15	56	Clayey, SILT with organics	MH
▲	B- 1	S-14A	22.9	47	42	5	53	SILT with clay	ML
★	B- 1	S-14B	23.9	56	43	13	57	Clayey, SILT with organics	MH
⊙	B- 1	S-15	24.5	54	33	21	62	Clayey, SILT with organics	MH
✿	B- 1	S-19	32.1	80	39	41	59	Clayey, SILT	MH
○	B- 2	S-8	12.5	62	47	15	77	Clayey, SILT with sand and organics	MH
△	B- 2	S-15A	24.3	63	39	24	58	Clayey, SILT with sand and organics	MH
⊗	B- 2	S-15B	24.9	64	44	20	58	Clayey, SILT with sand and organics	MH
⊕	B- 2	S-15C	25.5	67	42	25	64	Clayey, SILT with sand and organics	MH

ASTM D 4318 Test Method

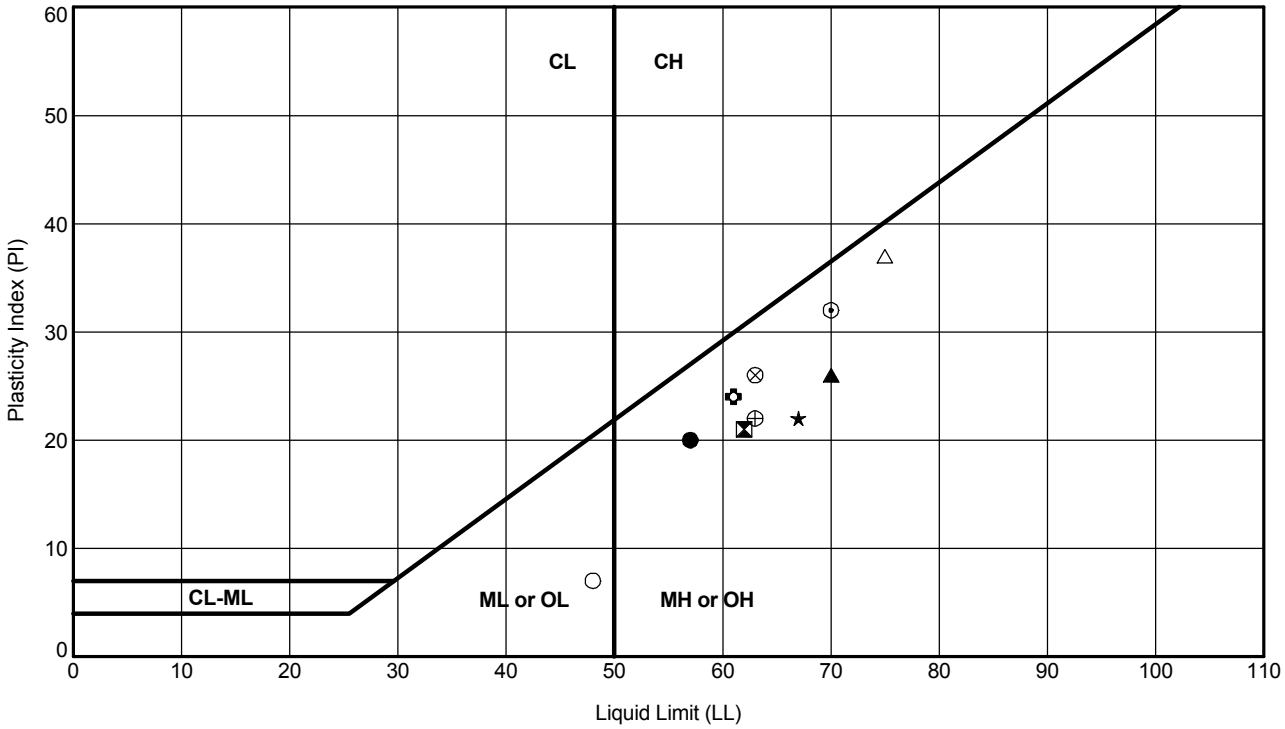
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 1

Figure
B-26



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 3	S-6	9.0	57	37	20	72	Clayey, SILT with interbeds of sand and organics	MH
⊠	B- 3	S-11	17.0	62	41	21	71	Clayey, SILT with interbeds of sand and organics	MH
▲	B- 3	S-14A	22.9	70	44	26	69	Clayey, SILT with interbeds of sand and organics	MH
★	B- 3	S-14B	23.4	67	45	22	72	Clayey, SILT with interbeds of sand and organics	MH
⊙	B- 3	S-18	29.0	70	38	32	131	Clayey, SILT with abundant organics	MH
✿	B- 4	S-7	10.5	61	37	24	81	Clayey, SILT with sand and abundant organics	MH
○	B- 4	S-14	23.9	48	41	7	51	SILT with fine sand	ML
△	B- 5	S-9	14.0	75	38	37	84	Clayey, SILT with trace organics	MH
⊗	B- 6	S-6	11.5	63	37	26	76	Clayey, SILT with organics	MH
⊕	B- 6	S-12	24.5	63	41	22	62	Clayey, SILT with fine sand and organics	MH

ASTM D 4318 Test Method

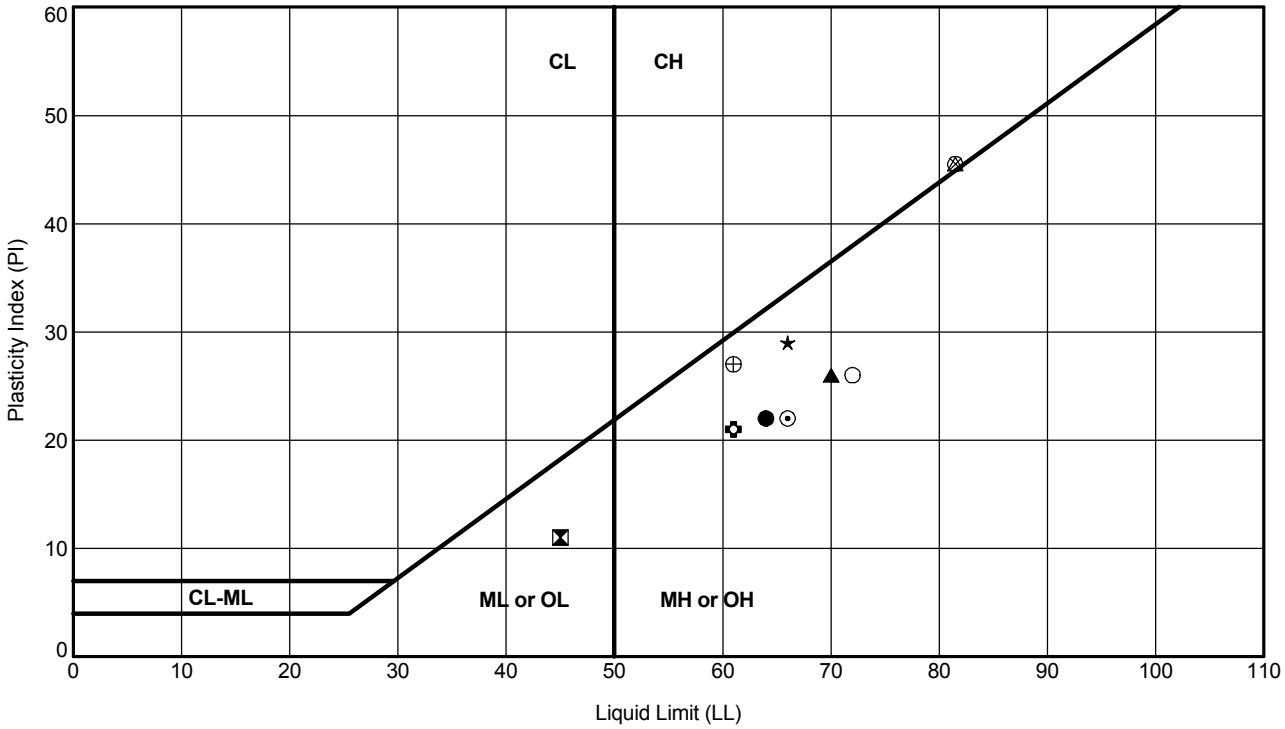
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 1

Figure
B-27



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 7	S-9	14.0	64	42	22	68	Clayey, SILT with fine sand and organics	MH
⊠	B- 7	S-16	25.5	45	34	11	53	SILT with fine sand and interbeds of silty, fine SAND	ML
▲	B- 8	S-3	9.0	70	44	26	85	SILT trace fine organics	MH
★	B- 9	S-3	9.0	66	37	29	69	Clayey SILT	MH
⊙	B- 9	S-6	16.5	66	44	22	79	SILT	MH
✿	B-10	S-6	14.0	61	40	21	59	SILT with trace fine organics	MH
○	B-10	S-9	21.5	72	46	26	69	SILT with trace fine organics	MH
△	B-11	S-8	26.5	82	36	46	67	Silty CLAY	CH
⊗	B-11	S-8	26.5	82	36	46	67	Silty CLAY	CH
⊕	B-12	S-4	11.5	61	34	27	76	Clayey SILT with trace fine shells and organics	MH

ASTM D 4318 Test Method

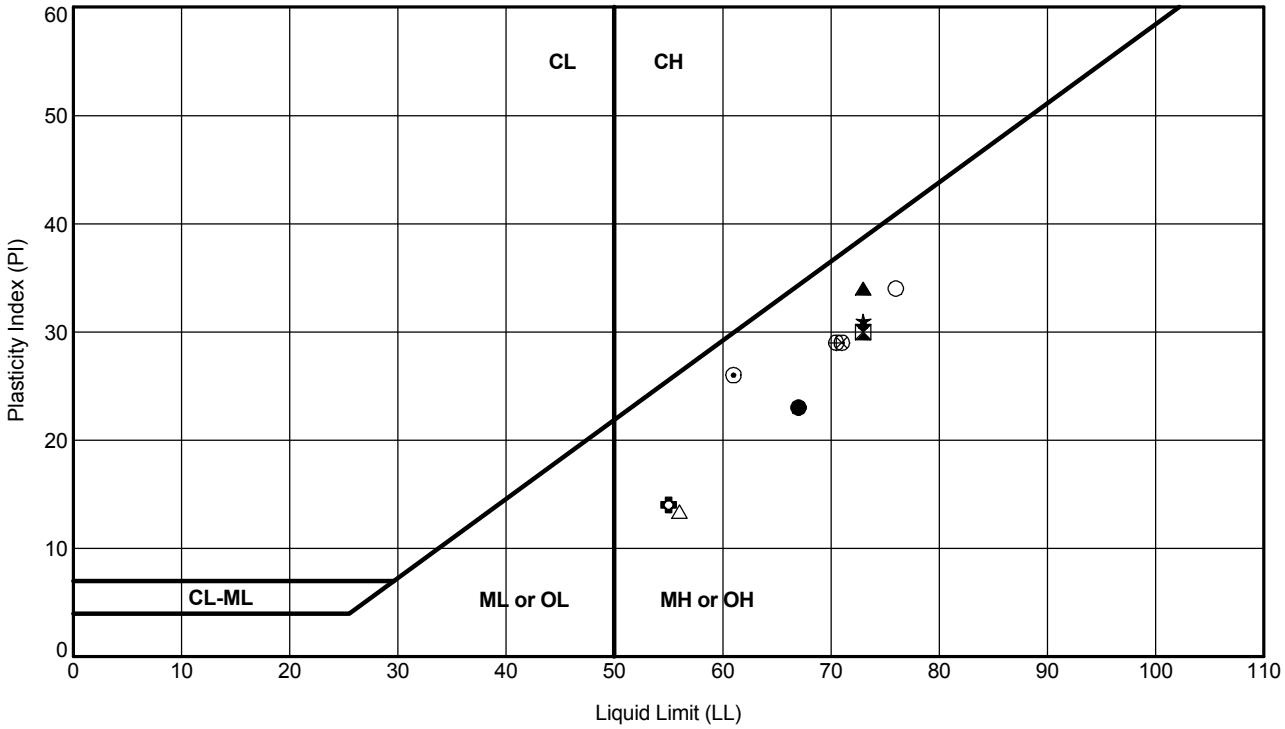
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 1

Figure
B-28

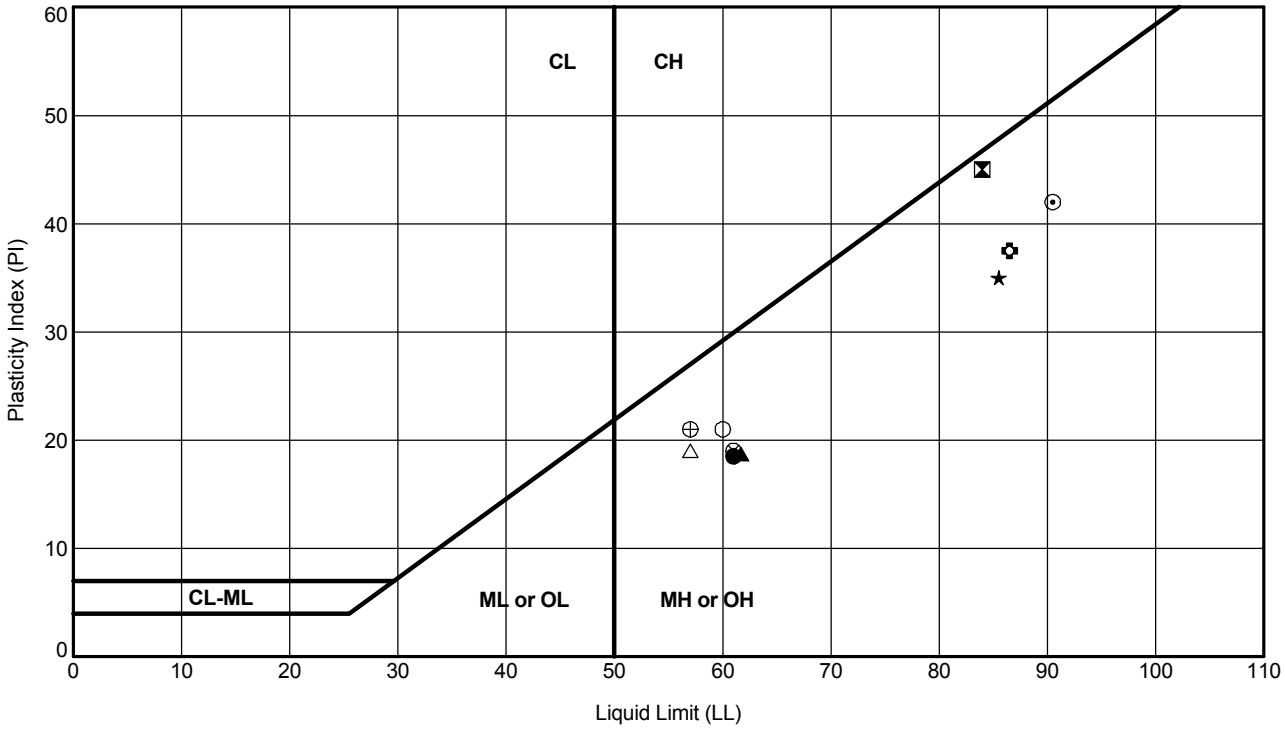


ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-12	S-10	26.5	67	44	23	74	SILT with trace woods	MH
⊠	B-13	S-5	14.0	73	43	30	83	Clayey SILT	MH
▲	B-13	S-6	16.6	73	39	34	64	Clayey SILT with fine organics	MH
★	B-14	S-4	11.5	73	42	31	85	Clayey SILT with fine organics	MH
⊙	B-14	S-10	26.5	61	35	26	63	Clayey SILT with wood and fine organics	MH
✿	B-15	S-4	11.5	55	41	14	72	SILT with fine wood and organics	MH
○	B-15	S-8	23.3	76	42	34	72	Clayey SILT	MH
△	B-16	S-5	14.0	56	43	13	59	SILT with fine sand	MH
⊗	B-16	S-7	20.8	71	42	29	70	Clayey SILT	MH
⊕	B-16	S-10	26.5	71	42	28	65	Clayey SILT	MH

ASTM D 4318 Test Method

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-17	S-5	14.0	61	43	19	61	SILT with fine sand trace fine organics	MH
⊠	B-17	S-8	23.0	84	39	45	66	Clayey SILT	MH
▲	B-18	S-1	2.5	62	43	19	64	Clayey SILT	MH
★	B-18	S-7	15.0	86	51	36	76	Clayey SILT	MH
⊙	B-18	S-10	22.5	91	49	42	82	Clayey SILT	MH
✿	B-19	S4	7.5	87	49	37	88	Clayey SILT	MH
○	TH-27-08	S-3	14.1	60	39	21	61	High plasticity SILT with organics	MH
△	TH-27-08	S-3	14.6	57	38	19	65	High plasticity SILT	MH
⊗	TH-27-08	S-3	15.1	61	42	19	62	High plasticity, SILT with organics	MH
⊕	TH-28-SW-08	S-2	13.0	57	36	21	84	High plasticity SILT	MH

ASTM D 4318 Test Method

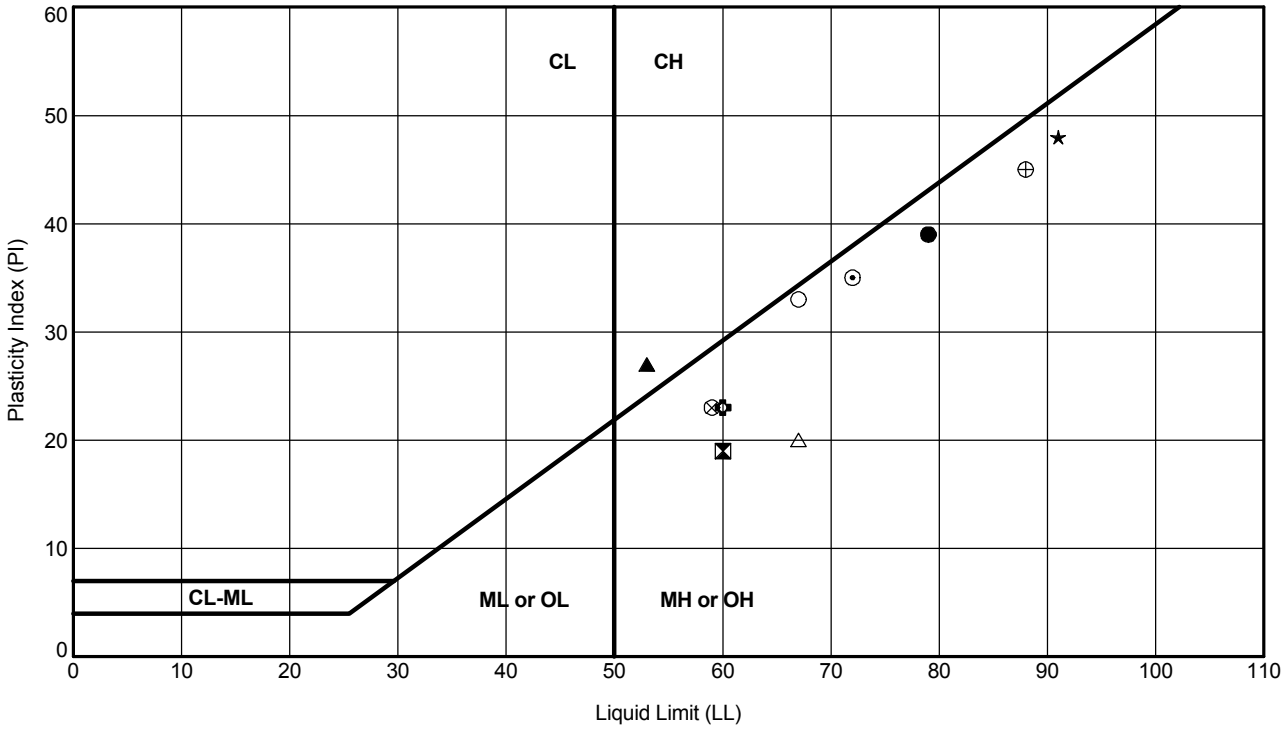
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 1

Figure
B-30



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TH-29-SW-08	S-1	15.9	79	40	39	84	High plasticity, SILT with organics	MH
⊠	TH-30-SW-08	S-1	14.7	60	41	19	63	High plasticity SILT	MH
▲	TH-31-SW-08	S-3	15.7	53	26	27	72	High plasticity CLAY	CH
★	TH-32-08	S-4	13.2	91	43	48	86	High plasticity SILT	MH
⊙	TH-32-08	S-8	24.0	72	37	35	69	High plasticity SILT	MH
✿	TH-34-08	S-5	11.5	60	37	23	58	High plasticity SILT	MH
○	TH-36-08	S-4	12.0	67	34	33	58	High plasticity SILT	MH
△	TH-36-08	S-7	20.4	67	47	20	65	High plasticity, SILT with organics	MH
⊗	TH-37-08	S-6	12.0	59	36	23	71	High plasticity SILT	MH
⊕	TH-39-08	S-5	11.5	88	43	45	57	High plasticity SILT	MH

ASTM D 4318 Test Method

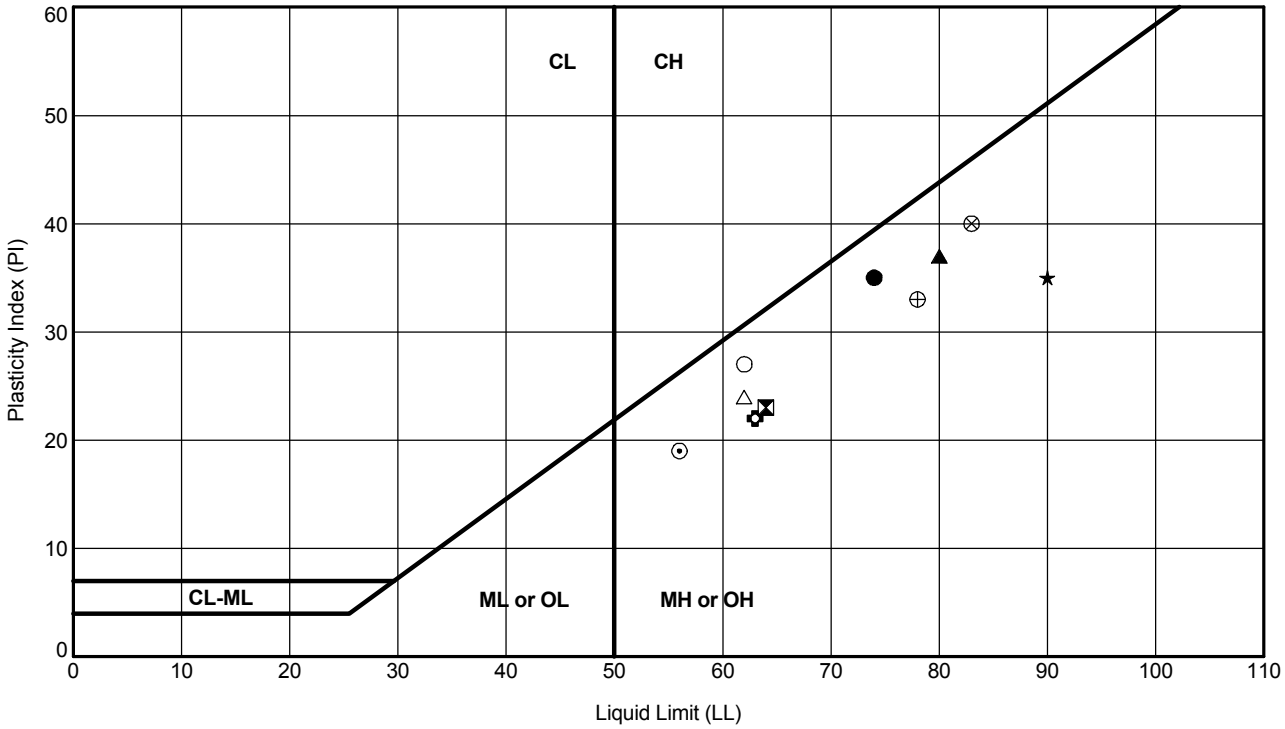
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 1

Figure
B-31



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TH-40-08	S-5	11.5	74	39	35	70	High plasticity SILT	MH
⊠	TH-42P-08	S-7	16.5	64	41	23	68	High plasticity SILT	MH
▲	TH-44P-08	S-4	9.0	80	43	37	83	High plasticity SILT	MH
★	TH-46P-08	S-1A	0.5	90	55	35	45	High plasticity SILT	MH
⊙	TH-48-08	S-7	14.9	56	37	19	56	High plasticity, SILT with organics	MH
✿	TH-49P-08	S-5	11.5	63	41	22	71	High plasticity SILT	MH
○	TH-50-08	S-5	10.5	62	35	27	67	High plasticity SILT	MH
△	TH-51-08	S-1	0.5	62	38	24	57	High plasticity SILT	MH
⊗	TH-53-08	S-4	9.0	83	43	40	73	High plasticity SILT	MH
⊕	TH-54-08	S-2	4.0	78	45	33	85	High plasticity SILT	MH

ASTM D 4318 Test Method

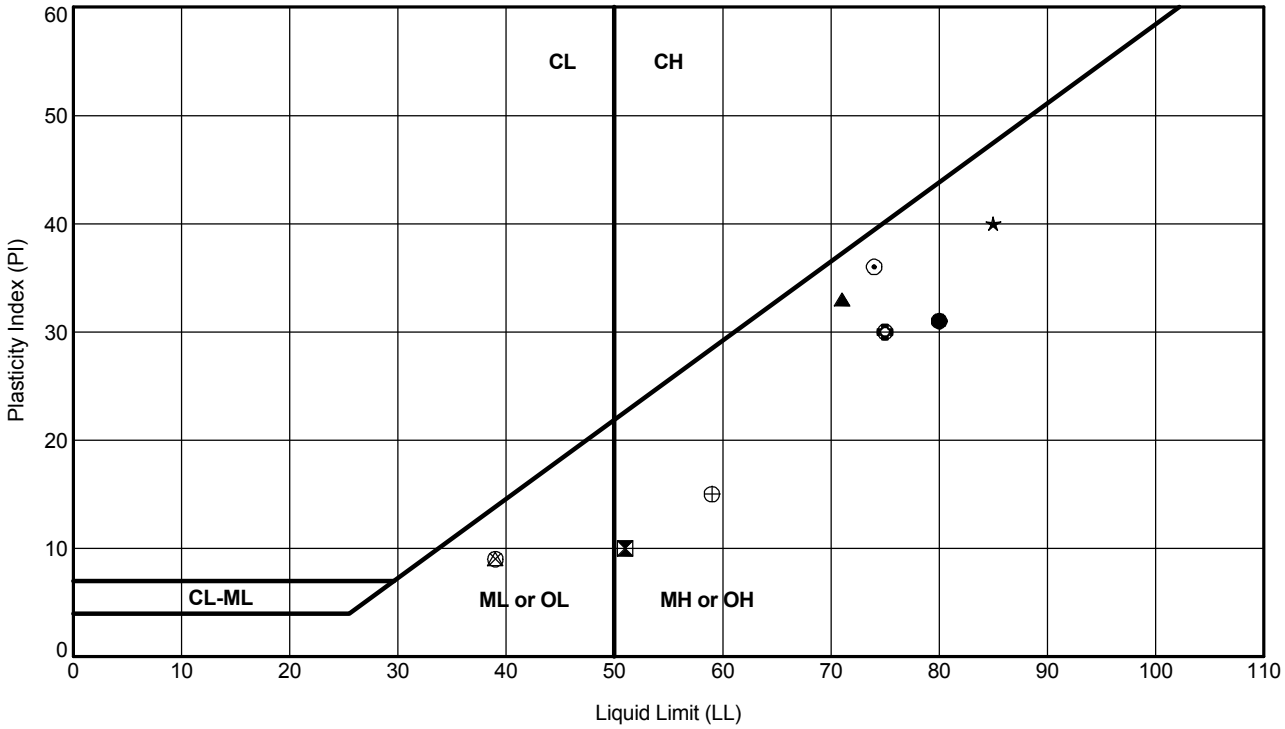
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 1

Figure
B-32



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TH-55-08	S-5	11.5	80	49	31	67	High plasticity SILT	MH
⊠	TH-56-08	S-7	16.5	51	41	10	54	High plasticity SILT	MH
▲	TH-58-08	S-7	16.5	71	38	33	64	High plasticity SILT	MH
★	TH-59-08	S-2	4.0	85	45	40	54	High plasticity SILT	MH
⊙	TH-60-08	S-6	14.0	74	38	36	82	High plasticity SILT	MH
✿	TH-61-08	S-1B	1.0	75	45	30	66	High plasticity SILT	MH
○	TH-61-08	S-1B	1.0	75	45	30	66	High plasticity SILT	MH
△	TH-62-08	S-1B	1.0	39	30	9	40	Low plasticity SILT	ML
⊗	TH-62-08	S-1B	1.0	39	30	9	40	Low plasticity SILT	ML
⊕	TH-62-08	S-4	9.0	59	44	15	60	High plasticity SILT	MH

ASTM D 4318 Test Method

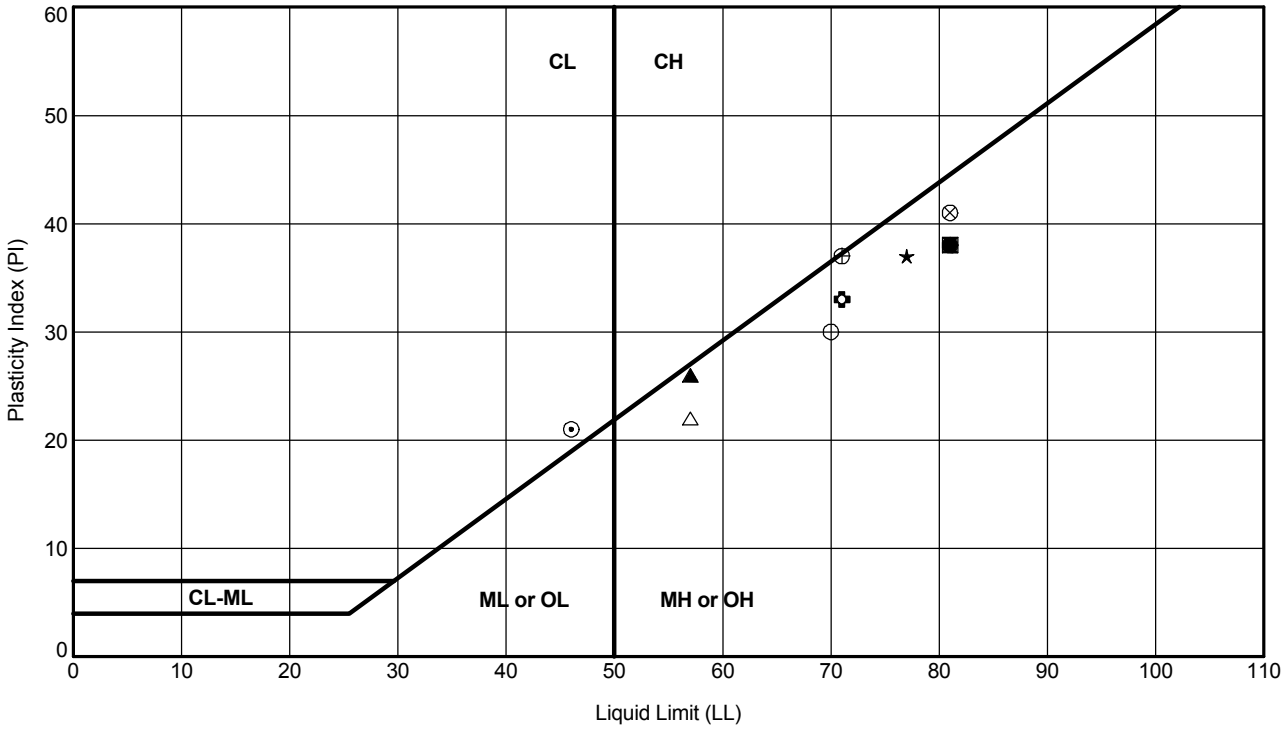
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 1

Figure
B-33



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TH-63-08	S-5	11.5	81	43	38	80	High plasticity SILT	MH
⊠	TH-63-08	S-5	11.5	81	43	38	80	High plasticity SILT	MH
▲	TH-67P-08	S-2	17.3	57	31	26	64	High plasticity, SILT with organics	MH
★	TH-67P-08	S-2	17.8	77	40	37	65	High plasticity, SILT with organics	MH
⊙	TH-67P-08	S-5A	29.0	46	25	21	56	Low plasticity CLAY	CL
✿	TP-16-08	S-3	12.0	71	38	33	66	High plasticity SILT	MH
○	TP-17-08	S-3	17.0	70	40	30	64	High plasticity SILT	MH
△	TP-19-08	S-3	10.0	57	35	22	58	High plasticity SILT	MH
⊗	TP-20-08	S-1	7.0	81	40	41	72	High plasticity SILT	MH
⊕	TP-22-08	S-1	1.0	71	34	37	64	High plasticity SILT	MH

ASTM D 4318 Test Method

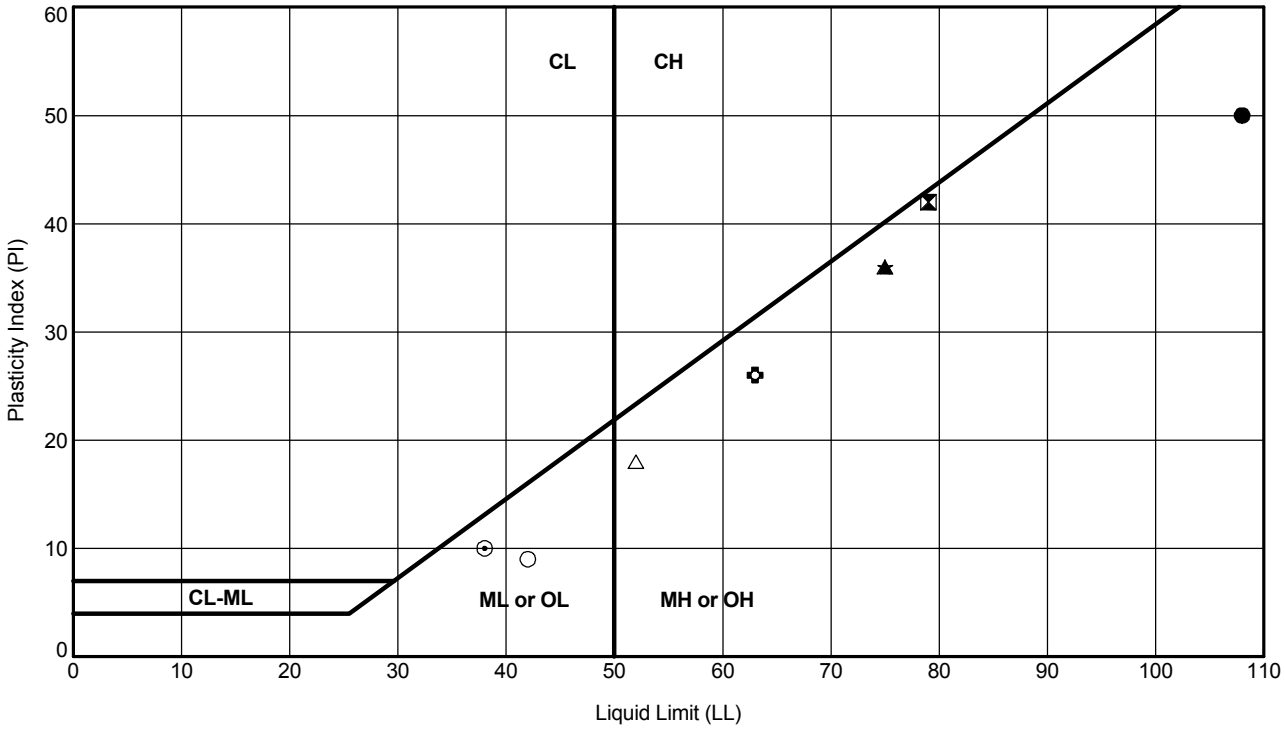
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 1

Figure
B-34



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TP-23-08	S-1	2.0	108	58	50	84	High plasticity SILT	MH
⊠	TP-23-08	S-3	8.0	79	37	42	74	High plasticity SILT	MH
▲	TP-25-08	S-2	3.0	75	39	36	58	High plasticity SILT	MH
★	TP-25-08	S-2	3.0	75	39	36	58	High plasticity SILT	MH
⊙	TP-26-08	S-1	2.0	38	28	10	43	Low plasticity SILT	ML
✿	TP-26-08	S-3	14.0	63	37	26	57	High plasticity SILT	MH
○	TP-27-08	S-1	1.5	42	33	9	42	Low plasticity SILT	ML
△	TP-27-08	S-4	12.0	52	34	18	55	High plasticity SILT	MH

ASTM D 4318 Test Method

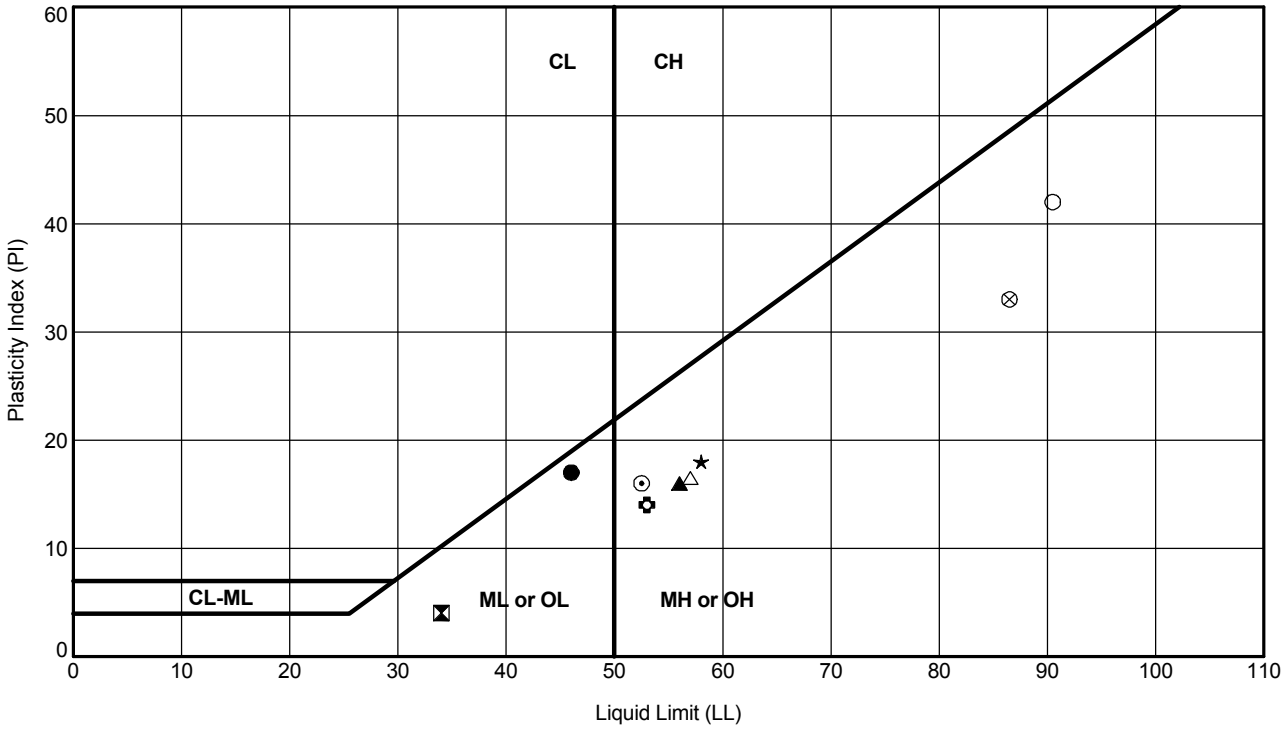
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 1

Figure
B-35



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 1	S-28	54.0	46	29	17	54	SILT with sand and silty, SAND interbeds	ML
⊠	B- 2	S-25	44.0	34	30	4	46	Sandy, SILT	ML
▲	B- 2	S-30	69.0	56	40	16	62	Clayey, SILT with sand and organics	MH
★	B-17	S-12	31.5	58	40	18	56	SILT with fine sand trace fine organcs	MH
⊙	B-17	S-17	54.0	53	37	16	59	SILT with fine sand trace fine shells and organics	MH
✿	B-17	S-23	79.0	53	39	14	45	SILT with trace fine sand and organics	MH
○	B-18	S-10	22.5	91	49	42	82	Clayey SILT	MH
△	B-18	S-12	32.8	57	41	17	54	Clayey SILT	MH
⊗	B-19	S7	15.0	87	54	32	78	Clayey SILT	MH

ASTM D 4318 Test Method

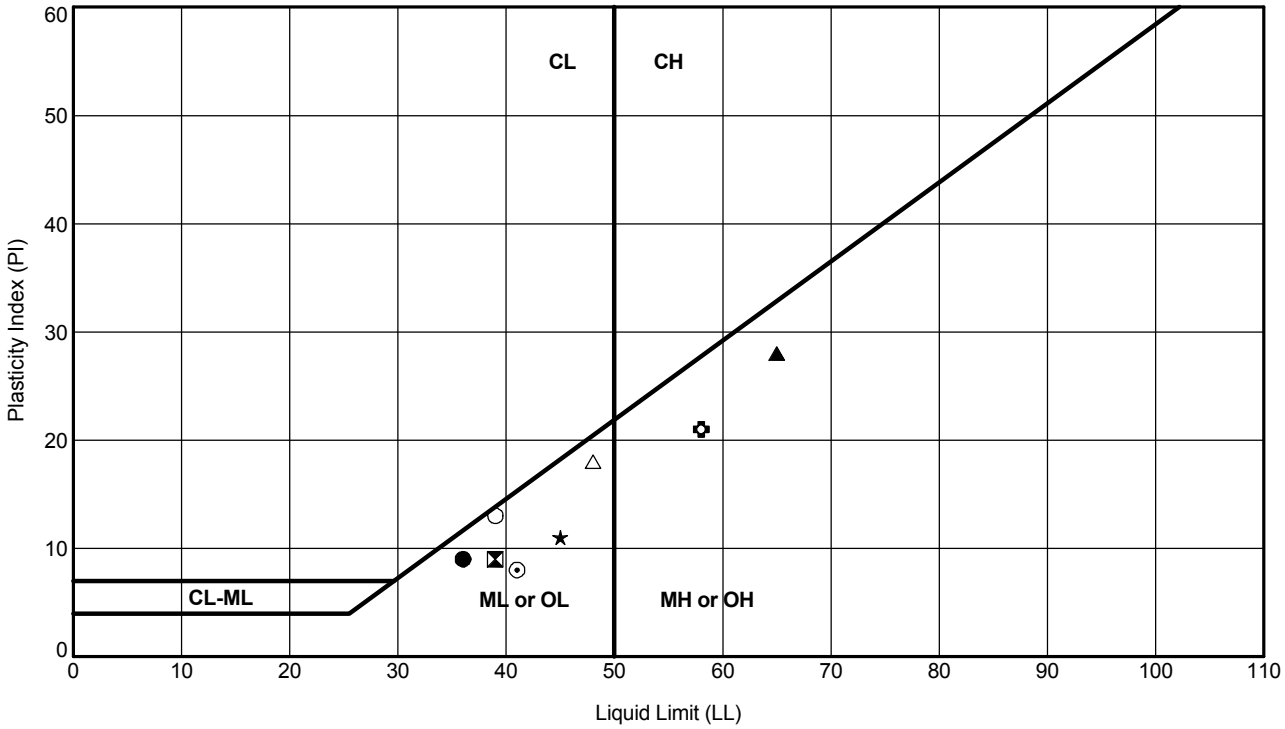
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 2A

Figure
B-36



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 4	S-28	54.0	36	27	9	54	SILT with interbeds of silty, fine SAND	ML
⧓	B- 5	S-27	54.0	39	30	9	50	SILT with thin interbeds of silty, sand	ML
▲	B- 6	S-18	35.5	65	37	28	69	Clayey, SILT with sand, shells, and organics	MH
★	B- 7	S-16	25.5	45	34	11	53	SILT with fine sand and interbeds of silty, fine SAND	ML
⊙	B- 7	S-25	49.0	41	33	8	47	SILT with fine sand and trace organics	ML
✿	B-10	S-23	79.0	58	37	21	54	SILT with trace organics	MH
○	B-15	S-11	29.0	39	26	13	53	SILT with fine organics	ML
△	TH-67P-08	S-8	44.0	48	30	18	52	Low plasticity SILT	ML

ASTM D 4318 Test Method

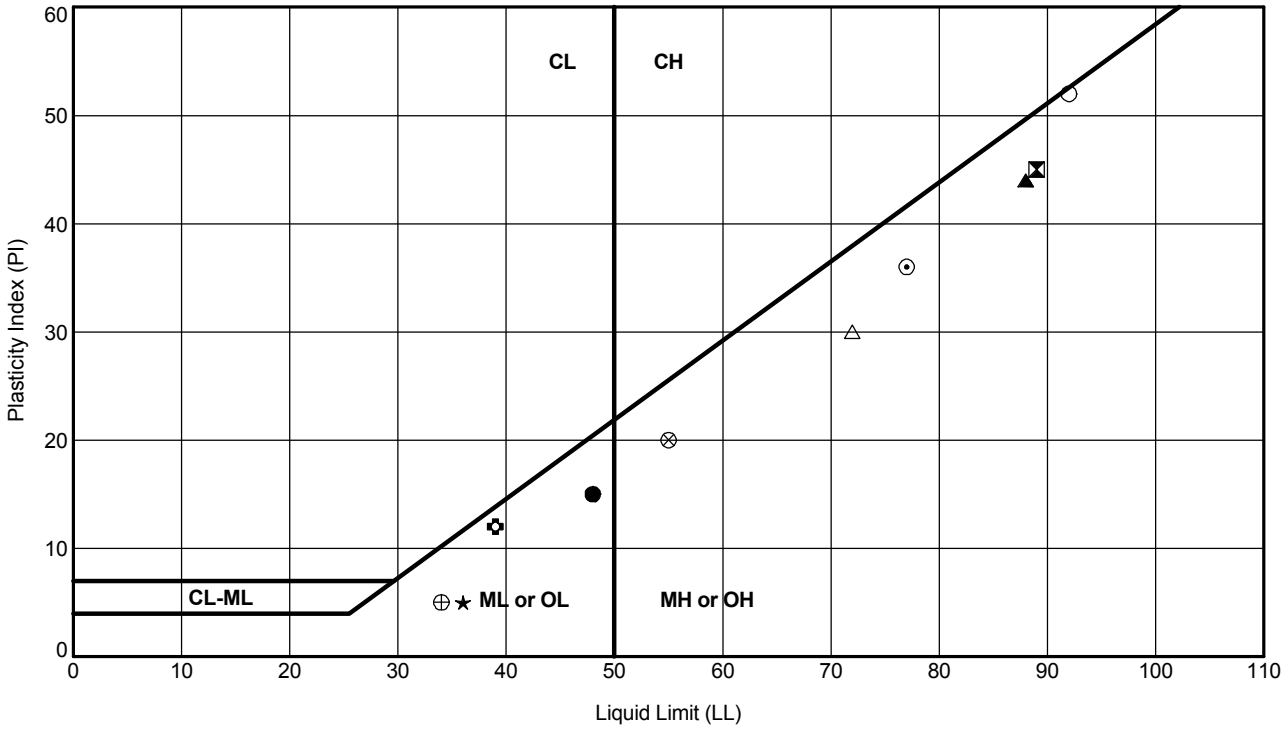
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 2B

Figure
B-37



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 1	S-33	79.0	48	33	15	51	SILT with sand and silty, SAND interbeds	ML
⧓	B- 1	S-38A	101.2	89	44	45	76	Clayey, SILT with abundant organics	MH
▲	B- 1	S-38B	101.8	88	44	44	75	Clayey, SILT with abundant organics	MH
★	B- 2	S-33	84.0	36	31	5	47	SILT with interbeds of sandy, SILT	ML
⊙	B- 2	S-42	124.0	77	41	36	57	Clayey, SILT with abundant organics	MH
✿	B- 3	S-32	84.0	39	27	12	53	SILT with interbeds of silty, fine SAND	ML
○	B- 3	S-35	99.0	92	40	52	74	Clayey, SILT with scattered organics	MH
△	B- 3	S-37	109.0	72	42	30	69	Clayey, SILT with abundant organics	MH
⊗	B- 3	S-41	129.0	55	35	20	52	Clayey, SILT with abundant organics	MH
⊕	B- 3	S-43	139.0	34	29	5	40	SILT with fine sand	ML

ASTM D 4318 Test Method

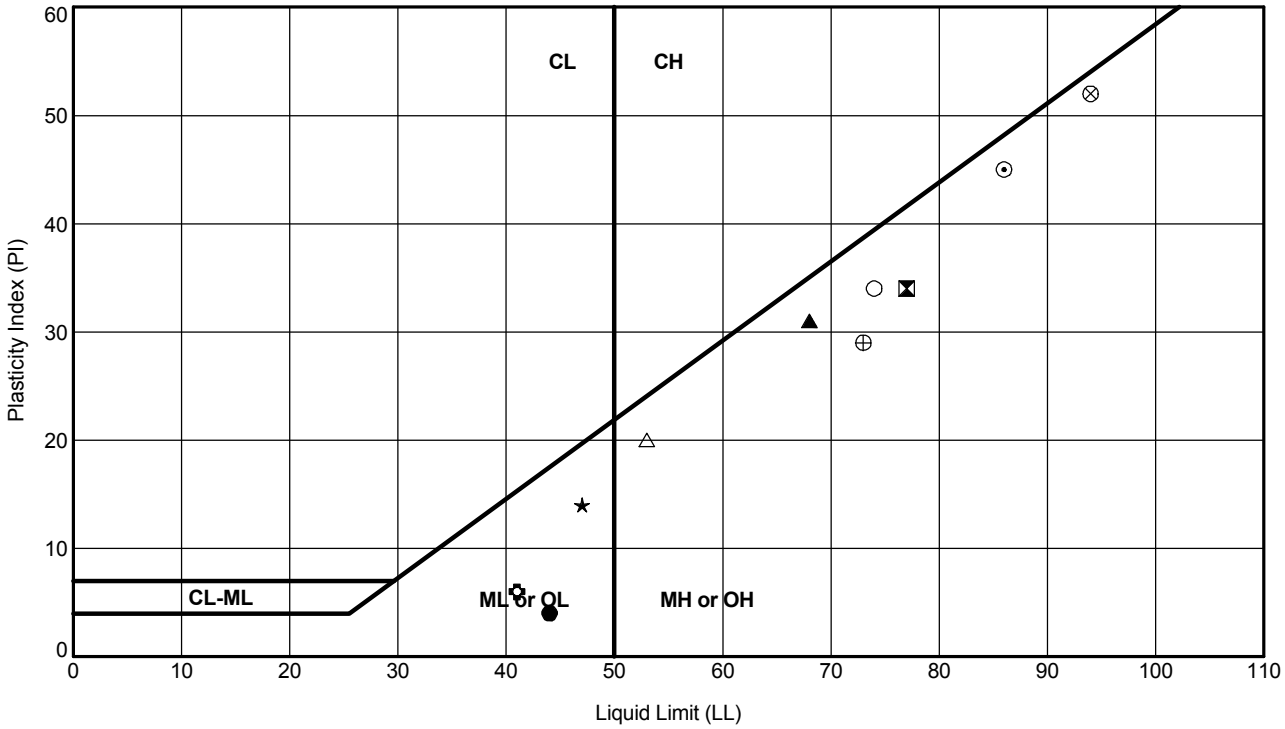
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 3

Figure
B-38



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 4	S-36	95.1	44	40	4	43	Sandy, SILT	ML
⊠	B- 4	S-38	99.0	77	43	34	96	Clayey, SILT with abundant organics	MH
▲	B- 4	S-41	114.0	68	37	31	59	Clayey, SILT with abundant organics	MH
★	B- 4	S-44	129.0	47	33	14	50	SILT with interbeds of sandy, SILT	ML
⊙	B- 5	S-37	109.0	86	41	45	70	Clayey, SILT with interbeds of sand and organics	MH
✿	B- 6	S-29	89.0	41	35	6	50	SILT with organics	ML
○	B- 6	S-34	109.0	74	40	34	59	Clayey, SILT with fine sand and organics	MH
△	B- 7	S-34	109.0	53	33	20	49	Clayey, SILT with abundant organics	MH
⊗	B- 8	S-26	96.6	94	42	52	74	Clayey SILT	MH
⊕	B- 8	S-29	109.0	73	44	29	57	Clayey SILT	MH

ASTM D 4318 Test Method

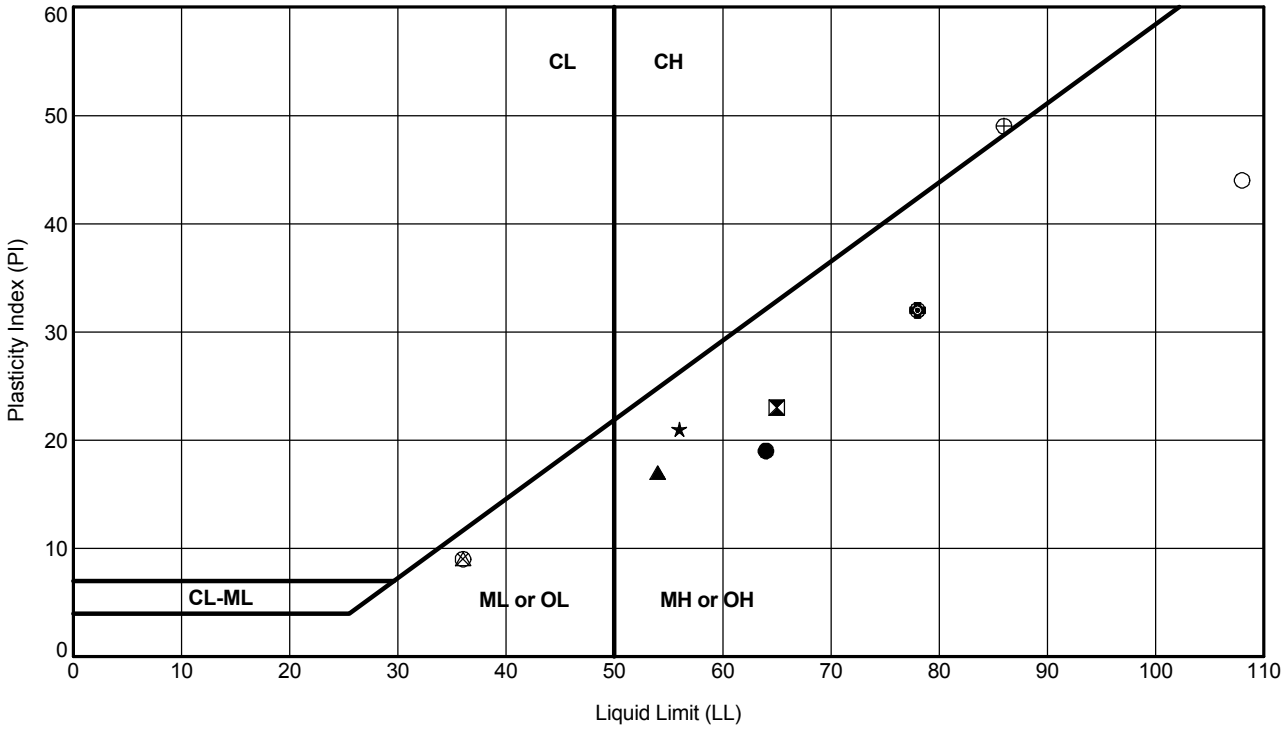
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 3

Figure
B-39

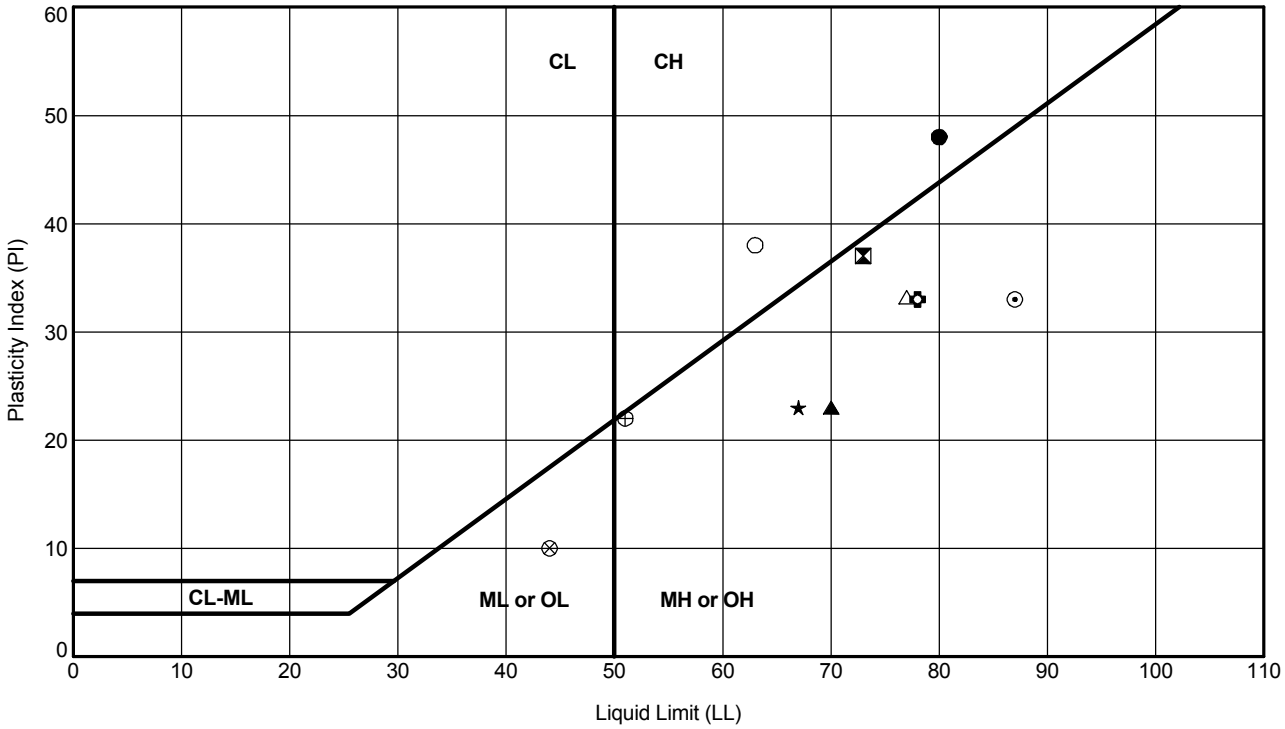


ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 8	S-33	129.0	64	45	19	62	Clayey SILT	MH
⊠	B- 9	S-27	100.3	65	42	23	59	Clayey SILT	MH
▲	B- 9	S-28	101.5	54	37	17	51	Clayey SILT	MH
★	B-10	S-28	106.1	56	35	21	53	Clayey SILT	MH
⊙	B-11	S-24	99.0	78	46	32	61	Clayey SILT	MH
✿	B-11	S-24	99.0	78	46	32	61	Clayey SILT	MH
○	B-11	S-29	124.0	108	64	44	86	Clayey SILT	MH
△	B-11	S-32	139.0	36	27	9	32	SILT with fine sand	ML
⊗	B-11	S-32	139.0	36	27	9	32	SILT with fine sand	ML
⊕	B-12	S-27	100.6	86	37	49	72	Silty CLAY with fine organics	CH

ASTM D 4318 Test Method

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B-12	S-28	101.5	80	32	48	64	Silty CLAY with fine organics	CH
⊠	B-13	S-25	100.5	73	36	37	71	Clayey SILT	MH
▲	B-13	S-27	109.0	70	47	23	58	Clayey SILT	MH
★	B-17	S-32	119.0	67	44	23	57	Clayey SILT with trace fine sand and organics	MH
⊙	B-17	S-36	139.0	87	54	33	45	Clayey SILT with trace fine organics	MH
✿	B-18	S-22	80.0	78	45	33	70	Clayey SILT	MH
○	B-18	S-23	84.1	63	25	38	59	Silty Clay	CH
△	B-19	S24	85.7	77	44	33	67	Clayey SILT	MH
⊗	B-19	S29	104.2	44	34	10	47	SILT	ML
⊕	TH-29-SW-08	S-6A	86.0	51	29	22	67	High plasticity SILT	MH

ASTM D 4318 Test Method

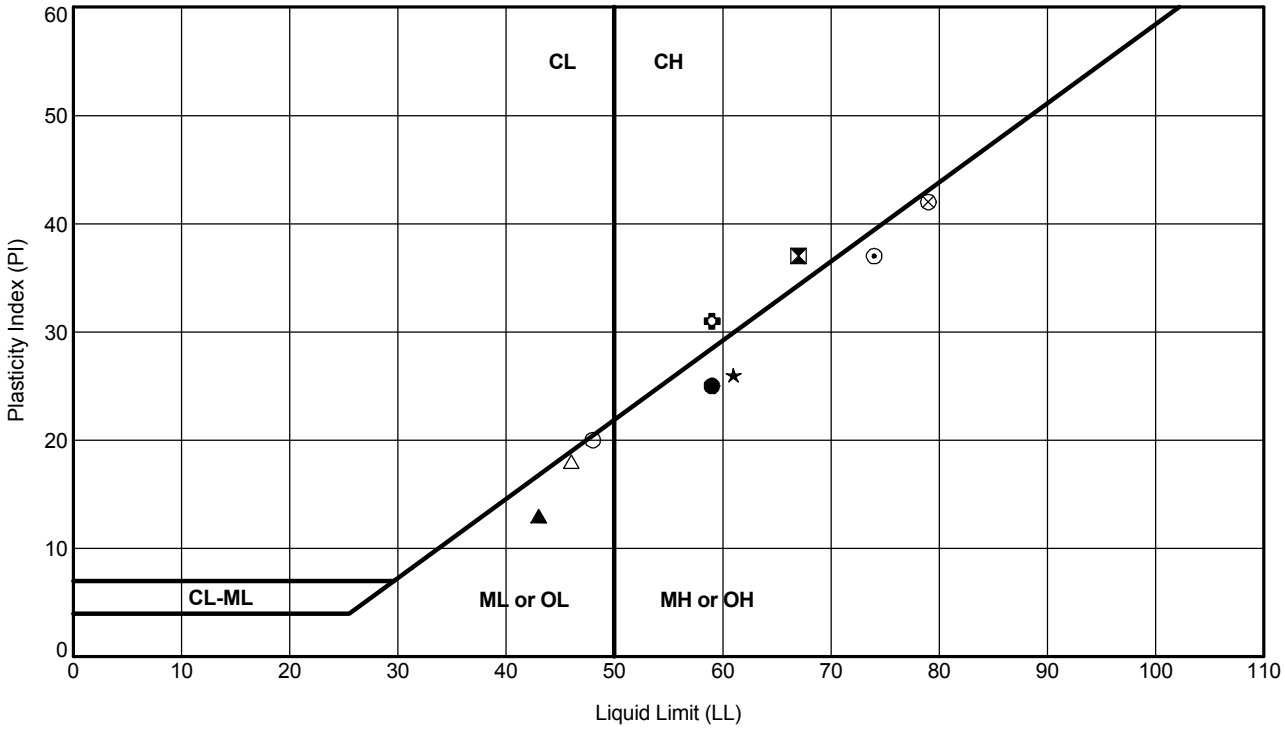
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 3

Figure
B-41



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	TH-29-SW-08	S-10	105.1	59	34	25	54	High plasticity, SILT with organics	MH
⊠	TH-29-SW-08	S-10	105.3	67	30	37	61	High plasticity, CLAY with organics	CH
▲	TH-30-SW-08	S-5	85.8	43	30	13	51	Low plasticity SILT	ML
★	TH-30-SW-08	S-10	105.0	61	35	26	59	High plasticity SILT	MH
⊙	TH-30-SW-08	S-15	124.5	74	37	37	71	High plasticity SILT	MH
✿	TH-31-SW-08	S-9	85.0	59	28	31	53	High plasticity CLAY	CH
○	TH-31-SW-08	S-17	119.0	48	28	20	48	Low plasticity SILT	ML
△	TH-32-08	S-20	84.0	46	28	18	49	Low plasticity SILT	ML
⊗	TH-33-08	S-31	105.3	79	37	42	78	High plasticity SILT	MH

ASTM D 4318 Test Method

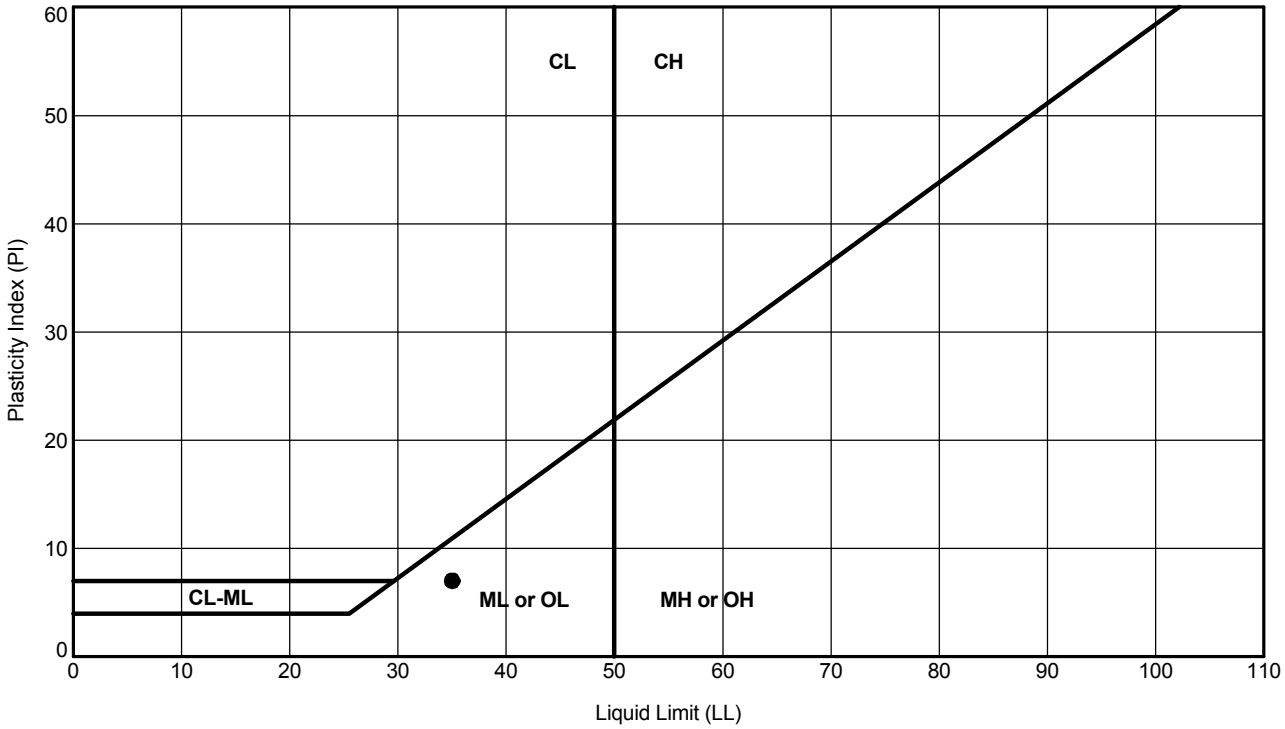
122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 3

Figure
B-42



ATTERBERG LIMIT TEST RESULTS

Symbol	Exploration Number	Sample Number	Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Natural Moisture (%)	Soil Description	Unified Soil Classification
●	B- 4	S-47	144.0	35	28	7	46	SILT with fine sand	ML

ASTM D 4318 Test Method

122025.02 1/2/09 \\EDMDATA\GINT\GINT7\PROJECTS\122025.020.GPJ ATTBG LIMITS FIG - MULT LINE

LANDAU ASSOCIATES

SR 520 Pontoon Construction Project
Port of Grays Harbor, Washington

Plasticity Chart
Soil Unit 4

Figure
B-43

Soil Technology, Inc. Report

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-27-08
Sample No. S-3
Depth of Sample 13.9-16.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.10 (feet)

Date 9/9/08
Sample Pushed by AJA
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample 2.85 (inches)
Sample Quality XGood __Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							13.5	Top of recovery
	61	WC	.15	.1			14.0	Crack Medium- sand lense
ATT	61	CU 3					14.5	LL=60, PL=39, PI=21 Soft, wet, grey, organic Silt (OH)
ATT	65	CU 2					15.0	LL=57, PL=38, PI=19
ATT	62	CON						LL=61, PL=42, PI=19
		CU 1					15.5	
	65	WC	.1	.75			16.0	Disturbed
								Bottom of recovery

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-27-08
Sample No. S-23
Depth of Sample 98.9-101.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.1 (feet)

Date 9/12/08
Sample Pushed by AJA
Sample Logged by RGS
Type of Sample _X_ shelby ___ other
Diameter of Sample __2.85 (inches)
Sample Quality __Good _X_ Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							98.5	Top of recovery
							99.0	Sand
	47	WC	.35	2.0	Stiff		99.5	
ATT	72 69	WC CON	.30	2.0				LL=72, PL=34, PI=38
							100.0	Medium- stiff, moist, grey, organic Silts (OH)
	62	WC	.20	1.5	M-stiff		100.5	
	47	WC			M-Dense		1.01.0	Silty- sand
								Bottom of recovery

Soil Technology
J-08-2275

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-29-SW-08
Sample No. S-1
Depth of Sample 14.9-17.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.1 (feet)

Date 9/4/08
Sample Pushed by AJA
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample 2.85 (inches)
Sample Quality __Good X Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							14.5	½" Free H_2O
								Top of recovery
							15.0	Disturbed, very soft
	81	WC	.25	.5			15.5	Soft, wet, dark- grey, organic Silt (OH)
ATT	84	CON	.25	.5	Soft		16.0	LL=80, PL=40, PI=39
	70	WC	.25	.5			16.5	
							17.0	
								Bottom of recovery

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-29-SW-08
Sample No. S-3
Depth of Sample 18.8-21.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.2 (feet)

Date 9/15/08
Sample Pushed by RGS
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample 2.85 (inches)
Sample Quality X Good __Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							18.5	Top of recovery
	65	WC	.25	.75	Soft-M- stiff		19.0	Crack
							19.5	Washout void
ATT	74	UU						LL=79, PL=37, PI=42
							20.0	Soft, wet, grey, organic Silt (OH)
			.20	.5				Washout void
							20.5	
	70.	WC						
							21.0	
								Bottom of recovery

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-29-SW-08
Sample No. S-10
Depth of Sample 103.9-106.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.2 (feet)

Date 9/10/08
Sample Pushed by RGS
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample __2.85 (inches)
Sample Quality X Good __Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							103.5	Top of recovery
							104.0	Disturbed
	63	WC	.4	1.5			104.5	
		UU 1						Medium- stiff, moist, grey, organic Silt (OH)
							105.0	
ATT	54	CON	.35					LL=59, PL=34, PI=25
							105.5	
ATT	61	UU 2	.50	1.0				LL=67, PL=30, PI,=37
								Black organics
							106.0	

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-30-SW-08
Sample No. S-1
Depth of Sample 14.0-16.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.2 (feet)

Date 8/19/08
Sample Pushed by AJA
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample 2.85 (inches)
Sample Quality X Good ___Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							13.5	Top of recovery
	61	WC	.25	1.0			14.0	
	58	WC	.20	1.0			14.5	
ATT	63	CON	.25	1.0				LL=60, PL=41, PI=19
							15.0	Medium- stiff, wet, black, Silt (MH)
	54	WC	.25	1.0			15.5	
	50	WC	.20	1.0			16.0	
								Bottom of recovery

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-30-SW-08
Sample No. S-5
Depth of Sample 84.0-86.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.2 (feet)

Date 8/25/08
Sample Pushed by AJA
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample __2.85 (inches)
Sample Quality X Good ___Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							83.5	Top of recovery
							84.0	Hairline cracks
	47	WC	.20	2.5				
	54	WC	.20	2.0			84.5	
								Medium- stiff, moist, grey, Silt (ML)
	47	WC	.10	1.75			85.0	
ATT	51	CON	.15	1.25			85.5	LL=43, PL=30, PI=13
							86.0	
								Bottom of recovery

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-30-SW-08
Sample No. S-10
Depth of Sample 104.0-106.0
Sampled Length (from log) 103.9-106.0 (feet)
Sample Recovery 2.1 (feet)

Date 9/3/08
Sample Pushed by AJA & CJE
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample 2.85 (inches)
Sample Quality __Good X Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
								Top of recovery
							104.0	
	73	WC	.30	1.25	M-stiff	Grey		
	68	WC	.35	1.25	M-stiff		104.5	
								Medium- stiff, moist, grey, Silt (MH)
							105.0	
ATT	59	CON	.35	2.0	Stiff	Grey		LL=61, PL=35, PI=26
							105.5	
	61	WC	.45	1.75	Stiff	Dark Grey		
							106.0	
								Bottom of recovery
							106.5	

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-30-SW-08
Sample No. S-15
Depth of Sample 123.9-126.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.1 (feet)

Date 9/2/08
Sample Pushed by AJA
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample __2.85 (inches)
Sample Quality X Good __Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							123.5	Top of recovery
							124.0	
	69	WC	.15	1.5				
							124.5	
ATT	71	CON	.35	1.5	M-stiff			LL=74, PL=37, PI=37
							125.0	Medium- stiff, wet, grey, Silt (MH)
	74	WC	.40	1.75				
							125.5	
	72	WC	.30	1.5				
							126.0	
								Bottom of recovery

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-31-PMT-SW-08
Sample No. S-3
Depth of Sample 13.9-16.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.1 (feet)

Date 8/28/08
Sample Pushed by AJA
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample __2.85 (inches)
Sample Quality X good __Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							13.5	Top of recovery
							14.0	
	64	WC	.25	.75	Soft	Grey		
	64	CU 3					14.5	
								Soft, moist, grey, Clay (CH)
	64	CU 2					15.0	
	87	CU 1					15.5	
ATT	72	CON						LL=53, PL=26, PI=27
	75	WC	.125	.5	Soft	Grey	16.0	
								Bottom of recovery

Soil Technology
J-08-2275

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-31-PMT-SW-08
Sample No. S-9
Depth of Sample 84.0-86.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.1 (feet)

Date 8/11/08
Sample Pushed by RGS & AJA
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample __2.85 (inches)
Sample Quality X Good ___Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							83.5	
							84.0	Top of recovery
	50	WC	.3	1.75				
							84.5	
			.15	.5				
								Medium- stiff to stiff, wet, grey, Clay (CH)
			.4	1.5			85.0	
ATT	53	CON						LL=59, PL=28, PI=31
	60	WC	.275	1.0				
							85.5	
	58	WC	.3	1.0				
							86.0	
								Bottom of recovery

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-32-08
Sample No. S-4
Depth of Sample 11.8-14.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.2 (feet)

Date 9/23/08
Sample Pushed by RGS
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample __2.85 (inches)
Sample Quality X Good __Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							11.5	Top of recovery
	81	WC	.10	.25			12.0	
							12.5	Cracked
	71	WC	.15	.5			13.0	Very soft to soft, wet, grey, Silt (MH)
ATT	86	CON						LL=91, PL=43, PI=48
					V-soft		13.5	
		UU						
ATT	100	WC					14.0	
								Bottom of recovery

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-33-08
Sample No. S-7
Depth of Sample 13.9-16.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.1 (feet)

Date 9/22/08
Sample Pushed by RGS
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample 2.85 (inches)
Sample Quality X Good __Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							13.5	1" Free H_{20}
								Top of recovery
							14.0	
					V.soft			
							14.5	
	79	WC	.0	.25				Very soft to soft, wet, grey, organic Silt (OH)
							15.0	
							15.5	
ATT	78	UU	.1	.5	Soft			LL=65, PL=30, PI=35
							16.0	
								Bottom of recovery

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-33-08
Sample No. S-31
Depth of Sample 104.6-106.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 1.4 (feet)

Date 916/08
Sample Pushed by RGS
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample __2.85 (inches)
Sample Quality X Good __Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							104.0	
							104.5	Top of recovery
								Disturbed
							105.0	
	70	WC	.40	1.5	M-stiff-Stiff			Medium-stiff to stiff, wet, Silt (OH) With saturated organics
			.30					
ATT	64	CON						LL=79, PL=37, PI=42
							105.5	
			.35	1.25				
	59	WC						
							106.0	
								Bottom of recovery
							106.5	

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-36A-08
Sample No. S-3
Depth of Sample 19.2-21.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 1.8 (feet)

Date 9/22/08
Sample Pushed by RGS
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample __2.85 (inches)
Sample Quality XGood __Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							18.5	
							19.0	Top of recovery
							19.5	
	65	WC	.15	.5	Soft			
							20.0	Medium- stiff to soft, wet, grey, organic Silt (OH)
	61	WC	.25	1.0	M-stiff			
								20.4 Void
							20.5	
ATT	65	UU						LL=67, PL=36, PI=20
							21.0	
								Bottom of recovery

Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-48-08
Sample No. S-7
Depth of Sample 13.9-16.0
Sampled Length (from log) 2.0 (feet)
Sample Recovery 2.1 (feet)

Date 9/22/08
Sample Pushed by RGS
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample 2.85 (inches)
Sample Quality X Good __Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							13.5	Top of recovery
					V-soft		14.0	
							14.5	Medium- stiff, wet, grey, organic Silt (OH)
							15.0	
ATT	56	UU						LL=56, PL=37, PI=19
							15.5	
	184	WC	.20	1.0				
							16.0	
								Bottom of recovery

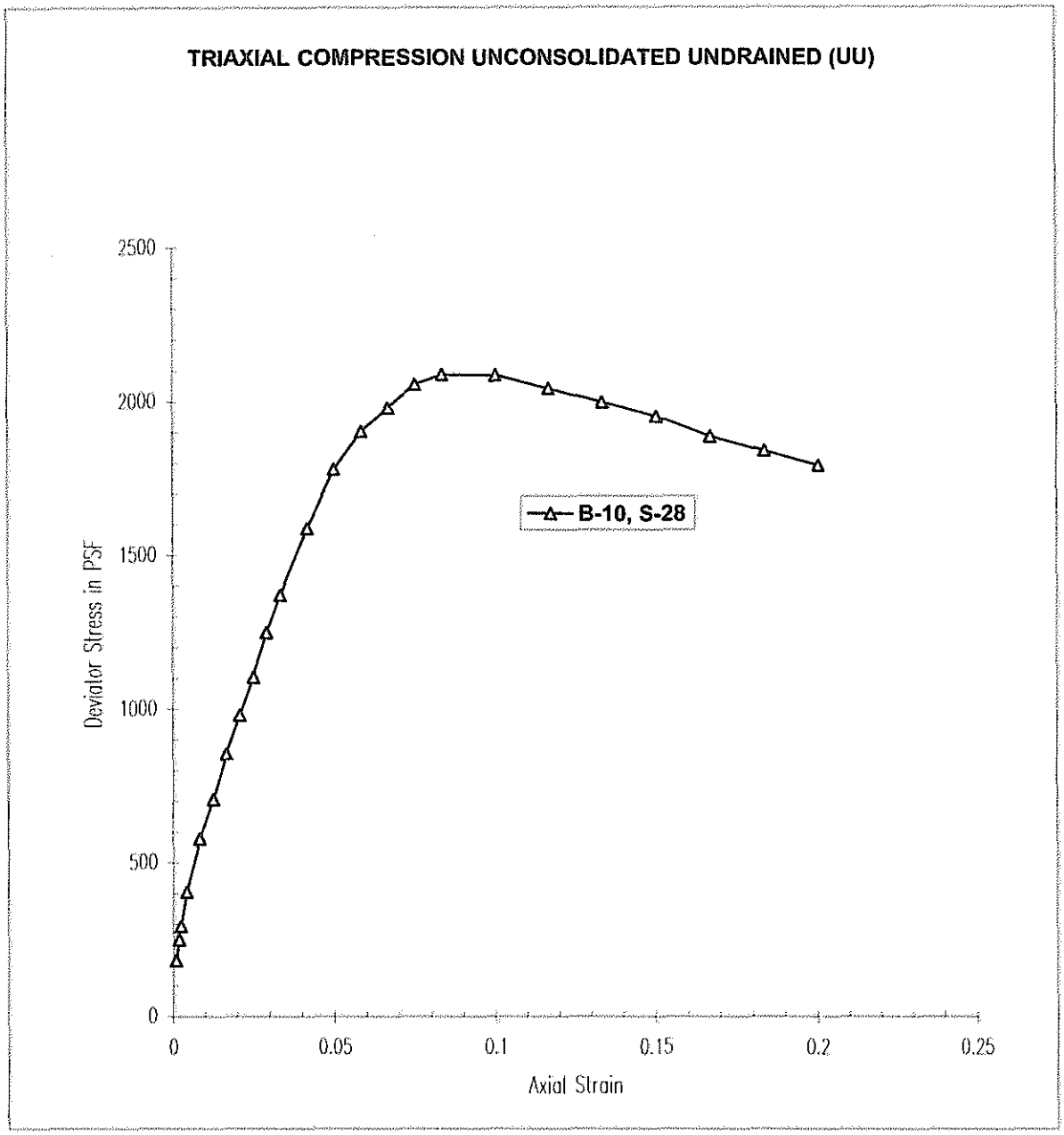
Shelby Tube Visual Classification

Job WSDOT Grays Harbor
Job No. 08-2275
Exploration No TH-67P-08
Sample No. S-2
Depth of Sample 16.0-18.0
Sampled Length (from log) 1.8 (feet)
Sample Recovery 2.2 (feet)

Date 9/14/08
Sample Pushed by AJA
Sample Logged by RGS
Type of Sample X shelby ___ other
Diameter of Sample 2.2 (inches)
Sample Quality X Good ___Fair __Poor __ Disturbed

Specimen saved	Water content %	Test type	Strength Index TV TSF	Strength Index PP TSF	Consistency	Color	Depth (ft)	Classification and Description
							15.5	Top of recovery
	58	WC	.20	.50			16.0	
	74	CU 3			Soft	Dark-Grey	16.5	Soft, wet, grey, organic Silts (OH)
	70	CU 2					17.0	
ATT	64	CU 1					17.5	LL=57, PL-31, PI=26
ATT	65	CON					18.0	LL=77, PL=40, PI=37
								Bottom of recovery

WSDOT Special Projects Facility
Landau Associates
Project No. 244039.020



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	B-10	S-28	04.8-105.:	59				98	62	73

Soil Technology
J-06-2154

WSDOT Special Projects Facility
Landau Associates Project No. 244039.020

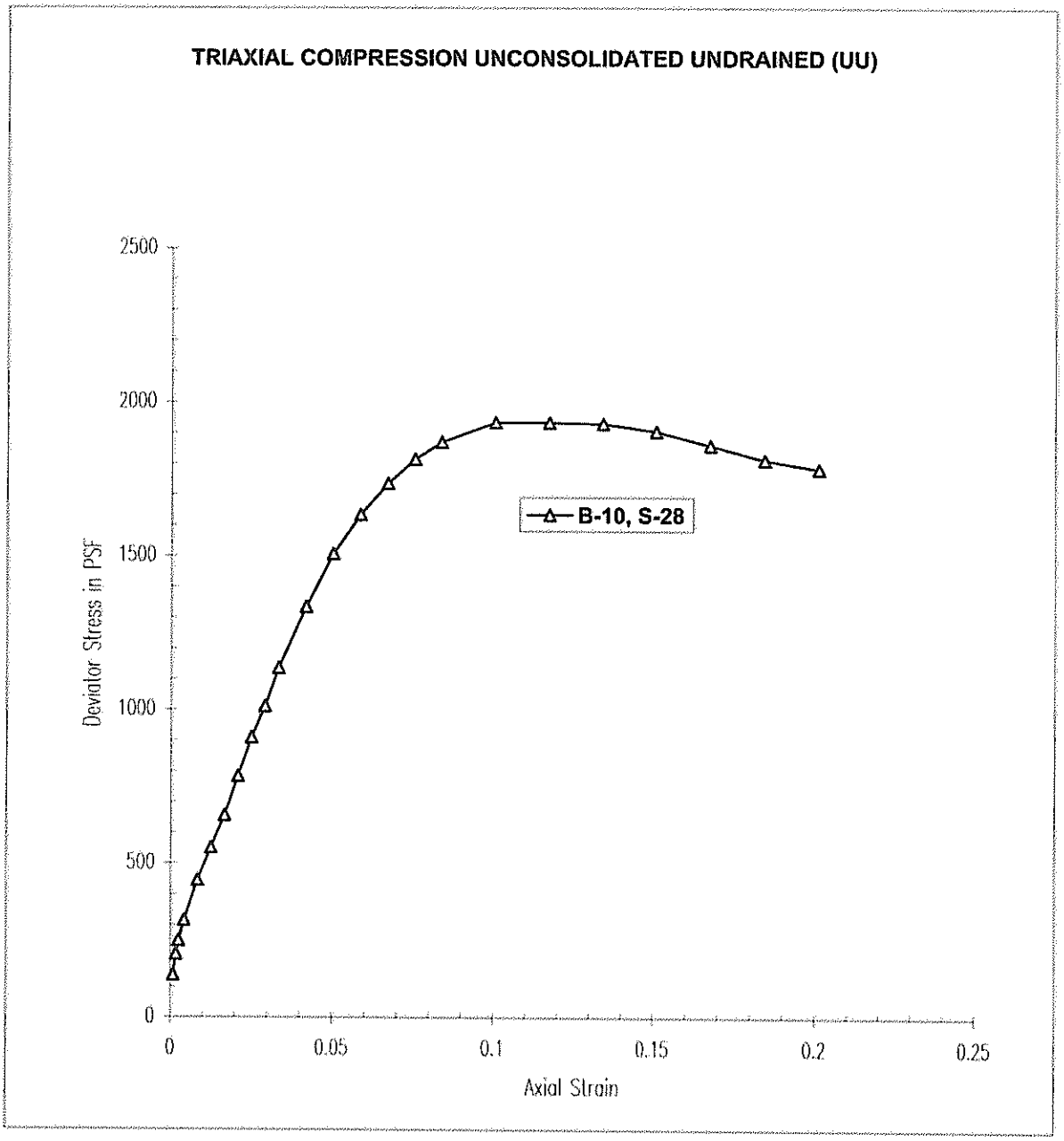
Job #	J-2154
Exploration #	B-10
Sample ID #	S-28
Sample Depth (ft)	104.8-105.3
Type of Test	UU
Cell Pressure (psi)	73
Strain Rate (in/min)	0.06
Initial Platen Reading (mm)	0
Initial Load Cell Reading (lbs)	15
Date	8/28/2006
Test by	RGS
Initial Length (in)	5.985
Area (ft**2)	0.043682
Youngs Modulus for membrane(lbs/in2)	200
Membrane Thickness in.	0.012

B-10, S-28

Deflection READ	Load Read lb	Strain Ratio	Deviator Stress psf
5	23	0.000835	182
10	26	0.001671	249
15	28	0.002506	293
25	33	0.004177	405
50	41	0.008354	579
75	47	0.012531	706
100	54	0.016708	855
125	60	0.020886	980
150	66	0.025063	1104
175	73	0.02924	1249
200	79	0.033417	1370
250	90	0.041771	1587
300	100	0.050125	1779
350	107	0.05848	1902
400	112	0.066834	1980
450	117	0.075188	2056
500	120	0.083542	2087
600	123	0.100251	2086
700	124	0.116959	2042
800	125	0.133668	1997
900	126	0.150376	1951
1000	126	0.167084	1886
1100	127	0.183793	1839
1200	128	0.200501	1791

Soil Technology.
J-06-2154

WSDOT Special Projects Facility
Landau Associates
Project No. 244039.020



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	B-10	S-28	05.4-105.!	52				104	68	73

Soil Technology
J-06-2154

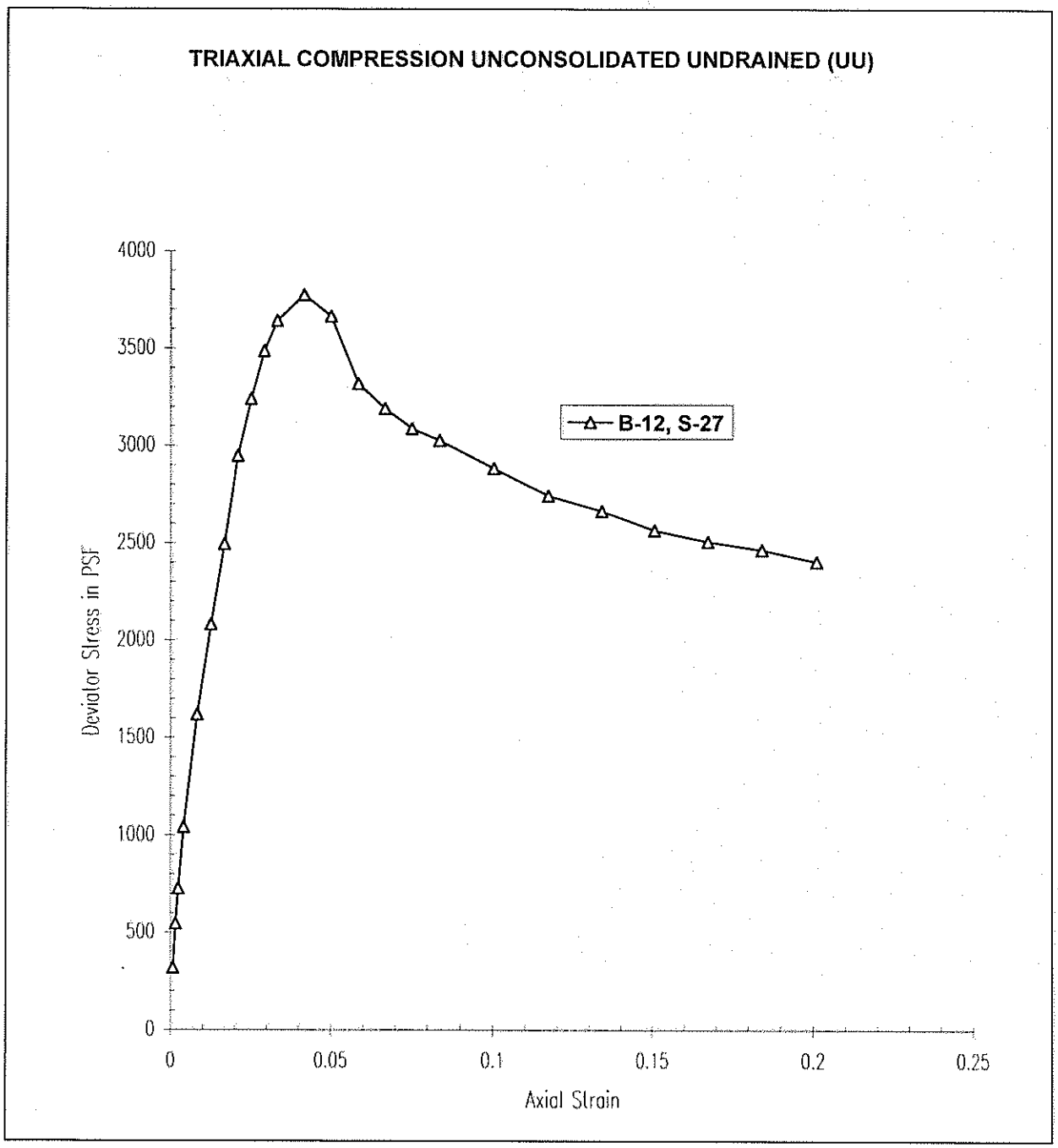
WSDOT Special Projects Facility
Landau Associates Project No. 244039.020

Job #	J-2154
Exploration #	B-10
Sample ID #	S-28
Sample Depth (ft)	105.4-105.9
Type of Test	UU
Cell Pressure (psi)	73
Strain Rate (in/min)	0.06
Initial Platen Reading (mm)	0
Initial Load Cell Reading (lbs)	14
Date	8/28/2006
Test by	RGS
Initial Length (in)	5.97
Area (ft**2)	0.043374
Youngs Modulus for membrane(lbs/in2)	200
Membrane Thickness in.	0.012

B-10, S-28

Deflection READ	Load Read lb	Strain Ratio	Deviator Stress psf
5	20	0.000838	137
10	23	0.001675	205
15	25	0.002513	249
25	28	0.004188	316
50	34	0.008375	446
75	39	0.012563	552
100	44	0.01675	657
125	50	0.020938	784
150	56	0.025126	909
175	61	0.029313	1011
200	67	0.033501	1135
250	77	0.041876	1334
300	86	0.050251	1507
350	93	0.058626	1634
400	99	0.067002	1736
450	104	0.075377	1814
500	108	0.083752	1870
600	114	0.100503	1935
700	117	0.117253	1934
800	120	0.134003	1931
900	122	0.150754	1906
1000	123	0.167504	1861
1100	124	0.184255	1814
1200	126	0.201005	1785

WSDOT Special Projects Facility
Landau Associates
Project No. 244039.020



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	B-12	S-27	99.5-100.0	69	86	37	49	100	59	70

Soil Technology
J-06-2154

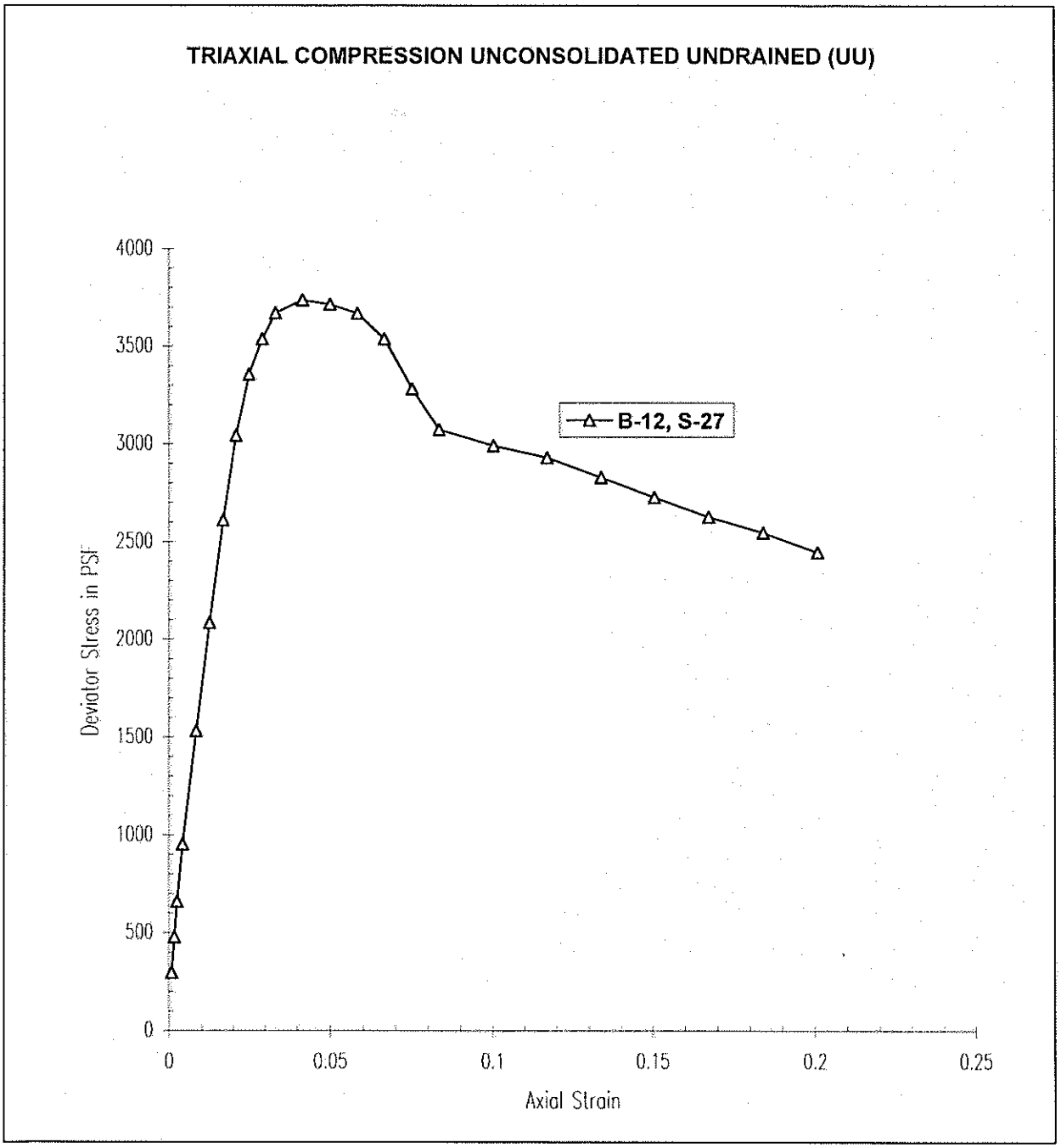
WSDOT Special Projects Facility
Landau Associates Project No. 244039.020

Job #	J-2154
Exploration #	B-12
Sample ID #	S-27
Sample Depth (ft)	99.5-100.0
Type of Test	UU
Cell Pressure (psi)	70
Strain Rate (in/min)	0.06
Initial Platen Reading (mm)	0
Initial Load Cell Reading (lbs)	16
Date	8/2/2006
Test by	RGS
Initial Length (in)	5.9666
Area (ft**2)	0.043754
Youngs Modulus for membrane(lbs/in2)	200
Membrane Thickness in.	0.012

B-12, S-27

Deflection READ	Load Read lb	Strain Ratio	Deviator Stress psf
5	30	0.000838	319
10	40	0.001676	545
15	48	0.002514	726
25	62	0.00419	1041
50	88	0.00838	1620
75	109	0.01257	2081
100	128	0.01676	2494
125	149	0.02095	2947
150	163	0.02514	3240
175	175	0.02933	3487
200	183	0.03352	3643
250	191	0.0419	3774
300	188	0.05028	3664
350	174	0.05866	3318
400	170	0.06704	3191
450	167	0.07542	3087
500	166	0.0838	3025
600	163	0.10056	2883
700	160	0.11732	2743
800	160	0.13408	2665
900	159	0.15084	2567
1000	160	0.1676	2508
1100	162	0.18436	2467
1200	163	0.20112	2406

WSDOT Special Projects Facility
Landau Associates
Project No. 244039.020



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	B-12	S-27	100-100.5	69	86	37	49	100	59	70

Soil Technology
J-06-2154

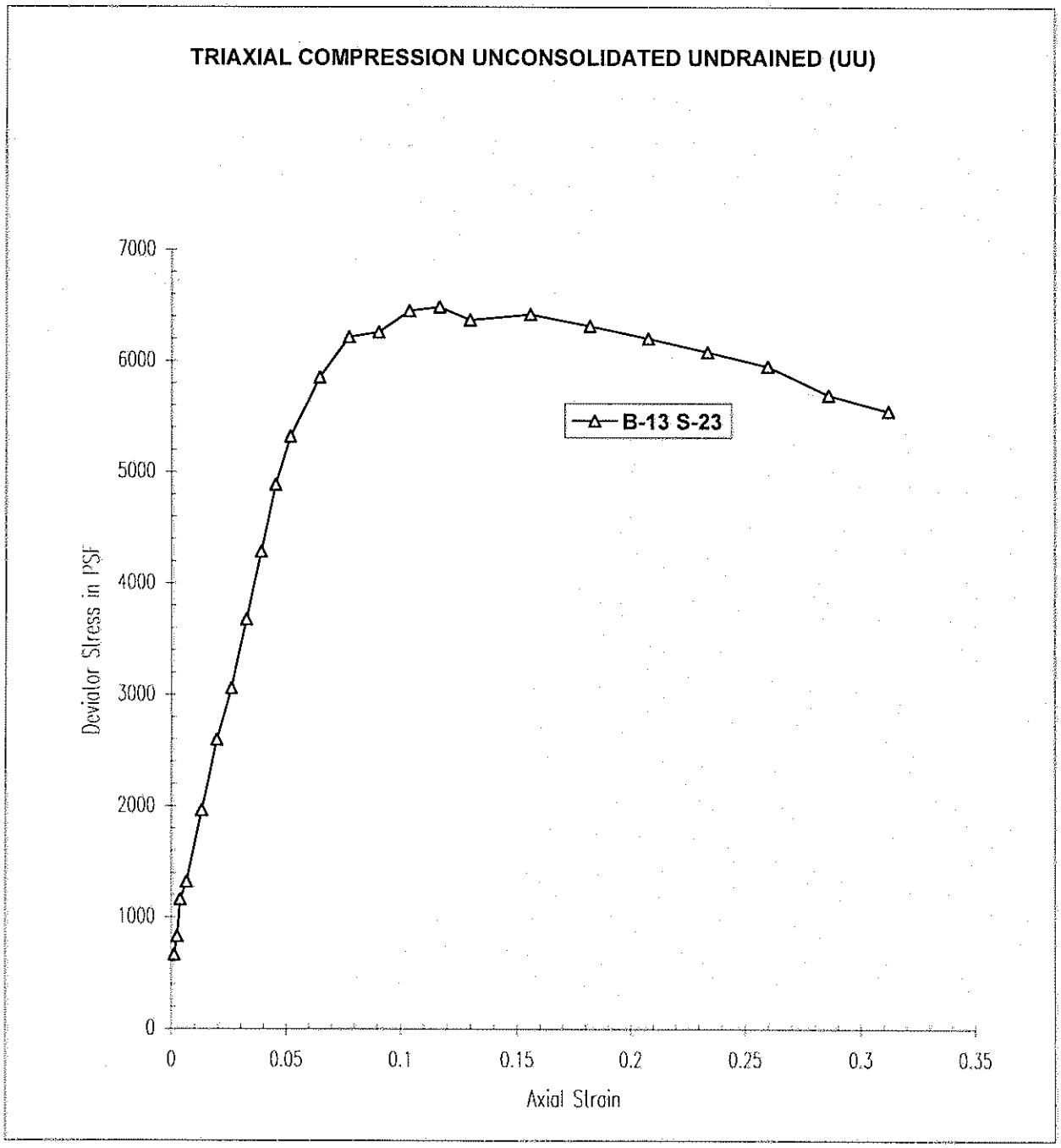
WSDOT Special Projects Facility
Landau Associates Project No. 244039.020

Job #	J-2154
Exploration #	B-12
Sample ID #	S-27
Sample Depth (ft)	100.0-100.5
Type of Test	UU
Cell Pressure (psi)	70
Strain Rate (in/min)	0.06
Initial Platen Reading (mm)	0
Initial Load Cell Reading (lbs)	14
Date	8/2/2006
Test by	RGS
Initial Length (in)	5.97
Area (ft**2)	0.043682
Youngs Modulus for membrane(lbs/in2)	200
Membrane Thickness in.	0.012

B-12, S-27

Deflection READ	Load Read lb	Strain Ratio	Deviator Stress psf
5	27	0.000838	296
10	35	0.001675	478
15	43	0.002513	659
25	56	0.004188	952
50	82	0.008375	1532
75	107	0.012563	2085
100	131	0.01675	2610
125	151	0.020938	3042
150	166	0.025126	3358
175	175	0.029313	3537
200	182	0.033501	3671
250	187	0.041876	3737
300	188	0.050251	3714
350	188	0.058626	3669
400	184	0.067002	3538
450	174	0.075377	3283
500	166	0.083752	3072
600	166	0.100503	2991
700	167	0.117253	2930
800	166	0.134003	2828
900	165	0.150754	2727
1000	164	0.167504	2627
1100	164	0.184255	2546
1200	163	0.201005	2448

WSDOT Special Projects Facility
Landau Associates
Project No. 244039.020



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	B-13	S-23	85.7-86.0	54				106	69	70

Soil Technology
J-06-2154

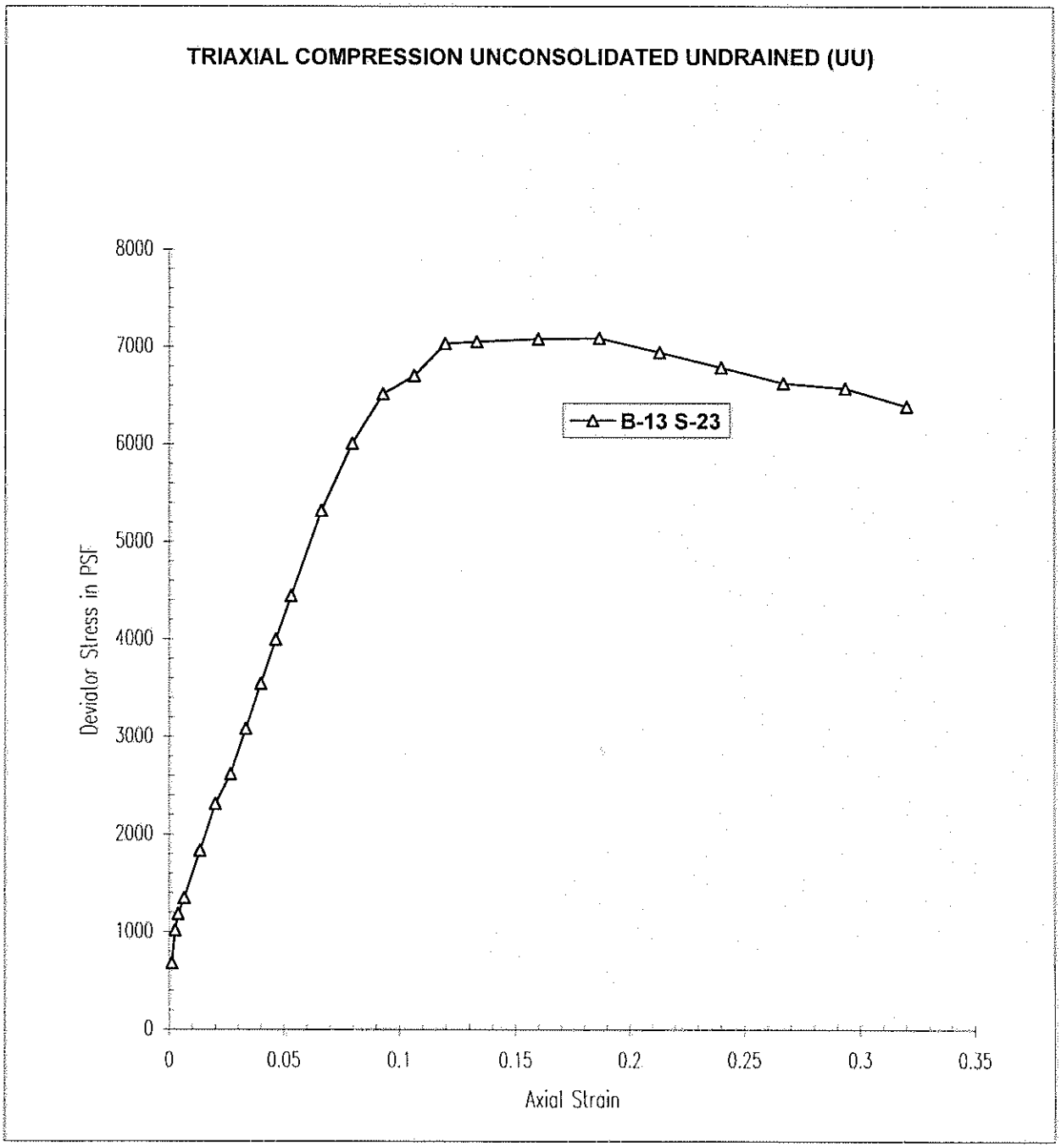
WSDOT Special Projects Facility
Landau Associates Project No. 244039.020

Job #	J-2154
Exploration #	B-13
Sample ID #	S-23
Sample Depth (ft)	85.7-86.0
Type of Test	UU
Cell Pressure (psi)	70
Strain Rate (in/min)	0.04
Initial Platen Reading (mm)	0
Initial Load Cell Reading (lbs)	12
Date	10/25/2006
Test by	RGS
Initial Length (in)	3.84666
Area (ft**2)	0.0059786
Youngs Modulus for membrane(lbs/in2)	200
Membrane Thickness in.	0.012

B-13 S-23

Deflection READ	Load Read lb	Strain Ratio	Deviator Stress psf
5	16	0.0013	666
10	17	0.0026	831
15	19	0.003899	1161
25	20	0.006499	1320
50	24	0.012998	1963
75	28	0.019497	2597
100	31	0.025997	3059
125	35	0.032496	3677
150	39	0.038995	4286
175	43	0.045494	4886
200	46	0.051993	5319
250	50	0.064991	5853
300	53	0.07799	6215
350	54	0.090988	6260
400	56	0.103986	6451
450	57	0.116985	6485
500	57	0.129983	6369
600	59	0.155979	6420
700	60	0.181976	6316
800	61	0.207973	6204
900	62	0.233969	6083
1000	63	0.259966	5953
1100	63	0.285962	5696
1200	64	0.311959	5553

WSDOT Special Projects Facility
Landau Associates
Project No. 244039.020



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	B-13	S-23	86.0-86.4	51	NT	NT	NT	104	69	70

Soil Technology
J-06-2154

WSDOT Special Projects Facility
Landau Associates Project No. 244039.020

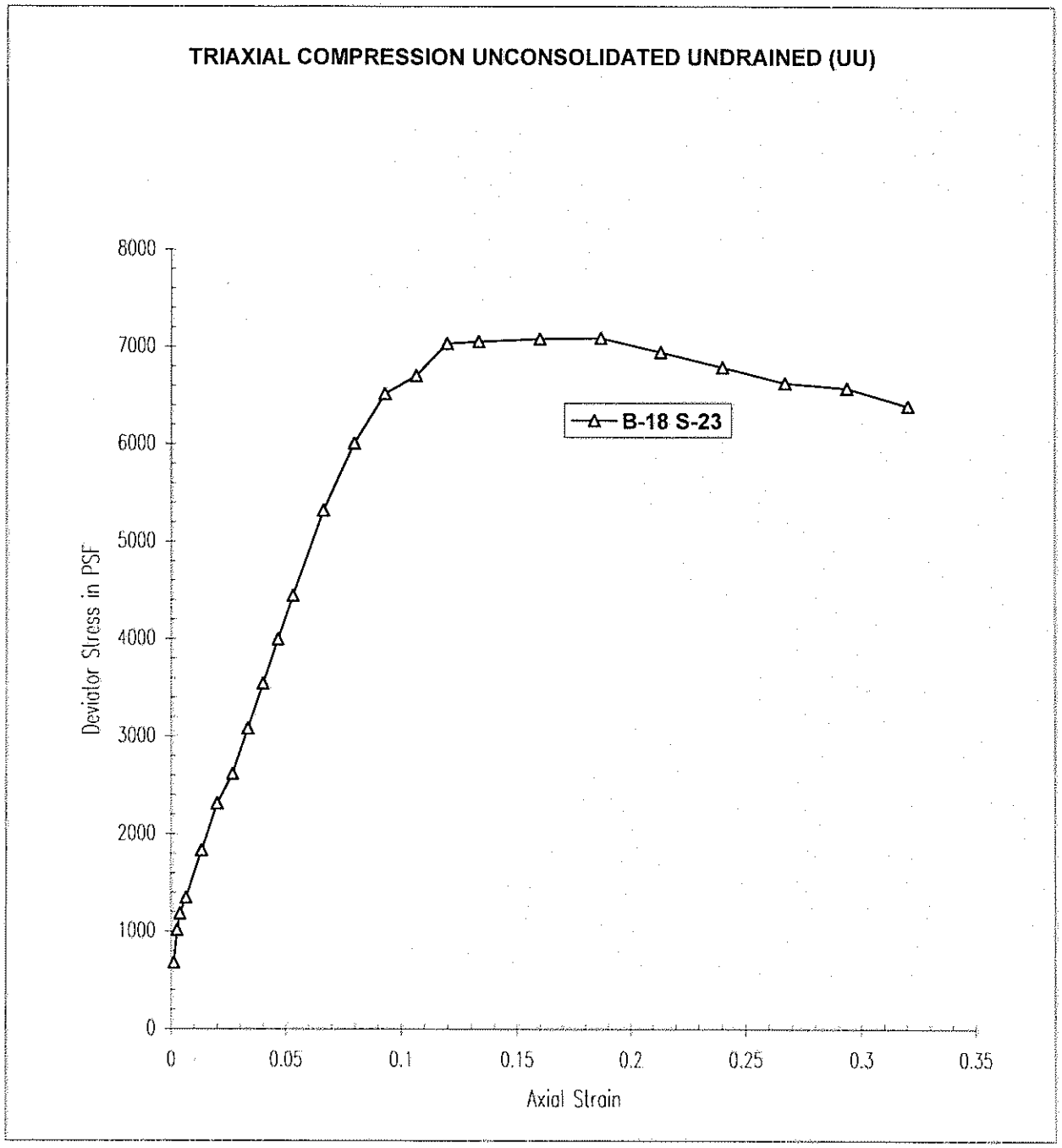
Job #	J-2154
Exploration #	B-13
Sample ID #	S-23
Sample Depth (ft)	86.0-86.4
Type of Test	UU
Cell Pressure (psi)	70
Strain Rate (in/min)	0.04
Initial Platen Reading (mm)	0
Initial Load Cell Reading (lbs)	12
Date	10/25/2006
Test by	RGS
Initial Length (in)	3.74333
Area (ft**2)	0.0058651
Youngs Modulus for membrane(lbs/in2)	200
Membrane Thickness in.	0.012

B-13 S-23

Deflection READ	Load Read lb	Strain Ratio	Deviator Stress psf
5	16	0.001336	679
10	18	0.002671	1017
15	19	0.004007	1183
25	20	0.006679	1346
50	23	0.013357	1832
75	26	0.020036	2311
100	28	0.026714	2618
125	31	0.033393	3085
150	34	0.040071	3545
175	37	0.04675	3999
200	40	0.053428	4445
250	46	0.066785	5318
300	51	0.080143	6006
350	55	0.0935	6517
400	57	0.106857	6705
450	60	0.120214	7034
500	61	0.133571	7054
600	63	0.160285	7080
700	65	0.186999	7088
800	66	0.213713	6944
900	67	0.240428	6791
1000	68	0.267142	6628
1100	70	0.293856	6577
1200	71	0.32057	6392

Soil Technology.
J-06-2154

WSDOT Special Projects Facility
Landau Associates
Project No. 244039.020



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	B-18	S-23	86.0-86.4	51	NT	NT	NT	104	69	70

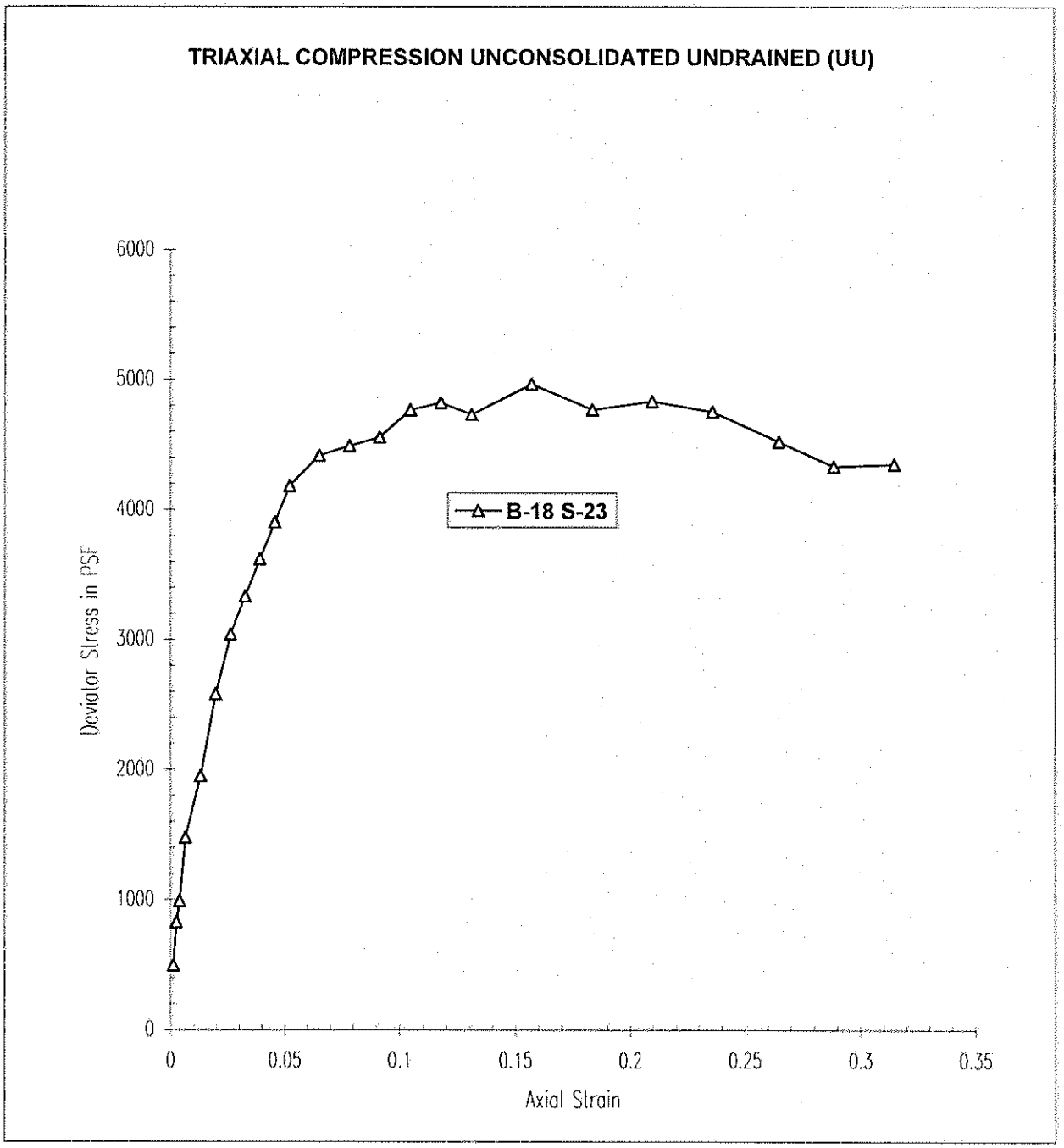
Soil Technology
J-06-2154

WSDOT Special Projects Facility
Landau Associates Project No. 244039.020

Job #	J-2154	Deflection	Load Read	Strain	Deviator Stress
Exploration #	B-18	READ	lb	Ratio	psf
Sample ID #	S-23	5	16	0.001336	679
Sample Depth (ft)	86.0-86.4	10	18	0.002671	1017
Type of Test	UU	15	19	0.004007	1183
Cell Pressure (psi)	70	25	20	0.006679	1346
Strain Rate (in/min)	0.04	50	23	0.013357	1832
Initial Platen Reading (mm)	0	75	26	0.020036	2311
Initial Load Cell Reading (lbs)	12	100	28	0.026714	2618
Date	10/25/2006	125	31	0.033393	3085
Test by	RGS	150	34	0.040071	3545
Initial Length (in)	3.74333	175	37	0.04675	3999
Area (ft**2)	0.0058651	200	40	0.053428	4445
Youngs Modulus for membrane(lbs/in2)	200	250	46	0.066785	5318
Membrane Thickness in.	0.012	300	51	0.080143	6006
		350	55	0.0935	6517
		400	57	0.106857	6705
		450	60	0.120214	7034
		500	61	0.133571	7054
B-18 S-23		600	63	0.160285	7080
		700	65	0.186999	7088
		800	66	0.213713	6944
		900	67	0.240428	6791
		1000	68	0.267142	6628
		1100	70	0.293856	6577
		1200	71	0.32057	6392

Soil Technology.
J-06-2154

WSDOT Special Projects Facility
Landau Associates
Project No. 244039.020



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	B-18	S-23	86.4-86.7	59	63	38	25	100	63	70

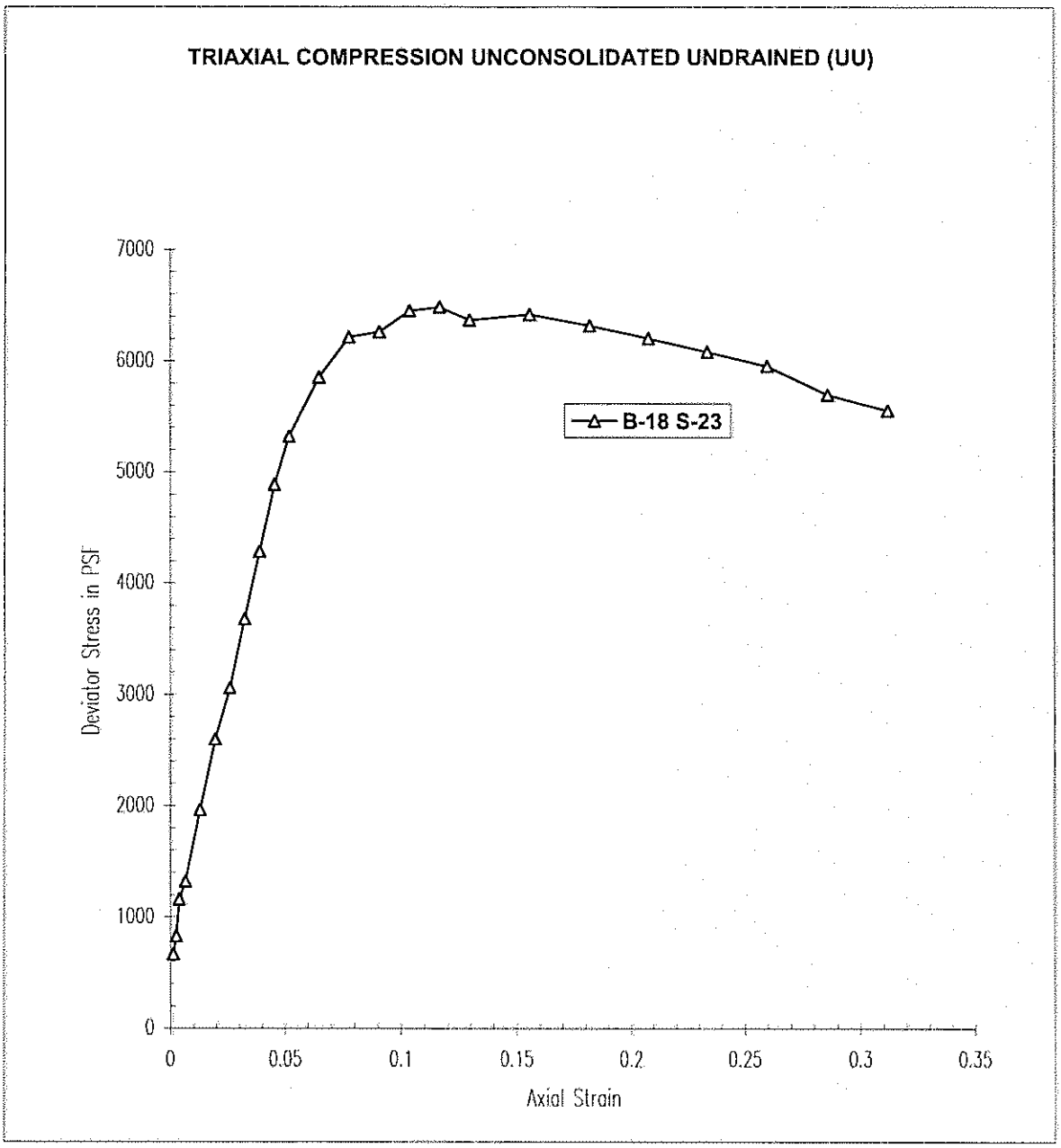
Soil Technology
J-06-2154

WSDOT Special Projects Facility
Landau Associates Project No. 244039.020

Job #	J-2154	Deflection	Load Read	Strain	Deviator Stress
Exploration #	B-18	READ	lb	Ratio	psf
Sample ID #	S-23	5	17	0.001312	496
Sample Depth (ft)	86.4-86.7	10	19	0.002625	826
Type of Test	UU	15	20	0.003937	989
Cell Pressure (psi)	70	25	23	0.006562	1478
Strain Rate (in/min)	0.04	50	26	0.013123	1952
Initial Platen Reading (mm)	0	75	30	0.019685	2582
Initial Load Cell Reading (lbs)	14	100	33	0.026247	3041
Date	10/25/2006	125	35	0.032808	3333
Test by	RGS	150	37	0.03937	3620
Initial Length (in)	3.81	175	39	0.045932	3904
Area (ft**2)	0.0060125	200	41	0.052493	4182
Youngs Modulus for membrane(lbs/in2)	200	250	43	0.065617	4416
Membrane Thickness in.	0.012	300	44	0.07874	4488
		350	45	0.091864	4555
		400	47	0.104987	4767
		450	48	0.11811	4824
		500	48	0.131234	4731
B-18 S-23		600	51	0.15748	4967
		700	51	0.183727	4769
		800	53	0.209974	4834
		900	54	0.23622	4755
		1010	54	0.265092	4523
		1100	54	0.288714	4333
		1200	56	0.314961	4350

Soil Technology.
J-06-2154

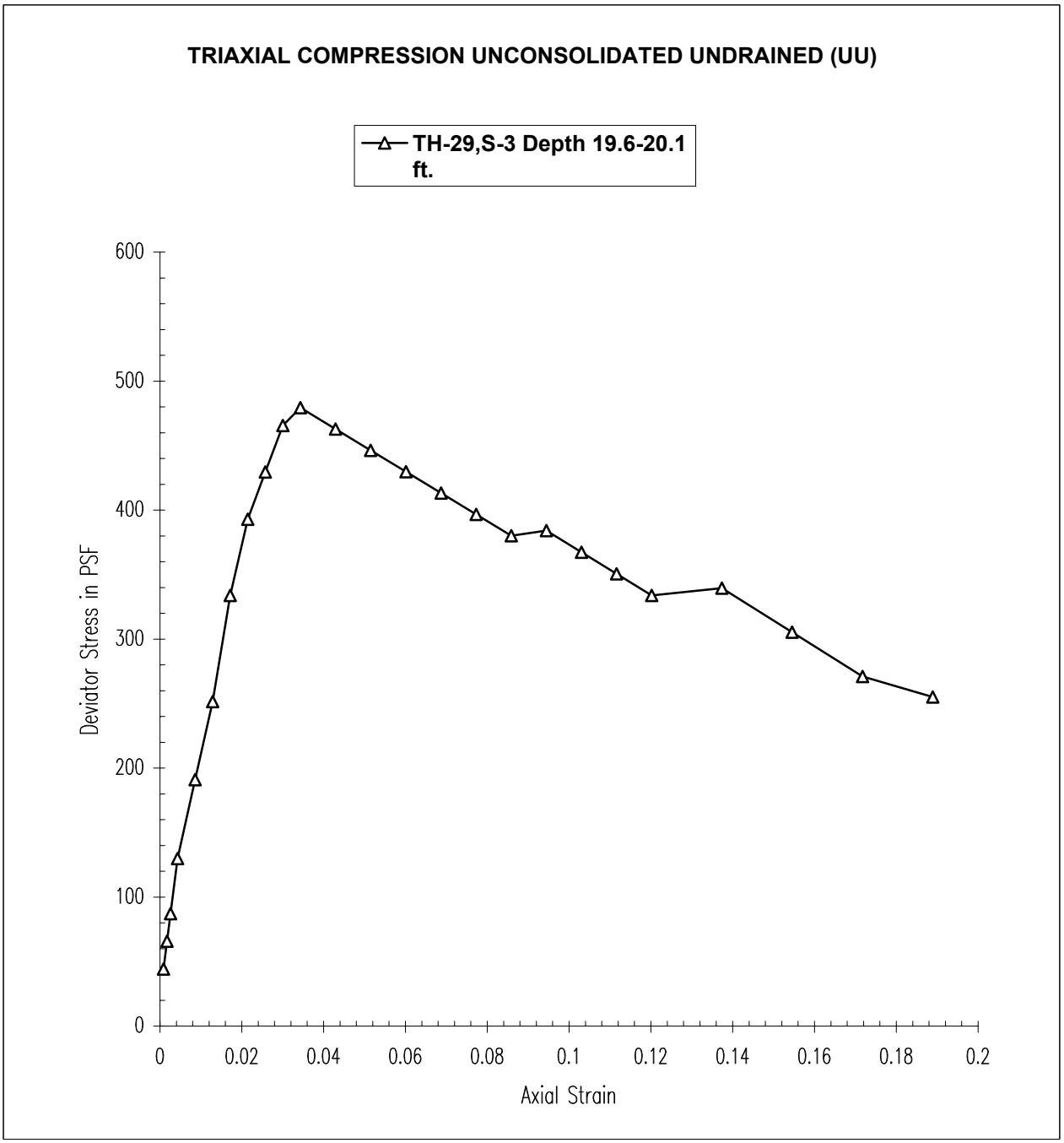
WSDOT Special Projects Facility
Landau Associates
Project No. 244039.020



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	B-18	S-23	85.7-86.0	54	NT	NT	NT	106	69	70

Soil Technology
J-06-2154

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	TH-29	S-3	19.6-20.1	74	80	37	42	95	55	14

Soil Technology.
J-08-2275

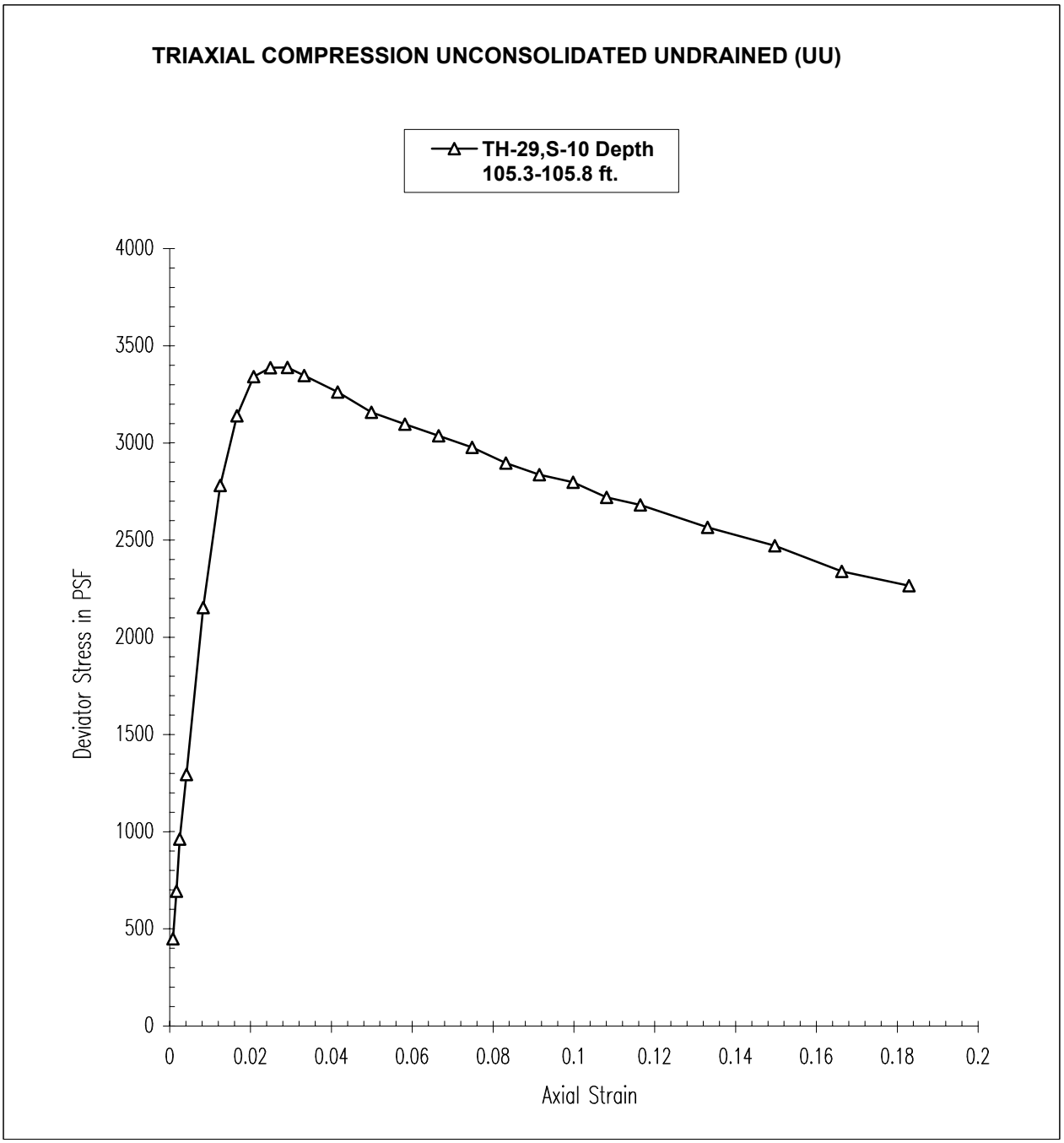
WSDOT Grays Harbor Construction Facility
Landau Associates

Job #	J-08-2275
Exploration #	TH-29
Sample ID #	S-3
Sample Depth (ft)	19.6-20.1
Type of Test	UU
Cell Pressure (psi)	14
Strain Rate (in/min)	0.058
Initial Platen Reading (mm)	0
Initial Load Cell Reading (lbs)	2
Date	9/15/2008
Test by	RGS
Initial Length (in)	5.82333
Area (ft**2)	0.043991
Youngs Modulus for membrane(lbs/in2)	200
Membrane Thickness in.	0.012

TH-29,S-3 Depth 19.6-20.1 ft.

Deflection READ	Load Read lb	Strain Ratio	Deviator Stress psf
5	4	0.000859	44
10	5	0.001717	66
15	6	0.002576	87
25	8	0.004293	130
50	11	0.008586	191
75	14	0.012879	251
100	18	0.017172	334
125	21	0.021465	393
150	23	0.025758	429
175	25	0.030052	466
200	26	0.034345	479
250	26	0.042931	463
300	26	0.051517	446
350	26	0.060103	430
400	26	0.068689	413
450	26	0.077275	397
500	26	0.085862	380
550	27	0.094448	384
600	27	0.103034	367
650	27	0.11162	351
700	27	0.120206	334
800	29	0.137378	340
900	29	0.154551	305
1000	29	0.171723	271
1100	30	0.188895	255

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	TH-29	S-10	105.3	61	67	30	37	101	62	73

Soil Technology.
J-08-2275

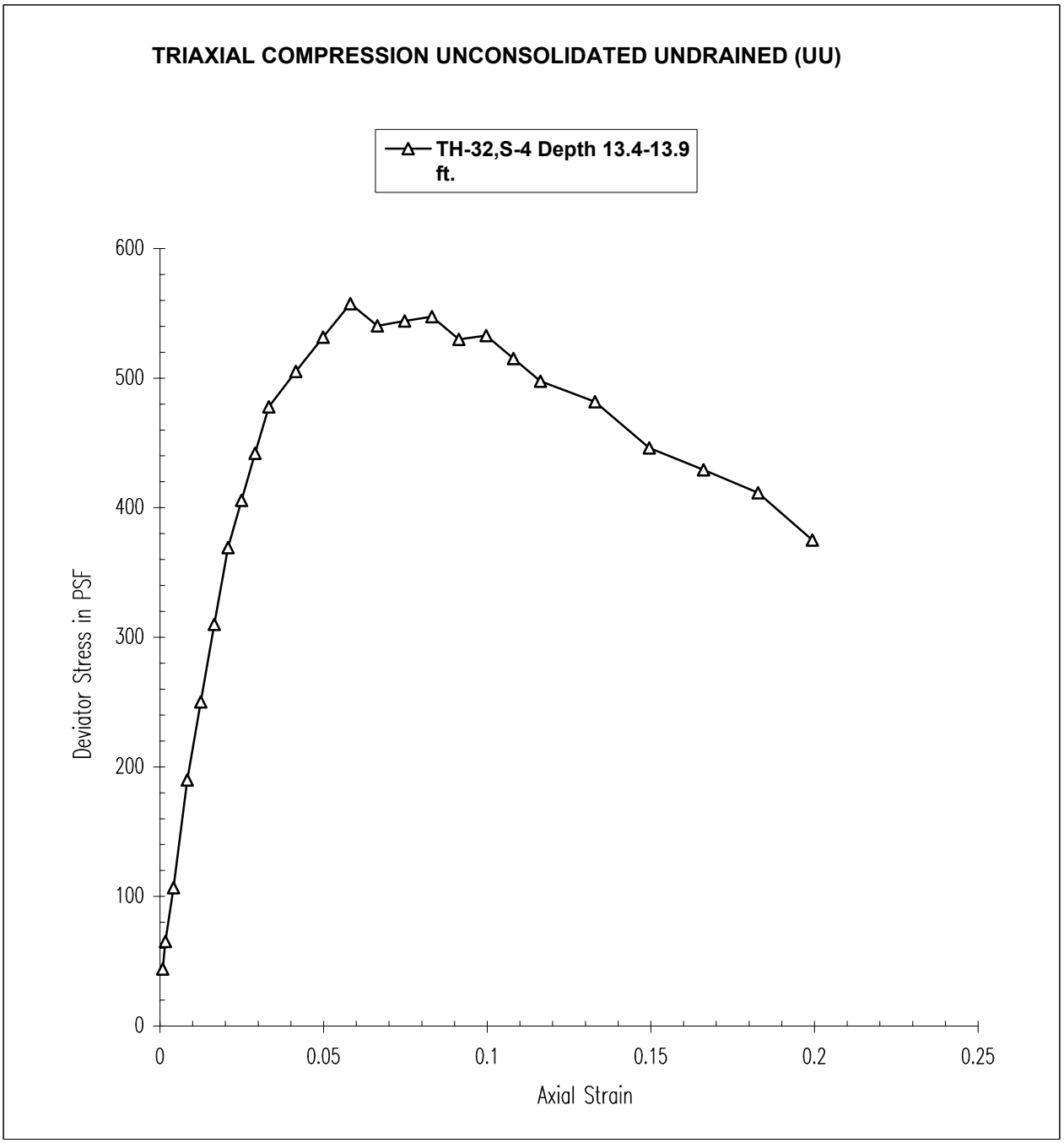
WSDOT Grays Harbor Construction Facility
Landau Associates

Job #	J-08-2275
Exploration #	TH-29
Sample ID #	S-10
Sample Depth (ft)	105.3-105.8
Type of Test	UU
Cell Pressure (psi)	73
Strain Rate (in/min)	0.06
Initial Platen Reading (mm)	0
Initial Load Cell Reading (lbs)	20
Date	9/11/2008
Test by	RGS
Initial Length (in)	6.0133
Area (ft**2)	0.0444569
Youngs Modulus for membrane(lbs/in2)	200
Membrane Thickness in.	0.012

TH-29,S-10 Depth 105.3-105.8 ft.

Deflection READ	Load Read lb	Strain Ratio	Deviator Stress psf
5	40	0.000831	448
10	51	0.001663	694
15	63	0.002494	961
25	78	0.004157	1293
50	117	0.008315	2152
75	146	0.012472	2782
100	163	0.01663	3140
125	173	0.020787	3341
150	176	0.024945	3387
175	177	0.029102	3389
200	176	0.03326	3346
250	174	0.041575	3263
300	171	0.049889	3158
350	170	0.058204	3097
400	169	0.066519	3037
450	168	0.074834	2976
500	166	0.083149	2896
550	165	0.091464	2837
600	165	0.099779	2798
650	163	0.108094	2719
700	163	0.116409	2681
800	161	0.133038	2566
900	160	0.149668	2471
1000	157	0.166298	2339
1100	157	0.182928	2265
1200	154	0.199558	2137

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	TH-32	S-4	13.4-13.9	86	91	43	48	98	58	9

Soil Technology.
J-08-2275

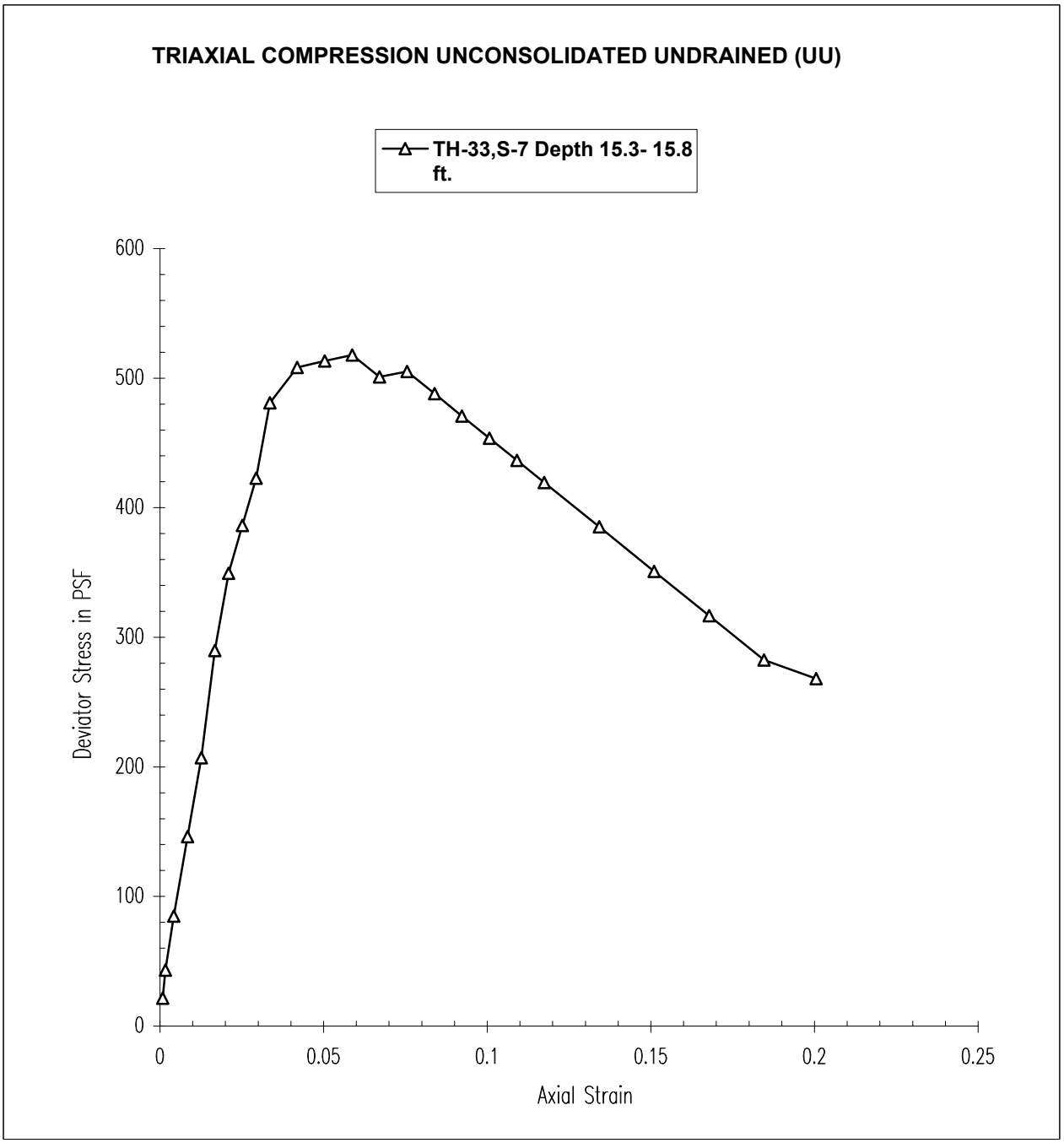
WSDOT Grays Harbor Construction Facility
Landau Associates

Job #	J-08-2275
Exploration #	TH-32
Sample ID #	S-4
Sample Depth (ft)	13.4-13.9
Type of Test	UU
Cell Pressure (psi)	9
Strain Rate (in/min)	0.06
Initial Platen Reading (mm)	0
Initial Load Cell Reading (lbs)	1
Date	9/23/2008
Test by	RGS
Initial Length (in)	6.02
Area (ft**2)	0.04430137
Youngs Modulus for membrane(lbs/in2)	200
Membrane Thickness in.	0.012

TH-32,S-4 Depth 13.4-13.9 ft.

Deflection READ	Load Read lb	Strain Ratio	Deviator Stress psf
5	3	0.000831	44
10	4	0.001661	65
25	6	0.004153	107
50	10	0.008306	190
75	13	0.012458	250
100	16	0.016611	310
125	19	0.020764	369
150	21	0.024917	406
175	23	0.02907	442
200	25	0.033223	478
250	27	0.041528	505
300	29	0.049834	532
350	31	0.05814	557
400	31	0.066445	540
450	32	0.074751	544
500	33	0.083056	548
550	33	0.091362	530
600	34	0.099668	533
650	34	0.107973	515
700	34	0.116279	498
800	35	0.13289	482
900	35	0.149502	446
1000	36	0.166113	429
1100	37	0.182724	412
1200	37	0.199336	375

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	TH-33	S-7	15.3-15.8	78	65	30	35	97	55	10

Soil Technology.
J-08-2275

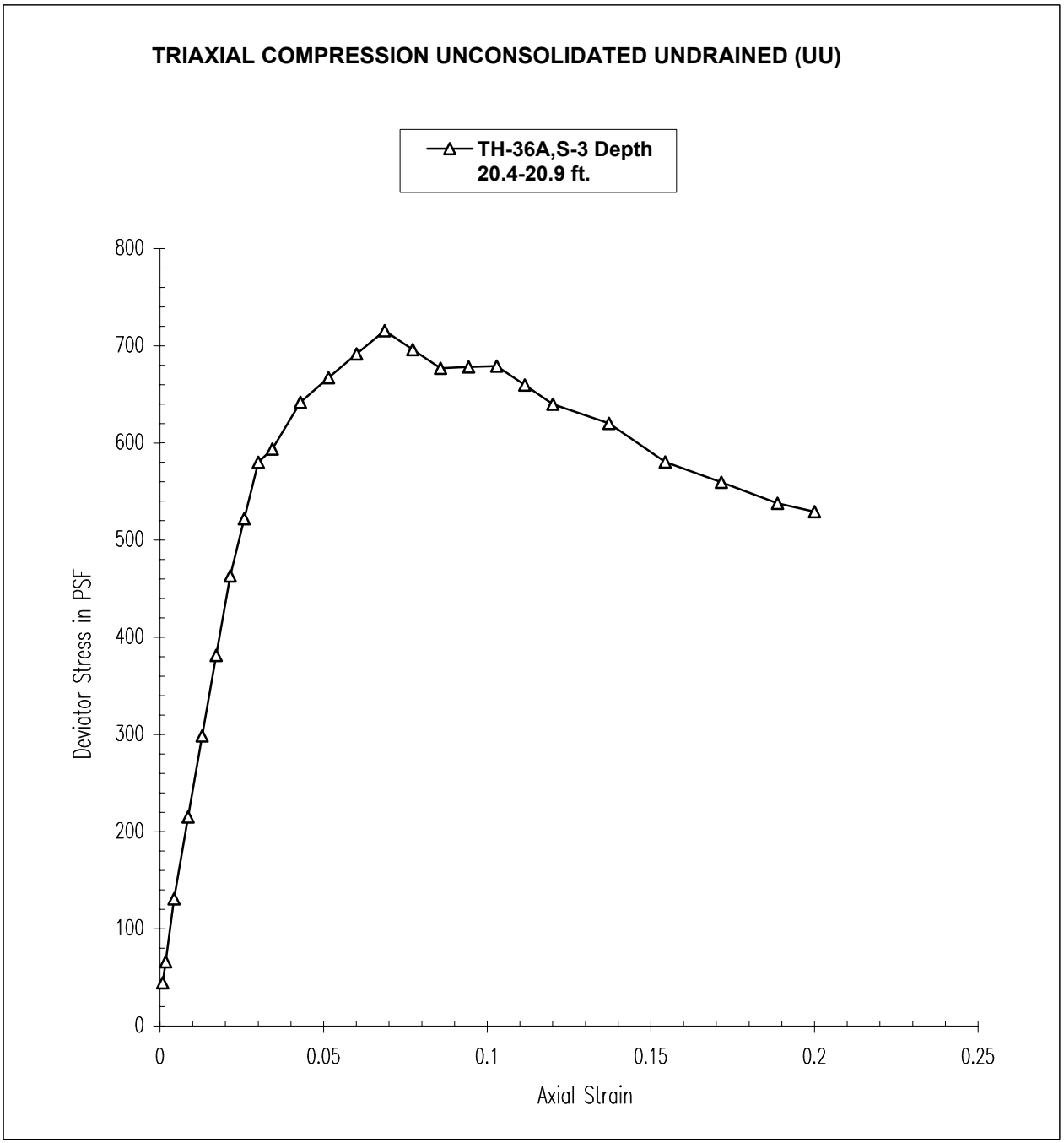
WSDOT Grays Harbor Construction Facility
Landau Associates

Job #	J-08-2275
Exploration #	TH-33
Sample ID #	S-7
Sample Depth (ft)	15.3-15.8
Type of Test	UU
Cell Pressure (psi)	10
Strain Rate (in/min)	0.06
Initial Platen Reading (mm)	0
Initial Load Cell Reading (lbs)	2
Date	9/22/2008
Test by	RGS
Initial Length (in)	5.96
Area (ft**2)	0.04399102
Youngs Modulus for membrane(lbs/in2)	200
Membrane Thickness in.	0.012

TH-33,S-7 Depth 15.3- 15.8 ft.

Deflection READ	Load Read lb	Strain Ratio	Deviator Stress psf
5	3	0.000839	22
10	4	0.001678	43
25	6	0.004195	85
50	9	0.008389	146
75	12	0.012584	207
100	16	0.016779	290
125	19	0.020973	349
150	21	0.025168	386
175	23	0.029362	423
200	26	0.033557	481
250	28	0.041946	508
300	29	0.050336	513
350	30	0.058725	518
400	30	0.067114	501
450	31	0.075503	505
500	31	0.083893	488
550	31	0.092282	471
600	31	0.100671	454
650	31	0.10906	437
700	31	0.11745	419
800	31	0.134228	385
900	31	0.151007	351
1000	31	0.167785	317
1100	31	0.184564	282
1195	32	0.200503	268

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	TH-36A	S-3	20.4-20.9	65	67	36	31	102	62	13

Soil Technology.
J-08-2275

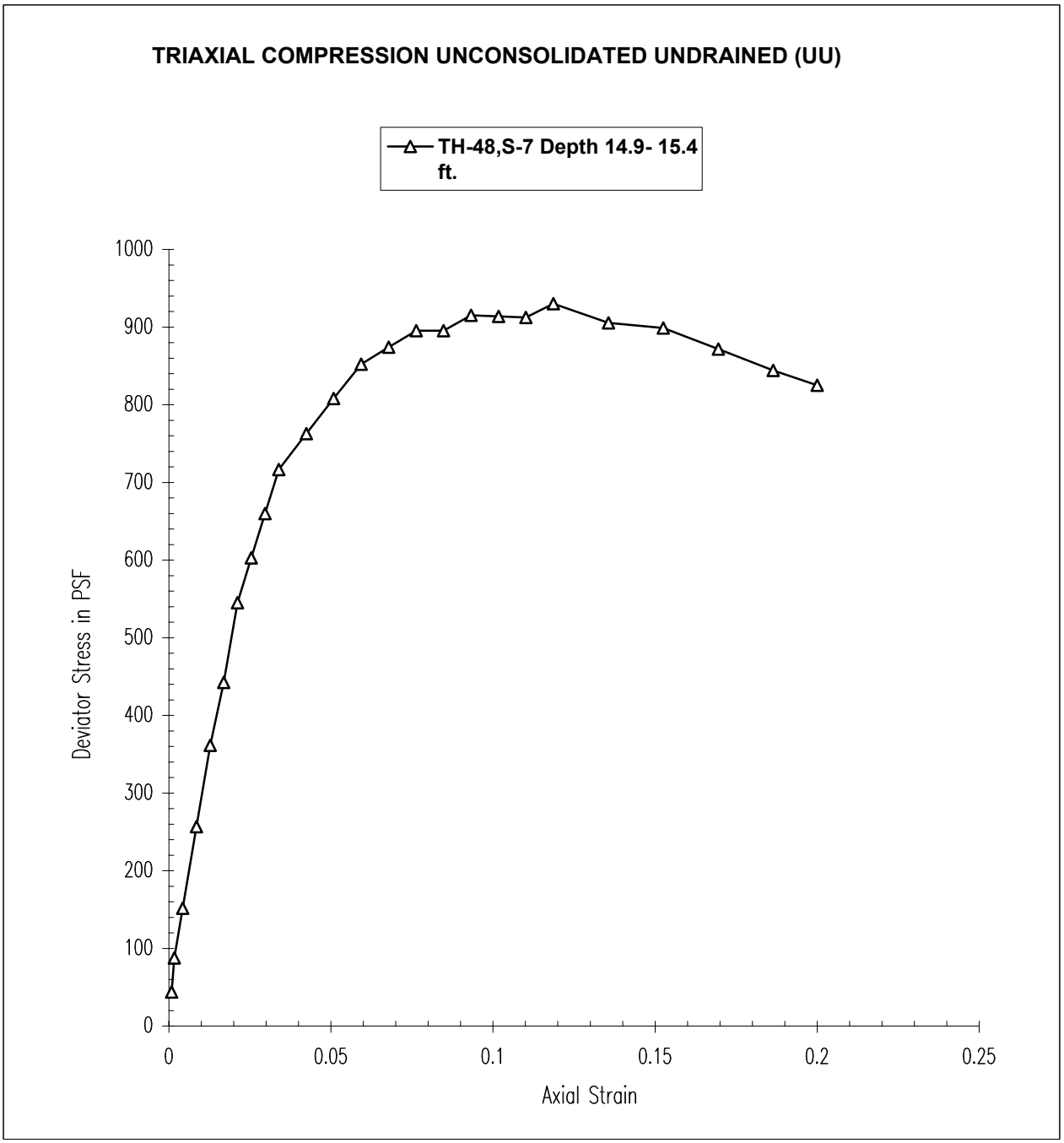
WSDOT Grays Harbor Construction Facility
Landau Associates

Job #	J-08-2275
Exploration #	TH-36A
Sample ID #	S-3
Sample Depth (ft)	20.4-20.9
Type of Test	UU
Cell Pressure (psi)	13
Strain Rate (in/min)	0.058
Initial Platen Reading (mm)	0
Initial Load Cell Reading (lbs)	2
Date	9.22/08
Test by	RGS
Initial Length (in)	5.83
Area (ft**2)	0.043682
Youngs Modulus for membrane(lbs/in2)	200
Membrane Thickness in.	0.012

TH-36A,S-3 Depth 20.4-20.9 ft.

Deflection READ	Load Read lb	Strain Ratio	Deviator Stress psf
5	4	0.000858	45
10	5	0.001715	66
25	8	0.004288	131
50	12	0.008576	215
75	16	0.012864	299
100	20	0.017153	381
125	24	0.021441	463
150	27	0.025729	522
175	30	0.030017	580
200	31	0.034305	594
250	34	0.042882	642
300	36	0.051458	667
350	38	0.060034	692
400	40	0.068611	715
450	40	0.077187	696
500	40	0.085763	677
550	41	0.09434	678
600	42	0.102916	679
650	42	0.111492	659
700	42	0.120069	640
800	43	0.137221	620
900	43	0.154374	580
1000	44	0.171527	559
1100	45	0.188679	538
1166	46	0.2	529

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent				Unit Weight		Cell Pressure psi
				Natural	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	
Δ	TH-48	S-7	14.9-15.4	56	56	37	19	105	67	10

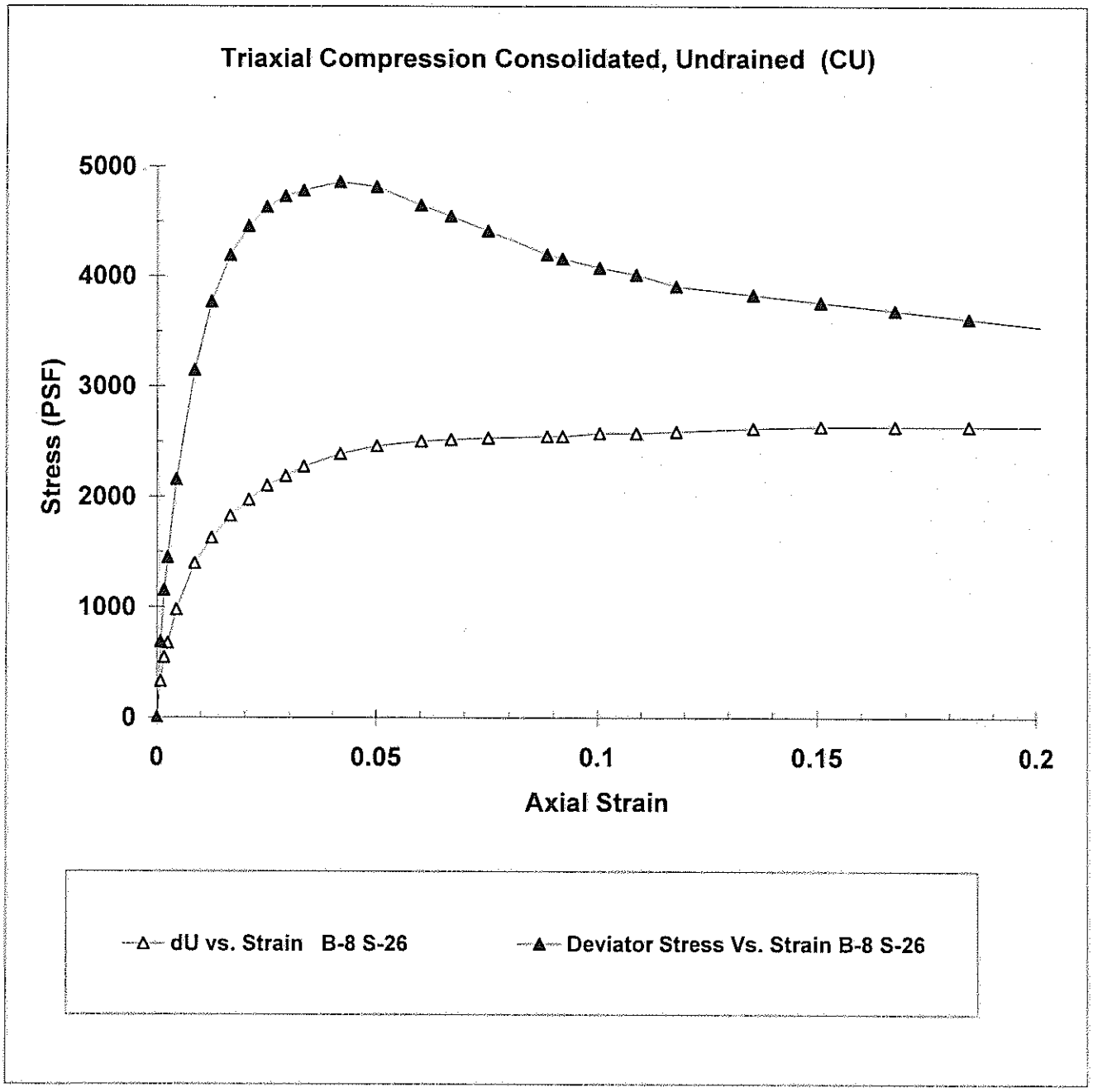
Soil Technology.
J-08-2275

WSDOT Grays Harbor Construction Facility
Landau Associates

Job #	J-08-2275
Exploration #	TH-47
Sample ID #	S-7
Sample Depth (ft)	14.9-15.4
Type of Test	UU
Cell Pressure (psi)	10
Strain Rate (in/min)	0.059
Initial Platen Reading (mm)	0
Initial Load Cell Reading (lbs)	2
Date	9/22/2008
Test by	RGS
Initial Length (in)	5.9
Area (ft**2)	0.04430137
Youngs Modulus for membrane(lbs/in2)	200
Membrane Thickness in.	0.012

TH-48,S-7 Depth 14.9- 15.4 ft.

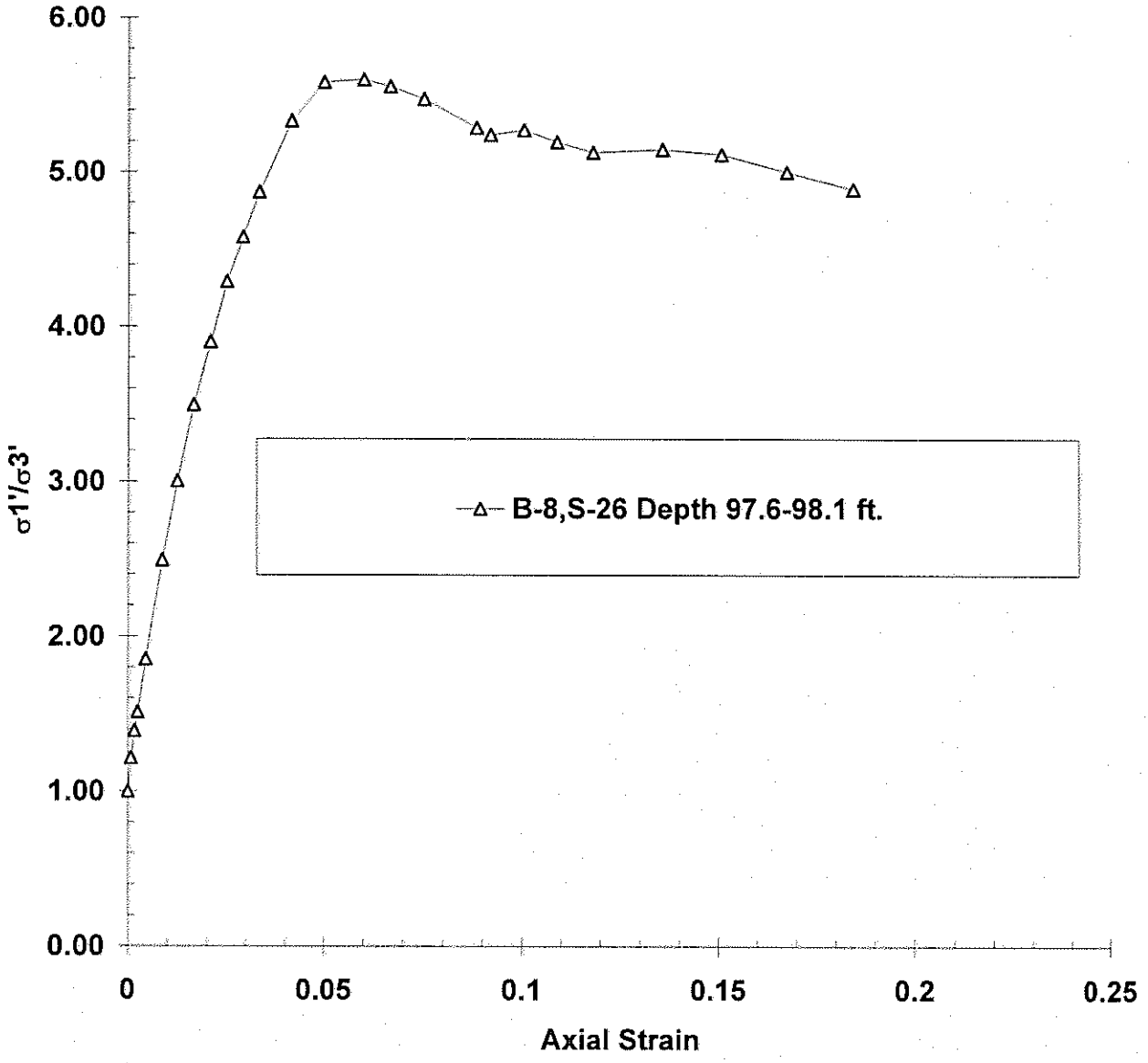
Deflection READ	Load Read lb	Strain Ratio	Deviator Stress psf
5	4	0.000847	44
10	6	0.001695	88
25	9	0.004237	151
50	14	0.008475	257
75	19	0.012712	361
100	23	0.016949	443
125	28	0.021186	545
150	31	0.025424	603
175	34	0.029661	660
200	37	0.033898	716
250	40	0.042373	763
300	43	0.050847	808
350	46	0.059322	852
400	48	0.067797	874
450	50	0.076271	895
500	51	0.084746	895
550	53	0.09322	915
600	54	0.101695	914
650	55	0.110169	912
700	57	0.118644	930
800	58	0.135593	905
900	60	0.152542	899
1000	61	0.169492	872
1100	62	0.186441	844
1180	63	0.2	825



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-8	S-26	97.6-98.1	77	73	NT	NT	NT	96	54	24.3	54.3	30

WSDOT Grays Harbor Special Projects
Landau Assoicates

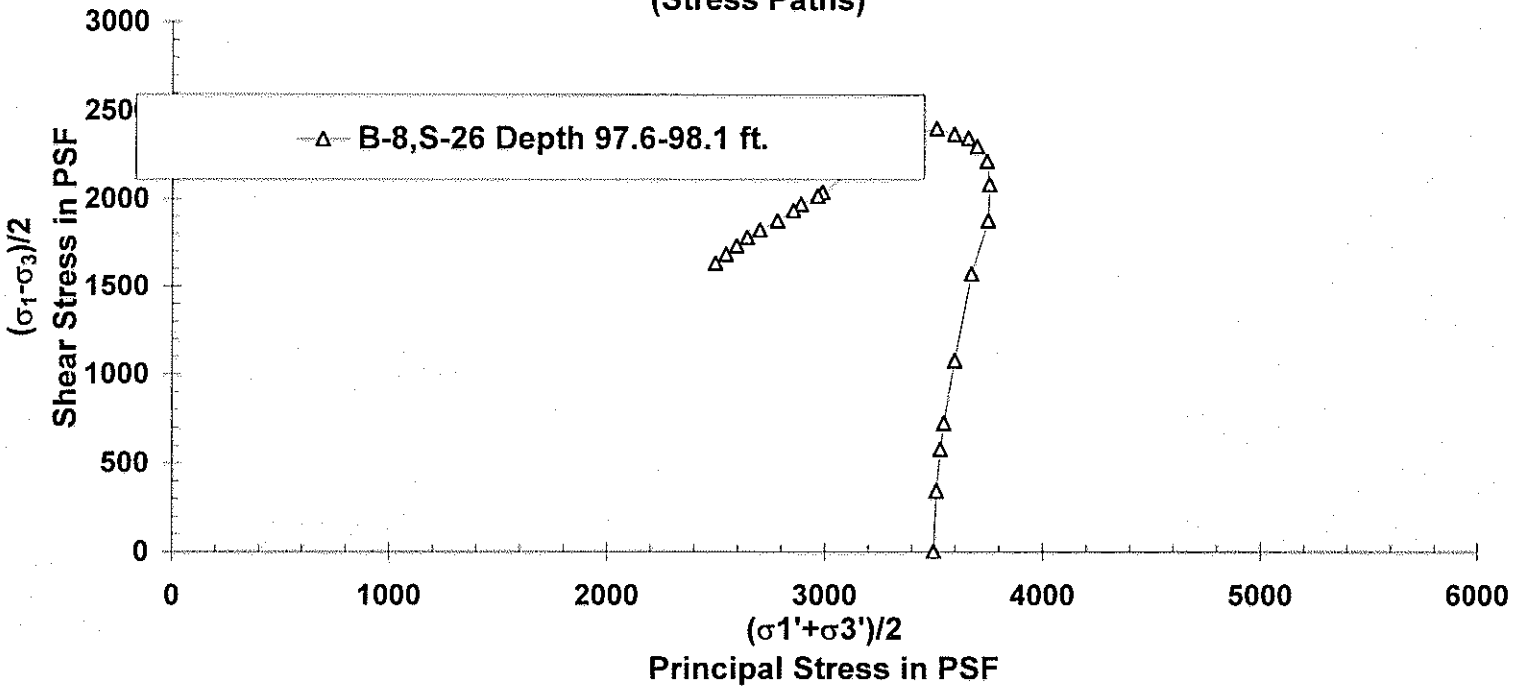
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)

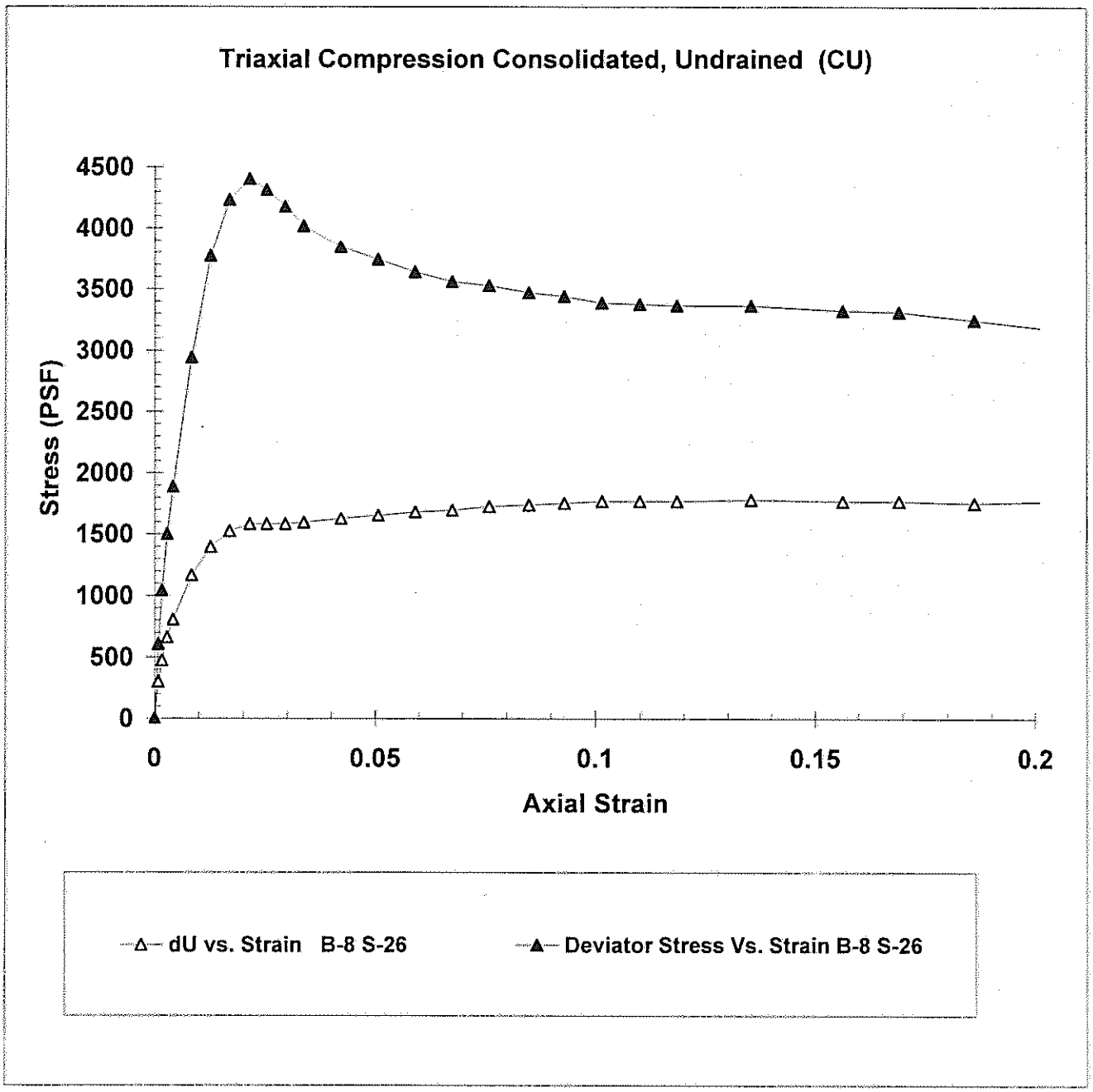


Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	11	0	0	0.040606	0	30.0	0.00	0.00	#DIV/0!	3499.20	3499.20	1.00	0.00	3499.20
Exploration #	B-8	5	5	39	28	0.00084	0.040640	688	32.3	2.30	331.20	0.48	3168.00	3855.81	1.22	343.91	3511.91
Sample ID #	S-26	10	10	58	47	0.00168	0.040675	1153	33.8	3.80	547.20	0.47	2952.00	4105.20	1.39	576.60	3528.60
Sample Depth (ft)	97.6-98.1	15	15	70	59	0.00252	0.040709	1446	34.7	4.70	676.80	0.47	2822.40	4268.25	1.51	722.92	3545.32
Type of Test	CU	27	27	99	88	0.00453	0.040791	2151	36.8	6.80	979.20	0.46	2520.00	4671.08	1.85	1075.54	3595.54
Cell Pressure (psi)	54.3	52	52	140	129	0.00872	0.040963	3137	39.7	9.70	1396.80	0.45	2102.40	5239.49	2.49	1568.55	3670.95
Back Pressure (psi)	30	75	75	166	155	0.01258	0.041123	3752	41.3	11.30	1627.20	0.43	1872.00	5623.76	3.00	1875.88	3747.88
Strain Rate (in/min)	0.004	100	100	184	173	0.01677	0.041299	4166	42.7	12.70	1828.80	0.44	1670.40	5836.21	3.49	2082.90	3753.30
Initial Platen Reading (in x 10^{-3})	0	125	125	196	185	0.02096	0.041476	4431	43.7	13.70	1972.80	0.45	1526.40	5957.88	3.90	2215.74	3742.14
Initial Load Cell Reading (lbs)	11	150	150	204	193	0.02515	0.041654	4599	44.6	14.60	2102.40	0.46	1396.80	5995.45	4.29	2299.32	3696.12
Date	########	175	175	209	198	0.02934	0.041834	4692	45.2	15.20	2188.80	0.47	1310.40	6002.85	4.58	2346.22	3656.62
Test by	RGS	200	200	212	201	0.03353	0.042015	4738	45.8	15.80	2275.20	0.48	1224.00	5961.62	4.87	2368.81	3592.81
Initial Length (in)	6.05	250	250	217	206	0.04192	0.042383	4803	46.6	16.60	2390.40	0.50	1108.80	5911.30	5.33	2401.25	3510.05
Area (ft^2)	0.043682	300	300	217	206	0.05030	0.042757	4748	47.1	17.10	2462.40	0.52	1036.80	5785.18	5.58	2374.19	3410.99
Height after Consolidation	5.964	360	360	212	201	0.06036	0.043215	4568	47.4	17.40	2505.60	0.55	993.60	5561.34	5.60	2283.87	3277.47
Area after Consolidation	0.040606	400	400	209	198	0.06707	0.043526	4456	47.5	17.50	2520.00	0.57	979.20	5435.54	5.55	2228.17	3207.37
Youngs Modulus for membrane(lbs/in2)	200	450	450	205	194	0.07545	0.043920	4313	47.6	17.60	2534.40	0.59	964.80	5277.60	5.47	2156.40	3121.20
Membrane Thickness in.	0.012	529	529	198	187	0.08870	0.044559	4074	47.7	17.70	2548.80	0.63	950.40	5024.50	5.29	2037.05	2987.45
		550	550	197	186	0.09222	0.044731	4031	47.7	17.70	2548.80	0.63	950.40	4981.06	5.24	2015.33	2965.73
		600	600	195	184	0.10060	0.045148	3936	47.9	17.90	2577.60	0.65	921.60	4857.98	5.27	1968.19	2889.79
		650	650	194	183	0.10899	0.045573	3865	47.9	17.90	2577.60	0.67	921.60	4786.45	5.19	1932.43	2854.03
		705	705	191	180	0.11821	0.046050	3745	48.0	18.00	2592.00	0.69	907.20	4652.60	5.13	1872.70	2779.90
		810	810	191	180	0.13581	0.046988	3643	48.2	18.20	2620.80	0.72	878.40	4521.42	5.15	1821.51	2699.91
		900	900	191	180	0.15091	0.047823	3555	48.3	18.30	2635.20	0.74	864.00	4419.26	5.11	1777.63	2641.63
		1000	1000	191	180	0.16767	0.048786	3458	48.3	18.30	2635.20	0.76	864.00	4321.76	5.00	1728.88	2592.88

WSDOT Special Projects
Landau Associates

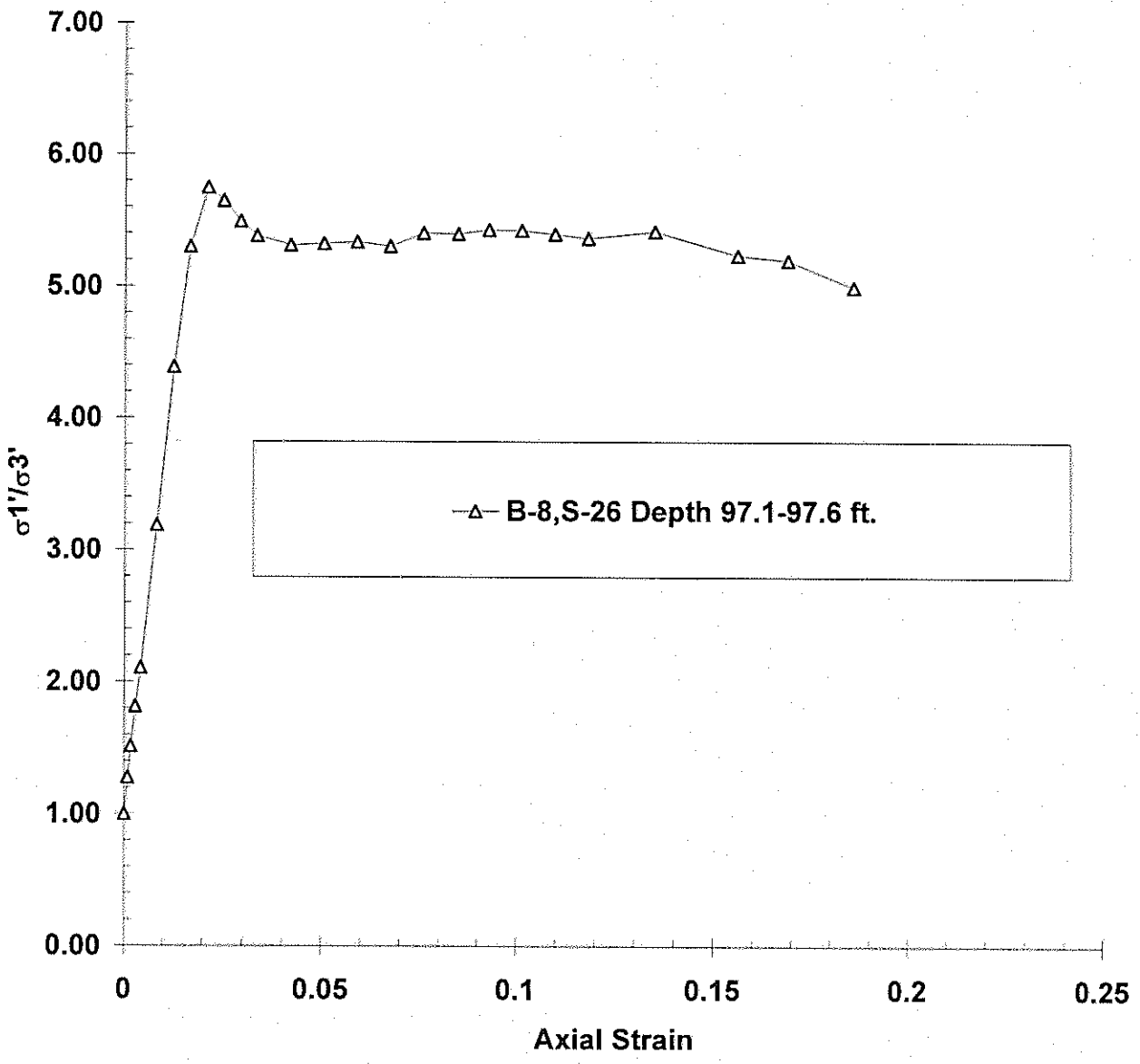


Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-8	S-26	97.1-97.6	79	78	NT	NT	NT	97	54	17.4	47.4	30

Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Assoicates

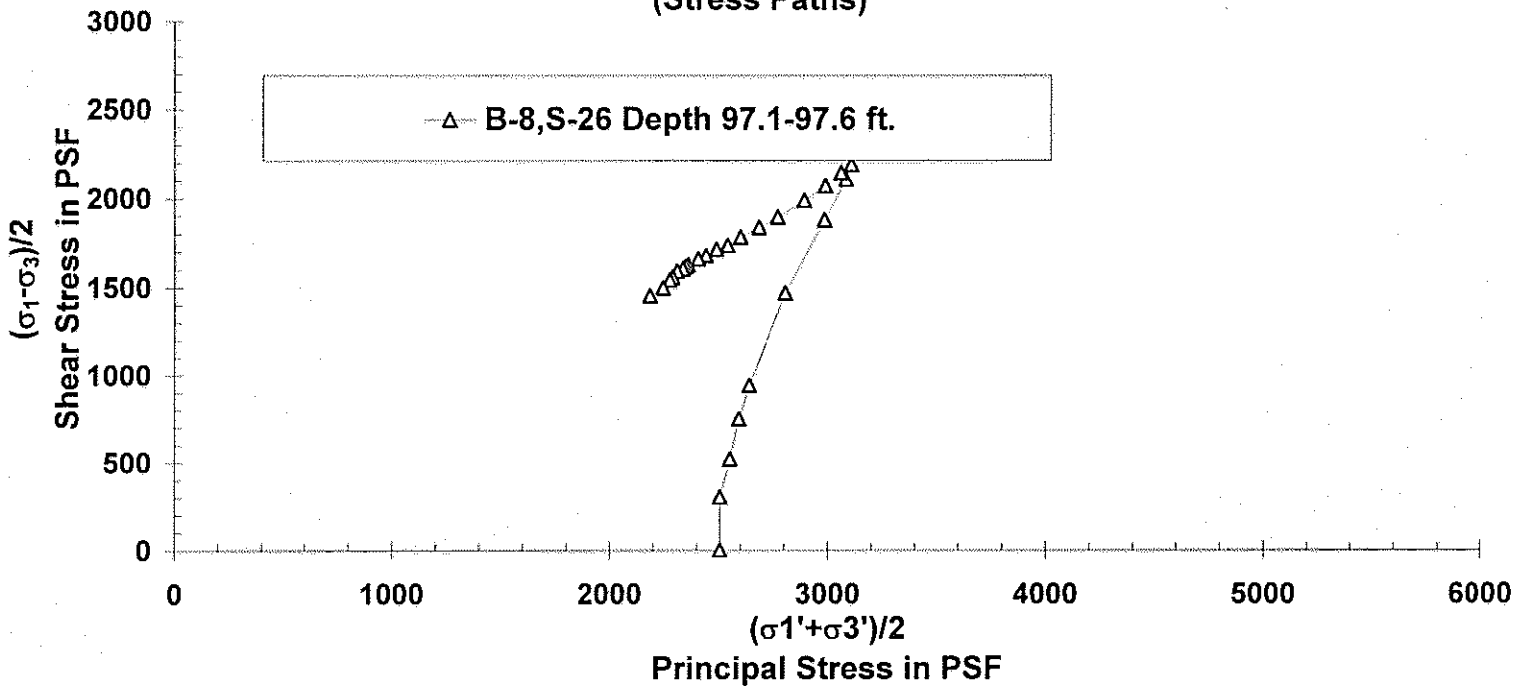
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)

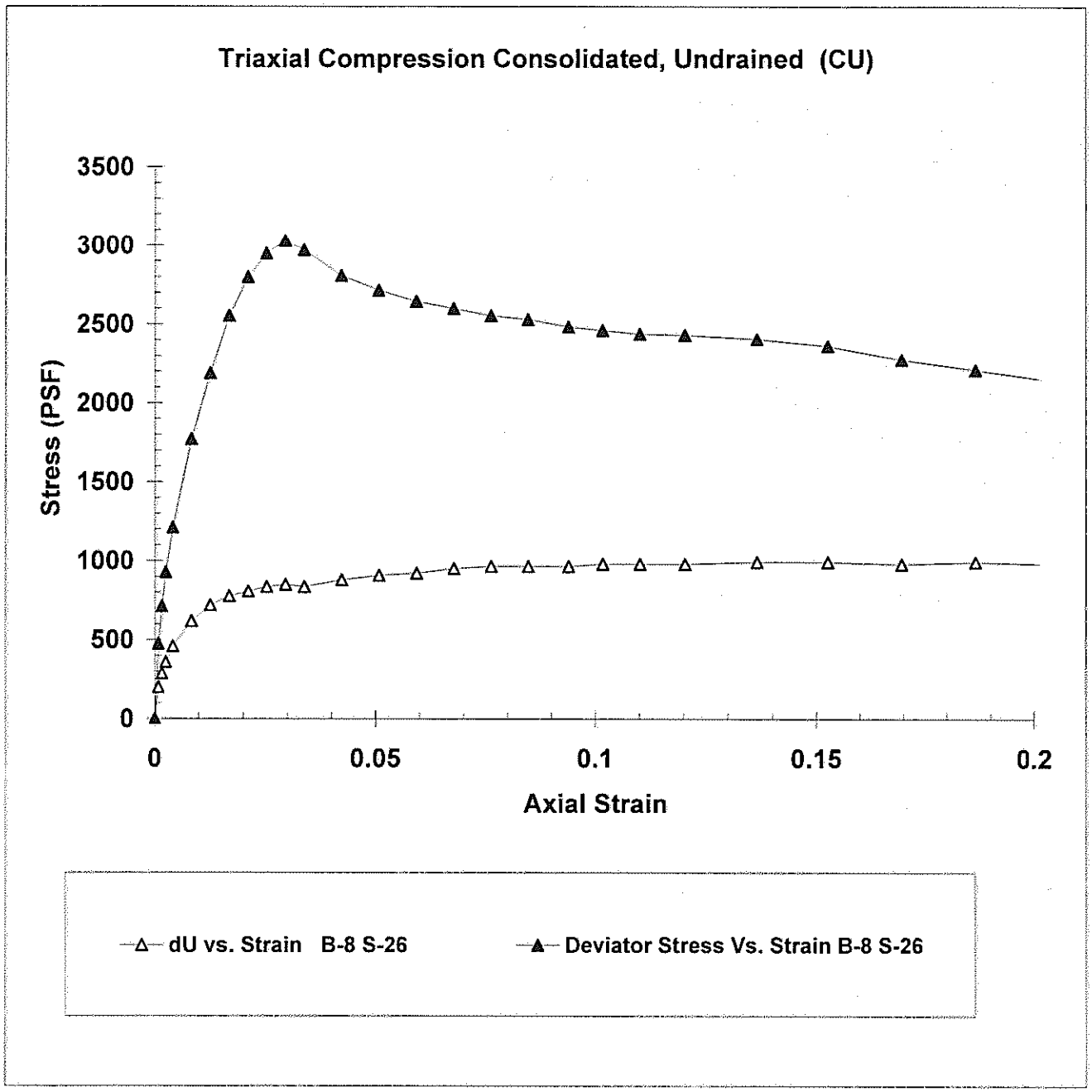


Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	9	0	0	0.041090	0	30.0	0.00	0.00	#DIV/0!	2505.60	2505.60	1.00	0.00	2505.60
Exploration #	B-8	5	5	34	25	0.00085	0.041125	607	32.1	2.10	302.40	0.50	2203.20	2809.93	1.28	303.37	2506.57
Sample ID #	S-26	10	10	52	43	0.00169	0.041160	1042	33.3	3.30	475.20	0.46	2030.40	3072.77	1.51	521.18	2551.58
Sample Depth (ft)	97.1-97.6	17	17	71	62	0.00288	0.041209	1501	34.6	4.60	662.40	0.44	1843.20	3343.76	1.81	750.28	2593.48
Type of Test	CU	25	25	87	78	0.00423	0.041265	1884	35.6	5.60	806.40	0.43	1699.20	3583.59	2.11	942.19	2641.39
Cell Pressure (psi)	47.4	50	50	131	122	0.00846	0.041441	2932	38.1	8.10	1166.40	0.40	1339.20	4271.46	3.19	1466.13	2805.33
Back Pressure (psi)	30	75	75	166	157	0.01269	0.041618	3755	39.7	9.70	1396.80	0.37	1108.80	4863.63	4.39	1877.42	2986.22
Strain Rate (in/min)	0.004	100	100	186	177	0.01692	0.041797	4211	40.6	10.60	1526.40	0.36	979.20	5190.52	5.30	2105.66	3084.86
Initial Platen Reading (in x 10^{-3})	0	127	127	194	185	0.02149	0.041993	4376	41.0	11.00	1584.00	0.36	921.60	5297.43	5.75	2187.92	3109.52
Initial Load Cell Reading (lbs)	9	150	150	191	182	0.02538	0.042160	4282	41.0	11.00	1584.00	0.37	921.60	5203.38	5.65	2140.89	3062.49
Date	########	175	175	186	177	0.02961	0.042344	4139	41.0	11.00	1584.00	0.38	921.60	5060.71	5.49	2069.56	2991.16
Test by	RGS	200	200	180	171	0.03384	0.042529	3974	41.1	11.10	1598.40	0.40	907.20	4881.16	5.38	1986.98	2894.18
Initial Length (in)	5.99	250	250	174	165	0.04230	0.042905	3787	41.3	11.30	1627.20	0.43	878.40	4665.62	5.31	1893.61	2772.01
Area (ft^2)	0.043888	300	300	171	162	0.05076	0.043288	3672	41.5	11.50	1656.00	0.45	849.60	4521.84	5.32	1836.12	2685.72
Height after Consolidation	5.91	350	350	168	159	0.05922	0.043677	3559	41.7	11.70	1684.80	0.47	820.80	4379.31	5.34	1779.25	2600.05
Area after Consolidation	0.04109	400	400	166	157	0.06768	0.044073	3469	41.8	11.80	1699.20	0.49	806.40	4275.10	5.30	1734.35	2540.75
Youngs Modulus for membrane(lbs/in2)	200	450	450	166	157	0.07614	0.044477	3425	42.0	12.00	1728.00	0.50	777.60	4202.27	5.40	1712.34	2489.94
Membrane Thickness in.	0.012	503	503	165	156	0.08511	0.044913	3356	42.1	12.10	1742.40	0.52	763.20	4118.95	5.40	1677.87	2441.07
		550	550	165	156	0.09306	0.045307	3315	42.2	12.20	1756.80	0.53	748.80	4063.36	5.43	1657.28	2406.08
		600	600	164	155	0.10152	0.045733	3249	42.3	12.30	1771.20	0.55	734.40	3983.28	5.42	1624.44	2358.84
		650	650	165	156	0.10998	0.046168	3227	42.3	12.30	1771.20	0.55	734.40	3951.33	5.39	1613.47	2347.87
		700	700	166	157	0.11844	0.046611	3205	42.3	12.30	1771.20	0.55	734.40	3938.97	5.36	1602.29	2336.69
		800	800	169	160	0.13536	0.047523	3180	42.4	12.40	1785.60	0.56	720.00	3899.66	5.42	1589.83	2309.83
		924	924	171	162	0.15635	0.048705	3110	42.3	12.30	1771.20	0.57	734.40	3844.42	5.23	1555.01	2289.41
		1000	1000	173	164	0.16920	0.049459	3082	42.3	12.30	1771.20	0.57	734.40	3816.38	5.20	1540.99	2275.39

WSDOT Special Projects
Landau Associates

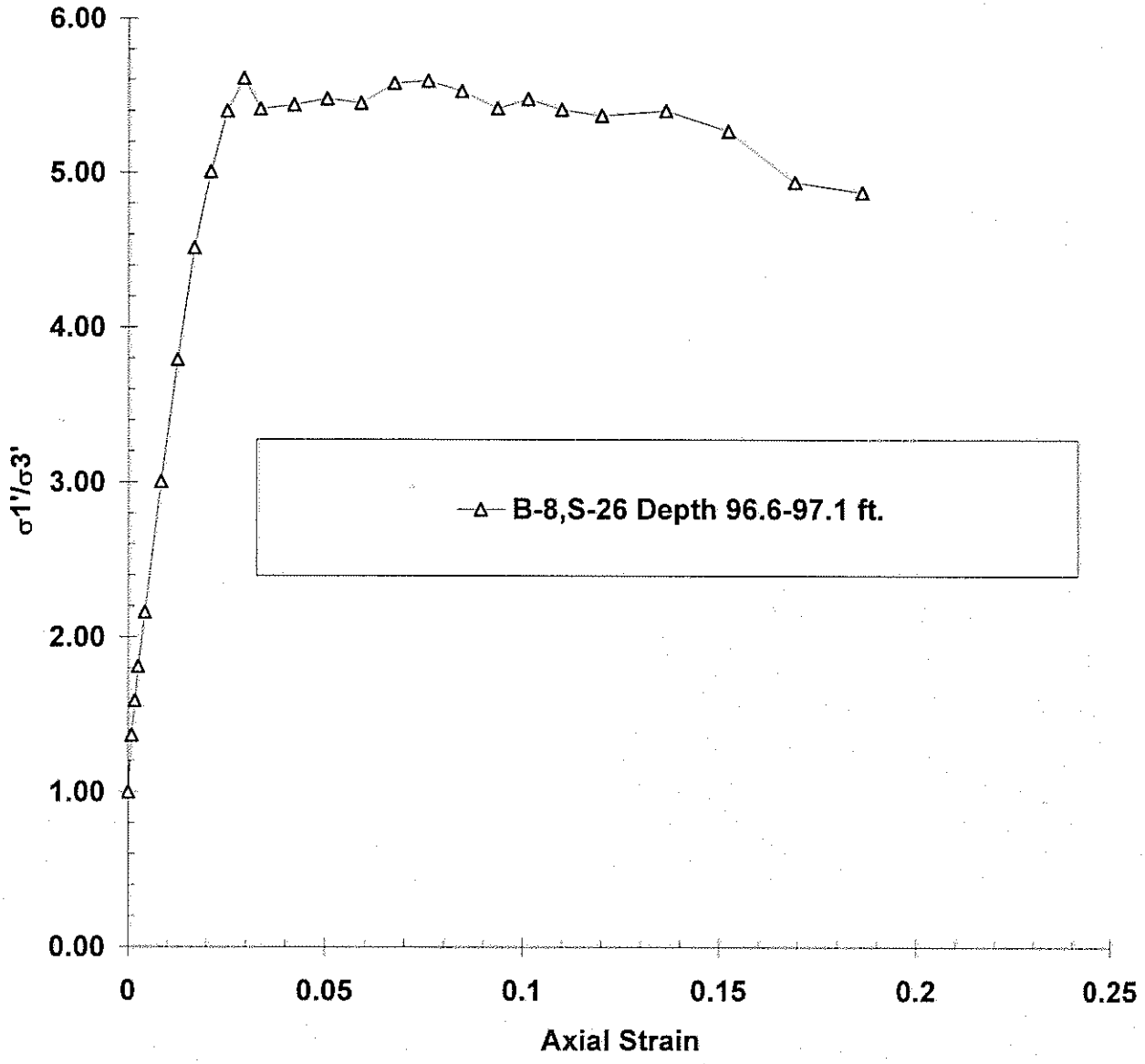


Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-8	S-26	96.6-97.1	73	73	94	42	52	96	56	10.4	50.4	40

Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Assoicates

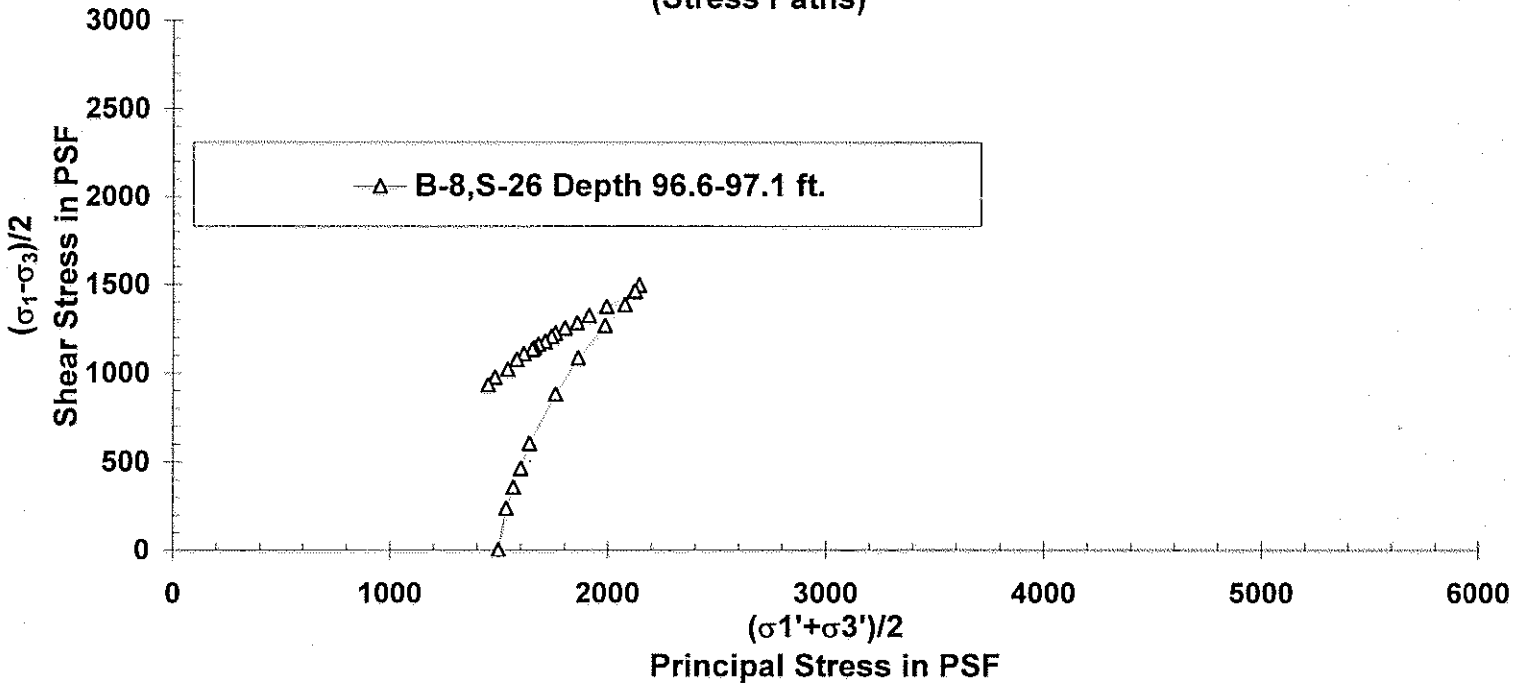
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

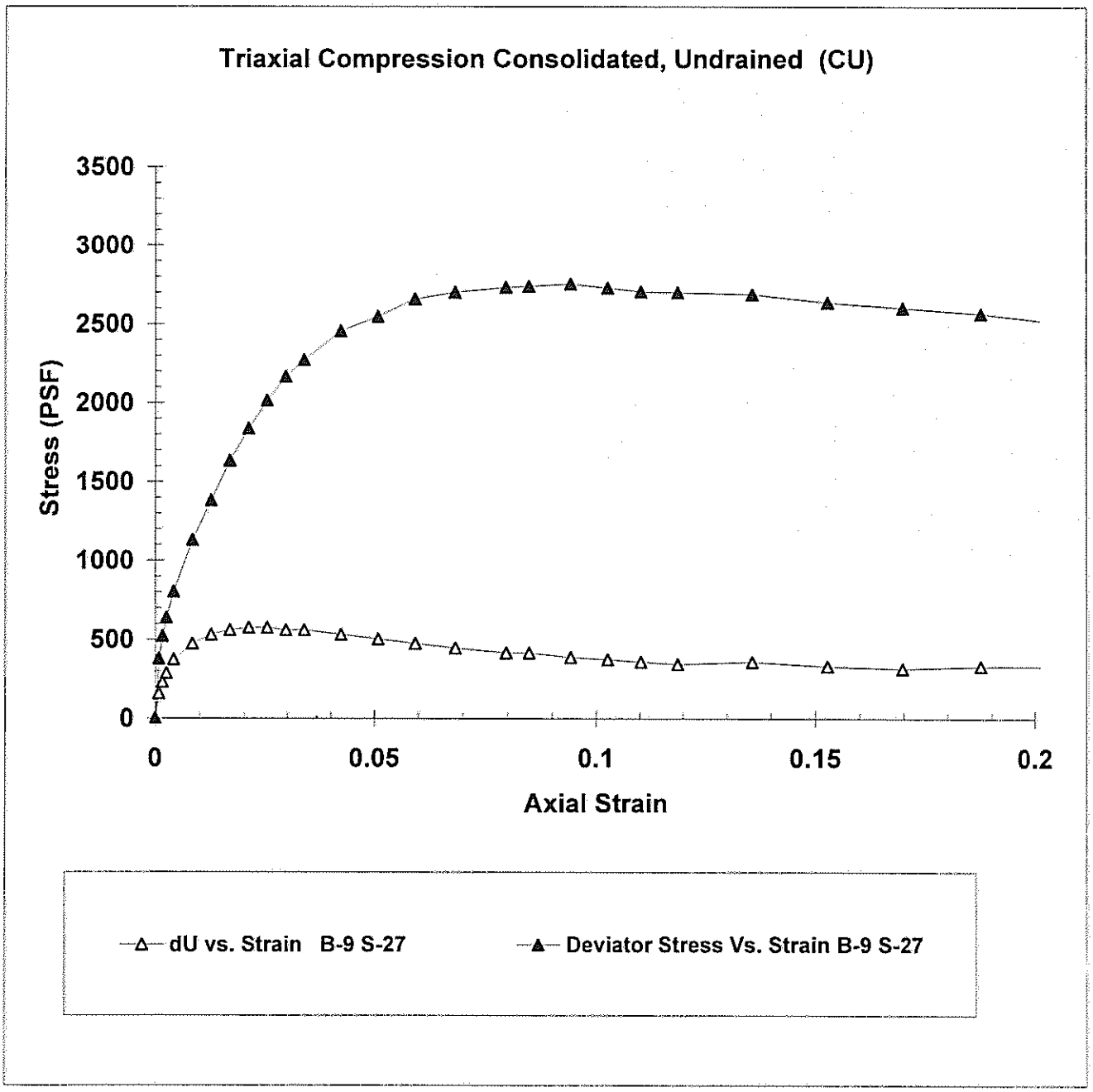
TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

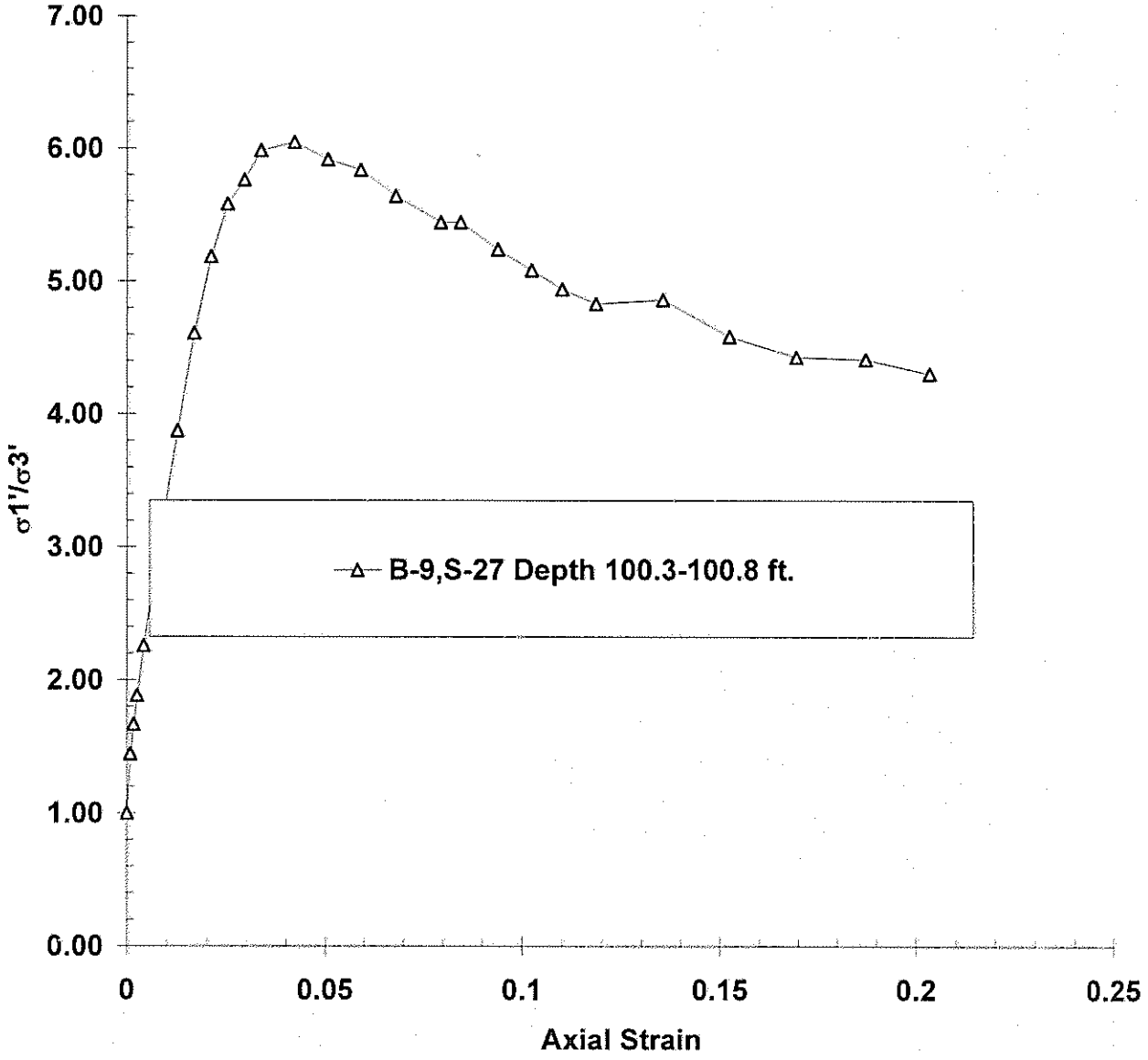
		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	11	0	0	0.041965	0	40.0	0.00	0.00	#DIV/0!	1497.60	1497.60	1.00	0.00	1497.60
Exploration #	B-8	5	5	31	20	0.00085	0.042000	475	41.4	1.40	201.60	0.42	1296.00	1771.01	1.37	237.51	1533.51
Sample ID #	S-26	10	10	41	30	0.00170	0.042036	711	42.0	2.00	288.00	0.40	1209.60	1920.93	1.59	355.66	1565.26
Sample Depth (ft)	96.6-97.1	15	15	50	39	0.00254	0.042072	923	42.5	2.50	360.00	0.39	1137.60	2061.07	1.81	461.73	1599.33
Type of Test	CU	25	25	62	51	0.00424	0.042144	1204	43.2	3.20	460.80	0.38	1036.80	2241.09	2.16	602.14	1638.94
Cell Pressure (psi)	50.4	50	50	86	75	0.00848	0.042324	1760	44.3	4.30	619.20	0.35	878.40	2638.73	3.00	880.17	1758.57
Back Pressure (psi)	40	75	75	104	93	0.01272	0.042506	2170	45.0	5.00	720.00	0.33	777.60	2947.96	3.79	1085.18	1862.78
Strain Rate (in/min)	0.004	100	100	120	109	0.01696	0.042689	2530	45.4	5.40	777.60	0.31	720.00	3249.91	4.51	1264.96	1984.96
Initial Platen Reading (in x 10^{-3})	0	125	125	131	120	0.02120	0.042874	2770	45.6	5.60	806.40	0.29	691.20	3460.80	5.01	1384.80	2076.00
Initial Load Cell Reading (lbs)	11	150	150	138	127	0.02544	0.043060	2914	45.8	5.80	835.20	0.29	662.40	3576.58	5.40	1457.09	2119.49
Date	10/9/2006	175	175	142	131	0.02968	0.043249	2988	45.9	5.90	849.60	0.28	648.00	3635.97	5.61	1493.98	2141.98
Test by	RGS	200	200	140	129	0.03392	0.043438	2923	45.8	5.80	835.20	0.29	662.40	3585.23	5.41	1461.41	2123.81
Initial Length (in)	5.9666	250	250	134	123	0.04240	0.043823	2748	46.1	6.10	878.40	0.32	619.20	3367.32	5.44	1374.06	1993.26
Area (ft^2)	0.04425	300	300	131	120	0.05089	0.044215	2644	46.3	6.30	907.20	0.34	590.40	3234.09	5.48	1321.84	1912.24
Height after Consolidation	5.8956	350	350	129	118	0.05937	0.044613	2563	46.4	6.40	921.60	0.36	576.00	3138.88	5.45	1281.44	1857.44
Area after Consolidation	0.041965	400	400	128	117	0.06785	0.045019	2505	46.6	6.60	950.40	0.38	547.20	3052.30	5.58	1252.55	1799.75
Youngs Modulus for membrane(lbs/in2)	200	450	450	127	116	0.07633	0.045433	2448	46.7	6.70	964.80	0.39	532.80	2980.52	5.59	1223.86	1756.66
Membrane Thickness in.	0.012	500	500	127	116	0.08481	0.045854	2413	46.7	6.70	964.80	0.40	532.80	2945.35	5.53	1206.28	1739.08
		554	554	126	115	0.09397	0.046317	2353	46.7	6.70	964.80	0.41	532.80	2885.78	5.42	1176.49	1709.29
		600	600	126	115	0.10177	0.046719	2321	46.8	6.80	979.20	0.42	518.40	2839.21	5.48	1160.41	1678.81
		650	650	126	115	0.11025	0.047165	2286	46.8	6.80	979.20	0.43	518.40	2804.25	5.41	1142.92	1661.32
		710	710	127	116	0.12043	0.047711	2265	46.8	6.80	979.20	0.43	518.40	2783.25	5.37	1132.42	1650.82
		806	806	128	117	0.13671	0.048610	2218	46.9	6.90	993.60	0.45	504.00	2721.90	5.40	1108.95	1612.95
		900	900	128	117	0.15266	0.049525	2151	46.9	6.90	993.60	0.46	504.00	2655.41	5.27	1075.70	1579.70
		1000	1000	126	115	0.16962	0.050537	2041	46.8	6.80	979.20	0.48	518.40	2559.49	4.94	1020.55	1538.95



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-9	S-27	100.3-100.8	60	58	65	42	23	104	65	7	47	40

WSDOT Grays Harbor Special Projects
Landau Assoicates

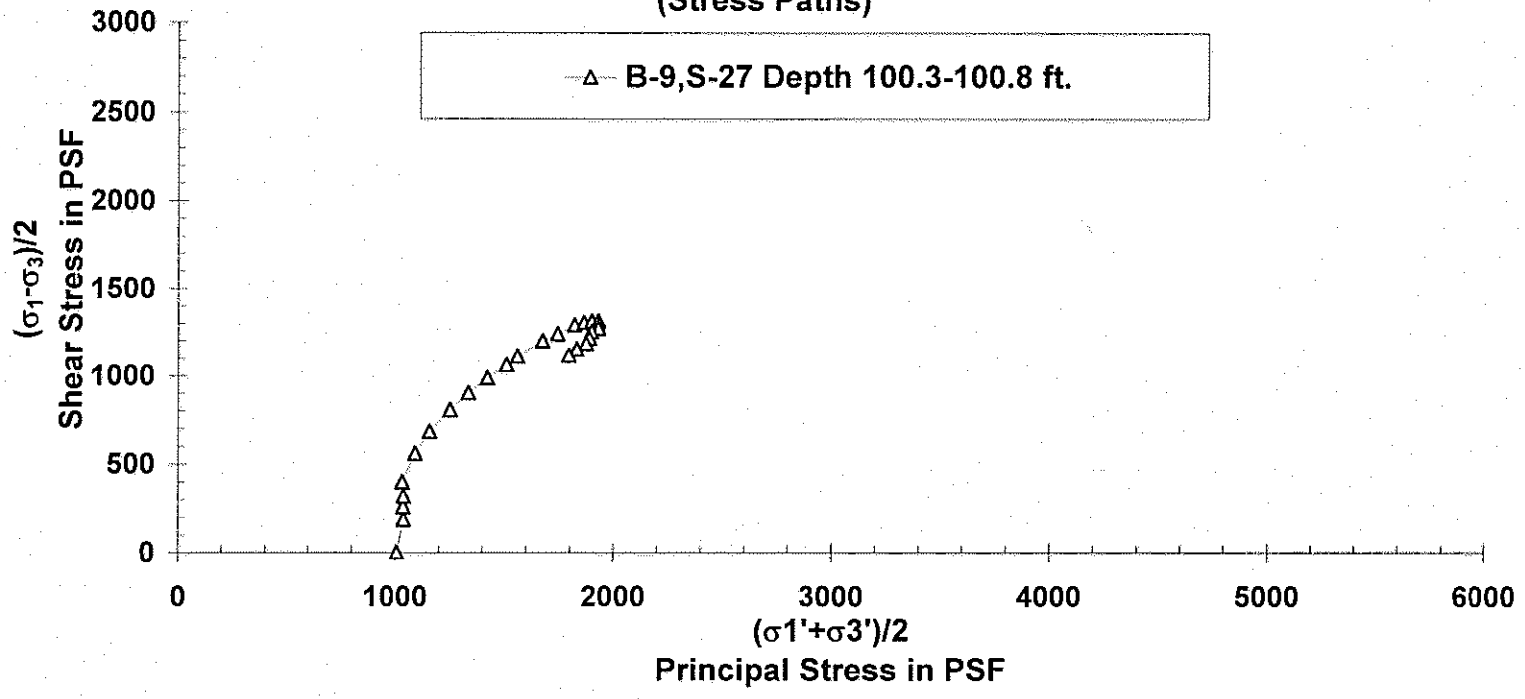
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

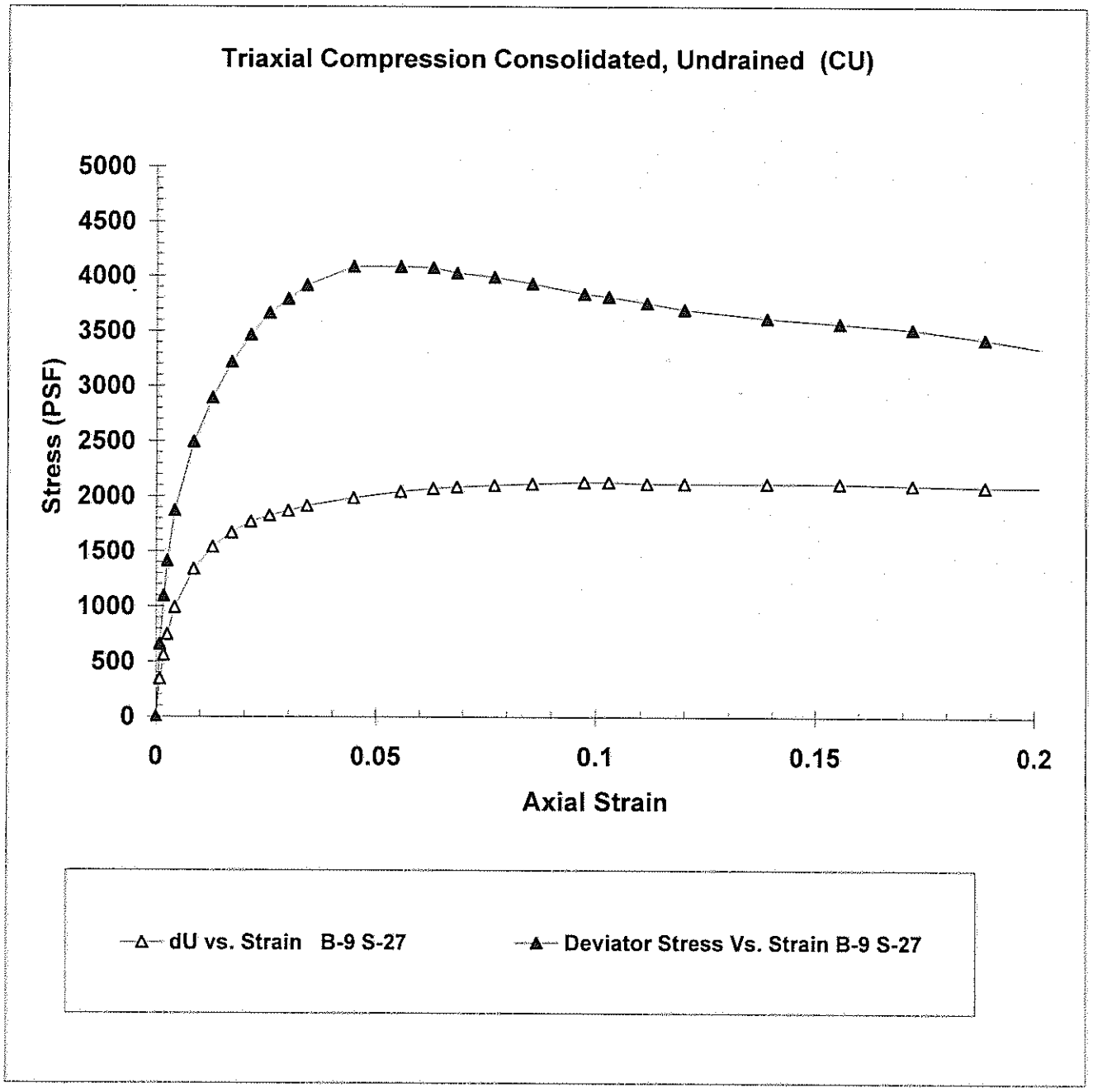
TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

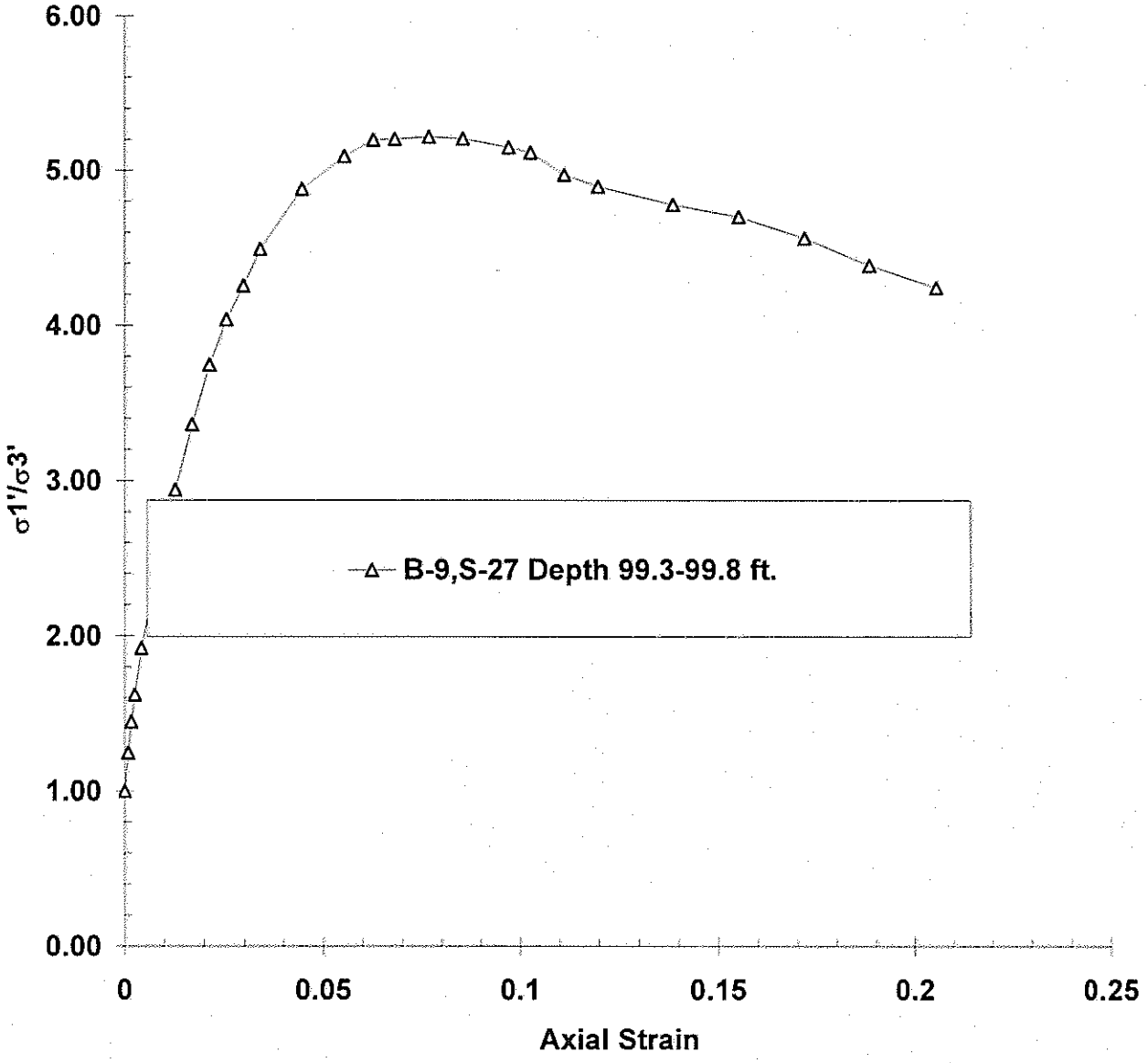
		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	9	0	0	0.042087	0	40.0	0.00	0.00	#DIV/0!	1008.00	1008.00	1.00	0.00	1008.00
Exploration #	B-9	5	5	25	16	0.00085	0.042123	379	41.1	1.10	158.40	0.42	849.60	1228.27	1.45	189.34	1038.94
Sample ID #	S-27	10	10	31	22	0.00170	0.042158	519	41.6	1.60	230.40	0.44	777.60	1297.09	1.67	259.75	1037.35
Sample Depth (ft)	100.3-100.8	15	15	36	27	0.00255	0.042194	636	42.0	2.00	288.00	0.45	720.00	1356.38	1.88	318.19	1038.19
Type of Test	CU	25	25	43	34	0.00424	0.042266	799	42.6	2.60	374.40	0.47	633.60	1432.16	2.26	399.28	1032.88
Cell Pressure (psi)	47	50	50	57	48	0.00849	0.042447	1119	43.3	3.30	475.20	0.42	532.80	1651.89	3.10	559.54	1092.34
Back Pressure (psi)	40	75	75	68	59	0.01273	0.042630	1366	43.7	3.70	532.80	0.39	475.20	1841.62	3.88	683.21	1158.41
Strain Rate (in/min)	0.004	100	100	79	70	0.01697	0.042814	1612	43.9	3.90	561.60	0.35	446.40	2057.93	4.61	805.77	1252.17
Initial Platen Reading (in x 10^{-3})	0	125	125	88	79	0.02122	0.042999	1808	44.0	4.00	576.00	0.32	432.00	2239.92	5.18	903.96	1335.96
Initial Load Cell Reading (lbs)	9	150	150	96	87	0.02546	0.043186	1979	44.0	4.00	576.00	0.29	432.00	2411.33	5.58	989.67	1421.67
Date	########	175	175	103	94	0.02970	0.043375	2126	43.9	3.90	561.60	0.26	446.40	2572.48	5.76	1063.04	1509.44
Test by	RGS	200	200	108	99	0.03394	0.043566	2226	43.9	3.90	561.60	0.25	446.40	2671.90	5.99	1112.75	1559.15
Initial Length (in)	5.9883	250	250	117	108	0.04243	0.043952	2399	43.7	3.70	532.80	0.22	475.20	2873.78	6.05	1199.29	1674.49
Area (ft^2)	0.044094	300	300	122	113	0.05092	0.044345	2478	43.5	3.50	504.00	0.20	504.00	2981.83	5.92	1238.91	1742.91
Height after Consolidation	5.892	350	350	128	119	0.05940	0.044745	2577	43.3	3.30	475.20	0.18	532.80	3110.21	5.84	1288.70	1821.50
Area after Consolidation	0.042087	403	403	131	122	0.06840	0.045177	2606	43.1	3.10	446.40	0.17	561.60	3167.54	5.64	1302.97	1864.57
Youngs Modulus for membrane(lbs/in2)	200	470	470	134	125	0.07977	0.045735	2623	42.9	2.90	417.60	0.16	590.40	3213.25	5.44	1311.43	1901.83
Membrane Thickness in.	0.012	500	500	135	126	0.08486	0.045990	2622	42.9	2.90	417.60	0.16	590.40	3212.84	5.44	1311.22	1901.62
		555	555	137	128	0.09420	0.046464	2625	42.7	2.70	388.80	0.15	619.20	3243.83	5.24	1312.32	1931.52
		605	605	137	128	0.10268	0.046903	2587	42.6	2.60	374.40	0.14	633.60	3220.69	5.08	1293.55	1927.15
		650	650	137	128	0.11032	0.047306	2553	42.5	2.50	360.00	0.14	648.00	3201.30	4.94	1276.65	1924.65
		700	700	138	129	0.11881	0.047761	2537	42.4	2.40	345.60	0.14	662.40	3199.10	4.83	1268.35	1930.75
		800	800	140	131	0.13578	0.048699	2502	42.5	2.50	360.00	0.14	648.00	3150.29	4.86	1251.14	1899.14
		900	900	140	131	0.15275	0.049675	2426	42.3	2.30	331.20	0.14	676.80	3102.80	4.58	1213.00	1889.80
		1000	1000	141	132	0.16972	0.050690	2369	42.2	2.20	316.80	0.13	691.20	3060.64	4.43	1184.72	1875.92



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-9	S-27	99.3-99.8	63	58	NT	NT	NT	100	61	21	51	30

WSDOT Grays Harbor Special Projects
Landau Assoicates

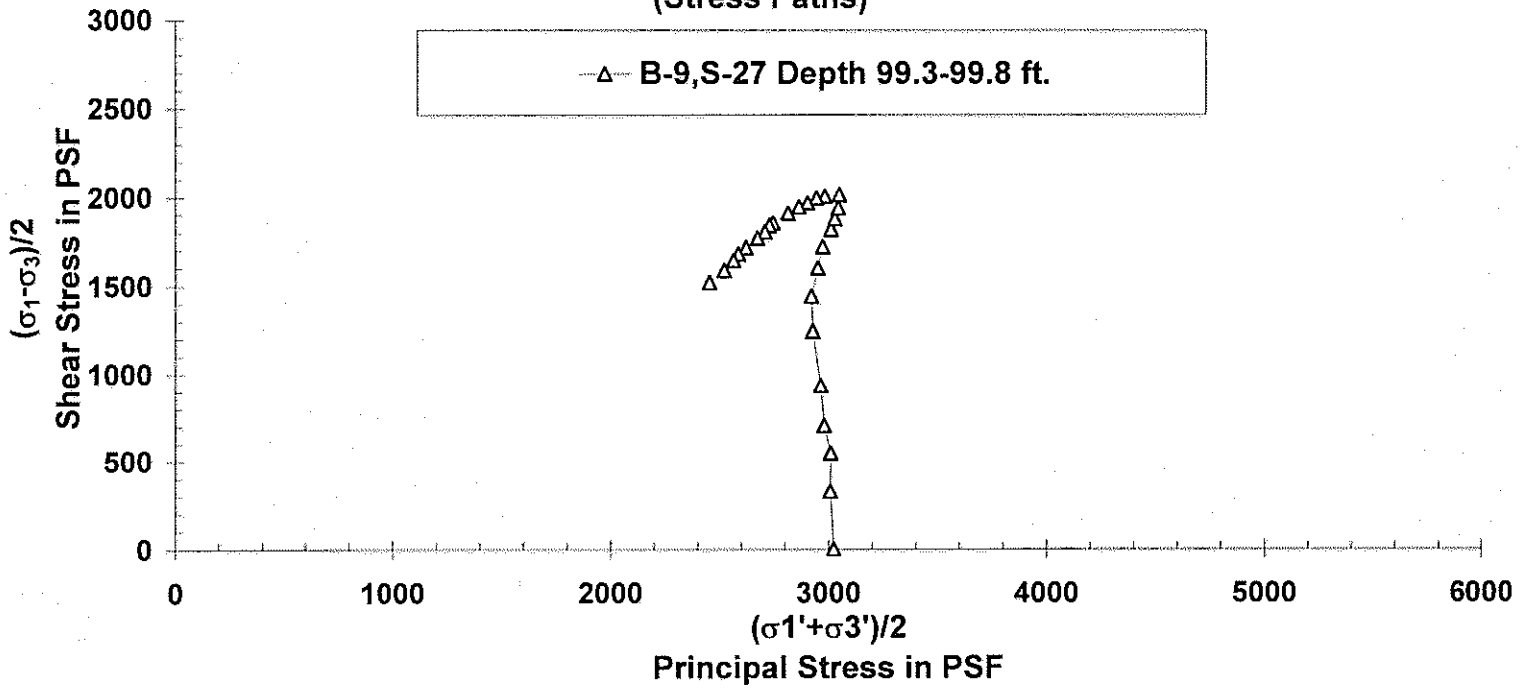
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

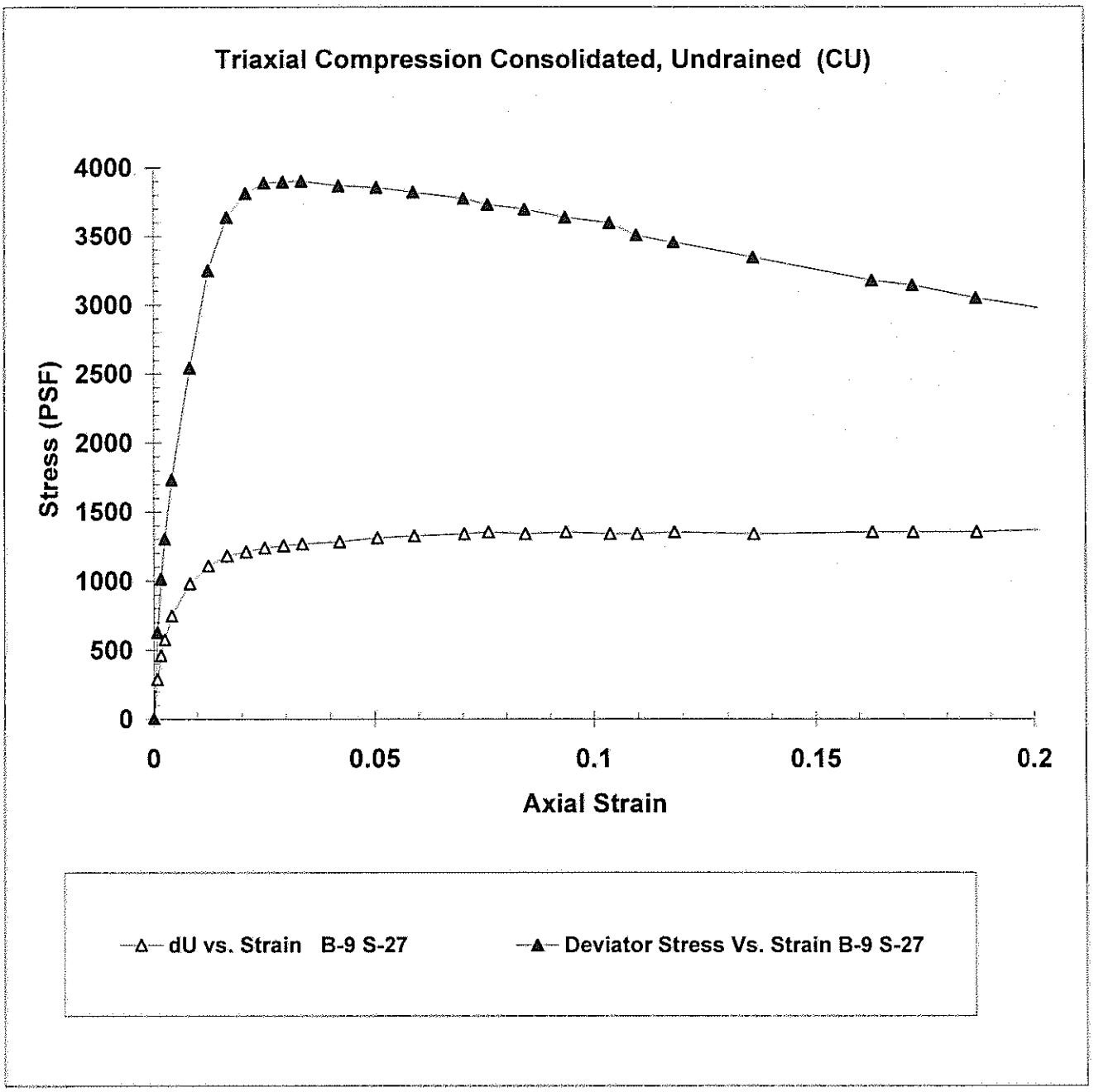
TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

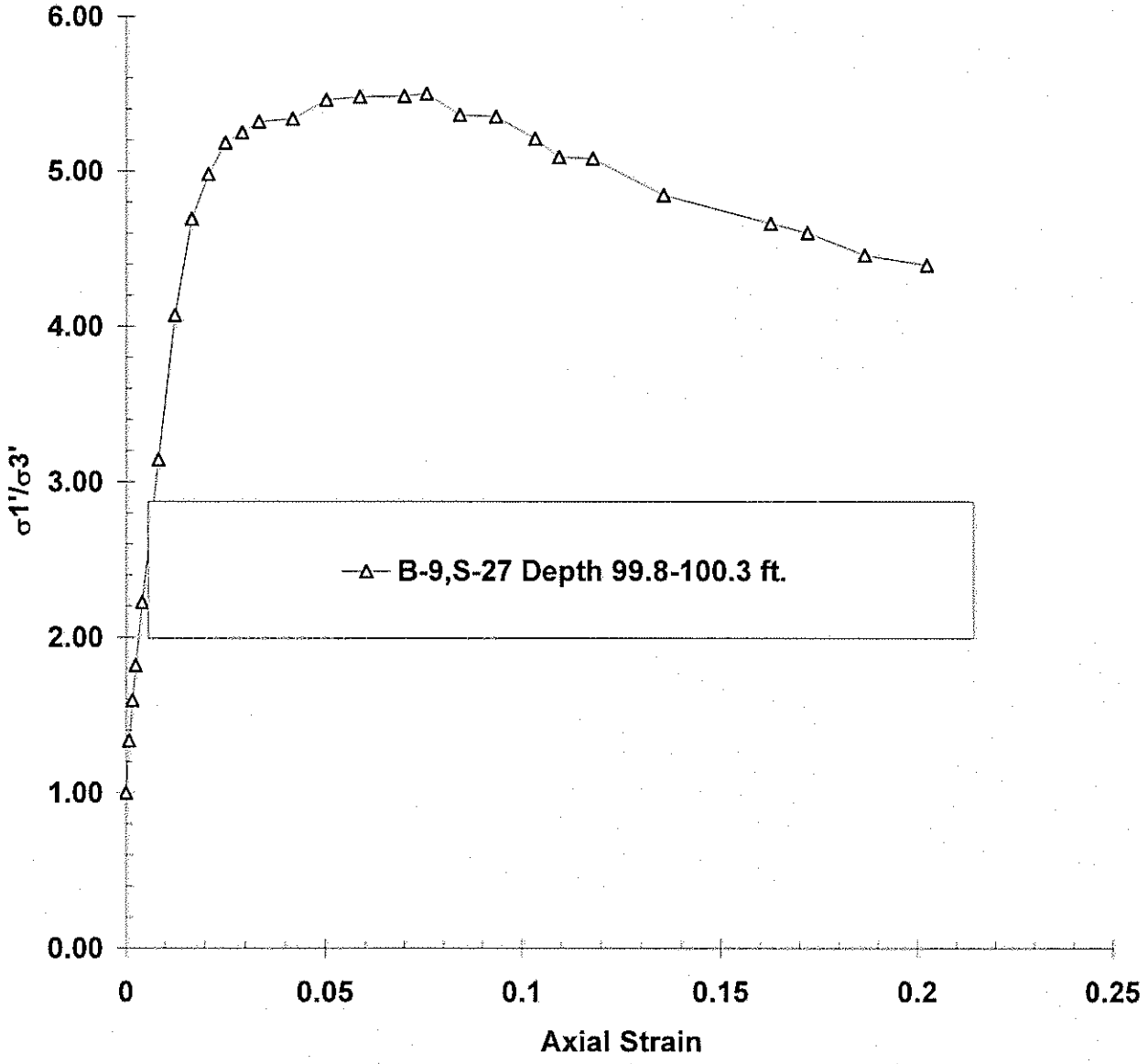
		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	11	0	0	0.040911	0	30.0	0.00	0.00	#DIV/0!	3024.00	3024.00	1.00	0.00	3024.00
Exploration #	B-9	5	5	38	27	0.00086	0.040946	658	32.4	2.40	345.60	0.53	2678.40	3336.63	1.25	329.11	3007.51
Sample ID #	S-27	10	10	56	45	0.00171	0.040981	1096	33.9	3.90	561.60	0.51	2462.40	3558.10	1.44	547.85	3010.25
Sample Depth (ft)	99.3-99.8	15	15	69	58	0.00257	0.041016	1411	35.2	5.20	748.80	0.53	2275.20	3685.73	1.62	705.26	2980.46
Type of Test	CU	25	25	88	77	0.00429	0.041087	1868	36.9	6.90	993.60	0.53	2030.40	3898.56	1.92	934.08	2964.48
Cell Pressure (psi)	51	50	50	114	103	0.00857	0.041264	2484	39.3	9.30	1339.20	0.54	1684.80	4169.05	2.47	1242.12	2926.92
Back Pressure (psi)	30	75	75	131	120	0.01286	0.041444	2878	40.7	10.70	1540.80	0.54	1483.20	4360.92	2.94	1438.86	2922.06
Strain Rate (in/min)	0.004	100	100	145	134	0.01715	0.041624	3196	41.6	11.60	1670.40	0.52	1353.60	4549.16	3.36	1597.78	2951.38
Initial Platen Reading (in x 10^{-3})	0	125	125	156	145	0.02144	0.041807	3439	42.3	12.30	1771.20	0.52	1252.80	4691.51	3.74	1719.35	2972.15
Initial Load Cell Reading (lbs)	11	150	150	165	154	0.02572	0.041991	3632	42.7	12.70	1828.80	0.50	1195.20	4827.12	4.04	1815.96	3011.16
Date	########	175	175	171	160	0.03001	0.042176	3752	43.0	13.00	1872.00	0.50	1152.00	4904.11	4.26	1876.06	3028.06
Test by	RGS	200	200	177	166	0.03430	0.042364	3871	43.3	13.30	1915.20	0.49	1108.80	4979.85	4.49	1935.52	3044.32
Initial Length (in)	6	262	262	186	175	0.04493	0.042835	4023	43.8	13.80	1987.20	0.49	1036.80	5060.11	4.88	2011.66	3048.46
Area (ft^2)	0.043939	325	325	188	177	0.05574	0.043325	4008	44.2	14.20	2044.80	0.51	979.20	4987.52	5.09	2004.16	2983.36
Height after Consolidation	5.831	368	368	189	178	0.06311	0.043666	3989	44.4	14.40	2073.60	0.52	950.40	4939.52	5.20	1994.56	2944.96
Area after Consolidation	0.040911	400	400	188	177	0.06860	0.043924	3935	44.5	14.50	2088.00	0.53	936.00	4870.89	5.20	1967.45	2903.45
Youngs Modulus for membrane(lbs/in2)	200	450	450	188	177	0.07717	0.044332	3886	44.6	14.60	2102.40	0.54	921.60	4807.54	5.22	1942.97	2864.57
Membrane Thickness in.	0.012	500	500	187	176	0.08575	0.044748	3815	44.7	14.70	2116.80	0.55	907.20	4721.94	5.20	1907.32	2814.52
		568	568	185	174	0.09741	0.045326	3704	44.8	14.80	2131.20	0.58	892.80	4597.02	5.15	1852.11	2744.91
		600	600	185	174	0.10290	0.045603	3673	44.8	14.80	2131.20	0.58	892.80	4566.09	5.11	1836.65	2729.45
		650	650	184	173	0.11147	0.046043	3603	44.7	14.70	2116.80	0.59	907.20	4510.45	4.97	1801.63	2708.83
		700	700	183	172	0.12005	0.046492	3534	44.7	14.70	2116.80	0.60	907.20	4440.83	4.90	1766.81	2674.01
		810	810	183	172	0.13891	0.047510	3428	44.7	14.70	2116.80	0.62	907.20	4335.44	4.78	1714.12	2621.32
		907	907	184	173	0.15555	0.048446	3356	44.7	14.70	2116.80	0.63	907.20	4263.14	4.70	1677.97	2585.17
		1004	1004	185	174	0.17218	0.049420	3283	44.6	14.60	2102.40	0.64	921.60	4204.43	4.56	1641.42	2563.02



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-9	S-27	99.8-100.3	60	58	NT	NT	NT	103	64	15	55	40

WSDOT Grays Harbor Special Projects
Landau Assoicates

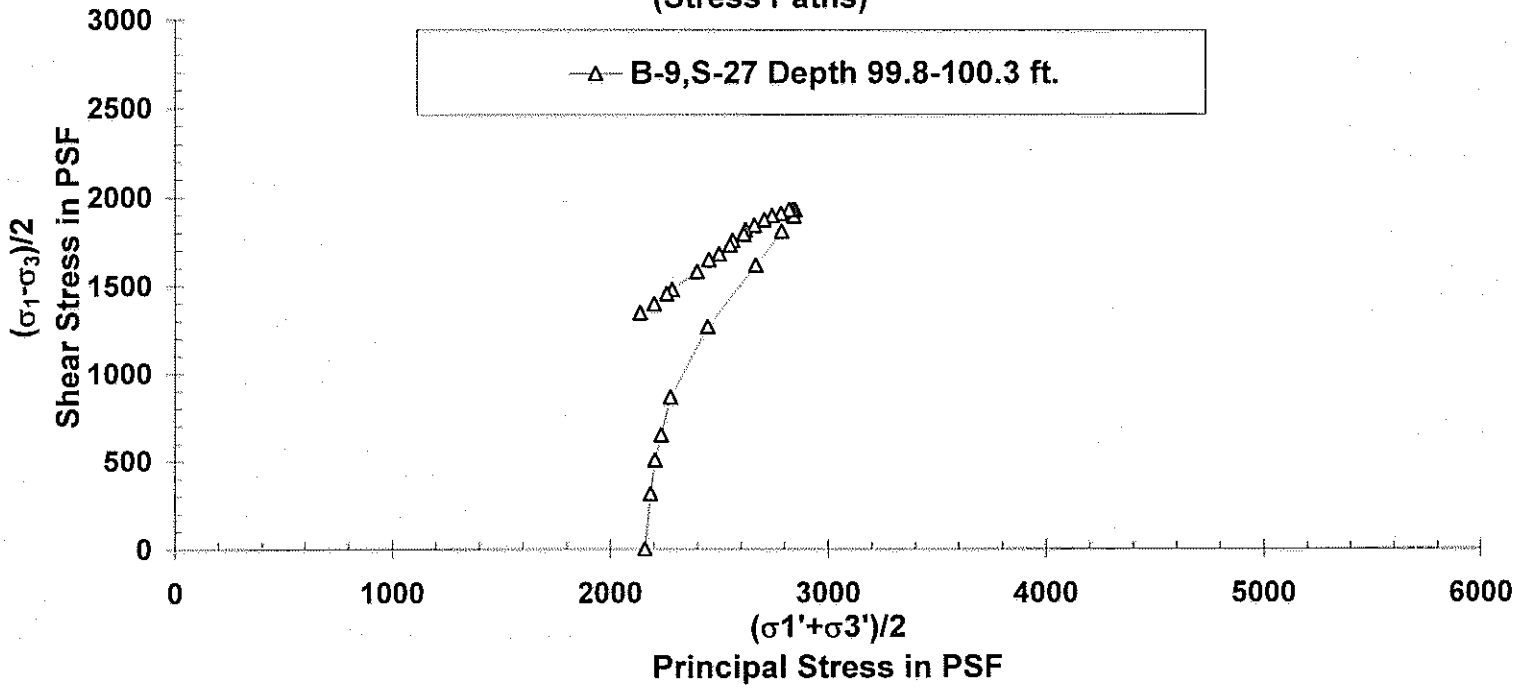
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)

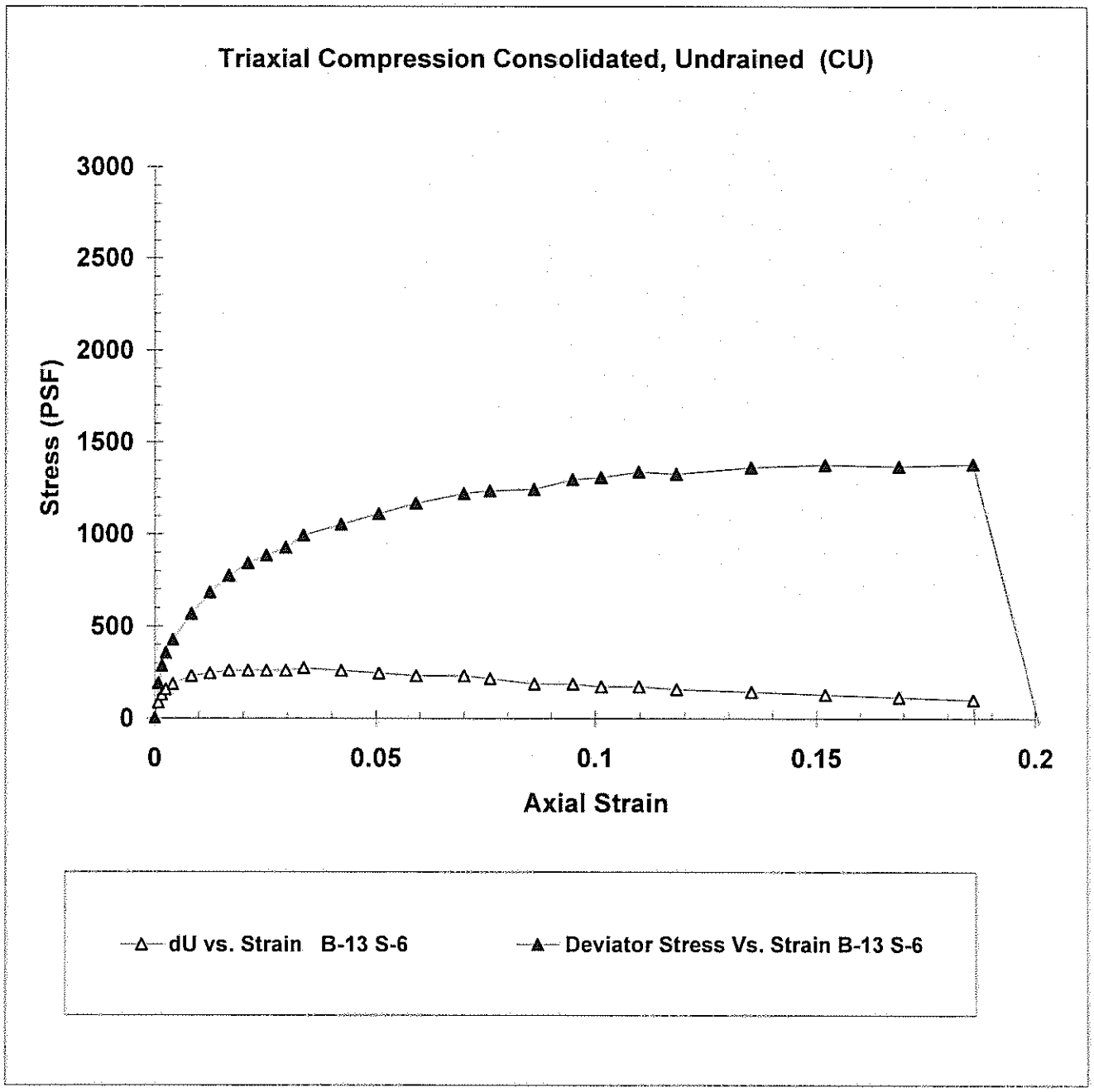


Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	11	0	0	0.041346	0	40.0	0.00	0.00	#DIV/0!	2160.00	2160.00	1.00	0.00	2160.00
Exploration #	B-9	5	5	37	26	0.00085	0.041381	627	42.0	2.00	288.00	0.46	1872.00	2499.13	1.34	313.57	2185.57
Sample ID #	S-27	10	10	53	42	0.00169	0.041416	1012	43.2	3.20	460.80	0.46	1699.20	2710.96	1.60	505.88	2205.08
Sample Depth (ft)	99.8-100.3	15	15	65	54	0.00254	0.041451	1299	44.0	4.00	576.00	0.44	1584.00	2883.22	1.82	649.61	2233.61
Type of Test	CU	25	25	83	72	0.00423	0.041522	1728	45.2	5.20	748.80	0.43	1411.20	3139.39	2.22	864.09	2275.29
Cell Pressure (psi)	55	50	50	117	106	0.00845	0.041699	2530	46.8	6.80	979.20	0.39	1180.80	3711.16	3.14	1265.18	2445.98
Back Pressure (psi)	40	75	75	147	136	0.01268	0.041877	3230	47.7	7.70	1108.80	0.34	1051.20	4281.26	4.07	1615.03	2666.23
Strain Rate (in/min)	0.004	100	100	164	153	0.01691	0.042057	3615	48.2	8.20	1180.80	0.33	979.20	4593.72	4.69	1807.26	2786.46
Initial Platen Reading (in x 10^{-3})	0	125	125	172	161	0.02113	0.042239	3782	48.4	8.40	1209.60	0.32	950.40	4732.84	4.98	1891.22	2841.62
Initial Load Cell Reading (lbs)	11	150	150	176	165	0.02536	0.042422	3854	48.6	8.60	1238.40	0.32	921.60	4776.03	5.18	1927.21	2848.81
Date	########	175	175	177	166	0.02959	0.042607	3855	48.7	8.70	1252.80	0.32	907.20	4762.39	5.25	1927.59	2834.79
Test by	RGS	200	200	178	167	0.03381	0.042793	3856	48.8	8.80	1267.20	0.33	892.80	4748.54	5.32	1927.87	2820.67
Initial Length (in)	5.99	250	250	178	167	0.04227	0.043171	3810	48.9	8.90	1281.60	0.34	878.40	4688.32	5.34	1904.96	2783.36
Area (ft^2)	0.043991	300	300	179	168	0.05072	0.043555	3787	49.1	9.10	1310.40	0.35	849.60	4636.65	5.46	1893.52	2743.12
Height after Consolidation	5.915	350	350	179	168	0.05917	0.043947	3741	49.2	9.20	1324.80	0.35	835.20	4576.21	5.48	1870.51	2705.71
Area after Consolidation	0.041346	417	417	179	168	0.07050	0.044482	3679	49.3	9.30	1339.20	0.36	820.80	4500.13	5.48	1839.67	2660.47
Youngs Modulus for membrane(lbs/in2)	200	450	450	178	167	0.07608	0.044751	3627	49.4	9.40	1353.60	0.37	806.40	4433.00	5.50	1813.30	2619.70
Membrane Thickness in.	0.012	500	500	178	167	0.08453	0.045164	3581	49.3	9.30	1339.20	0.37	820.80	4401.58	5.36	1790.39	2611.19
		555	555	177	166	0.09383	0.045627	3508	49.4	9.40	1353.60	0.39	806.40	4314.85	5.35	1754.22	2560.62
		614	614	177	166	0.10380	0.046135	3455	49.3	9.30	1339.20	0.39	820.80	4275.41	5.21	1727.31	2548.11
		650	650	174	163	0.10989	0.046451	3357	49.3	9.30	1339.20	0.40	820.80	4177.98	5.09	1678.59	2499.39
		700	700	173	162	0.11834	0.046896	3291	49.4	9.40	1353.60	0.41	806.40	4097.24	5.08	1645.42	2451.82
		805	805	171	160	0.13609	0.047860	3155	49.3	9.30	1339.20	0.42	820.80	3975.76	4.84	1577.48	2398.28
		965	965	168	157	0.16314	0.049407	2952	49.4	9.40	1353.60	0.46	806.40	3758.57	4.66	1476.09	2282.49
		1020	1020	168	157	0.17244	0.049962	2904	49.4	9.40	1353.60	0.47	806.40	3710.41	4.60	1452.01	2258.41

WSDOT Special Projects
Landau Associates

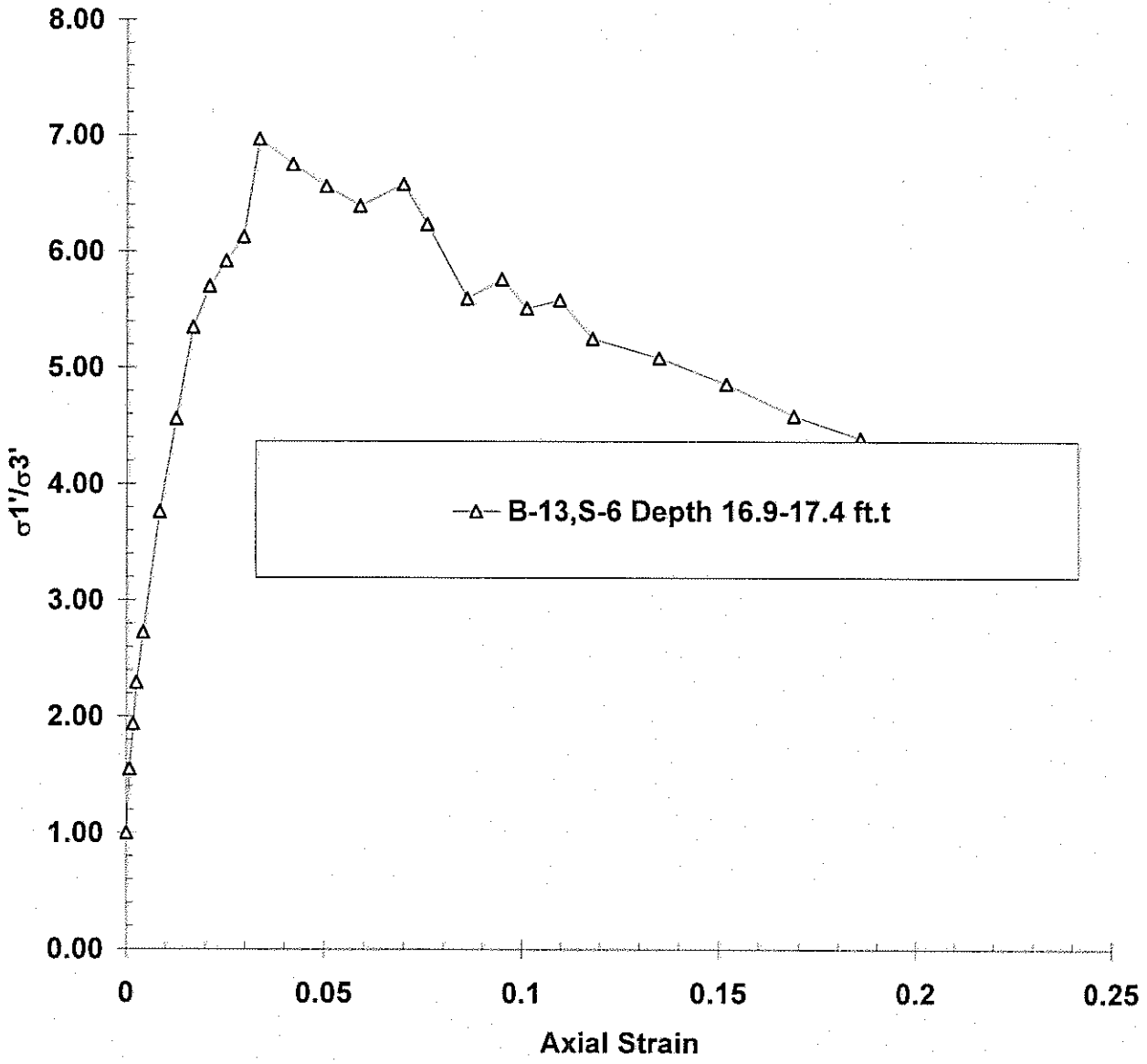


Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-13	S-6	16.9-17.4	0	0	73	39	34	102	0	3	53	50

Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Assoicates

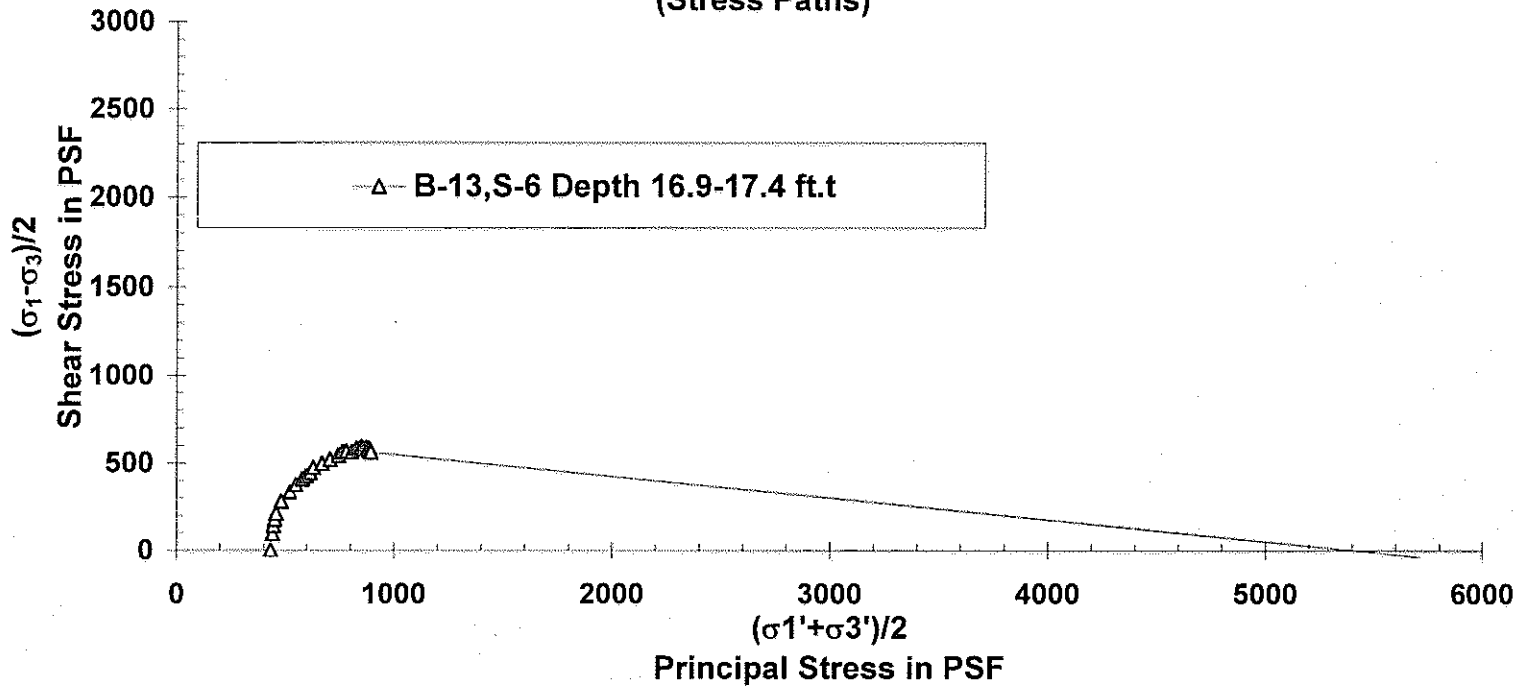
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)

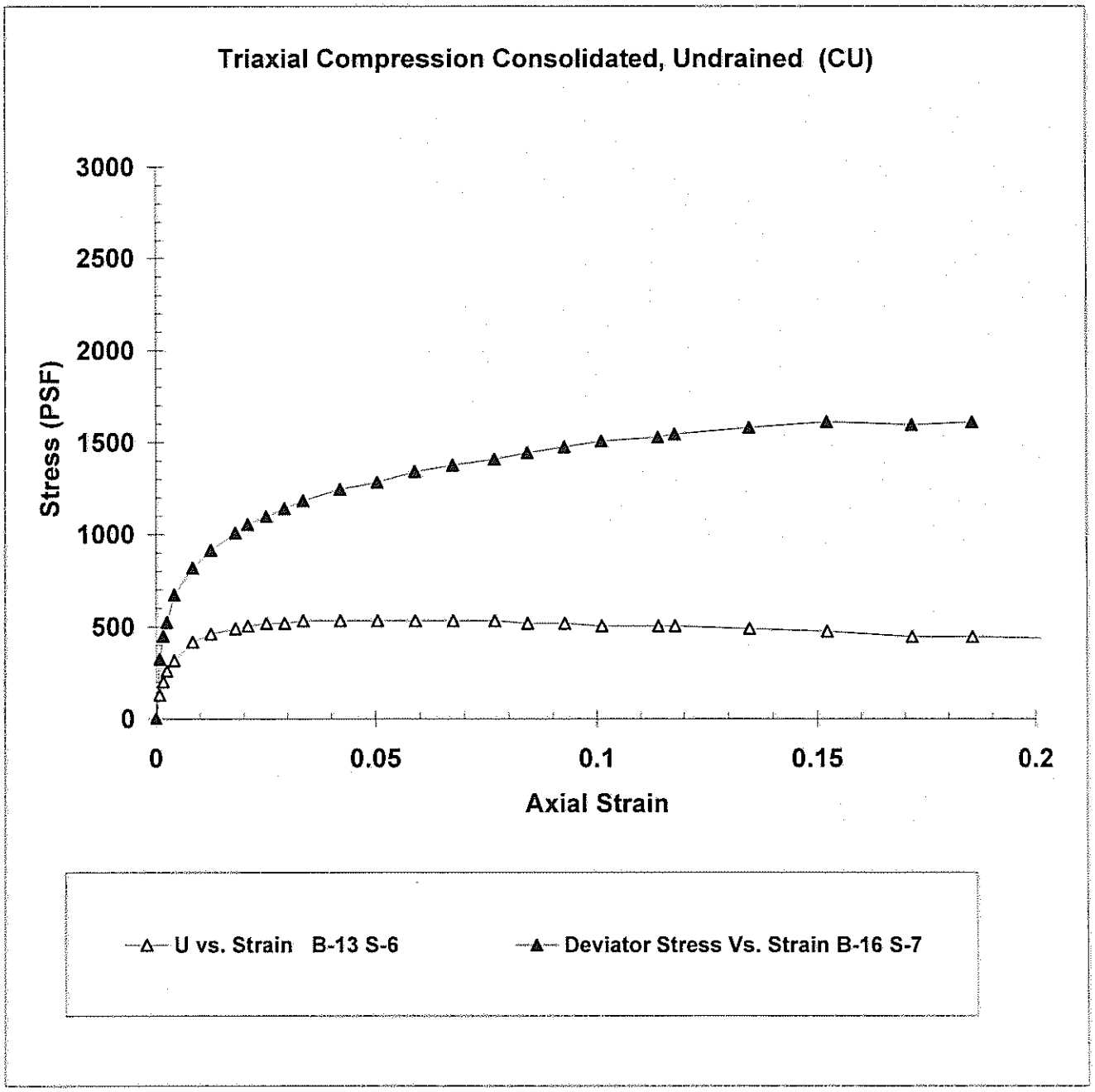


Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	11	0	0	0.041856	0	50.0	0.00	0.00	#DIV/0!	432.00	432.00	1.00	0.00	432.00
Exploration #	B-13	5	5	19	8	0.00084	0.041891	190	50.6	0.60	86.40	0.46	345.60	535.40	1.55	94.90	440.50
Sample ID #	S-6	10	10	23	12	0.00169	0.041927	284	50.9	0.90	129.60	0.46	302.40	586.28	1.94	141.94	444.34
Sample Depth (ft)	16.9-17.4	15	15	26	15	0.00253	0.041962	354	51.1	1.10	158.40	0.45	273.60	627.56	2.29	176.98	450.58
Type of Test	CU	25	25	29	18	0.00422	0.042034	422	51.3	1.30	187.20	0.44	244.80	667.19	2.73	211.19	455.99
Cell Pressure (psi)	53	50	50	35	24	0.00845	0.042213	557	51.6	1.60	230.40	0.41	201.60	758.47	3.76	278.43	480.03
Back Pressure (psi)	50	75	75	40	29	0.01267	0.042393	667	51.7	1.70	244.80	0.37	187.20	853.75	4.56	333.27	520.47
Strain Rate (in/min)	0.004	100	100	44	33	0.01690	0.042576	752	51.8	1.80	259.20	0.34	172.80	924.53	5.35	375.87	548.67
Initial Platen Reading (in x 10^{-3})	0	125	125	47	36	0.02112	0.042759	813	51.8	1.80	259.20	0.32	172.80	985.52	5.70	406.36	579.16
Initial Load Cell Reading (lbs)	11	150	150	49	38	0.02535	0.042945	850	51.8	1.80	259.20	0.31	172.80	1022.52	5.92	424.91	597.71
Date	8/25/2006	176	176	51	40	0.02974	0.043139	886	51.8	1.80	259.20	0.29	172.80	1058.92	6.13	443.06	615.86
Test by	RGS	200	200	54	43	0.03380	0.043320	946	51.9	1.90	273.60	0.29	158.40	1104.29	6.97	472.95	631.35
Initial Length (in)	5.973	250	250	57	46	0.04224	0.043702	994	51.8	1.80	259.20	0.26	172.80	1166.98	6.75	497.09	669.89
Area (ft^2)	0.044301	300	300	60	49	0.05069	0.044091	1041	51.7	1.70	244.80	0.24	187.20	1228.45	6.56	520.63	707.83
Height after Consolidation	5.918	350	350	63	52	0.05914	0.044487	1087	51.6	1.60	230.40	0.21	201.60	1288.72	6.39	543.56	745.16
Area after Consolidation	0.041856	415	415	66	55	0.07013	0.045013	1125	51.6	1.60	230.40	0.20	201.60	1326.54	6.58	562.47	764.07
Youngs Modulus for membrane(lbs/in2)	200	450	450	67	56	0.07604	0.045301	1131	51.5	1.50	216.00	0.19	216.00	1347.07	6.24	565.53	781.53
Membrane Thickness in.	0.012	510	510	68	57	0.08618	0.045603	1125	51.3	1.30	187.20	0.17	244.80	1370.12	5.60	562.66	807.46
		562	562	71	60	0.09496	0.046248	1166	51.3	1.30	187.20	0.16	244.80	1410.87	5.76	583.04	827.84
		600	600	72	61	0.10139	0.046578	1169	51.2	1.20	172.80	0.15	259.20	1428.66	5.51	584.73	843.93
		650	650	74	63	0.10983	0.047021	1188	51.2	1.20	172.80	0.15	259.20	1447.20	5.58	594.00	853.20
		700	700	74	63	0.11828	0.047471	1164	51.1	1.10	158.40	0.14	273.60	1437.21	5.25	581.80	855.40
		800	800	77	66	0.13518	0.048399	1177	51.0	1.00	144.00	0.12	288.00	1464.80	5.09	588.40	876.40
		900	900	79	68	0.15208	0.049363	1167	50.9	0.90	129.60	0.11	302.40	1469.71	4.86	583.66	886.06
		1000	1000	80	69	0.16898	0.050367	1136	50.8	0.80	115.20	0.10	316.80	1453.15	4.59	568.18	884.98

AMEC
RP-Project

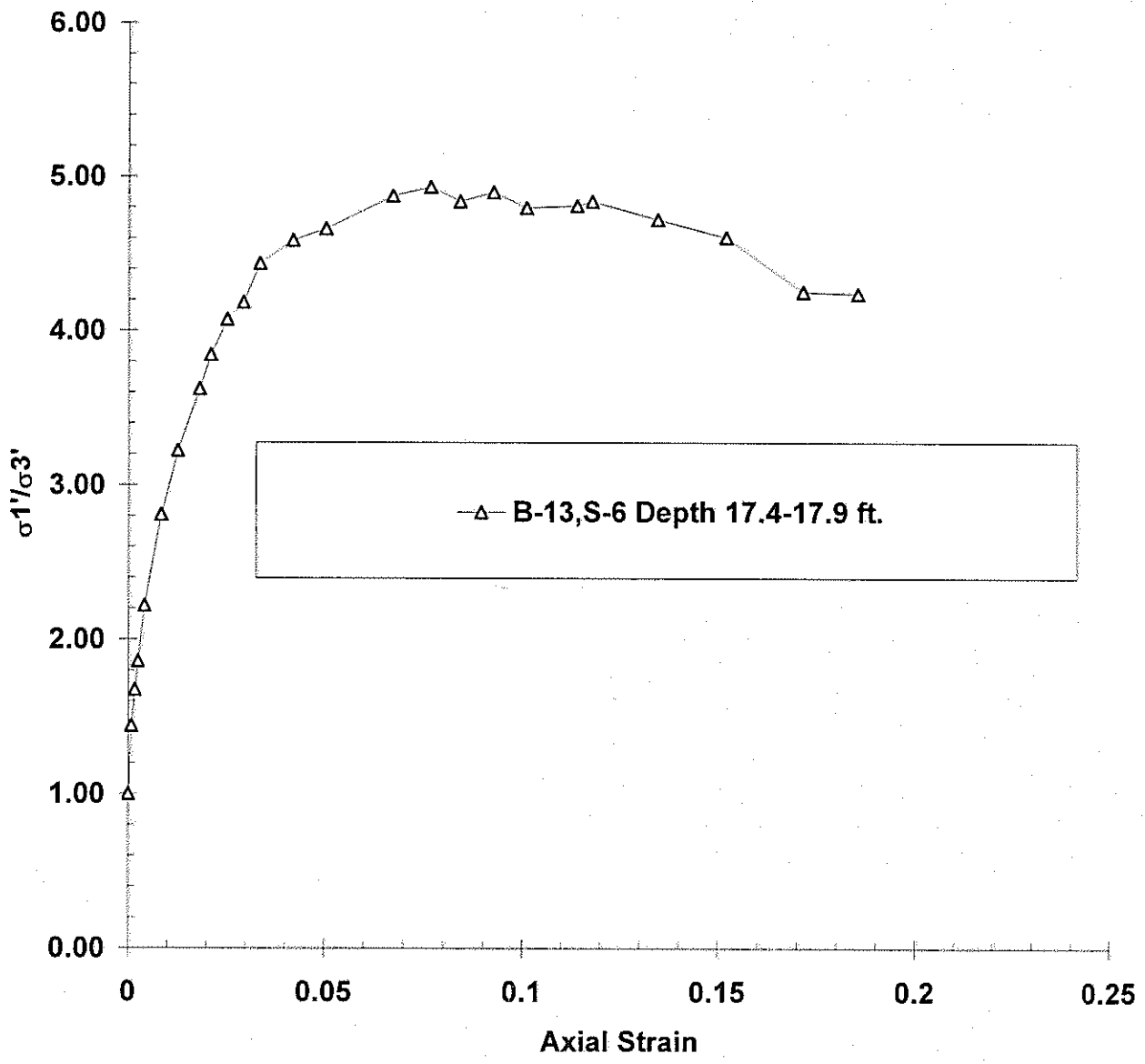


Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-13	S-6	17.4-17.9	59	53	73	39	34	104	66	6	46	40

Soil Technology
J-06-2135

WSDOT Grays Harbor Special Projects
Landau Assoicates

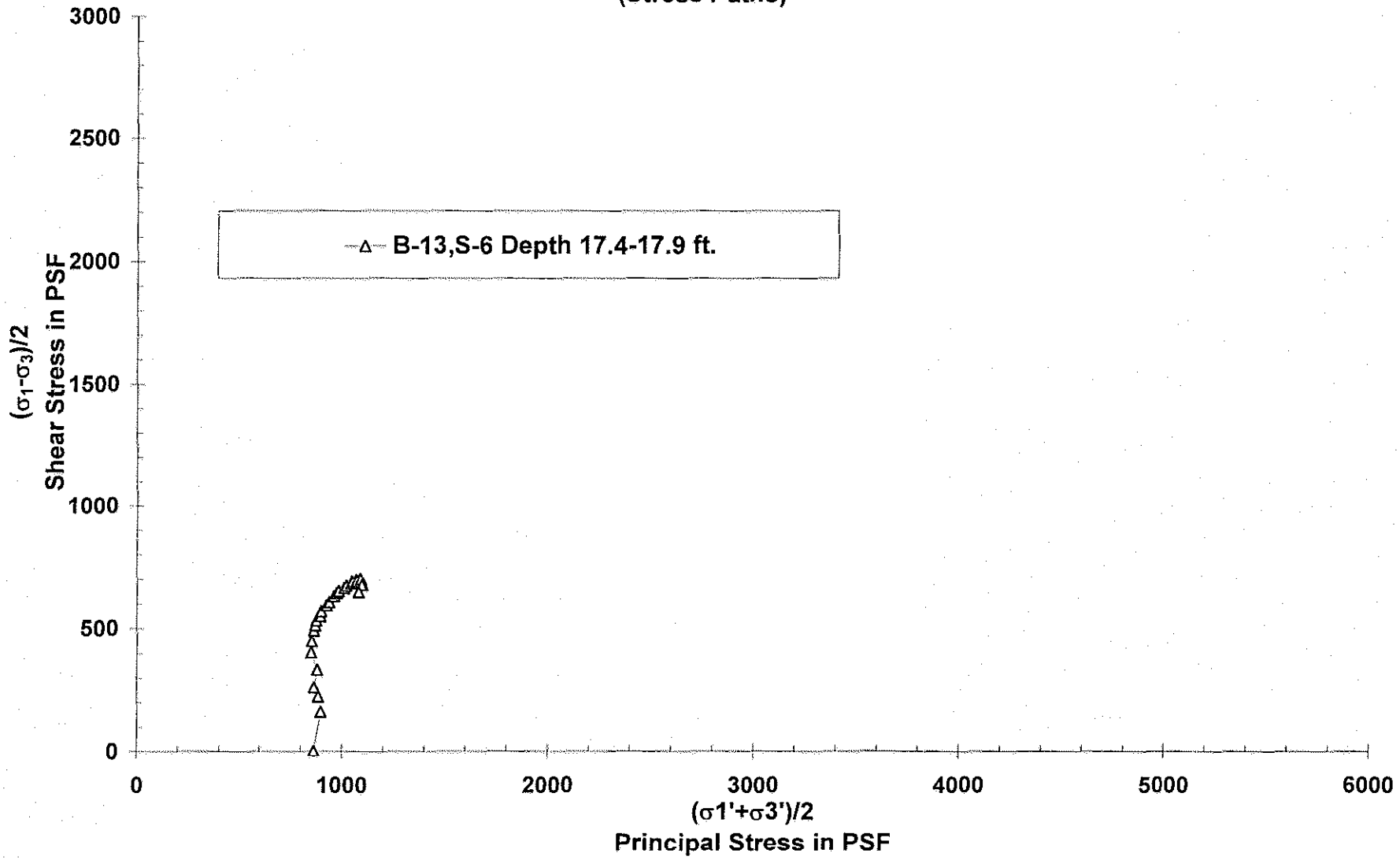
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)

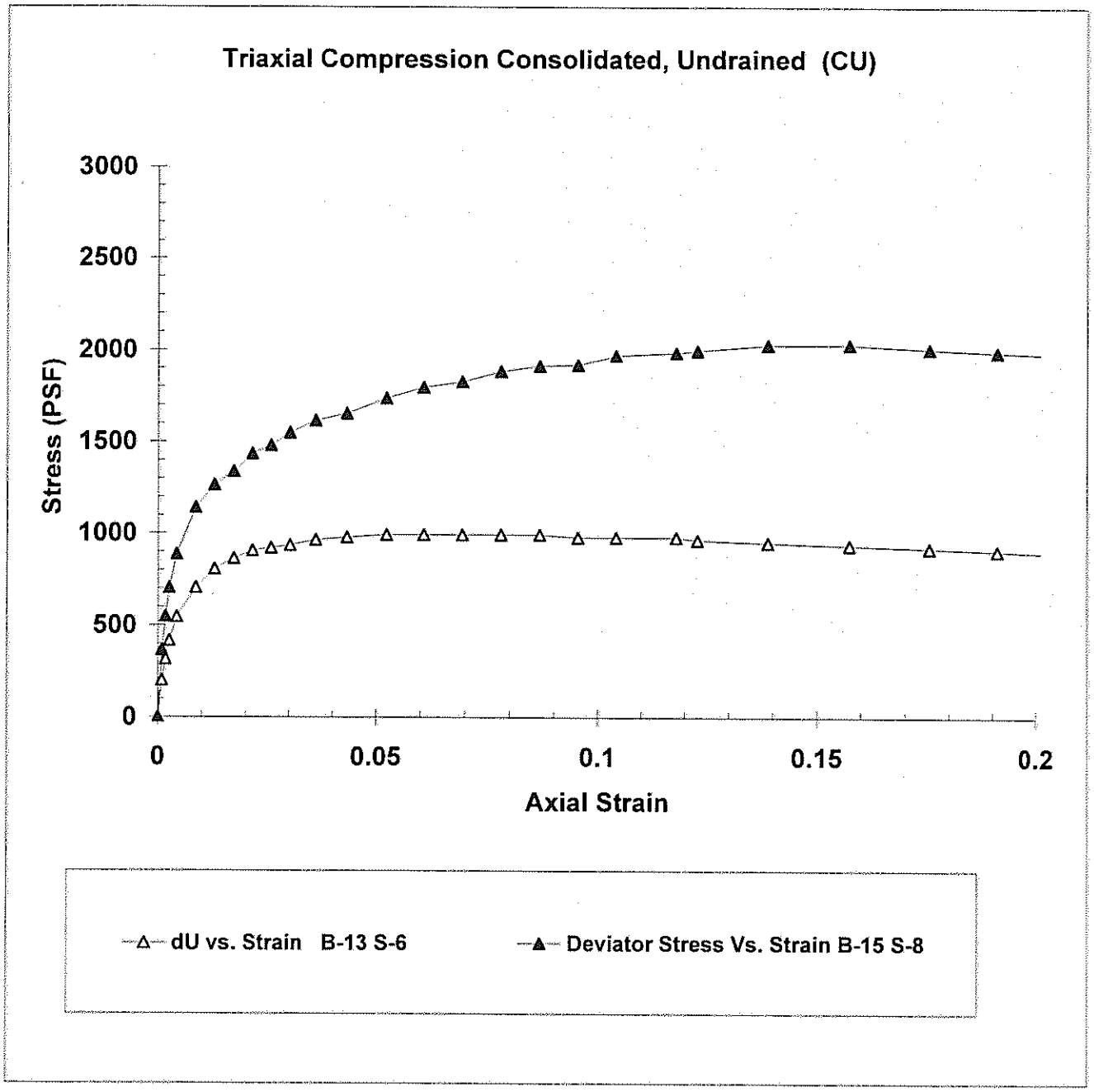


Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

		0	0	10	0	0	0.039966	0	40.0	0.00	0.00	#DIV/0!	864.00	864.00	1.00	0.00	864.00
Job #	J-06-2154	5	5	23	13	0.00084	0.040000	324	40.9	0.90	129.60	0.40	734.40	1058.24	1.44	161.92	896.32
Exploration #	B-13	10	10	28	18	0.00169	0.040034	447	41.4	1.40	201.60	0.45	662.40	1109.69	1.68	223.65	886.05
Sample ID #	S-6	15	15	31	21	0.00253	0.040068	521	41.8	1.80	259.20	0.50	604.80	1125.42	1.86	260.31	865.11
Sample Depth (ft)	17.4-17.9	25	25	37	27	0.00422	0.040135	667	42.2	2.20	316.80	0.48	547.20	1214.10	2.22	333.45	880.65
Type of Test	CU	50	50	43	33	0.00843	0.040306	807	42.9	2.90	417.60	0.52	446.40	1253.48	2.81	403.54	849.94
Cell Pressure (psi)	46	75	75	47	37	0.01265	0.040478	897	43.2	3.20	460.80	0.51	403.20	1299.79	3.22	448.30	851.50
Back Pressure (psi)	40	108	108	51	41	0.01621	0.040708	982	43.4	3.40	489.60	0.50	374.40	1356.41	3.62	491.00	865.40
Strain Rate (in/min)	0.004	125	125	53	43	0.02108	0.040827	1024	43.5	3.50	504.00	0.49	360.00	1384.09	3.84	512.05	872.05
Initial Platen Reading (in x 10^{-3})	0	150	150	55	45	0.02530	0.041003	1063	43.6	3.60	518.40	0.49	345.60	1408.10	4.07	531.25	876.85
		175	175	57	47	0.02951	0.041181	1100	43.6	3.60	518.40	0.47	345.60	1446.09	4.18	550.25	895.85
Initial Load Cell Reading (lbs)	10	200	200	59	49	0.03373	0.041361	1138	43.7	3.70	532.80	0.47	331.20	1469.26	4.44	569.03	900.23
Date	8/24/2006	250	250	62	52	0.04216	0.041725	1188	43.7	3.70	532.80	0.45	331.20	1519.17	4.59	593.98	925.18
Test by	RGS	300	300	64	54	0.05059	0.042096	1213	43.7	3.70	532.80	0.44	331.20	1544.05	4.66	606.43	937.63
Initial Length (in)	6	350	350	67	57	0.06745	0.042857	1283	43.7	3.70	532.80	0.42	331.20	1614.62	4.88	641.71	972.91
Area (ft^2)	0.043785	400	400	69	59	0.07690	0.043295	1303	43.7	3.70	532.80	0.41	331.20	1633.82	4.93	651.31	982.51
Height after Consolidation	5.93	456	456	71	61	0.08432	0.043646	1327	43.6	3.60	518.40	0.39	345.60	1672.46	4.84	663.43	1009.03
Area after Consolidation	0.039966	500	500	73	63	0.09275	0.044052	1347	43.6	3.60	518.40	0.38	345.60	1692.92	4.90	673.66	1019.26
Youngs Modulus for membrane(lbs/in2)	200	550	550	75	65	0.10118	0.044465	1367	43.5	3.50	504.00	0.37	360.00	1726.93	4.80	683.46	1043.46
Membrane Thickness in.	0.012	600	600	77	67	0.11417	0.045117	1372	43.5	3.50	504.00	0.37	360.00	1731.54	4.81	685.77	1045.77
		677	677	79	69	0.11804	0.045315	1382	43.5	3.50	504.00	0.36	360.00	1741.55	4.84	690.77	1050.77
		700	700	80	70	0.13491	0.046199	1394	43.4	3.40	489.60	0.35	374.40	1768.03	4.72	696.82	1071.22
		800	800	83	73	0.15228	0.047145	1402	43.3	3.30	475.20	0.34	388.80	1790.33	4.60	700.77	1089.57
		903	903	86	76	0.17167	0.048249	1359	43.1	3.10	446.40	0.33	417.60	1776.17	4.25	679.29	1096.89
		1018	1018	87	77	0.18550	0.049068	1354	43.1	3.10	446.40	0.33	417.60	1771.17	4.24	676.79	1094.39
		1100	1100	89	79	0.21417	0.050858	1297	43.0	3.00	432.00	0.33	432.00	1728.60	4.00	648.30	1080.30
		1270	1270	91	81	0.00000	0.000000	0	0.0	-40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

WSDOT Special Projects
Landau Associates

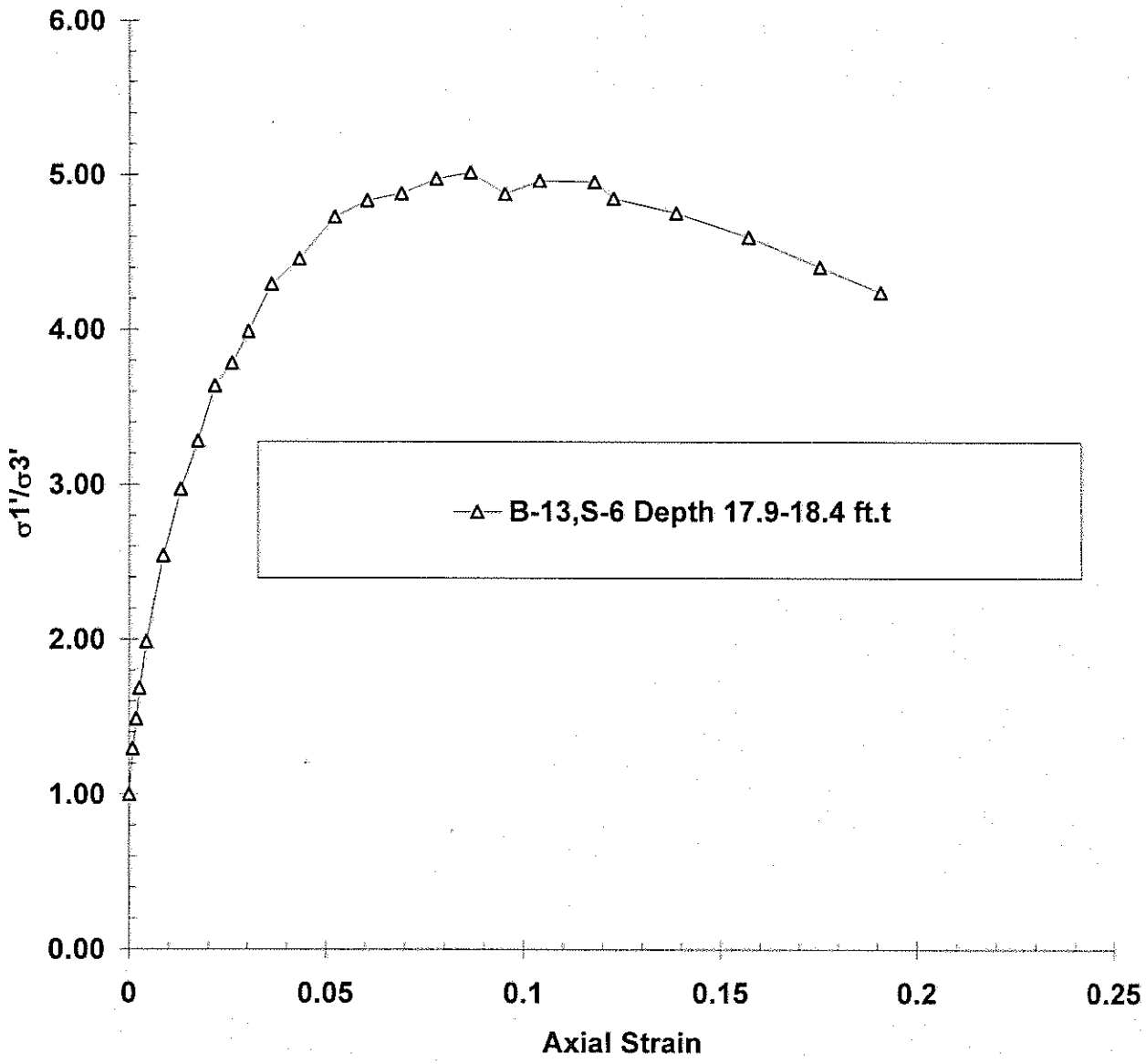


Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-13	S-6	17.9-18.4	67	55	73	39	34	100	60	10	50	40

Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Assoicates

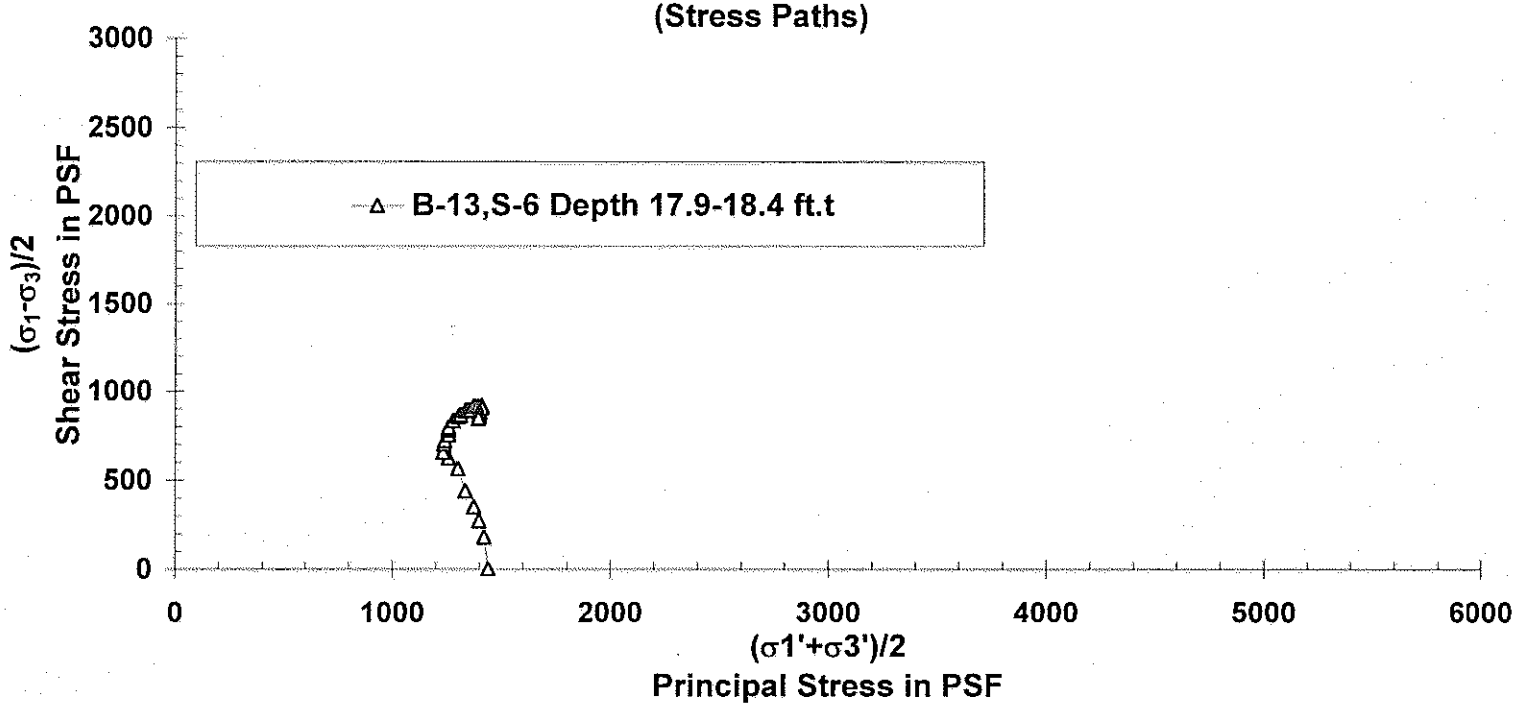
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)

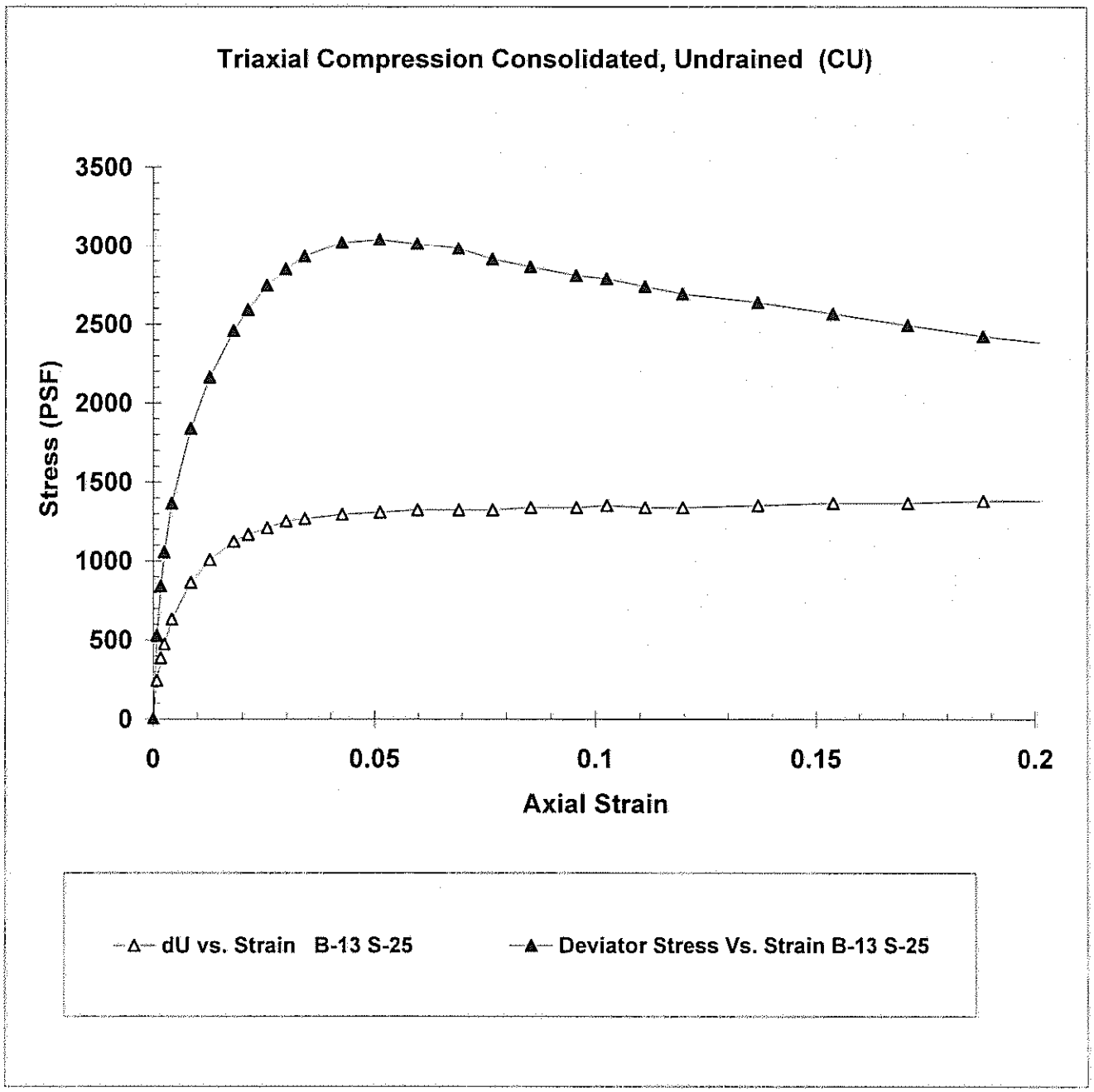


Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	10	0	0	0.038182	0	40.0	0.00	0.00	#DIV/0!	1440.00	1440.00	1.00	0.00	1440.00
Exploration #	B-13	5	5	24	14	0.00087	0.038215	365	41.4	1.40	201.60	0.55	1238.40	1603.55	1.29	182.58	1420.98
Sample ID #	S-6	10	10	31	21	0.00174	0.038248	547	42.2	2.20	316.80	0.58	1123.20	1669.85	1.49	273.32	1396.52
Sample Depth (ft)	17.9-18.4	15	15	37	27	0.00261	0.038281	702	42.9	2.90	417.60	0.60	1022.40	1724.11	1.69	350.85	1373.25
Type of Test	CU	25	25	44	34	0.00434	0.038348	881	43.8	3.80	547.20	0.62	892.80	1773.42	1.99	440.31	1333.11
Cell Pressure (psi)	50	50	50	54	44	0.00868	0.038516	1130	44.9	4.90	705.60	0.62	734.40	1864.78	2.54	565.19	1299.59
Back Pressure (psi)	40	75	75	59	49	0.01303	0.038685	1249	45.6	5.60	806.40	0.65	633.60	1882.22	2.97	624.31	1257.91
Strain Rate (in/min)	0.004	100	100	62	52	0.01737	0.038856	1314	46.0	6.00	864.00	0.66	576.00	1890.26	3.28	657.13	1233.13
Initial Platen Reading (in x 10^{-3})	0	125	125	66	56	0.02171	0.039029	1405	46.3	6.30	907.20	0.65	532.80	1937.63	3.64	702.41	1235.21
Initial Load Cell Reading (lbs)	10	150	150	68	58	0.02605	0.039203	1443	46.4	6.40	921.60	0.64	518.40	1961.88	3.78	721.74	1240.14
Date	8/23/2006	175	175	71	61	0.03039	0.039378	1507	46.5	6.50	936.00	0.62	504.00	2011.06	3.99	753.53	1257.53
Test by	RGS	209	209	74	64	0.03630	0.039620	1565	46.7	6.70	964.80	0.62	475.20	2040.39	4.29	782.59	1257.79
Initial Length (in)	5.98	250	250	76	66	0.04342	0.039915	1594	46.8	6.80	979.20	0.61	460.80	2054.31	4.46	796.76	1257.56
Area (ft^2)	0.043579	302	302	80	70	0.05245	0.040295	1665	46.9	6.90	993.60	0.60	446.40	2111.09	4.73	832.34	1278.74
Height after Consolidation	5.758	350	350	83	73	0.06078	0.040653	1712	46.9	6.90	993.60	0.58	446.40	2158.08	4.83	855.84	1302.24
Area after Consolidation	0.038182	400	400	85	75	0.06947	0.041032	1732	46.9	6.90	993.60	0.57	446.40	2178.21	4.88	865.91	1312.31
Youngs Modulus for membrane(lbs/in2)	200	450	450	88	78	0.07815	0.041418	1775	46.9	6.90	993.60	0.56	446.40	2221.58	4.98	887.59	1333.99
Membrane Thickness in.	0.012	500	500	90	80	0.08684	0.041812	1793	46.9	6.90	993.60	0.55	446.40	2239.67	5.02	896.64	1343.04
		550	550	91	81	0.09552	0.042214	1787	46.8	6.80	979.20	0.55	460.80	2247.56	4.88	893.38	1354.18
		600	600	94	84	0.10420	0.042623	1827	46.8	6.80	979.20	0.54	460.80	2287.52	4.96	913.36	1374.16
		680	680	96	86	0.11810	0.043294	1823	46.8	6.80	979.20	0.54	460.80	2283.94	4.96	911.57	1372.37
		708	708	97	87	0.12296	0.043534	1828	46.7	6.70	964.80	0.53	475.20	2303.64	4.85	914.22	1389.42
		800	800	100	90	0.13894	0.044342	1838	46.6	6.60	950.40	0.52	489.60	2327.20	4.75	918.80	1408.40
		906	906	102	92	0.15735	0.045311	1813	46.5	6.50	936.00	0.52	504.00	2316.90	4.60	906.45	1410.45
		1011	1011	103	93	0.17558	0.046313	1765	46.4	6.40	921.60	0.52	518.40	2283.74	4.41	882.67	1401.07

WSDOT Special Projects
Landau Associates

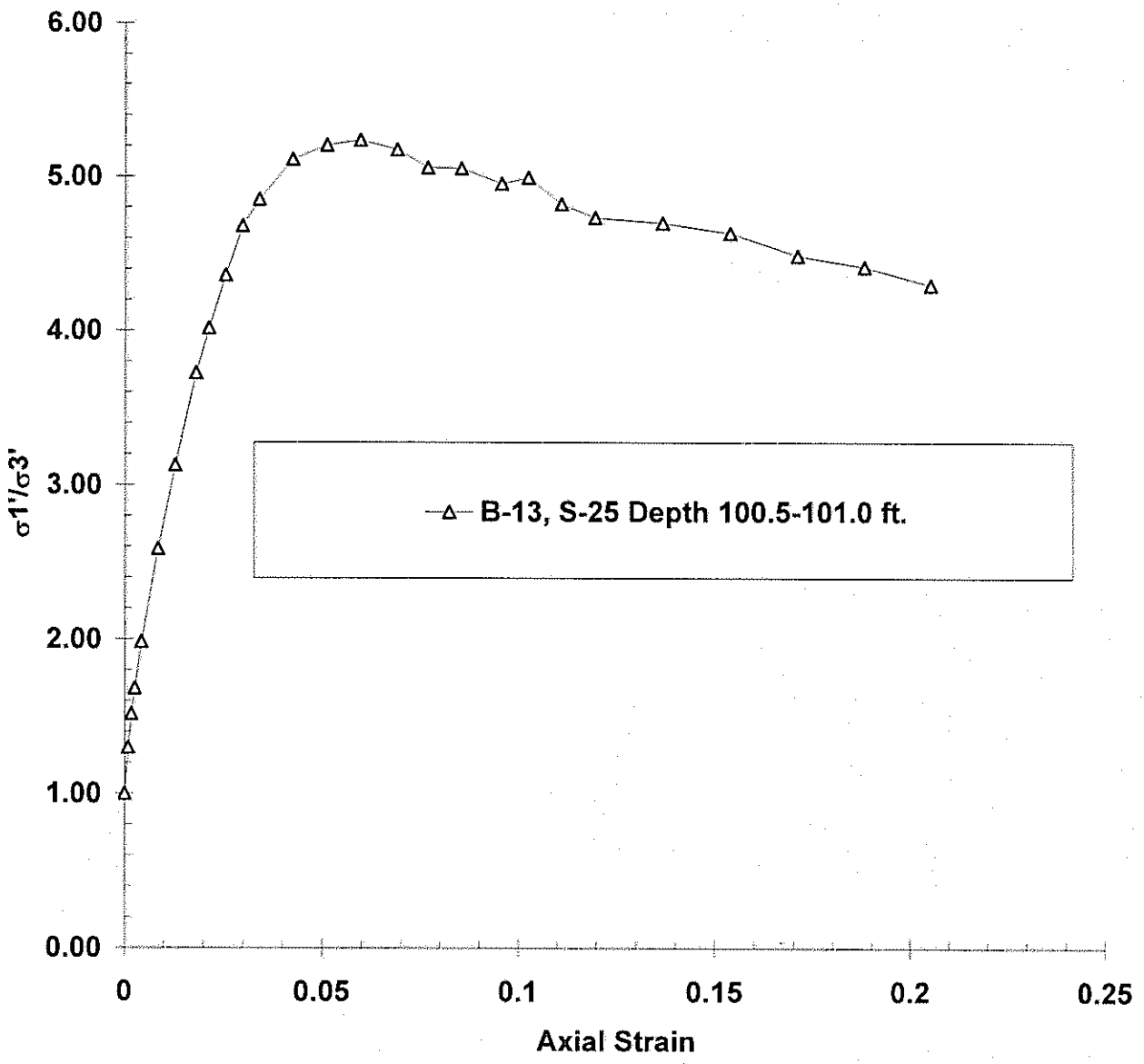


Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-13	S-25	100.5-101	70	66	79	43	36	98	58	14	54	40

Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Assoicates

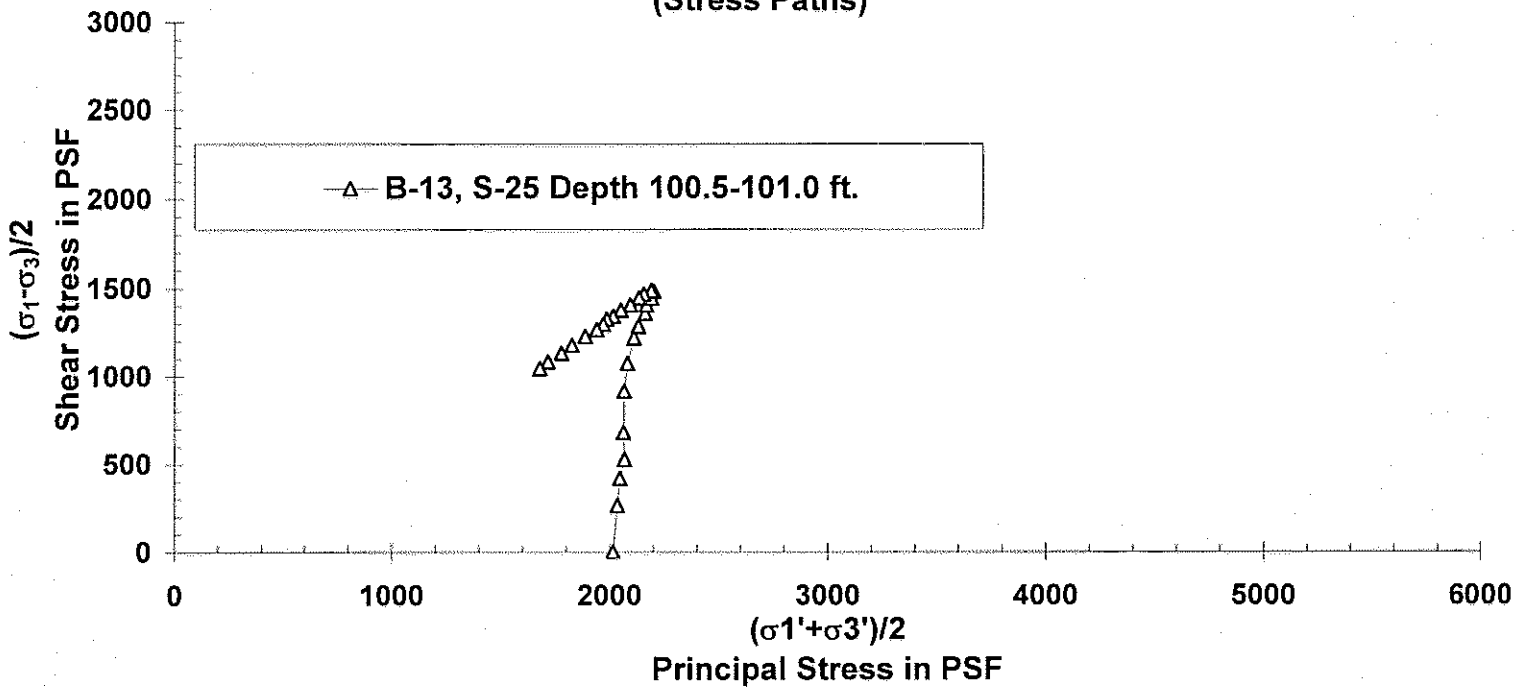
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

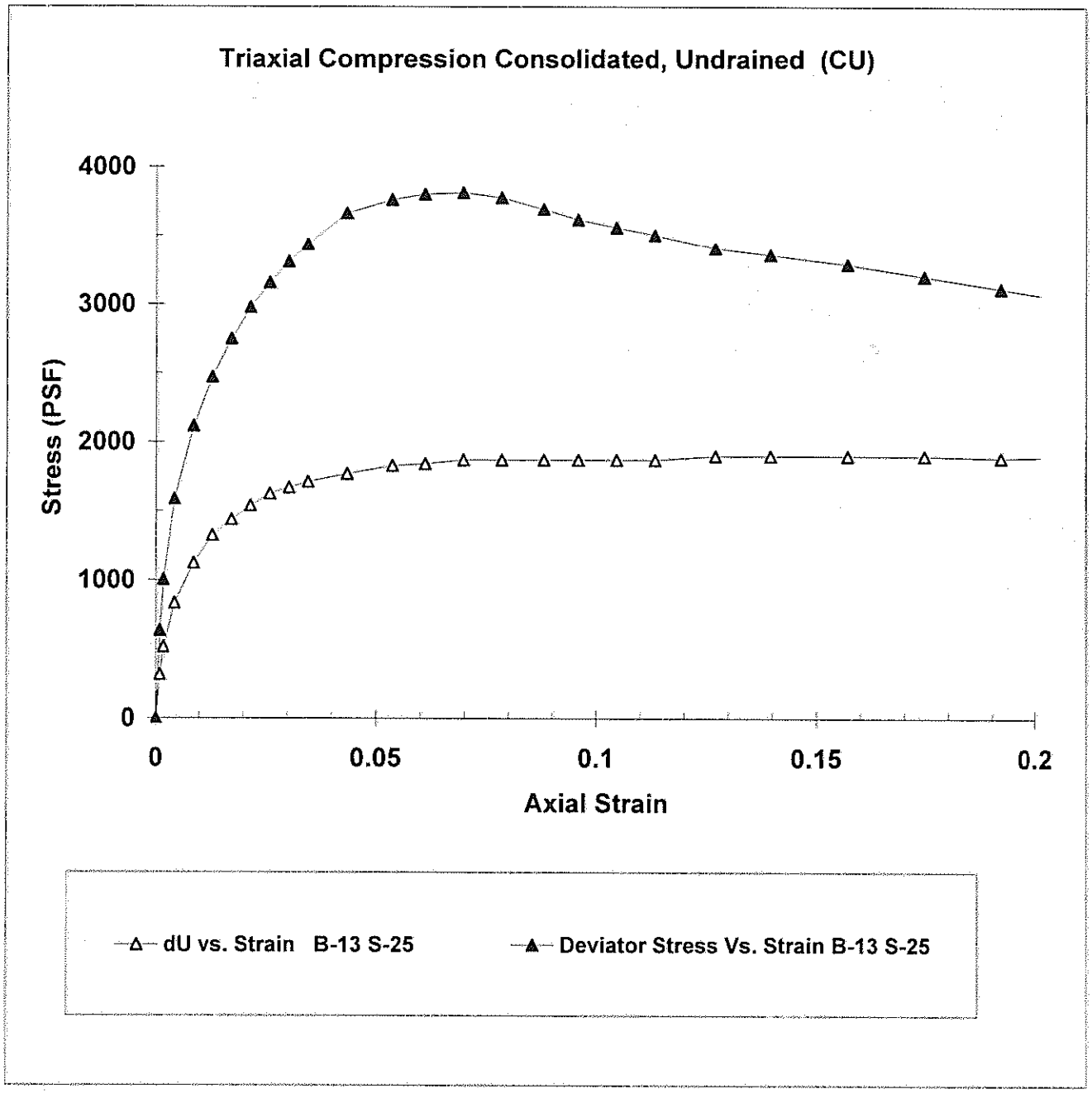
TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

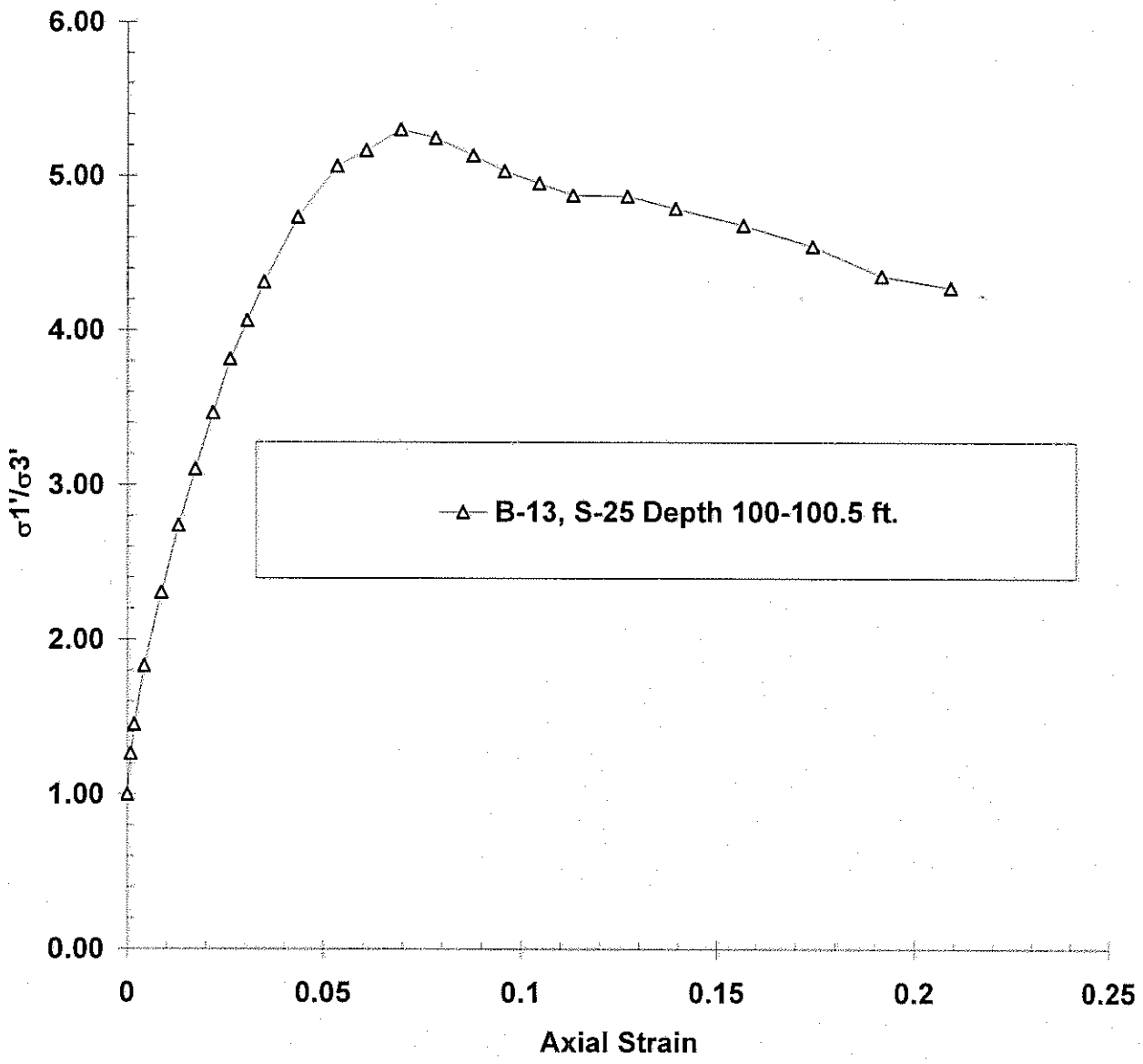
		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	13	0	0	0.041520	0	40.0	0.00	0.00	#DIV/0!	2016.00	2016.00	1.00	0.00	2016.00
Exploration #	B-13	5	5	35	22	0.00086	0.041555	528	41.7	1.70	244.80	0.46	1771.20	2299.43	1.30	264.12	2035.32
Sample ID #	S-25	10	10	48	35	0.00171	0.041591	839	42.7	2.70	388.80	0.46	1627.20	2466.36	1.52	419.58	2046.78
Sample Depth (ft)	100.5-101	15	15	57	44	0.00257	0.041627	1053	43.3	3.30	475.20	0.45	1540.80	2594.27	1.68	526.73	2067.53
Type of Test	CU	25	25	70	57	0.00428	0.041698	1361	44.4	4.40	633.60	0.47	1382.40	2743.45	1.98	680.53	2062.93
Cell Pressure (psi)	54	50	50	90	77	0.00856	0.041878	1827	46.0	6.00	864.00	0.47	1152.00	2978.84	2.59	913.42	2065.42
Back Pressure (psi)	40	75	75	104	91	0.01284	0.042060	2146	47.0	7.00	1008.00	0.47	1008.00	3153.85	3.13	1072.92	2080.92
Strain Rate (in/min)	0.004	106	106	117	104	0.01814	0.042287	2434	47.8	7.80	1123.20	0.46	892.80	3327.11	3.73	1217.16	2109.96
Initial Platen Reading (in x 10^{-3})	0	125	125	123	110	0.02139	0.042427	2563	48.1	8.10	1166.40	0.46	849.60	3412.69	4.02	1281.54	2131.14
Initial Load Cell Reading (lbs)	13	150	150	130	117	0.02567	0.042614	2710	48.4	8.40	1209.60	0.45	806.40	3516.50	4.36	1355.05	2161.45
Date	########	175	175	135	122	0.02995	0.042802	2809	48.7	8.70	1252.80	0.45	763.20	3572.15	4.68	1404.47	2167.67
Test by	RGS	200	200	139	126	0.03423	0.042991	2884	48.8	8.80	1267.20	0.44	748.80	3632.30	4.85	1441.75	2190.55
Initial Length (in)	5.97666	250	250	144	131	0.04279	0.043376	2961	49.0	9.00	1296.00	0.44	720.00	3680.97	5.11	1480.49	2200.49
Area (ft^2)	0.044094	300	300	146	133	0.05135	0.043767	2968	49.1	9.10	1310.40	0.44	705.60	3673.44	5.21	1483.92	2189.52
Height after Consolidation	5.8427	350	350	146	133	0.05990	0.044165	2929	49.2	9.20	1324.80	0.45	691.20	3619.80	5.24	1464.30	2155.50
Area after Consolidation	0.04152	405	405	146	133	0.06932	0.044612	2885	49.2	9.20	1324.80	0.46	691.20	3576.63	5.17	1442.71	2133.91
Youngs Modulus for membrane(lbs/in2)	200	450	450	144	131	0.07702	0.044984	2806	49.2	9.20	1324.80	0.47	691.20	3496.85	5.06	1402.83	2094.03
Membrane Thickness in.	0.012	500	500	143	130	0.08558	0.045405	2745	49.3	9.30	1339.20	0.49	676.80	3421.60	5.06	1372.40	2049.20
		560	560	142	129	0.09585	0.045921	2677	49.3	9.30	1339.20	0.50	676.80	3353.47	4.95	1338.33	2015.13
		600	600	142	129	0.10269	0.046271	2646	49.4	9.40	1353.60	0.51	662.40	3308.33	4.99	1322.97	1985.37
		650	650	141	128	0.11125	0.046717	2586	49.3	9.30	1339.20	0.52	676.80	3262.91	4.82	1293.06	1969.86
		700	700	140	127	0.11981	0.047171	2527	49.3	9.30	1339.20	0.53	676.80	3203.50	4.73	1263.35	1940.15
		800	800	140	127	0.13692	0.048107	2451	49.4	9.40	1353.60	0.55	662.40	3113.09	4.70	1225.34	1887.74
		900	900	139	126	0.15404	0.049080	2354	49.5	9.50	1368.00	0.58	648.00	3002.30	4.63	1177.15	1825.15
		1000	1000	138	125	0.17115	0.050093	2259	49.5	9.50	1368.00	0.61	648.00	2906.74	4.49	1129.37	1777.37



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-13	S-25	100-100.5	70	62	NT	NT	NT	99	58	19	59	40

WSDOT Grays Harbor Special Projects
Landau Assoicates

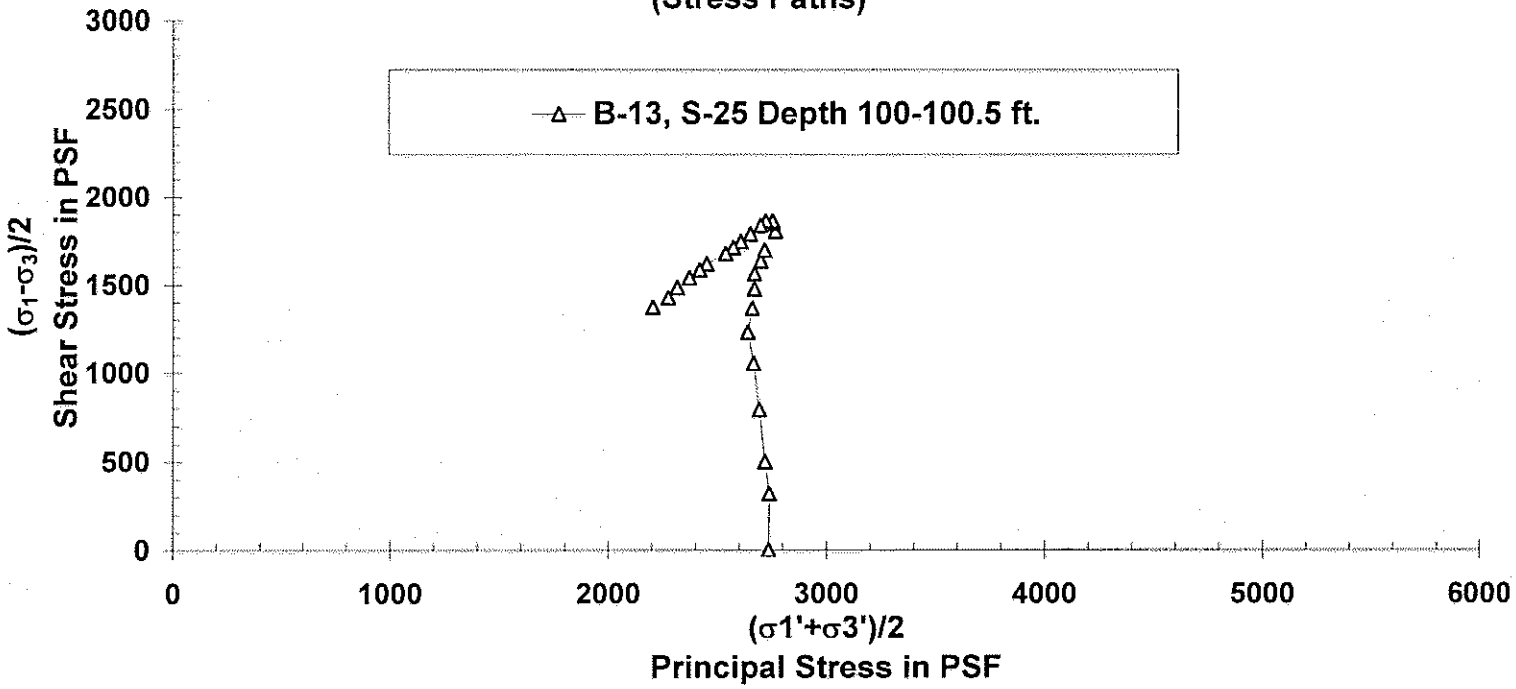
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)

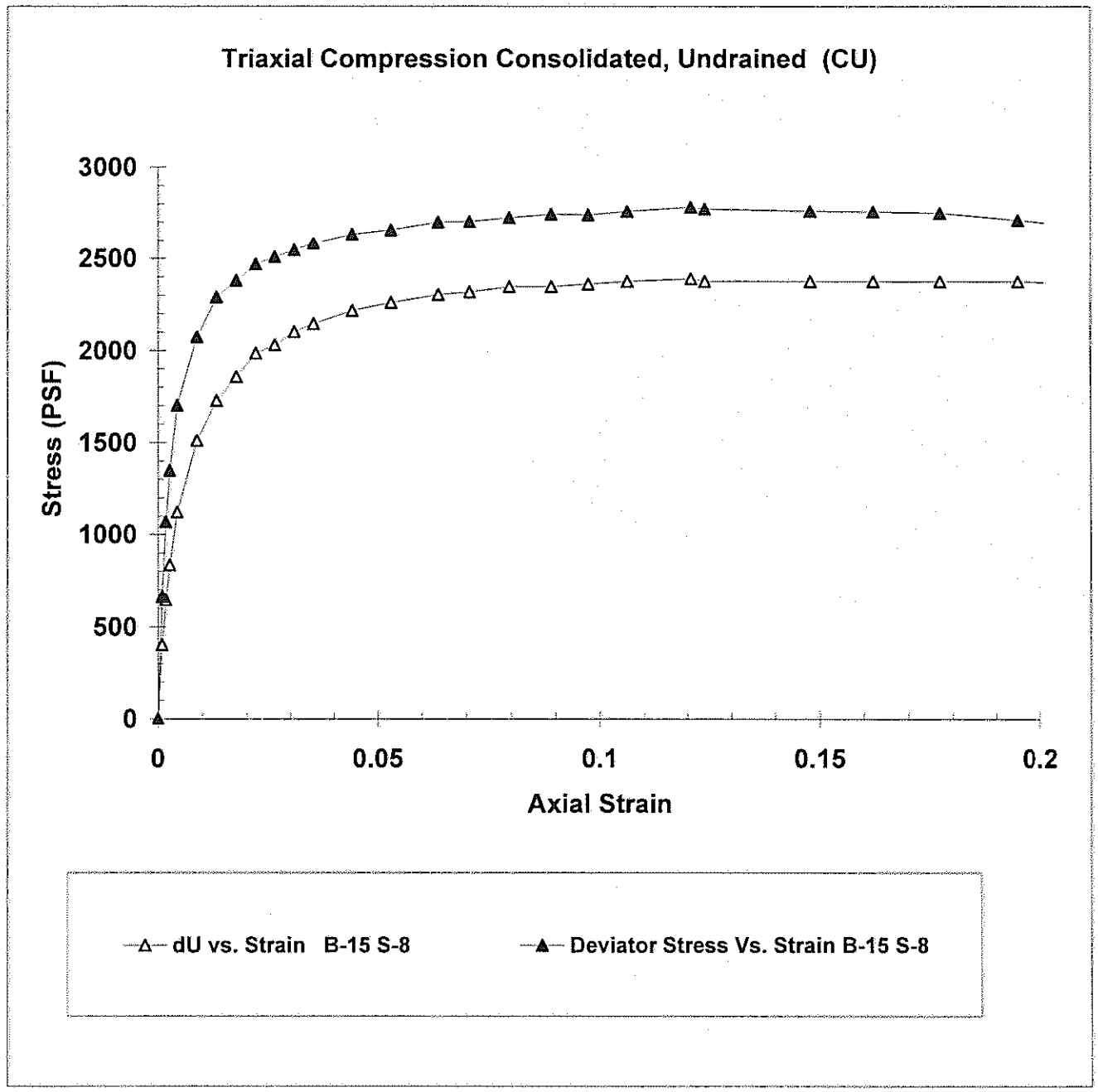


Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

		0	0	12	0	0	0.040734	0	40.0	0.00	0.00	#DIV/0!	2736.00	2736.00	1.00	0.00	2736.00
Job #	J-06-2154	5	5	38	26	0.00087	0.040770	637	42.2	2.20	316.80	0.50	2419.20	3055.72	1.26	318.26	2737.46
Exploration #	B-13	10	10	53	41	0.00175	0.040806	1002	43.6	3.60	518.40	0.52	2217.60	3219.95	1.45	501.18	2718.78
Sample ID #	S-25	25	25	77	65	0.00436	0.040913	1583	45.8	5.80	835.20	0.53	1900.80	3483.51	1.83	791.35	2692.15
Sample Depth (ft)	100-100.5	50	50	99	87	0.00873	0.041093	2105	47.8	7.80	1123.20	0.53	1612.80	3717.88	2.31	1052.54	2665.34
Type of Test	CU	75	75	114	102	0.01309	0.041275	2453	49.2	9.20	1324.80	0.54	1411.20	3864.35	2.74	1226.57	2637.77
Cell Pressure (psi)	59	100	100	126	114	0.01746	0.041458	2726	50.0	10.00	1440.00	0.53	1296.00	4021.64	3.10	1362.82	2658.82
Back Pressure (psi)	40	125	125	136	124	0.02182	0.041643	2948	50.7	10.70	1540.80	0.52	1195.20	4142.73	3.47	1473.77	2668.97
Strain Rate (in/min)	0.004	150	150	144	132	0.02618	0.041830	3119	51.3	11.30	1627.20	0.52	1108.80	4228.27	3.81	1559.73	2668.53
Initial Platen Reading (in x 10^{-3})	0	175	175	151	139	0.03055	0.042018	3266	51.6	11.60	1670.40	0.51	1065.60	4331.49	4.06	1632.94	2698.54
Initial Load Cell Reading (lbs)	12	200	200	157	145	0.03491	0.042208	3387	51.9	11.90	1713.60	0.51	1022.40	4409.52	4.31	1693.56	2715.96
Date	########	250	250	168	156	0.04364	0.042593	3602	52.3	12.30	1771.20	0.49	964.80	4567.05	4.73	1801.12	2765.92
Test by	RGS	308	308	174	162	0.05376	0.043049	3689	52.7	12.70	1828.80	0.50	907.20	4596.06	5.07	1844.43	2751.63
Initial Length (in)	5.98	350	350	177	165	0.06109	0.043385	3719	52.8	12.80	1843.20	0.50	892.80	4611.51	5.17	1859.36	2752.16
Area (ft^2)	0.044198	400	400	179	167	0.06982	0.043792	3717	53.0	13.00	1872.00	0.50	864.00	4580.97	5.30	1858.48	2722.48
Height after Consolidation	5.729	450	450	179	167	0.07855	0.044207	3669	53.0	13.00	1872.00	0.51	864.00	4533.12	5.25	1834.56	2698.56
Area after Consolidation	0.040734	505	505	177	165	0.08815	0.044672	3572	53.0	13.00	1872.00	0.52	864.00	4435.72	5.13	1785.86	2649.86
Youngs Modulus for membrane(lbs/in2)	200	550	550	175	163	0.09600	0.045060	3485	53.0	13.00	1872.00	0.54	864.00	4348.66	5.03	1742.33	2606.33
Membrane Thickness in.	0.012	600	600	174	162	0.10473	0.045500	3416	53.0	13.00	1872.00	0.55	864.00	4279.70	4.95	1707.85	2571.85
		650	650	173	161	0.11346	0.045947	3347	53.0	13.00	1872.00	0.56	864.00	4211.16	4.87	1673.58	2537.58
		729	729	171	159	0.12725	0.046673	3231	53.2	13.20	1900.80	0.59	835.20	4065.94	4.87	1615.37	2450.57
		800	800	171	159	0.13964	0.047346	3165	53.2	13.20	1900.80	0.60	835.20	4000.43	4.79	1582.62	2417.82
		900	900	171	159	0.15710	0.048326	3073	53.2	13.20	1900.80	0.62	835.20	3908.17	4.68	1536.49	2371.69
		1000	1000	170	158	0.17455	0.049348	2960	53.2	13.20	1900.80	0.64	835.20	3795.64	4.54	1480.22	2315.42
		1100	1100	169	157	0.19201	0.050414	2849	53.1	13.10	1886.40	0.66	849.60	3698.37	4.35	1424.39	2273.99
		1200	1200	168	156	0.20946	0.051527	2738	53.2	13.20	1900.80	0.69	835.20	3573.16	4.28	1368.98	2204.18

WSDOT Special Projects
Landau Associates

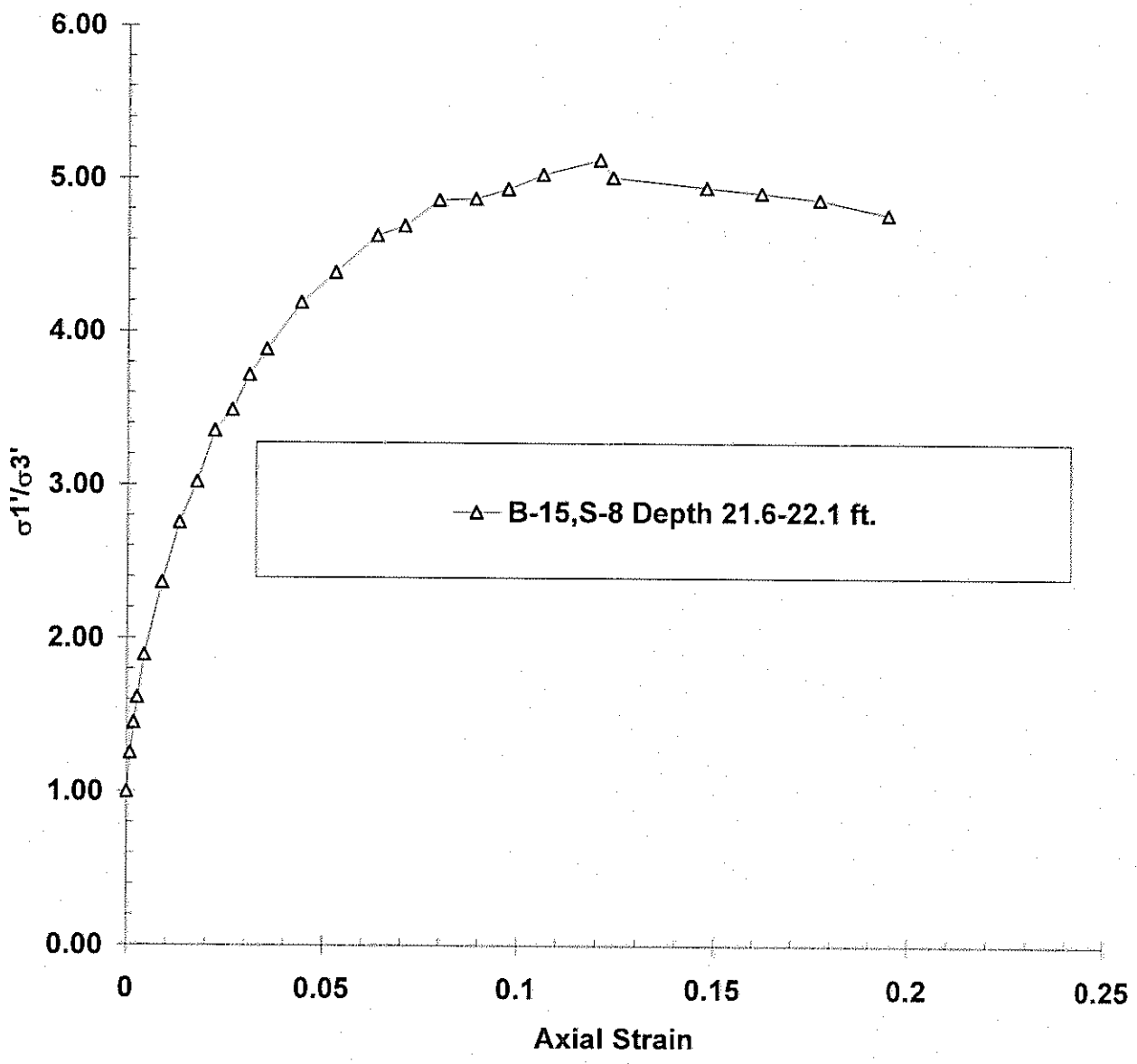


Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-15	S-8	21.6-22.1	76	58	76	42	34	97	55	21	71	50

Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Assoicates

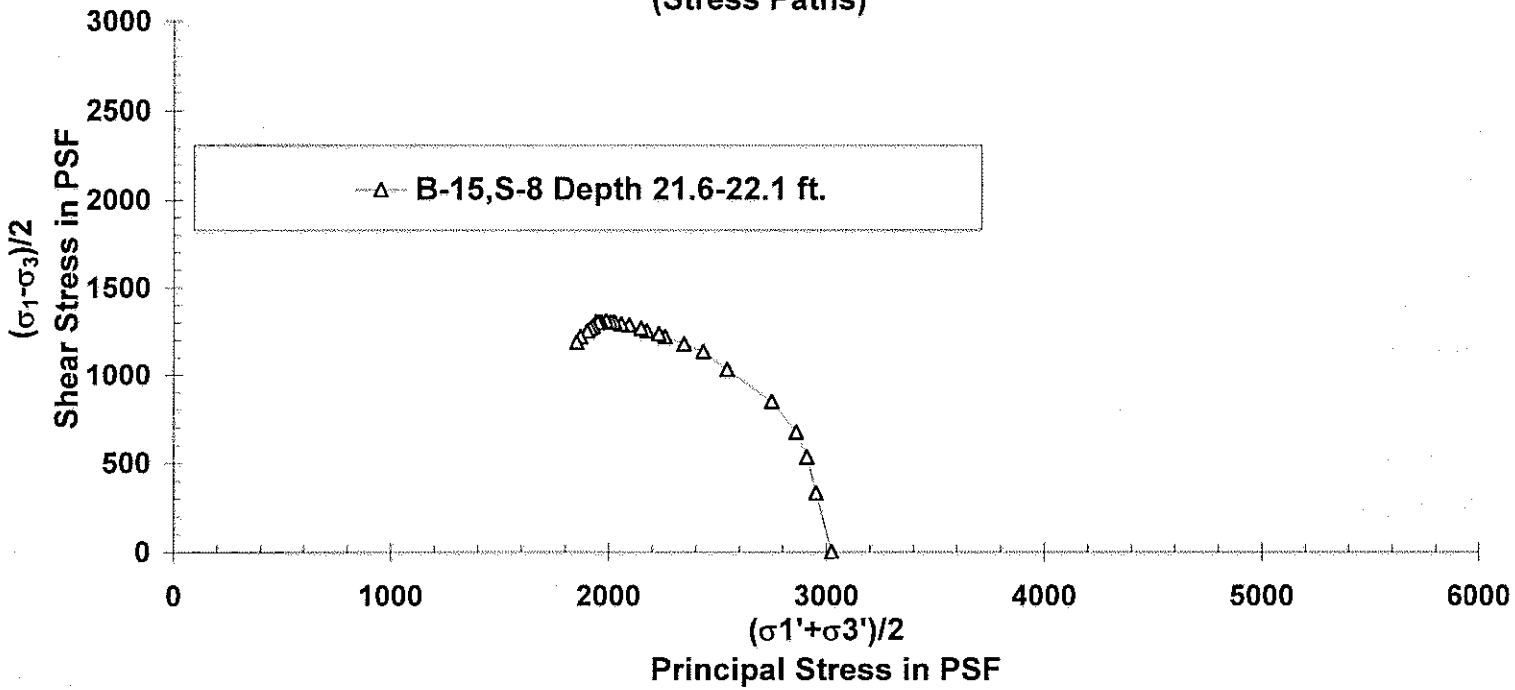
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)

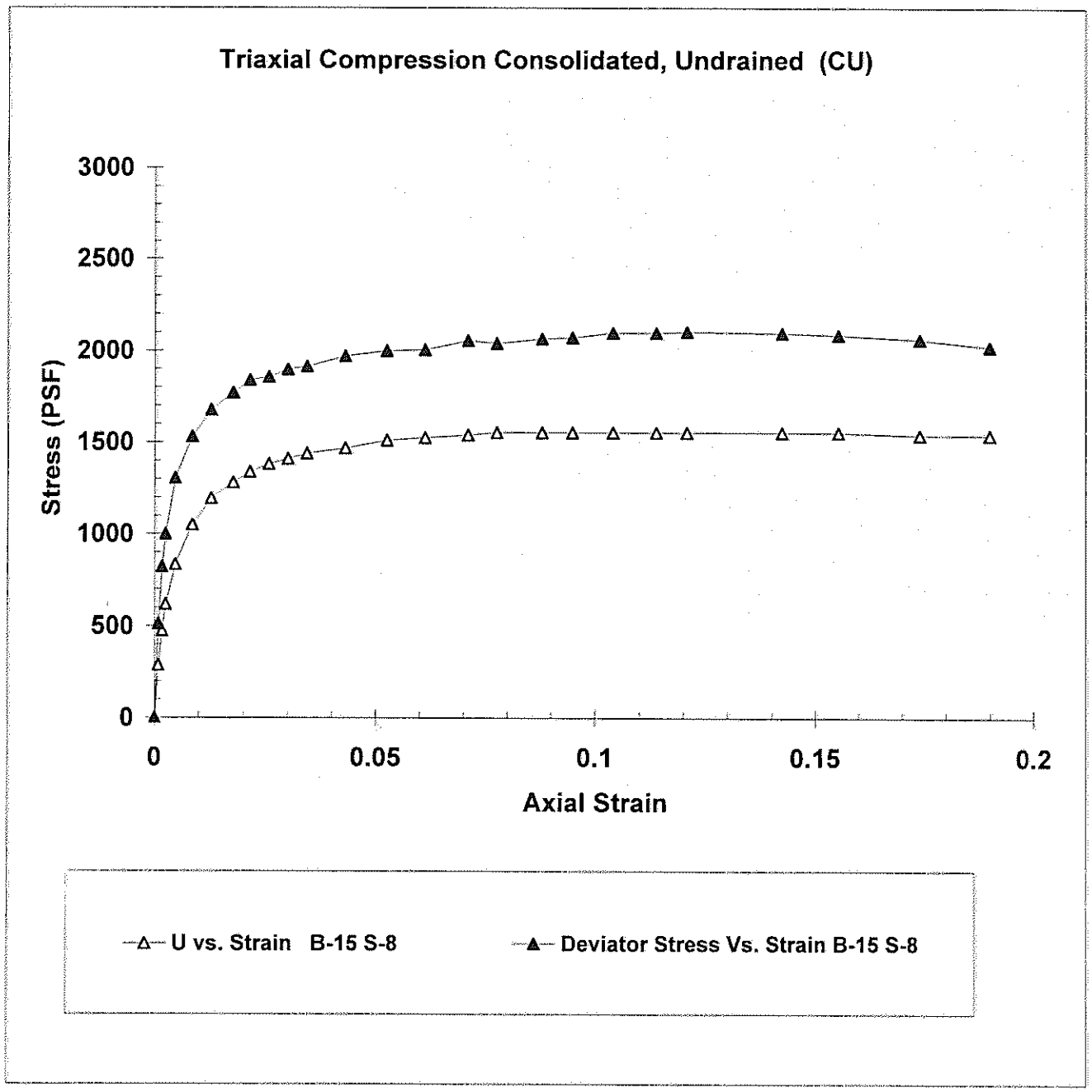


Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	15	0	0	0.039190	0	50.0	0.00	0.00	#DIV/0!	3024.00	3024.00	1.00	0.00	3024.00
Exploration #	B-15	5	5	41	26	0.00089	0.039225	662	52.8	2.80	403.20	0.61	2620.80	3282.41	1.25	330.81	2951.61
Sample ID #	S-8	10	10	57	42	0.00177	0.039260	1067	54.5	4.50	648.00	0.61	2376.00	3443.34	1.45	533.67	2909.67
Sample Depth (ft)	21.6-22.1	15	15	68	53	0.00266	0.039295	1345	55.8	5.80	835.20	0.62	2188.80	3533.90	1.61	672.55	2861.35
Type of Test	CU	25	25	82	67	0.00443	0.039365	1696	57.8	7.80	1123.20	0.66	1900.80	3596.70	1.89	847.95	2748.75
Cell Pressure (psi)	71	50	50	97	82	0.00886	0.039541	2062	60.5	10.50	1512.00	0.73	1512.00	3573.56	2.36	1030.78	2542.78
Back Pressure (psi)	50	75	75	106	91	0.01329	0.039718	2273	62.0	12.00	1728.00	0.76	1296.00	3568.75	2.75	1136.38	2432.38
Strain Rate (in/min)	0.004	100	100	110	95	0.01772	0.039898	2357	62.9	12.90	1857.60	0.79	1166.40	3523.00	3.02	1178.30	2344.70
Initial Platen Reading (in x 10^{-3})	0	125	125	114	99	0.02216	0.040078	2440	63.8	13.80	1987.20	0.81	1036.80	3476.33	3.35	1219.77	2256.57
Initial Load Cell Reading (lbs)	15	150	150	116	101	0.02659	0.040261	2472	64.1	14.10	2030.40	0.82	993.60	3465.49	3.49	1235.95	2229.55
Date	8/3/2006	175	175	118	103	0.03102	0.040445	2504	64.6	14.60	2102.40	0.84	921.60	3425.40	3.72	1251.90	2173.50
Test by	RGS	200	200	120	105	0.03545	0.040631	2535	64.9	14.90	2145.60	0.85	878.40	3413.65	3.89	1267.62	2146.02
Initial Length (in)	5.98	250	250	123	108	0.04431	0.041007	2572	65.4	15.40	2217.60	0.86	806.40	3378.81	4.19	1286.21	2092.61
Area (ft^2)	0.043991	300	300	125	110	0.05317	0.041391	2584	65.7	15.70	2260.80	0.87	763.20	3347.26	4.39	1292.03	2055.23
Height after Consolidation	5.642	360	360	128	113	0.06381	0.041861	2611	66.0	16.00	2304.00	0.88	720.00	3331.17	4.63	1305.59	2025.59
Area after Consolidation	0.03919	400	400	129	114	0.07090	0.042181	2605	66.1	16.10	2318.40	0.89	705.60	3310.24	4.69	1302.32	2007.92
Youngs Modulus for membrane(lbs/in2)	200	450	450	131	116	0.07976	0.042587	2614	66.3	16.30	2347.20	0.90	676.80	3290.37	4.86	1306.79	1983.59
Membrane Thickness in.	0.012	503	503	133	118	0.08915	0.043026	2619	66.3	16.30	2347.20	0.90	676.80	3296.06	4.87	1309.63	1986.43
		550	550	134	119	0.09748	0.043423	2606	66.4	16.40	2361.60	0.91	662.40	3268.09	4.93	1302.85	1965.25
		600	600	136	121	0.10635	0.043854	2612	66.5	16.50	2376.00	0.91	648.00	3260.14	5.03	1306.07	1954.07
		682	682	139	124	0.12088	0.044579	2614	66.6	16.60	2390.40	0.91	633.60	3248.07	5.13	1307.24	1940.84
		700	700	139	124	0.12407	0.044741	2600	66.5	16.50	2376.00	0.91	648.00	3247.97	5.01	1299.98	1947.98
		835	835	142	127	0.14800	0.045998	2556	66.5	16.50	2376.00	0.93	648.00	3204.40	4.95	1278.20	1926.20
		915	915	144	129	0.16218	0.046776	2534	66.5	16.50	2376.00	0.94	648.00	3181.61	4.91	1266.80	1914.80
		1000	1000	146	131	0.17724	0.047633	2505	66.5	16.50	2376.00	0.95	648.00	3153.18	4.87	1252.59	1900.59

AMEC
RP-Project

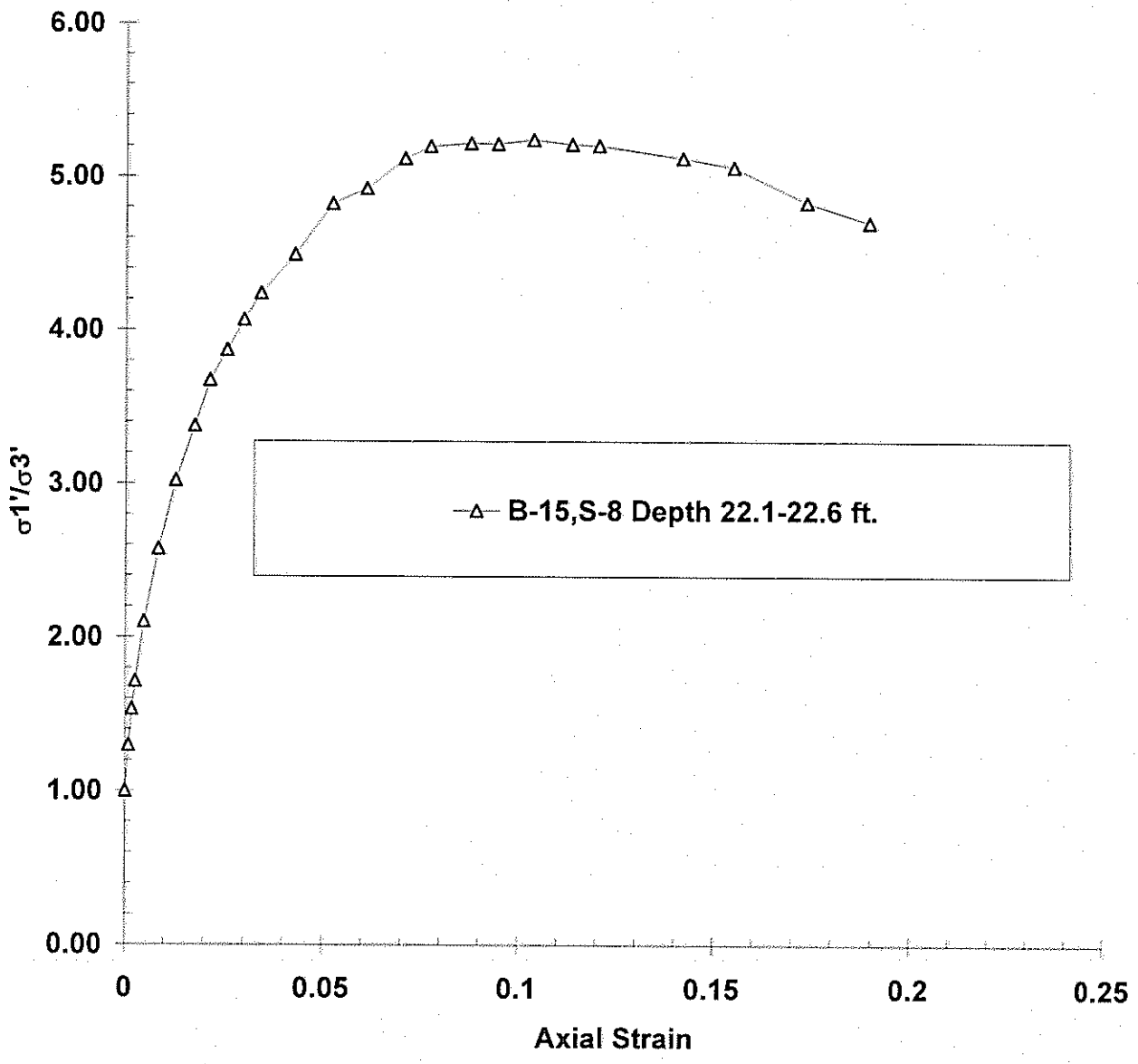


Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-15	S-8	22.1-22.6	64	58	76	42	34	98	60	14	64	50

Soil Technology
J-06-2135

WSDOT Grays Harbor Special Projects
Landau Assoicates

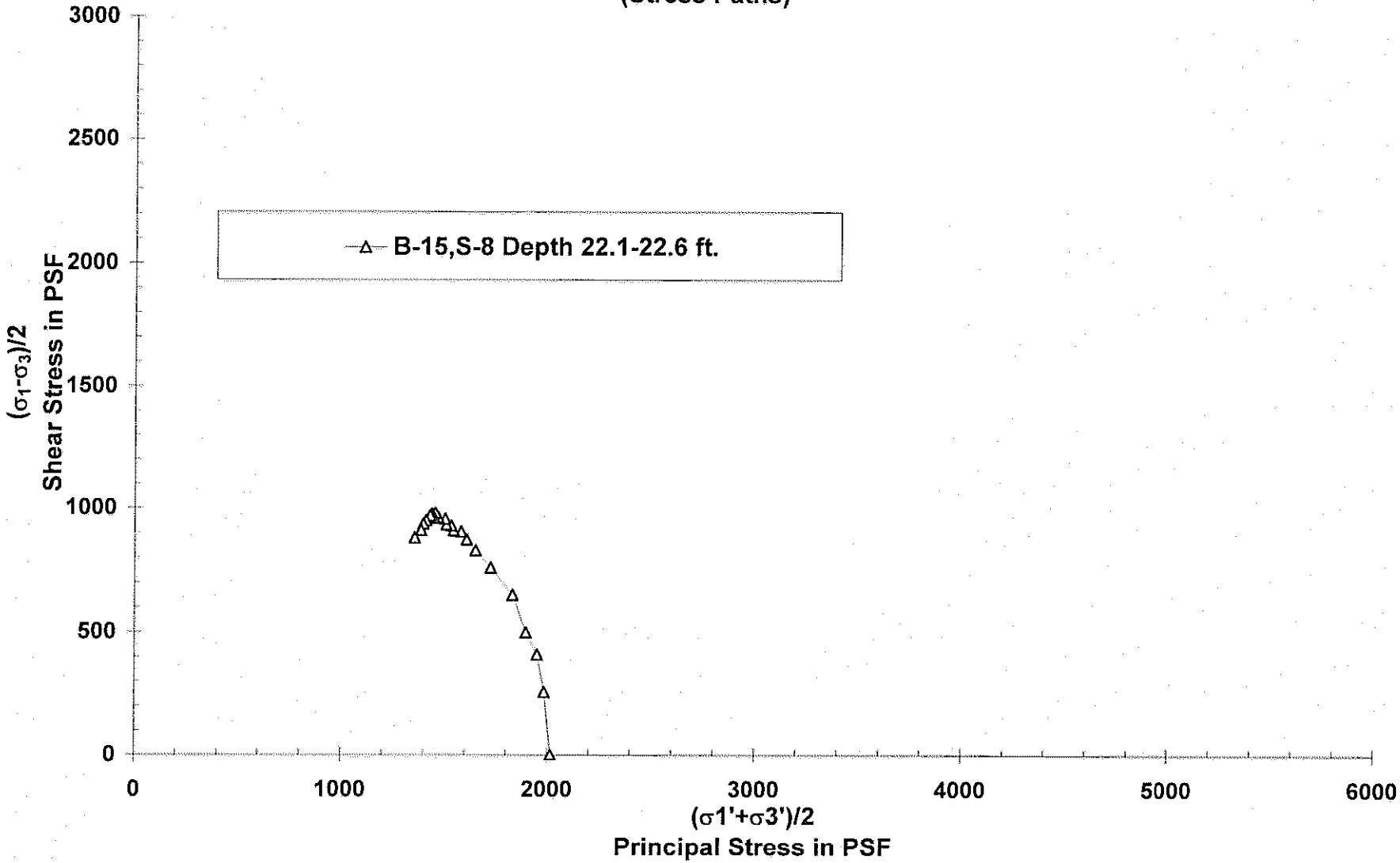
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)

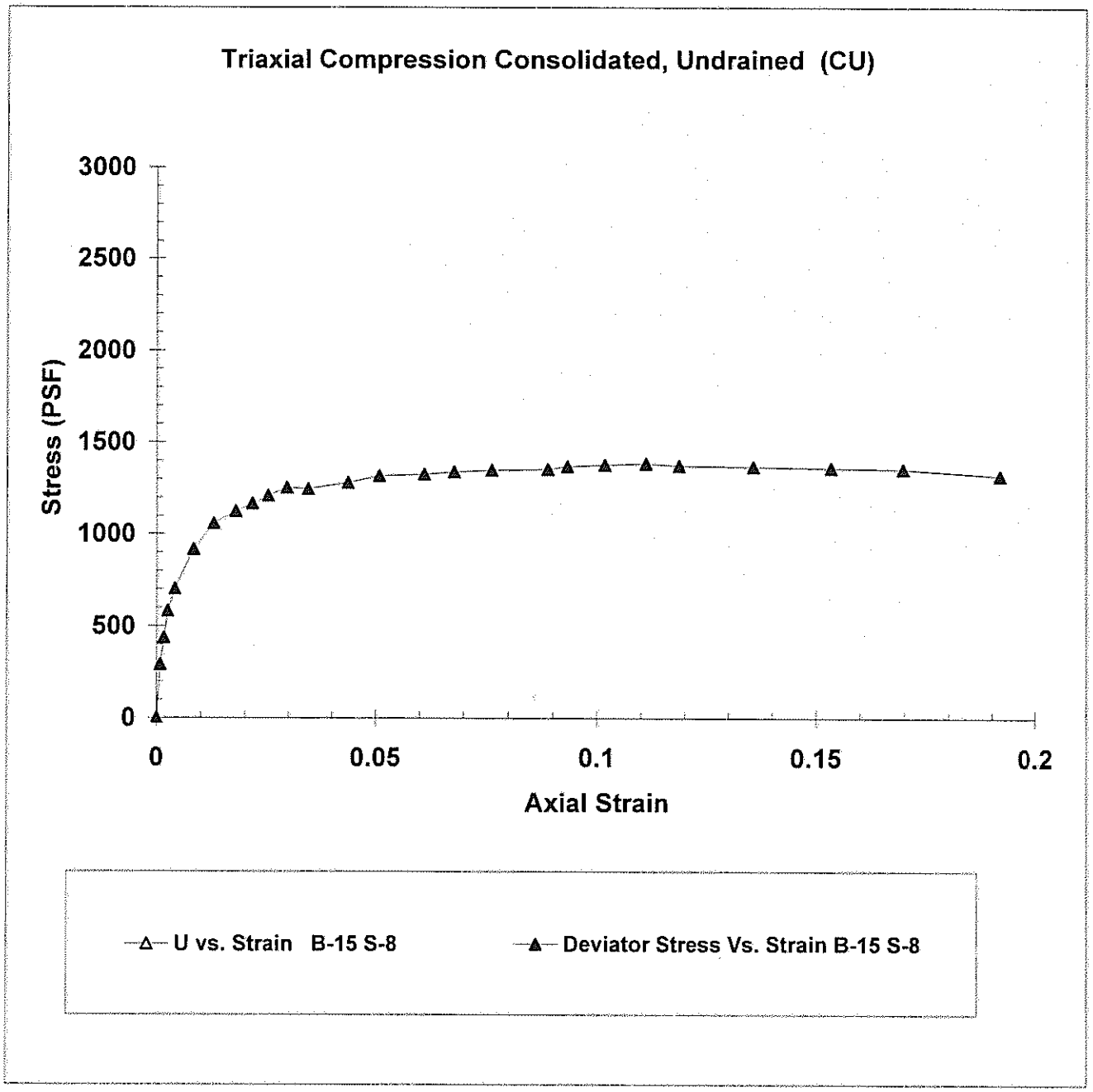


Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	14	0	0	0.038854	0	50.0	0.00	0.00	#DIV/0!	2016.00	2016.00	1.00	0.00	2016.00
Exploration #	B-15	5	5	34	20	0.00086	0.038887	513	52.0	2.00	288.00	0.56	1728.00	2241.12	1.30	256.56	1984.56
Sample ID #	S-8	10	10	46	32	0.00173	0.038921	820	53.3	3.30	475.20	0.58	1540.80	2360.60	1.53	409.90	1950.70
Sample Depth (ft)	22.1-22.6	15	15	53	39	0.00259	0.038954	998	54.3	4.30	619.20	0.62	1396.80	2394.39	1.71	498.80	1895.60
Type of Test	CU	28	28	65	51	0.00483	0.039042	1300	55.8	5.80	835.20	0.64	1180.80	2480.40	2.10	649.80	1830.60
Cell Pressure (psi)	64	50	50	74	60	0.00863	0.039192	1519	57.3	7.30	1051.20	0.69	964.80	2483.80	2.57	759.50	1724.30
Back Pressure (psi)	50	75	75	80	66	0.01295	0.039363	1659	58.3	8.30	1195.20	0.72	820.80	2479.60	3.02	829.40	1650.20
Strain Rate (in/min)	0.004	103	103	84	70	0.01778	0.039557	1745	58.9	8.90	1281.60	0.73	734.40	2479.43	3.38	872.51	1606.91
Initial Platen Reading (in x 10^{-3})	0	125	125	87	73	0.02158	0.039710	1808	59.3	9.30	1339.20	0.74	676.80	2465.28	3.67	904.24	1581.04
Initial Load Cell Reading (lbs)	14	150	150	88	74	0.02589	0.039886	1819	59.6	9.60	1382.40	0.76	633.60	2453.08	3.87	909.74	1543.34
Date	8/3/2006	175	175	90	76	0.03021	0.040064	1855	59.8	9.80	1411.20	0.76	604.80	2460.01	4.07	927.61	1532.41
Test by	RGS	200	200	91	77	0.03452	0.040243	1866	60.0	10.00	1440.00	0.77	576.00	2441.66	4.24	932.83	1508.83
Initial Length (in)	6.01	250	250	94	80	0.04316	0.040606	1911	60.2	10.20	1468.80	0.77	547.20	2457.70	4.49	955.25	1502.45
Area (ft^2)	0.043374	305	305	96	82	0.05265	0.041013	1927	60.5	10.50	1512.00	0.78	504.00	2430.59	4.82	963.30	1467.30
Height after Consolidation	5.793	355	355	97	83	0.06128	0.041390	1921	60.6	10.60	1526.40	0.79	489.60	2410.21	4.92	960.30	1449.90
Area after Consolidation	0.038854	412	412	100	86	0.07112	0.041828	1958	60.7	10.70	1540.80	0.79	475.20	2432.91	5.12	978.85	1454.05
Youngs Modulus for membrane(lbs/in2)	200	450	450	100	86	0.07768	0.042126	1934	60.8	10.80	1555.20	0.80	460.80	2394.92	5.20	967.06	1427.86
Membrane Thickness in.	0.012	510	510	102	88	0.08804	0.042604	1944	60.8	10.80	1555.20	0.80	460.80	2404.52	5.22	971.91	1432.71
		550	550	103	89	0.09494	0.042929	1942	60.8	10.80	1555.20	0.80	460.80	2402.73	5.21	970.96	1431.76
		603	603	105	91	0.10409	0.043368	1954	60.8	10.80	1555.20	0.80	460.80	2415.24	5.24	977.22	1438.02
		660	660	106	92	0.11393	0.043849	1941	60.8	10.80	1555.20	0.80	460.80	2401.40	5.21	970.30	1431.10
		700	700	107	93	0.12084	0.044194	1937	60.8	10.80	1555.20	0.80	460.80	2398.13	5.20	968.67	1429.47
		825	825	109	95	0.14241	0.045306	1900	60.8	10.80	1555.20	0.82	460.80	2360.80	5.12	950.00	1410.80
		900	900	110	96	0.15536	0.046000	1872	60.8	10.80	1555.20	0.83	460.80	2332.98	5.06	936.09	1396.89
		1008	1008	111	97	0.17400	0.047038	1822	60.7	10.70	1540.80	0.85	475.20	2296.81	4.83	910.80	1386.00

AMEC
RP-Project

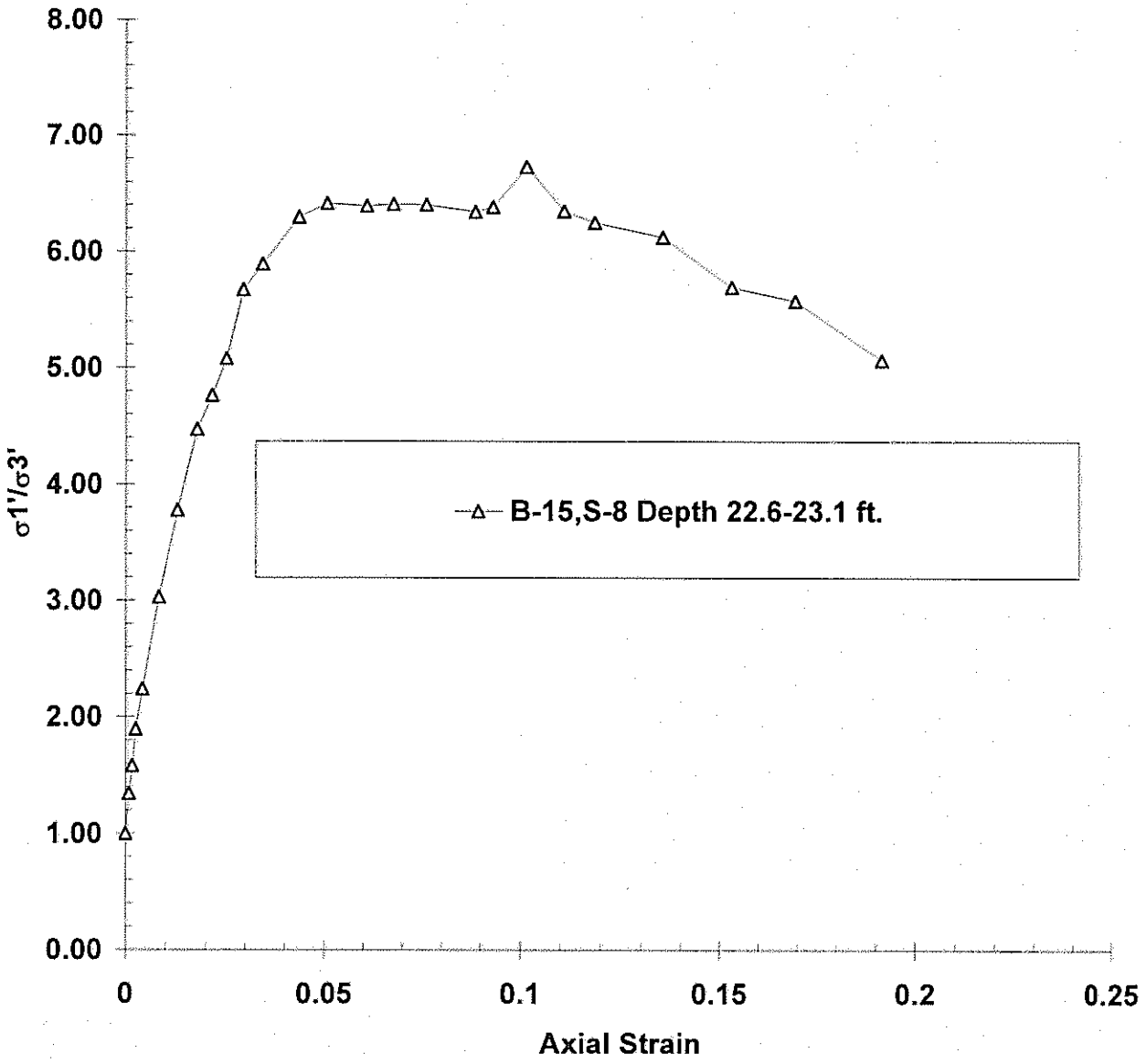


Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-15	S-8	22.6-23.1	66	61	0	0	0	101	61	7	67	60

Soil Technology
J-06-2135

WSDOT Grays Harbor Special Projects
Landau Assoicates

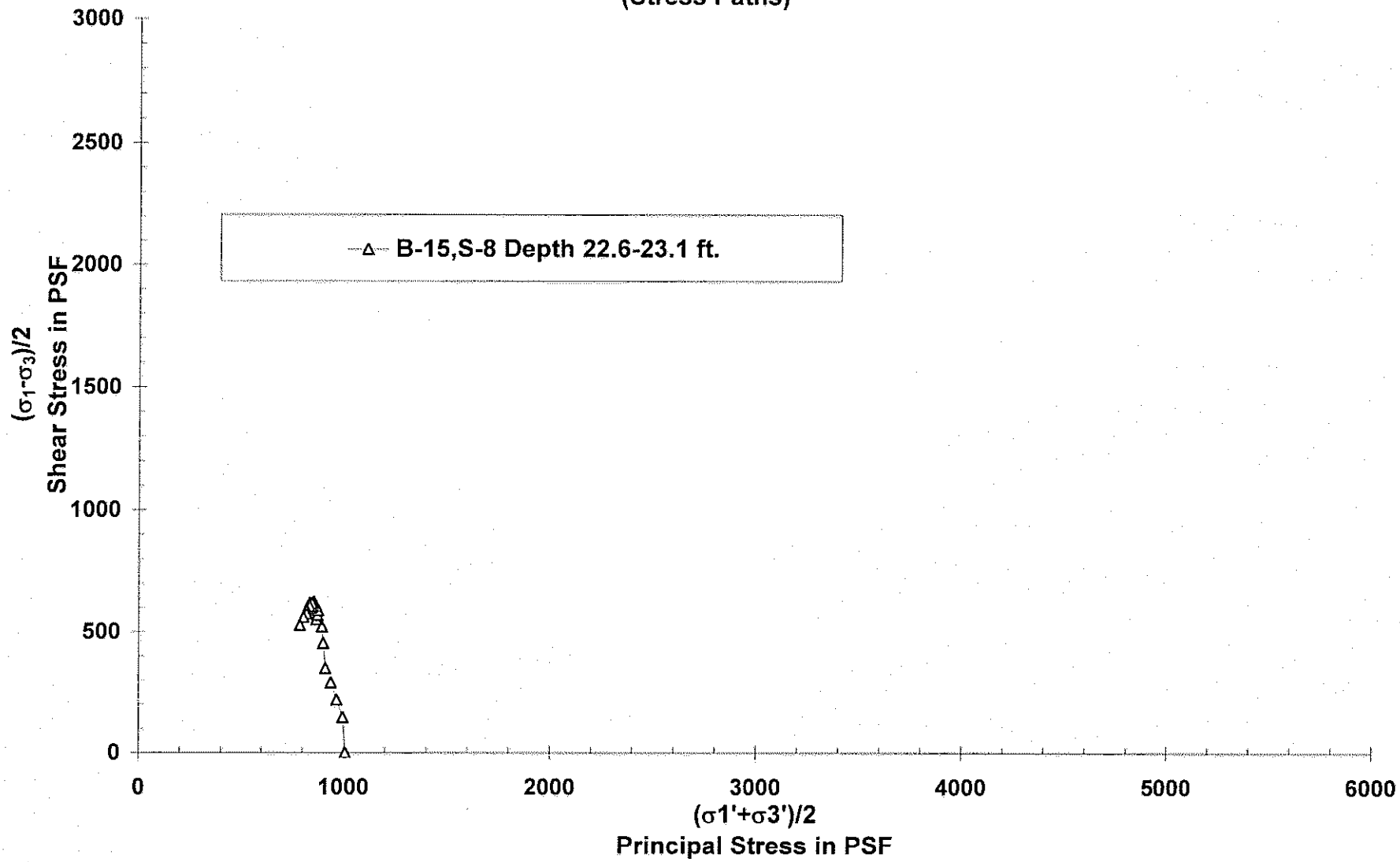
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)

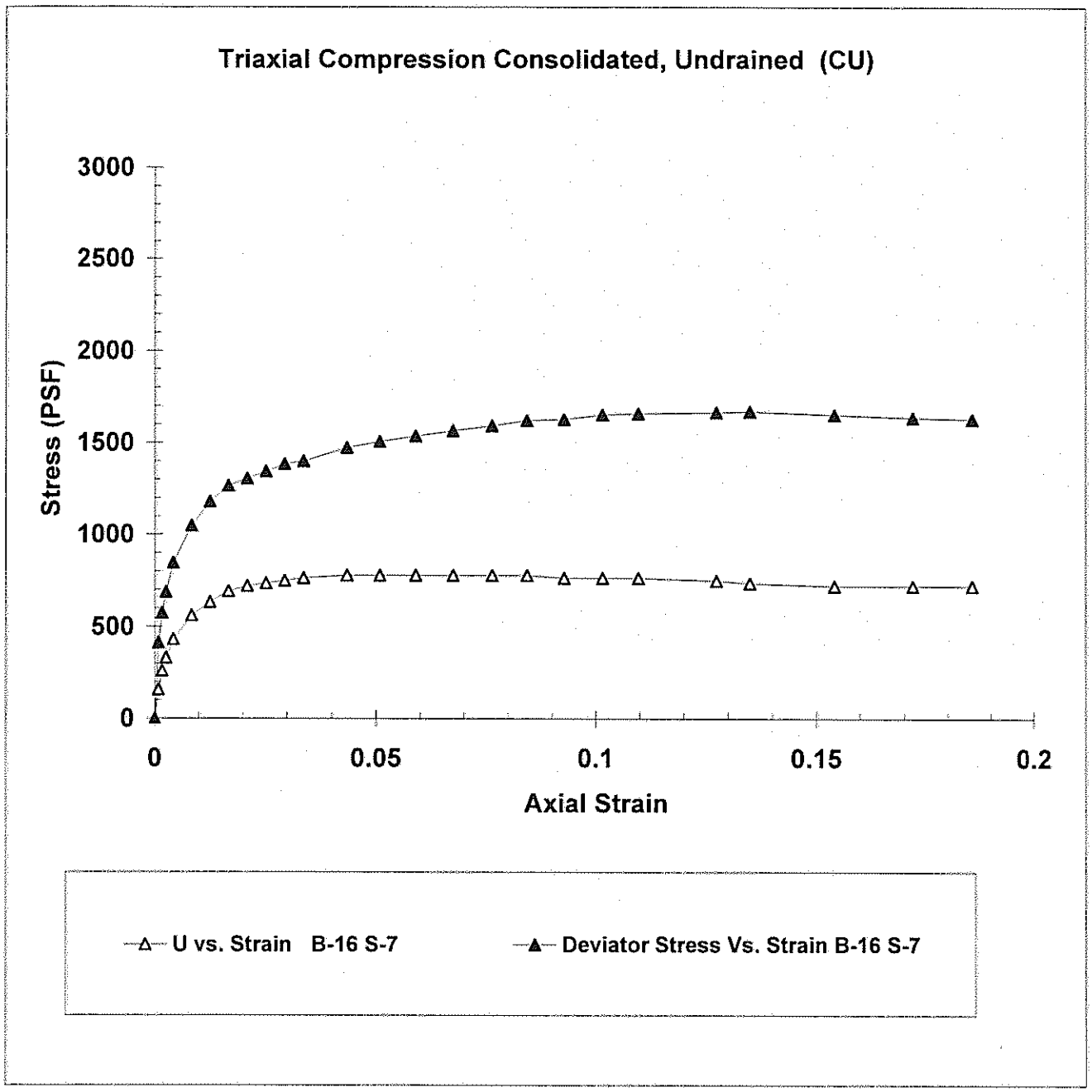


Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	13	0	0	0.041058	0	60.0	0.00	0.00	#DIV/0!	1008.00	1008.00	1.00	0.00	1008.00
Exploration #	B-15	5	5	25	12	0.00085	0.041093	291	61.1	1.10	158.40	0.54	849.60	1140.45	1.34	145.42	995.02
Sample ID #	S-8	10	10	31	18	0.00170	0.041128	435	61.8	1.80	259.20	0.60	748.80	1184.11	1.58	217.66	966.46
Sample Depth (ft)	22.6-23.1	15	15	37	24	0.00255	0.041163	580	62.5	2.50	360.00	0.62	648.00	1227.53	1.89	289.76	937.76
Type of Test	CU	25	25	42	29	0.00424	0.041233	697	63.1	3.10	446.40	0.64	561.60	1259.05	2.24	348.73	910.33
Cell Pressure (psi)	67	50	50	51	38	0.00849	0.041410	906	63.9	3.90	561.60	0.62	446.40	1352.33	3.03	452.97	899.37
Back Pressure (psi)	60	77	77	57	44	0.01307	0.041602	1040	64.4	4.40	633.60	0.61	374.40	1413.98	3.78	519.79	894.19
Strain Rate (in/min)	0.004	106	106	60	47	0.01799	0.041810	1099	64.8	4.80	691.20	0.63	316.80	1416.05	4.47	549.63	866.43
Initial Platen Reading (in x 10^{-3})	0	128	128	62	49	0.02172	0.041970	1137	64.9	4.90	705.60	0.62	302.40	1439.87	4.76	568.73	871.13
Initial Load Cell Reading (lbs)	13	150	150	64	51	0.02546	0.042131	1175	65.0	5.00	720.00	0.61	288.00	1463.32	5.08	587.66	875.66
Date	8/3/2006	175	175	66	53	0.02970	0.042315	1211	65.2	5.20	748.80	0.62	259.20	1470.65	5.67	605.73	864.93
Test by	RGS	204	204	66	53	0.03462	0.042531	1198	65.3	5.30	763.20	0.64	244.80	1443.09	5.89	599.15	843.95
Initial Length (in)	5.98	258	258	68	55	0.04379	0.042938	1220	65.4	5.40	777.60	0.64	230.40	1450.77	6.30	610.19	840.59
Area (ft^2)	0.043785	300	300	70	57	0.05092	0.043261	1247	65.4	5.40	777.60	0.62	230.40	1477.60	6.41	623.60	854.00
Height after Consolidation	5.892	360	360	71	58	0.06110	0.043730	1242	65.4	5.40	777.60	0.63	230.40	1472.25	6.39	620.93	851.33
Area after Consolidation	0.041058	400	400	72	59	0.06789	0.044049	1246	65.4	5.40	777.60	0.62	230.40	1475.98	6.41	622.79	853.19
Youngs Modulus for membrane(lbs/in2)	200	450	450	73	60	0.07637	0.044453	1244	65.4	5.40	777.60	0.63	230.40	1474.55	6.40	622.08	852.48
Membrane Thickness in.	0.012	524	524	74	61	0.08893	0.045066	1231	65.4	5.40	777.60	0.63	230.40	1461.02	6.34	615.31	845.71
		550	550	75	62	0.09335	0.045285	1240	65.4	5.40	777.60	0.63	230.40	1470.45	6.38	620.03	850.43
		600	600	76	63	0.10183	0.045713	1237	65.5	5.50	792.00	0.64	216.00	1453.38	6.73	618.69	834.69
		655	655	77	64	0.11117	0.046193	1232	65.4	5.40	777.60	0.63	230.40	1462.20	6.35	615.90	846.30
		700	700	77	64	0.11881	0.046594	1209	65.4	5.40	777.60	0.64	230.40	1439.74	6.25	604.67	835.07
		800	800	78	65	0.13578	0.047509	1180	65.4	5.40	777.60	0.66	230.40	1410.87	6.12	590.23	820.63
		904	904	79	66	0.15343	0.048499	1149	65.3	5.30	763.20	0.66	244.80	1393.54	5.69	574.37	819.17
		1000	1000	80	67	0.16972	0.049451	1120	65.3	5.30	763.20	0.68	244.80	1365.05	5.58	560.12	804.92

AMEC
RP-Project

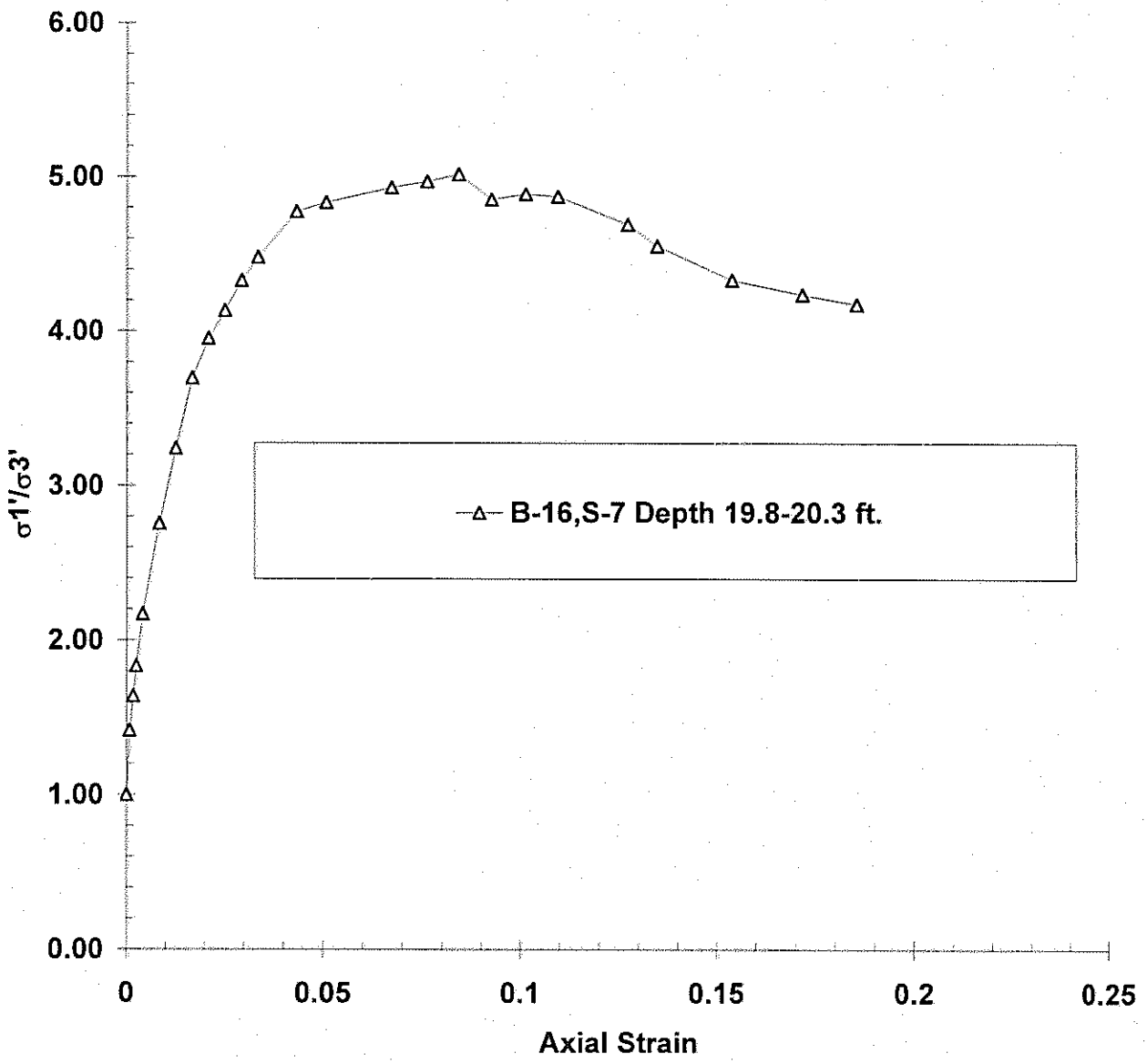


Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-16	S-7	19.8-20.3	62	57	0	0	0	103	64	8	48	40

Soil Technology
J-06-2135

WSDOT Grays Harbor Special Projects
Landau Assoicates

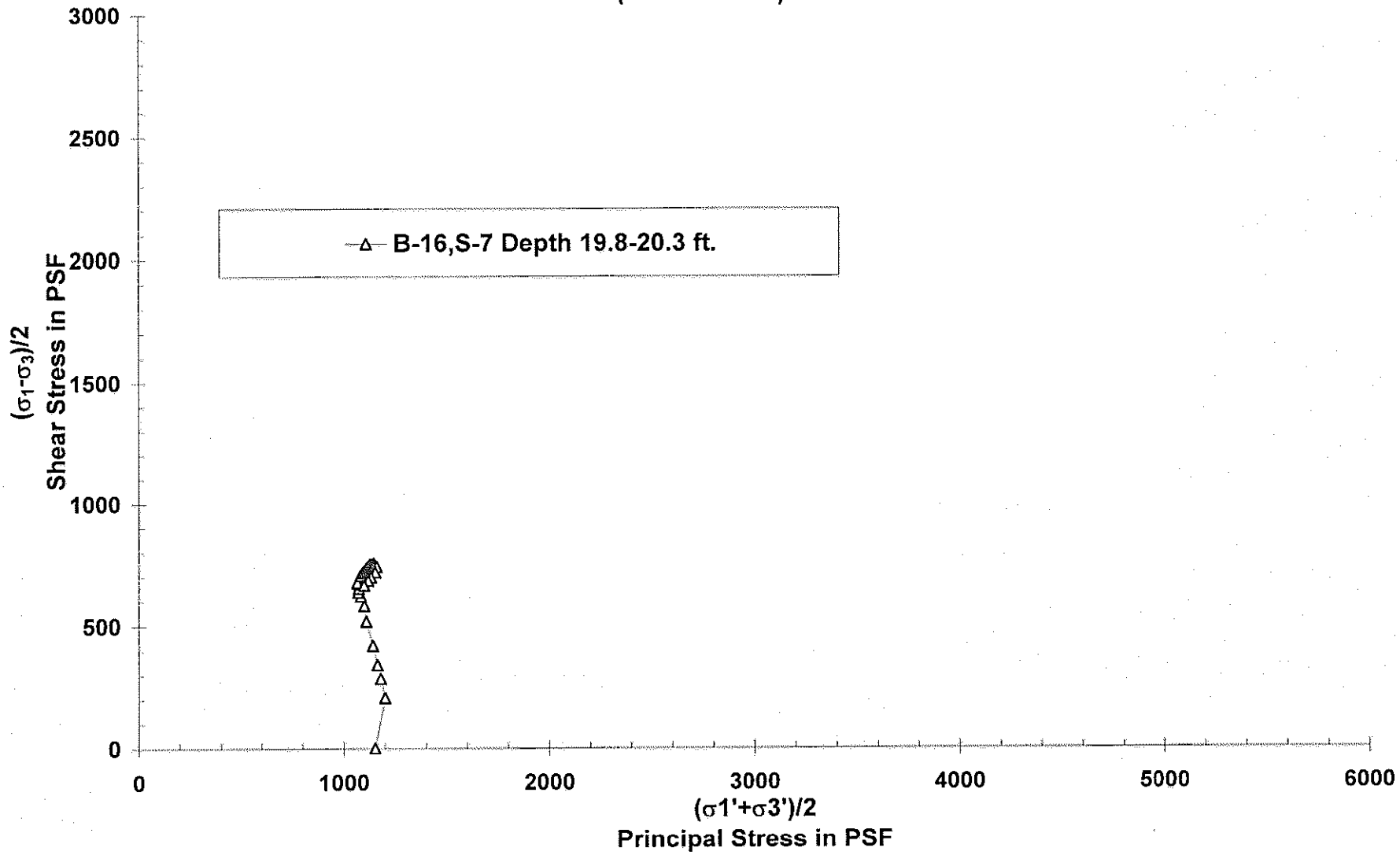
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)

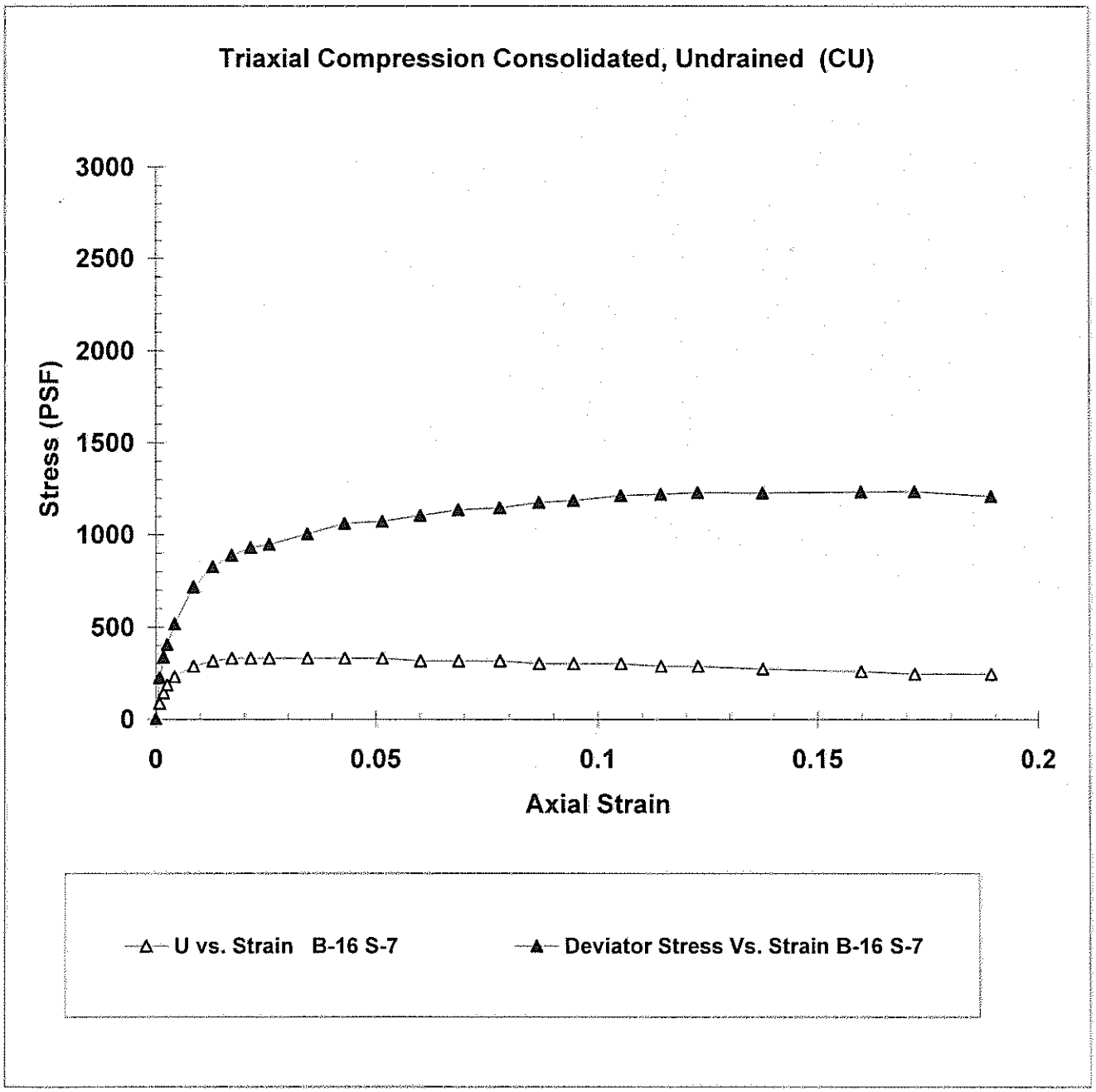


Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

		0	0	8	0	0	0.043505	0	40.0	0.00	0.00	#DIV/0!	1152.00	1152.00	1.00	0.00	1152.00
Job #	J-06-2154	5	5	26	18	0.00084	0.043541	412	41.1	1.10	158.40	0.38	993.60	1405.83	1.41	206.12	1199.72
Exploration #	B-16	10	10	33	25	0.00169	0.043578	571	41.8	1.80	259.20	0.45	892.80	1464.15	1.64	285.67	1178.47
Sample ID #	S-7	15	15	38	30	0.00253	0.043615	684	42.3	2.30	331.20	0.48	820.80	1505.13	1.83	342.17	1162.97
Sample Depth (ft)	19.8-20.3	25	25	45	37	0.00422	0.043689	841	43.0	3.00	432.00	0.51	720.00	1561.06	2.17	420.53	1140.53
Type of Test	CU	50	50	54	46	0.00844	0.043875	1037	43.9	3.90	561.60	0.54	590.40	1627.16	2.76	518.38	1108.78
Cell Pressure (psi)	48	75	75	60	52	0.01266	0.044063	1163	44.4	4.40	633.60	0.54	518.40	1681.04	3.24	581.32	1099.72
Back Pressure (psi)	40	100	100	64	56	0.01688	0.044252	1242	44.8	4.80	691.20	0.56	460.80	1702.95	3.70	621.08	1081.88
Strain Rate (in/min)	0.005	125	125	66	58	0.02110	0.044442	1276	45.0	5.00	720.00	0.56	432.00	1707.89	3.95	637.94	1069.94
Initial Platen Reading (in x 10^{-3})	0	150	150	68	60	0.02532	0.044635	1309	45.1	5.10	734.40	0.56	417.60	1726.84	4.14	654.62	1072.22
		175	175	70	62	0.02954	0.044829	1342	45.2	5.20	748.80	0.56	403.20	1745.40	4.33	671.10	1074.30
Initial Load Cell Reading (lbs)	8	200	200	71	63	0.03376	0.045025	1353	45.3	5.30	763.20	0.56	388.80	1741.36	4.48	676.28	1065.08
Date	8/18/2006	258	258	75	67	0.04355	0.045486	1413	45.4	5.40	777.60	0.55	374.40	1787.19	4.77	706.39	1080.79
Test by	RGS	302	302	77	69	0.05098	0.045842	1435	45.4	5.40	777.60	0.54	374.40	1809.11	4.83	717.35	1091.75
Initial Length (in)	5.997	350	350	79	71	0.06752	0.046655	1471	45.4	5.40	777.60	0.53	374.40	1845.74	4.93	735.67	1110.07
Area (ft^2)	.0435789	400	400	81	73	0.07647	0.047107	1486	45.4	5.40	777.60	0.52	374.40	1860.81	4.97	743.21	1117.61
Height after Consolidation	5.924	453	453	83	75	0.08440	0.047515	1504	45.4	5.40	777.60	0.52	374.40	1878.26	5.02	751.93	1126.33
Area after Consolidation	0.043505	500	500	85	77	0.09284	0.047957	1498	45.3	5.30	763.20	0.51	388.80	1886.91	4.85	749.05	1137.85
Youngs Modulus for membrane(lbs/in2)	200	550	550	86	78	0.10162	0.048426	1512	45.3	5.30	763.20	0.50	388.80	1900.33	4.89	755.77	1144.57
Membrane Thickness in.	0.012	602	602	88	80	0.10972	0.048866	1506	45.3	5.30	763.20	0.51	388.80	1894.70	4.87	752.95	1141.75
		650	650	89	81	0.12745	0.049859	1489	45.2	5.20	748.80	0.50	403.20	1891.71	4.69	744.25	1147.45
		755	755	91	83	0.13504	0.050297	1483	45.1	5.10	734.40	0.50	417.60	1900.99	4.55	741.70	1159.30
		800	800	92	84	0.15412	0.051431	1440	45.0	5.00	720.00	0.50	432.00	1871.64	4.33	719.82	1151.82
		913	913	93	85	0.17201	0.052543	1399	45.0	5.00	720.00	0.51	432.00	1830.98	4.24	699.49	1131.49
		1019	1019	94	86	0.18569	0.053425	1372	45.0	5.00	720.00	0.52	432.00	1803.76	4.18	685.88	1117.88
		1100	1100	95	87	0.20257	0.054556	1333	45.0	5.00	720.00	0.54	432.00	1765.00	4.09	666.50	1098.50
		1200	1200	96	88	0.00000	0.000000	0	0.0	-40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

AMEC
RP-Project

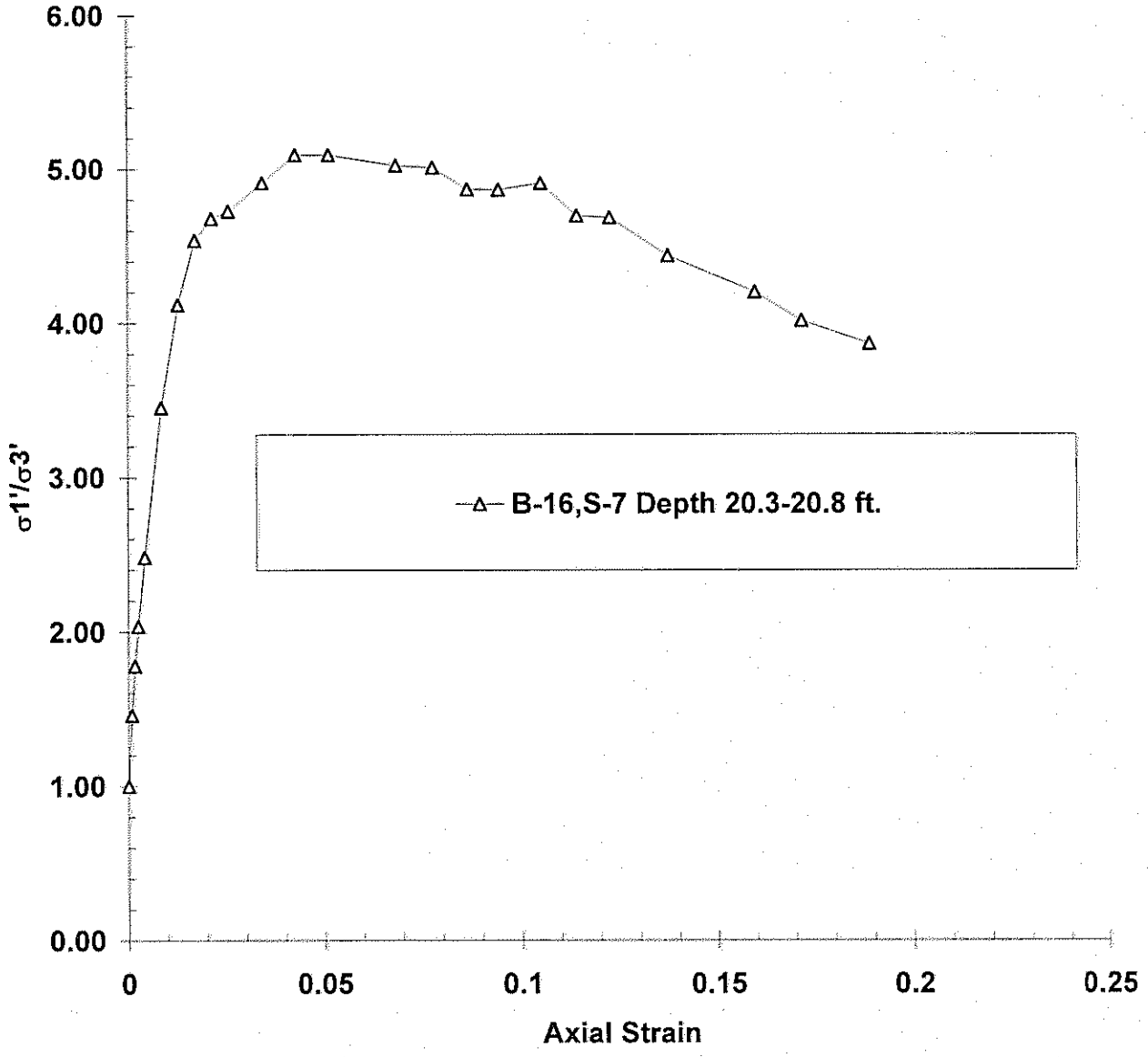


Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-16	S-7	20.3-20.8	58	56	71	42	29	104	66	4	44	40

Soil Technology
J-06-2135

WSDOT Grays Harbor Special Projects
Landau Assoicates

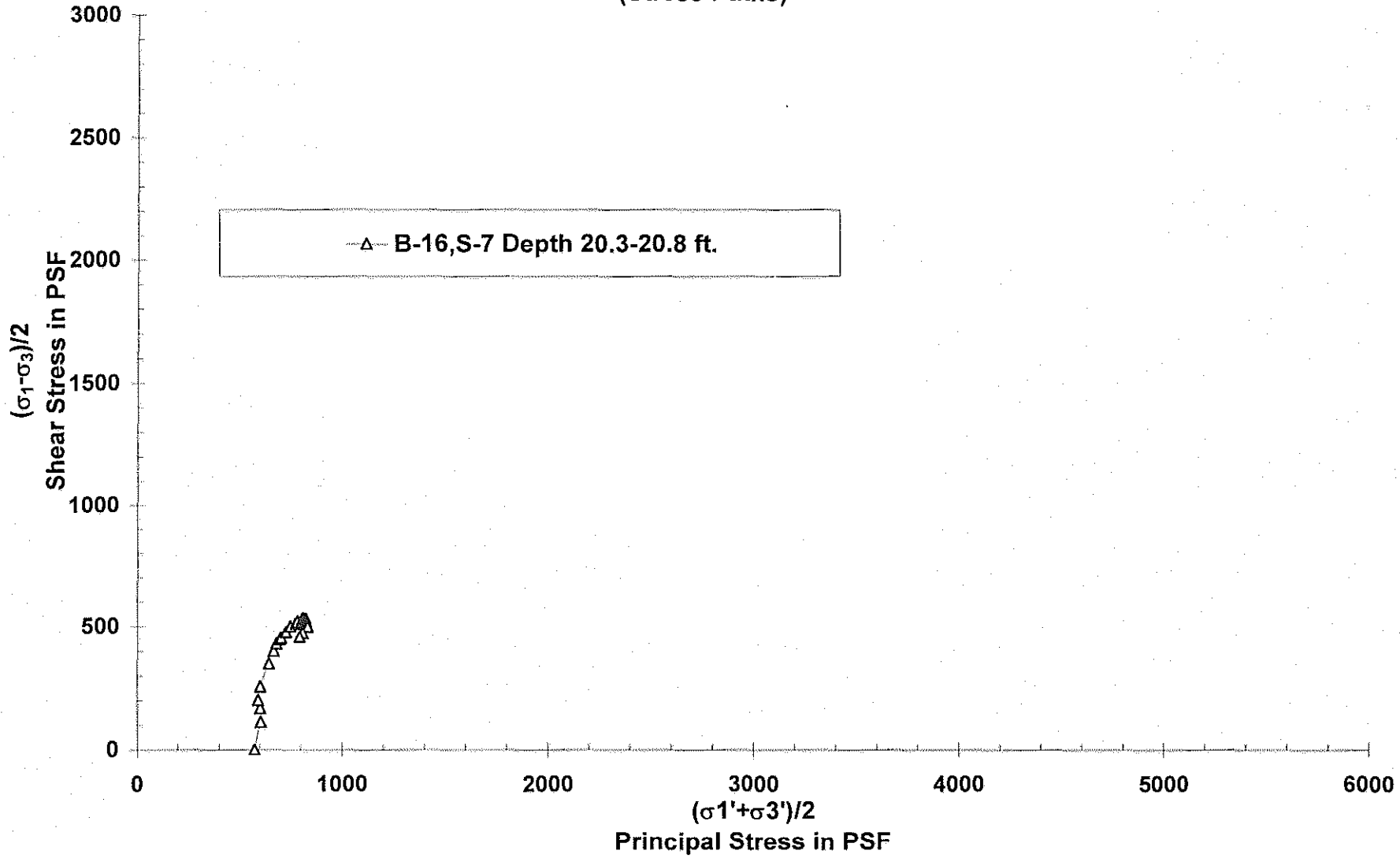
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

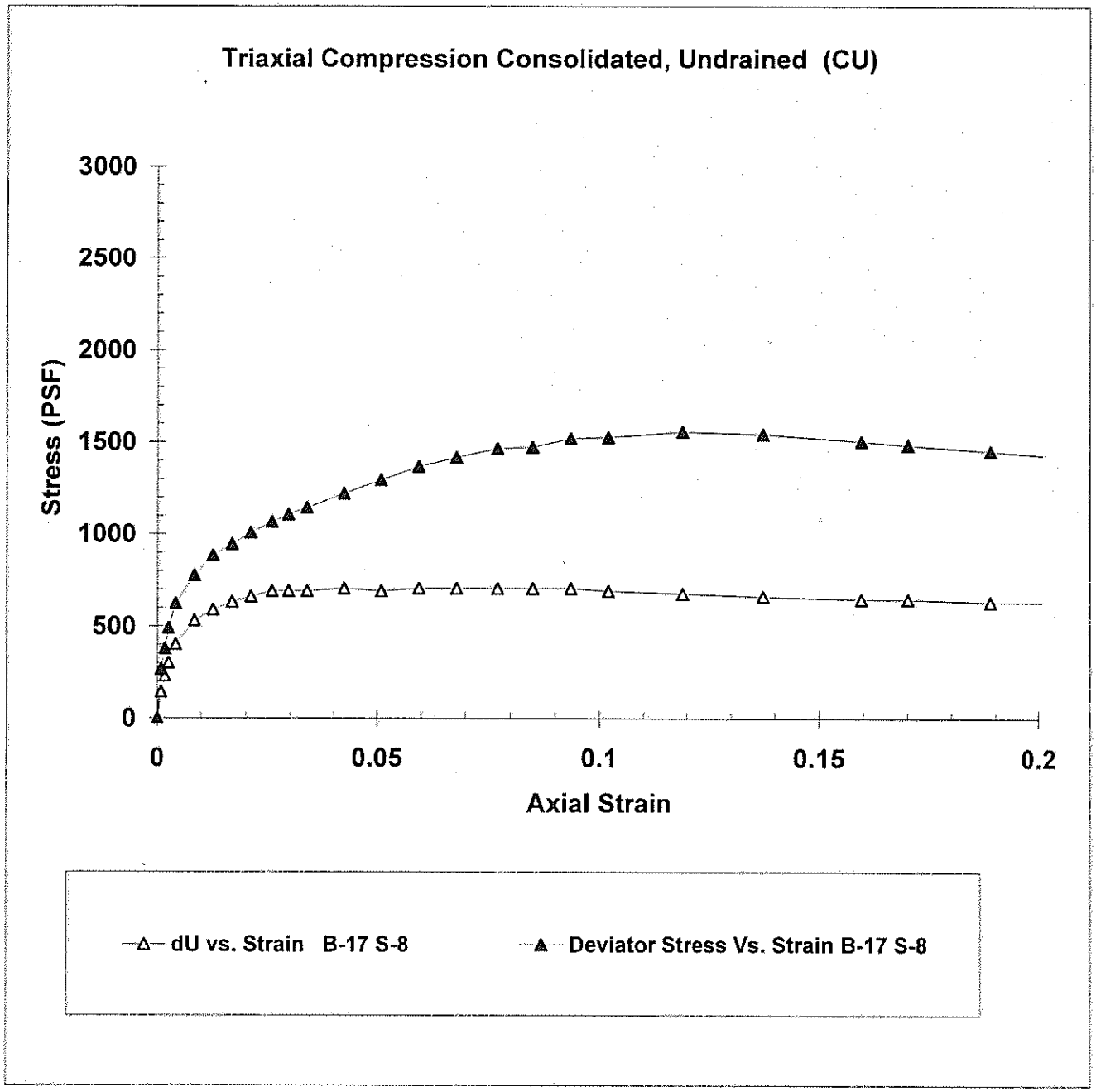
TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

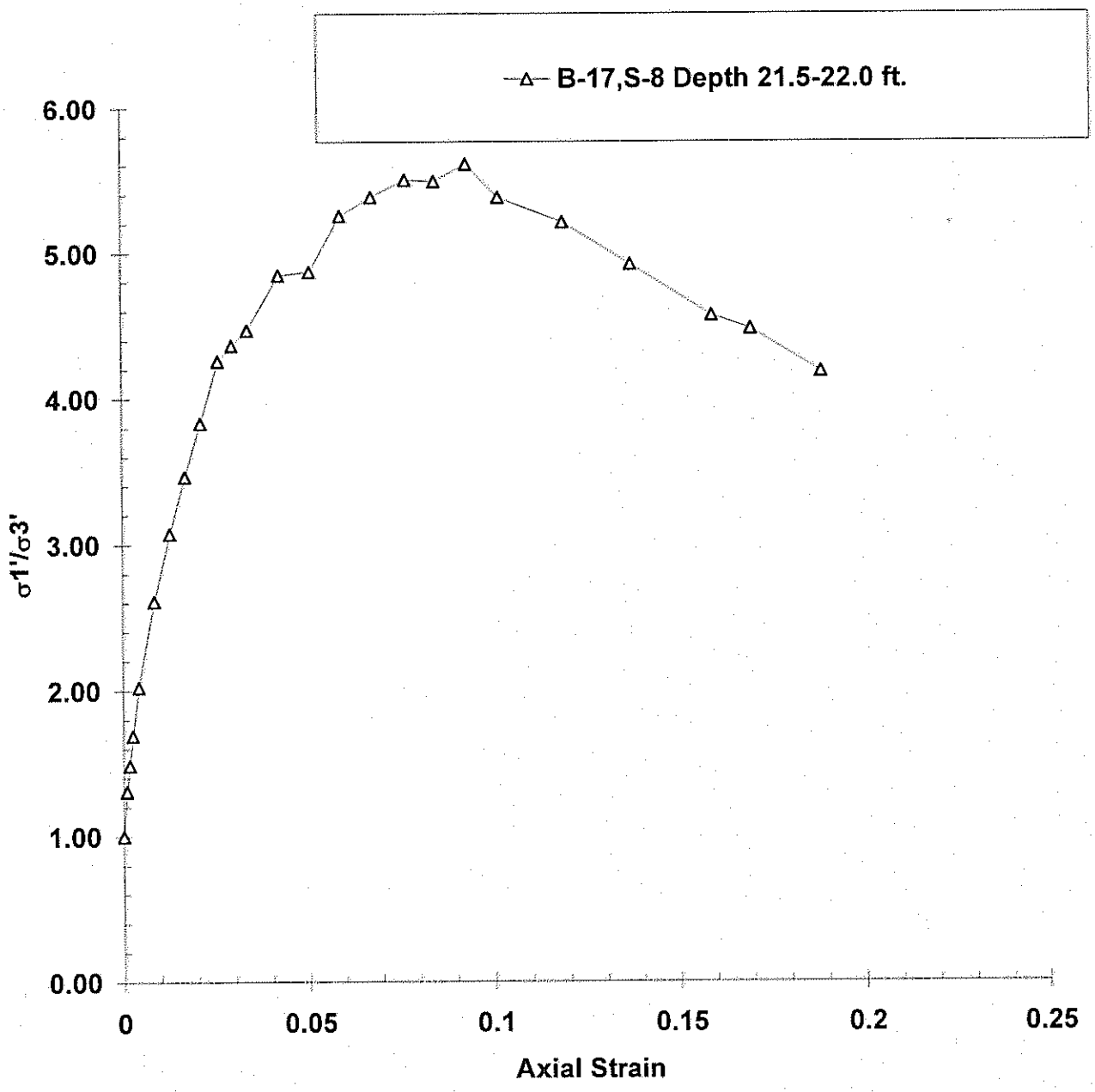
		0	0	8	0	0	0.044212	0	40.0	0.00	0.00	#DIV/0!	576.00	576.00	1.00	0.00	576.00
Job #	J-06-2154	5	5	18	10	0.00086	0.044250	225	40.6	0.60	86.40	0.38	489.60	714.40	1.46	112.40	602.00
Exploration #	B-16	10	10	23	15	0.00172	0.044288	336	41.0	1.00	144.00	0.43	432.00	768.32	1.78	168.16	600.16
Sample ID #	S-7	15	15	26	18	0.00258	0.044326	403	41.3	1.30	187.20	0.47	388.80	791.32	2.04	201.26	590.06
Sample Depth (ft)	20.3-20.8	25	25	31	23	0.00430	0.044402	512	41.6	1.60	230.40	0.45	345.60	857.65	2.48	256.02	601.62
Type of Test	CU	50	50	40	32	0.00860	0.044595	706	42.0	2.00	288.00	0.41	288.00	993.68	3.45	352.84	640.84
Cell Pressure (psi)	44	75	75	45	37	0.01290	0.044789	808	42.2	2.20	316.80	0.39	259.20	1067.46	4.12	404.13	663.33
Back Pressure (psi)	40	100	100	48	40	0.01720	0.044985	865	42.3	2.30	331.20	0.38	244.80	1110.21	4.54	432.71	677.51
Strain Rate (in/min)	0.005	125	125	50	42	0.02150	0.045183	900	42.3	2.30	331.20	0.37	244.80	1144.64	4.68	449.92	694.72
Initial Platen Reading (in x 10^{-3})	0	150	150	51	43	0.02580	0.045382	912	42.3	2.30	331.20	0.36	244.80	1156.65	4.72	455.92	700.72
Initial Load Cell Reading (lbs)	8	201	201	54	46	0.03457	0.045794	957	42.3	2.30	331.20	0.35	244.80	1201.51	4.91	478.35	723.15
Date	8/17/2006	250	250	57	49	0.04299	0.046198	1001	42.3	2.30	331.20	0.33	244.80	1246.03	5.09	500.61	745.41
Test by	RGS	300	300	58	50	0.05159	0.046616	1001	42.3	2.30	331.20	0.33	244.80	1246.06	5.09	500.63	745.43
Initial Length (in)	5.85	350	350	60	54	0.06879	0.047477	1042	42.2	2.20	316.80	0.30	259.20	1301.49	5.02	521.15	780.35
Area (ft^2)	0.043991	400	400	62	55	0.07807	0.047956	1039	42.2	2.20	316.80	0.30	259.20	1298.17	5.01	519.48	778.68
Height after Consolidation	5.815	454	454	63	57	0.08684	0.048416	1057	42.1	2.10	302.40	0.29	273.60	1330.84	4.86	528.62	802.22
Area after Consolidation	0.044212	505	505	65	58	0.09458	0.048830	1057	42.1	2.10	302.40	0.29	273.60	1330.64	4.86	528.52	802.12
Youngs Modulus for membrane(lbs/in2)	200	550	550	66	60	0.10525	0.049412	1069	42.1	2.10	302.40	0.28	273.60	1342.39	4.91	534.40	808.00
Membrane Thickness in.	0.012	612	612	68	61	0.11436	0.049920	1064	42.0	2.00	288.00	0.27	288.00	1351.86	4.69	531.93	819.93
		665	665	69	62	0.12279	0.050400	1060	42.0	2.00	288.00	0.27	288.00	1348.42	4.68	530.21	818.21
		714	714	70	63	0.13758	0.051264	1039	41.9	1.90	273.60	0.26	302.40	1341.14	4.44	519.37	821.77
		800	800	71	65	0.15993	0.052628	1014	41.8	1.80	259.20	0.26	316.80	1330.79	4.20	506.99	823.79
		930	930	73	66	0.17197	0.053394	998	41.7	1.70	244.80	0.25	331.20	1329.57	4.01	499.19	830.39
		1000	1000	74	66	0.18917	0.054526	949	41.7	1.70	244.80	0.26	331.20	1280.13	3.87	474.46	805.66
		1100	1100	74	67	0.20636	0.055707	917	41.7	1.70	244.80	0.27	331.20	1248.64	3.77	458.72	789.92
		1200	1200	75	0	0.00000	0.000000	0	0.0	-40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-17	S-8	21.5-22.0	63	59	NT	NT	NT	100	62	7	57	50

WSDOT Grays Harbor Special Projects
Landau Assoicates

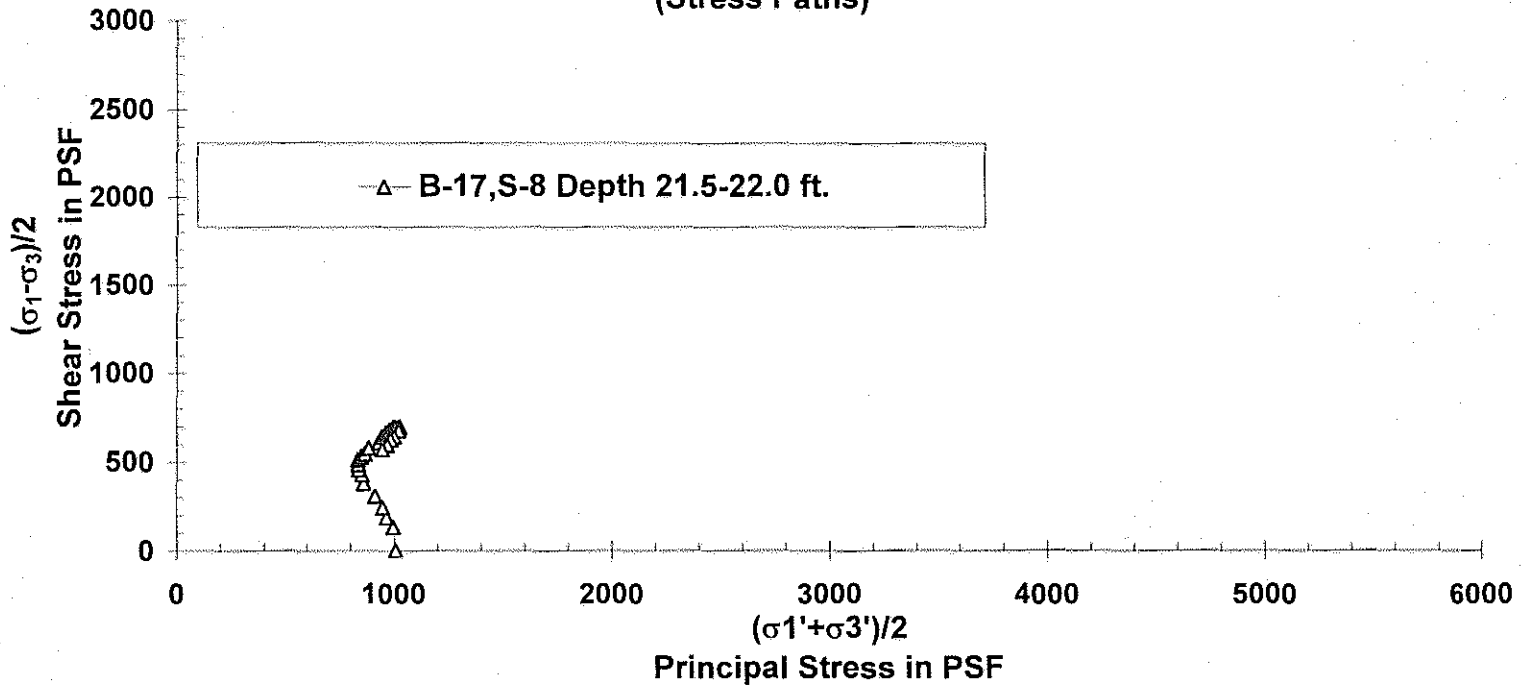
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

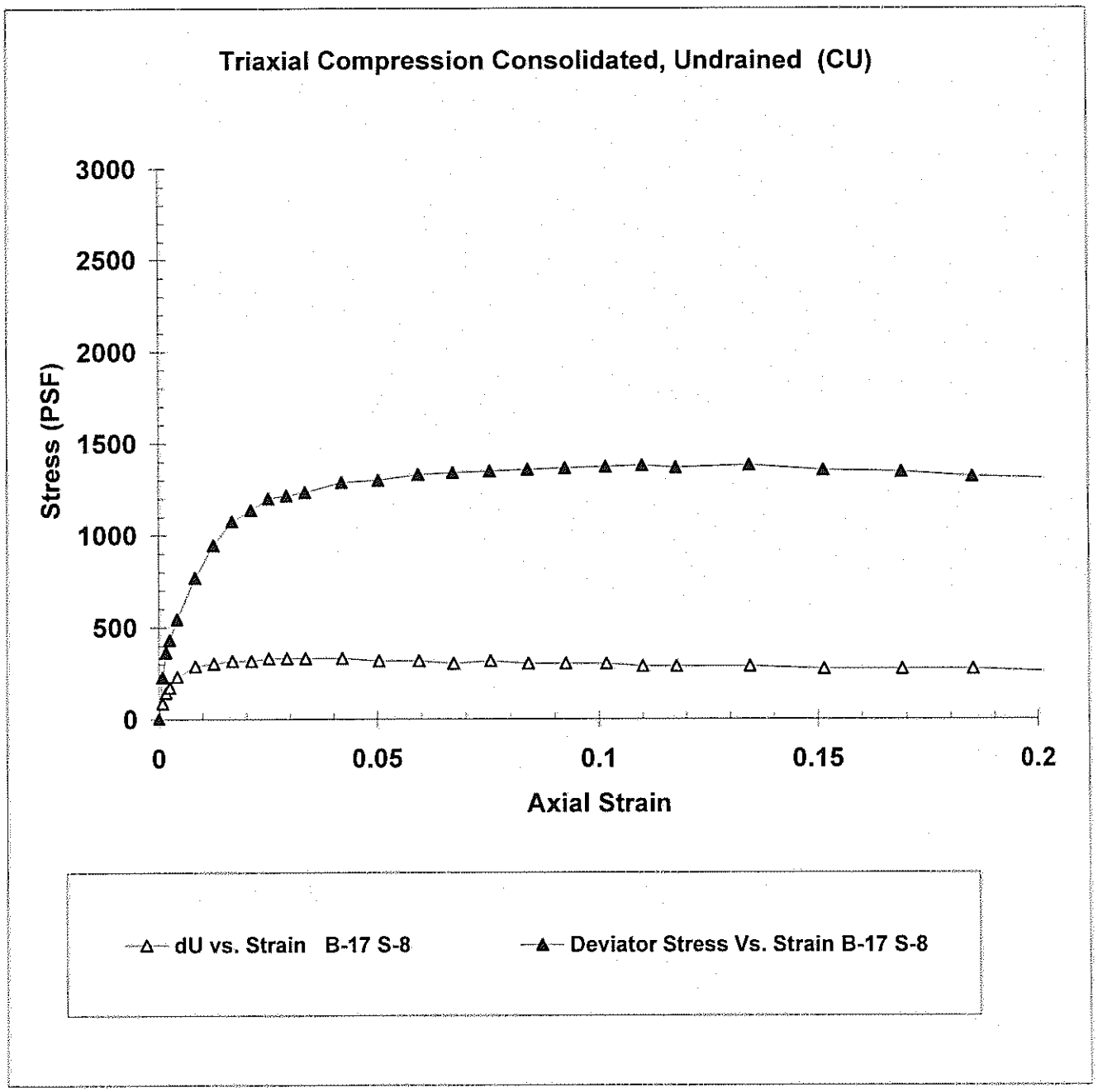
TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

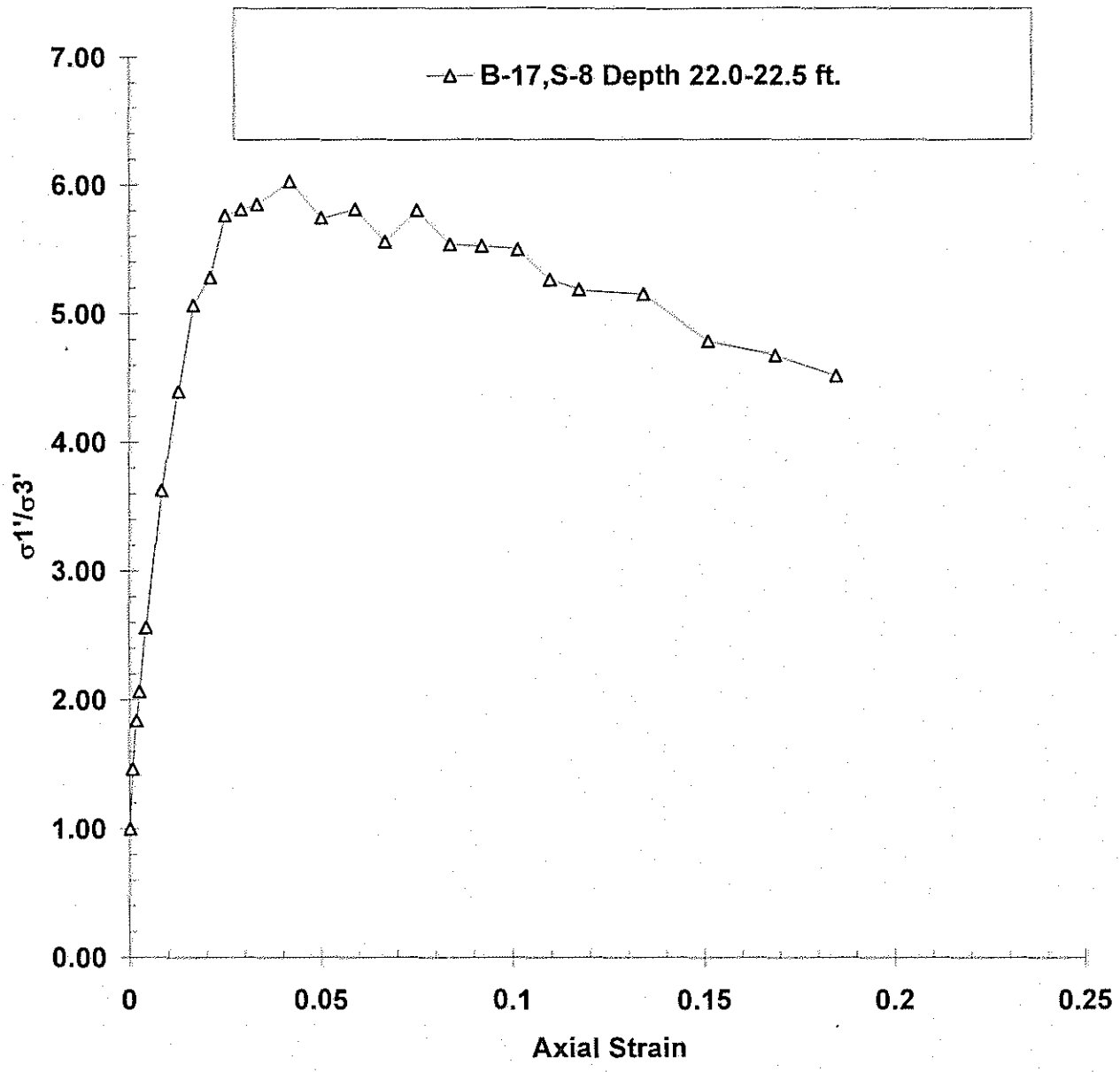
		0	0	11	0	0	0.044670	0	50.0	0.00	0.00	#DIV/0!	1008.00	1008.00	1.00	0.00	1008.00
Job #	J-06-2154	5	5	23	12	0.00085	0.044708	267	51.0	1.00	144.00	0.54	864.00	1131.23	1.31	133.62	997.62
Exploration #	B-17	10	10	28	17	0.00170	0.044746	378	51.6	1.60	230.40	0.61	777.60	1155.17	1.49	188.78	966.38
Sample ID #	S-8	15	15	33	22	0.00255	0.044785	488	52.1	2.10	302.40	0.62	705.60	1193.31	1.69	243.86	949.46
Sample Depth (ft)	21.5-22.0	25	25	39	28	0.00425	0.044861	618	52.8	2.80	403.20	0.65	604.80	1223.07	2.02	309.13	913.93
Type of Test	CU	50	50	46	35	0.00851	0.045054	765	53.7	3.70	532.80	0.70	475.20	1240.29	2.61	382.55	857.75
Cell Pressure (psi)	57	75	75	51	40	0.01276	0.045248	866	54.1	4.10	590.40	0.68	417.60	1283.98	3.07	433.19	850.79
Back Pressure (psi)	50	100	100	54	43	0.01701	0.045443	923	54.4	4.40	633.60	0.69	374.40	1297.11	3.46	461.36	835.76
Strain Rate (in/min)	0.004	125	125	57	46	0.02127	0.045641	978	54.6	4.60	662.40	0.68	345.60	1324.07	3.83	489.23	834.83
Initial Platen Reading (in x 10^{-3})	0	153	153	60	49	0.02603	0.045864	1032	54.8	4.80	691.20	0.67	316.80	1349.19	4.26	516.20	833.00
Initial Load Cell Reading (lbs)	11	175	175	62	51	0.02977	0.046041	1067	54.8	4.80	691.20	0.65	316.80	1383.35	4.37	533.28	850.08
Date	9/4/2006	200	200	64	53	0.03403	0.046244	1099	54.8	4.80	691.20	0.63	316.80	1415.86	4.47	549.53	866.33
Test by	RGS	250	250	68	57	0.04253	0.046655	1163	54.9	4.90	705.60	0.61	302.40	1465.35	4.85	581.47	883.87
Initial Length (in)	6.02	300	300	72	61	0.05104	0.047073	1225	54.8	4.80	691.20	0.56	316.80	1542.11	4.87	612.66	929.46
Area (ft^2)	0.043682	350	350	76	65	0.05954	0.047499	1286	54.9	4.90	705.60	0.55	302.40	1588.55	5.25	643.07	945.47
Height after Consolidation	5.878	400	400	79	68	0.06805	0.047932	1325	54.9	4.90	705.60	0.53	302.40	1627.00	5.38	662.30	964.70
Area after Consolidation	0.04467	454	454	82	71	0.07724	0.048409	1360	54.9	4.90	705.60	0.52	302.40	1662.29	5.50	679.94	982.34
Youngs Modulus for membrane(lbs/in2)	200	500	500	83	72	0.08506	0.048823	1357	54.9	4.90	705.60	0.52	302.40	1659.51	5.49	678.56	980.96
Membrane Thickness in.	0.012	550	550	86	75	0.09357	0.049282	1393	54.9	4.90	705.60	0.51	302.40	1694.92	5.60	696.26	998.66
		600	600	87	76	0.10208	0.049748	1387	54.8	4.80	691.20	0.50	316.80	1703.38	5.38	693.29	1010.09
		700	700	90	79	0.11909	0.050709	1393	54.7	4.70	676.80	0.49	331.20	1724.48	5.21	696.64	1027.84
		808	808	91	80	0.13746	0.051789	1355	54.6	4.60	662.40	0.49	345.60	1700.29	4.92	677.35	1022.95
		938	938	91	80	0.15958	0.053152	1285	54.5	4.50	648.00	0.50	360.00	1644.51	4.57	642.25	1002.25
		1000	1000	91	80	0.17013	0.053828	1251	54.5	4.50	648.00	0.52	360.00	1611.04	4.48	625.52	985.52
		1110	1110	91	80	0.18884	0.055070	1192	54.4	4.40	633.60	0.53	374.40	1566.05	4.18	595.83	970.23
		1200	1200	91	80	0.20415	0.056129	1143	54.4	4.40	633.60	0.55	374.40	1517.47	4.05	571.53	945.93



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-17	S-8	22.0-22.5	61	60	NT	NT	NT	103	64	4	54	50

WSDOT Grays Harbor Special Projects
Landau Assoicates

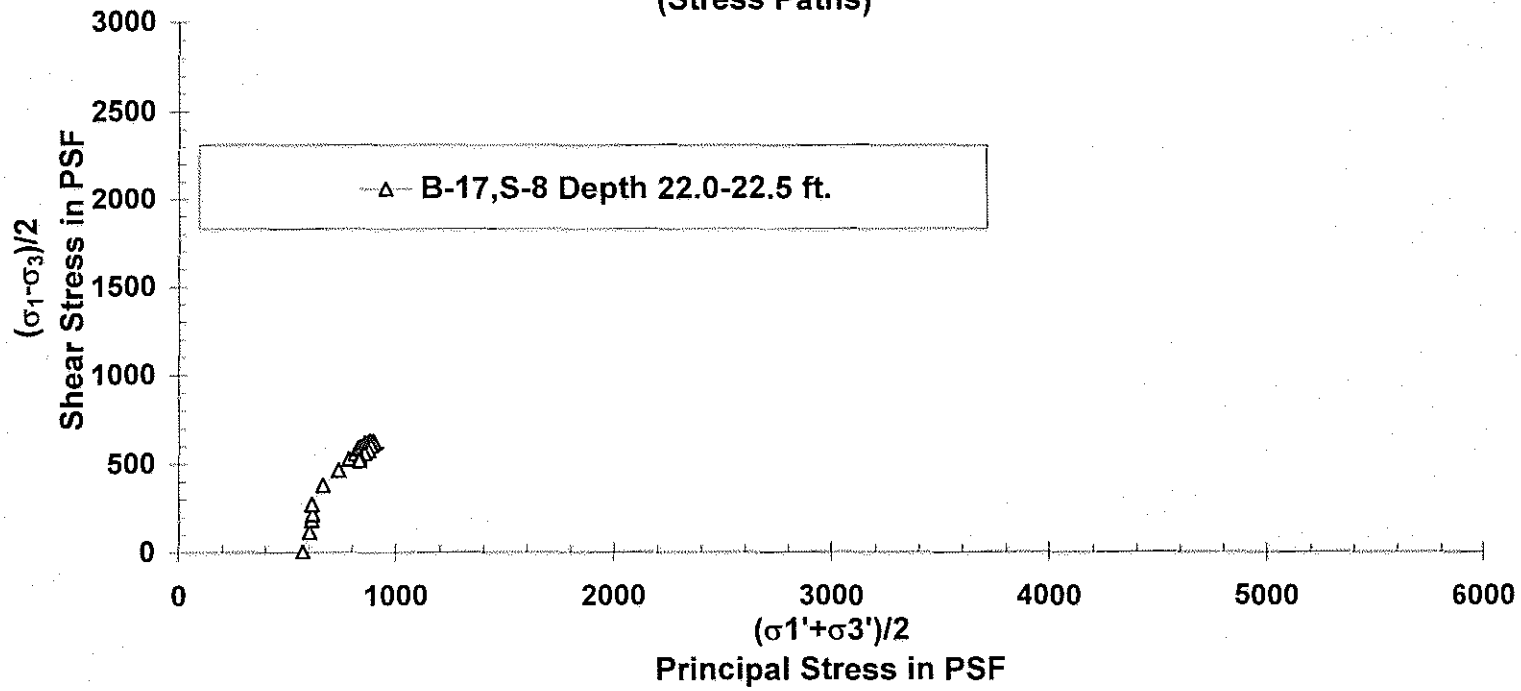
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

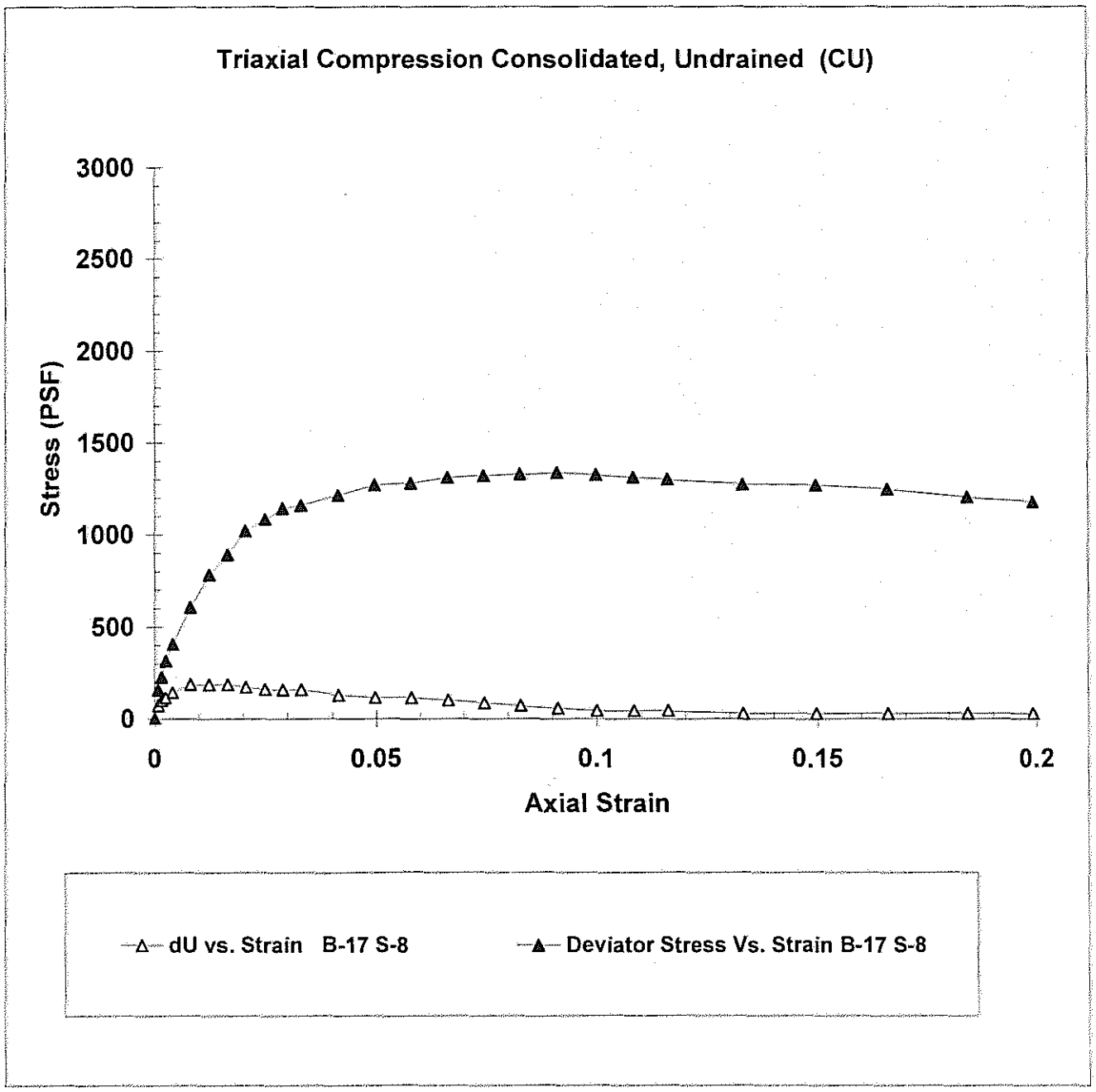
TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

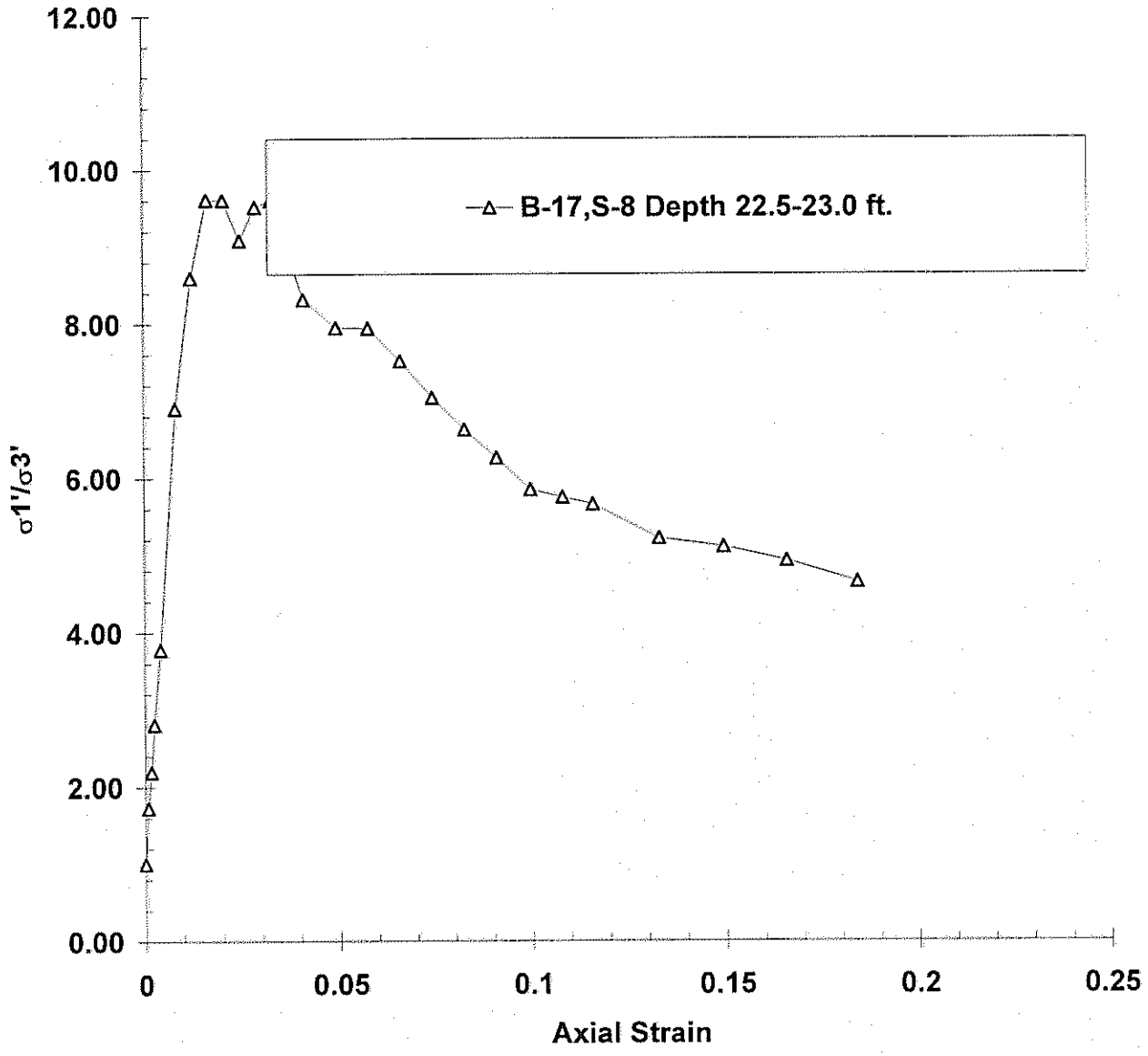
		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	12	0	0	0.043831	0	50.0	0.00	0.00	#DIV/0!	576.00	576.00	1.00	0.00	576.00
Exploration #	B-17	5	5	22	10	0.00084	0.043868	227	50.6	0.60	86.40	0.38	489.60	716.39	1.46	113.40	603.00
Sample ID #	S-8	10	10	28	16	0.00168	0.043905	362	51.0	1.00	144.00	0.40	432.00	794.10	1.84	181.05	613.05
Sample Depth (ft)	22.0-22.5	15	15	31	19	0.00252	0.043942	429	51.2	1.20	172.80	0.40	403.20	832.10	2.06	214.45	617.65
Type of Test	CU	25	25	36	24	0.00421	0.044016	539	51.6	1.60	230.40	0.43	345.60	885.04	2.56	269.72	615.32
Cell Pressure (psi)	54	50	50	46	34	0.00841	0.044203	758	52.0	2.00	288.00	0.38	288.00	1045.55	3.63	378.77	666.77
Back Pressure (psi)	50	75	75	54	42	0.01262	0.044391	929	52.1	2.10	302.40	0.33	273.60	1202.29	4.39	464.34	737.94
Strain Rate (in/min)	0.004	100	100	60	48	0.01683	0.044581	1053	52.2	2.20	316.80	0.30	259.20	1312.63	5.06	526.71	785.91
Initial Platen Reading (in x 10^{-3})	0	126	126	63	51	0.02120	0.044780	1110	52.2	2.20	316.80	0.29	259.20	1368.78	5.28	554.79	813.99
Initial Load Cell Reading (lbs)	12	150	150	66	54	0.02524	0.044966	1166	52.3	2.30	331.20	0.28	244.80	1410.82	5.76	583.01	827.81
Date	8/31/2006	175	175	67	55	0.02945	0.045161	1177	52.3	2.30	331.20	0.28	244.80	1421.96	5.81	588.58	833.38
Test by	RGS	200	200	68	56	0.03365	0.045357	1188	52.3	2.30	331.20	0.28	244.80	1432.92	5.85	594.06	838.86
Initial Length (in)	5.983	250	250	71	59	0.04207	0.045756	1231	52.3	2.30	331.20	0.27	244.80	1476.10	6.03	615.65	860.45
Area (ft^2)	0.043579	300	300	72	60	0.05048	0.046161	1230	52.2	2.20	316.80	0.26	259.20	1489.21	5.75	615.01	874.21
Height after Consolidation	5.943	354	354	74	62	0.05957	0.046607	1248	52.2	2.20	316.80	0.25	259.20	1507.12	5.81	623.96	883.16
Area after Consolidation	0.043831	400	400	75	63	0.06731	0.046994	1248	52.1	2.10	302.40	0.24	273.60	1521.15	5.56	623.78	897.38
Youngs Modulus for membrane(lbs/in2)	200	450	450	76	64	0.07572	0.047422	1245	52.2	2.20	316.80	0.25	259.20	1504.12	5.80	622.46	881.66
Membrane Thickness in.	0.012	500	500	77	65	0.08413	0.047857	1242	52.1	2.10	302.40	0.24	273.60	1515.50	5.54	620.95	894.55
		550	550	78	66	0.09255	0.048301	1238	52.1	2.10	302.40	0.24	273.60	1512.09	5.53	619.25	892.85
		605	605	79	67	0.10180	0.048799	1232	52.1	2.10	302.40	0.25	273.60	1505.86	5.50	616.13	889.73
		654	654	80	68	0.11005	0.049251	1229	52.0	2.00	288.00	0.23	288.00	1516.56	5.27	614.28	902.28
		700	700	80	68	0.11779	0.049683	1206	52.0	2.00	288.00	0.24	288.00	1493.85	5.19	602.93	890.93
		800	800	82	70	0.13461	0.050649	1196	52.0	2.00	288.00	0.24	288.00	1483.97	5.15	597.99	885.99
		900	900	82	70	0.15144	0.051653	1146	51.9	1.90	273.60	0.24	302.40	1448.24	4.79	572.92	875.32
		1005	1005	83	71	0.16911	0.052752	1112	51.9	1.90	273.60	0.25	302.40	1414.56	4.68	556.08	858.48



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	B-17	S-8	22.5-23.0	67	67	NT	NT	NT	98	59	2	52	50

WSDOT Grays Harbor Special Projects
Landau Assoicates

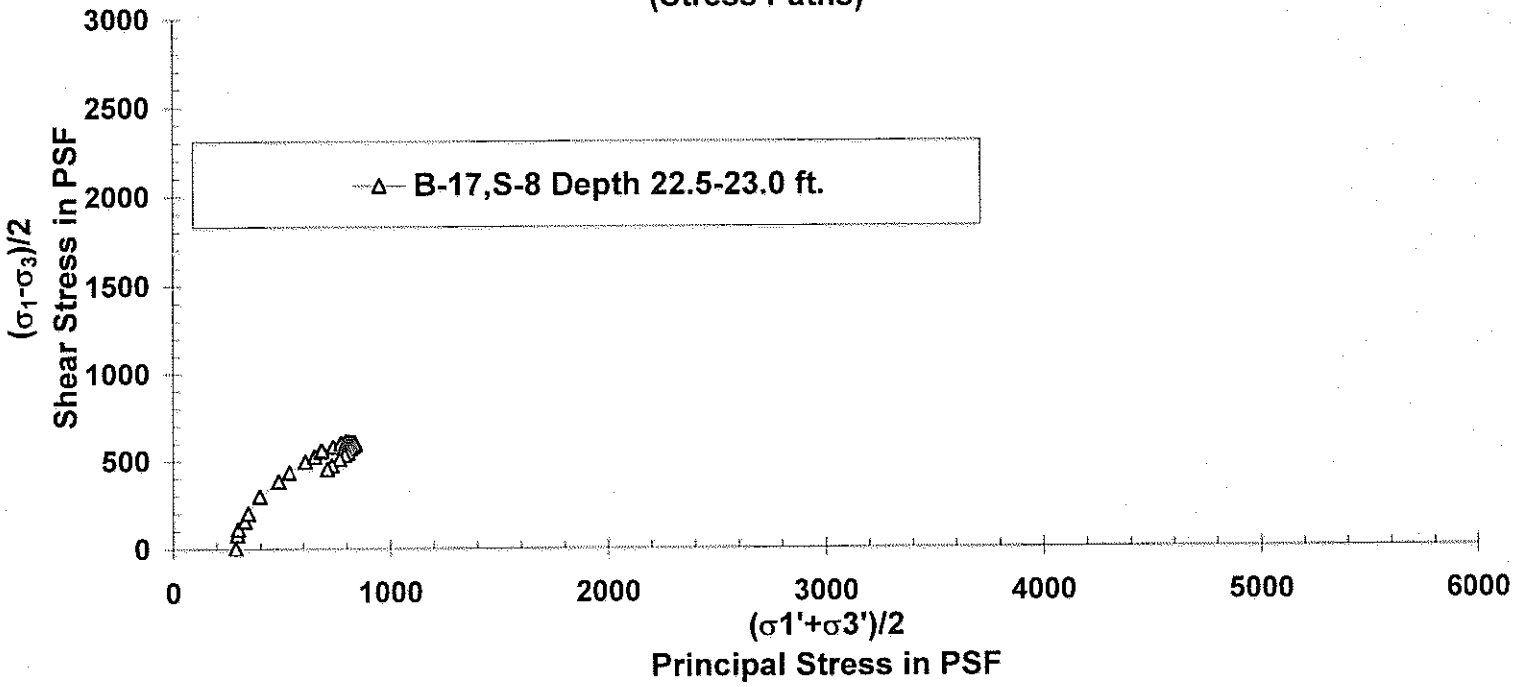
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)

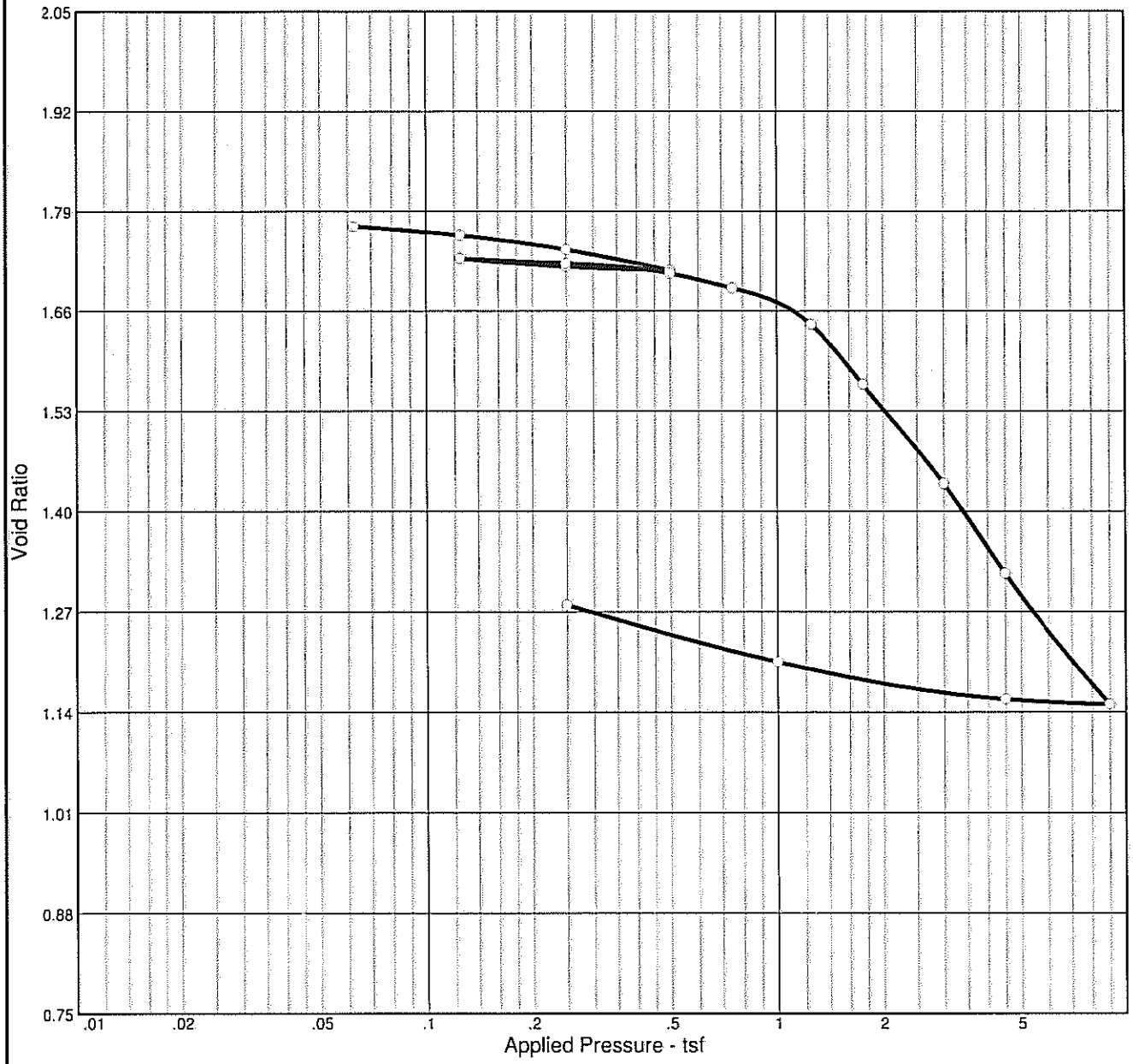


Soil Technology
J-06-2154

WSDOT Grays Harbor Special Projects
Landau Associates

		.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Job #	J-06-2154	0	0	11	0	0	0.044153	0	50.0	0.00	0.00	#DIV/0!	288.00	288.00	1.00	0.00	288.00
Exploration #	B-17	5	5	18	7	0.00083	0.044190	157	50.5	0.50	72.00	0.46	216.00	373.26	1.73	78.63	294.63
Sample ID #	S-8	10	10	21	10	0.00166	0.044227	224	50.7	0.70	100.80	0.45	187.20	411.01	2.20	111.91	299.11
Sample Depth (ft)	22.5-23.0	15	15	25	14	0.00249	0.044264	313	50.8	0.80	115.20	0.37	172.80	485.65	2.81	156.42	329.22
Type of Test	CU	25	25	29	18	0.00415	0.044337	400	51.0	1.00	144.00	0.36	144.00	544.24	3.78	200.12	344.12
Cell Pressure (psi)	52	50	50	38	27	0.00830	0.044523	595	51.3	1.30	187.20	0.31	100.80	695.76	6.90	297.48	398.28
Back Pressure (psi)	50	75	75	46	35	0.01245	0.044710	766	51.3	1.30	187.20	0.24	100.80	866.41	8.60	382.81	483.61
Strain Rate (in/min)	0.004	100	100	51	40	0.01660	0.044899	868	51.3	1.30	187.20	0.22	100.80	968.75	9.61	433.98	534.78
Initial Platen Reading (in x 10^{-3})	0	125	125	57	46	0.02075	0.045089	992	51.2	1.20	172.80	0.17	115.20	1106.73	9.61	495.76	610.96
Initial Load Cell Reading (lbs)	11	151	151	60	49	0.02506	0.045288	1047	51.1	1.10	158.40	0.15	129.60	1176.91	9.08	523.65	653.25
Date	8/30/2006	175	175	63	52	0.02905	0.045474	1103	51.1	1.10	158.40	0.14	129.60	1232.95	9.51	551.68	681.28
Test by	RGS	200	200	64	53	0.03320	0.045669	1115	51.1	1.10	158.40	0.14	129.60	1244.23	9.60	557.31	686.91
Initial Length (in)	6.05	250	250	67	56	0.04149	0.046065	1158	50.9	0.90	129.60	0.11	158.40	1316.72	8.31	579.16	737.56
Area (ft^2)	0.043991	300	300	70	59	0.04979	0.046467	1201	50.8	0.80	115.20	0.10	172.80	1373.68	7.95	600.44	773.24
Height after Consolidation	6.025	350	350	71	60	0.05809	0.046877	1200	50.8	0.80	115.20	0.10	172.80	1372.45	7.94	599.83	772.63
Area after Consolidation	0.044153	400	400	73	62	0.06639	0.047293	1219	50.7	0.70	100.80	0.08	187.20	1406.39	7.51	609.60	796.80
Youngs Modulus for membrane(lbs/in2)	200	450	450	74	63	0.07469	0.047717	1217	50.6	0.60	86.40	0.07	201.60	1418.62	7.04	608.51	810.11
Membrane Thickness in.	0.012	500	500	75	64	0.08299	0.048149	1214	50.5	0.50	72.00	0.06	216.00	1430.48	6.62	607.24	823.24
		550	550	76	65	0.09129	0.048589	1212	50.4	0.40	57.60	0.05	230.40	1441.96	6.26	605.78	836.18
		603	603	76	65	0.10008	0.049064	1186	50.3	0.30	43.20	0.04	244.80	1431.25	5.85	593.22	838.02
		653	653	76	65	0.10838	0.049521	1163	50.3	0.30	43.20	0.04	244.80	1407.56	5.75	581.38	826.18
		700	700	76	65	0.11618	0.049958	1140	50.3	0.30	43.20	0.04	244.80	1385.29	5.66	570.25	815.05
		802	802	76	65	0.13311	0.050933	1092	50.2	0.20	28.80	0.03	259.20	1351.37	5.21	546.08	805.28
		902	902	77	66	0.14971	0.051927	1064	50.2	0.20	28.80	0.03	259.20	1323.25	5.11	532.02	791.22
		1000	1000	77	66	0.16598	0.052940	1017	50.2	0.20	28.80	0.03	259.20	1276.45	4.92	508.62	767.82

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture								
99.3 %	65.7 %	60.5	84	45	2.7		1.25	0.60	1.786

MATERIAL DESCRIPTION	USCS	AASHTO
	MH	

Project No. 244039.020 **Client:** Landau Associates, Inc.

Project: WSDOT Special Projects Facility J-06-2154

Source: B-17 **Sample No.:** S-8 **Elev./Depth:** 23.0-23.1

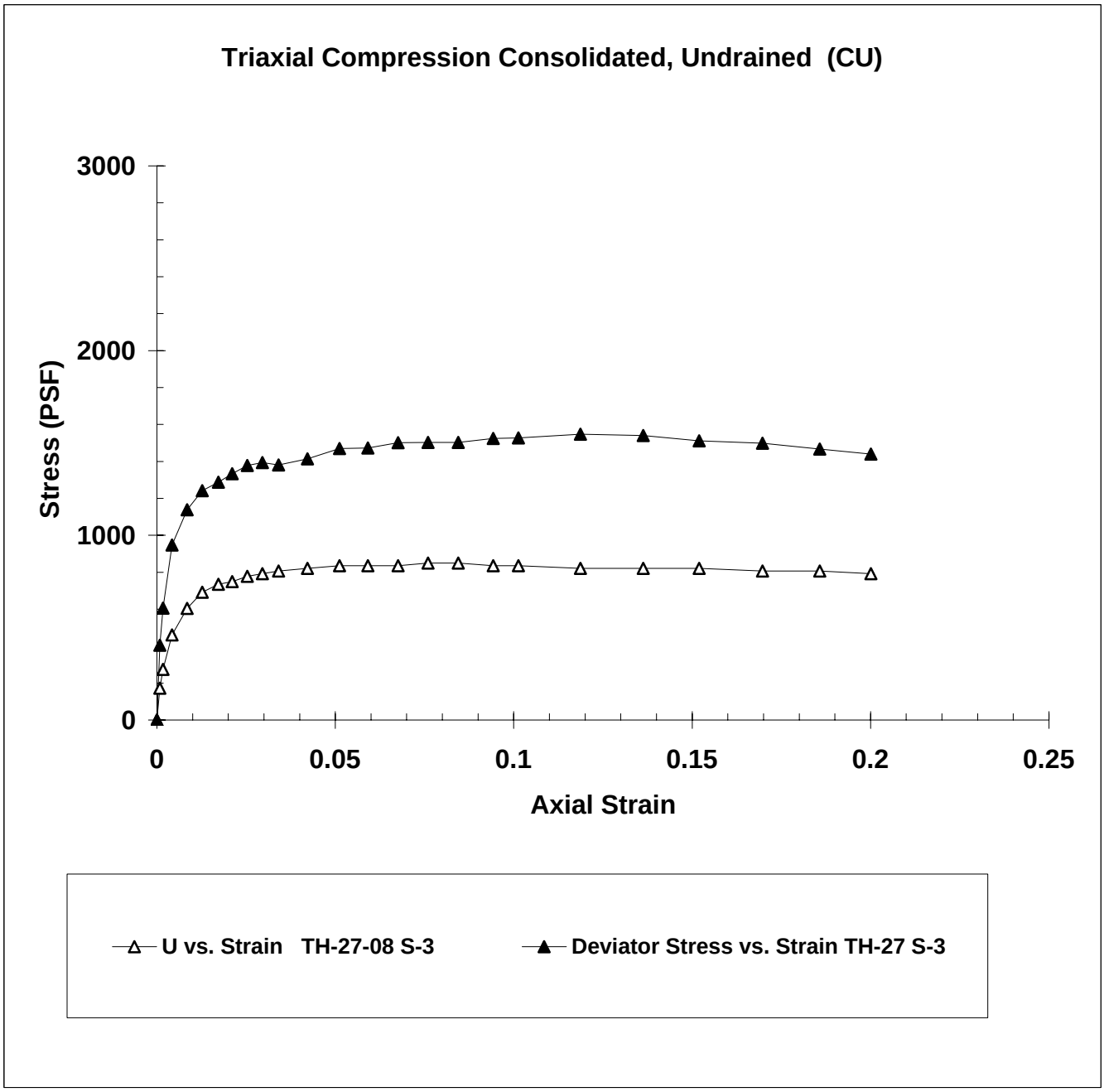
Remarks:
Sample contained sand lenses

CONSOLIDATION TEST REPORT

SOIL TECHNOLOGY

Figure 1

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	TH-27-08	S-3	14.6-15.1	65	59	57	38	19	102	62	8	48	40

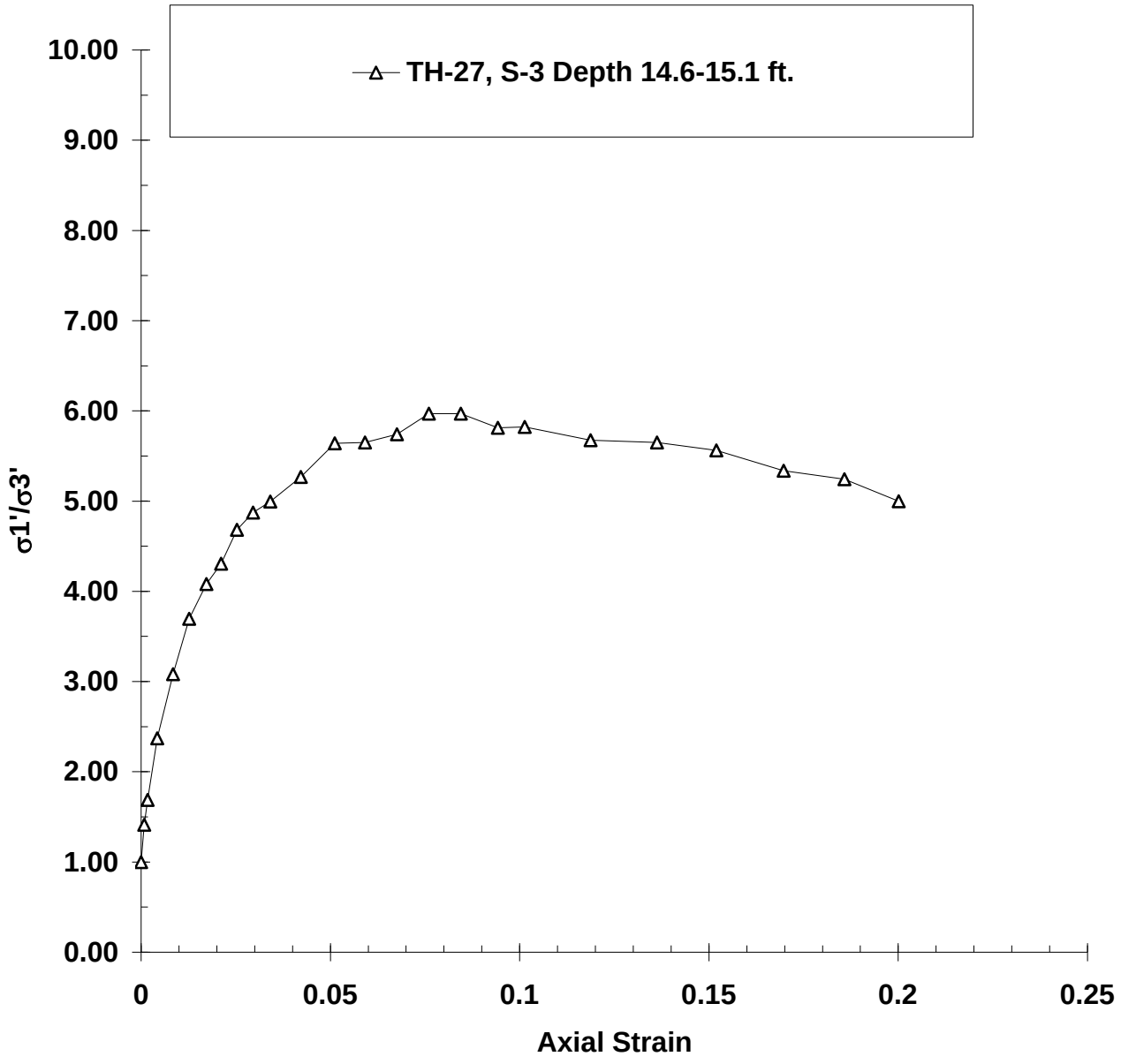
Soil Technology.
J-08-2275

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

		READ	ΔD	READ	PLOAD	STRAIN	Area	(σ1-σ3)	Read	Δ	Δυ	$\overline{A}$	σ'3	σ'1	σ'1/σ'3	(σ1−σ3)/2	(σ'1+σ'3)/2
Job #	J-08-2275	.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Exploration #	TH-27-08	0	0	10	0	0	0.034487	0	40.0	0.00	0.00	#DIV/0!	1152.00	1152.00	1.00	0.00	1152.00
Sample ID #	S-3	5	5	24	14	0.00084	0.034517	404	41.2	1.20	172.80	0.43	979.20	1383.64	1.41	202.22	1181.42
Sample Depth (ft)	14.6-15.1	10	10	31	21	0.00169	0.034546	606	41.9	1.90	273.60	0.45	878.40	1483.96	1.69	302.78	1181.18
Type of Test	CU	25	25	43	33	0.00422	0.034634	947	43.2	3.20	460.80	0.49	691.20	1638.19	2.37	473.50	1164.70
Cell Pressure (psi)	48	50	50	50	40	0.00844	0.034781	1138	44.2	4.20	604.80	0.53	547.20	1685.58	3.08	569.19	1116.39
Back Pressure (psi)	40	75	75	54	44	0.01267	0.034930	1242	44.8	4.80	691.20	0.56	460.80	1702.96	3.70	621.08	1081.88
Strain Rate (in/min)	0.003	102	102	56	46	0.01723	0.035092	1287	45.1	5.10	734.40	0.57	417.60	1704.63	4.08	643.52	1061.12
Initial Platen Reading (in x 10^{-3})	0	125	125	58	48	0.02111	0.035231	1333	45.2	5.20	748.80	0.56	403.20	1736.45	4.31	666.62	1069.82
Initial Load Cell Reading (lbs)	10	150	150	60	50	0.02533	0.035384	1378	45.4	5.40	777.60	0.56	374.40	1752.46	4.68	689.03	1063.43
Date	9/17/2008	175	175	61	51	0.02955	0.035538	1394	45.5	5.50	792.00	0.57	360.00	1754.24	4.87	697.12	1057.12
Test by	RGS	202	202	61	51	0.03411	0.035705	1381	45.6	5.60	806.40	0.58	345.60	1726.79	5.00	690.60	1036.20
Initial Length (in)	6.02833	250	250	63	53	0.04222	0.036008	1414	45.7	5.70	820.80	0.58	331.20	1744.74	5.27	706.77	1037.97
Area (ft^2)	0.043682	303	303	66	56	0.05117	0.036347	1470	45.8	5.80	835.20	0.57	316.80	1786.75	5.64	734.98	1051.78
Height after Consolidation	5.9213	350	350	67	57	0.05911	0.036654	1473	45.8	5.80	835.20	0.57	316.80	1790.17	5.65	736.69	1053.49
Area after Consolidation	0.034487	400	400	69	59	0.06755	0.036986	1502	45.8	5.80	835.20	0.56	316.80	1818.62	5.74	750.91	1067.71
Youngs Modulus for membrane(lbs/in2)	200	450	450	70	60	0.07600	0.037324	1502	45.9	5.90	849.60	0.57	302.40	1804.89	5.97	751.25	1053.65
Membrane Thickness in.	0.012	500	500	71	61	0.08444	0.037668	1503	45.9	5.90	849.60	0.57	302.40	1805.07	5.97	751.34	1053.74
		558	558	73	63	0.09424	0.038075	1524	45.8	5.80	835.20	0.55	316.80	1841.14	5.81	762.17	1078.97
		600	600	74	64	0.10133	0.038376	1528	45.8	5.80	835.20	0.55	316.80	1844.43	5.82	763.82	1080.62
		703	703	77	67	0.11872	0.039133	1548	45.7	5.70	820.80	0.53	331.20	1879.16	5.67	773.98	1105.18
		807	807	79	69	0.13629	0.039929	1540	45.7	5.70	820.80	0.53	331.20	1870.85	5.65	769.83	1101.03
		900	900	80	70	0.15199	0.040669	1511	45.7	5.70	820.80	0.54	331.20	1842.31	5.56	755.55	1086.75
		1005	1005	82	72	0.16973	0.041537	1499	45.6	5.60	806.40	0.54	345.60	1844.35	5.34	749.37	1094.97
		1100	1100	83	73	0.18577	0.042356	1467	45.6	5.60	806.40	0.55	345.60	1812.28	5.24	733.34	1078.94
		1185	1185	84	74	0.20012	0.043116	1440	45.5	5.50	792.00	0.55	360.00	1799.65	5.00	719.82	1079.82

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

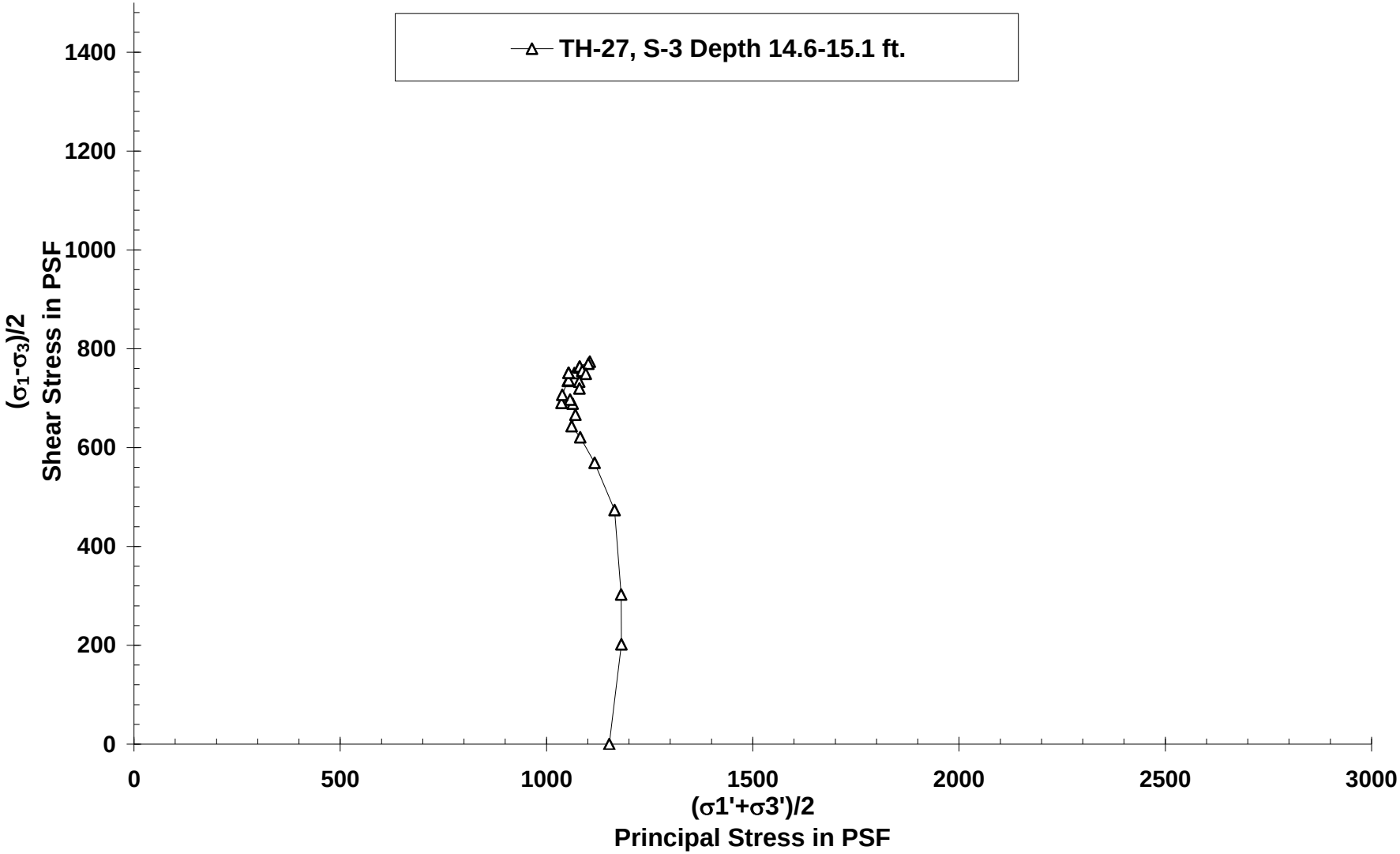
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-08-2275

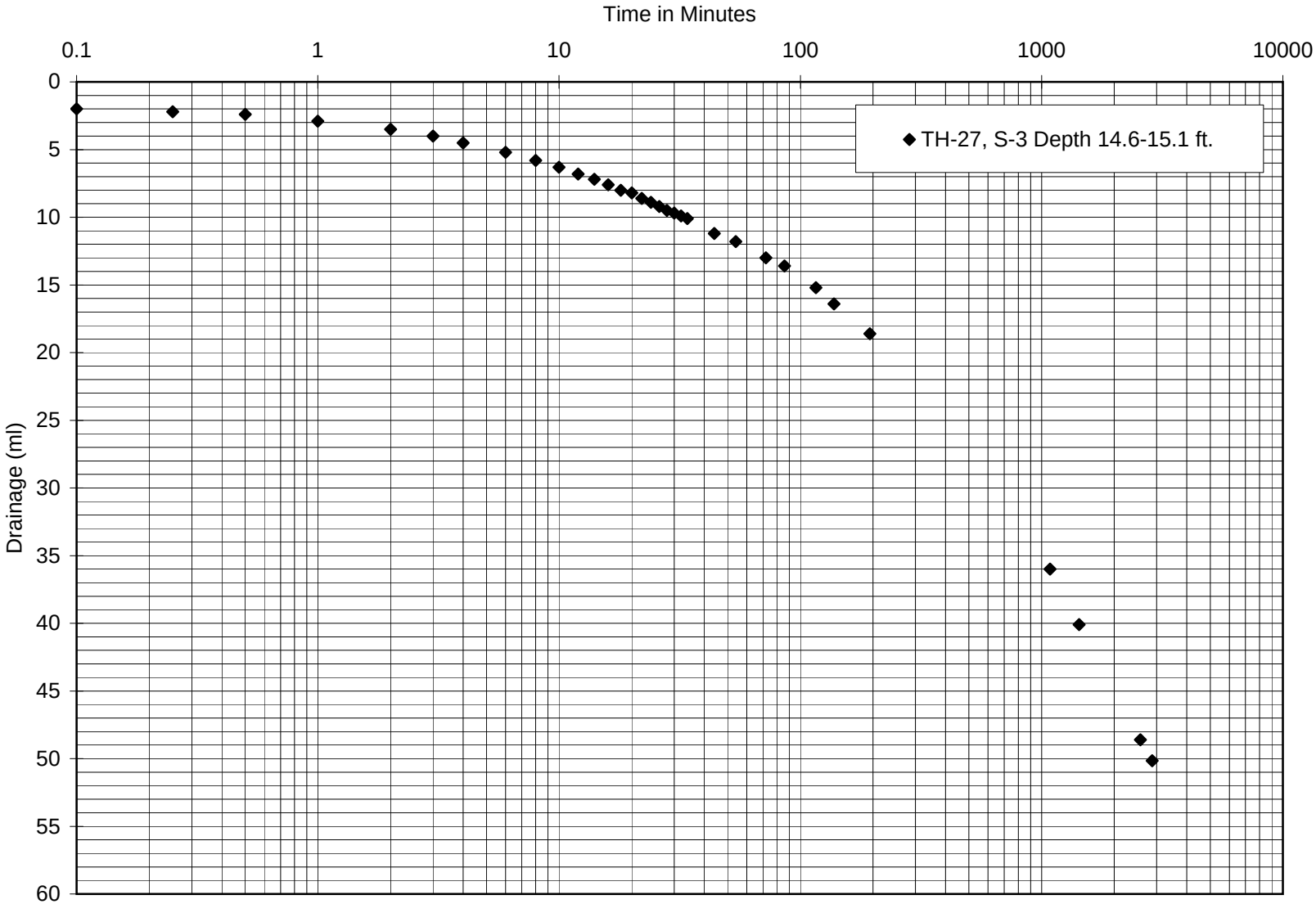
WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)



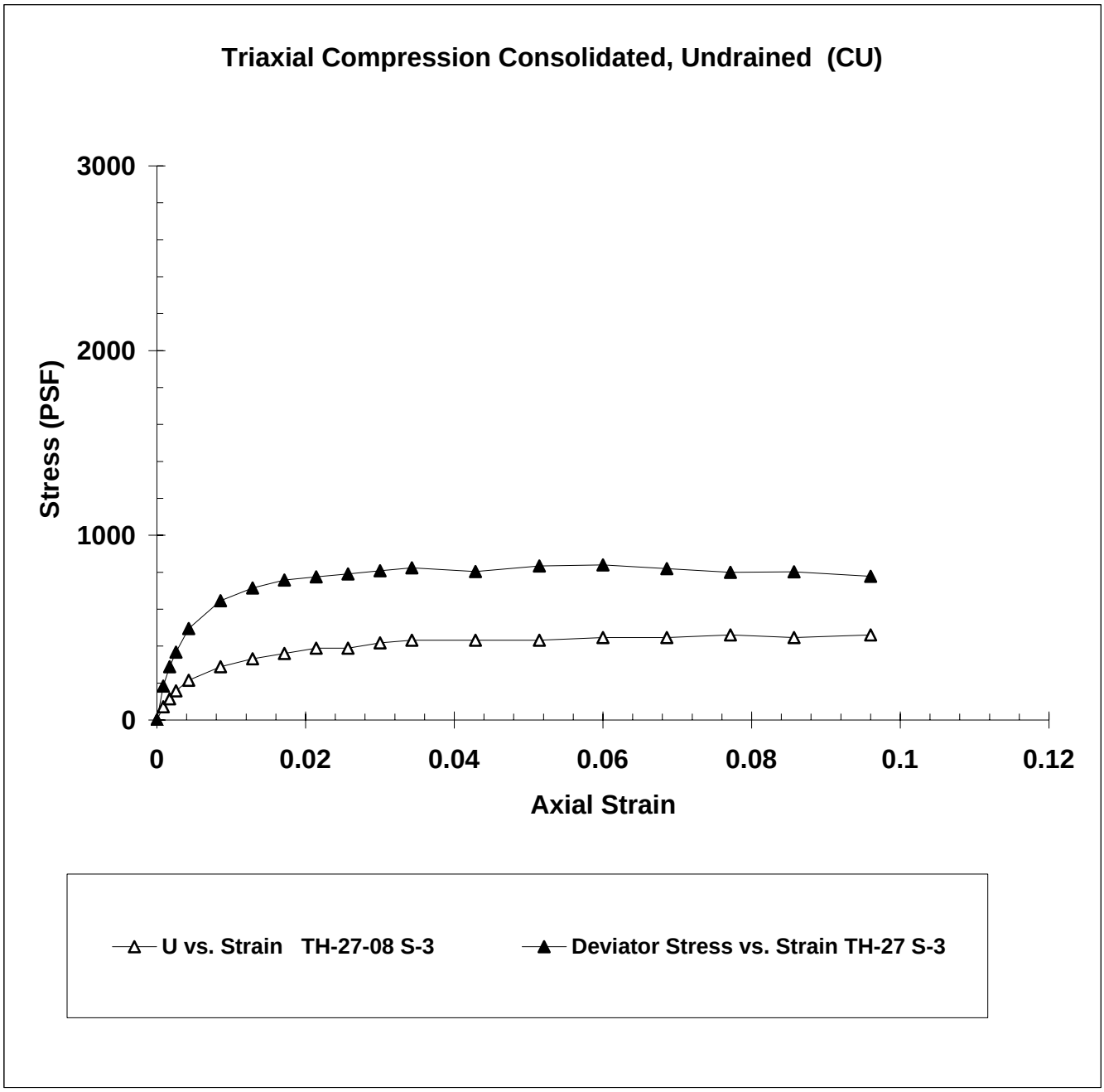
Soil Technology
J-08-2275

WSDOT Grays Harbor Pontoon Construction Facility
CU Drainage at Final Confining Stress of 8 psi



Soil Technology
J-08-2275

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	TH-27-08	S-3	15.3-15.8	77	76	61	42	19	97	55	4	44	40

Soil Technology.
J-08-2275

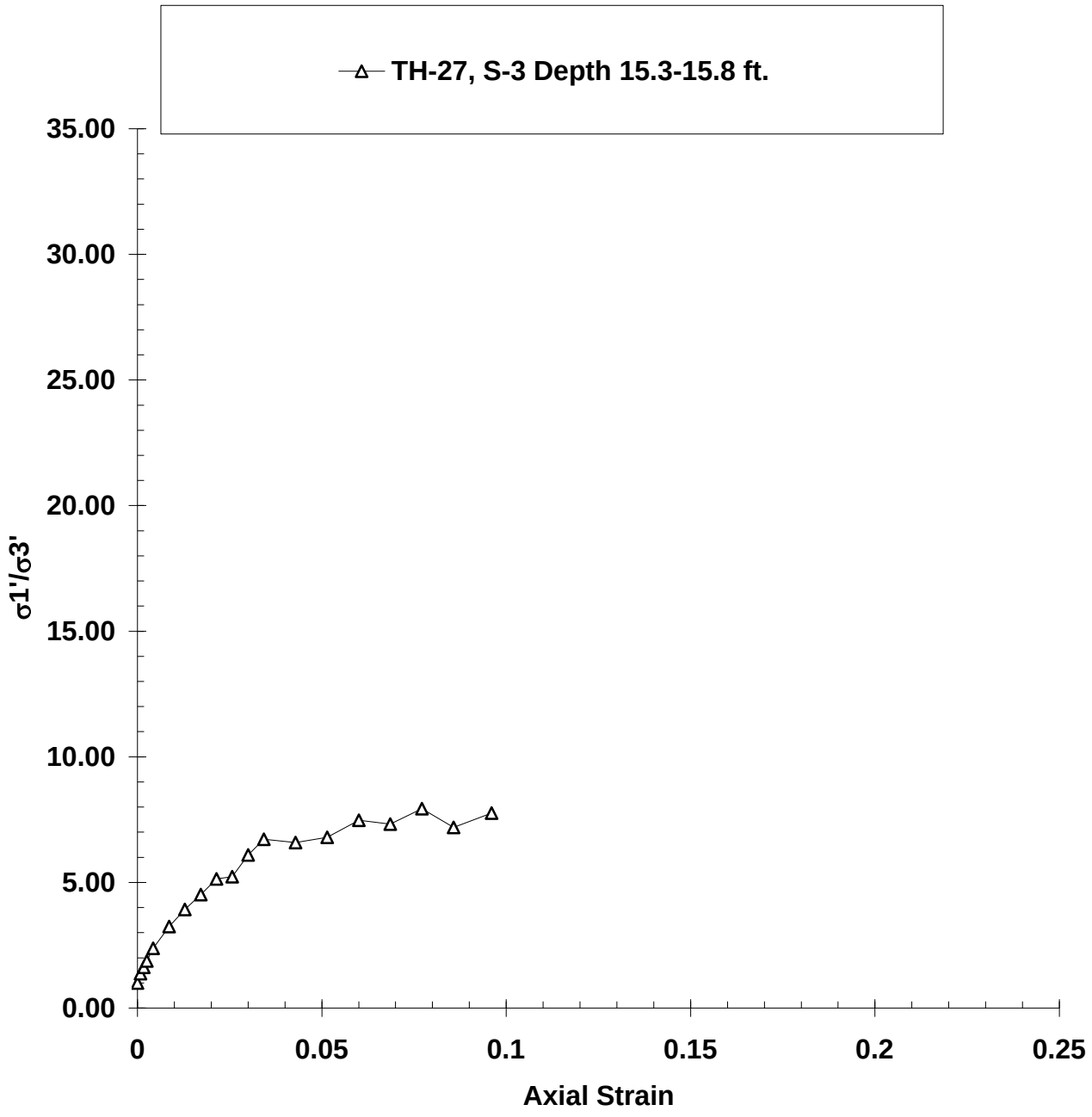
WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

		DIAL GAUGE		LOAD CELL		ε	Corrected		Pore Pressure								
Job #	J-08-2275	READ	ΔD	READ	PLOAD	STRAIN	Area	(σ1-σ3)	Read	Δ	Δυ	$\overline{A}$	σ'3	σ'1	σ'1/σ'3	(σ1−σ3)/2	(σ'1+σ'3)/2
Exploration #	TH-27-08	.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Sample ID #	S-3	0	0	9	0	0	0.037703	0	40.0	0.00	0.00	#DIV/0!	576.00	576.00	1.00	0.00	576.00
Sample Depth (ft)	15.3-15.8	5	5	16	7	0.00086	0.037735	184	40.5	0.50	72.00	0.39	504.00	688.32	1.37	92.16	596.16
Type of Test	CU	10	10	20	11	0.00171	0.037768	289	40.8	0.80	115.20	0.40	460.80	749.68	1.63	144.44	605.24
Cell Pressure (psi)	44	15	15	23	14	0.00257	0.037800	367	41.1	1.10	158.40	0.43	417.60	784.41	1.88	183.41	601.01
Back Pressure (psi)	40	25	25	28	19	0.00429	0.037865	496	41.5	1.50	216.00	0.44	360.00	855.85	2.38	247.93	607.93
Strain Rate (in/min)	0.003	50	50	34	25	0.00857	0.038029	646	42.0	2.00	288.00	0.45	288.00	933.54	3.24	322.77	610.77
Initial Platen Reading (in x 10^{-3})	0	75	75	37	28	0.01286	0.038194	715	42.3	2.30	331.20	0.46	244.80	960.12	3.92	357.66	602.46
Initial Load Cell Reading (lbs)	9	100	100	39	30	0.01714	0.038361	758	42.5	2.50	360.00	0.47	216.00	974.35	4.51	379.18	595.18
Date	9/12/2008	125	125	40	31	0.02143	0.038529	775	42.7	2.70	388.80	0.50	187.20	962.17	5.14	387.49	574.69
Test by	RGS	150	150	41	32	0.02572	0.038698	791	42.7	2.70	388.80	0.49	187.20	978.56	5.23	395.68	582.88
Initial Length (in)	5.893	175	175	42	33	0.03000	0.038869	808	42.9	2.90	417.60	0.52	158.40	965.93	6.10	403.76	562.16
Area (ft^2)	0.043991	200	200	43	34	0.03429	0.039042	823	43.0	3.00	432.00	0.52	144.00	967.47	6.72	411.73	555.73
Height after Consolidation	5.833	250	250	43	34	0.04286	0.039391	804	43.0	3.00	432.00	0.54	144.00	947.89	6.58	401.94	545.94
Area after Consolidation	0.037703	300	300	45	36	0.05143	0.039747	835	43.0	3.00	432.00	0.52	144.00	978.63	6.80	417.31	561.31
Youngs Modulus for membrane(lbs/in2)	200	350	350	46	37	0.06000	0.040110	840	43.1	3.10	446.40	0.53	129.60	969.12	7.48	419.76	549.36
Membrane Thickness in.	0.012	400	400	46	37	0.06858	0.040479	819	43.1	3.10	446.40	0.54	129.60	948.86	7.32	409.63	539.23
		450	450	46	37	0.07715	0.040855	799	43.2	3.20	460.80	0.58	115.20	914.20	7.94	399.50	514.70
		500	500	47	38	0.08572	0.041238	803	43.1	3.10	446.40	0.56	129.60	932.59	7.20	401.49	531.09
		560	560	47	38	0.09601	0.041707	778	43.2	3.20	460.80	0.59	115.20	893.60	7.76	389.20	504.40
		600	600	42	33	0.10286	0.042026	643	43.8	3.80	547.20	0.85	28.80	671.83	23.33	321.52	350.32
		700	700	34	25	0.12001	0.042845	418	43.9	3.90	561.60	1.34	14.40	432.01	30.00	208.80	223.20
		820	820	34	25	0.14058	0.043870	376	43.9	3.90	561.60	1.50	14.40	389.93	27.08	187.76	202.16
		900	900	35	26	0.15429	0.044582	370	43.8	3.80	547.20	1.48	28.80	398.70	13.84	184.95	213.75
		1000	1000	37	28	0.17144	0.045504	378	43.8	3.80	547.20	1.45	28.80	407.13	14.14	189.17	217.97
		1100	1100	37	28	0.18858	0.046466	342	43.8	3.80	547.20	1.60	28.80	370.70	12.87	170.95	199.75
		1142	1142	37	28	0.19578	0.046882	327	43.8	3.80	547.20	1.68	28.80	355.40	12.34	163.30	192.10

The data below this line were not plotted due to unusual sigma values.

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

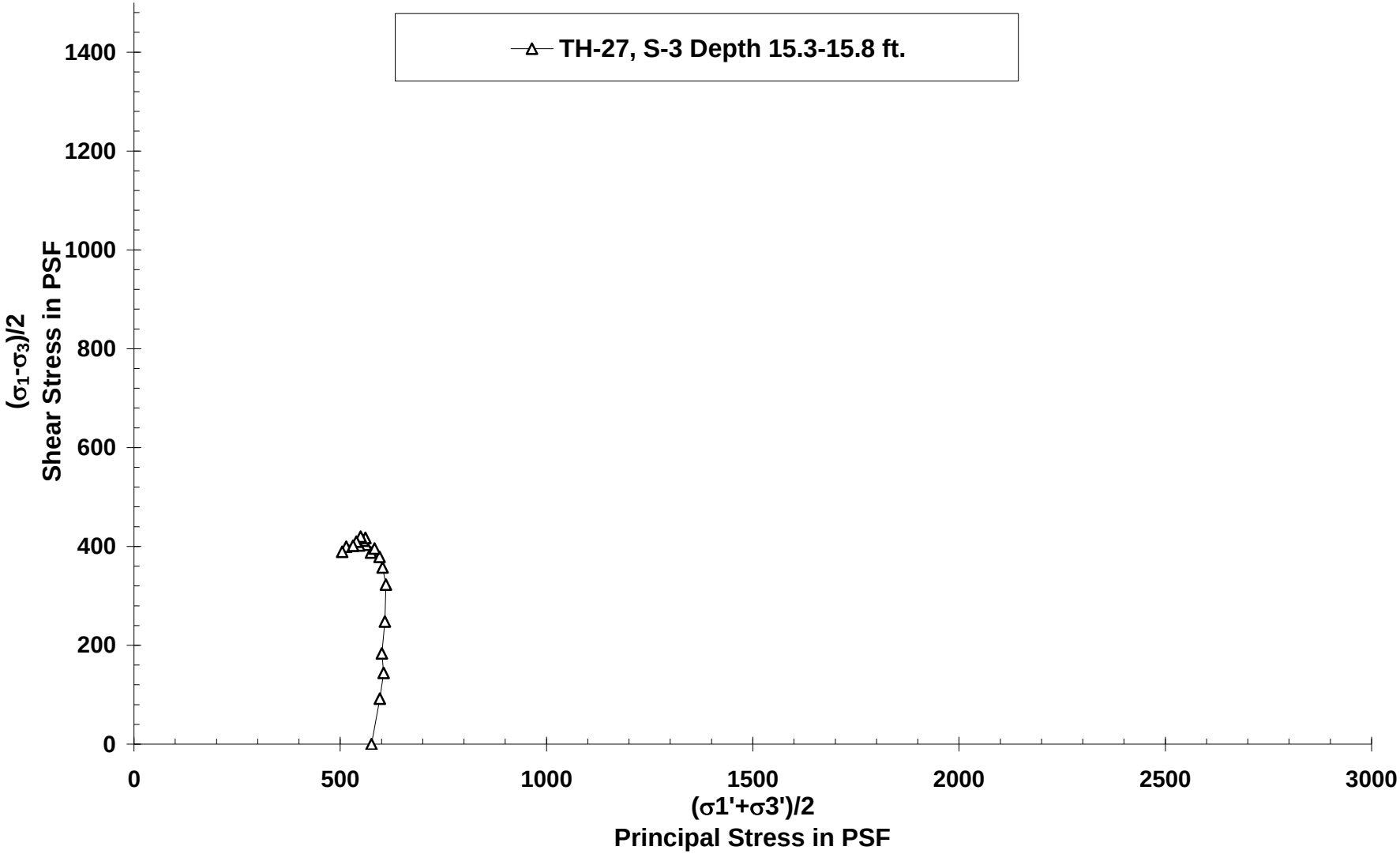
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-08-2275

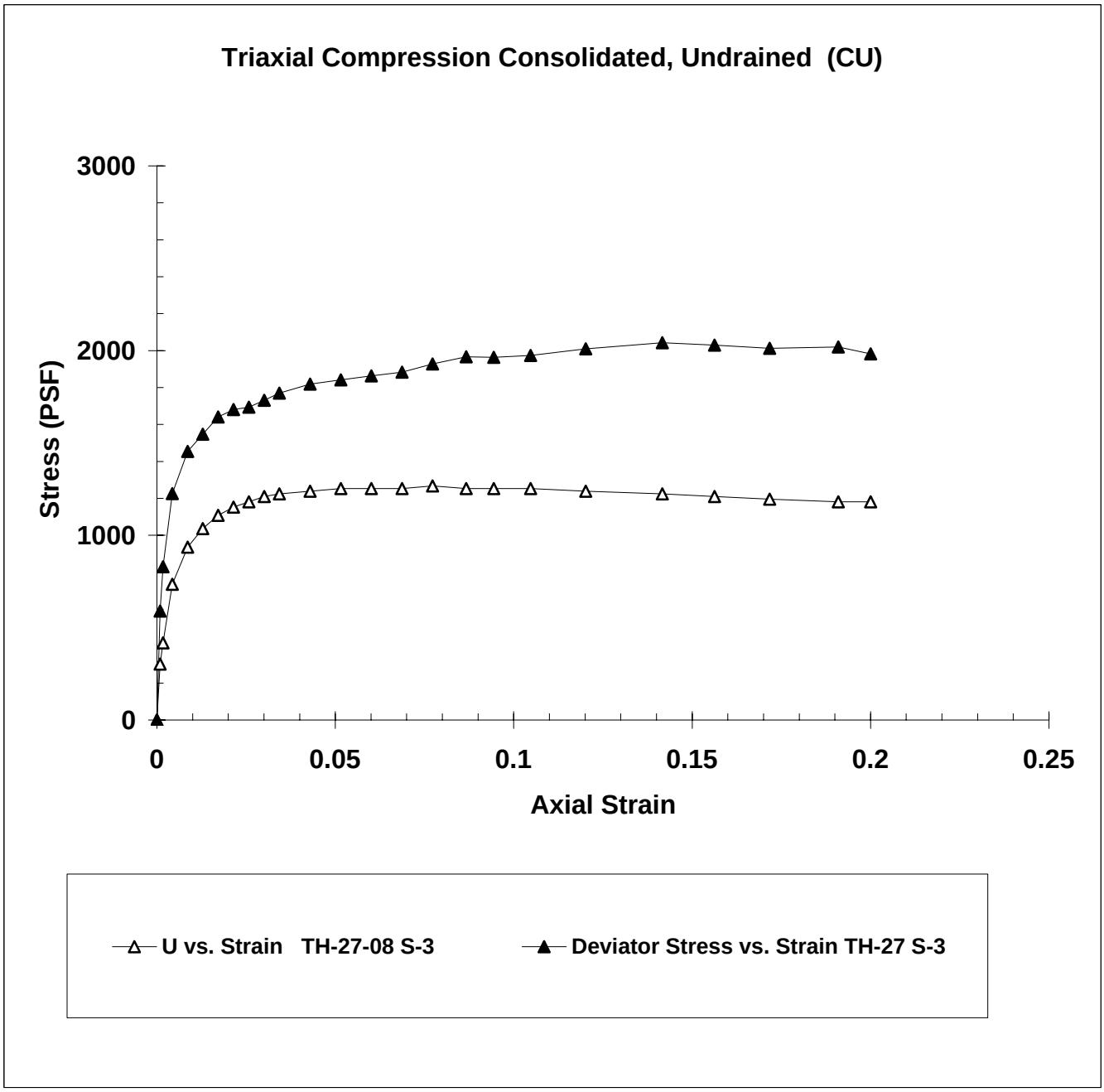
WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)



Soil Technology
J-08-2275

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	TH-27-08	S-3	14.1-14.6	61	53	60	39	21	103	64	12	52	40

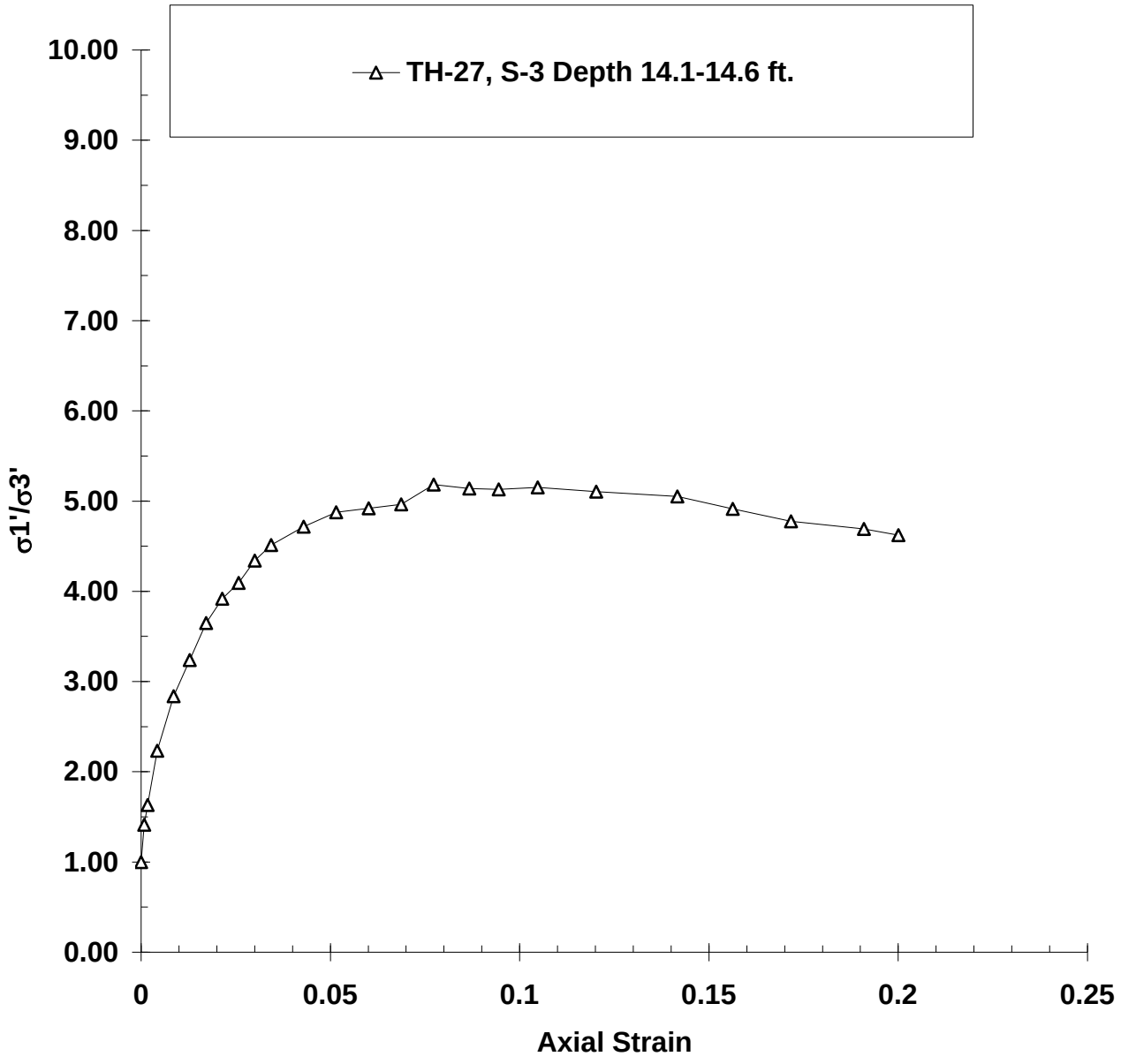
Soil Technology.
J-08-2275

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

		READ	ΔD	READ	PLOAD	STRAIN	Area	(σ1-σ3)	Read	Δ	Δυ	$\overline{A}$	σ'3	σ'1	σ'1/σ'3	(σ1−σ3)/2	(σ'1+σ'3)/2
Job #	J-08-2275	.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Exploration #	TH-27-08	0	0	12	0	0	0.037195	0	40.0	0.00	0.00	#DIV/0!	1728.00	1728.00	1.00	0.00	1728.00
Sample ID #	S-3	5	5	34	22	0.00086	0.037227	590	42.1	2.10	302.40	0.51	1425.60	2015.38	1.41	294.89	1720.49
Sample Depth (ft)	14.1-14.6	10	10	43	31	0.00172	0.037259	830	42.9	2.90	417.60	0.50	1310.40	2140.03	1.63	414.82	1725.22
Type of Test	CU	25	25	58	46	0.00429	0.037356	1225	45.1	5.10	734.40	0.60	993.60	2219.07	2.23	612.73	1606.33
Cell Pressure (psi)	52	50	50	67	55	0.00859	0.037518	1454	46.5	6.50	936.00	0.64	792.00	2246.11	2.84	727.06	1519.06
Back Pressure (psi)	40	75	75	71	59	0.01288	0.037681	1548	47.2	7.20	1036.80	0.67	691.20	2239.19	3.24	773.99	1465.19
Strain Rate (in/min)	0.003	100	100	75	63	0.01717	0.037845	1641	47.7	7.70	1108.80	0.68	619.20	2260.14	3.65	820.47	1439.67
Initial Platen Reading (in x 10^{-3})	0	125	125	77	65	0.02146	0.038011	1680	48.0	8.00	1152.00	0.69	576.00	2256.35	3.92	840.17	1416.17
Initial Load Cell Reading (lbs)	12	150	150	78	66	0.02576	0.038179	1693	48.2	8.20	1180.80	0.70	547.20	2240.30	4.09	846.55	1393.75
Date	9/18/2008	175	175	80	68	0.03005	0.038348	1732	48.4	8.40	1209.60	0.70	518.40	2250.11	4.34	865.85	1384.25
Test by	RGS	200	200	82	70	0.03434	0.038518	1770	48.5	8.50	1224.00	0.69	504.00	2273.85	4.51	884.93	1388.93
Initial Length (in)	5.965	250	250	85	73	0.04293	0.038864	1819	48.6	8.60	1238.40	0.68	489.60	2308.62	4.72	909.51	1399.11
Area (ft^2)	0.043733	300	300	87	75	0.05151	0.039215	1841	48.7	8.70	1252.80	0.68	475.20	2316.50	4.87	920.65	1395.85
Height after Consolidation	5.824	350	350	89	77	0.06010	0.039574	1863	48.7	8.70	1252.80	0.67	475.20	2337.86	4.92	931.33	1406.53
Area after Consolidation	0.037195	400	400	91	79	0.06868	0.039938	1883	48.7	8.70	1252.80	0.67	475.20	2358.30	4.96	941.55	1416.75
Youngs Modulus for membrane(lbs/in2)	200	450	450	94	82	0.07727	0.040310	1927	48.8	8.80	1267.20	0.66	460.80	2388.22	5.18	963.71	1424.51
Membrane Thickness in.	0.012	505	505	97	85	0.08671	0.040727	1967	48.7	8.70	1252.80	0.64	475.20	2442.40	5.14	983.60	1458.80
		550	550	98	86	0.09444	0.041074	1963	48.7	8.70	1252.80	0.64	475.20	2438.41	5.13	981.61	1456.81
		610	610	100	88	0.10474	0.041547	1973	48.7	8.70	1252.80	0.63	475.20	2448.49	5.15	986.64	1461.84
		700	700	104	92	0.12019	0.042277	2010	48.6	8.60	1238.40	0.62	489.60	2499.58	5.11	1004.99	1494.59
		825	825	109	97	0.14166	0.043334	2043	48.5	8.50	1224.00	0.60	504.00	2546.61	5.05	1021.30	1525.30
		910	910	111	99	0.15625	0.044084	2030	48.4	8.40	1209.60	0.60	518.40	2548.14	4.92	1014.87	1533.27
		1000	1000	113	101	0.17170	0.044906	2012	48.3	8.30	1195.20	0.59	532.80	2544.58	4.78	1005.89	1538.69
		1112	1112	117	105	0.19093	0.045973	2020	48.2	8.20	1180.80	0.58	547.20	2567.19	4.69	1009.99	1557.19
		1165	1165	117	105	0.20003	0.046496	1982	48.2	8.20	1180.80	0.60	547.20	2528.92	4.62	990.86	1538.06

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

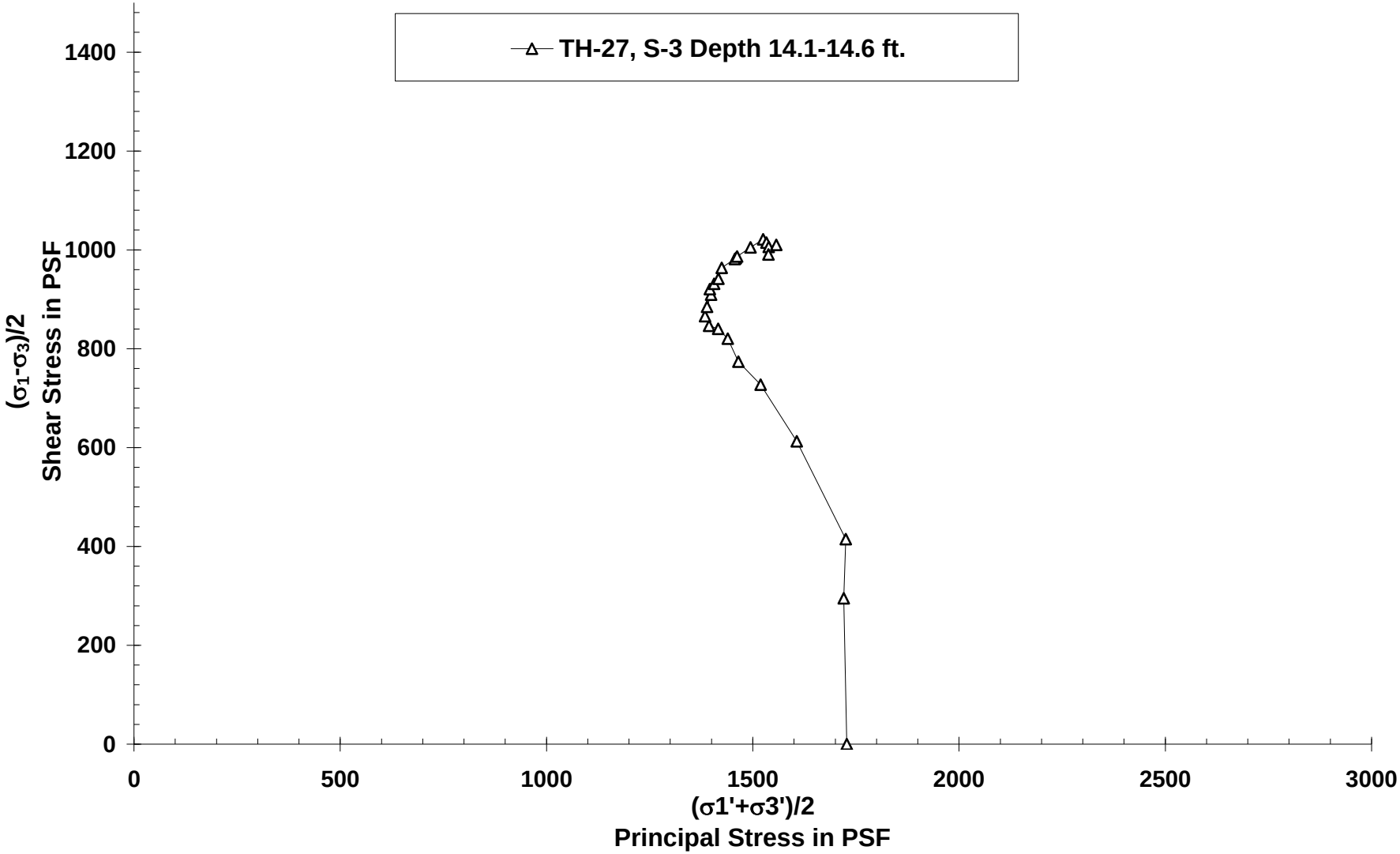
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-08-2275

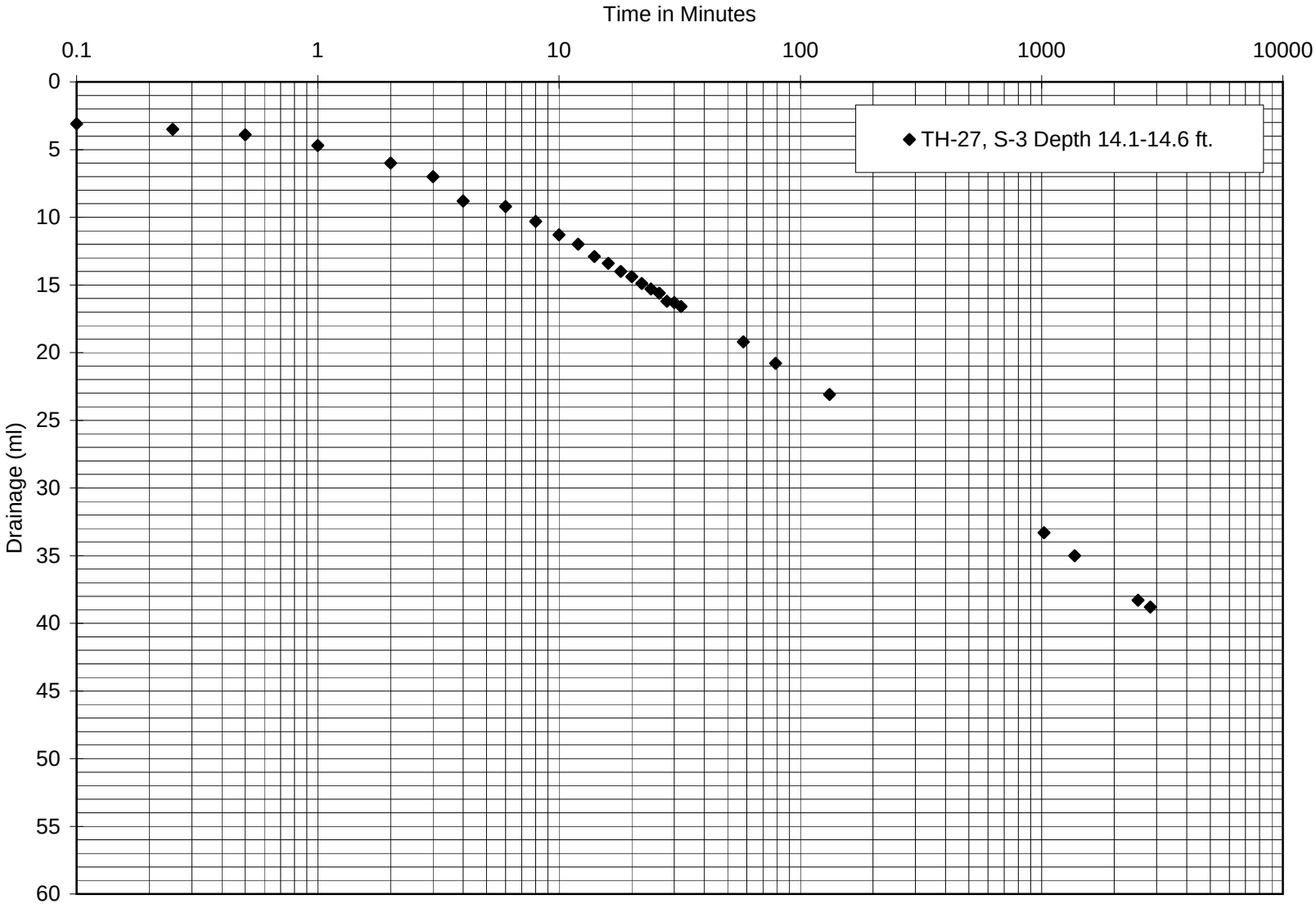
WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)



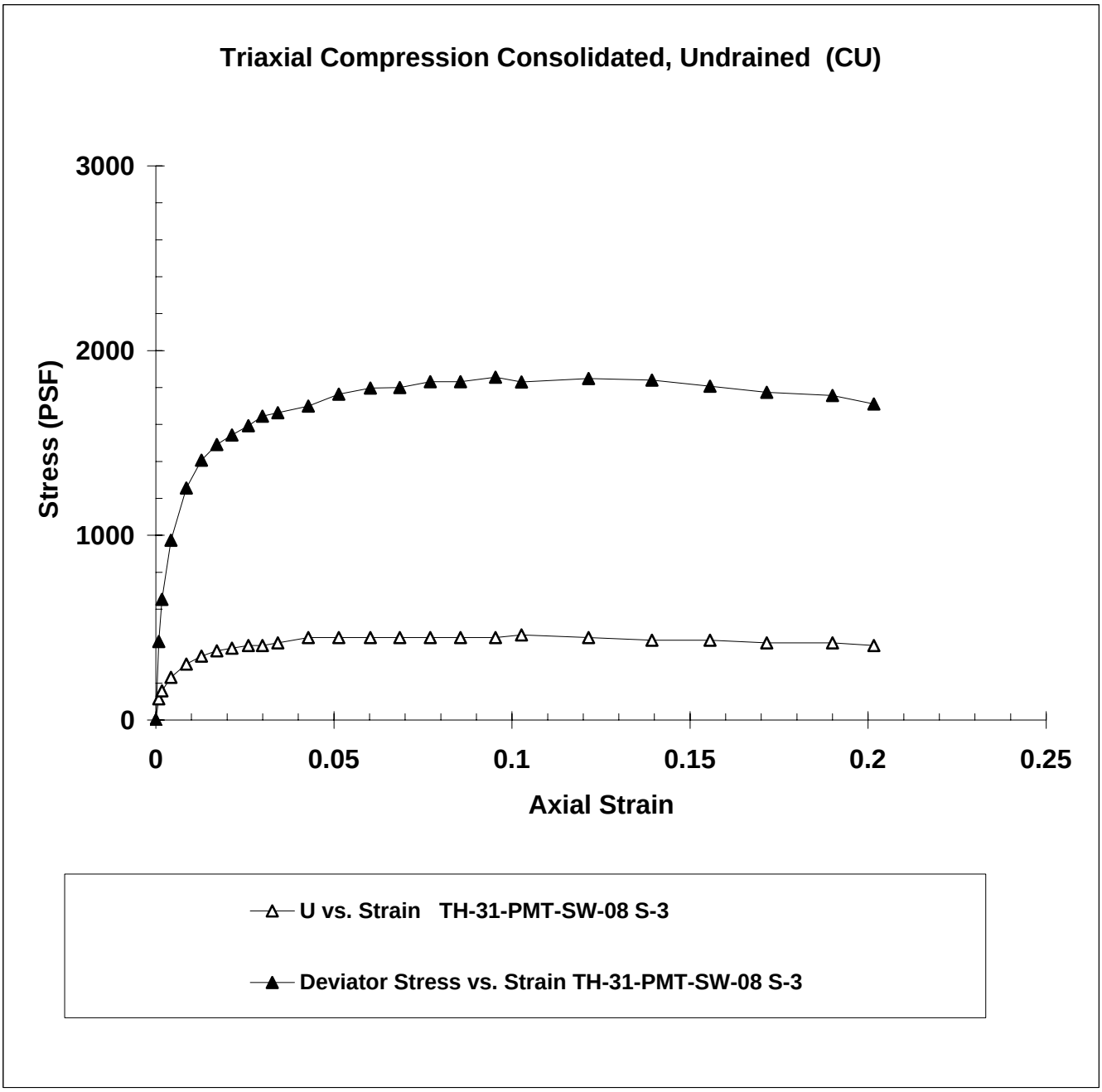
Soil Technology
J-08-2275

WSDOT Grays Harbor Pontoon Construction Facility
CU Drainage at Final Confining Stress of 12 psi



Soil Technology
J-08-2275

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	TH-31-PMT-SW-08	S-3	14.7-15.2	76	69	53	26	27	99	56	6	48	42

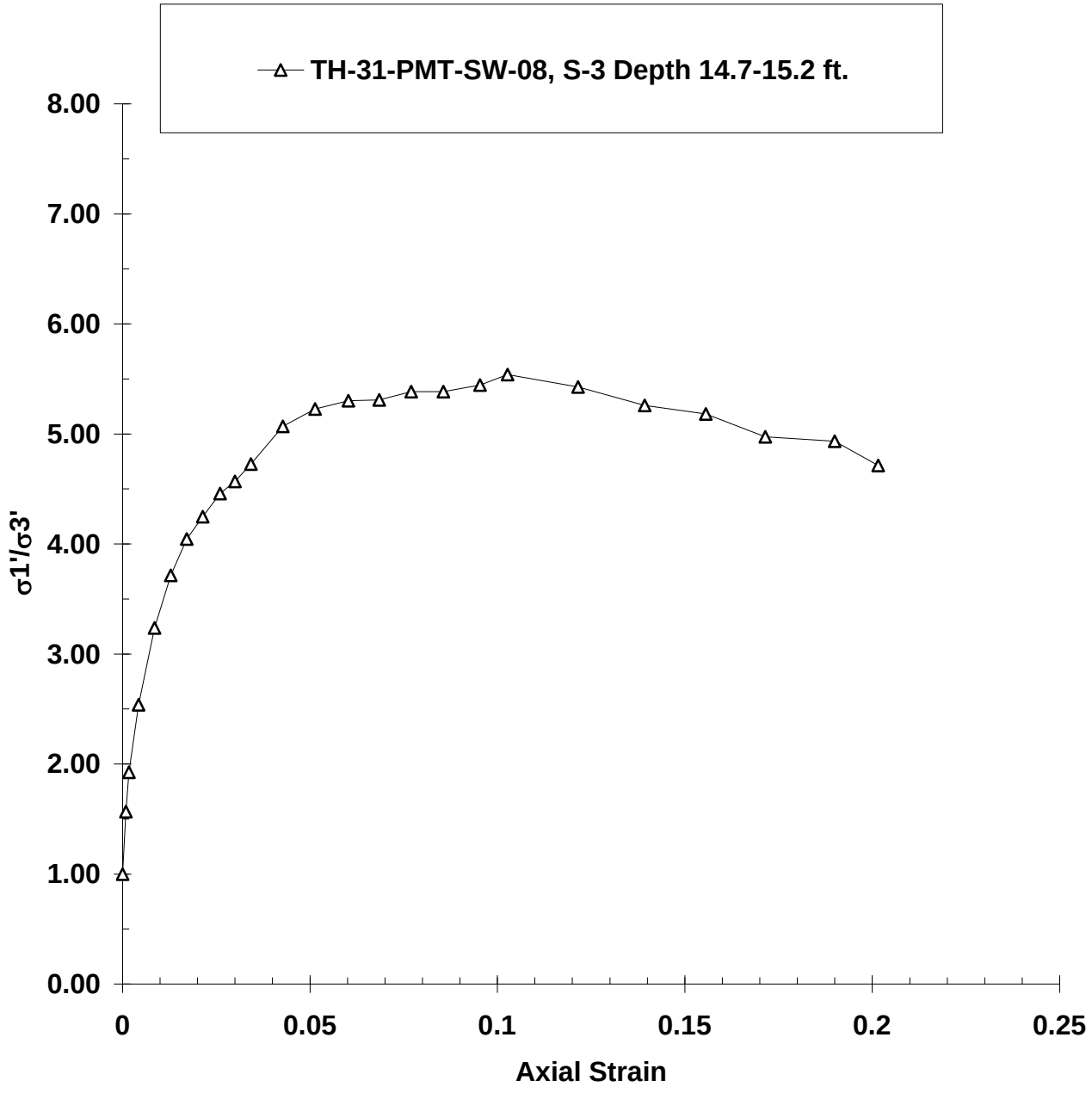
Soil Technology.
J-08-2275

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

		DIAL GAUGE		LOAD CELL		ε	Corrected		Pore Pressure								
Job #	J-08-2275	READ	ΔD	READ	PLOAD	STRAIN	Area	(σ1-σ3)	Read	Δ	$\Delta\upsilon$	$\overline{A}$	σ'3	σ'1	σ'1/σ'3	(σ1−σ3)/2	(σ'1+σ'3)/2
Exploration #	31-PMT-SW	.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Sample ID #	S-3	0	0	10	0	0	0.030490	0	42.0	0.00	0.00	#DIV/0!	864.00	864.00	1.00	0.00	864.00
Sample Depth (ft)	14.7-15.2	5	5	23	13	0.00086	0.030516	425	42.8	0.80	115.20	0.27	748.80	1173.62	1.57	212.41	961.21
Type of Test	CU	10	10	30	20	0.00171	0.030542	652	43.1	1.10	158.40	0.24	705.60	1358.06	1.92	326.23	1031.83
Cell Pressure (psi)	48	25	25	40	30	0.00428	0.030621	974	43.6	1.60	230.40	0.24	633.60	1607.40	2.54	486.90	1120.50
Back Pressure (psi)	42	50	50	49	39	0.00856	0.030753	1256	44.1	2.10	302.40	0.24	561.60	1817.92	3.24	628.16	1189.76
Strain Rate (in/min)	0.003	75	75	54	44	0.01284	0.030887	1407	44.4	2.40	345.60	0.25	518.40	1925.22	3.71	703.41	1221.81
Initial Platen Reading (in x 10^{-3})	0	100	100	57	47	0.01712	0.031021	1491	44.6	2.60	374.40	0.25	489.60	1981.04	4.05	745.72	1235.32
Initial Load Cell Reading (lbs)	10	125	125	59	49	0.02139	0.031157	1543	44.7	2.70	388.80	0.25	475.20	2018.32	4.25	771.56	1246.76
Date	9/5/2008	152	152	61	51	0.02602	0.031305	1593	44.8	2.80	403.20	0.25	460.80	2053.99	4.46	796.59	1257.39
Test by	RGS	175	175	63	53	0.02995	0.031432	1645	44.8	2.80	403.20	0.25	460.80	2105.59	4.57	822.40	1283.20
Initial Length (in)	5.9467	200	200	64	54	0.03423	0.031571	1663	44.9	2.90	417.60	0.25	446.40	2109.52	4.73	831.56	1277.96
Area (ft^2)	0.043784	250	250	66	56	0.04279	0.031853	1699	45.1	3.10	446.40	0.26	417.60	2116.52	5.07	849.46	1267.06
Height after Consolidation	5.8427	300	300	69	59	0.05135	0.032140	1765	45.1	3.10	446.40	0.25	417.60	2182.31	5.23	882.35	1299.95
Area after Consolidation	0.03049	352	352	71	61	0.06025	0.032445	1797	45.1	3.10	446.40	0.25	417.60	2214.43	5.30	898.41	1316.01
Youngs Modulus for membrane(lbs/in2)	200	400	400	72	62	0.06846	0.032731	1800	45.1	3.10	446.40	0.25	417.60	2217.19	5.31	899.79	1317.39
Membrane Thickness in.	0.012	450	450	74	64	0.07702	0.033034	1831	45.1	3.10	446.40	0.24	417.60	2248.50	5.38	915.45	1333.05
		500	500	75	65	0.08558	0.033344	1831	45.1	3.10	446.40	0.24	417.60	2248.70	5.38	915.55	1333.15
		557	557	77	67	0.09533	0.033703	1856	45.1	3.10	446.40	0.24	417.60	2273.75	5.44	928.08	1345.68
		600	600	77	67	0.10269	0.033980	1830	45.2	3.20	460.80	0.25	403.20	2233.01	5.54	914.90	1318.10
		710	710	80	70	0.12152	0.034708	1849	45.1	3.10	446.40	0.24	417.60	2266.45	5.43	924.42	1342.02
		814	814	82	72	0.13932	0.035426	1840	45.0	3.00	432.00	0.23	432.00	2271.83	5.26	919.91	1351.91
		909	909	83	73	0.15558	0.036108	1807	45.0	3.00	432.00	0.24	432.00	2238.65	5.18	903.33	1335.33
		1002	1002	84	74	0.17150	0.036802	1774	44.9	2.90	417.60	0.24	446.40	2220.11	4.97	886.86	1333.26
		1110	1110	86	76	0.18998	0.037641	1756	44.9	2.90	417.60	0.24	446.40	2202.83	4.93	878.21	1324.61
		1178	1178	86	76	0.20162	0.038190	1711	44.8	2.80	403.20	0.24	460.80	2172.13	4.71	855.66	1316.46

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

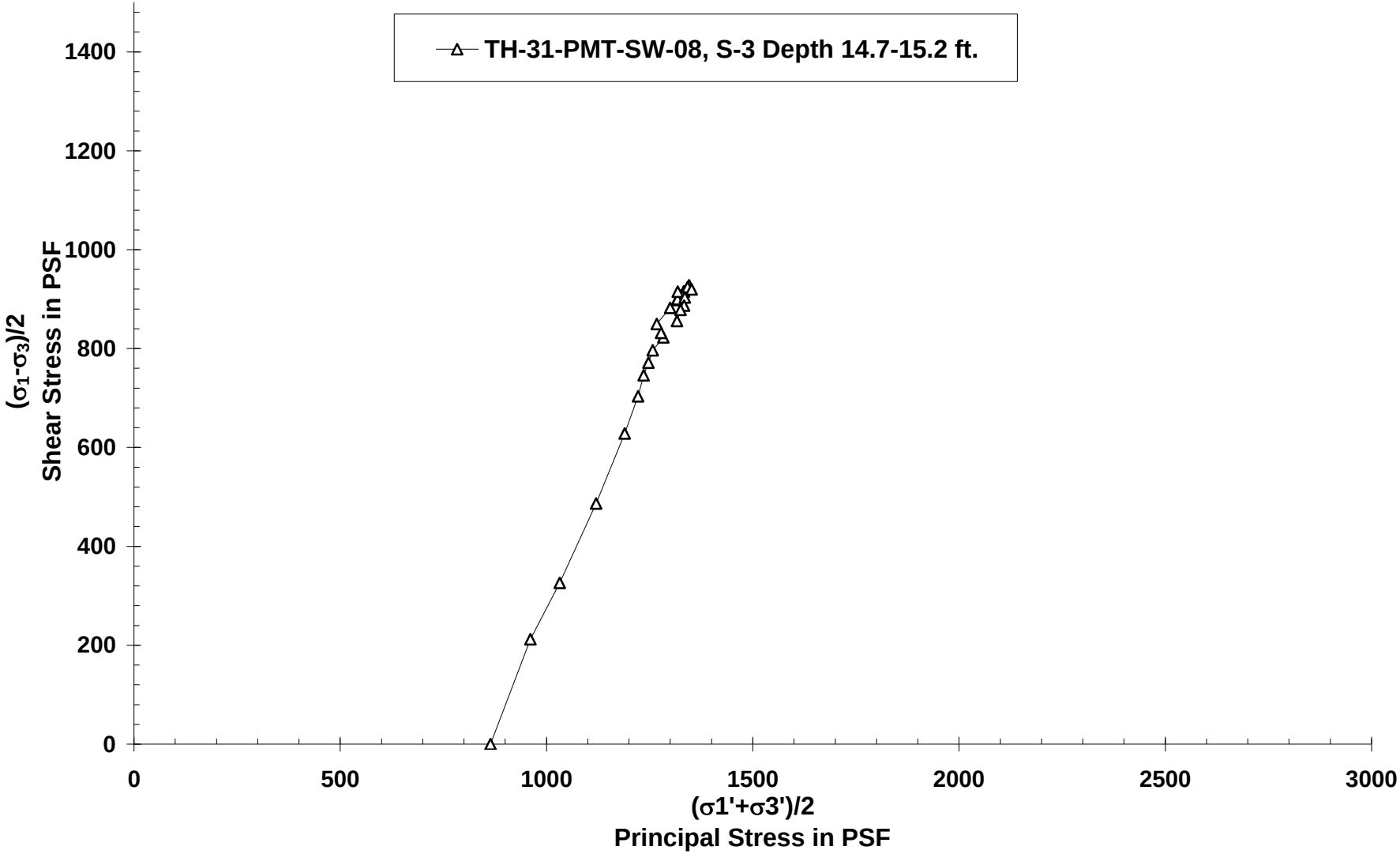
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-08-2275

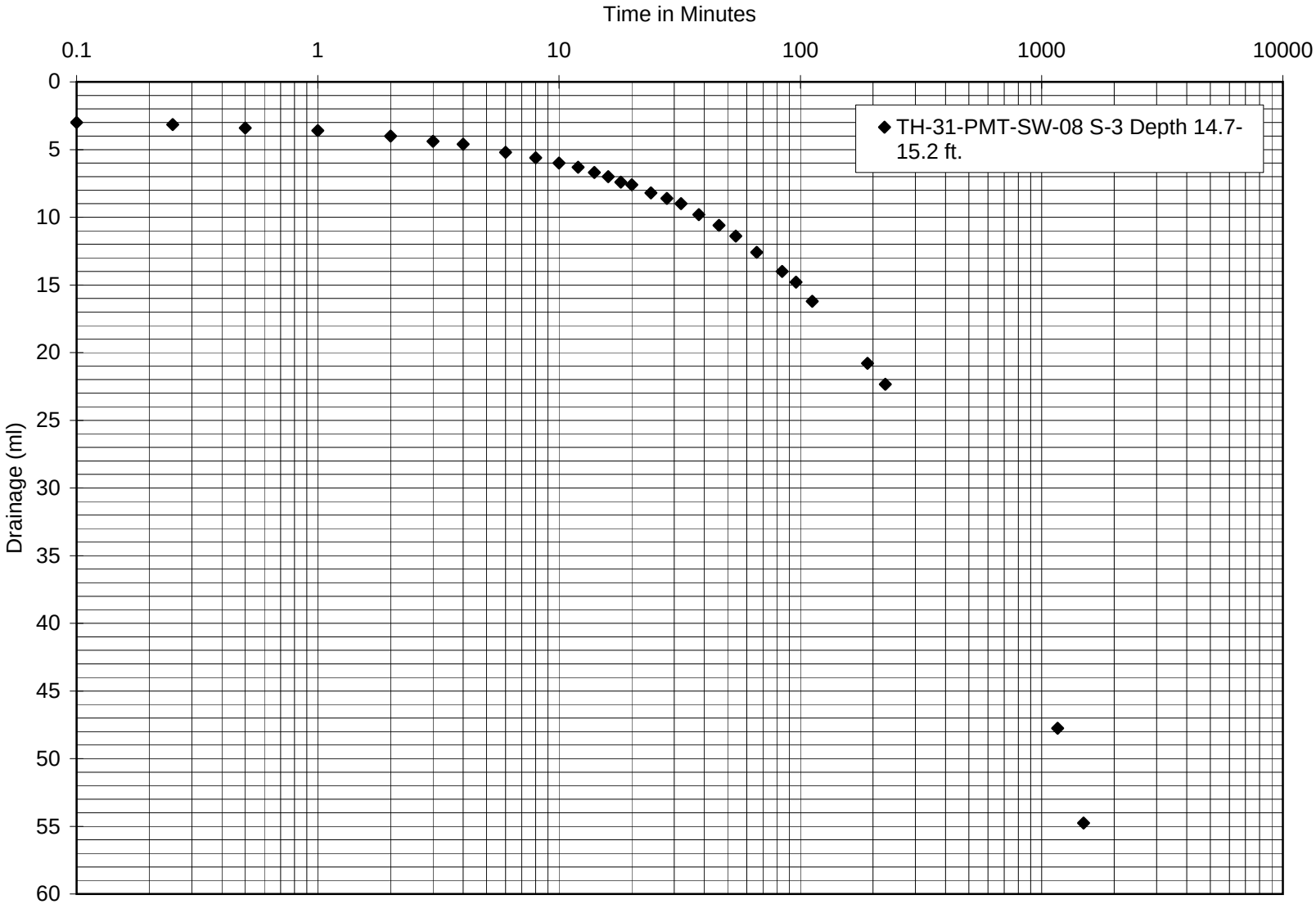
WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)



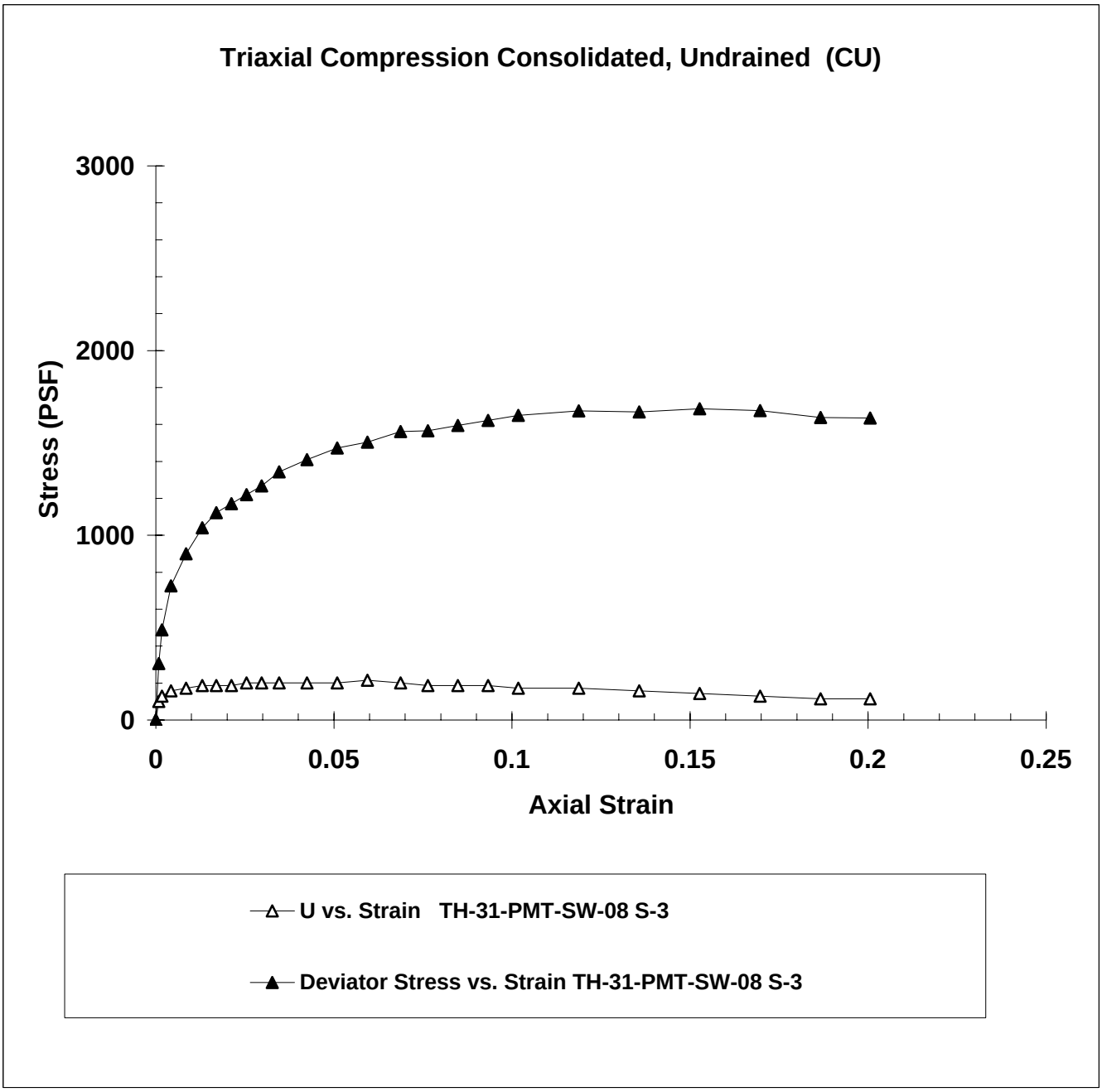
Soil Technology
J-08-2275

WSDOT Grays Harbor Pontoon Construction Facility
CU Drainage at Final Confining Stress of 8 psi



Soil Technology
J-08-2275

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates



Symbol	Boring Number	Sample Number	Depth ft	Water Content in Percent					Unit Weight		Pressure		
				Before	After	Liquid Limit	Plastic Limit	Plasticity Index	Wet pcf	Dry pcf	Consol psi	Cell psi	Back psi
Δ	TH-31-PMT-SW-08	S-3	14.2-14.7	66	58	53	26	27	101	61	4	48	44

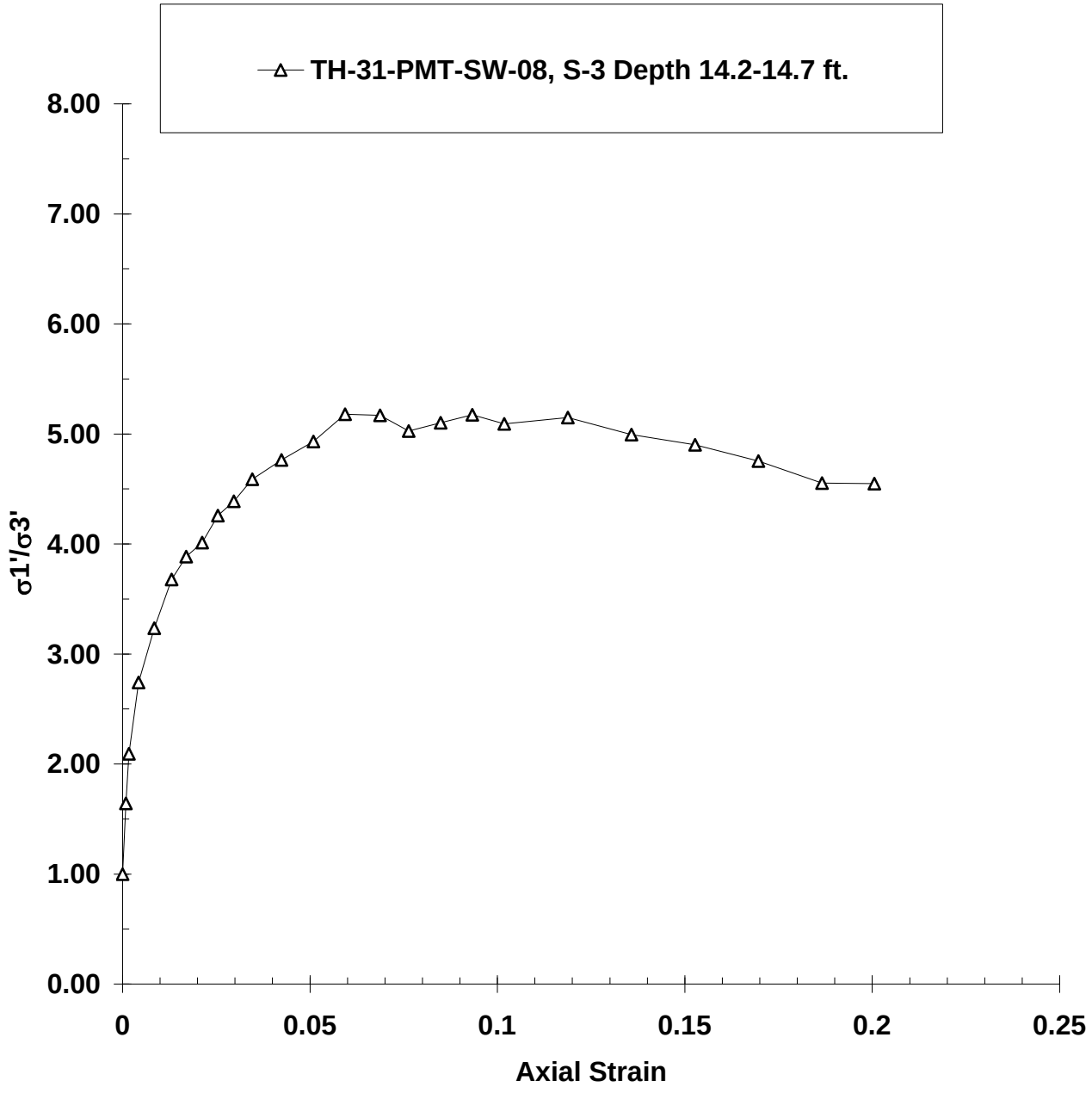
Soil Technology.
J-08-2275

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

		DIAL GAUGE		LOAD CELL		ε	Corrected		Pore Pressure								
Job #	J-08-2275	READ	ΔD	READ	PLOAD	STRAIN	Area	(σ1-σ3)	Read	Δ	Δυ	$\overline{A}$	σ'3	σ'1	σ'1/σ'3	(σ1−σ3)/2	(σ'1+σ'3)/2
Exploration #	31-PMT-SV	.001 in	.001 in	lb	lb	RATIO	ft^2	psf	psi	psi	(psf)		psf	psf			
Sample ID #	S-3	0	0	10	0	0	0.032613	0	44.0	0.00	0.00	#DIV/0!	576.00	576.00	1.00	0.00	576.00
Sample Depth (ft)	14.2-14.7	5	5	20	10	0.00085	0.032640	305	44.7	0.70	100.80	0.33	475.20	780.40	1.64	152.60	627.80
Type of Test	CU	10	10	26	16	0.00170	0.032668	487	44.9	0.90	129.60	0.27	446.40	933.83	2.09	243.71	690.11
Cell Pressure (psi)	48	25	25	34	24	0.00424	0.032752	727	45.1	1.10	158.40	0.22	417.60	1144.52	2.74	363.46	781.06
Back Pressure (psi)	44	50	50	40	30	0.00848	0.032892	900	45.2	1.20	172.80	0.19	403.20	1303.56	3.23	450.18	853.38
Strain Rate (in/min)	0.003	77	77	45	35	0.01306	0.033044	1041	45.3	1.30	187.20	0.18	388.80	1429.92	3.68	520.56	909.36
Initial Platen Reading (in x 10^{-3})	0	100	100	48	38	0.01697	0.033176	1122	45.3	1.30	187.20	0.17	388.80	1510.77	3.89	560.98	949.78
Initial Load Cell Reading (lbs)	10	125	125	50	40	0.02121	0.033319	1171	45.3	1.30	187.20	0.16	388.80	1559.99	4.01	585.59	974.39
Date	9/8/2008	150	150	52	42	0.02545	0.033464	1220	45.4	1.40	201.60	0.17	374.40	1594.29	4.26	609.94	984.34
Test by	RGS	175	175	54	44	0.02969	0.033611	1268	45.4	1.40	201.60	0.16	374.40	1642.46	4.39	634.03	1008.43
Initial Length (in)	6.02	204	204	57	47	0.03461	0.033782	1343	45.4	1.40	201.60	0.15	374.40	1717.83	4.59	671.71	1046.11
Area (ft^2)	0.043785	250	250	60	50	0.04242	0.034057	1409	45.4	1.40	201.60	0.14	374.40	1783.88	4.76	704.74	1079.14
Height after Consolidation	5.894	300	300	63	53	0.05090	0.034362	1472	45.4	1.40	201.60	0.14	374.40	1846.45	4.93	736.03	1110.43
Area after Consolidation	0.032613	350	350	65	55	0.05938	0.034672	1504	45.5	1.50	216.00	0.14	360.00	1864.22	5.18	752.11	1112.11
Youngs Modulus for membrane(lbs/in2)	200	405	405	68	58	0.06871	0.035019	1561	45.4	1.40	201.60	0.13	374.40	1935.65	5.17	780.63	1155.03
Membrane Thickness in.	0.012	450	450	69	59	0.07635	0.035308	1565	45.3	1.30	187.20	0.12	388.80	1954.24	5.03	782.72	1171.52
		500	500	71	61	0.08483	0.035636	1594	45.3	1.30	187.20	0.12	388.80	1983.29	5.10	797.25	1186.05
		550	550	73	63	0.09332	0.035969	1623	45.3	1.30	187.20	0.12	388.80	2011.30	5.17	811.25	1200.05
		600	600	75	65	0.10180	0.036309	1649	45.2	1.20	172.80	0.10	403.20	2052.67	5.09	824.73	1227.93
		700	700	78	68	0.11876	0.037008	1673	45.2	1.20	172.80	0.10	403.20	2076.46	5.15	836.63	1239.83
		800	800	80	70	0.13573	0.037734	1667	45.1	1.10	158.40	0.09	417.60	2085.03	4.99	833.72	1251.32
		900	900	83	73	0.15270	0.038490	1686	45.0	1.00	144.00	0.09	432.00	2117.51	4.90	842.75	1274.75
		1000	1000	85	75	0.16966	0.039277	1675	44.9	0.90	129.60	0.08	446.40	2121.39	4.75	837.50	1283.90
		1100	1100	86	76	0.18663	0.040096	1637	44.8	0.80	115.20	0.07	460.80	2098.26	4.55	818.73	1279.53
		1182	1182	88	78	0.20054	0.040794	1635	44.8	0.80	115.20	0.07	460.80	2095.64	4.55	817.42	1278.22

WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

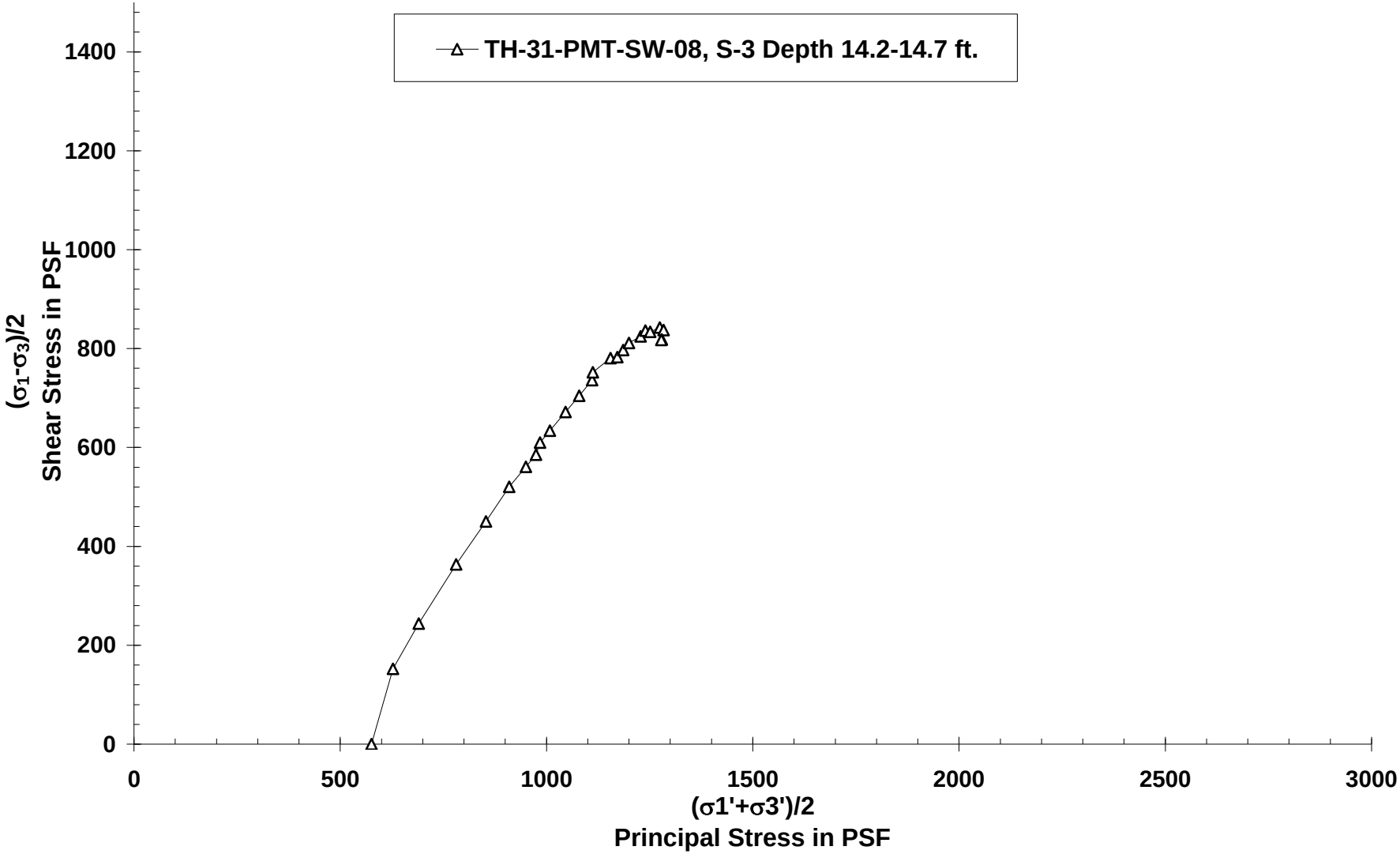
Triaxial Compression Consolidated, Undrained (CU)



Soil Technology
J-08-2275

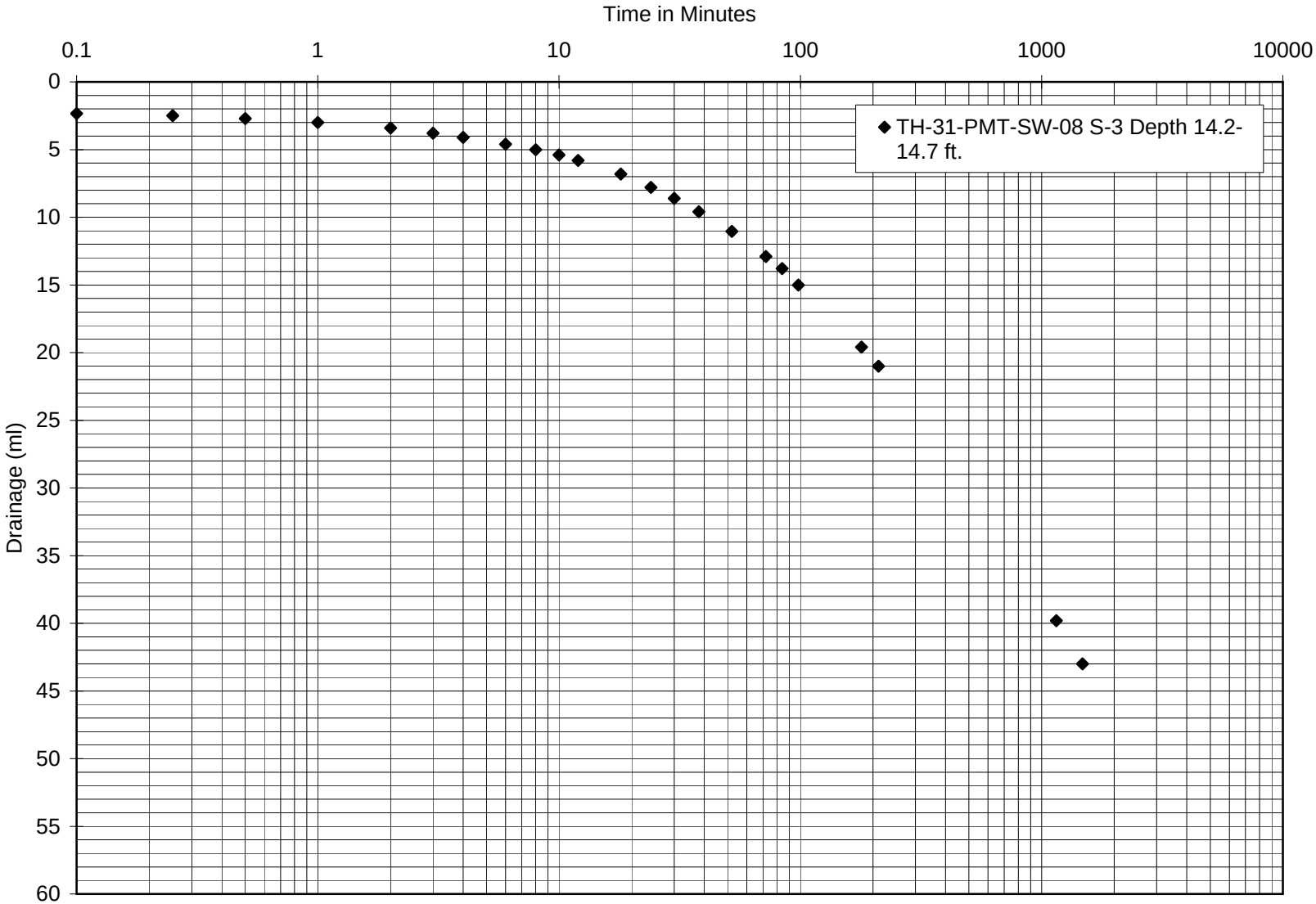
WSDOT Grays Harbor Pontoon Construction Facility
Landau Associates

TRIAXIAL COMPRESSION TEST CONSOLIDATED, UNDRAINED (CU)
Modified Mohr-Coulomb
(Stress Paths)



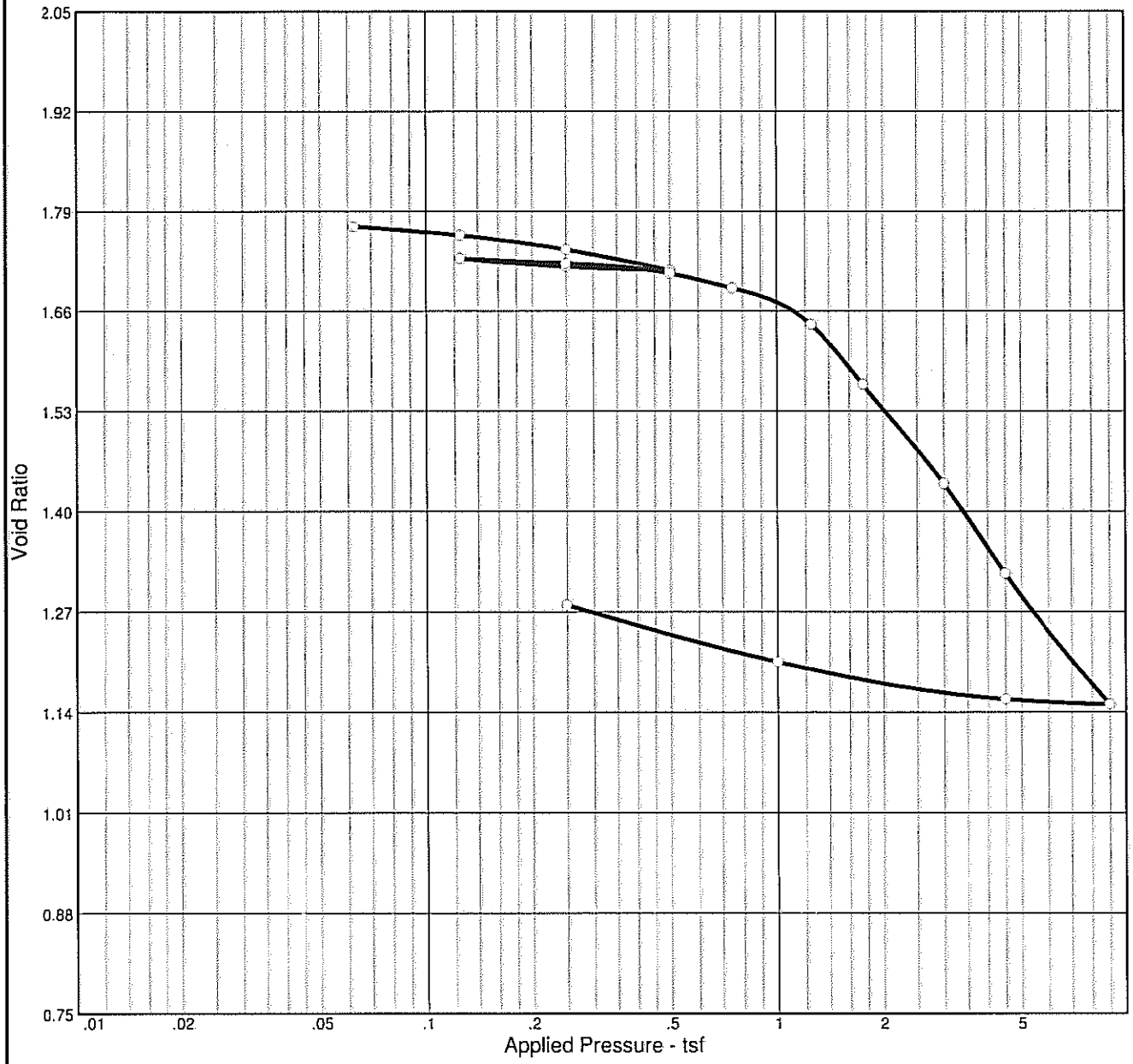
Soil Technology
J-08-2275

WSDOT Grays Harbor Pontoon Construction Facility
CU Drainage at Final Confining Stress of 8 psi



Soil Technology
J-08-2275

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture								
99.3 %	65.7 %	60.5	84	45	2.7		1.25	0.60	1.786

MATERIAL DESCRIPTION	USCS	AASHTO
	MH	

Project No. 244039.020 **Client:** Landau Associates, Inc.

Project: WSDOT Special Projects Facility J-06-2154

Source: B-17 **Sample No.:** S-8 **Elev./Depth:** 23.0-23.1

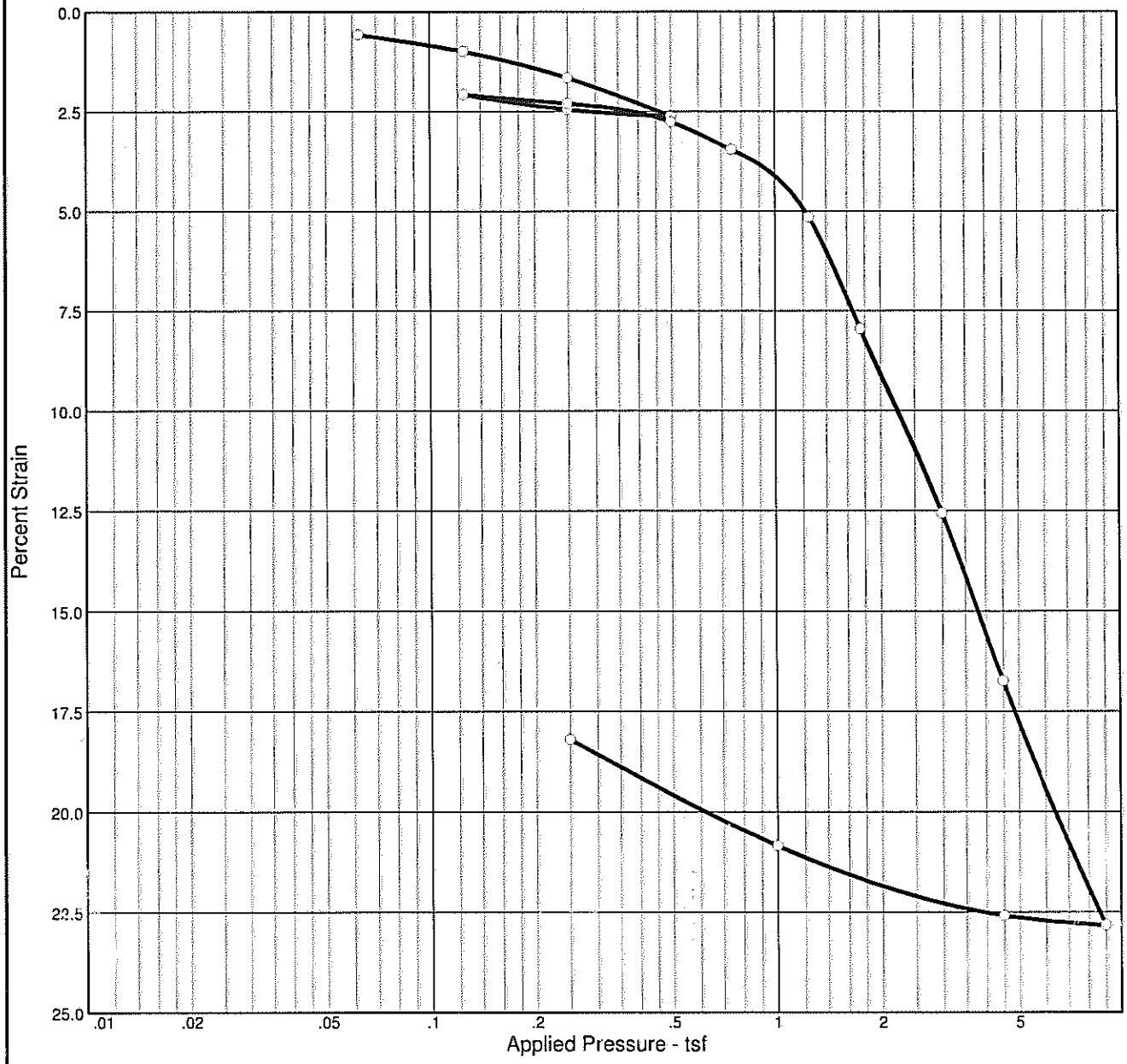
Remarks:
Sample contained sand lenses

CONSOLIDATION TEST REPORT

SOIL TECHNOLOGY

Figure 1

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture								
99.3 %	65.7 %	60.5	84	45	2.7		1.29	0.61	1.786

MATERIAL DESCRIPTION	USCS	AASHTO
	MH	

Project No. 244039.020 **Client:** Landau Associates, Inc.

Project: WSDOT Special Projects Facility J-06-2154

Source: B-17 **Sample No.:** S-8 **Elev./Depth:** 23.0-23.1

Remarks:
Sample contained sand lenses

CONSOLIDATION TEST REPORT

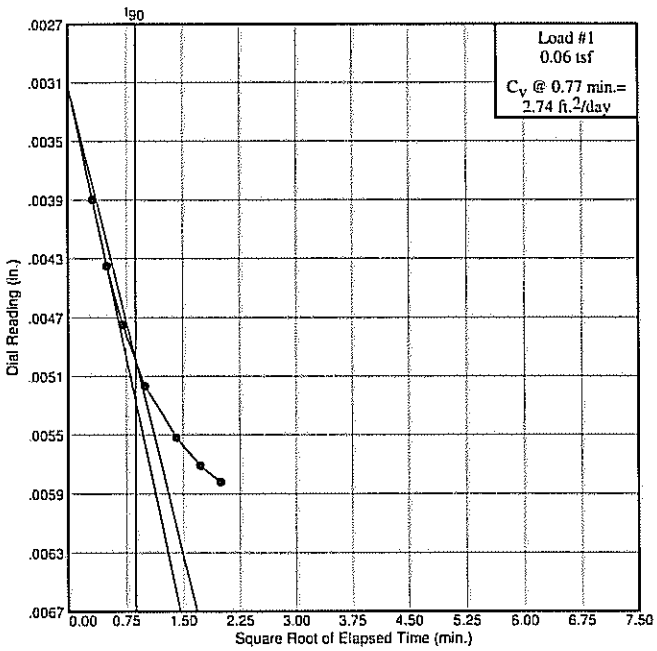
SOIL TECHNOLOGY

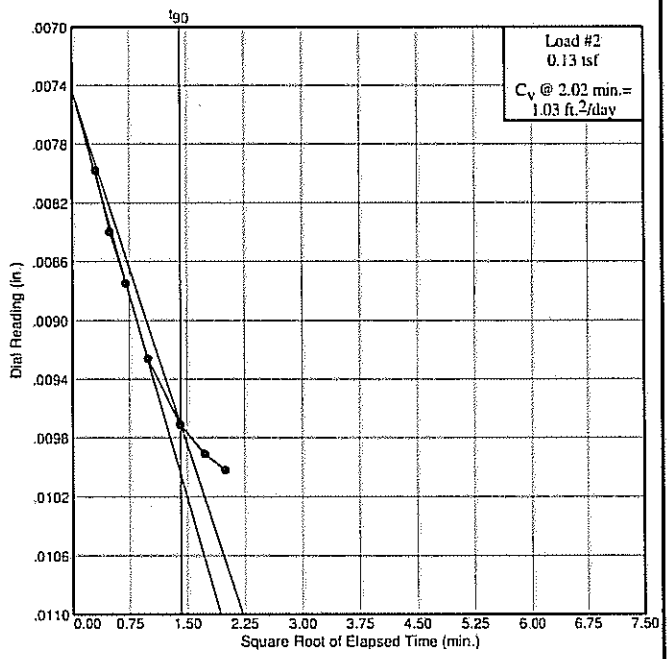
Figure 1

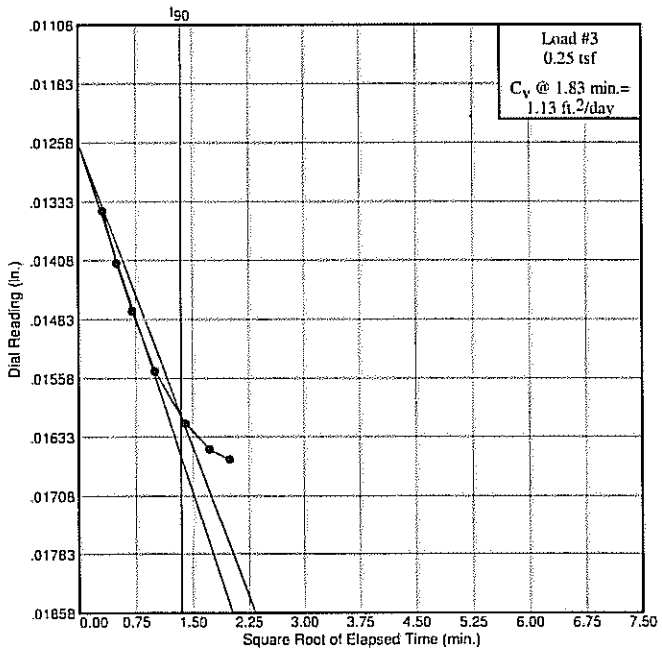
Dial Reading vs. Time

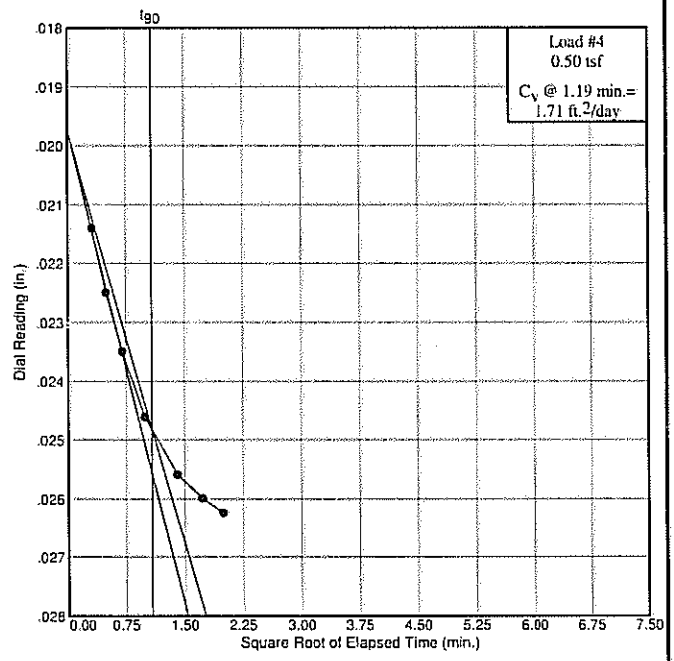
Project No.: 244039.020
Project: WSDOT Special Projects Facility J-06-2154

Source: B-17 Sample No.: S-8 Elev./Depth: 23.0-23.1









Dial Reading vs. Time

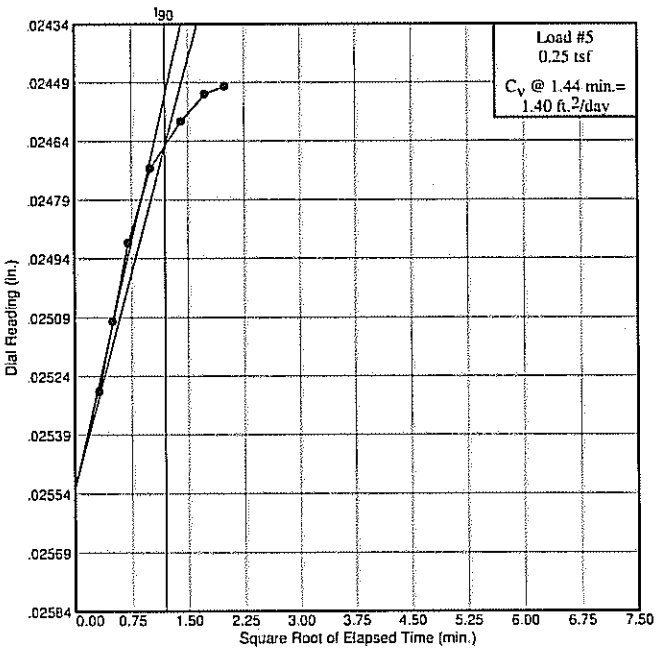
SOIL TECHNOLOGY

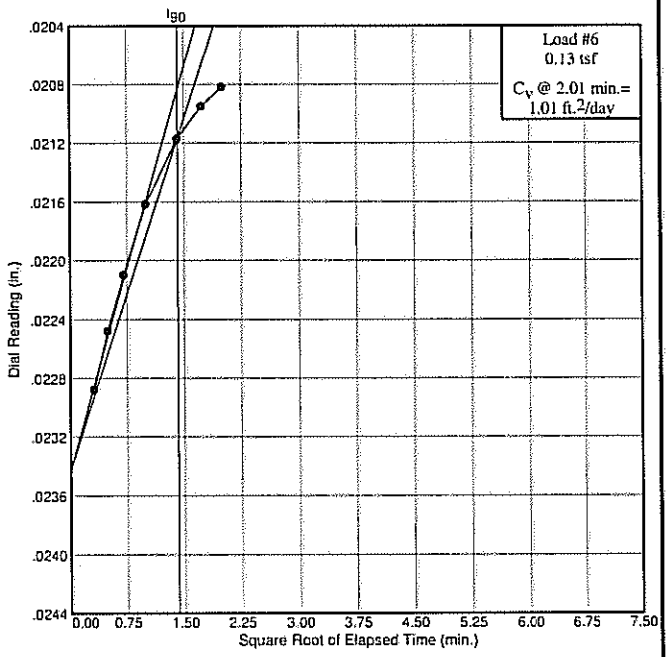
Figure 2

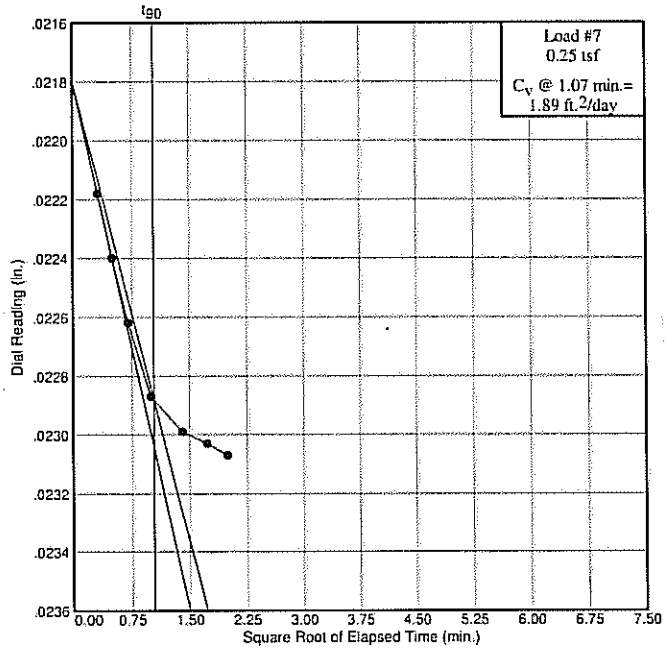
Dial Reading vs. Time

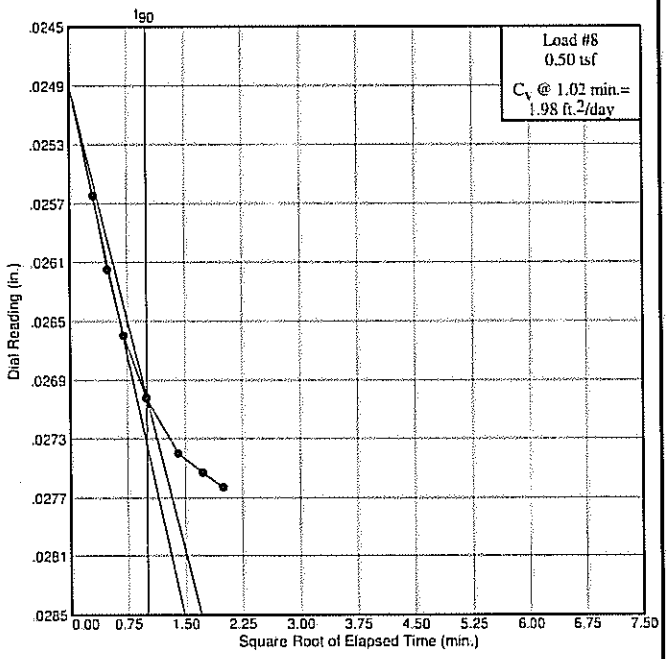
Project No.: 244039.020
Project: WSDOT Special Projects Facility J-06-2154

Source: B-17 Sample No.: S-8 Elev./Depth: 23.0-23.1









Dial Reading vs. Time

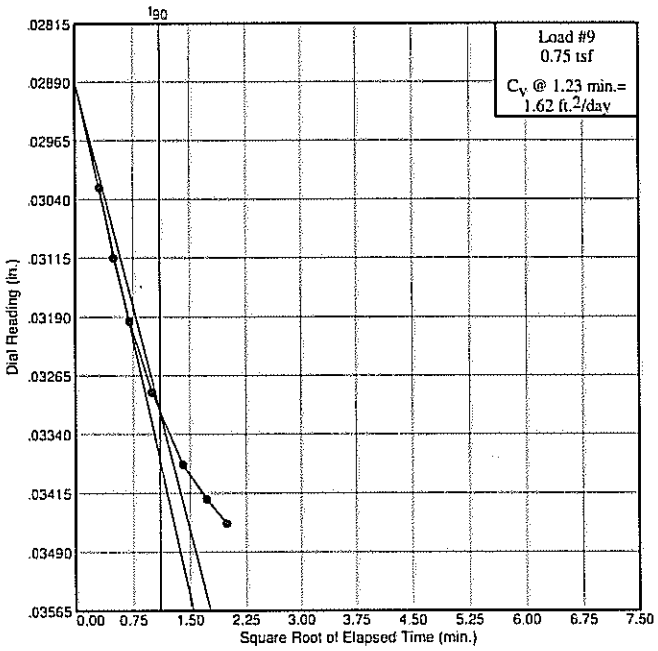
SOIL TECHNOLOGY

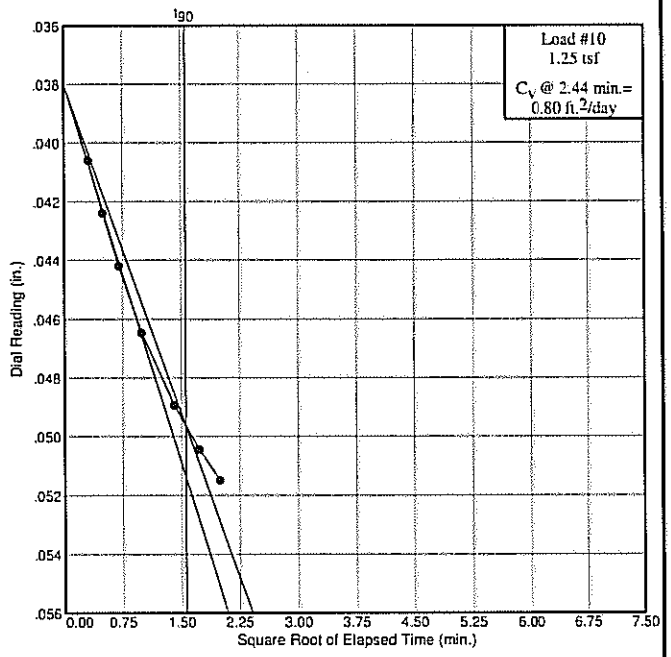
Figure 3

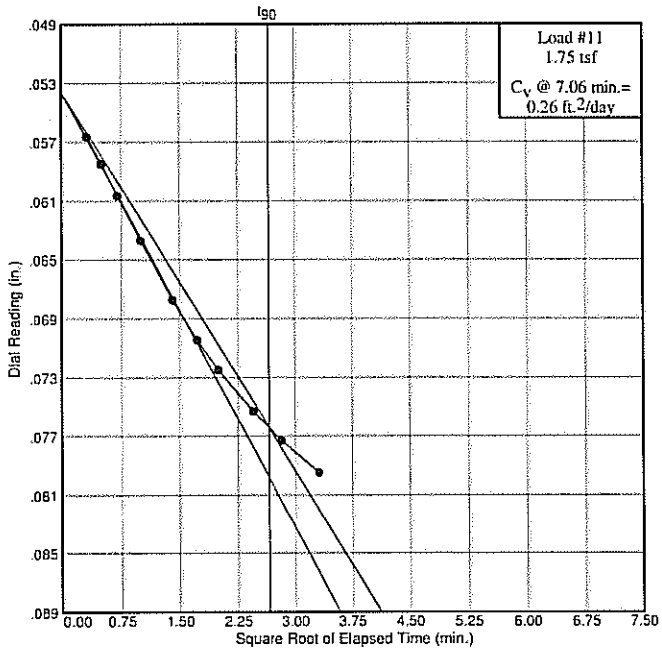
Dial Reading vs. Time

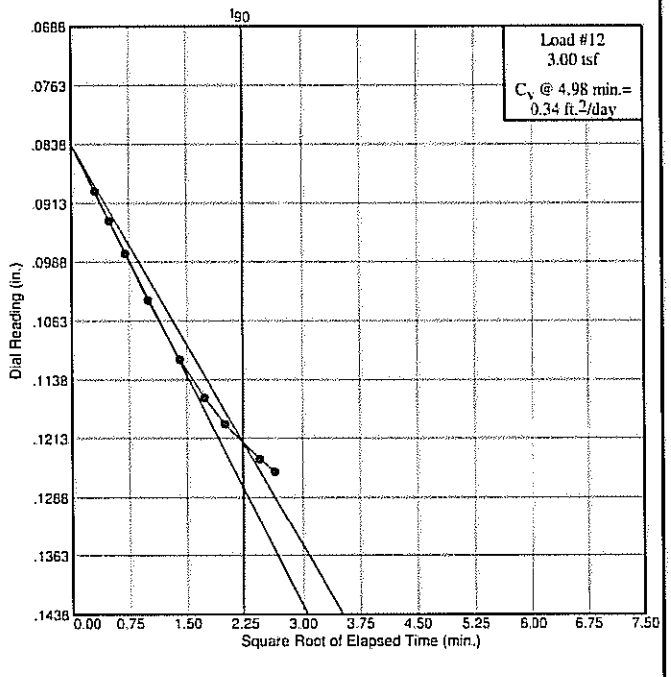
Project No.: 244039.020
Project: WSDOT Special Projects Facility J-06-2154

Source: B-17 Sample No.: S-8 Elev./Depth: 23.0-23.1









Dial Reading vs. Time

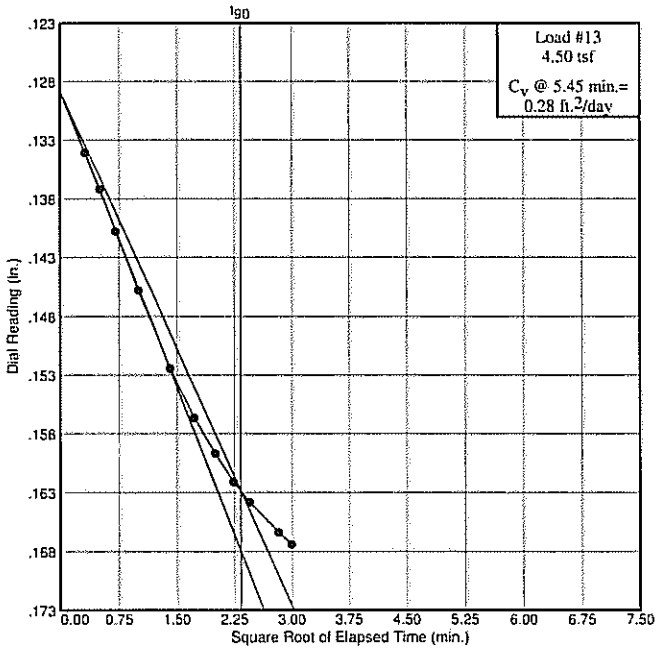
SOIL TECHNOLOGY

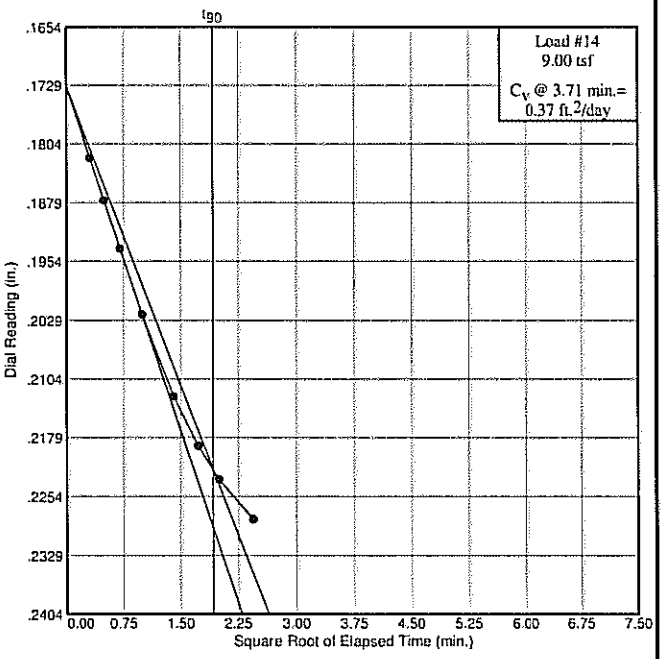
Figure 4

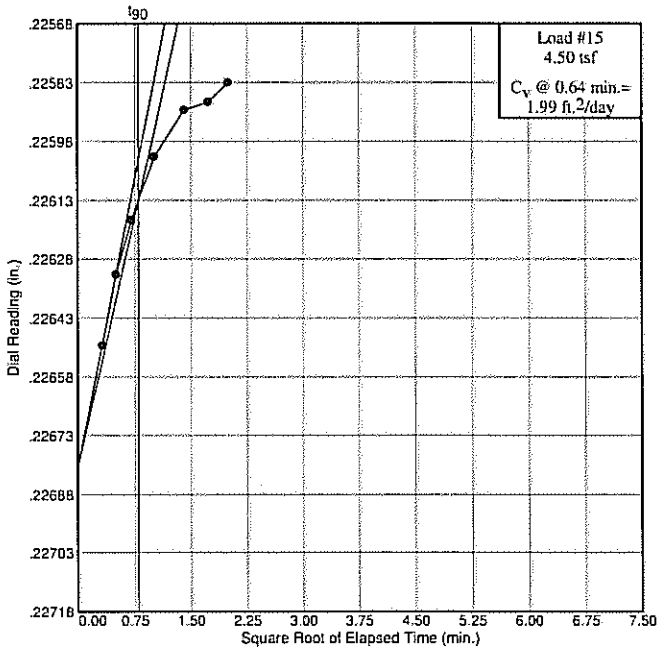
Dial Reading vs. Time

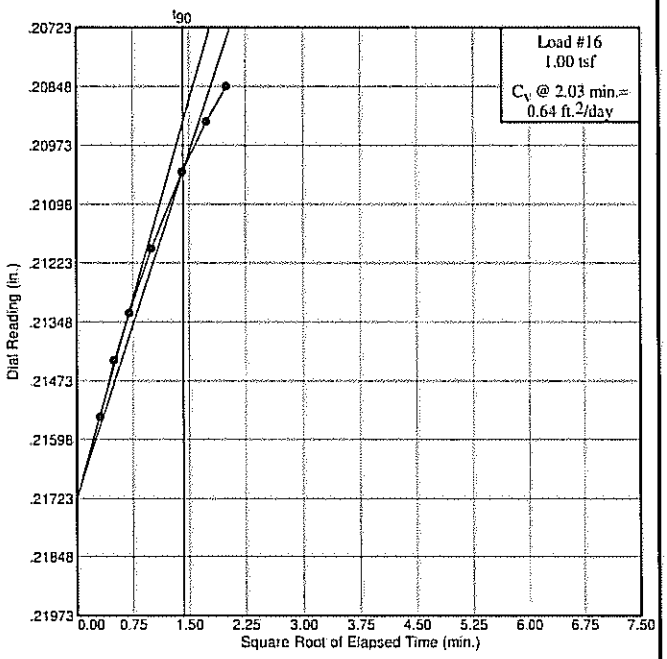
Project No.: 244039.020
Project: WSDOT Special Projects Facility J-06-2154

Source: B-17 Sample No.: S-8 Elev./Depth: 23.0-23.1









Dial Reading vs. Time

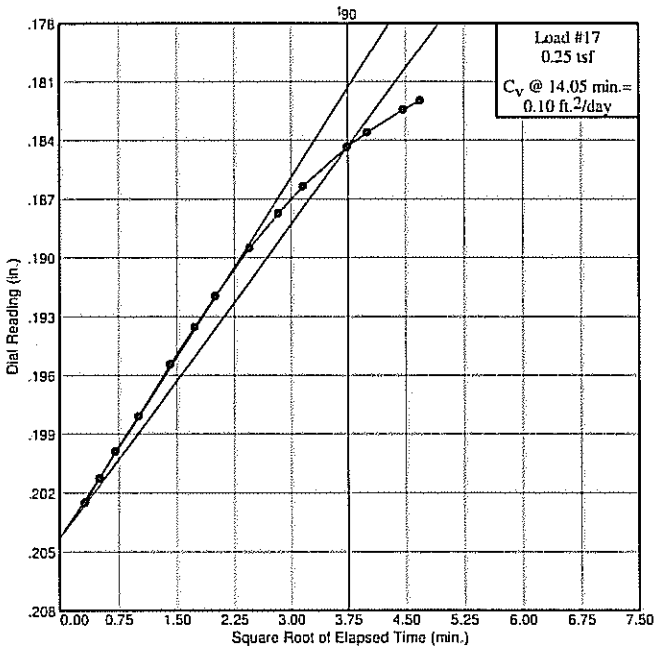
SOIL TECHNOLOGY

Figure 5

Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility J-06-2154

Source: B-17 Sample No.: S-8 Elev./Depth: 23.0-23.1

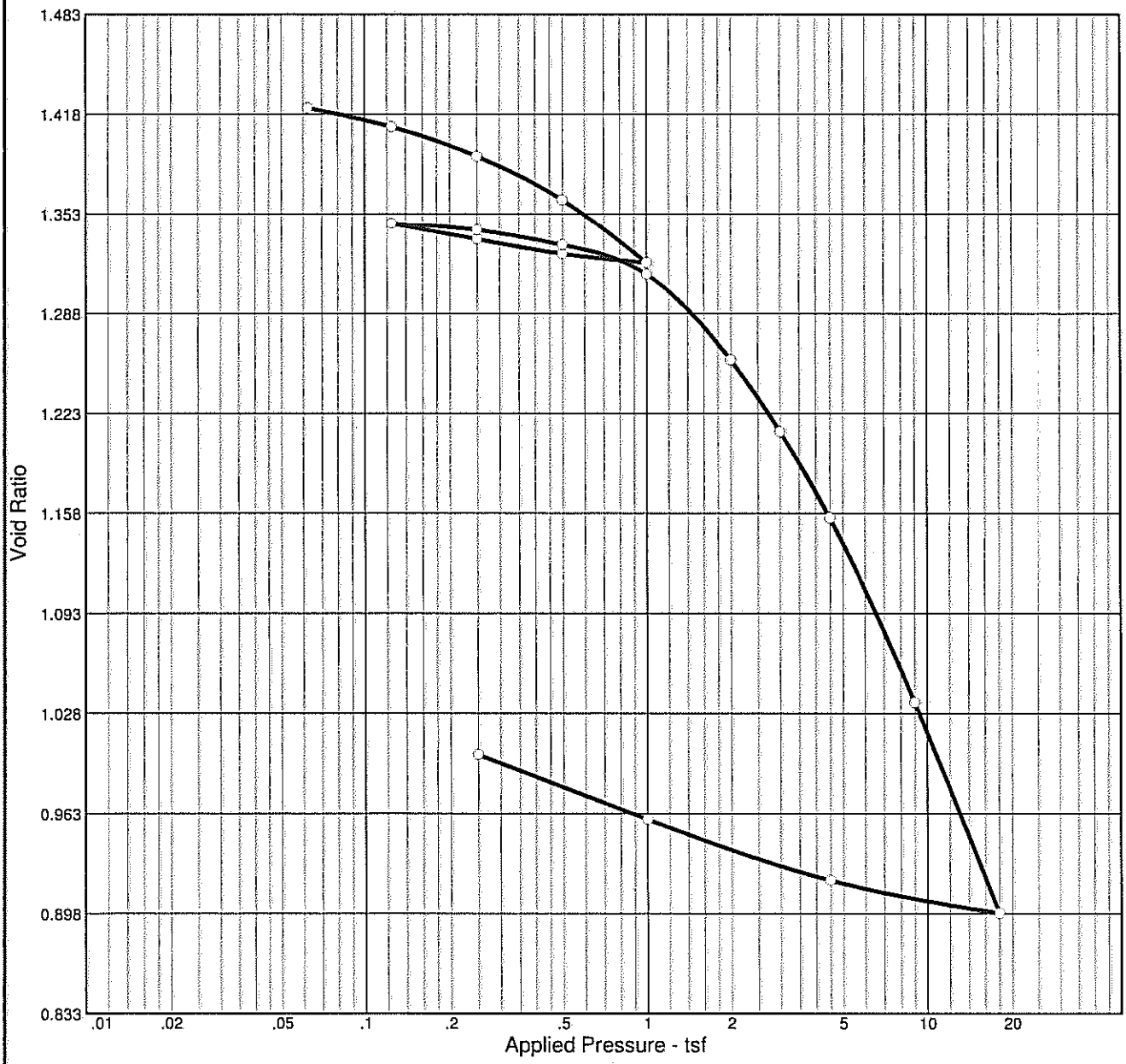


Dial Reading vs. Time

SOIL TECHNOLOGY

Figure 6

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture								
97.5 %	52.7 %	68.0	56	21	2.6 5		3.37	0.46	1.434

MATERIAL DESCRIPTION	USCS	AASHTO
Medium stiff, wet, grey, Silt	MH	-----

Project No. 244039.020 **Client:** Landau Associates, Inc.

Project: WSDOT Special Projects Facility J-06-2154

Source: B-10 **Sample No.:** S-28 **Elev./Depth:** 106.1-106.2

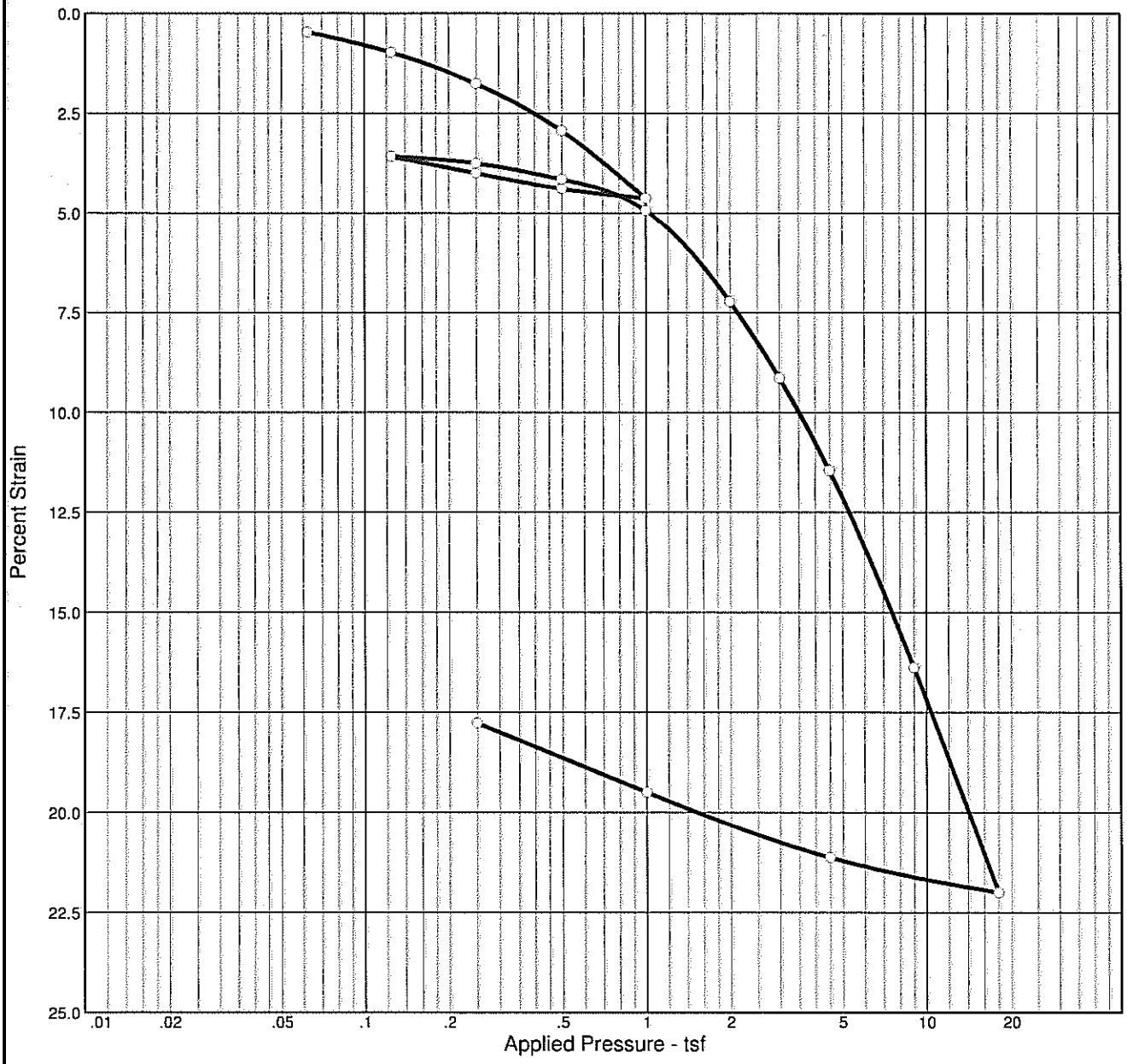
Remarks:

CONSOLIDATION TEST REPORT

SOIL TECHNOLOGY

Figure 5

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture								
97.5 %	52.7 %	68.0	56	21	2.6 5		3.37	0.46	1.434

MATERIAL DESCRIPTION	USCS	AASHTO
Medium stiff, wet, grey, Silt	MH	-----

Project No. 244039.020 **Client:** Landau Associates, Inc.

Project: WSDOT Special Projects Facility J-06-2154

Source: B-10 **Sample No.:** S-28 **Elev./Depth:** 106.1-106.2

Remarks:

CONSOLIDATION TEST REPORT

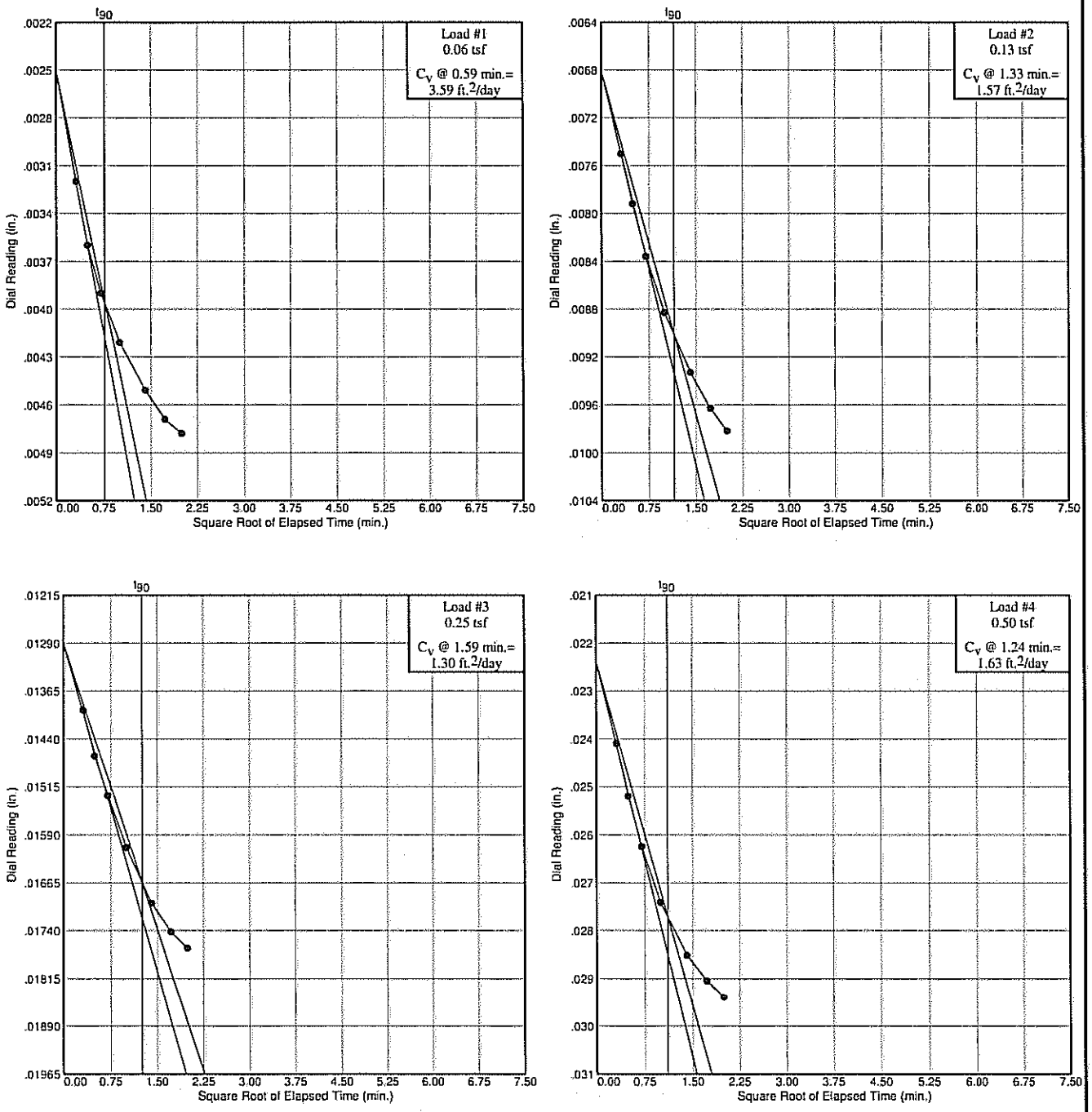
SOIL TECHNOLOGY

Figure 5

Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility J-06-2154

Source: B-10 Sample No.: S-28 Elev./Depth: 106.1-106.2



Dial Reading vs. Time

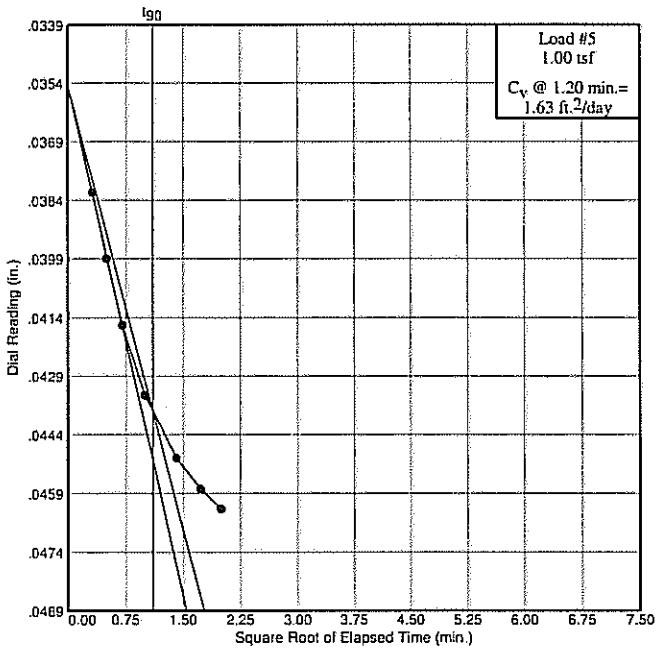
SOIL TECHNOLOGY

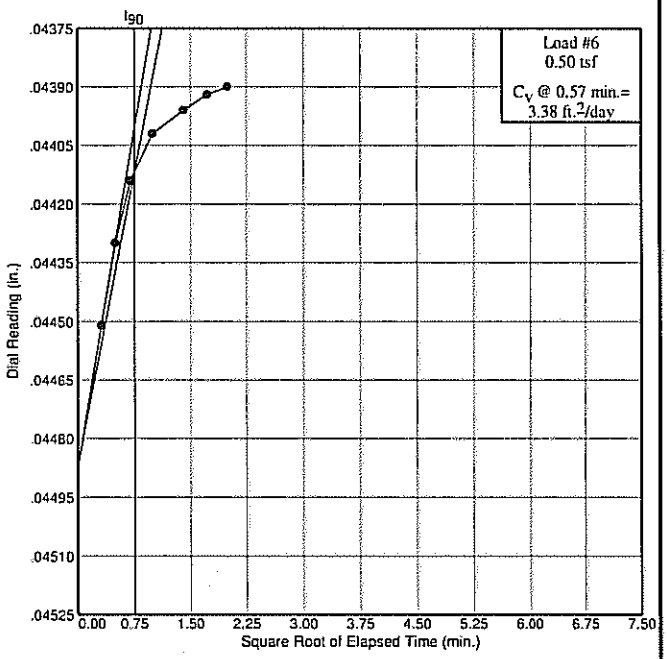
Figure 6

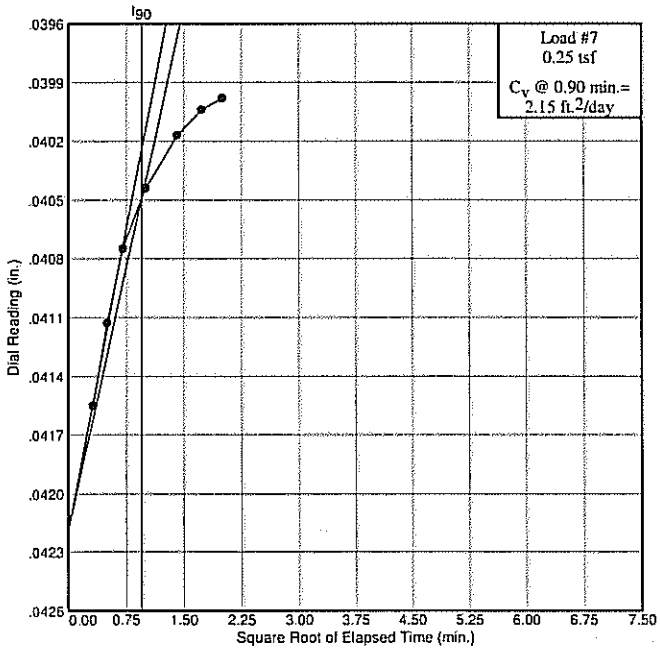
Dial Reading vs. Time

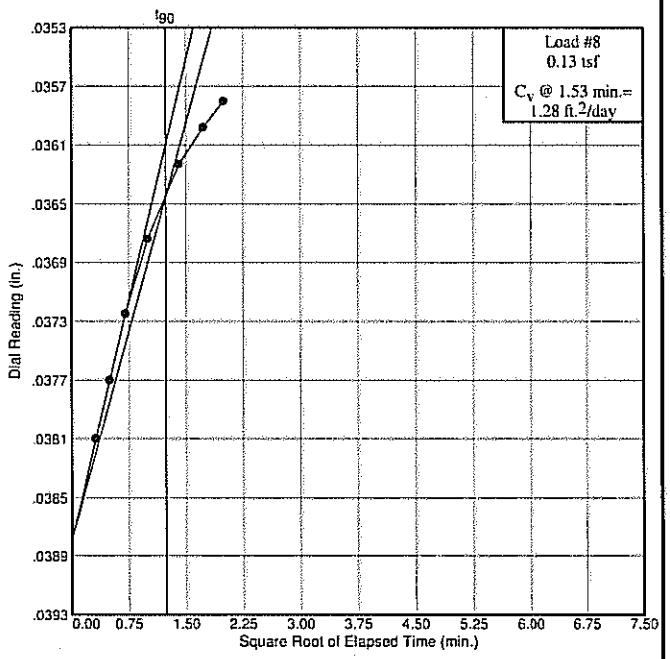
Project No.: 244039.020
Project: WSDOT Special Projects Facility J-06-2154

Source: B-10 Sample No.: S-28 Elev./Depth: 106.1-106.2









Dial Reading vs. Time

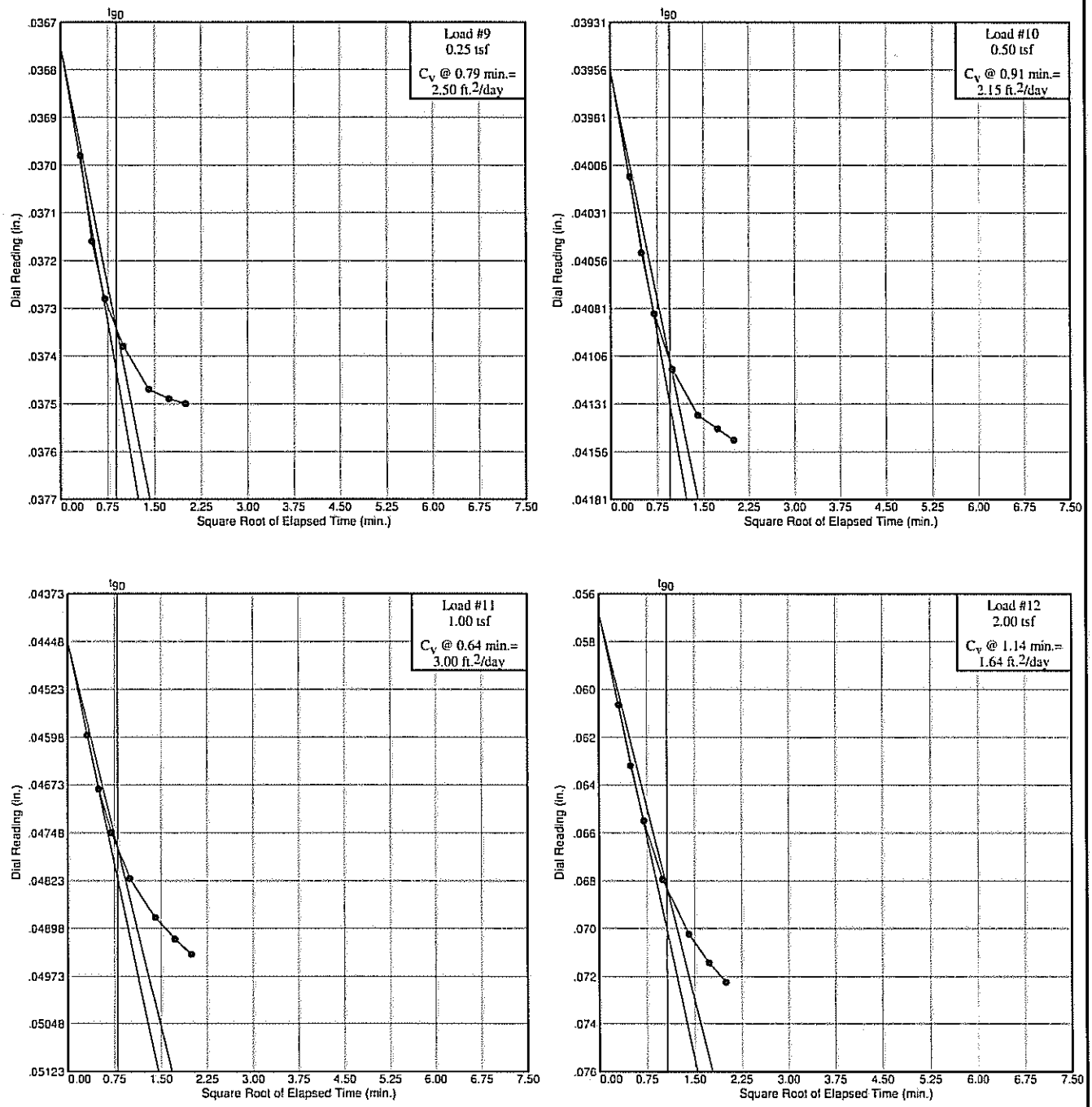
SOIL TECHNOLOGY

Figure 7

Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility J-06-2154

Source: B-10 Sample No.: S-28 Elev./Depth: 106.1-106.2



Dial Reading vs. Time

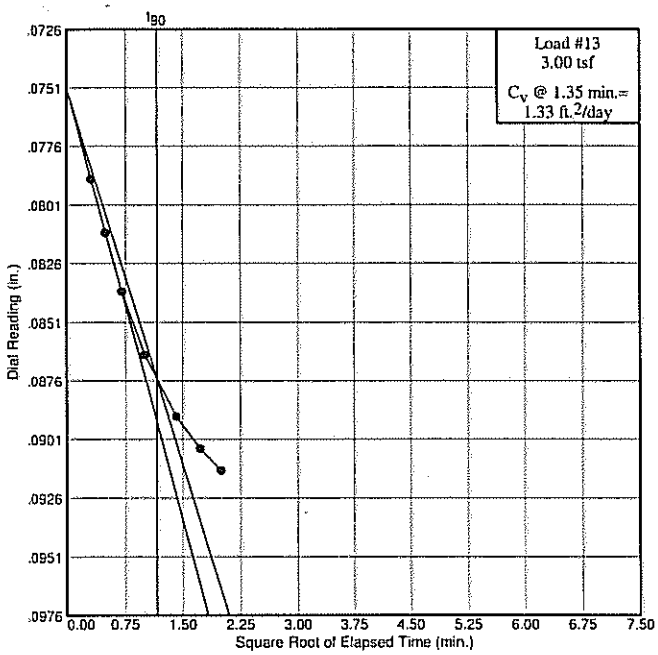
SOIL TECHNOLOGY

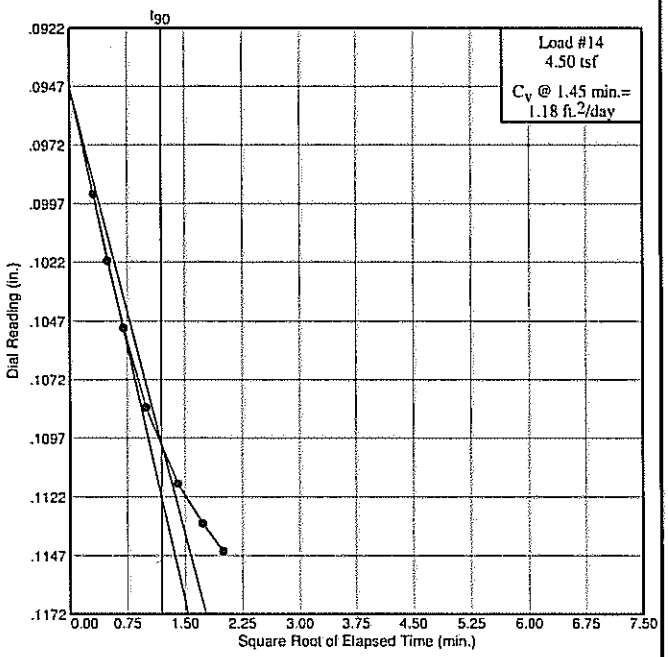
Figure 8

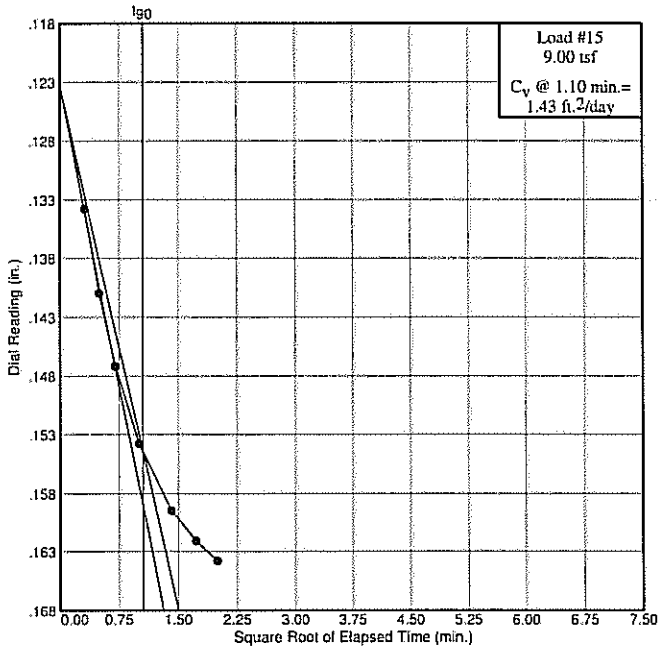
Dial Reading vs. Time

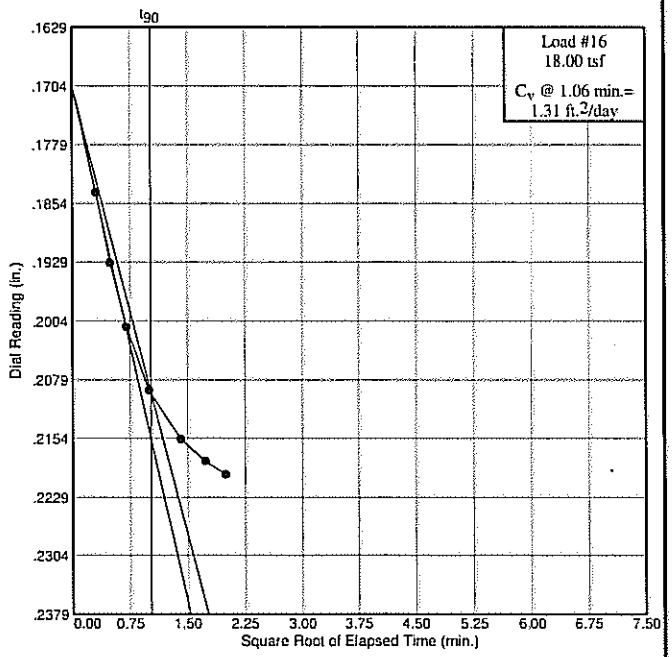
Project No.: 244039.020
Project: WSDOT Special Projects Facility J-06-2154

Source: B-10 Sample No.: S-28 Elev./Depth: 106.1-106.2









Dial Reading vs. Time

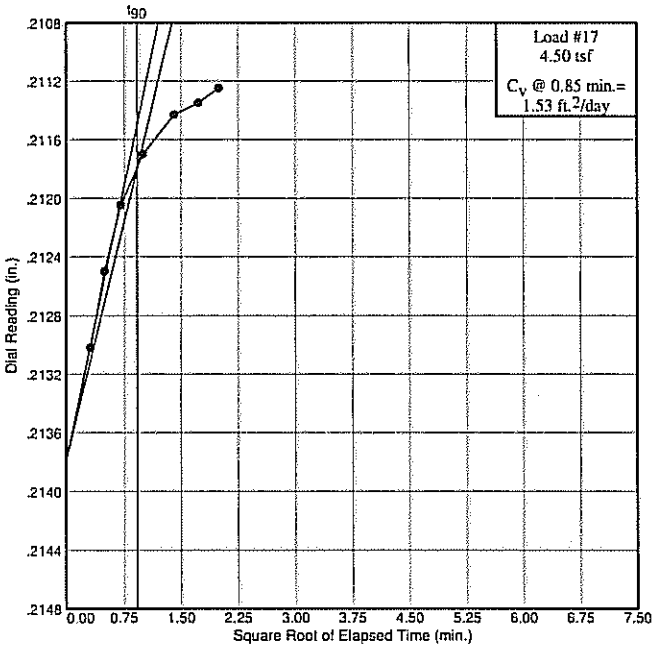
SOIL TECHNOLOGY

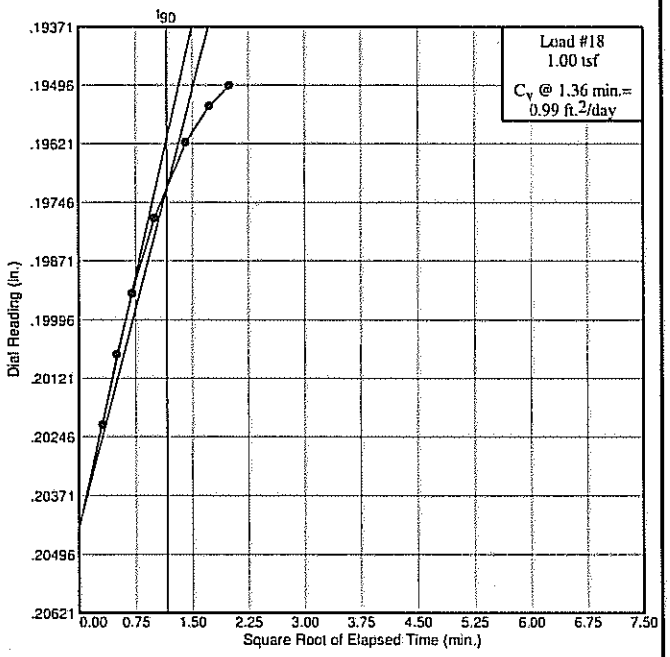
Figure 9

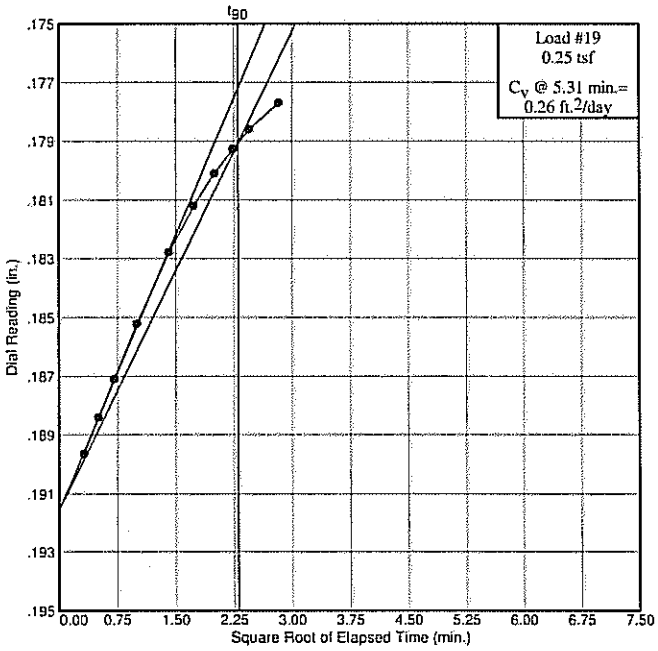
Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility J-06-2154

Source: B-10 Sample No.: S-28 Elev./Depth: 106.1-106.2





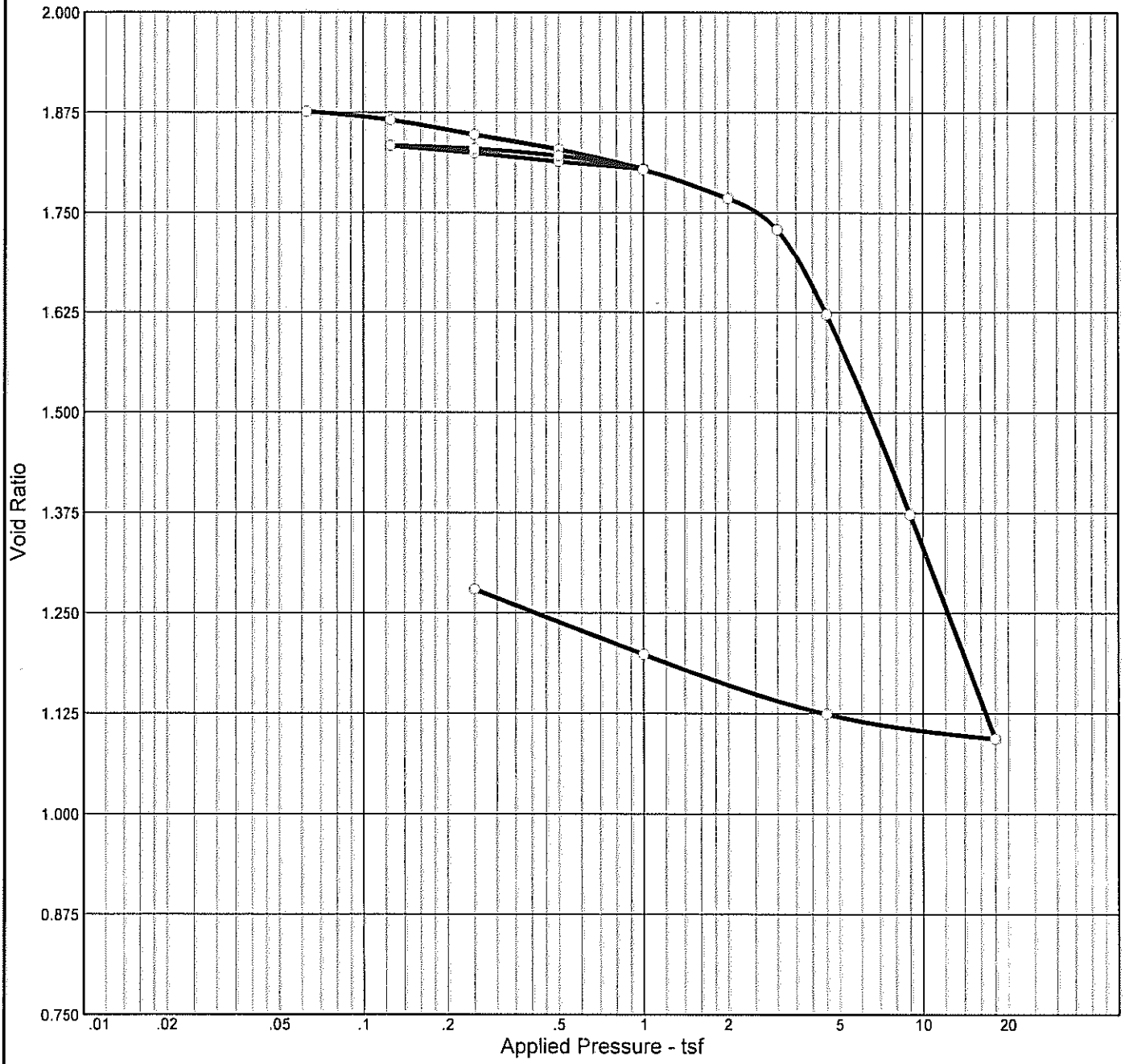


Dial Reading vs. Time

SOIL TECHNOLOGY

Figure 10

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture								
99.4 %	72.1 %	56.2	86	49	2.6		4.00	0.93	1.888

MATERIAL DESCRIPTION	USCS	AASHTO
Medium stiff,wet,dark grey silty,Clay	CH	----

Project No. 244039.020 **Client:** Landau Associates, Inc.

Project: WSDOT Special Projects Facility
Job No.: 06-2154

Source: B-12 **Sample No.:** S-27 **Elev./Depth:** 100.6'-100.7'

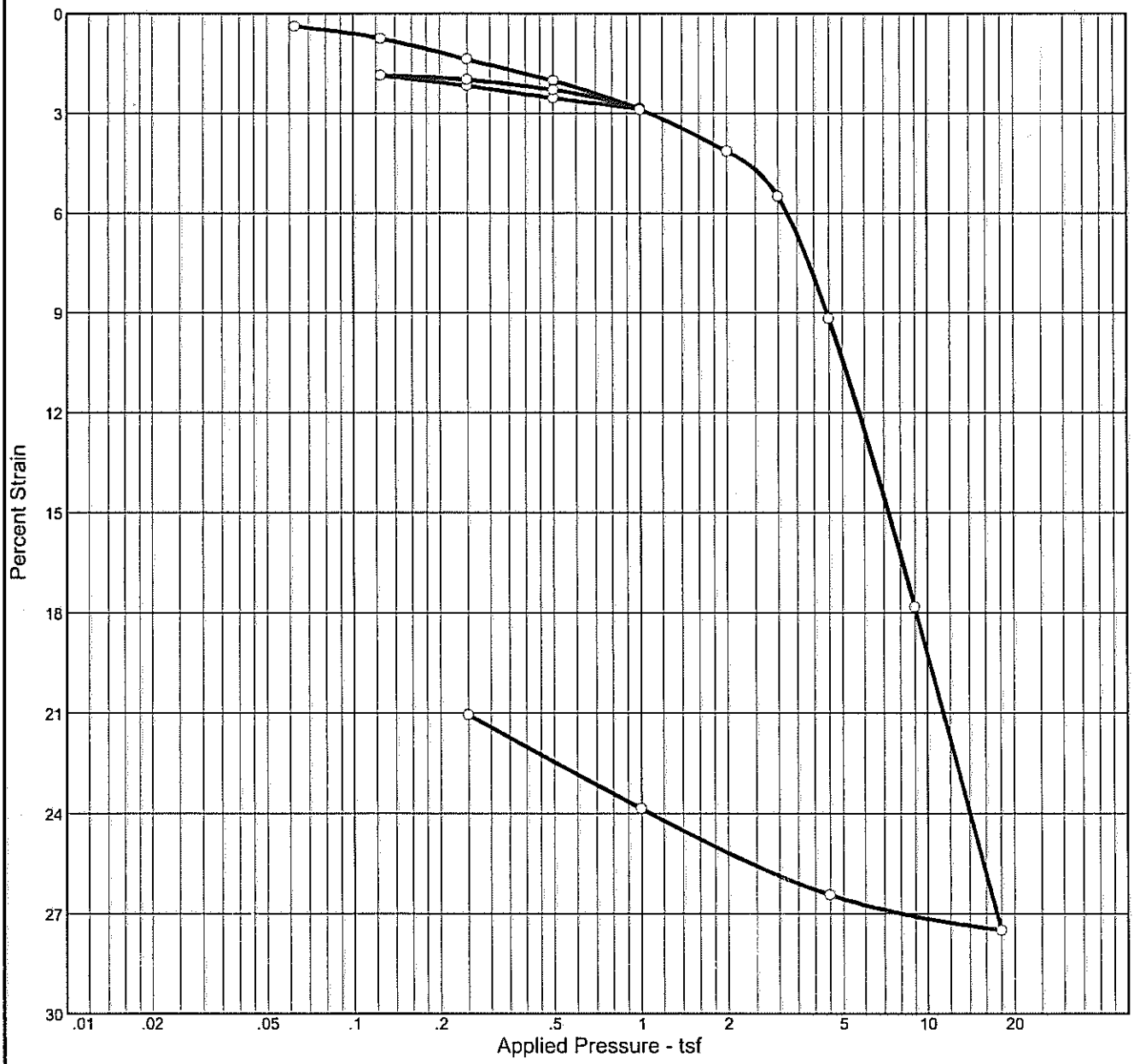
Remarks:
M-stiff to stiff,wet, silty Clay

CONSOLIDATION TEST REPORT

SOIL TECHNOLOGY

Figure

CONSOLIDATION TEST REPORT



Natural Sat.	Natural Moist.	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Swell Press. (tsf)	Swell %	e_o
99.4 %	72.1 %	56.2	86	49	2.6		4.00	0.93	0.05			1.888

MATERIAL DESCRIPTION	USCS	AASHTO
Medium stiff, wet, dark grey silty, Clay	CH	----

Project No. 244039.020 **Client:** Landau Associates, Inc.

Project: WSDOT Special Projects Facility

Source: B-12 **Sample No.:** S-27 **Elev./Depth:** 100.6-100.7 ft.

Remarks:
M-stiff to stiff,wet, silty Clay

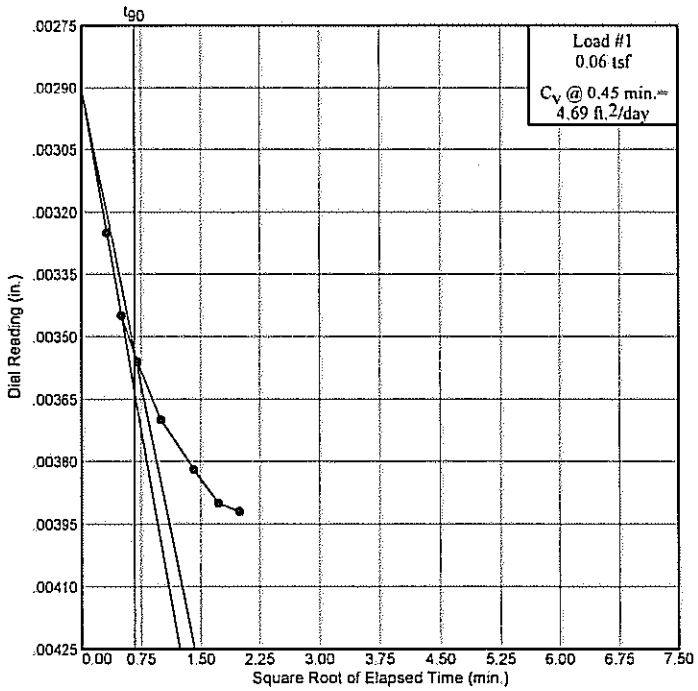
CONSOLIDATION TEST REPORT

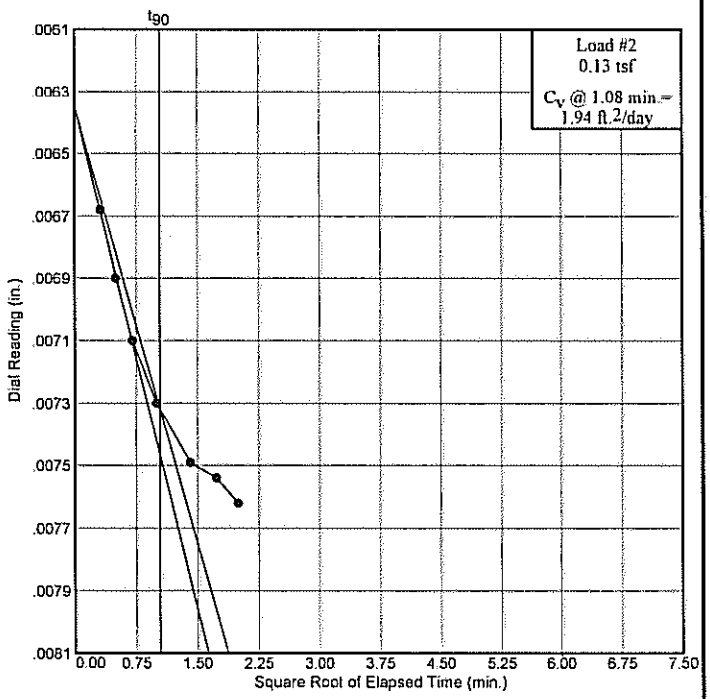
SOIL TECHNOLOGY

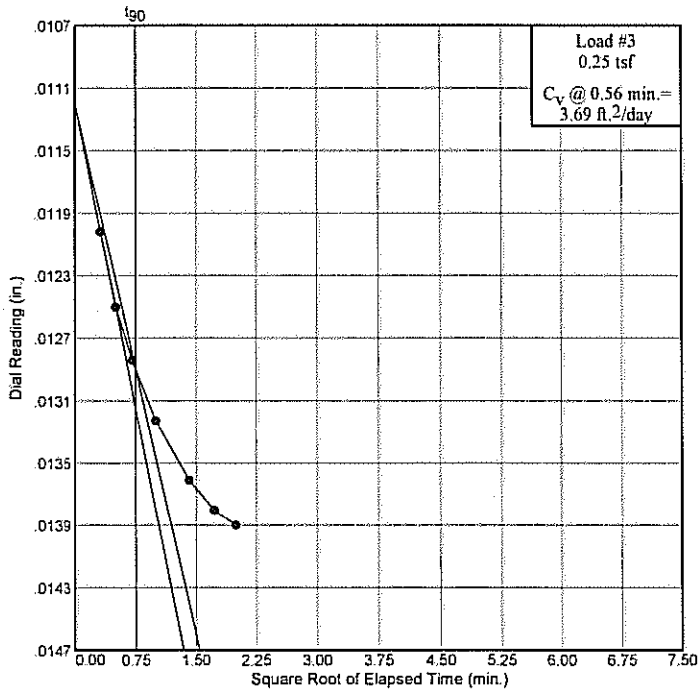
Figure 1

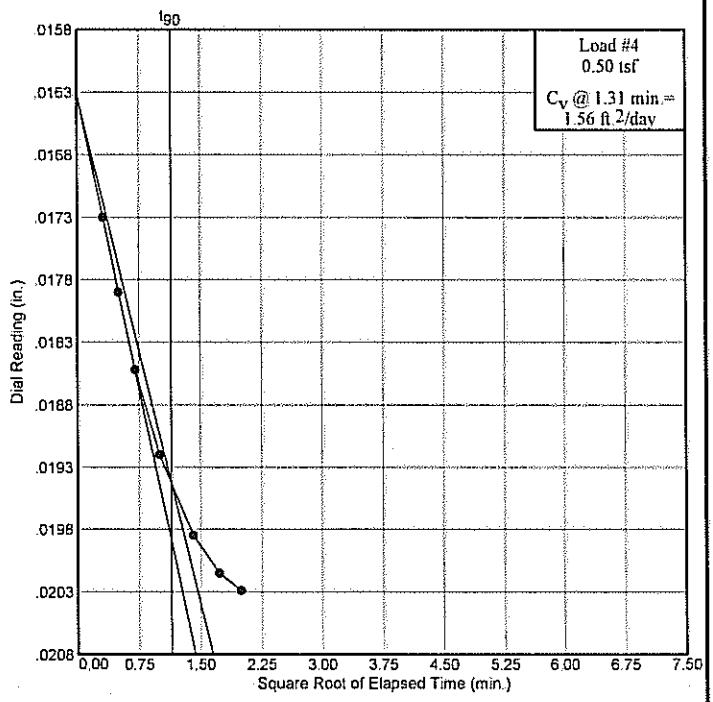
Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility
Job No.: 06-2154
Source: B-12 Sample No.: S-27 Elev./Depth: 100.6'-100.7'









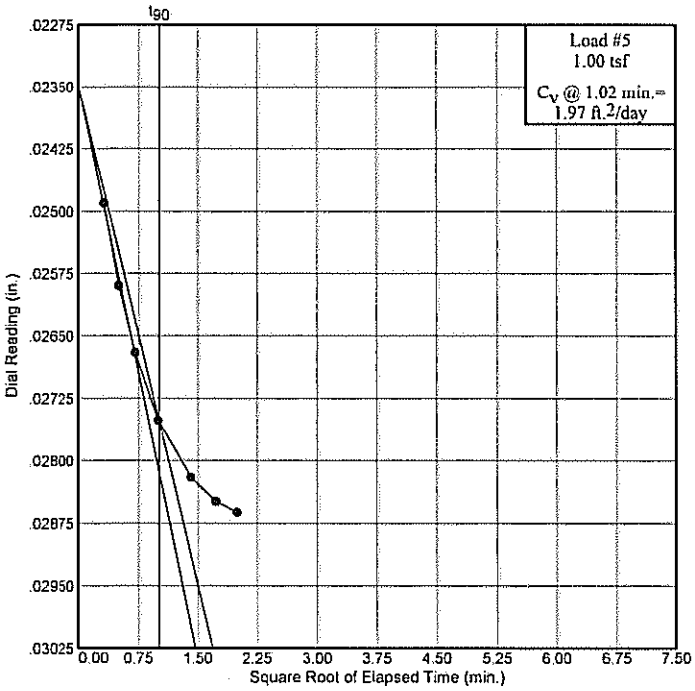
Dial Reading vs. Time

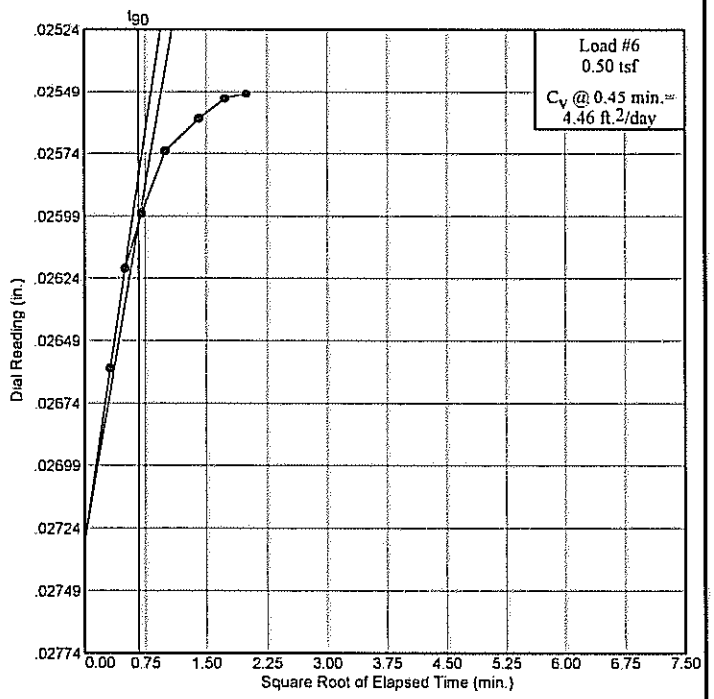
SOIL TECHNOLOGY

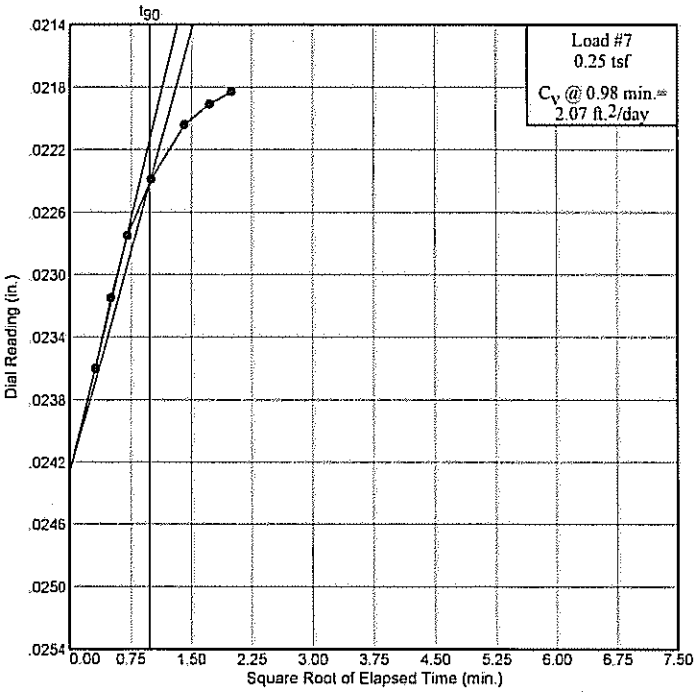
Figure

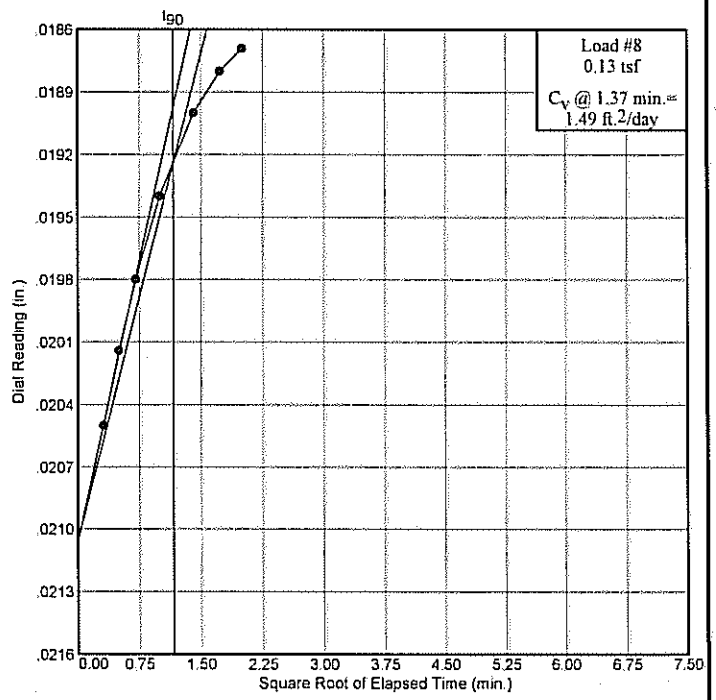
Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility
Job No.: 06-2154
Source: B-12 Sample No.: S-27 Elev./Depth: 100.6'-100.7'









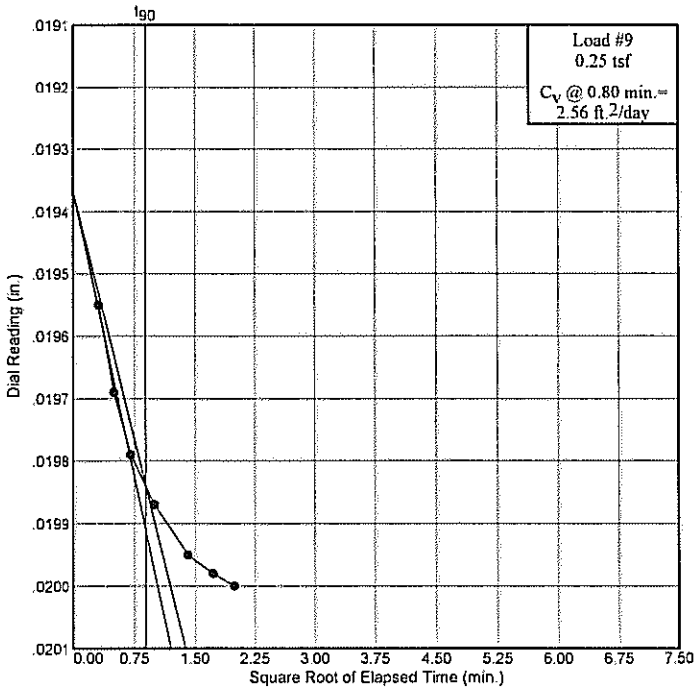
Dial Reading vs. Time

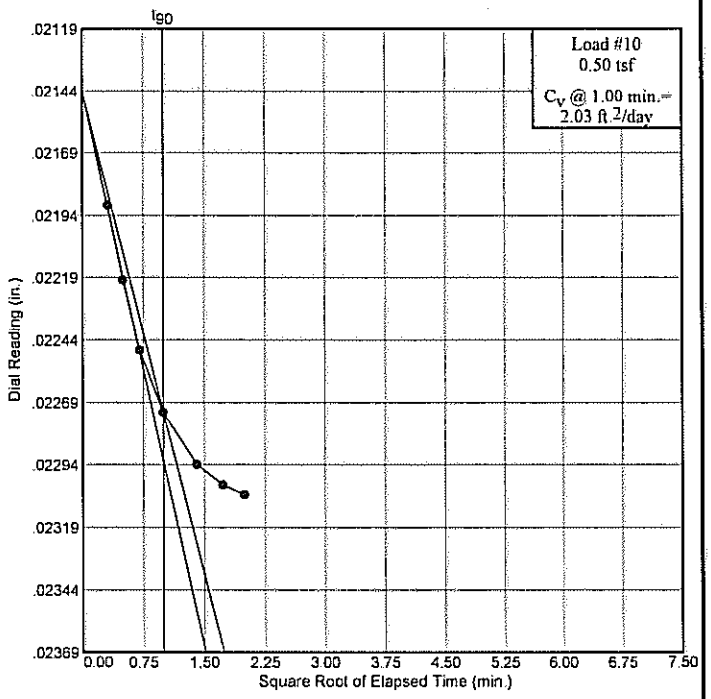
SOIL TECHNOLOGY

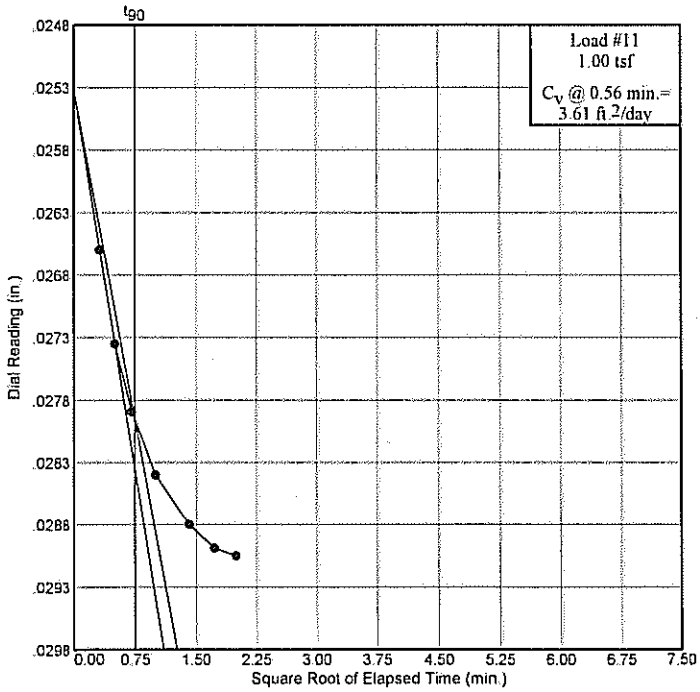
Figure

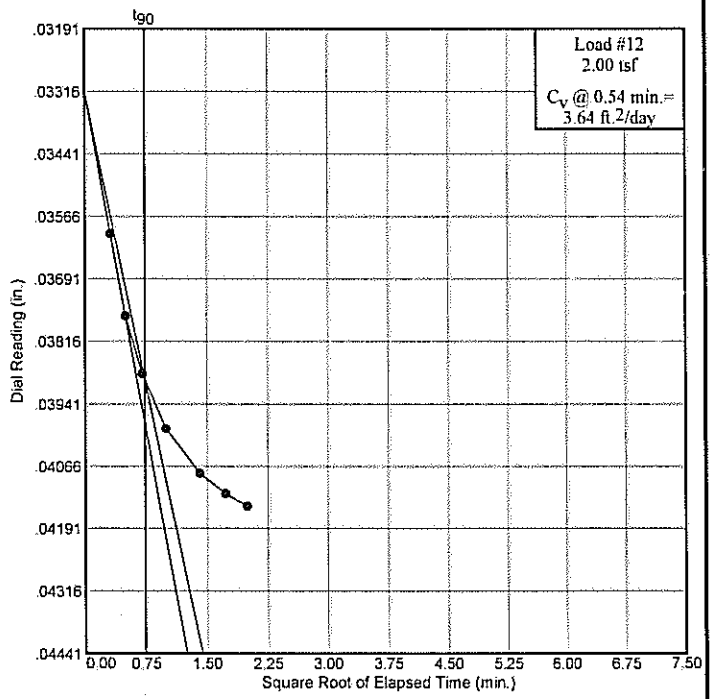
Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility
Job No.: 06-2154
Source: B-12 Sample No.: S-27 Elev./Depth: 100.6'-100.7'









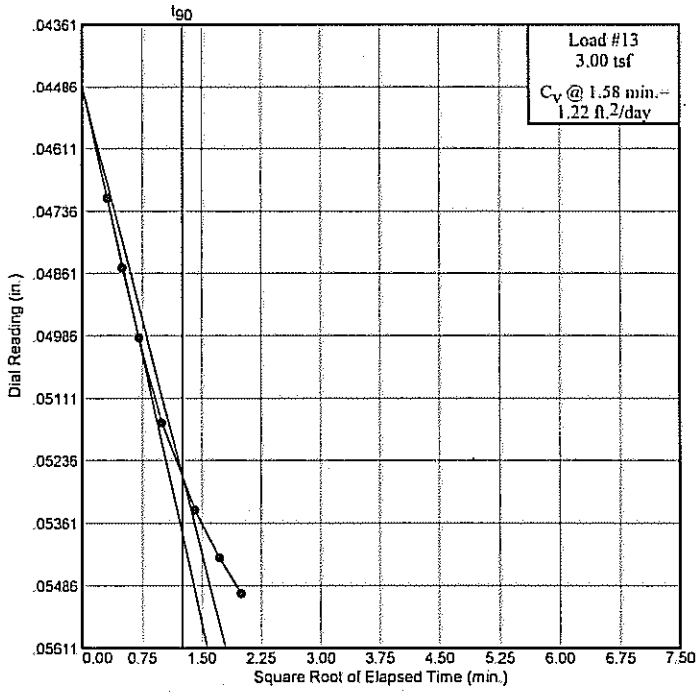
Dial Reading vs. Time

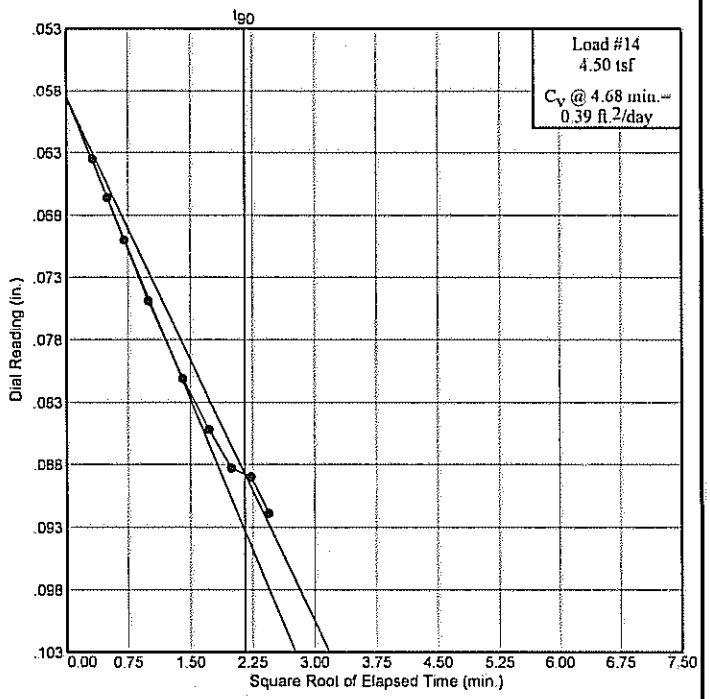
SOIL TECHNOLOGY

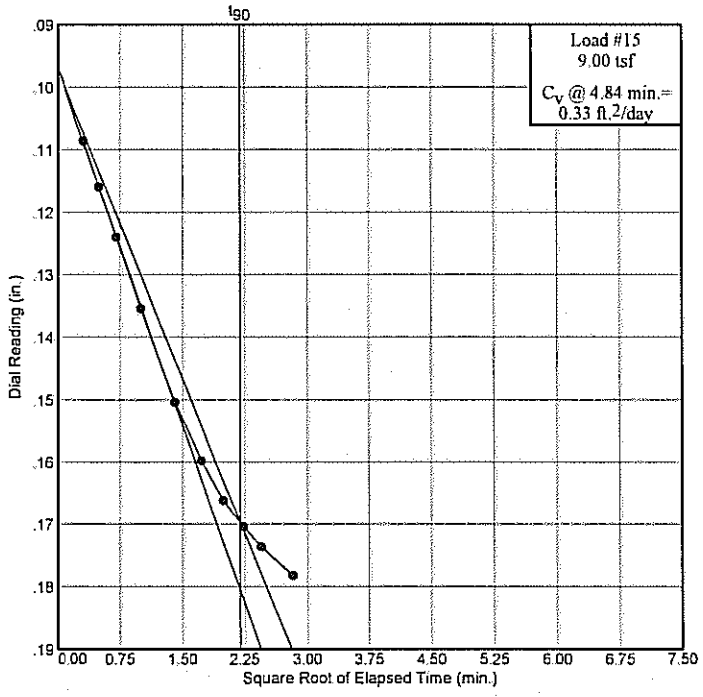
Figure

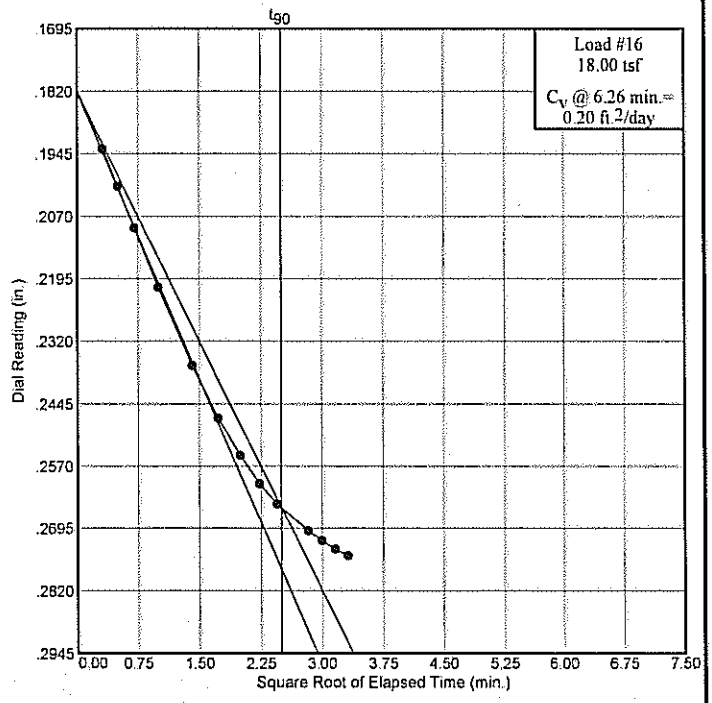
Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility
Job No.: 06-2154
Source: B-12 Sample No.: S-27 Elev./Depth: 100.6'-100.7'









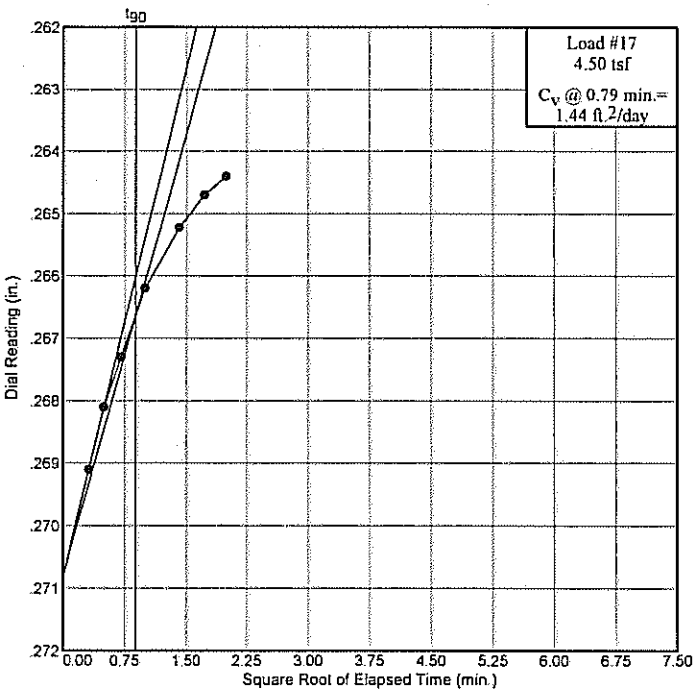
Dial Reading vs. Time

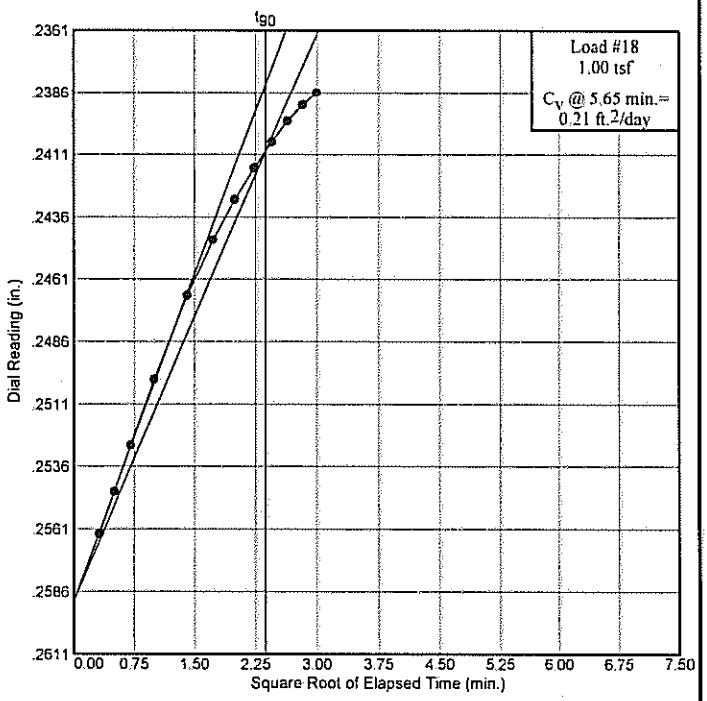
SOIL TECHNOLOGY

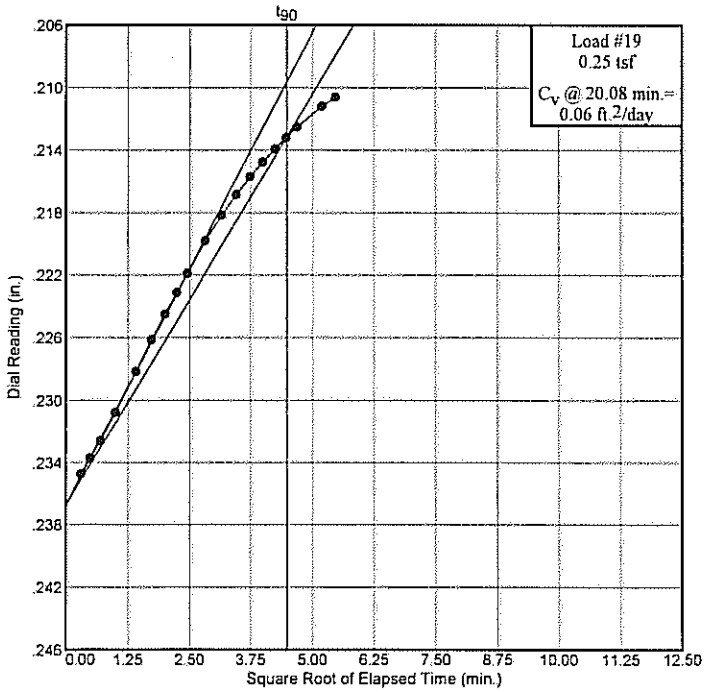
Figure

Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility
Job No.: 06-2154
Source: B-12 Sample No.: S-27 Elev./Depth: 100.6'-100.7'



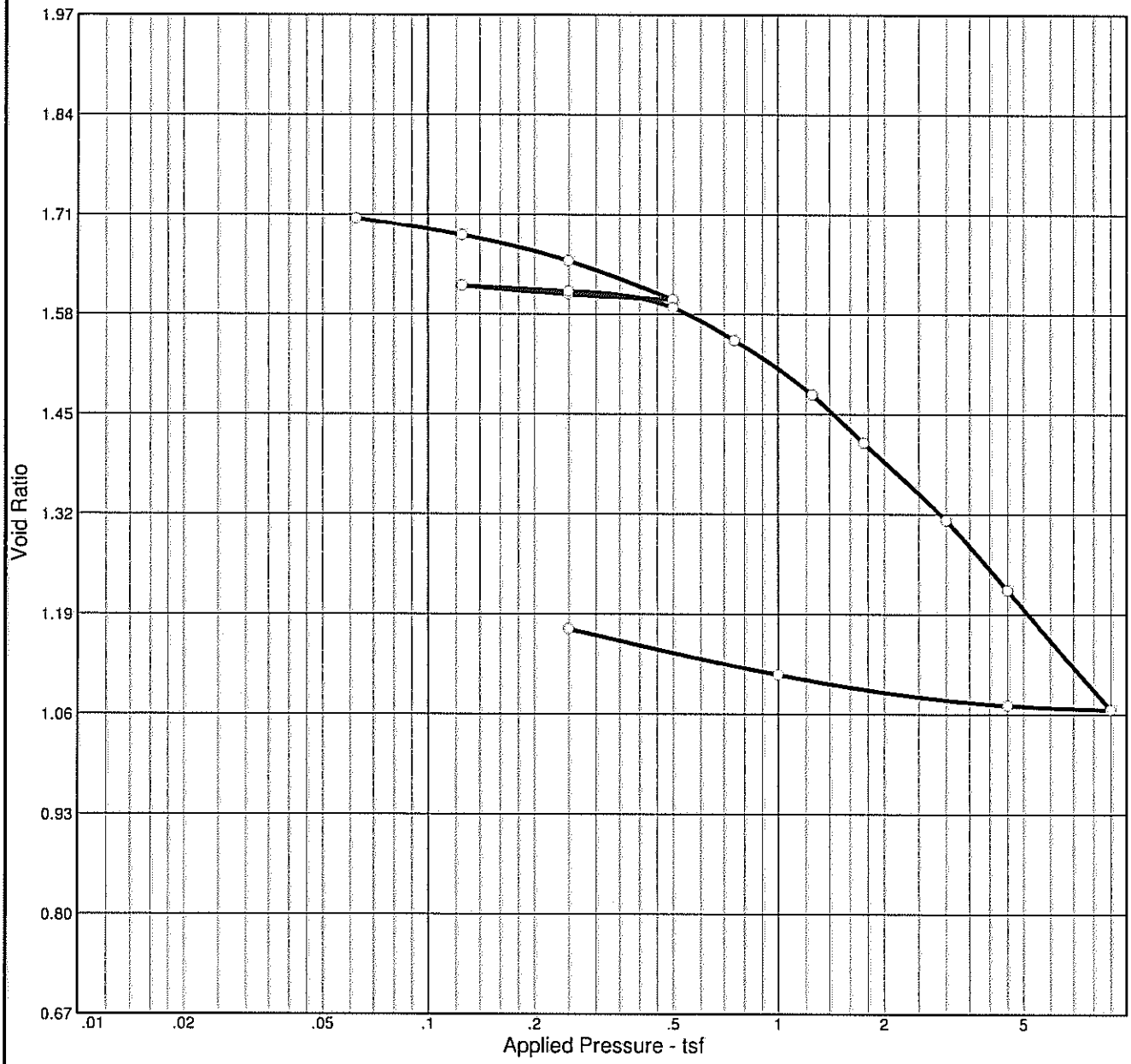




Dial Reading vs. Time

SOIL TECHNOLOGY

Figure



Natural		Dry Dens.	LL	PI	Sp. Gr.	Overburden	P_c	C_c	Initial Void Ratio
Saturation	Moisture								
98.4 %	64.3 %	60.5	73	34	2.65		1.15	0.51	1.733

MATERIAL DESCRIPTION	USCS	AASHTO
Very soft,wet,grey Silt MH with fine sand lenses (laminated)	MH	---

Project No. **Client:**

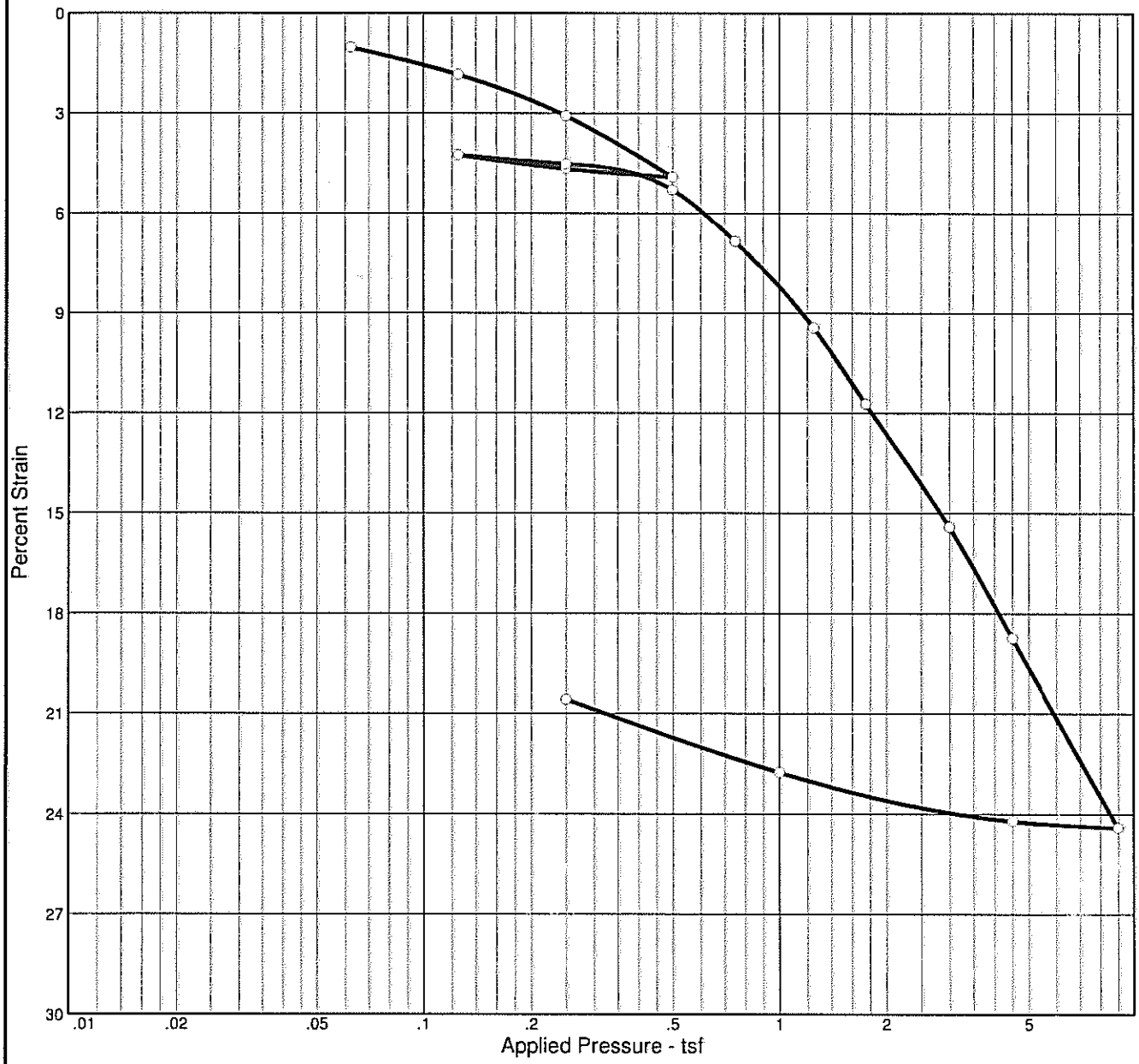
Project:

Source: B-13 **Sample No.:** S-6 **Elev./Depth:** 16.6-16.7 ft.

Remarks:
Very soft,wet,grey Silt MH
Laminated with fine sand lenses

CONSOLIDATION TEST REPORT

SOIL TECHNOLOGY



Natural Saturation	Natural Moisture	Dry Dens.	LL	PI	Sp. Gr.	Overburden	P_c	C_c	Initial Void Ratio
98.4 %	64.3 %	60.5	73	34	2.65		1.15	0.51	1.733

MATERIAL DESCRIPTION	USCS	AASHTO
Very soft,wet,grey Silt MH with fine sand lenses (laminated)	MH	---

Project No. **Client:**

Project:

Source: B-13 **Sample No.:** S-6 **Elev./Depth:** 16.6-16.7 ft.

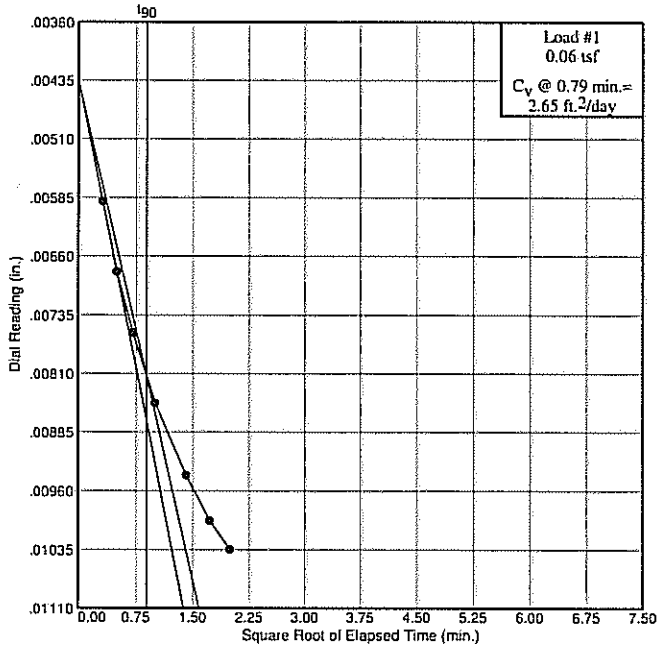
Remarks:
Very soft,wet,grey Silt MH
Laminated with fine sand lenses

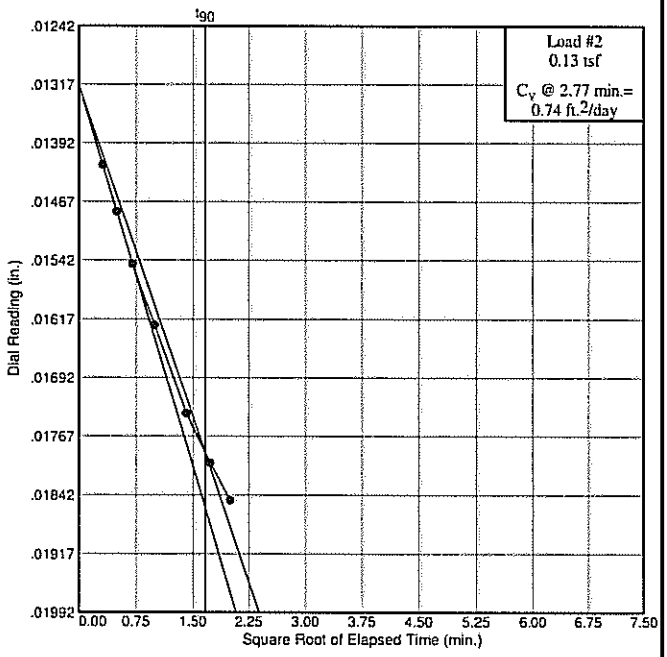
CONSOLIDATION TEST REPORT

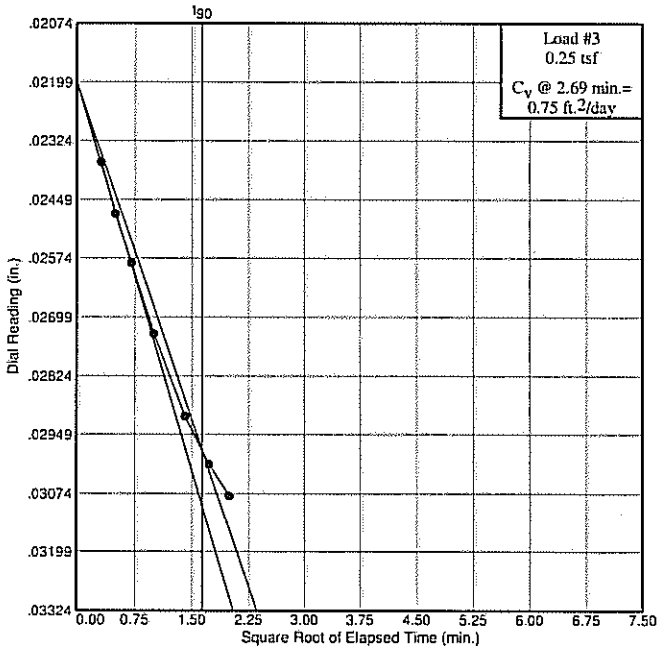
SOIL TECHNOLOGY

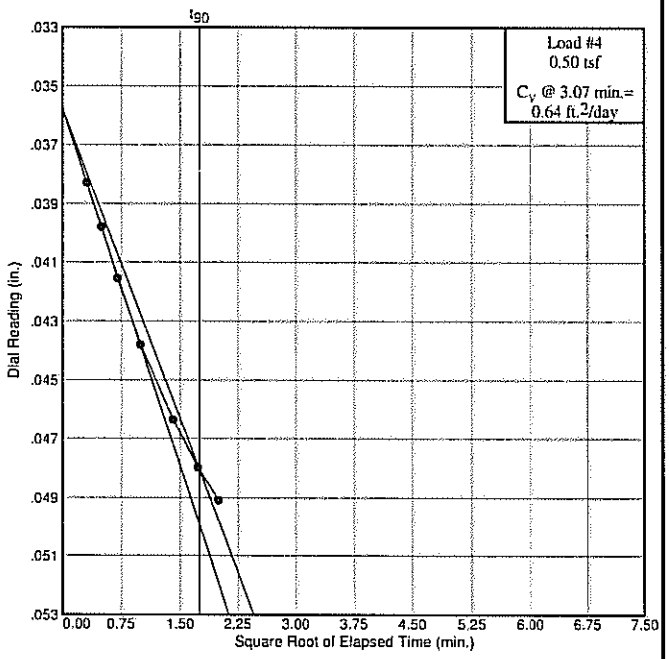
Project No.:
Project:

Source: B-13 Sample No.: S-6 Elev./Depth: 16.6-16.7 ft.







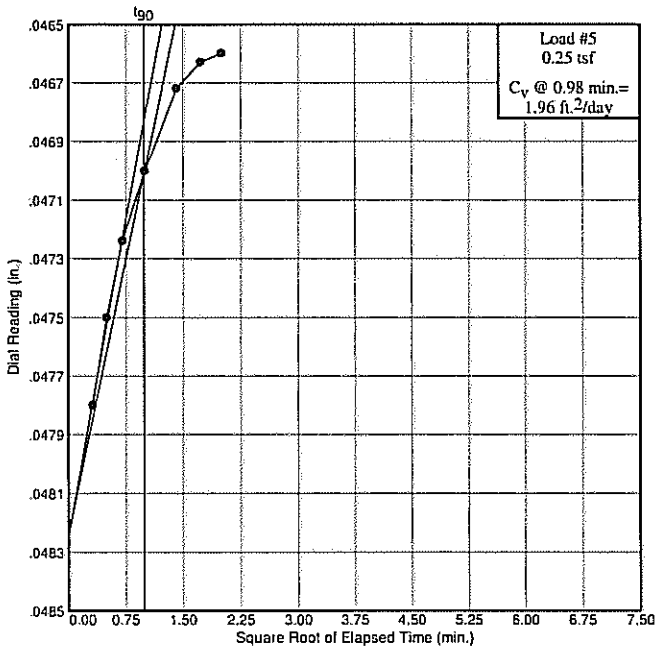


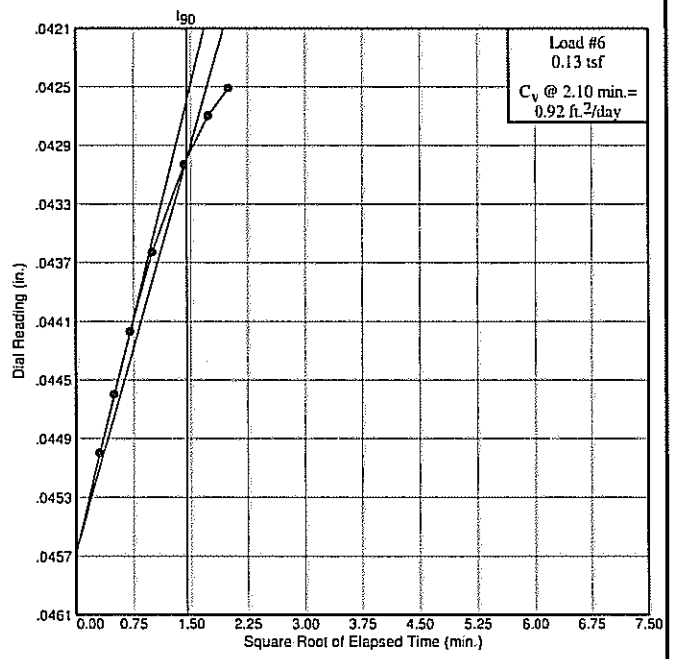
Dial Reading vs. Time

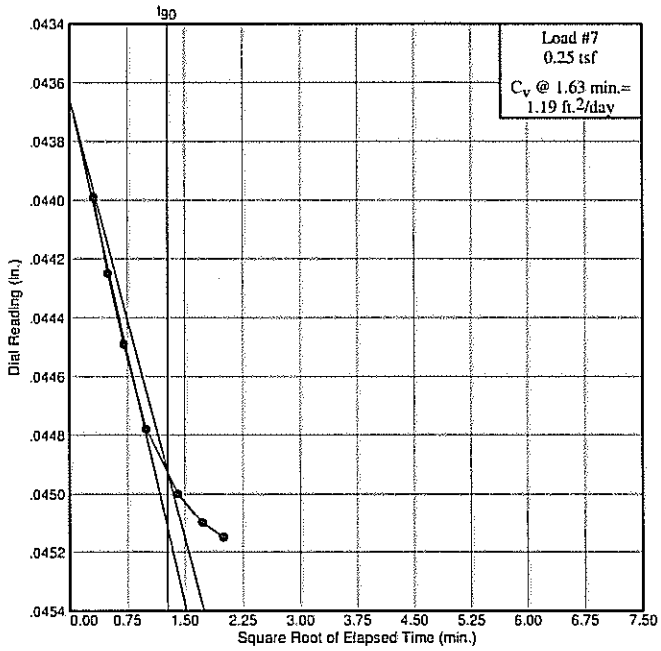
SOIL TECHNOLOGY

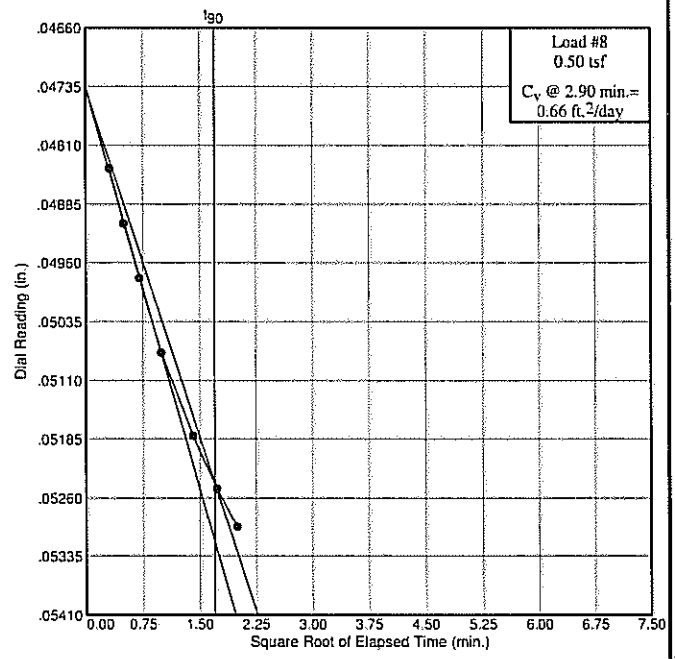
Project No.:
Project:

Source: B-13 Sample No.: S-6 Elev./Depth: 16.6-16.7 ft.







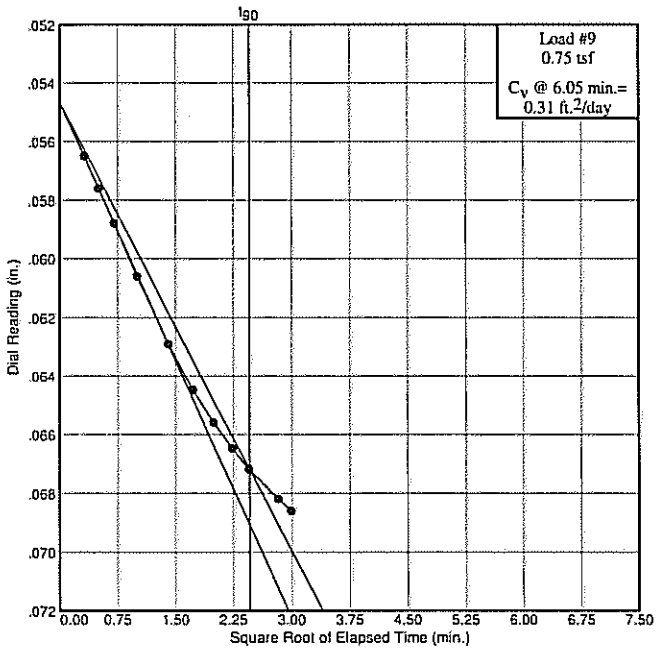


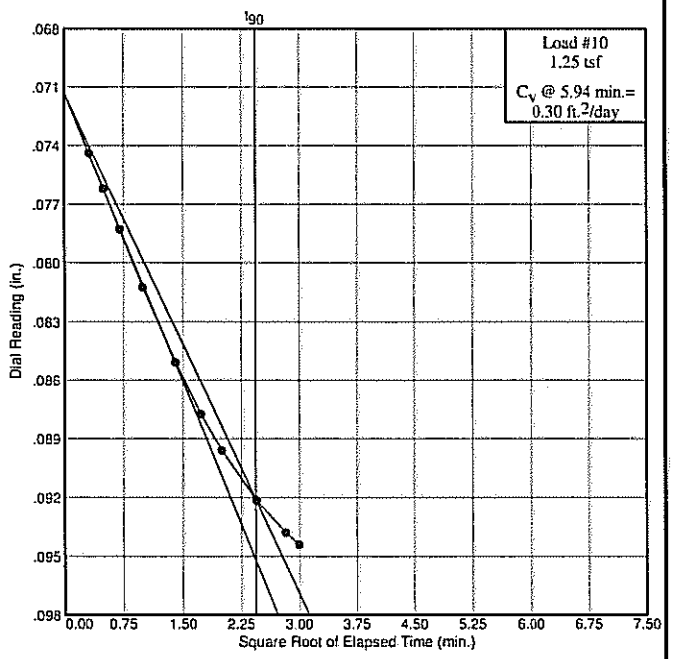
Dial Reading vs. Time

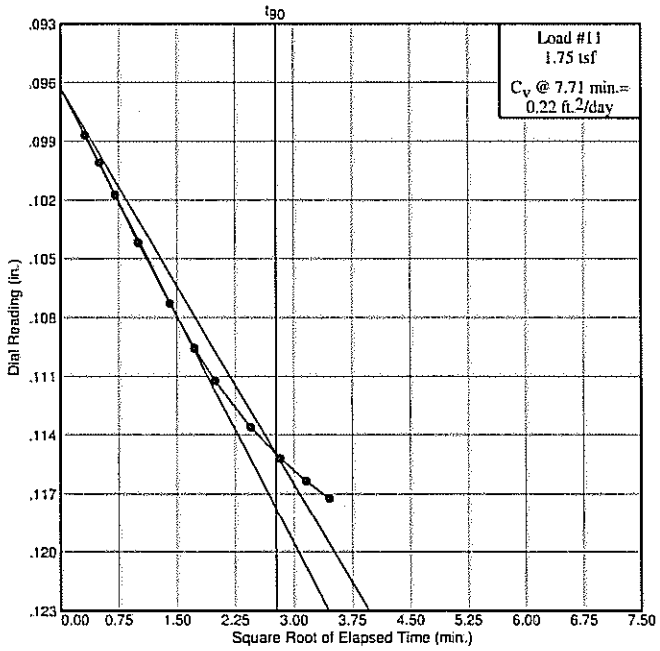
SOIL TECHNOLOGY

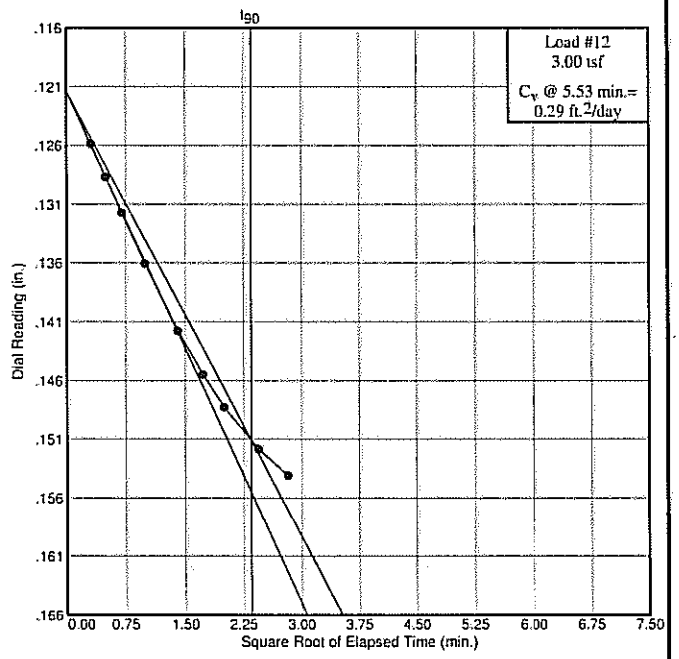
Project No.:
Project:

Source: B-13 Sample No.: S-6 Elev./Depth: 16.6-16.7 ft.







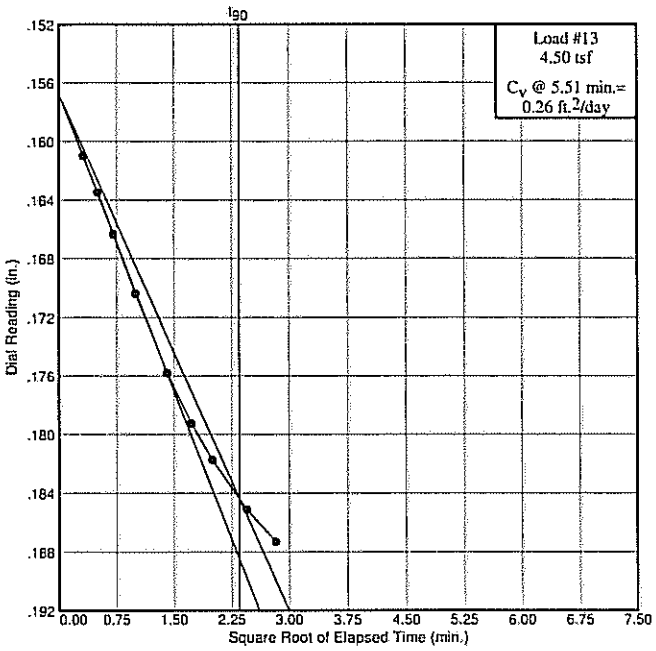


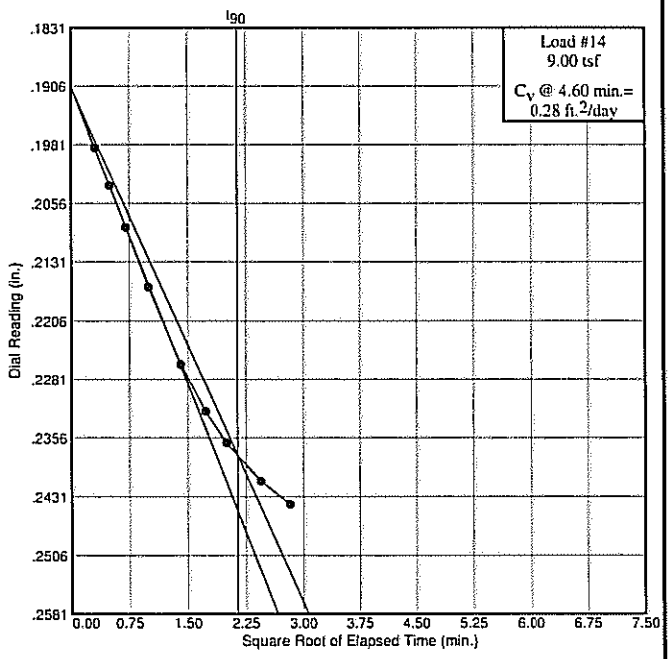
Dial Reading vs. Time

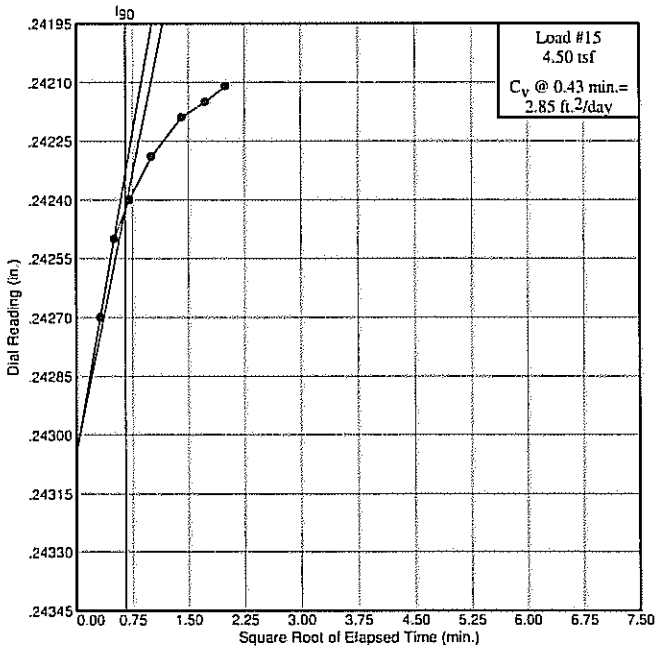
SOIL TECHNOLOGY

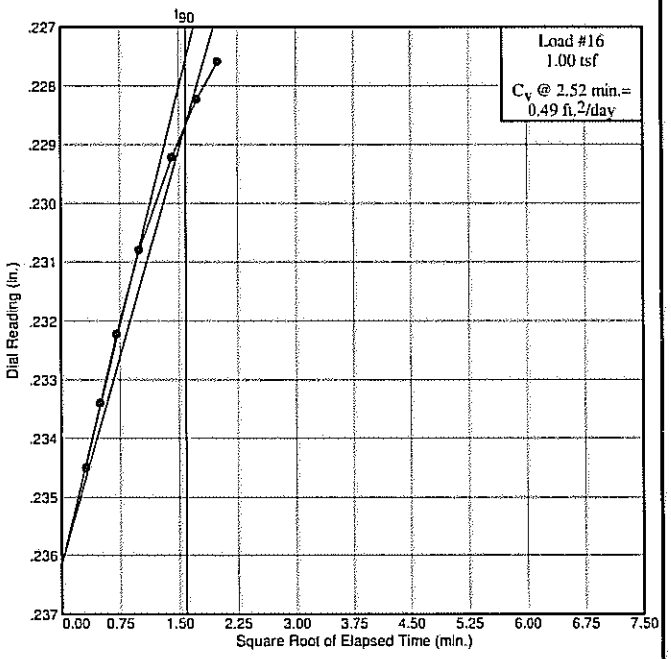
Project No.:
Project:

Source: B-13 Sample No.: S-6 Elev./Depth: 16.6-16.7 ft.







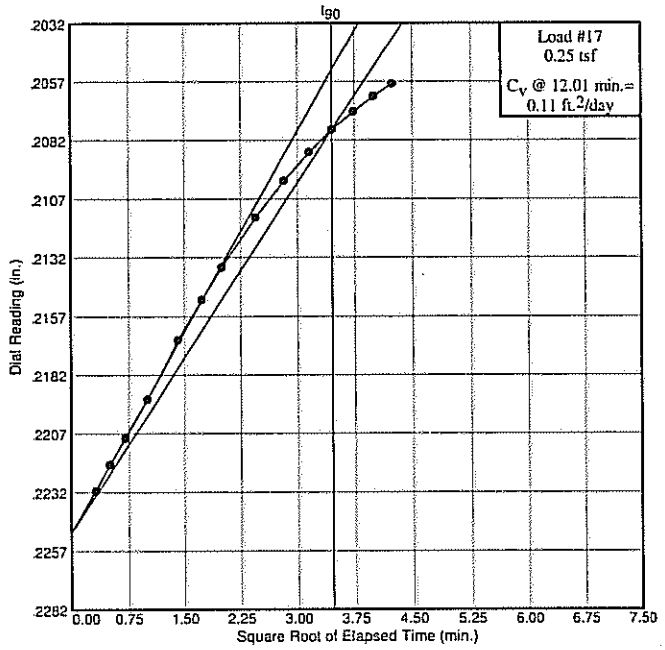


Dial Reading vs. Time

SOIL TECHNOLOGY

Project No.:
Project:

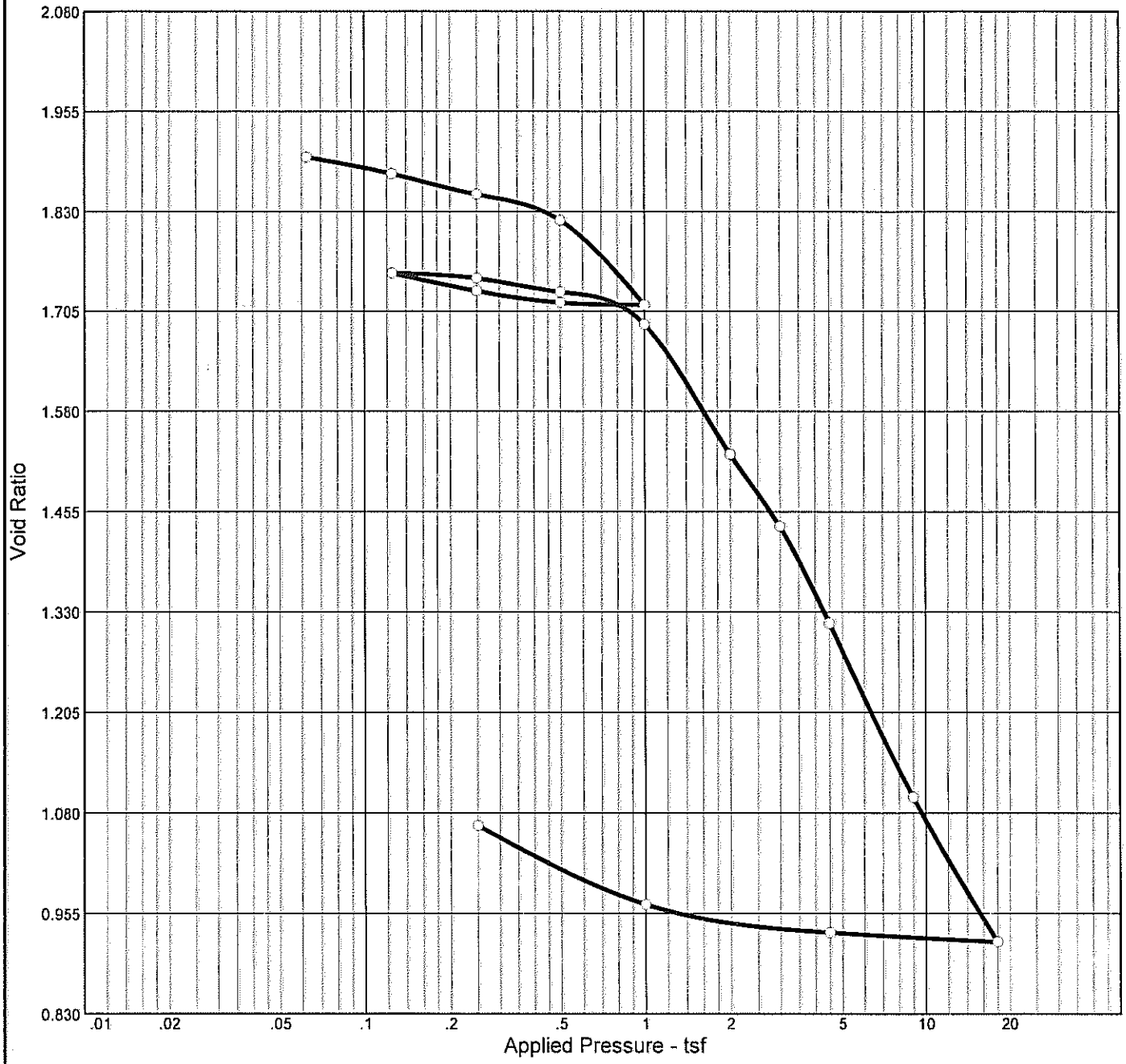
Source: B-13 Sample No.: S-6 Elev./Depth: 16.6-16.7 ft.



Dial Reading vs. Time

SOIL TECHNOLOGY

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture								
100.1 %	72.3 %	56.8	76	34	2.65		0.78	0.64	1.914

MATERIAL DESCRIPTION	USCS	AASHTO
Very soft,wet,grey elastic Silt	MH	---

Project No. 244039.020 **Client:** Landau Associates, Inc.

Project: WSDOT Special Projects Facility
Job No.: 06-2154

Source: B-15 **Sample No.:** S-8 **Elev./Depth:** 23.3'-23.4'

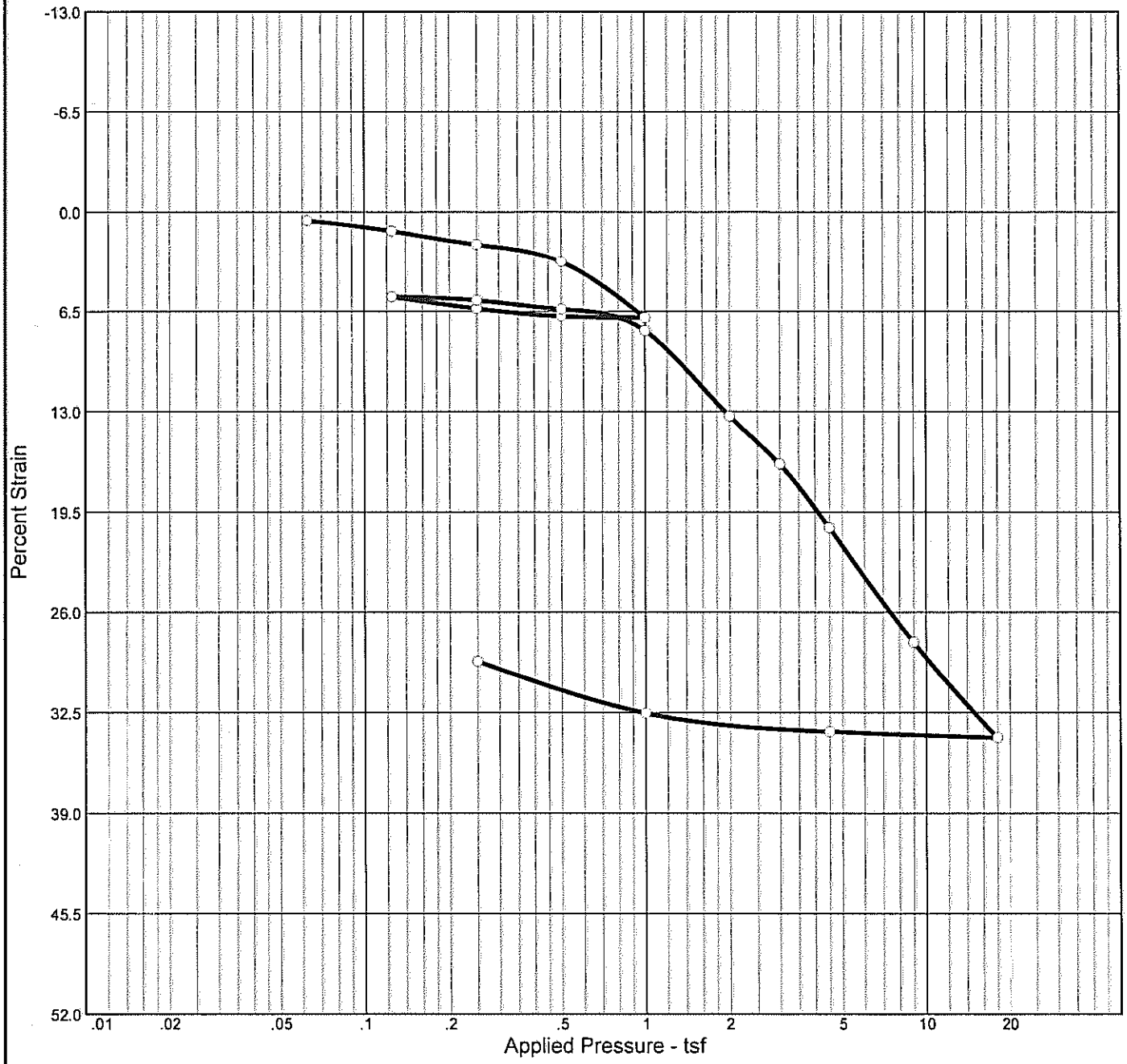
Remarks:
Very soft,wet,grey,elastic Silt

CONSOLIDATION TEST REPORT

SOIL TECHNOLOGY

Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture								
100.1 %	72.3 %	56.8	76	34	2.65		1.91	0.59	1.914

MATERIAL DESCRIPTION	USCS	AASHTO
Very soft,wet,grey elastic Silt	MH	---

Project No. 244039.020 **Client:** Landau Associates, Inc.

Project: WSDOT Special Projects Facility
Job No.: 06-2154

Source: B-15 **Sample No.:** S-8 **Elev./Depth:** 23.3'-23.4'

Remarks:
Very soft,wet,grey,elastic Silt

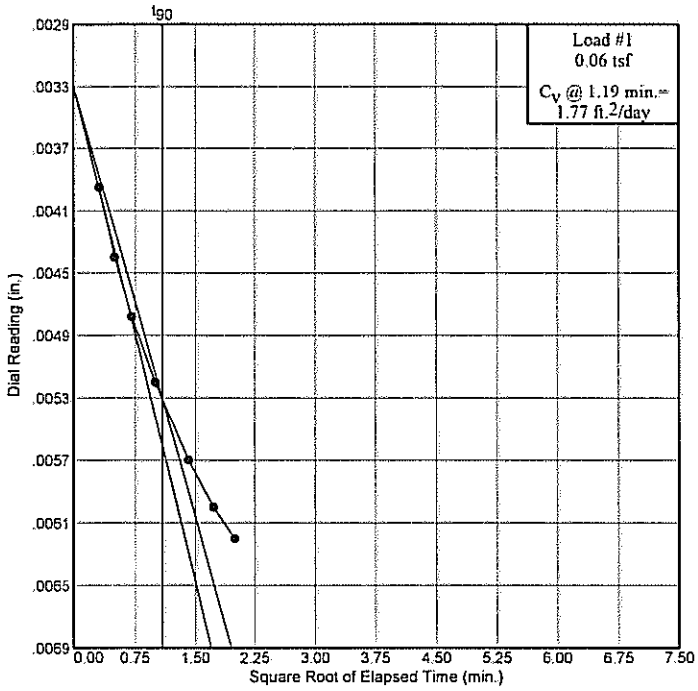
CONSOLIDATION TEST REPORT

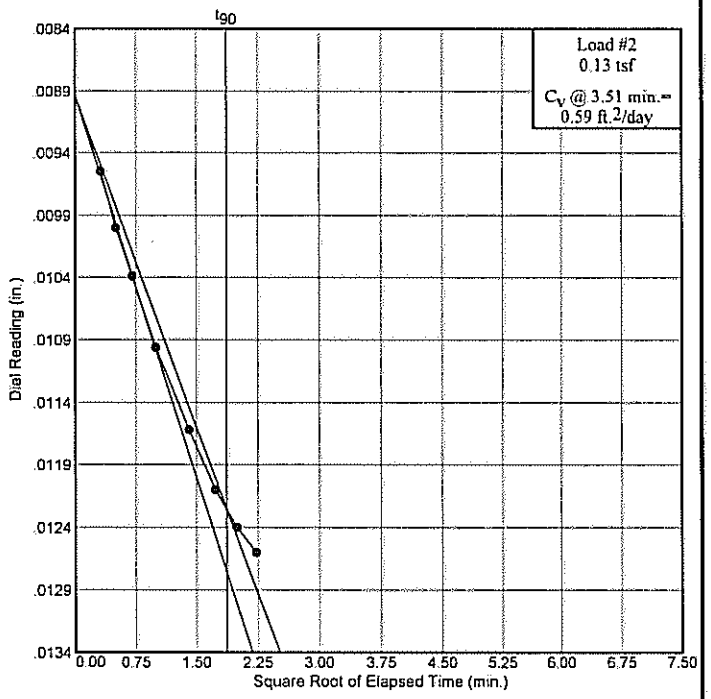
SOIL TECHNOLOGY

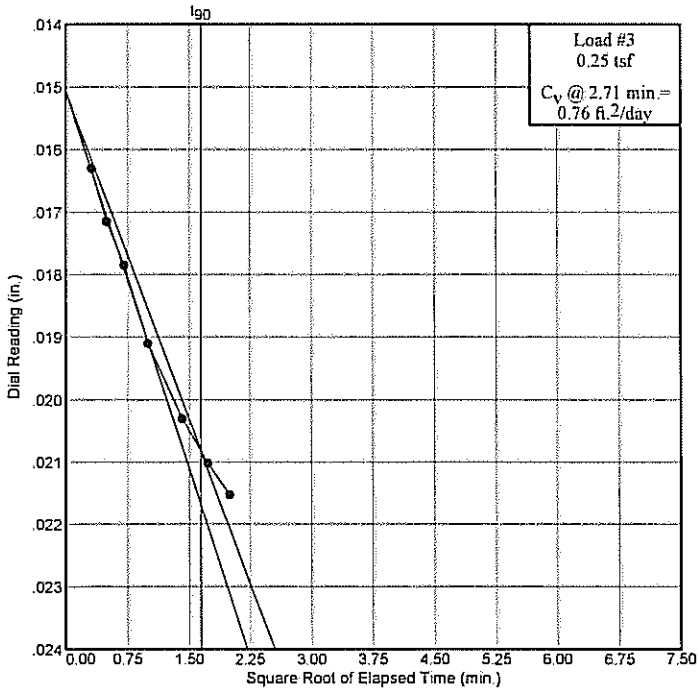
Figure

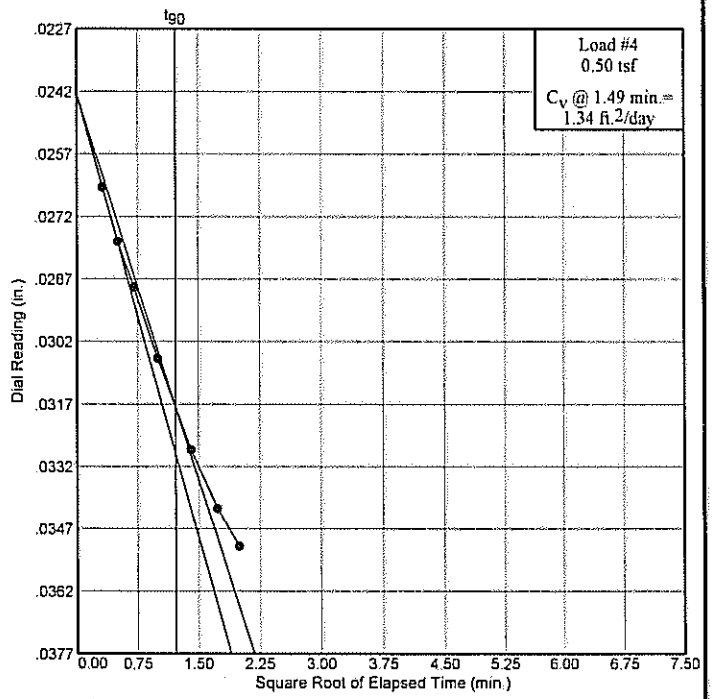
Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility
Job No.: 06-2154
Source: B-15 Sample No.: S-8 Elev./Depth: 23.3'-23.4'









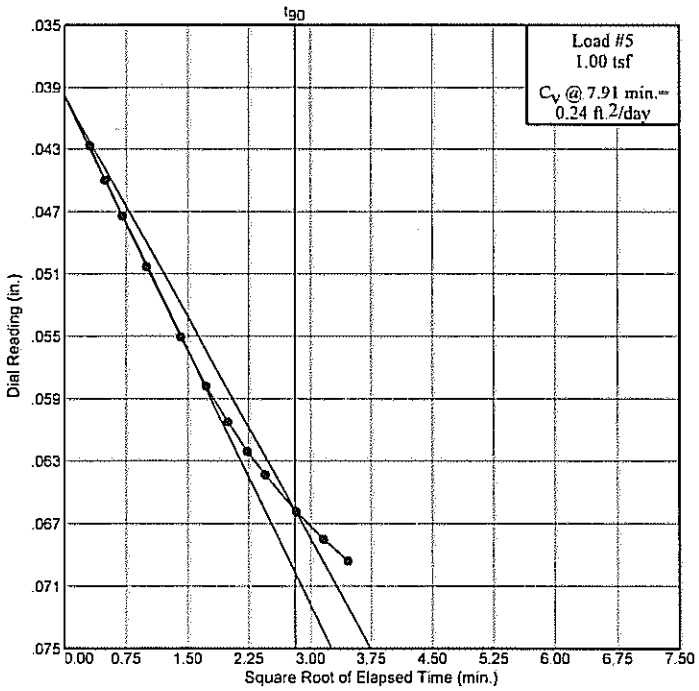
Dial Reading vs. Time

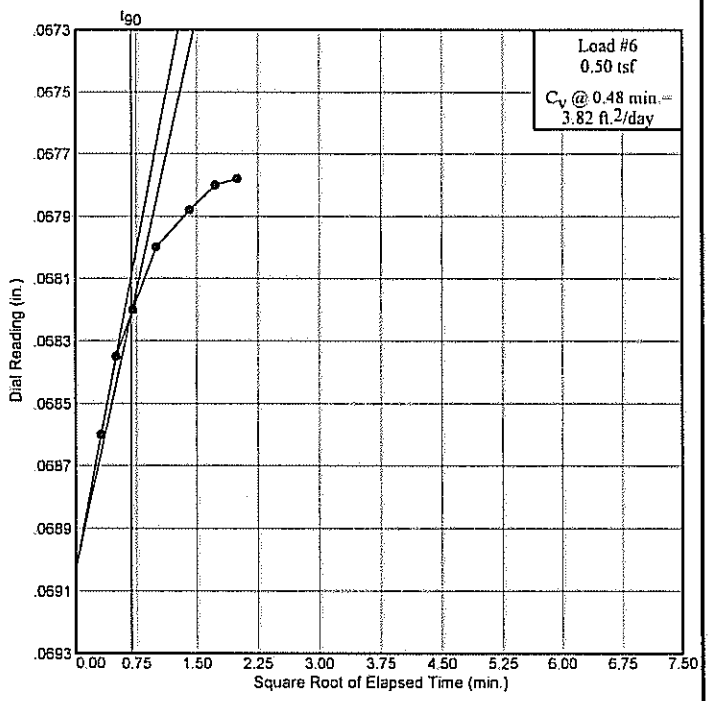
SOIL TECHNOLOGY

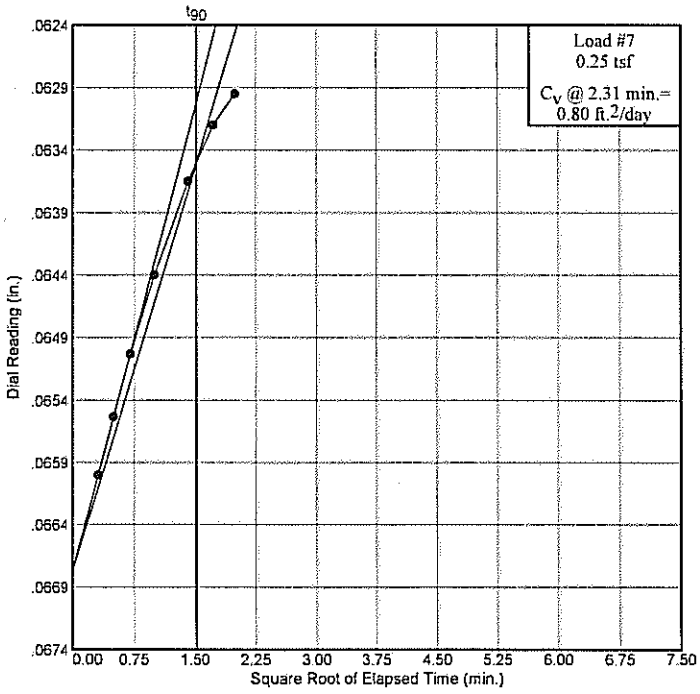
Figure

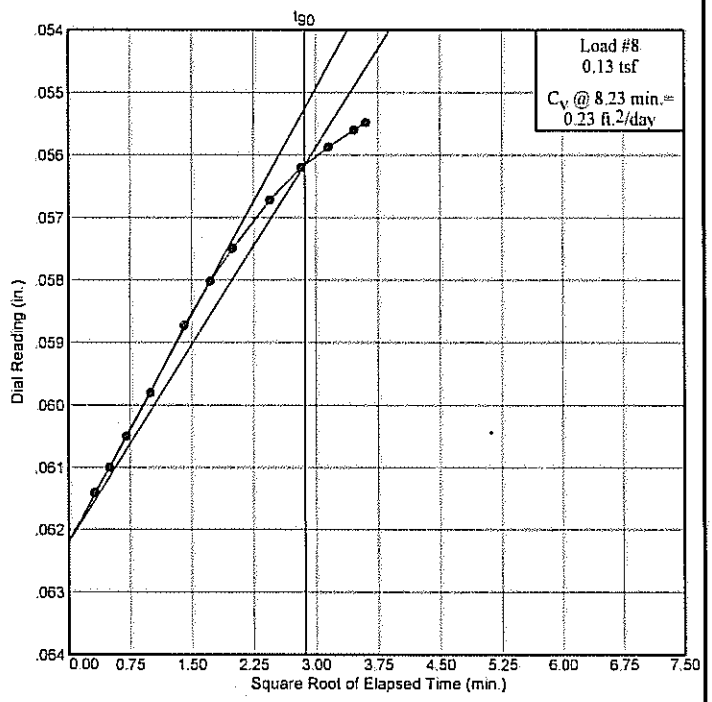
Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility
Job No.: 06-2154
Source: B-15 Sample No.: S-8 Elev./Depth: 23.3'-23.4'









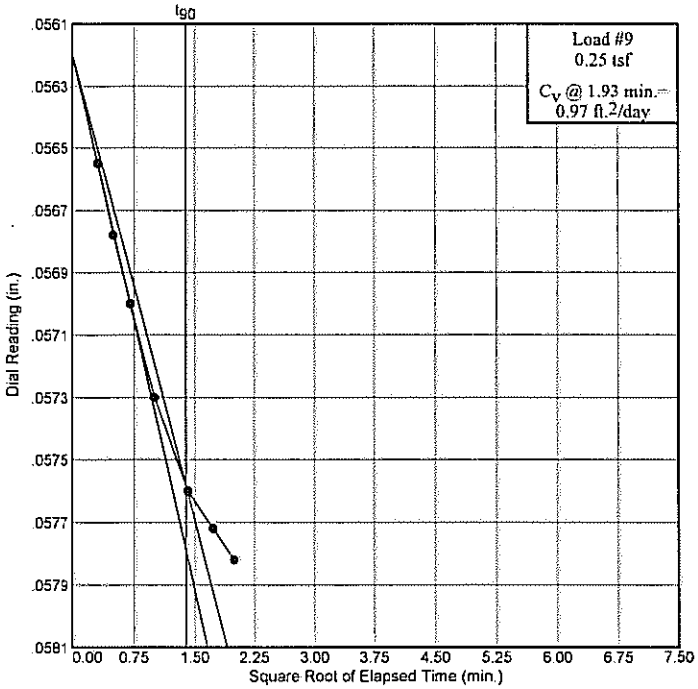
Dial Reading vs. Time

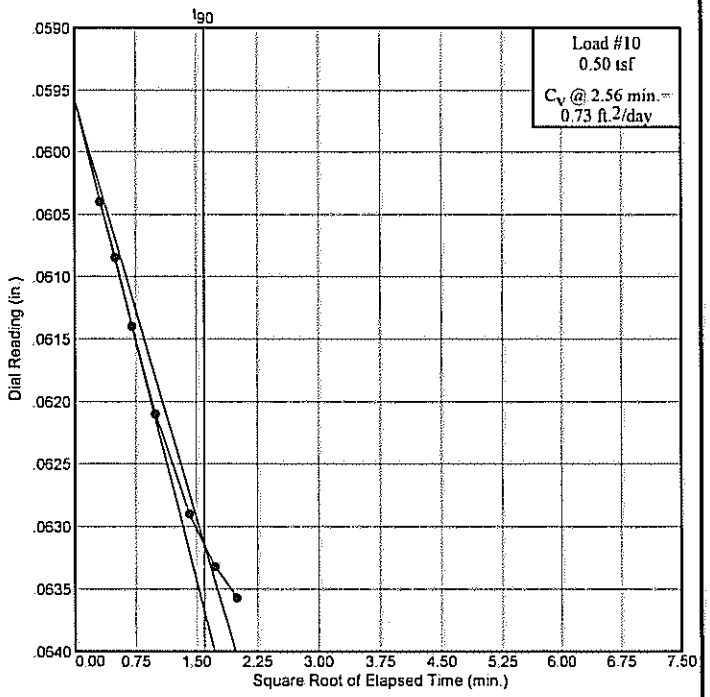
SOIL TECHNOLOGY

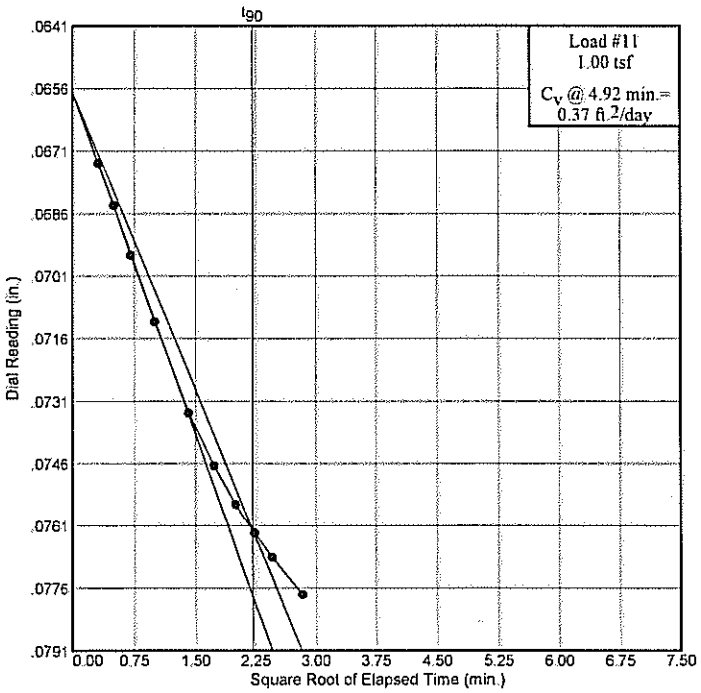
Figure

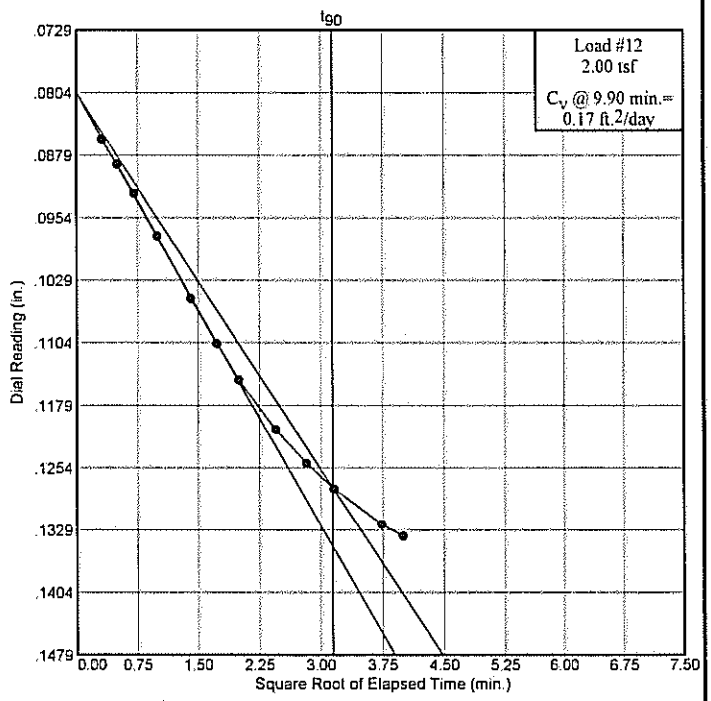
Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility
Job No.: 06-2154
Source: B-15 Sample No.: S-8 Elev./Depth: 23.3'-23.4'









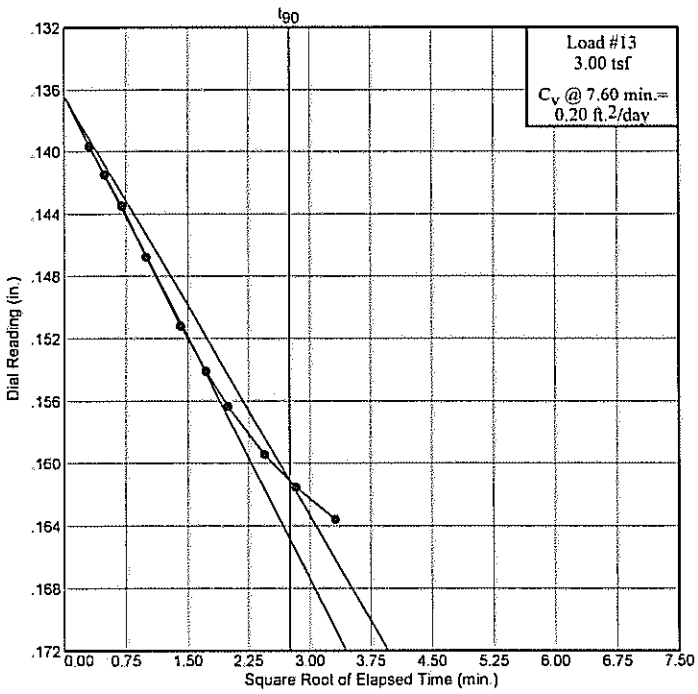
Dial Reading vs. Time

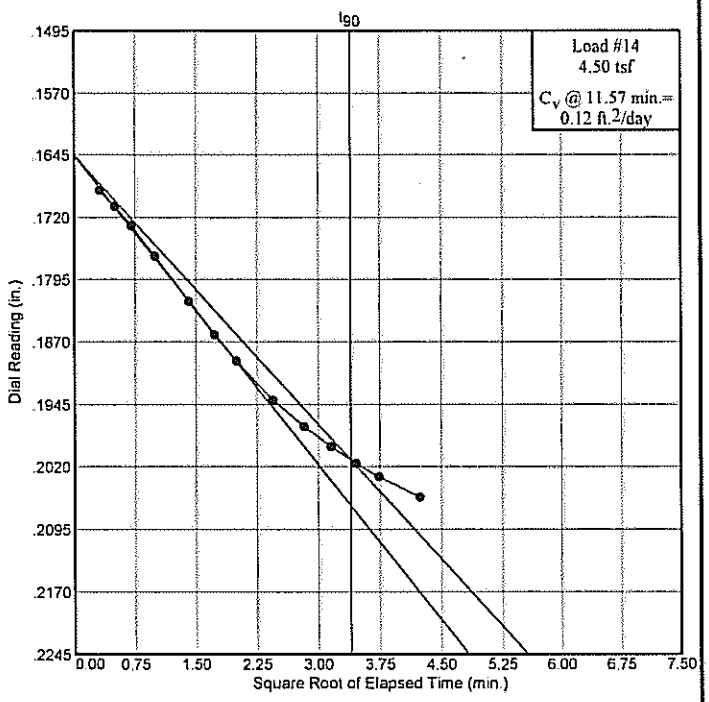
SOIL TECHNOLOGY

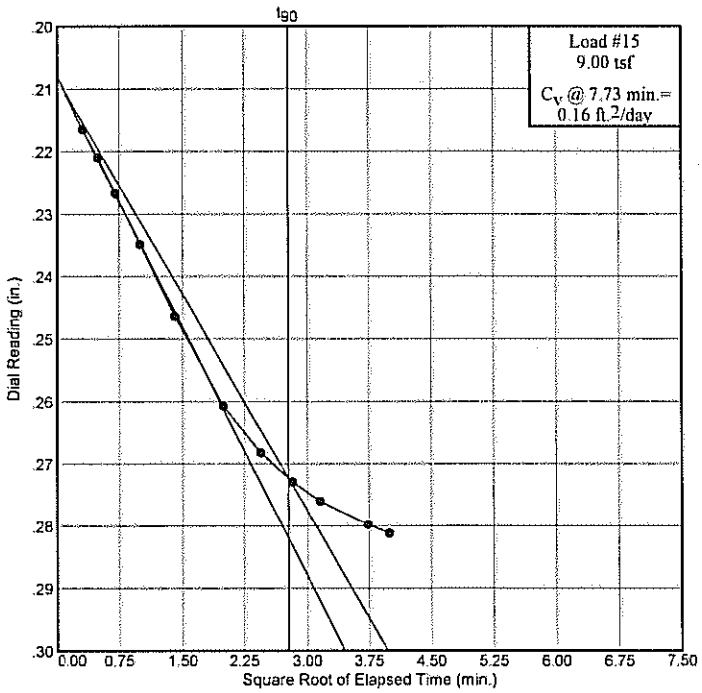
Figure

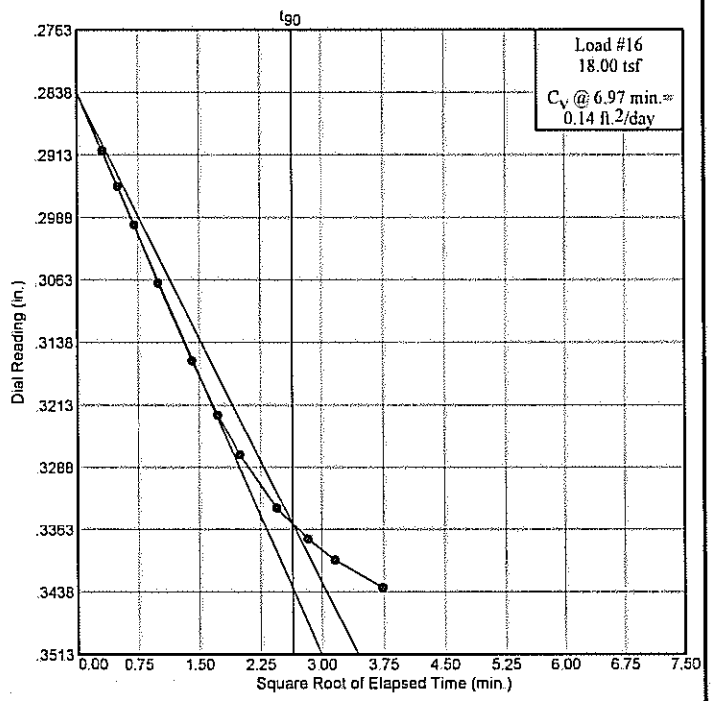
Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility
Job No.: 06-2154
Source: B-15 Sample No.: S-8 Elev./Depth: 23.3'-23.4'









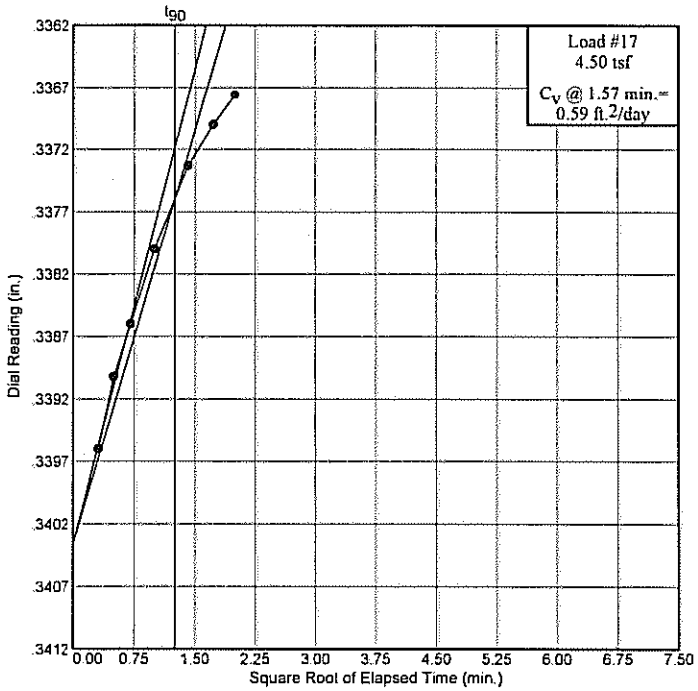
Dial Reading vs. Time

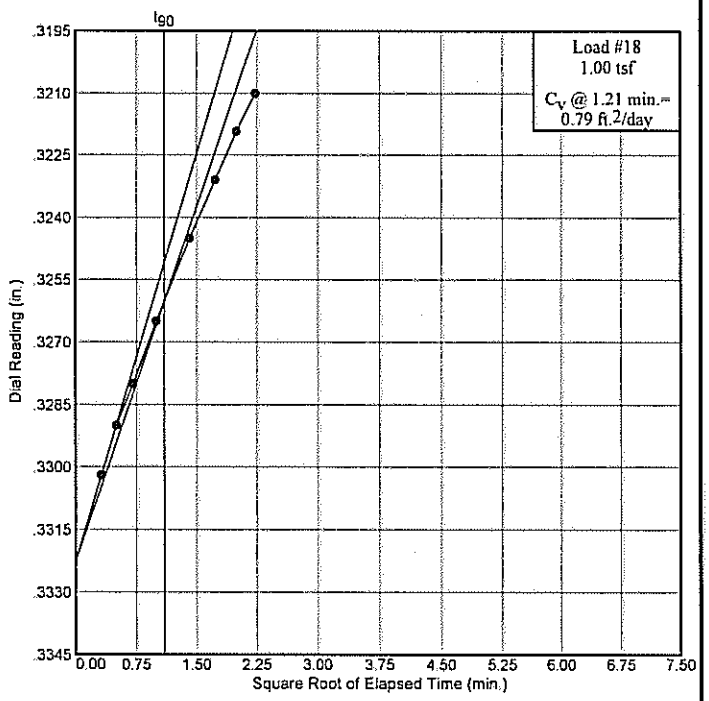
SOIL TECHNOLOGY

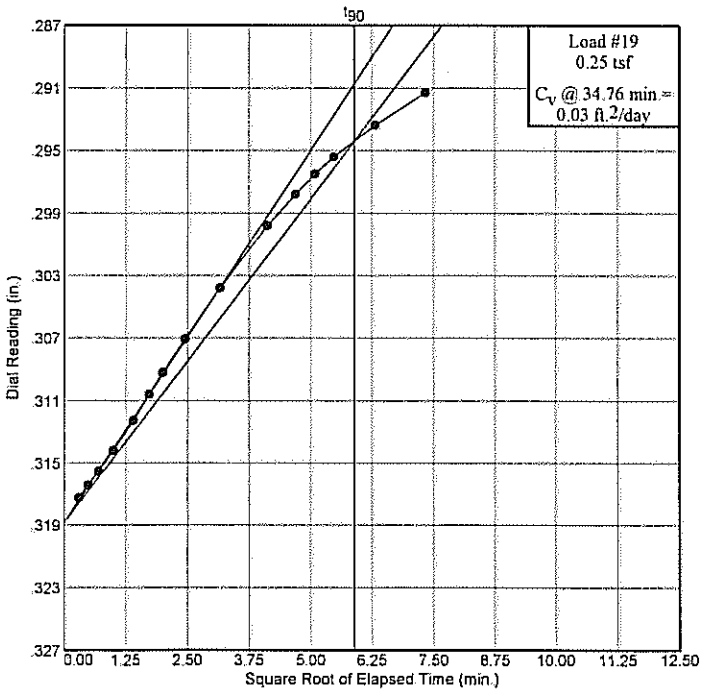
Figure

Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility
Job No.: 06-2154
Source: B-15 Sample No.: S-8 Elev./Depth: 23.3'-23.4'





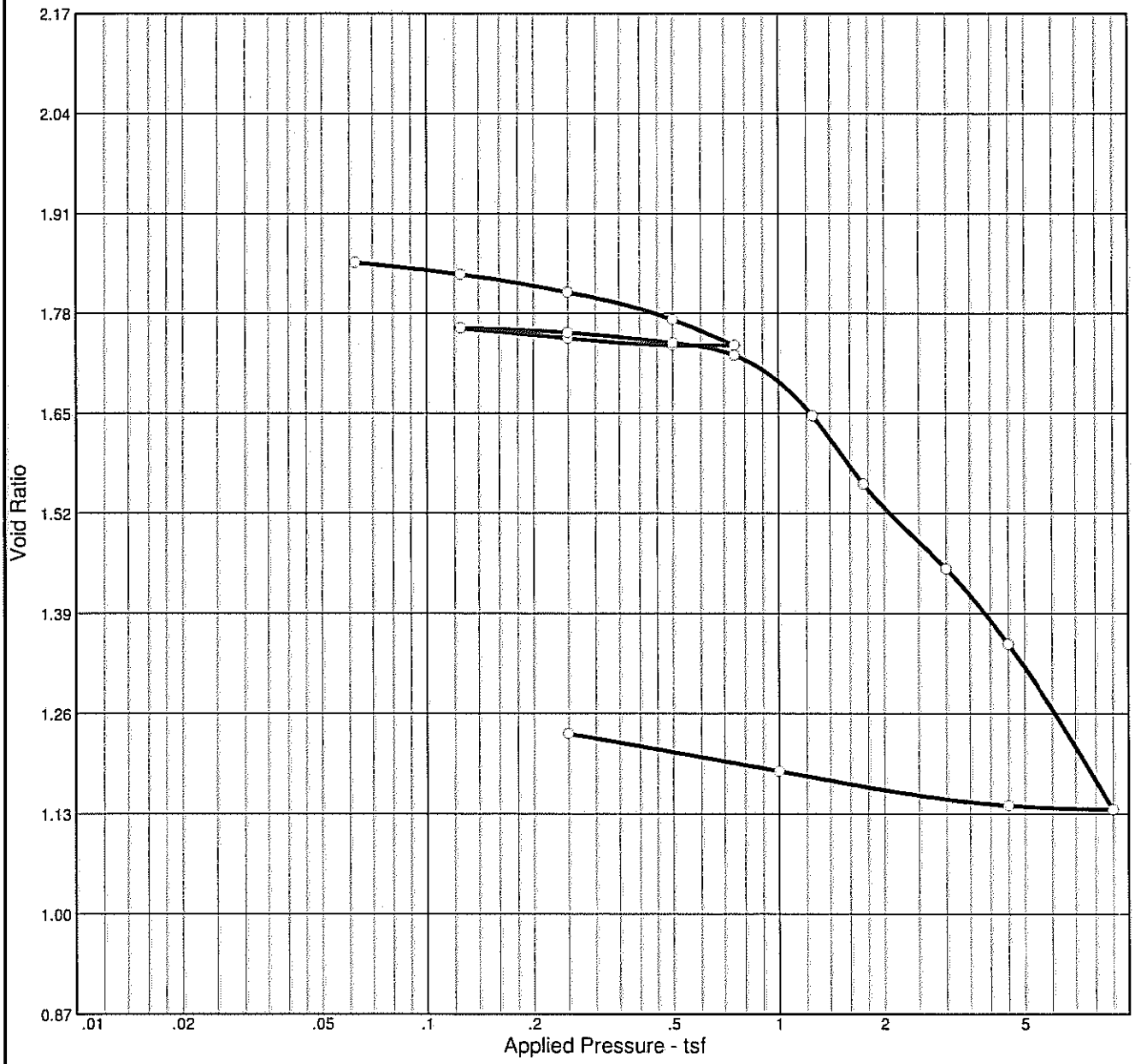


Dial Reading vs. Time

SOIL TECHNOLOGY

Figure

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture								
99.7 %	70.3 %	57.7	71	29	2.65		0.92	0.58	1.869

MATERIAL DESCRIPTION	USCS	AASHTO
	MH	----

Project No. 244039.020 **Client:** Landau Associates, Inc.

Project: WSDOT Special Projects Facility

Source: B-16 **Sample No.:** S-7 **Elev./Depth:** 20.8=20.9 ft.

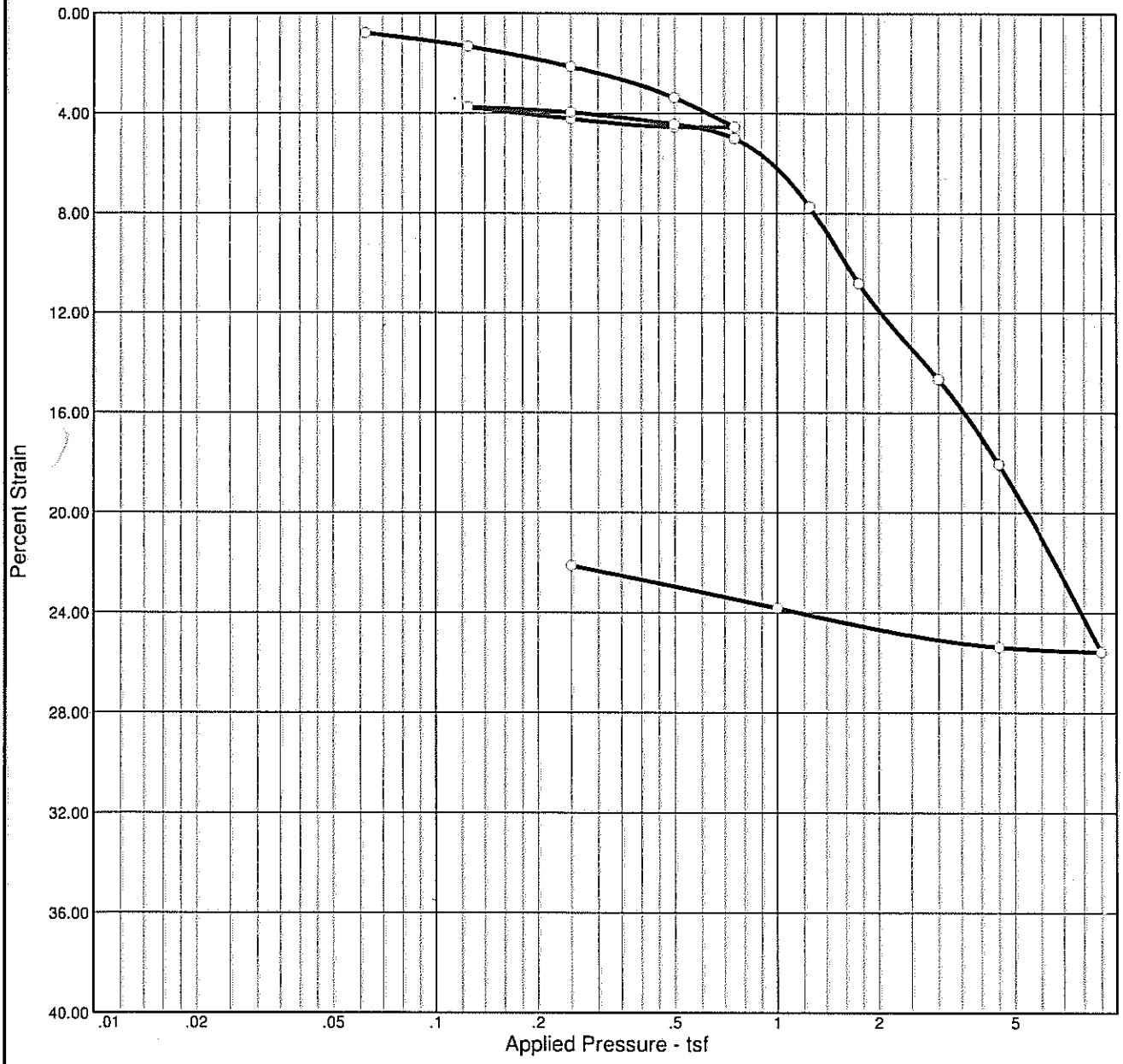
Remarks:
Soft,wet,grey, elastic Silt

CONSOLIDATION TEST REPORT

SOIL TECHNOLOGY

Figure 3

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture								
99.7 %	70.3 %	57.7	71	29	2.65		0.92	0.55	1.869

MATERIAL DESCRIPTION	USCS	AASHTO
	MH	----

Project No. 244039.020 **Client:** Landau Associates, Inc.

Project: WSDOT Special Projects Facility

Source: B-16 **Sample No.:** S-7 **Elev./Depth:** 20.8=20.9 ft.

Remarks:
Soft,wet,grey, elastic Silt

CONSOLIDATION TEST REPORT

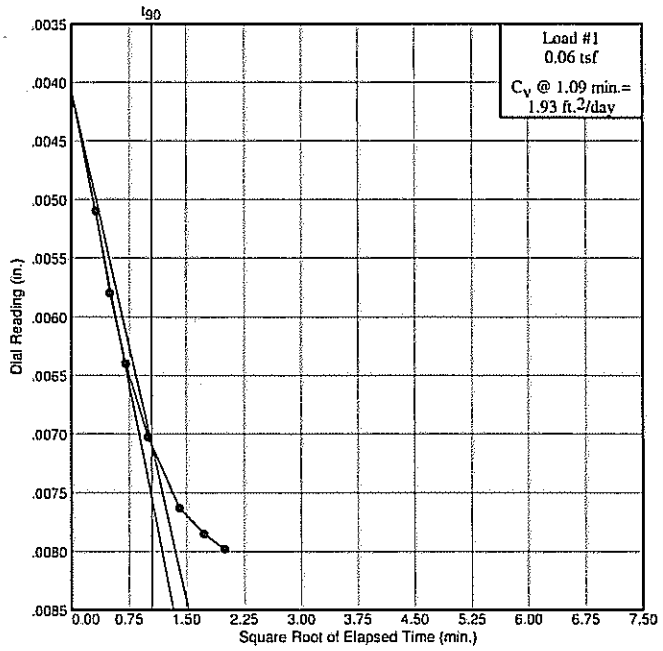
SOIL TECHNOLOGY

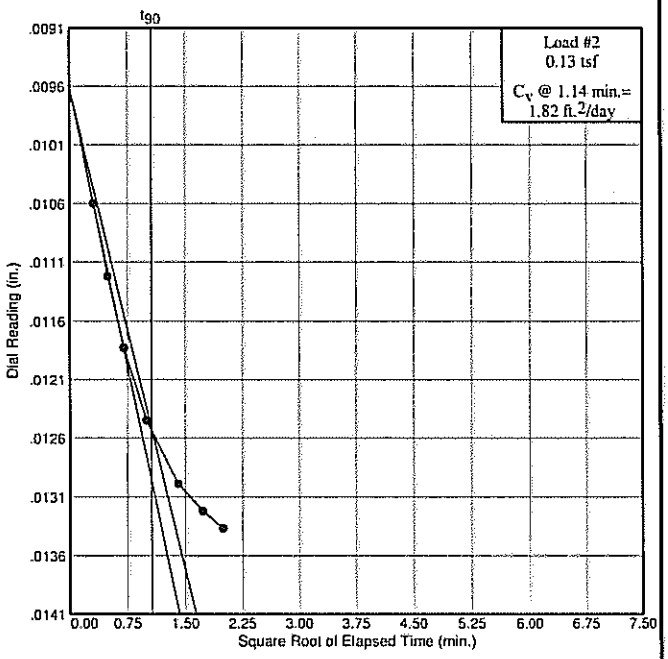
Figure 3

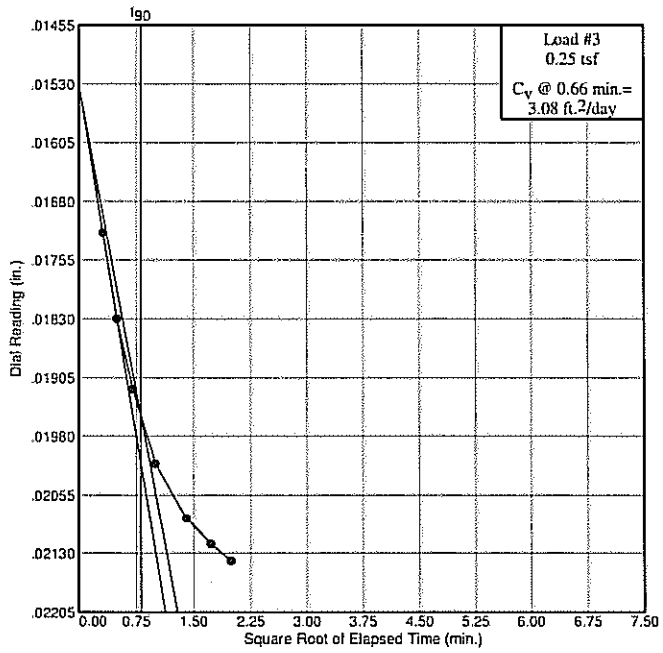
Dial Reading vs. Time

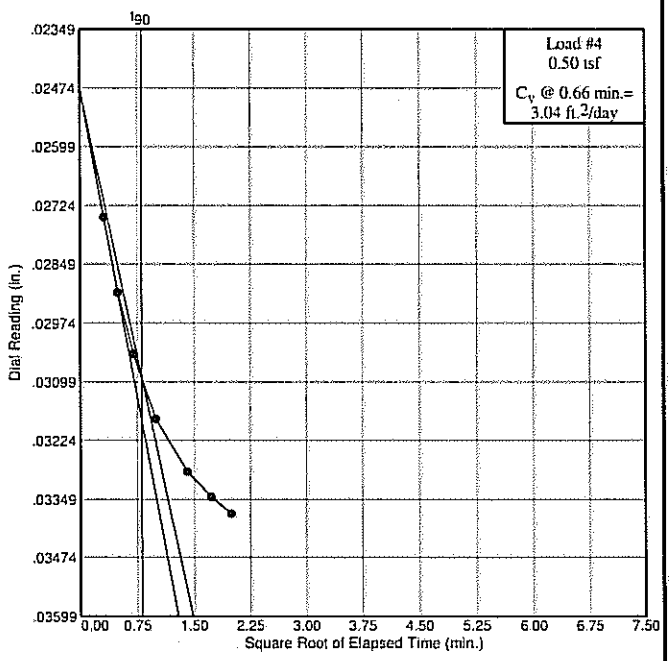
Project No.: 244039.020
Project: WSDOT Special Projects Facility

Source: B-16 Sample No.: S-7 Elev./Depth: 20.8=20.9 ft.









Dial Reading vs. Time

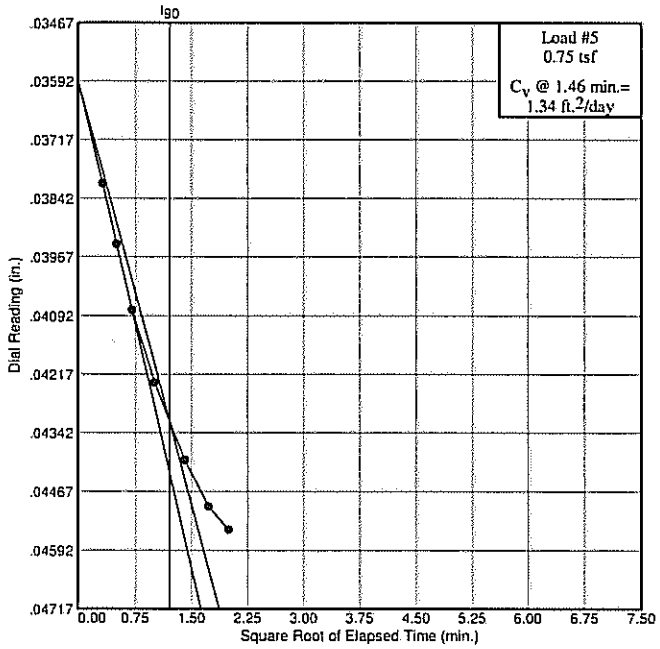
SOIL TECHNOLOGY

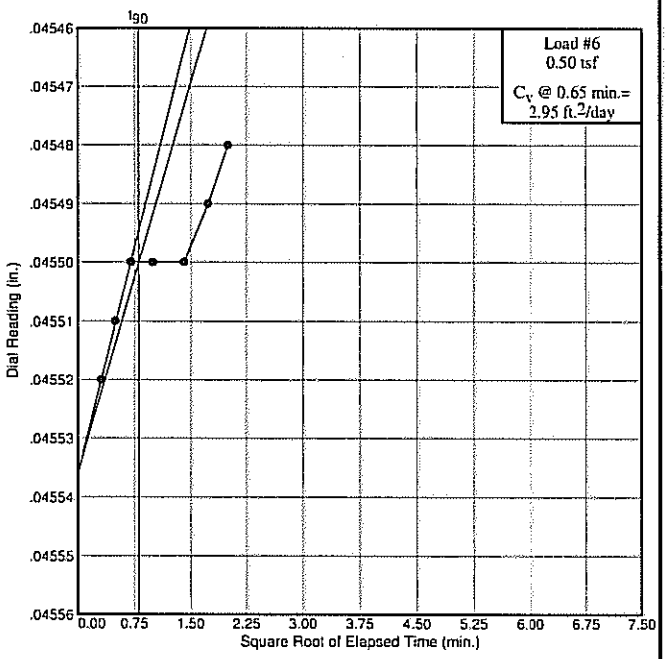
Figure 4

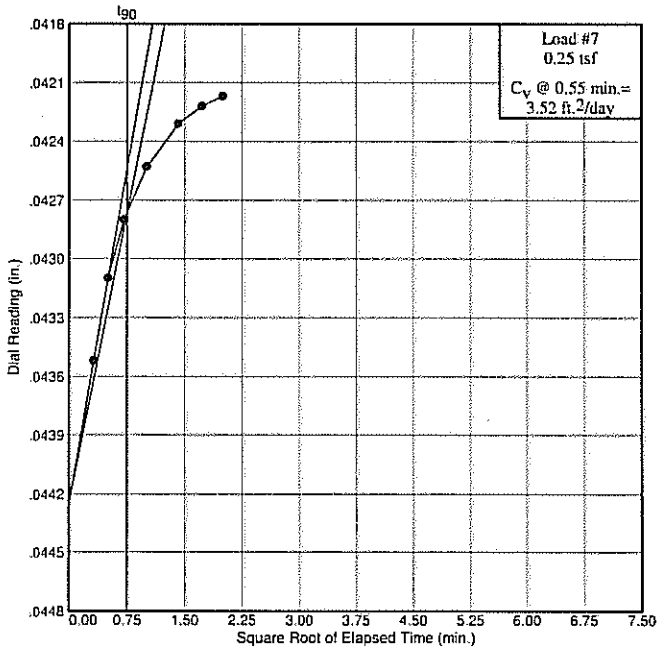
Dial Reading vs. Time

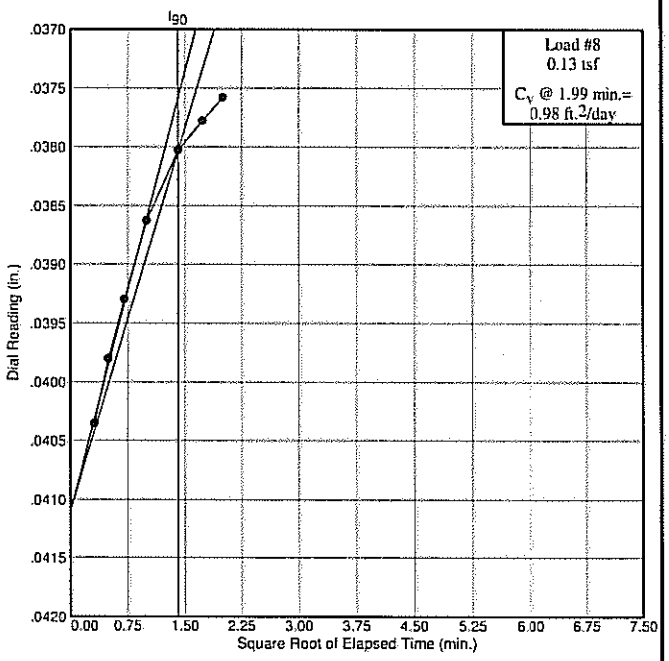
Project No.: 244039.020
Project: WSDOT Special Projects Facility

Source: B-16 Sample No.: S-7 Elev./Depth: 20.8=20.9 ft.









Dial Reading vs. Time

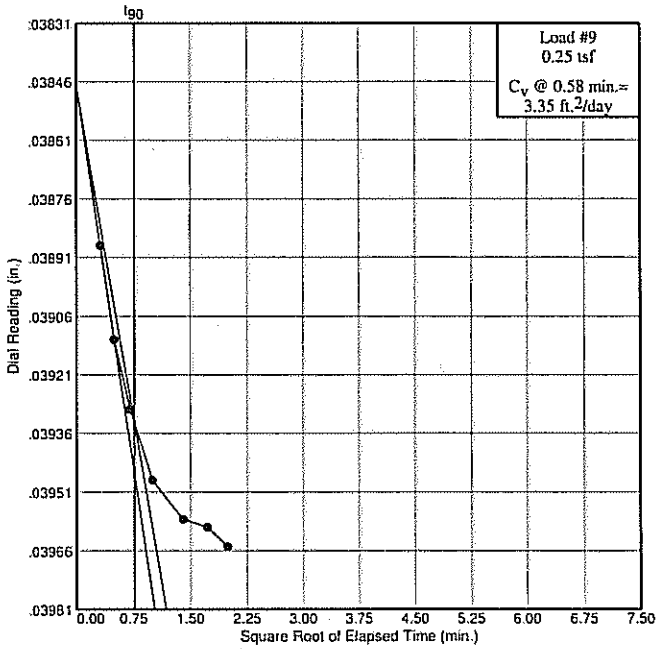
SOIL TECHNOLOGY

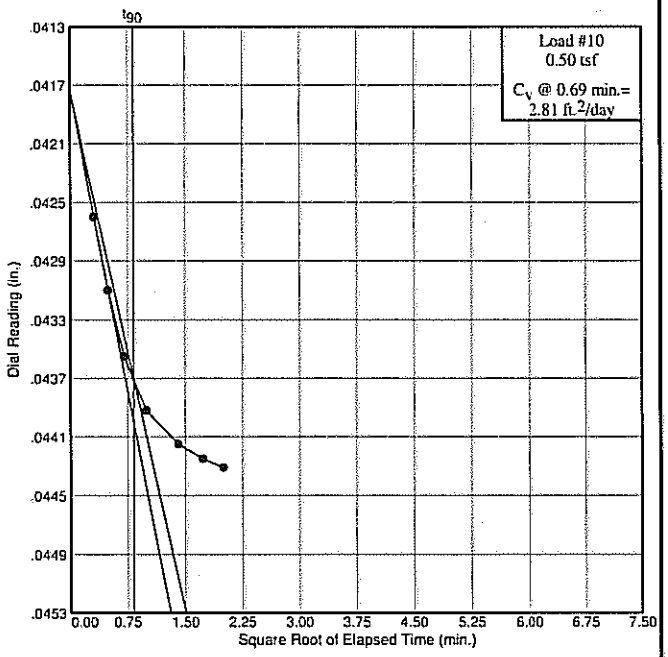
Figure 5

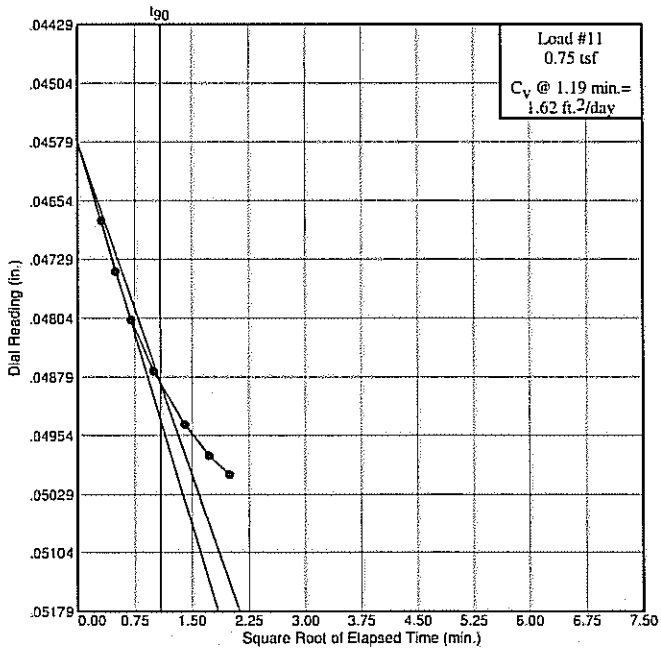
Dial Reading vs. Time

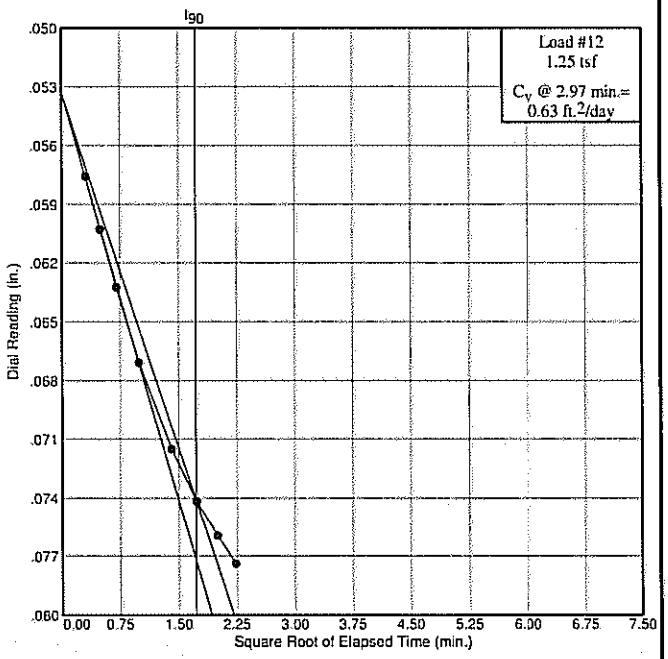
Project No.: 244039.020
Project: WSDOT Special Projects Facility

Source: B-16 Sample No.: S-7 Elev./Depth: 20.8=20.9 ft.









Dial Reading vs. Time

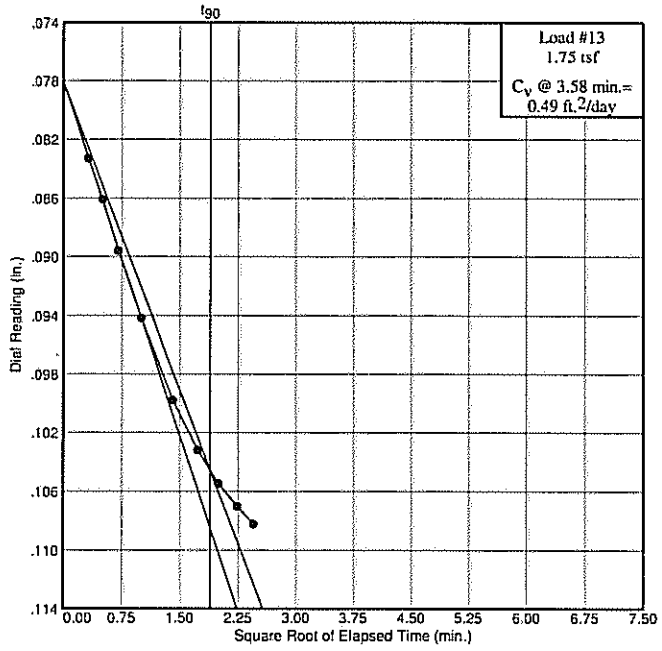
SOIL TECHNOLOGY

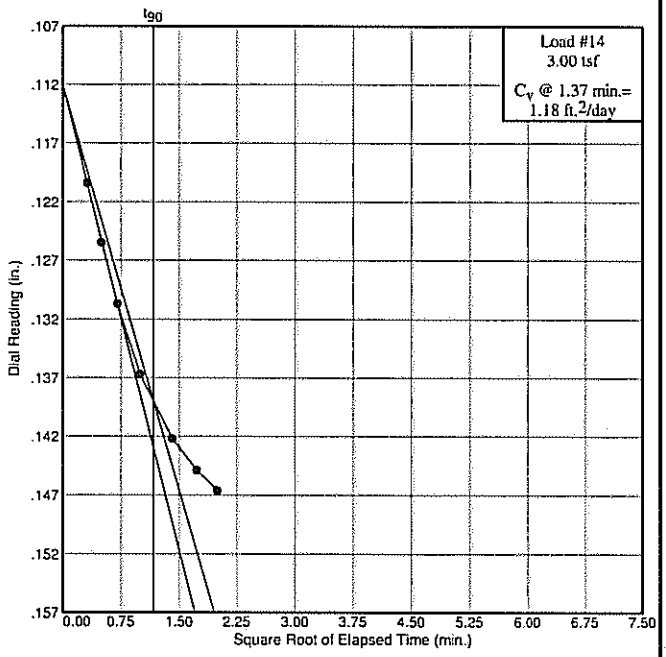
Figure 6

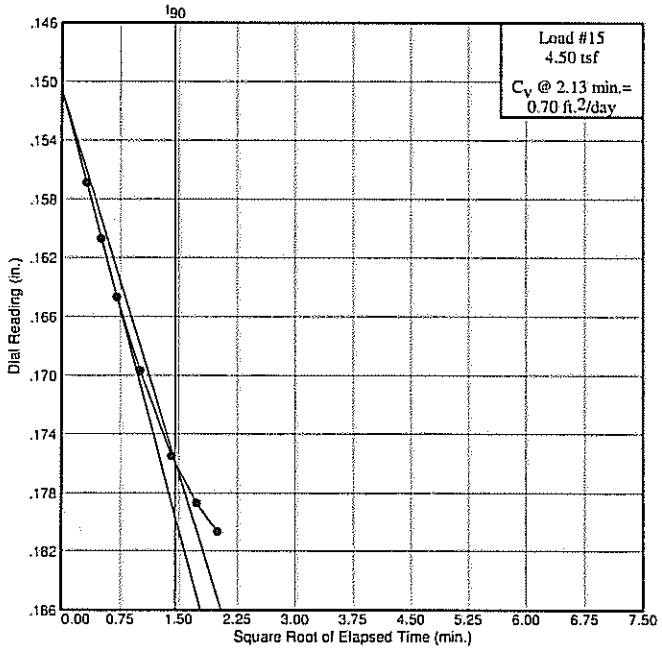
Dial Reading vs. Time

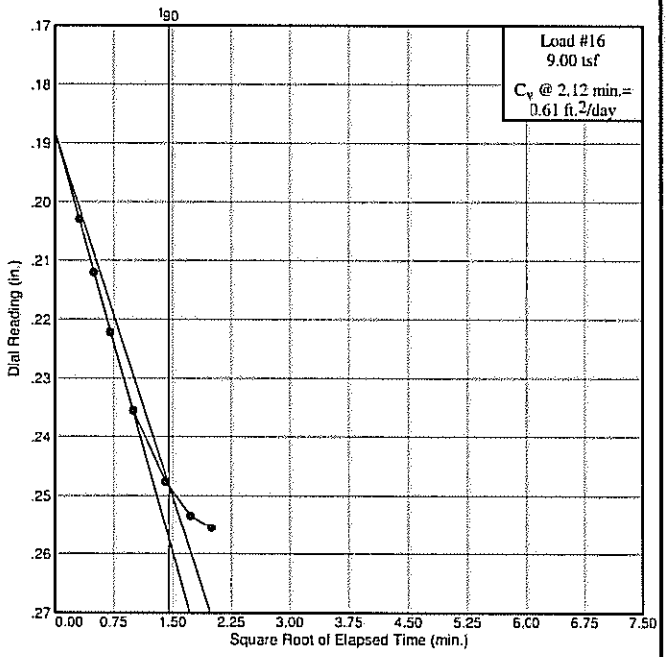
Project No.: 244039.020
Project: WSDOT Special Projects Facility

Source: B-16 Sample No.: S-7 Elev./Depth: 20.8=20.9 ft.









Dial Reading vs. Time

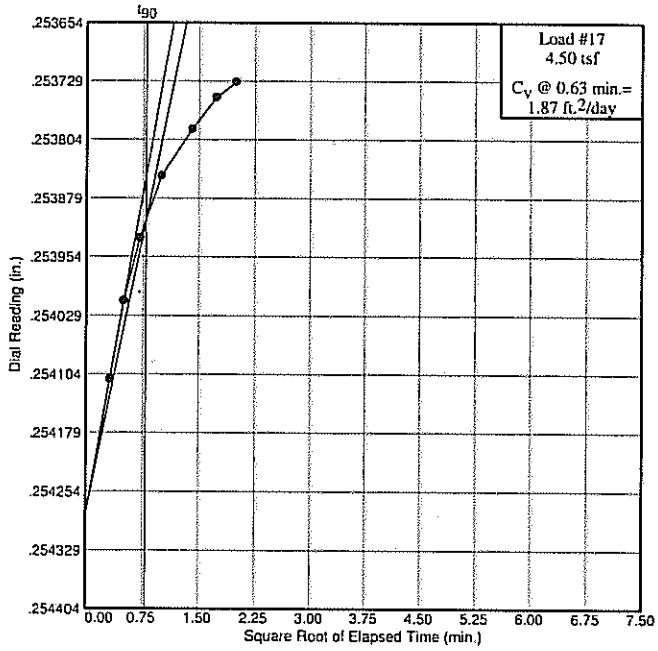
SOIL TECHNOLOGY

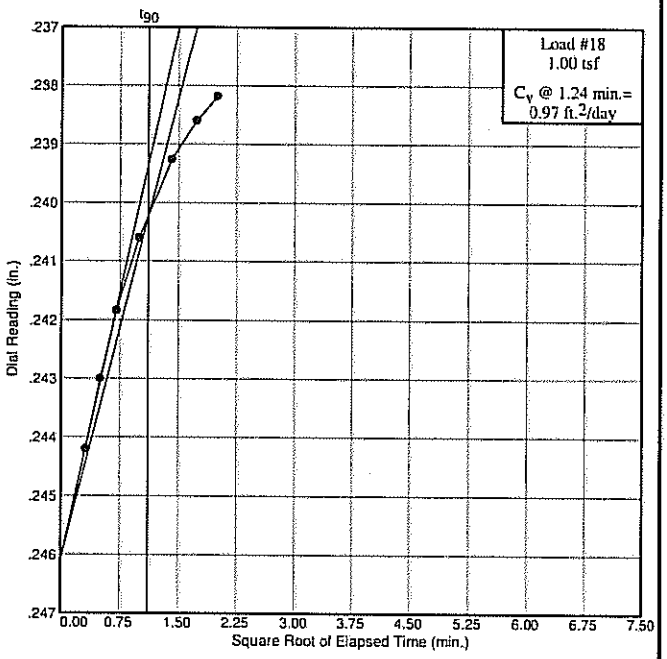
Figure 7

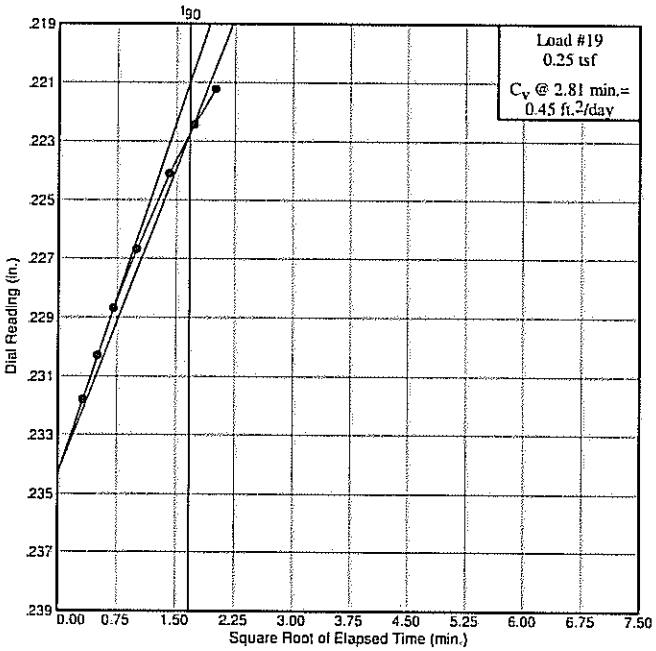
Dial Reading vs. Time

Project No.: 244039.020
Project: WSDOT Special Projects Facility

Source: B-16 Sample No.: S-7 Elev./Depth: 20.8=20.9 ft.





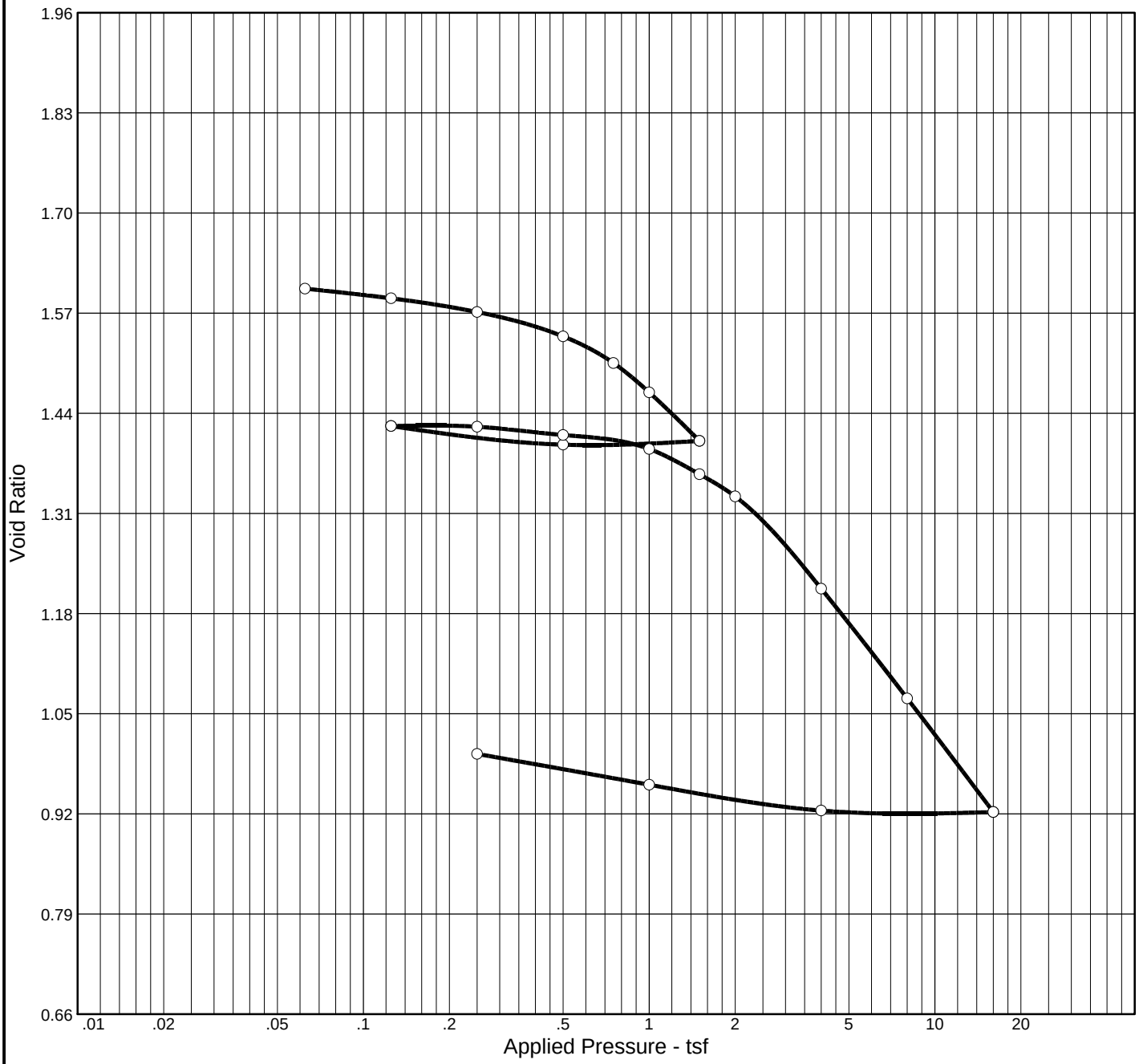


Dial Reading vs. Time

SOIL TECHNOLOGY

Figure 8

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.5 %	62.1 %	62.0	61	19	2.6	0.44	_	0.49	0.034	1.622

MATERIAL DESCRIPTION	USCS	AASHTO
Soft to M-stiff, wet, grey Organic SILT	OH	----

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-27-08 **Sample No.:** S-3 **Elev./Depth:** 15.1-15.2

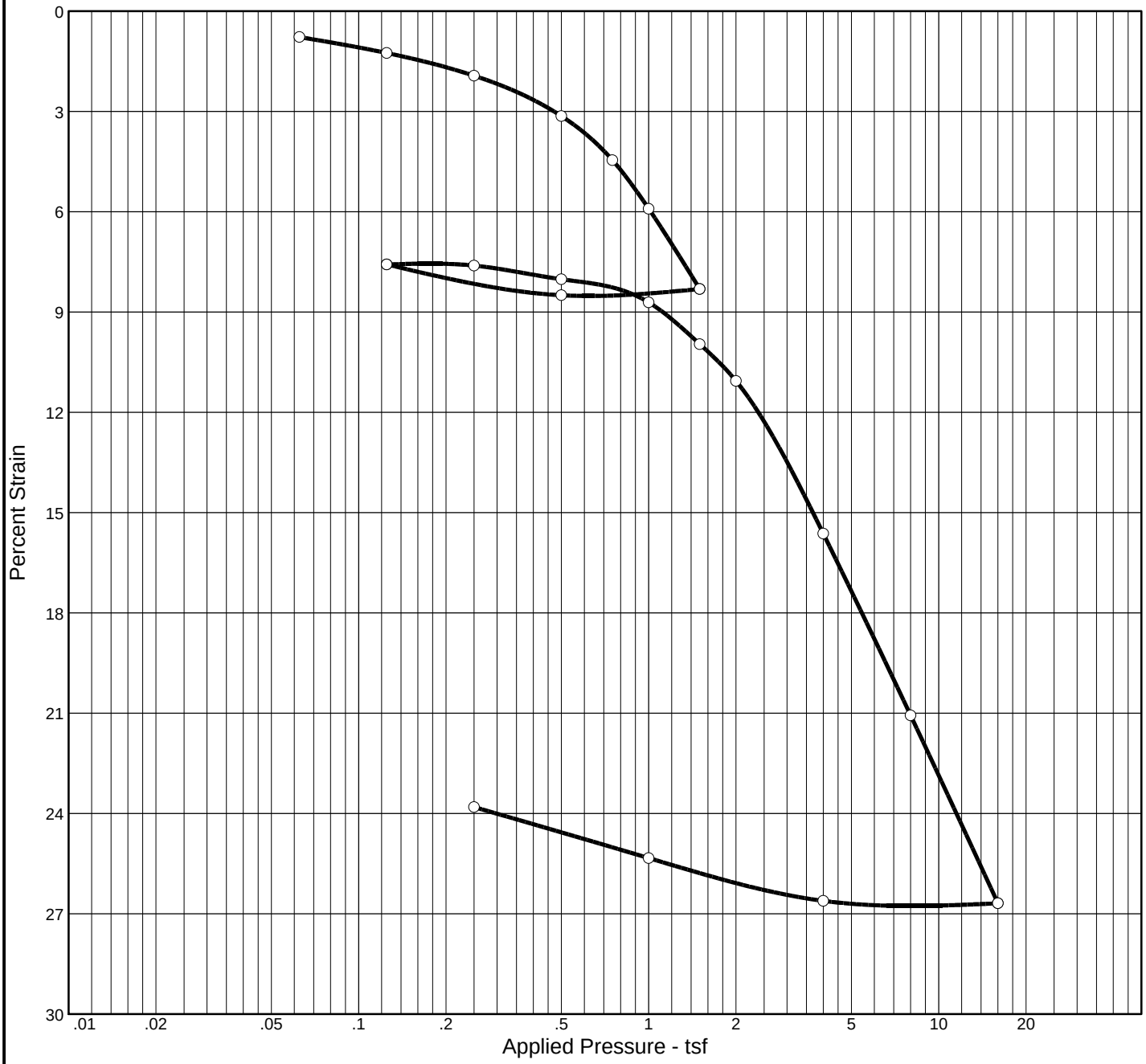
Remarks:
Specific gravity estimated

SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 1.0

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.5 %	62.1	62.0	61	19	2.6	0.44	_	0.49	0.034	1.622

MATERIAL DESCRIPTION	USCS	AASHTO
Soft to M-stiff, wet, grey Organic SILT	OH	----

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-27-08 **Sample No.:** S-3 **Elev./Depth:** 15.1-15.2

Remarks:
Specific gravity estimated

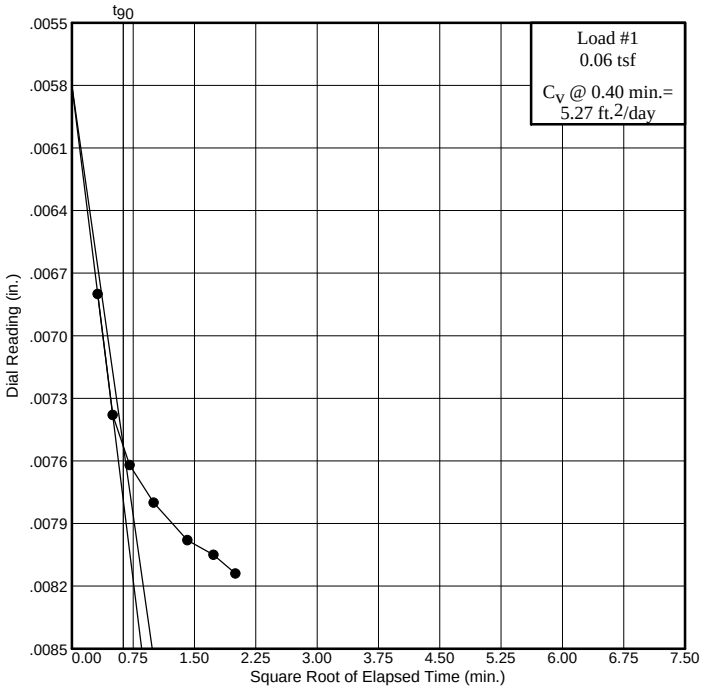
SOIL TECHNOLOGY

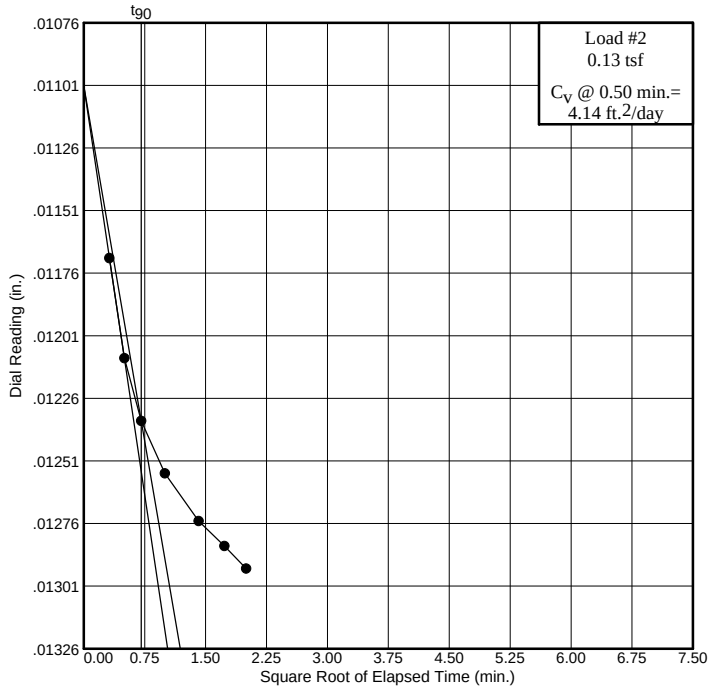
Bainbridge Island, WA

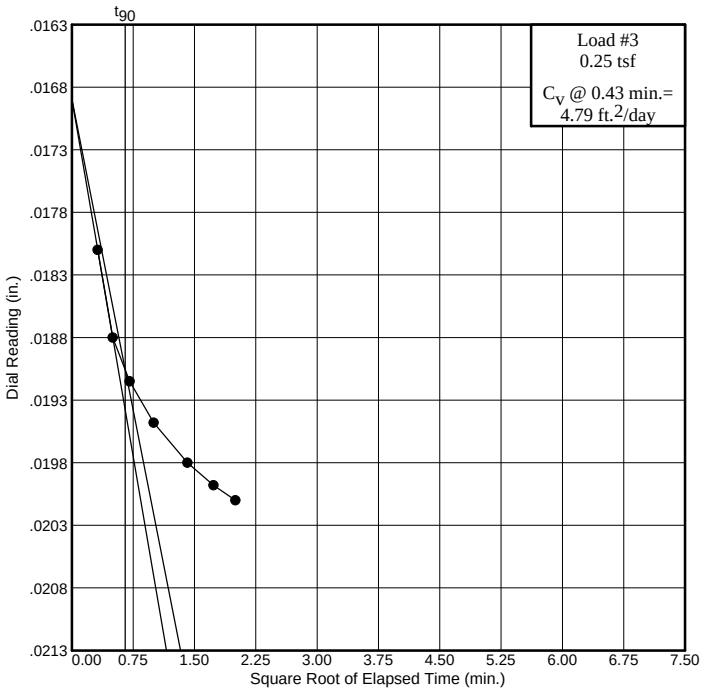
Figure 1.1

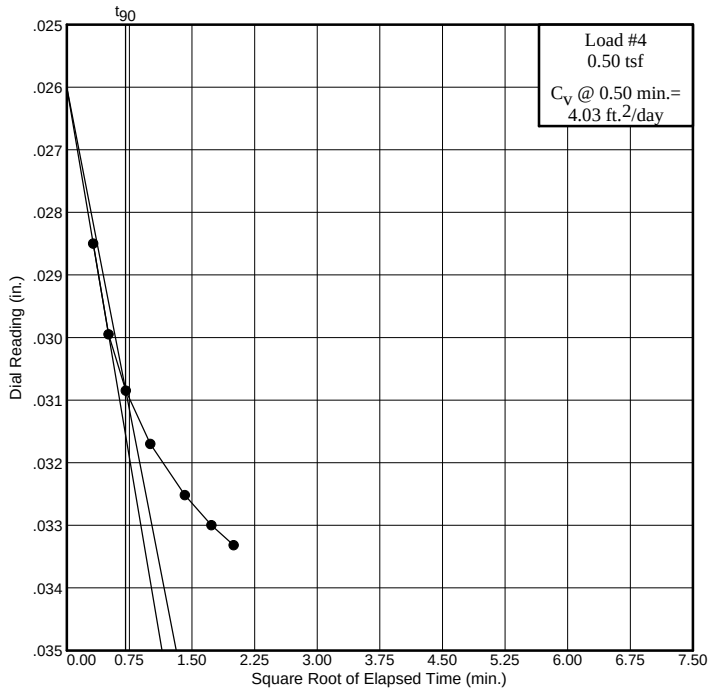
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-27-08 Sample No.: S-3 Elev./Depth: 15.1-15.2









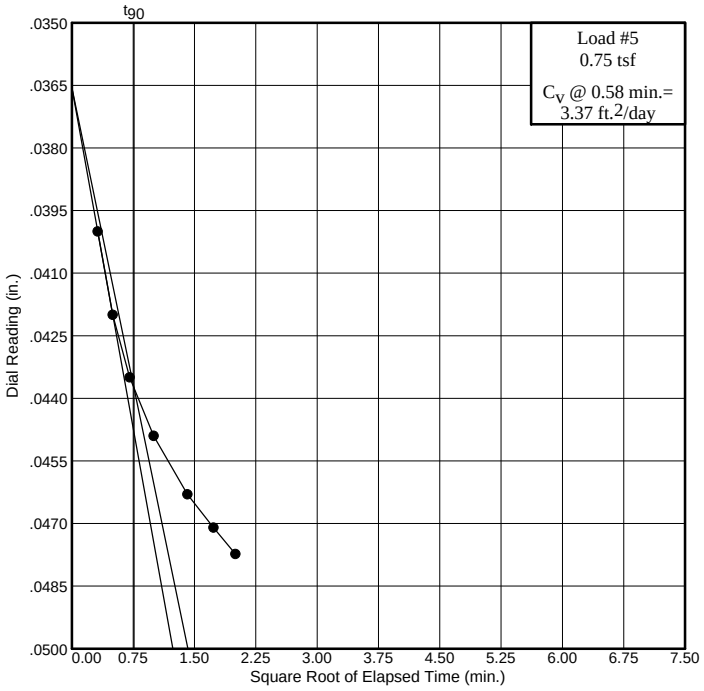
SOIL TECHNOLOGY

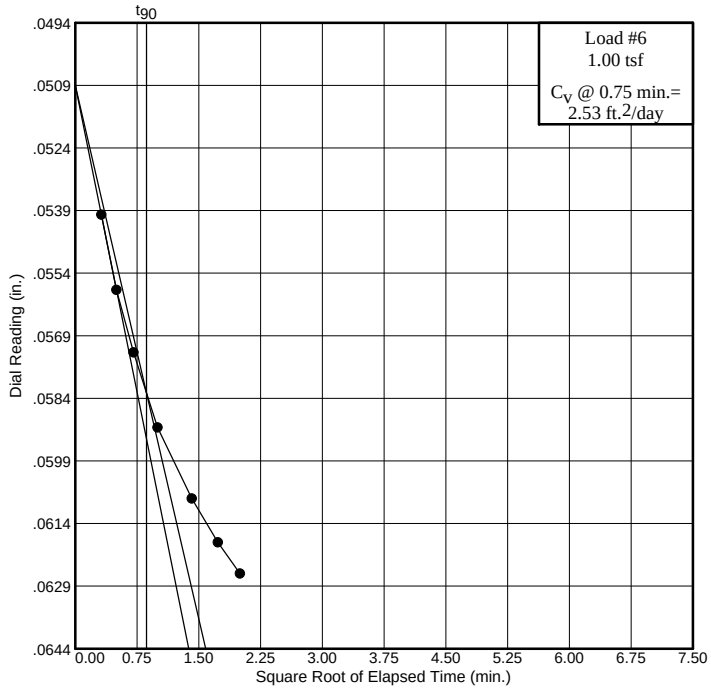
Bainbridge Island, WA

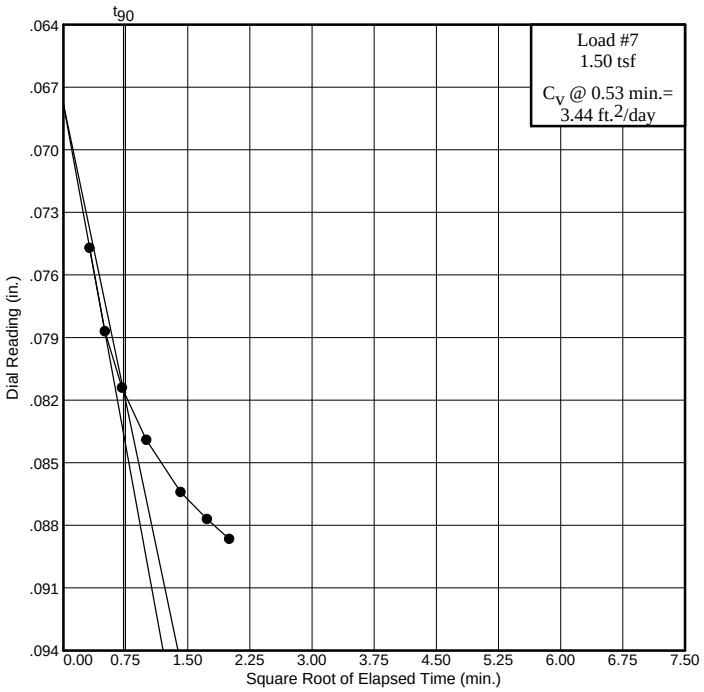
Figure 1.2

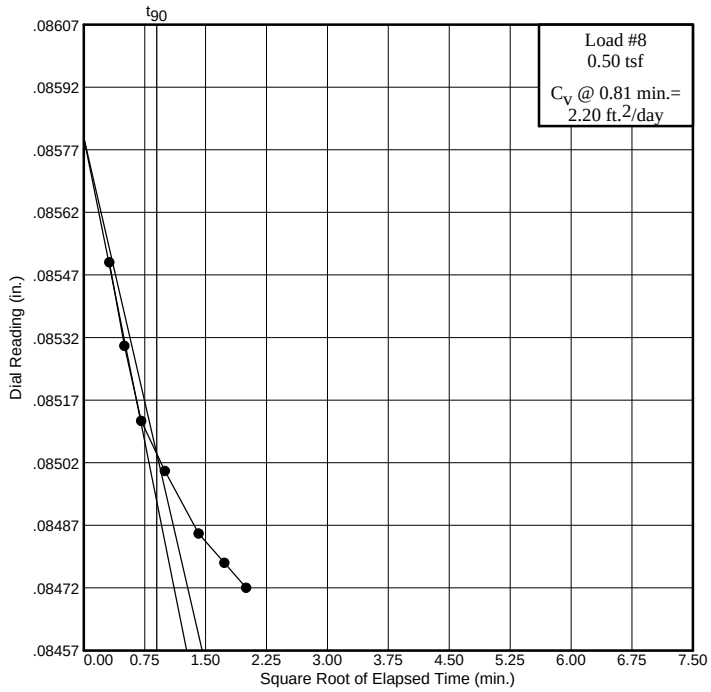
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-27-08 Sample No.: S-3 Elev./Depth: 15.1-15.2









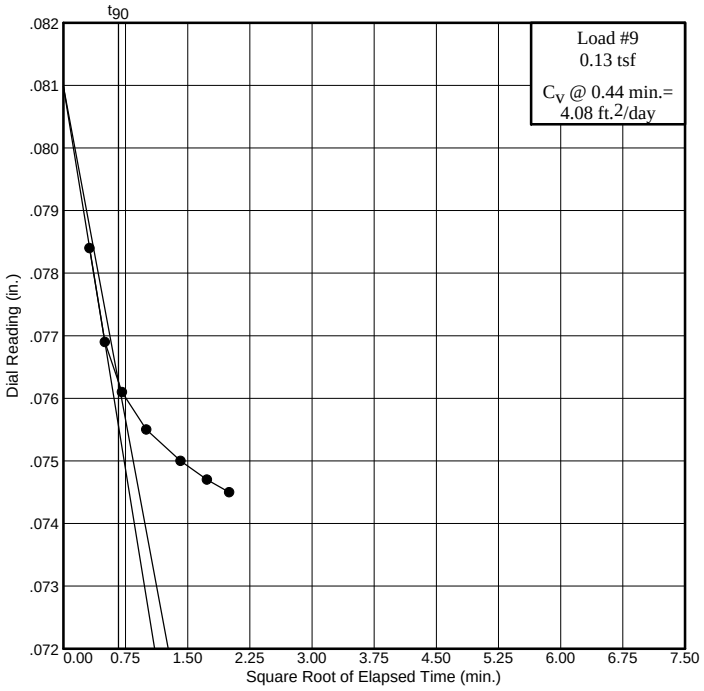
SOIL TECHNOLOGY

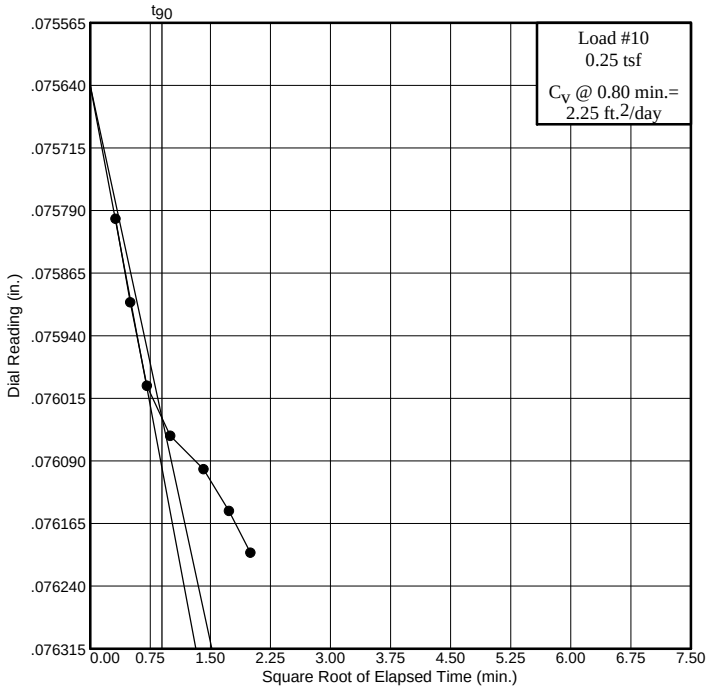
Bainbridge Island, WA

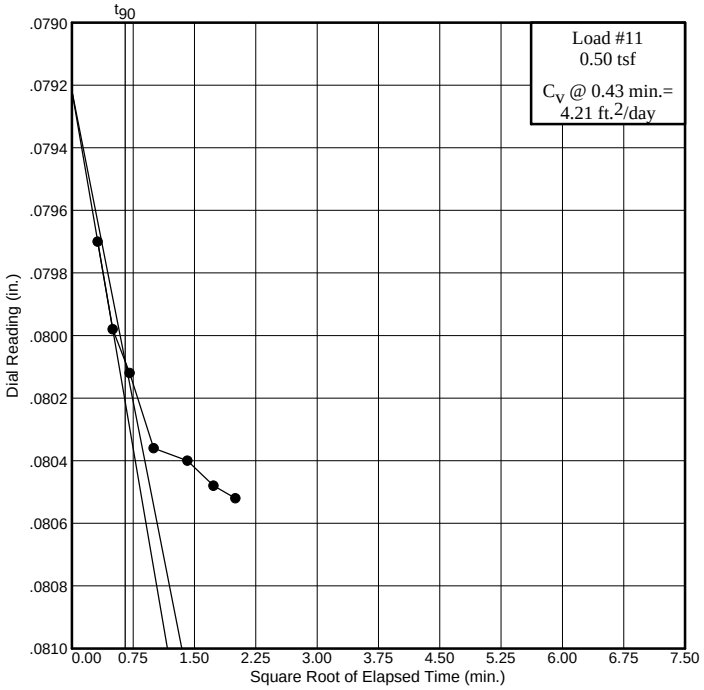
Figure 1.3

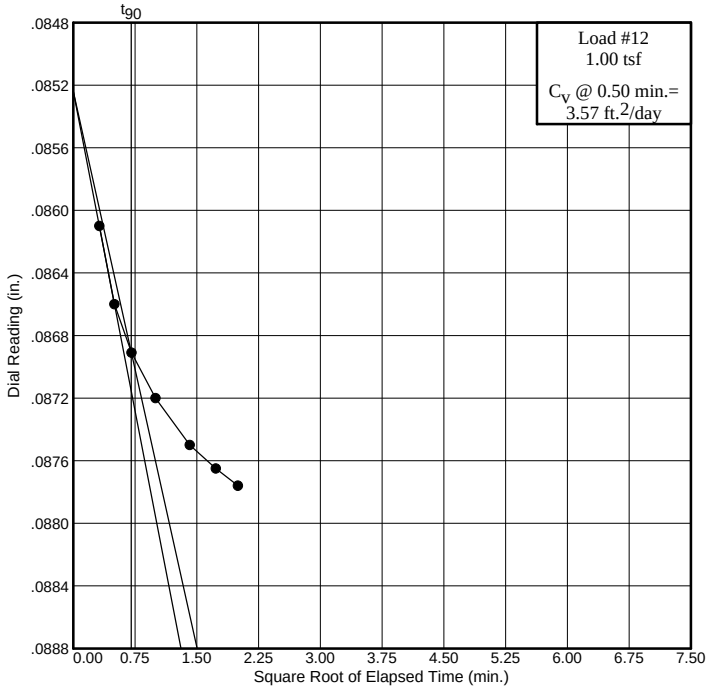
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-27-08 Sample No.: S-3 Elev./Depth: 15.1-15.2









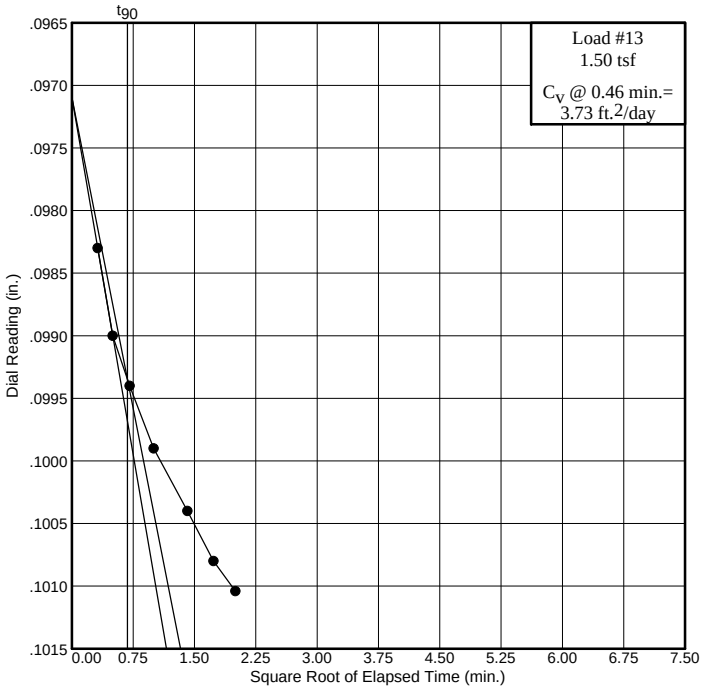
SOIL TECHNOLOGY

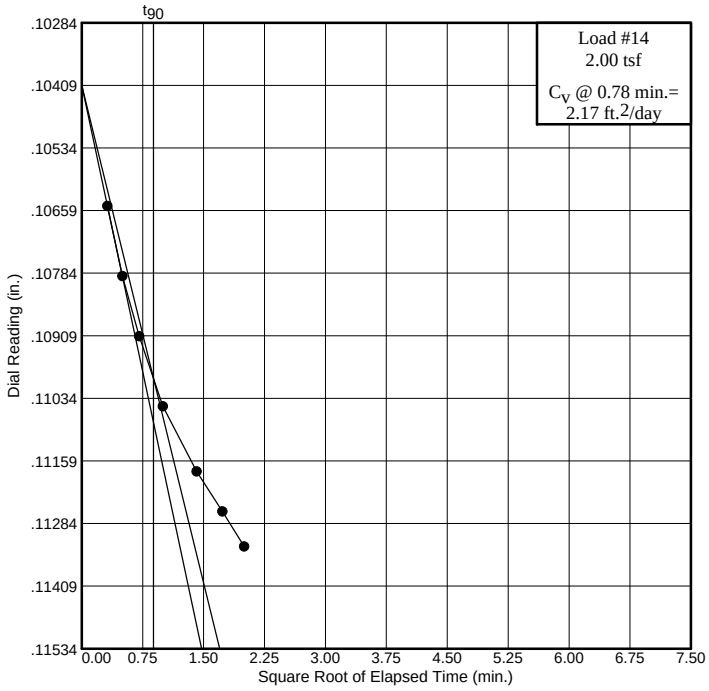
Bainbridge Island, WA

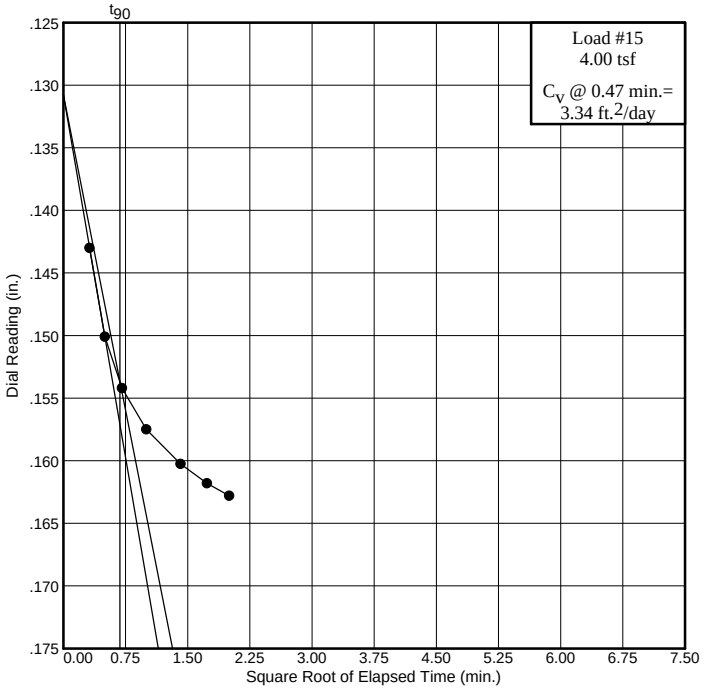
Figure 1.4

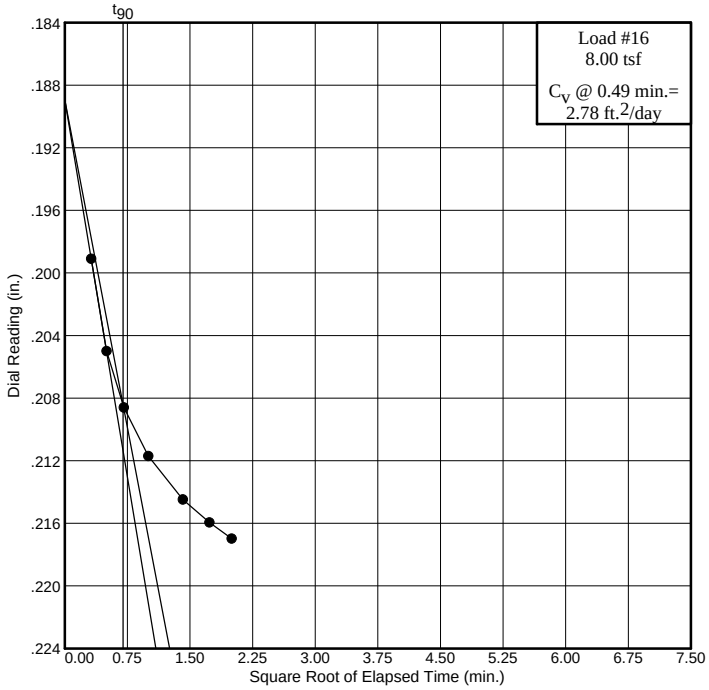
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-27-08 Sample No.: S-3 Elev./Depth: 15.1-15.2









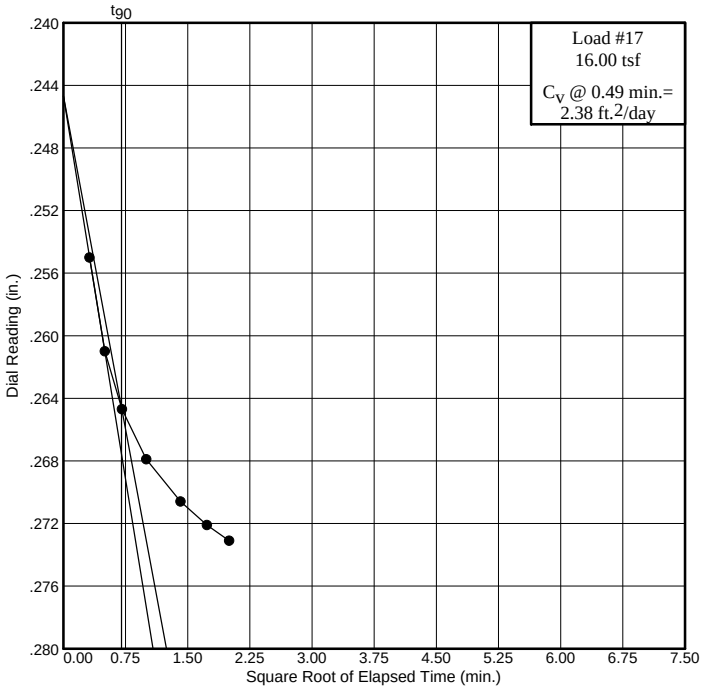
SOIL TECHNOLOGY

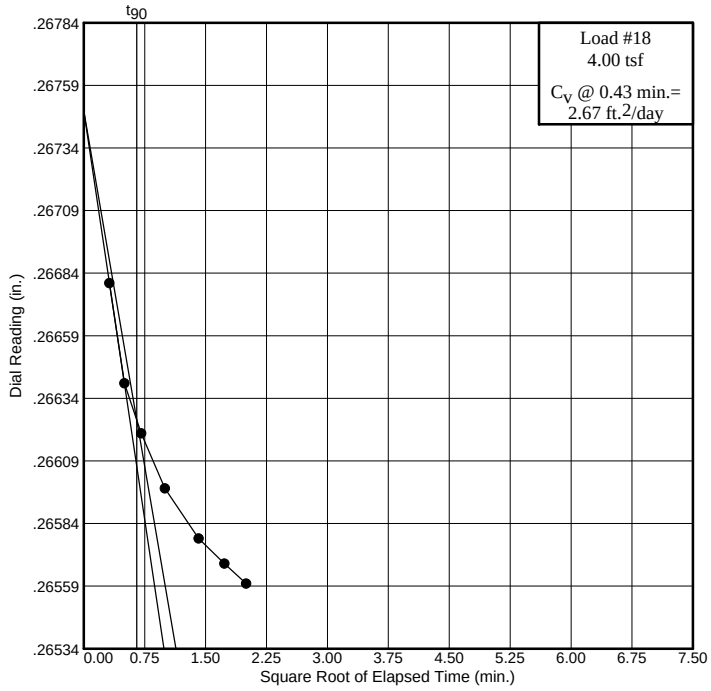
Bainbridge Island, WA

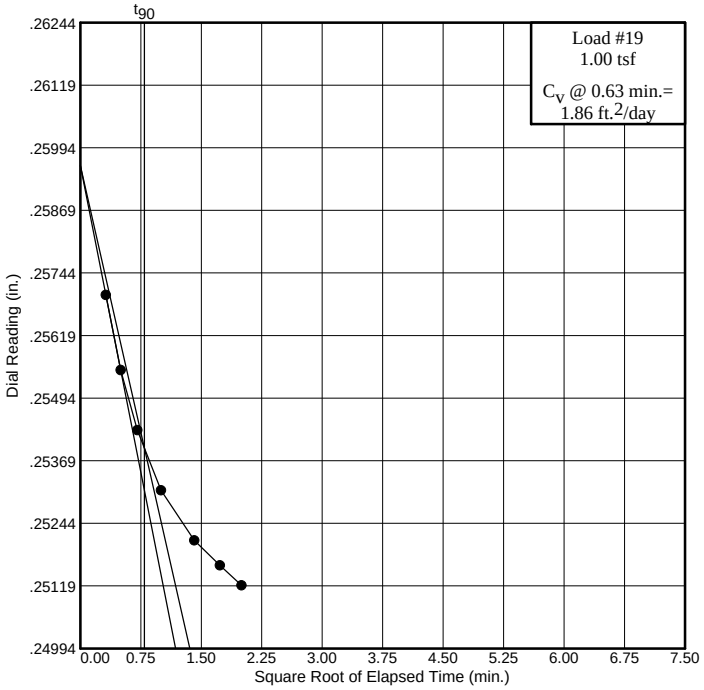
Figure 1.5

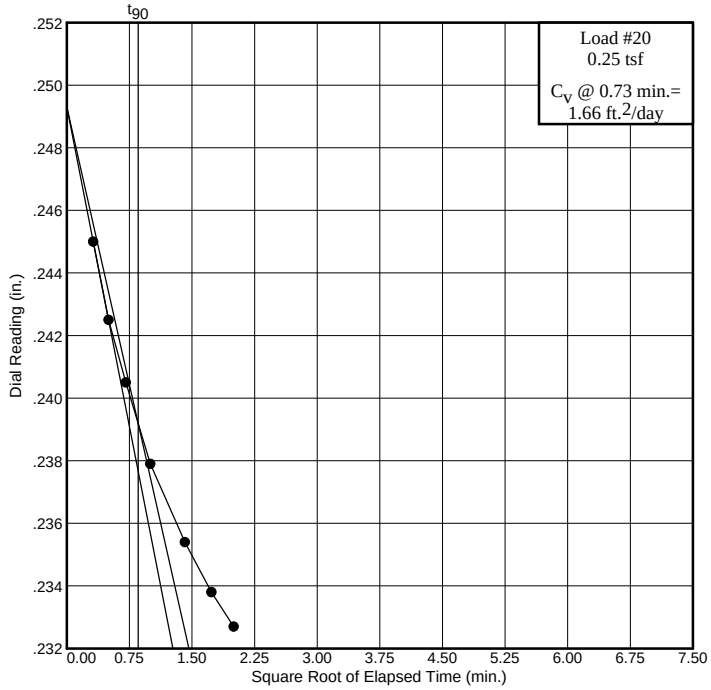
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-27-08 Sample No.: S-3 Elev./Depth: 15.1-15.2







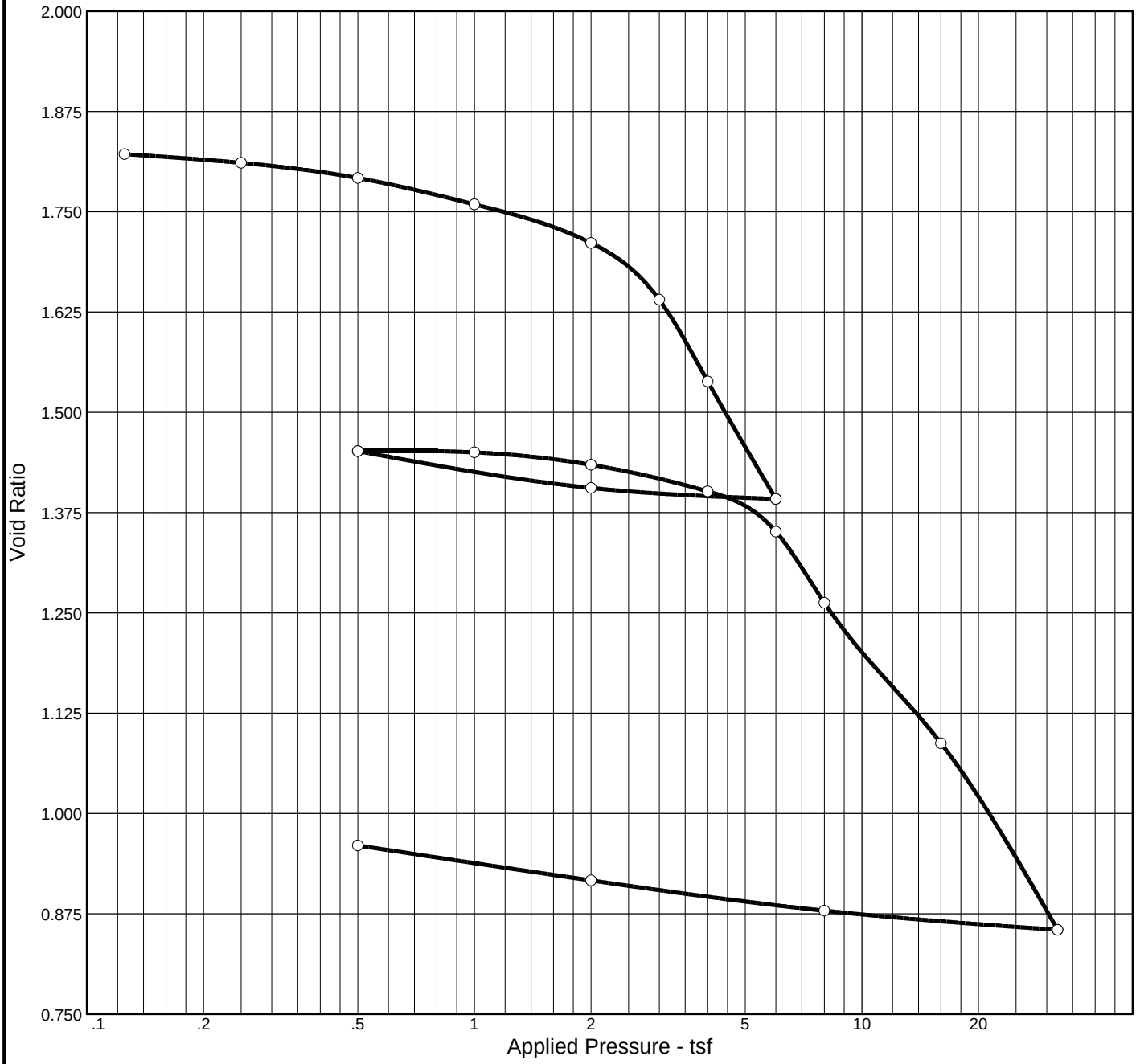


SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 1.6

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.7 %	69.4 %	58.2	72	38	2.64	2.20	__	0.76	0.055	1.837

MATERIAL DESCRIPTION	USCS	AASHTO
M-Stiff, wet, grey, Organic SILT	OH	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-27-08 **Sample No.:** S-23 **Elev./Depth:** 99.7-99.8

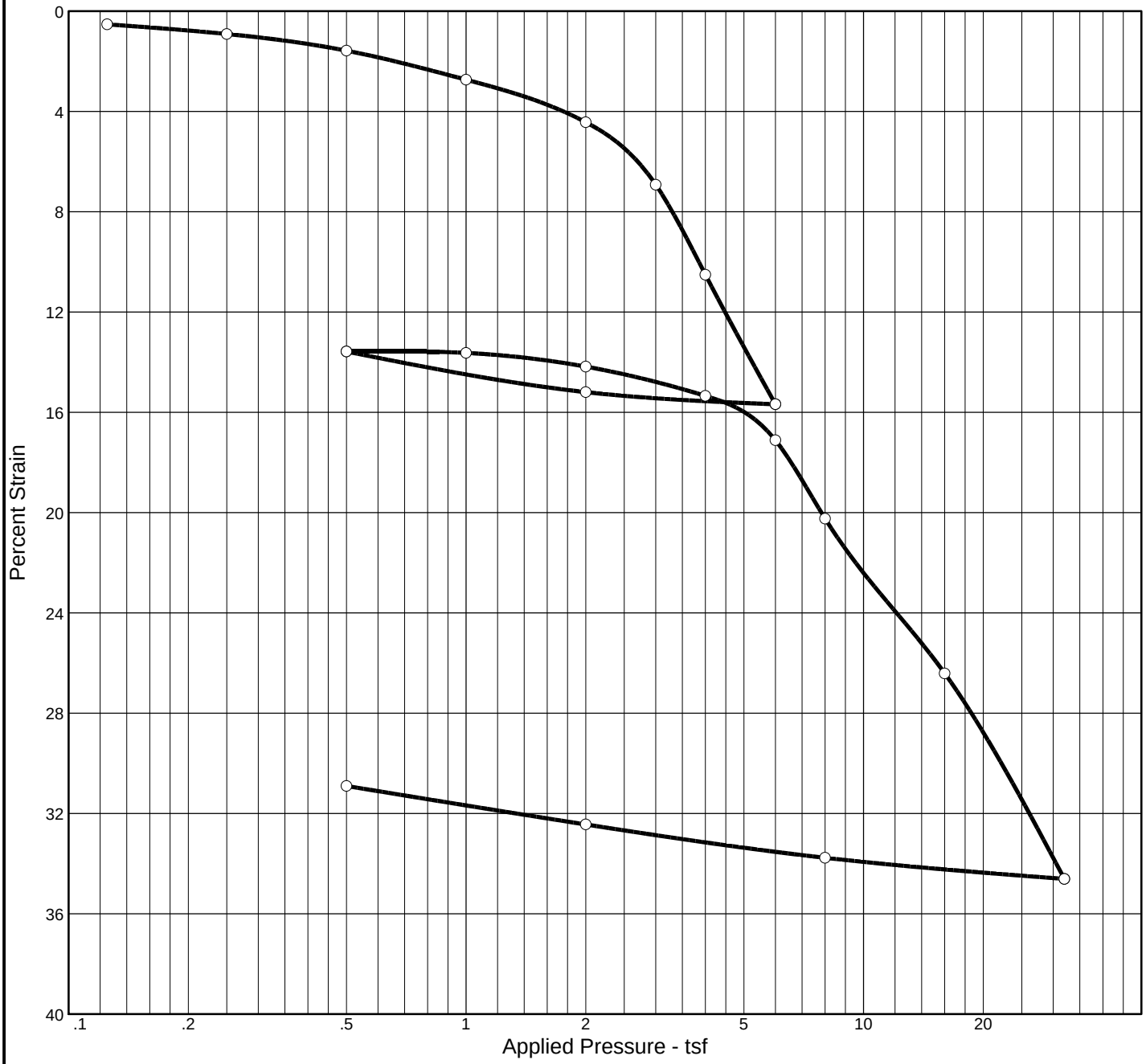
Remarks:
Specific gravity estimated

SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 2.0

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.7 %	69.4 %	58.2	72	38	2.64	2.20	___	0.76	0.055	1.83

MATERIAL DESCRIPTION	USCS	AASHTO
M-Stiff, wet, grey, Organic SILT	OH	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-27-08 **Sample No.:** S-23 **Elev./Depth:** 99.7-99.8

Remarks:
Specific gravity estimated

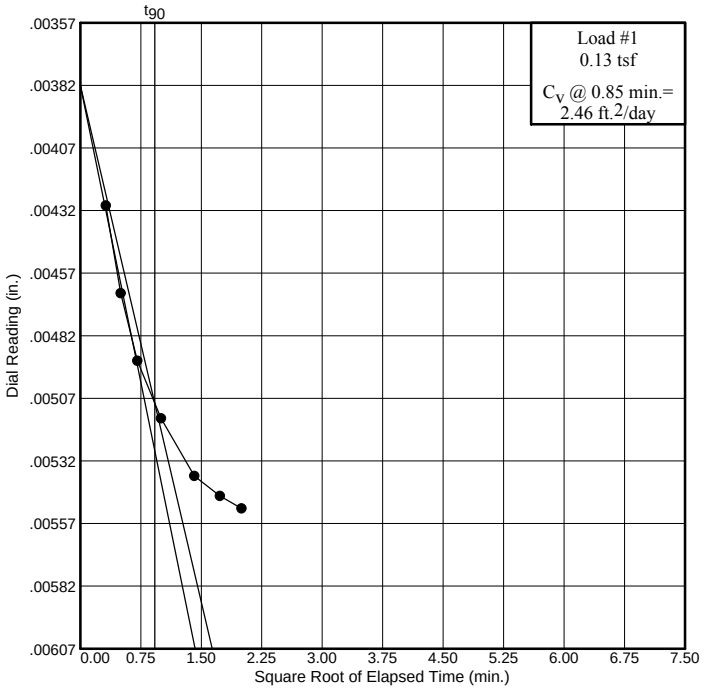
SOIL TECHNOLOGY

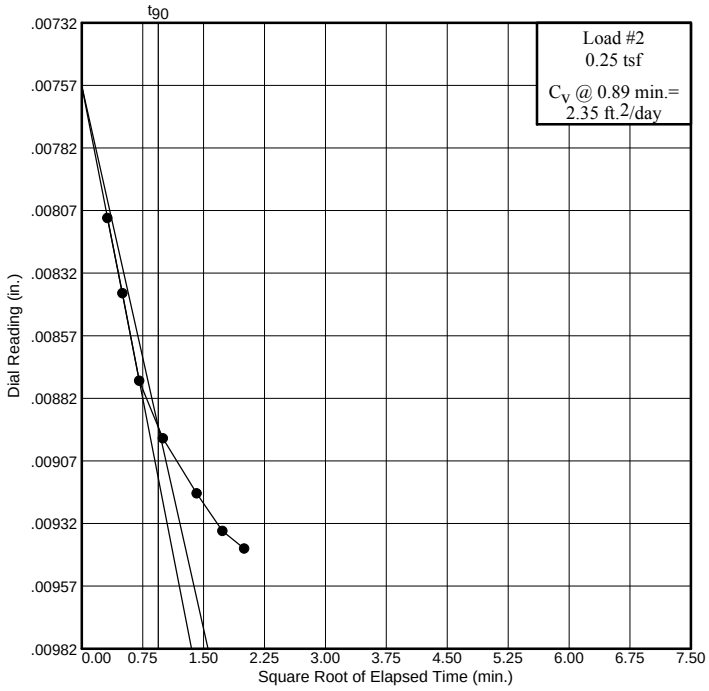
Bainbridge Island, WA

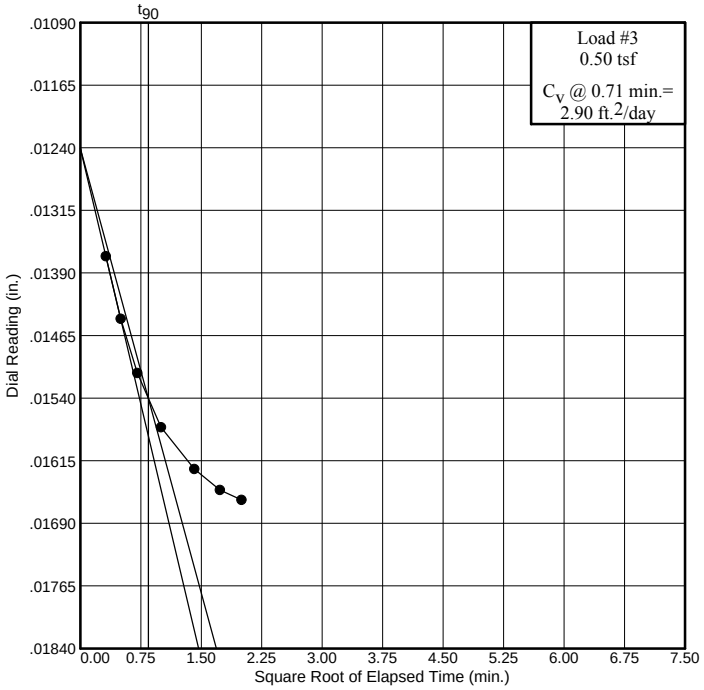
Figure 2.1

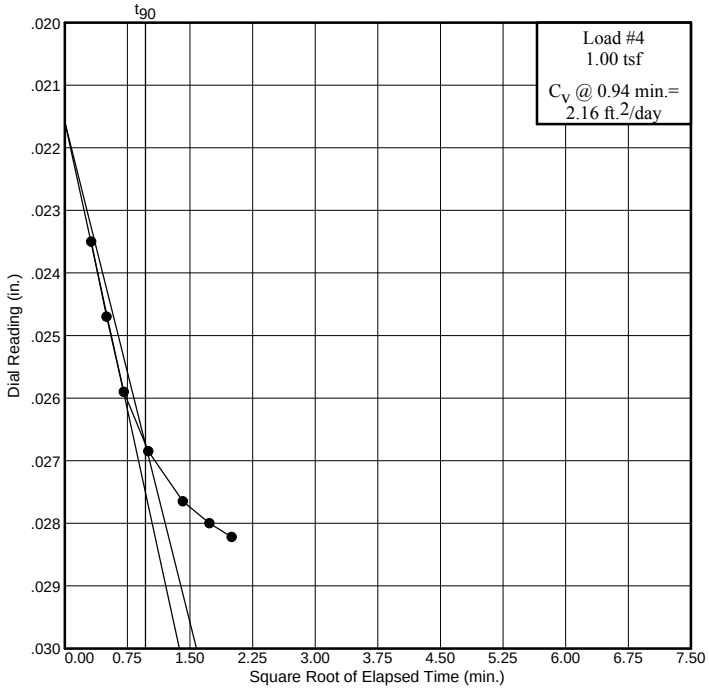
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-27-08 Sample No.: S-23 Elev./Depth: 99.7-99.8









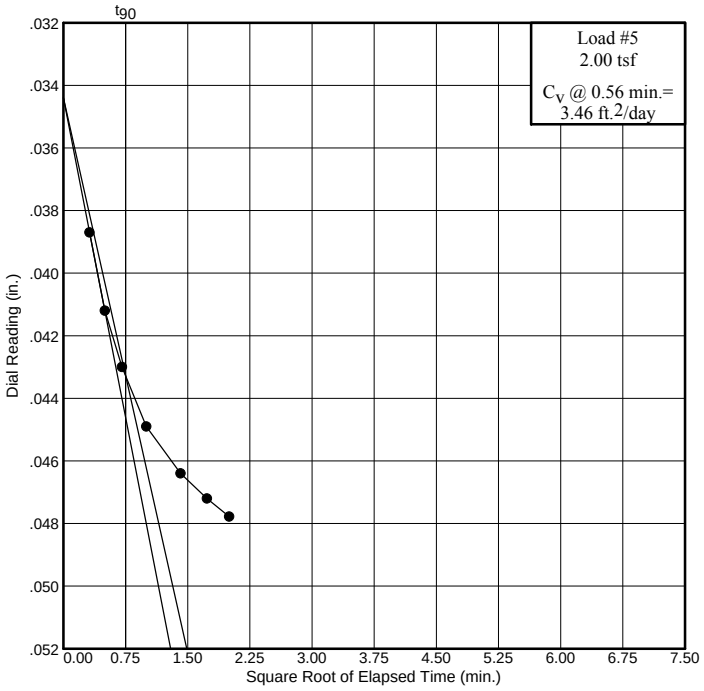
SOIL TECHNOLOGY

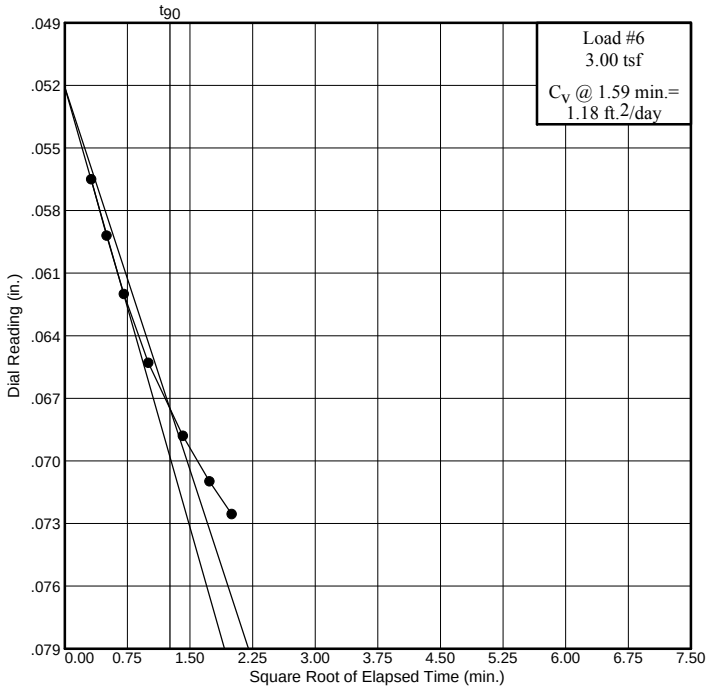
Bainbridge Island, WA

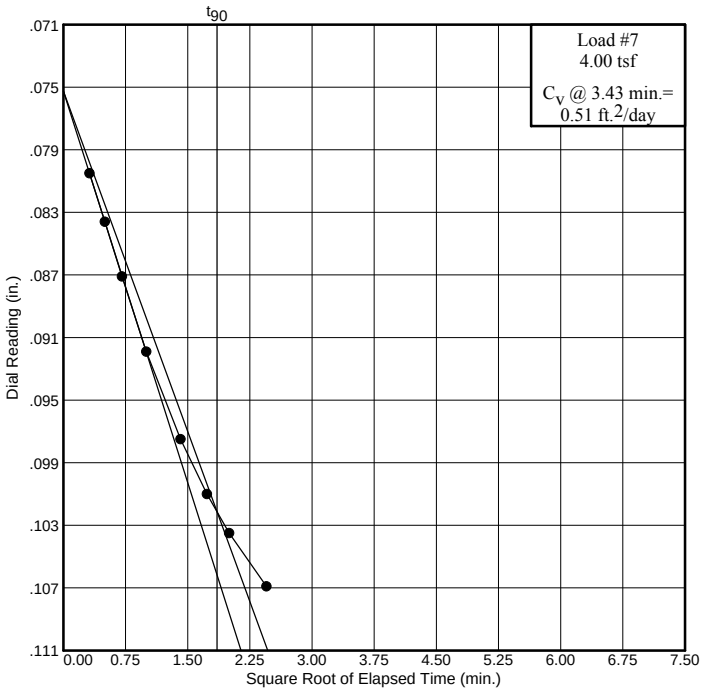
Figure 2.1

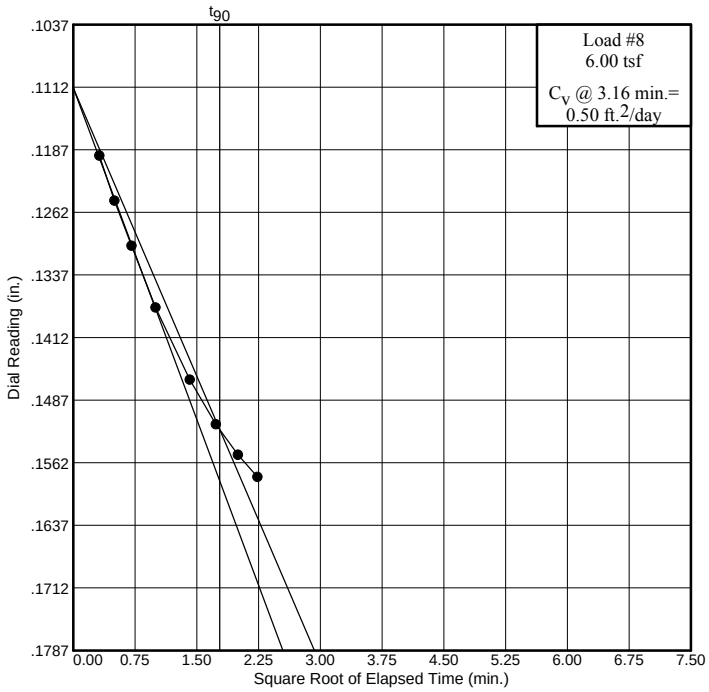
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-27-08 Sample No.: S-23 Elev./Depth: 99.7-99.8









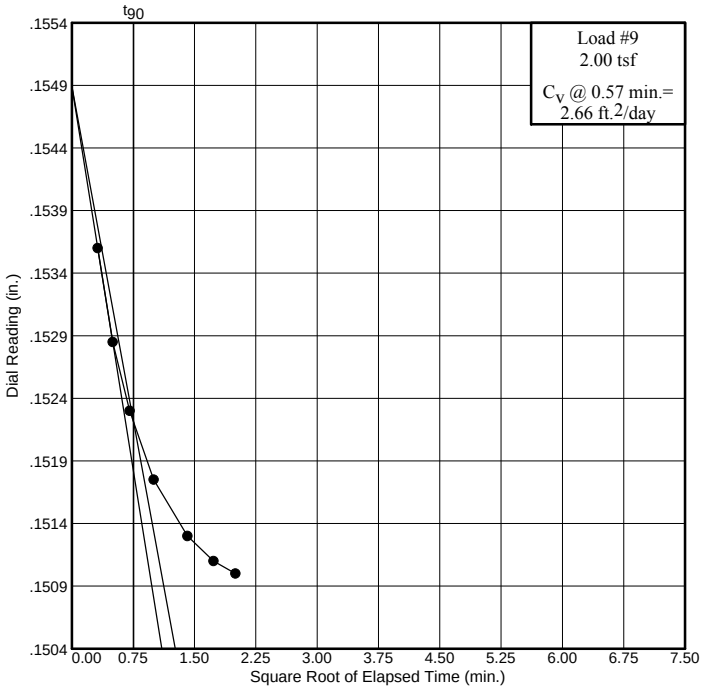
SOIL TECHNOLOGY

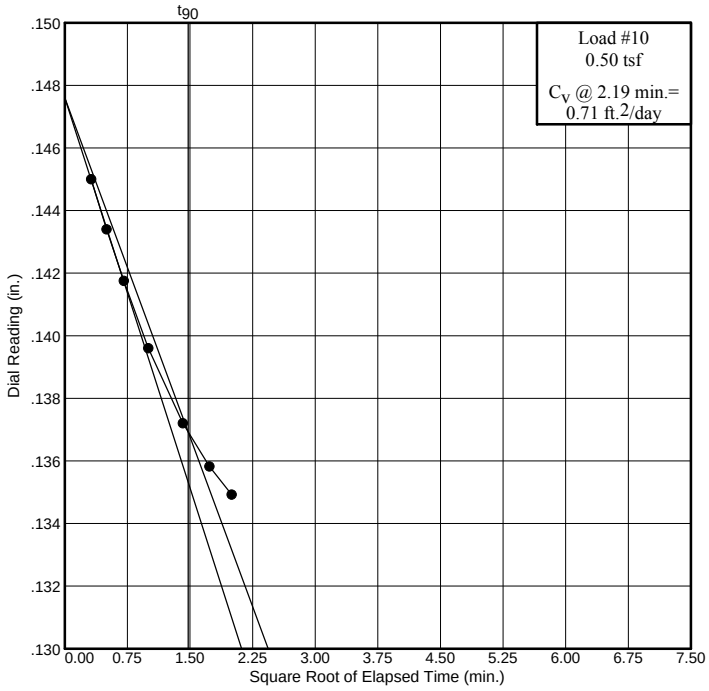
Bainbridge Island, WA

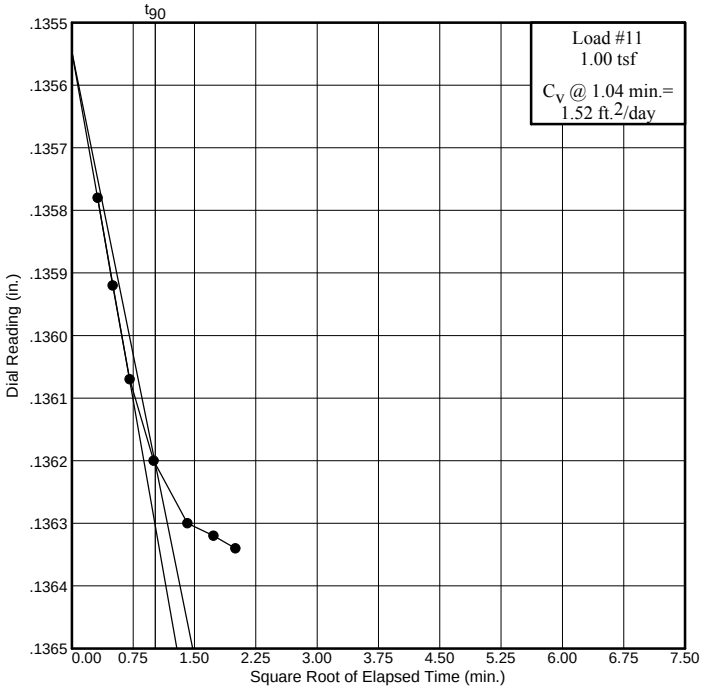
Figure 2.2

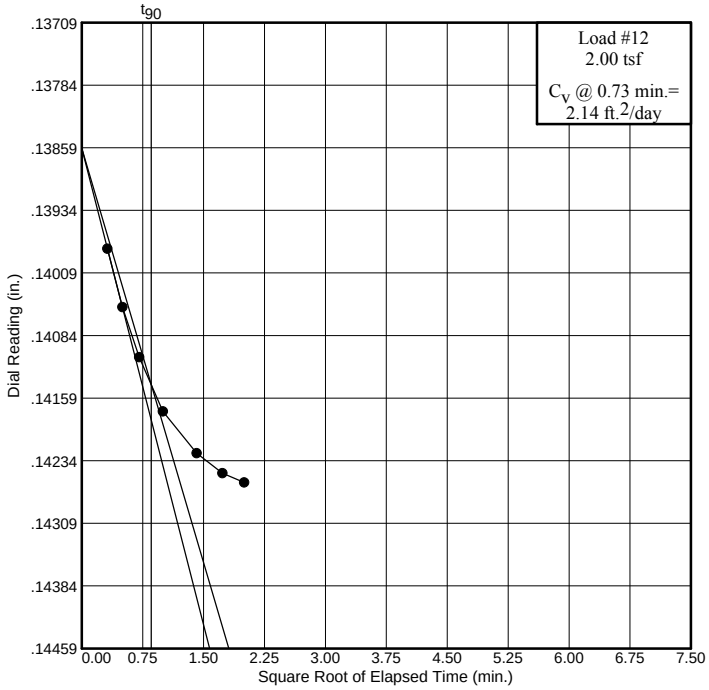
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-27-08 Sample No.: S-23 Elev./Depth: 99.7-99.8









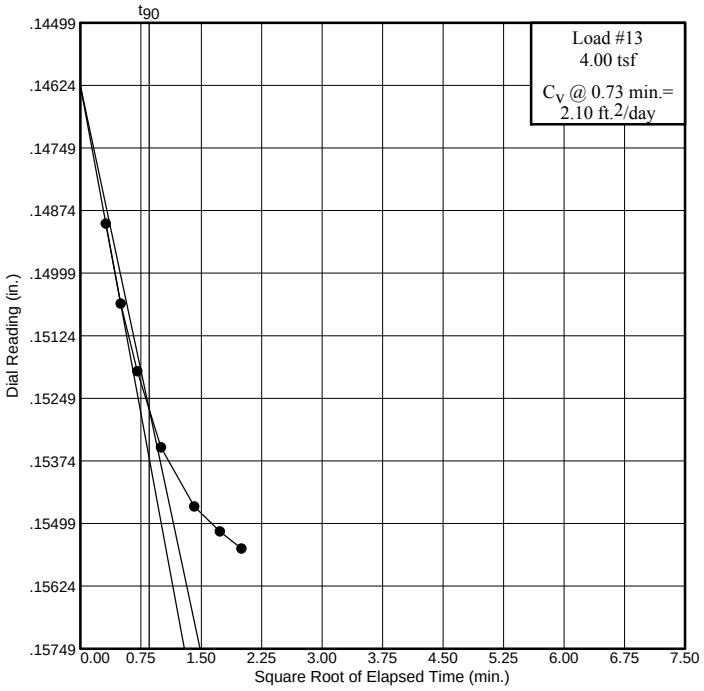
SOIL TECHNOLOGY

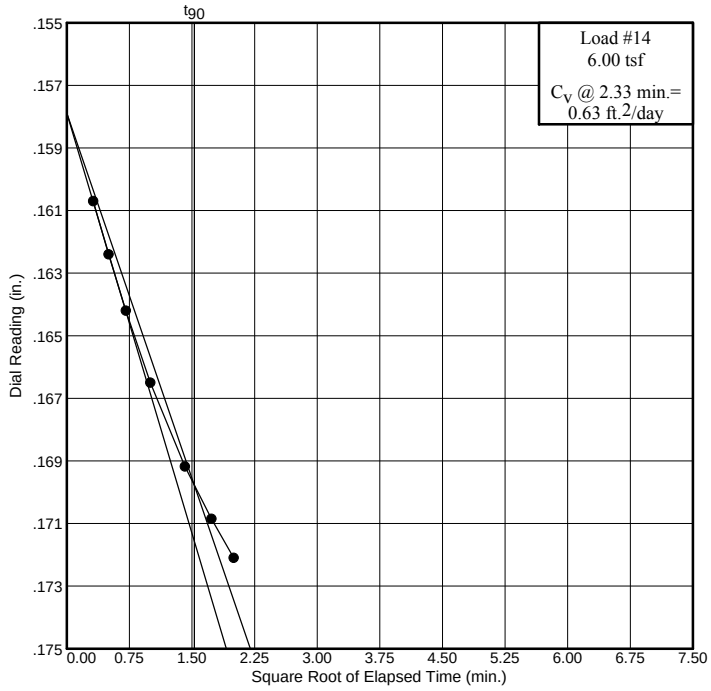
Bainbridge Island, WA

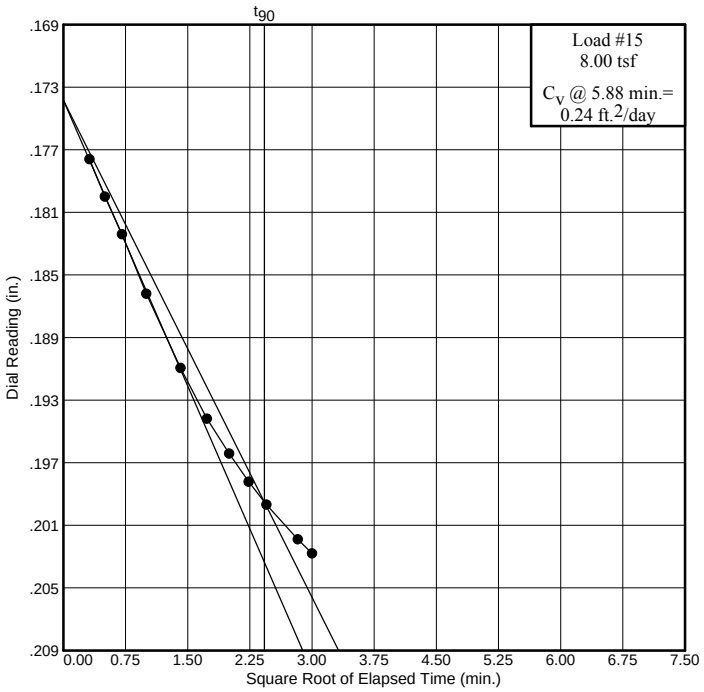
Figure 2.3

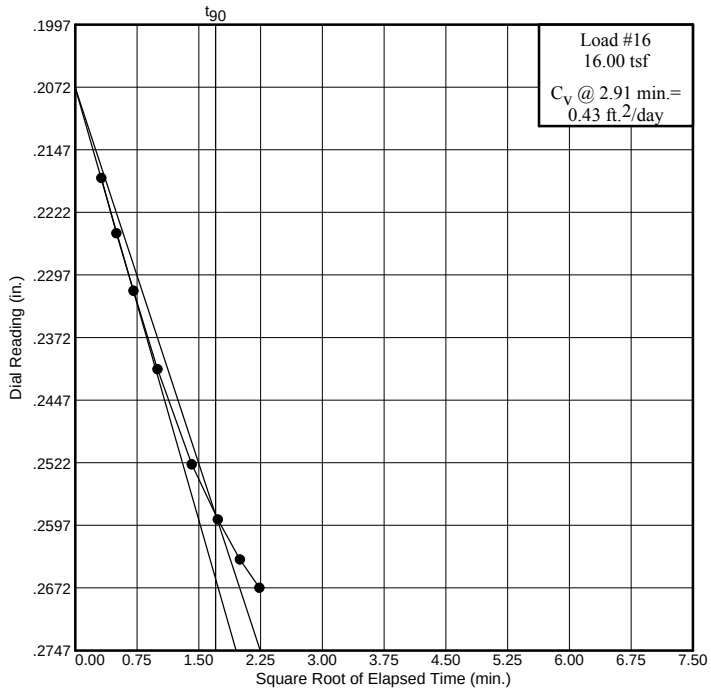
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-27-08 Sample No.: S-23 Elev./Depth: 99.7-99.8









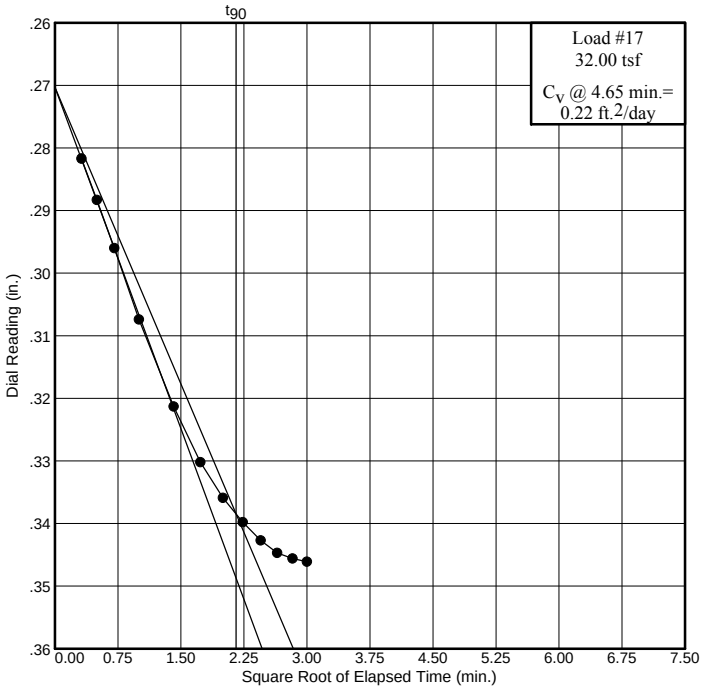
SOIL TECHNOLOGY

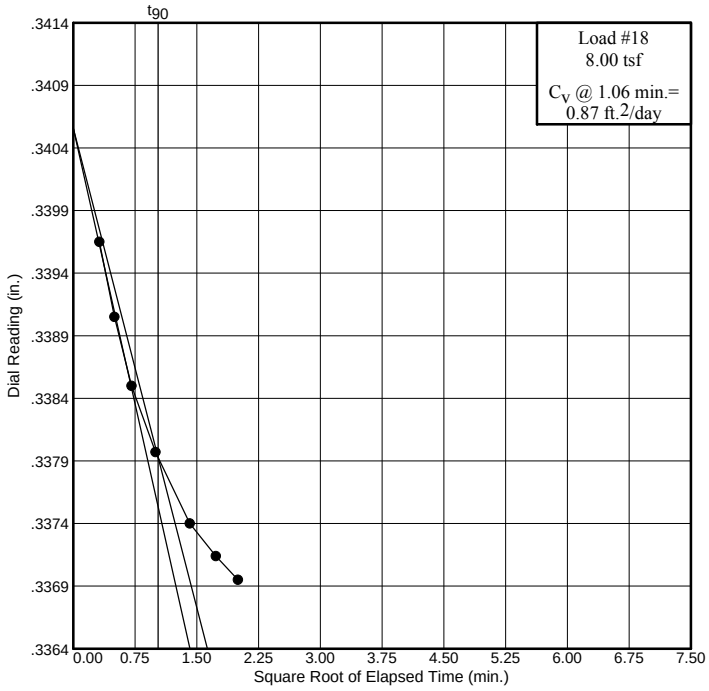
Bainbridge Island, WA

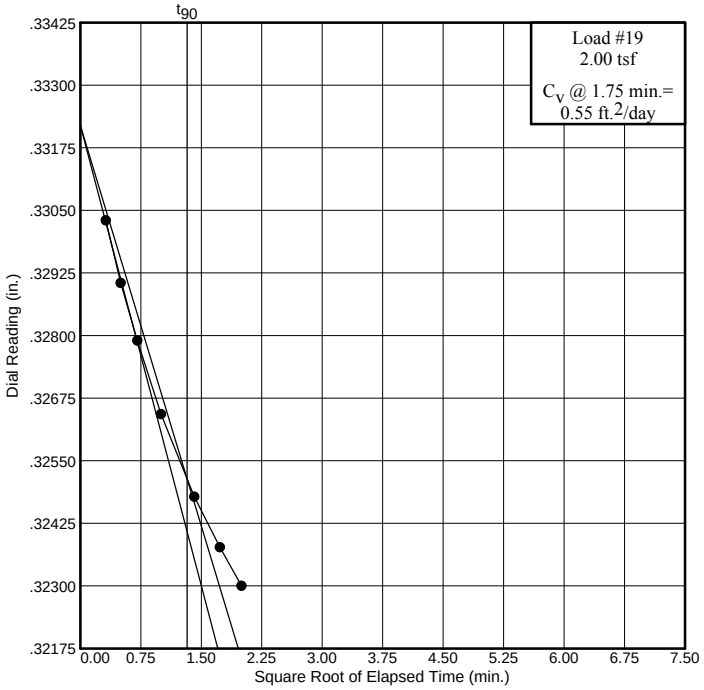
Figure 2.4

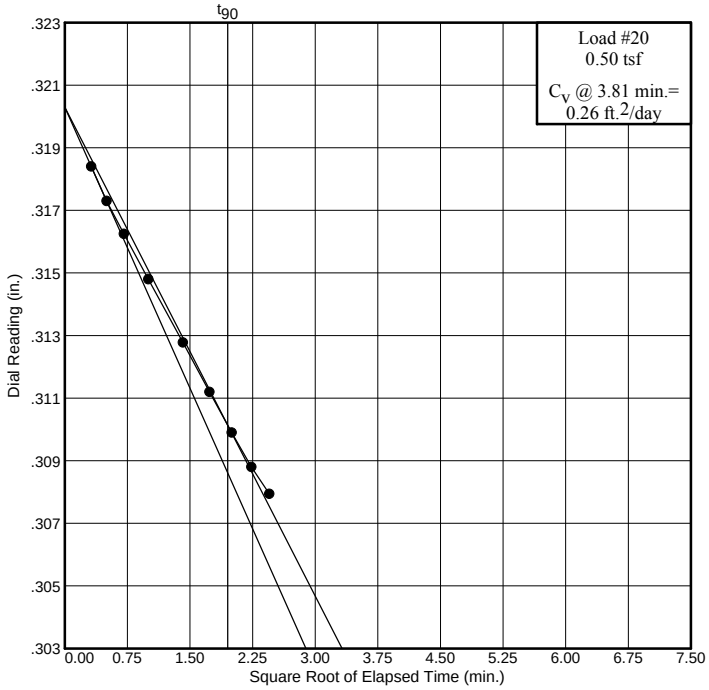
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-27-08 Sample No.: S-23 Elev./Depth: 99.7-99.8







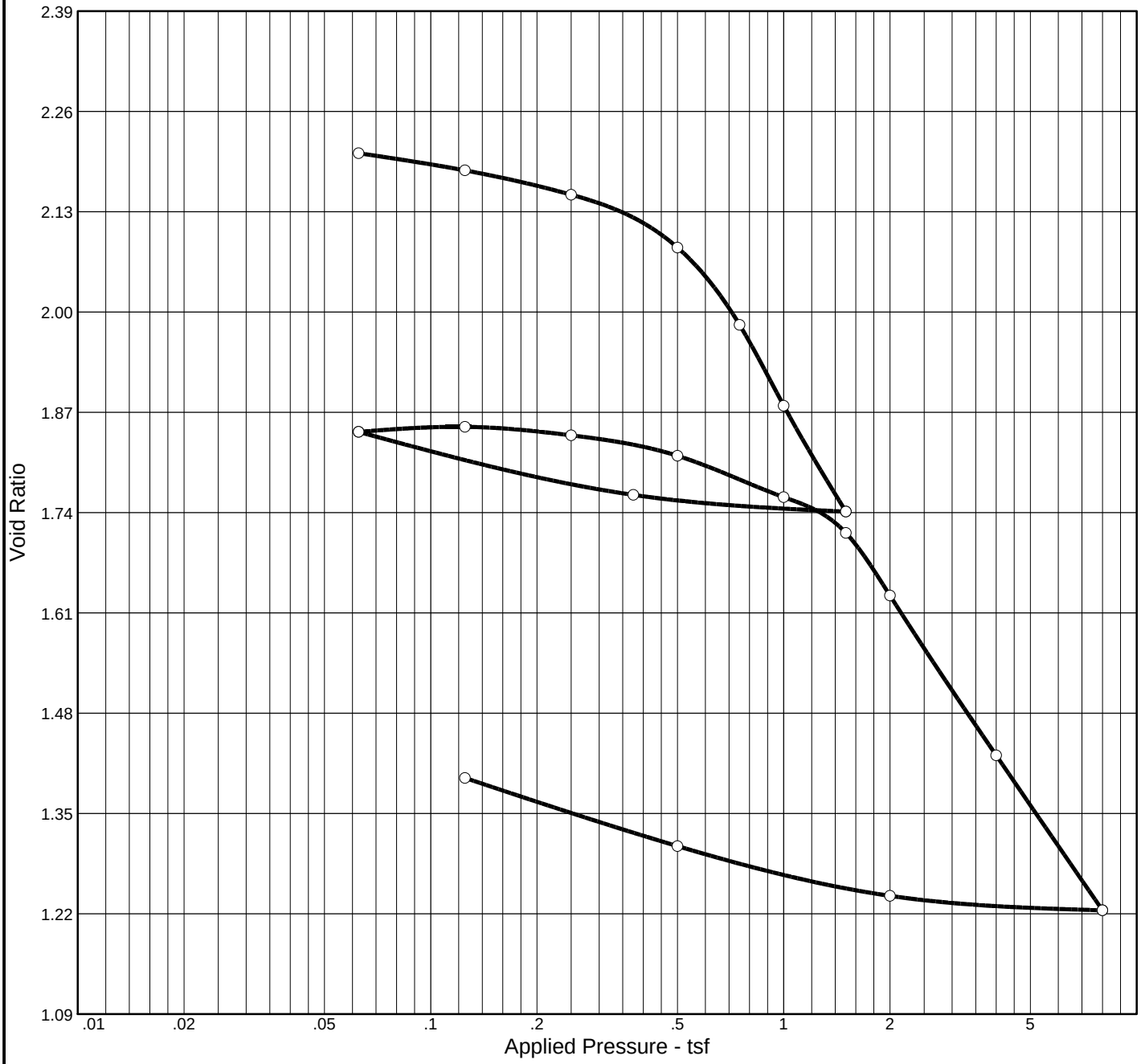


SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 2.5

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.3 %	84.3 %	51.4	80	40	2.66	0.44	0.55	0.74	0.081	2.236

MATERIAL DESCRIPTION	USCS	AASHTO
Soft, wet, grey, Organic SILT	OH	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-29-SW-08 **Sample No.:** S-1 **Elev./Depth:** 15.9-16.0

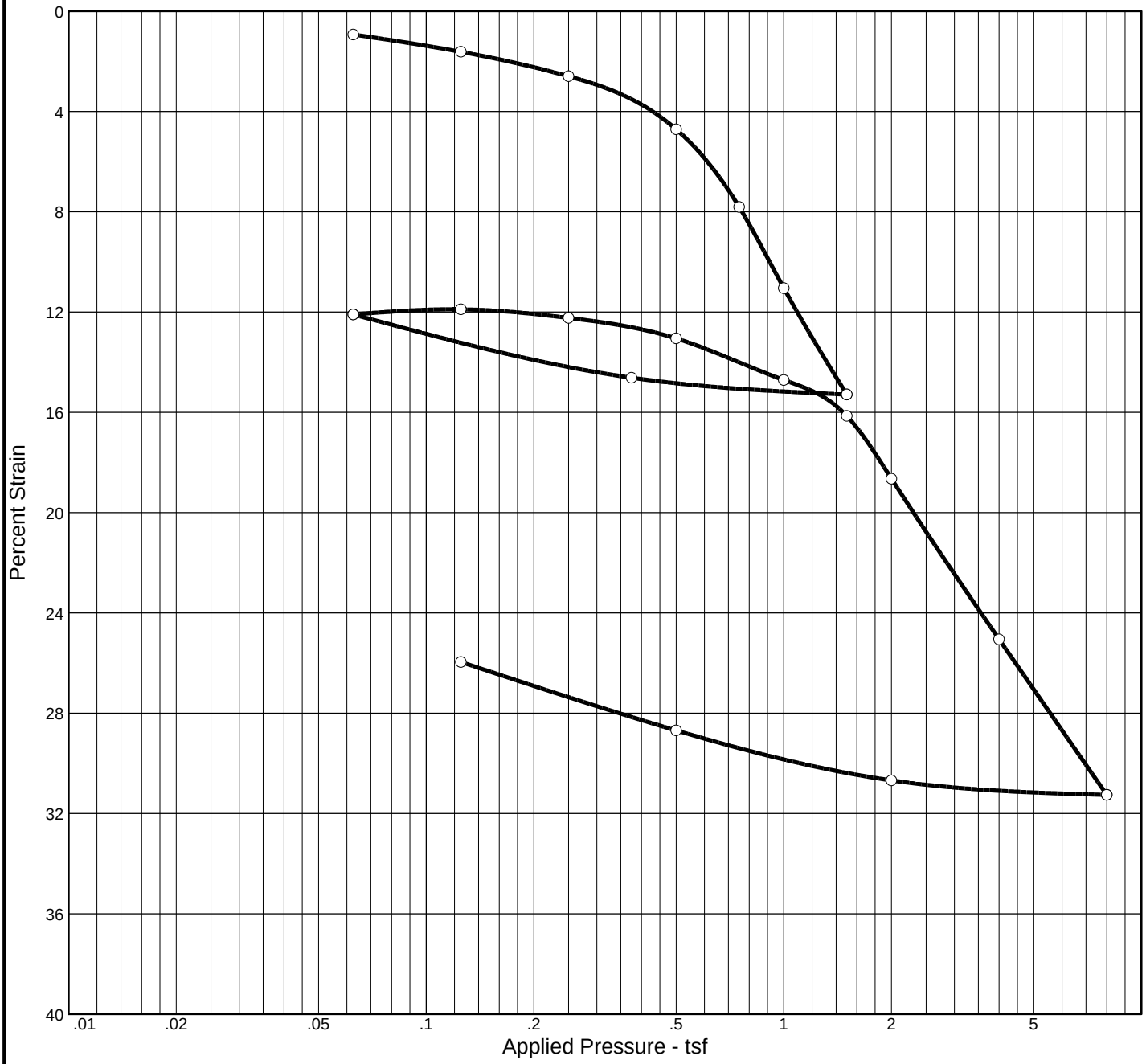
Remarks:
Specific gravity estimated

SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 3.0

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.3 %	84.3 %	51.4	80	40	2.66	0.44	0.55	0.74	0.081	2.236

MATERIAL DESCRIPTION	USCS	AASHTO
Soft, wet, grey, Organic SILT	OH	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-29-SW-08 **Sample No.:** S-1 **Elev./Depth:** 15.9-16.0

Remarks:
Specific gravity estimated

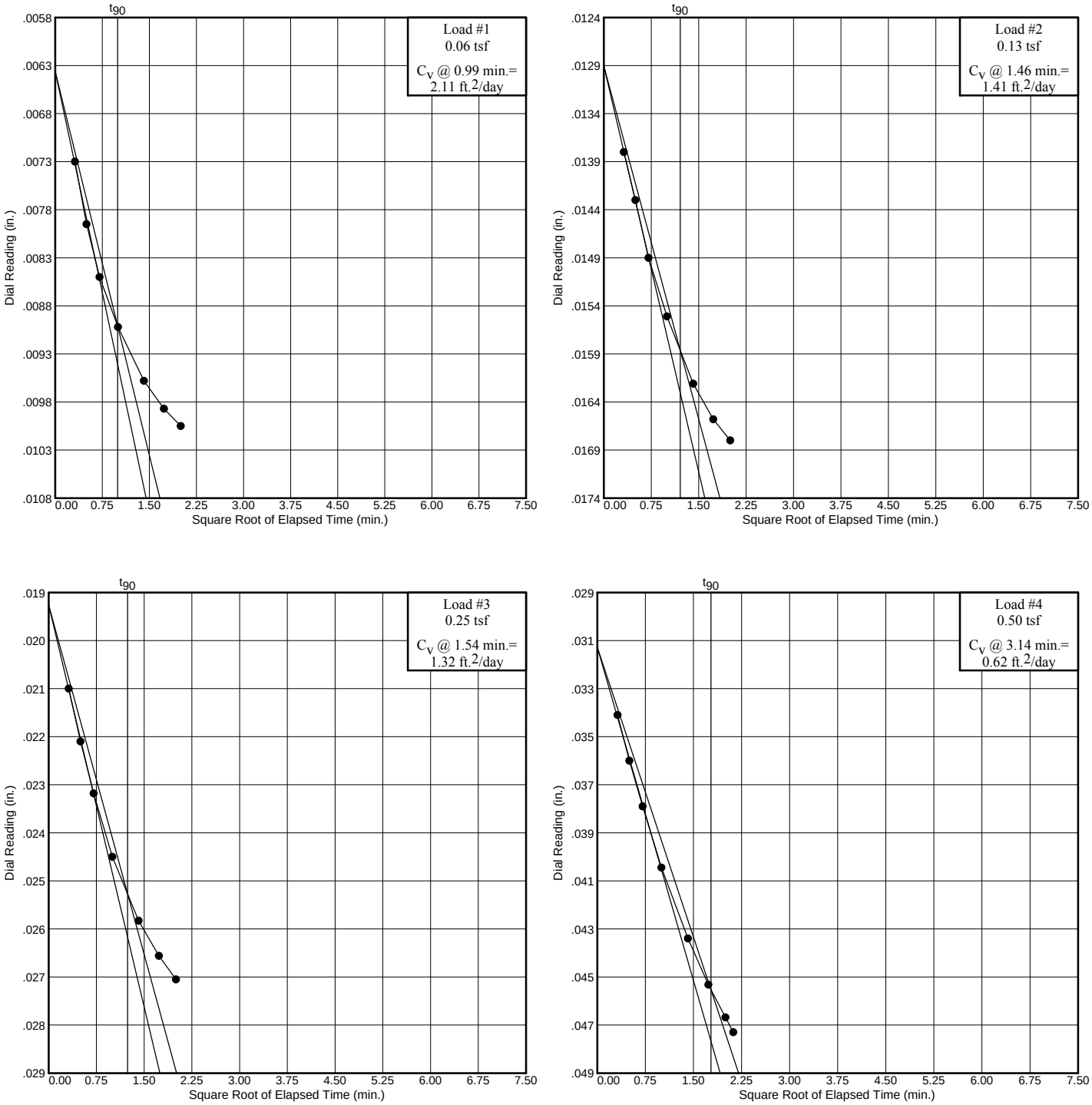
SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 3.1

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-29-SW-08 Sample No.: S-1 Elev./Depth: 15.9-16.0



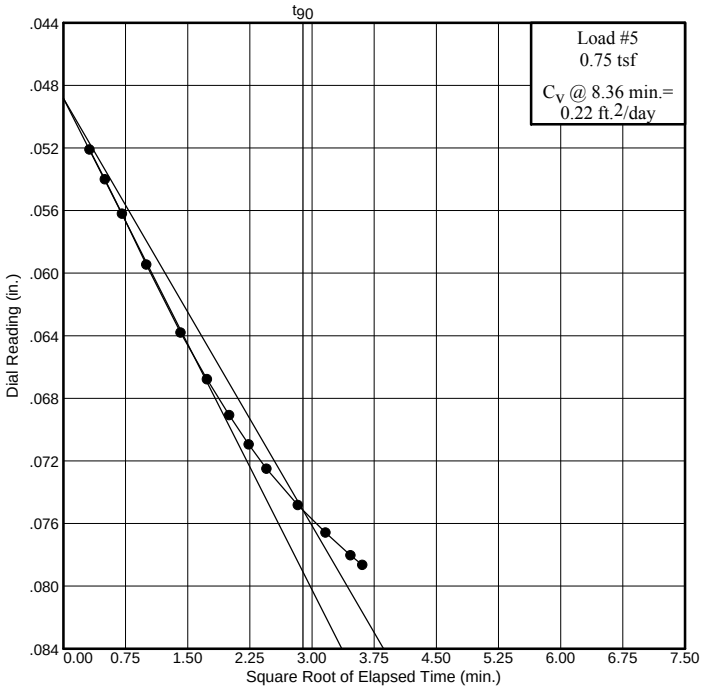
SOIL TECHNOLOGY

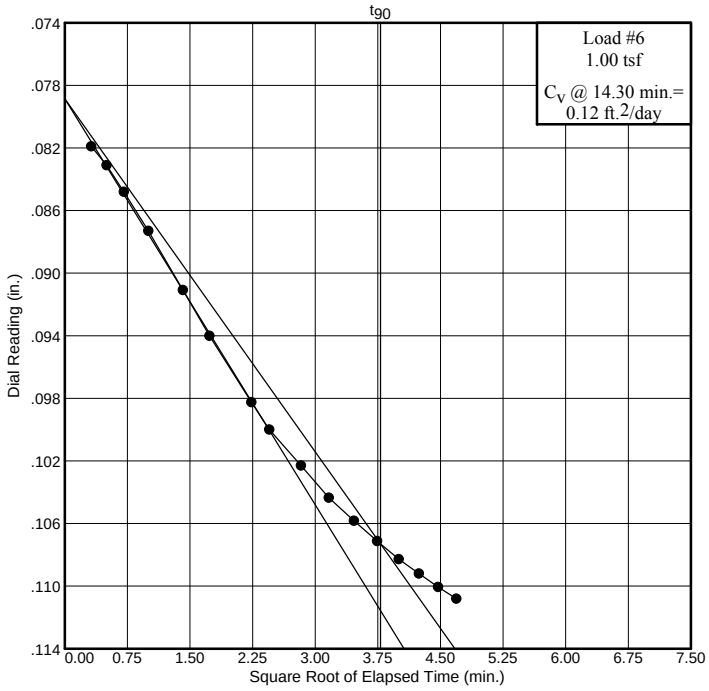
Bainbridge Island, WA

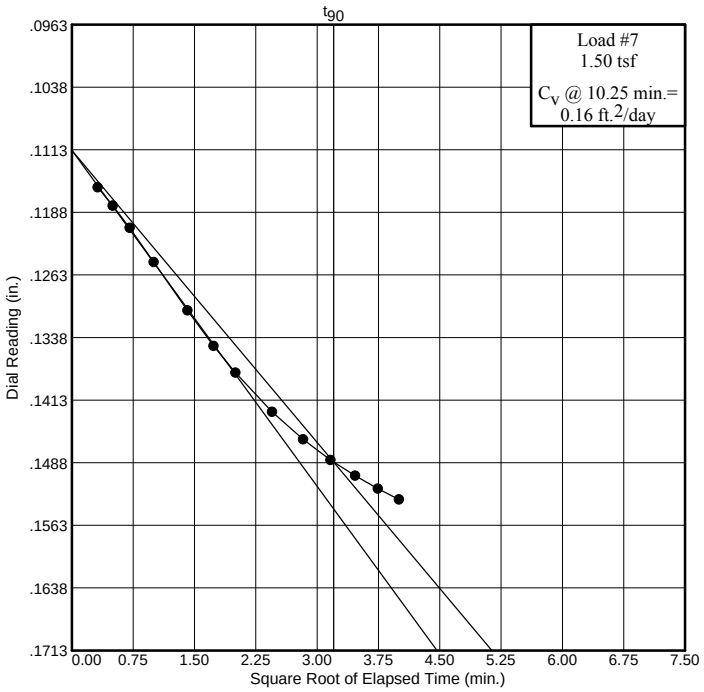
Figure 3.2

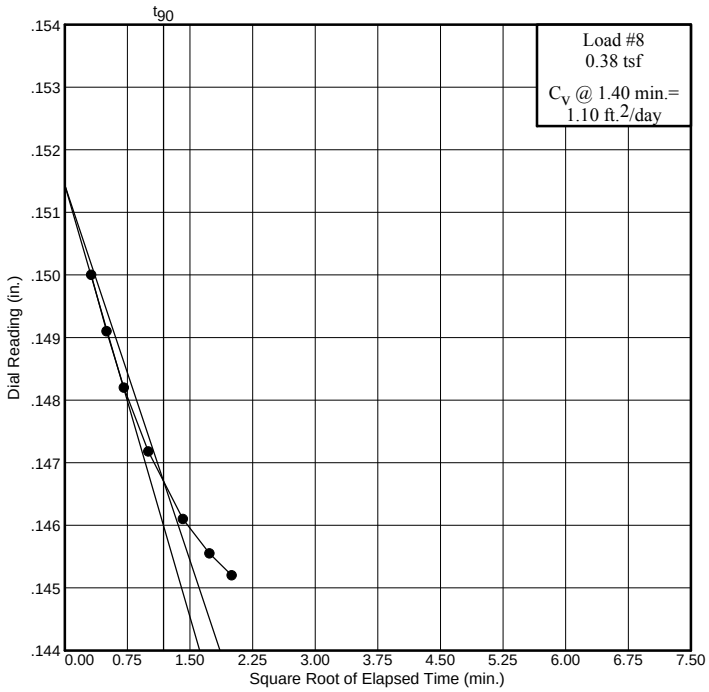
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-29-SW-08 Sample No.: S-1 Elev./Depth: 15.9-16.0









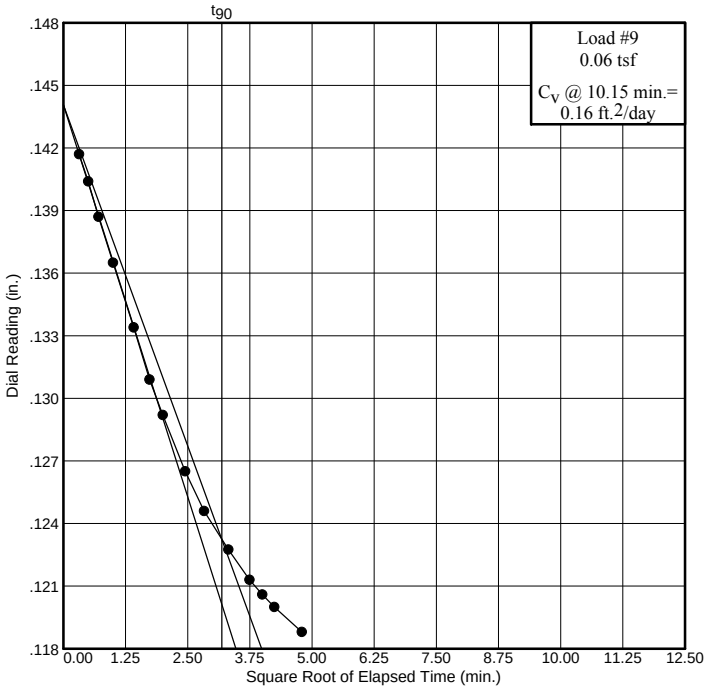
SOIL TECHNOLOGY

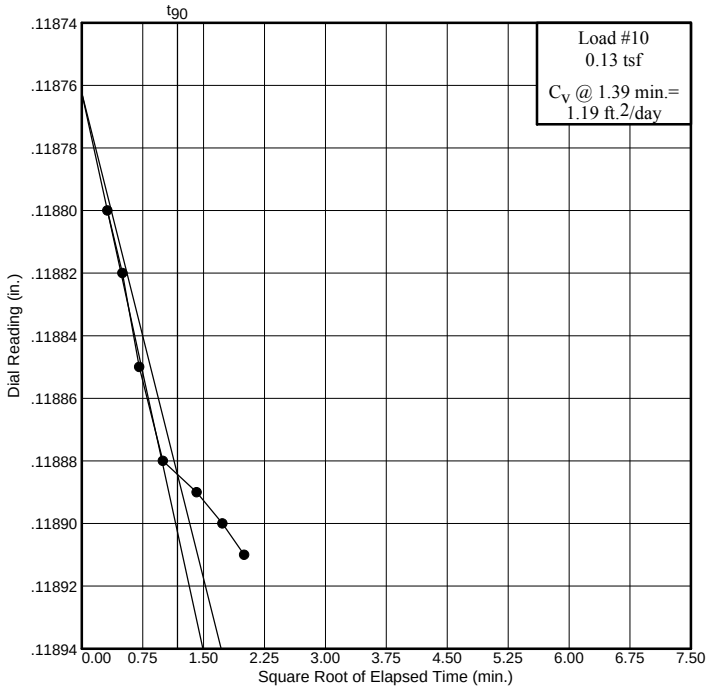
Bainbridge Island, WA

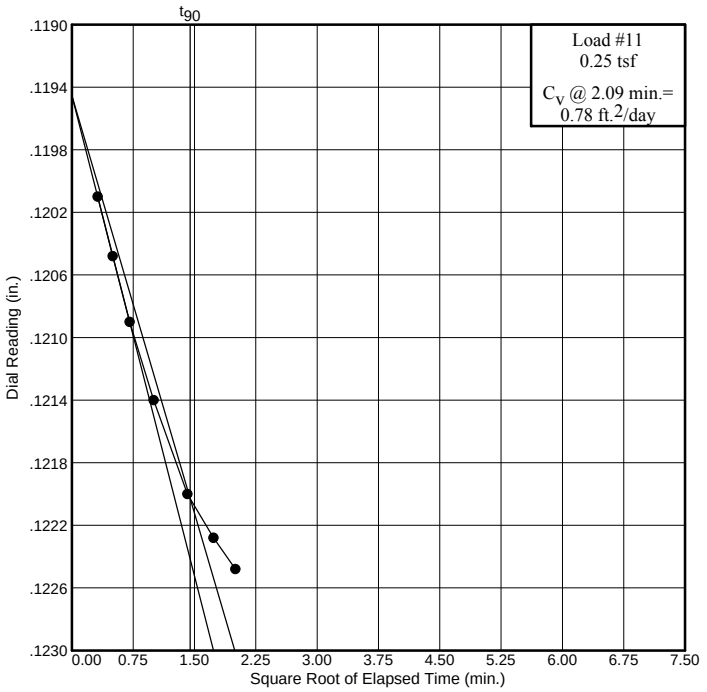
Figure 3.3

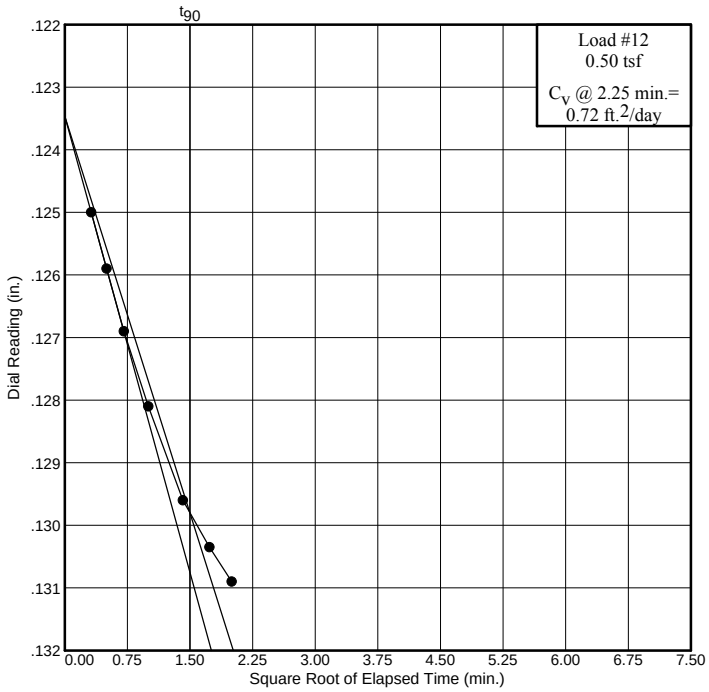
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-29-SW-08 Sample No.: S-1 Elev./Depth: 15.9-16.0









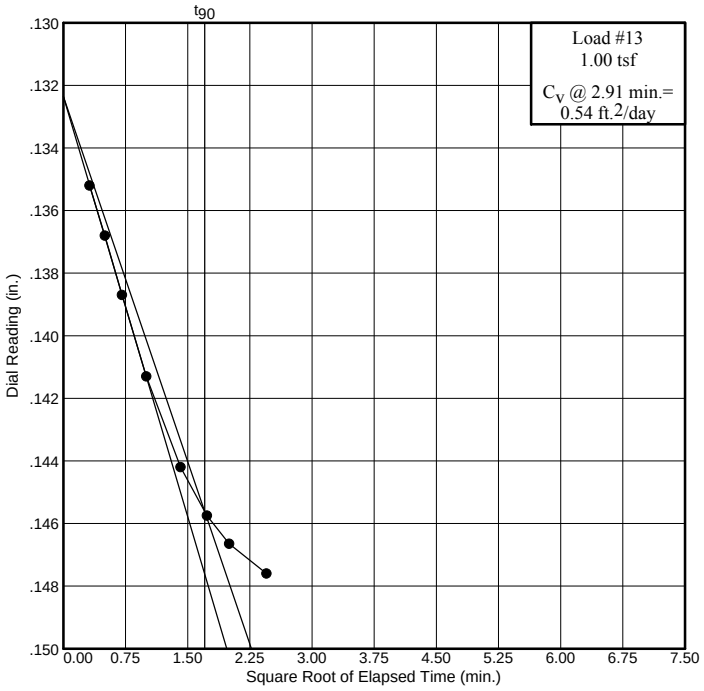
SOIL TECHNOLOGY

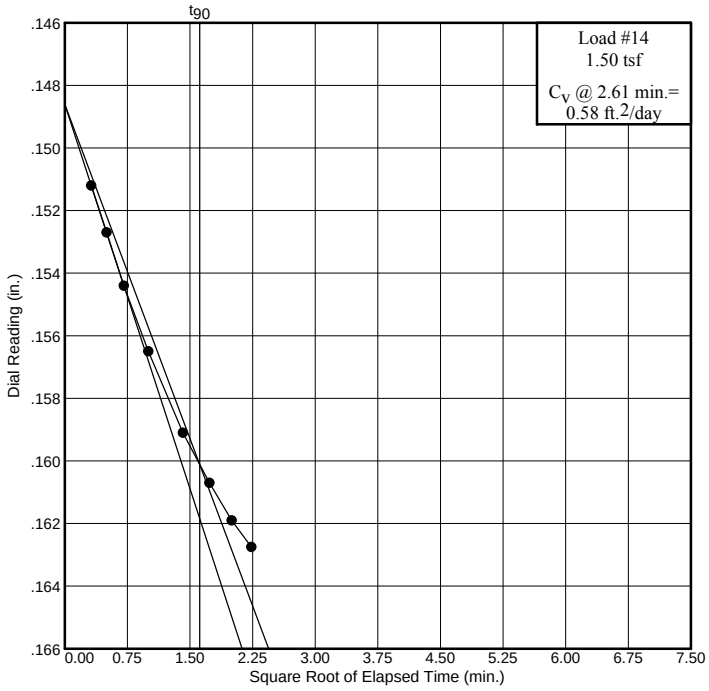
Bainbridge Island, WA

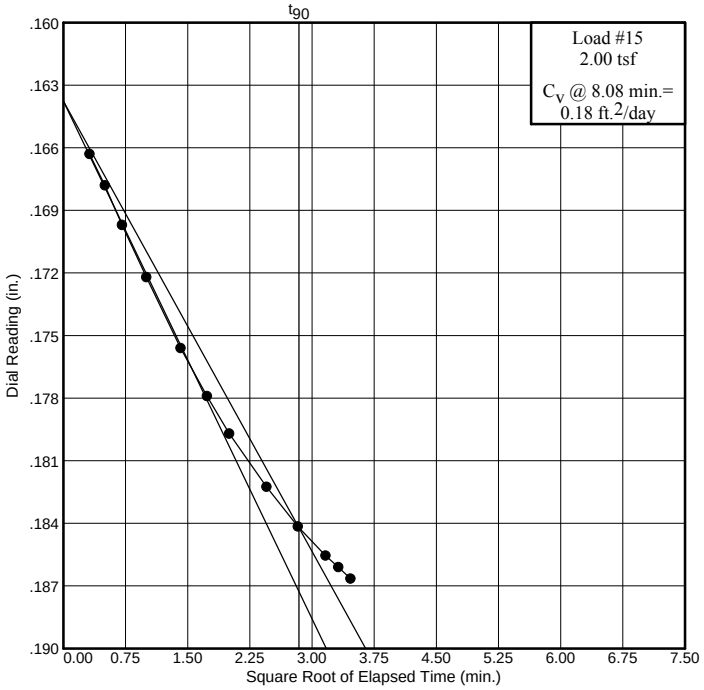
Figure 3.4

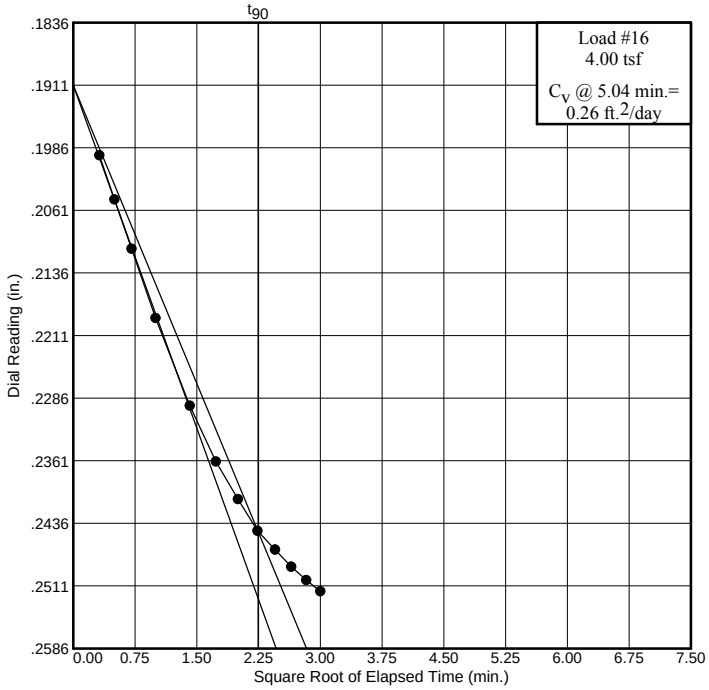
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-29-SW-08 Sample No.: S-1 Elev./Depth: 15.9-16.0









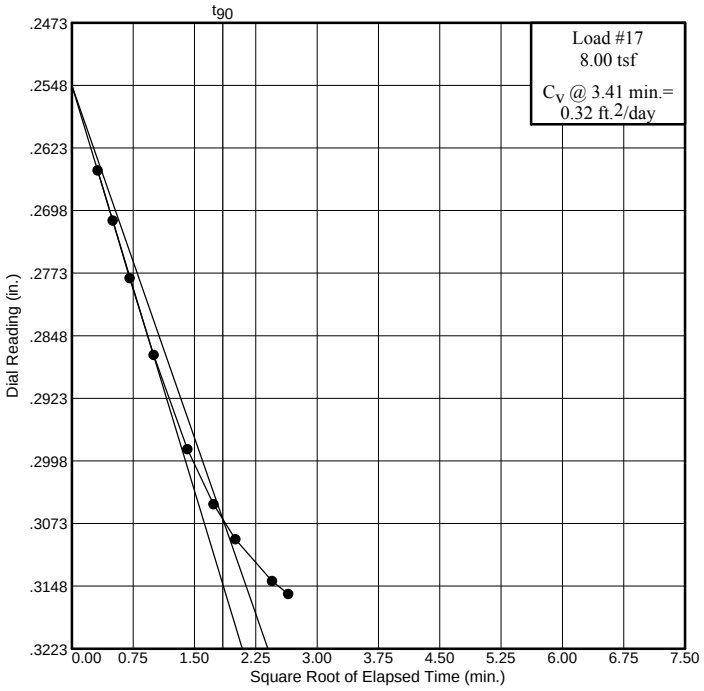
SOIL TECHNOLOGY

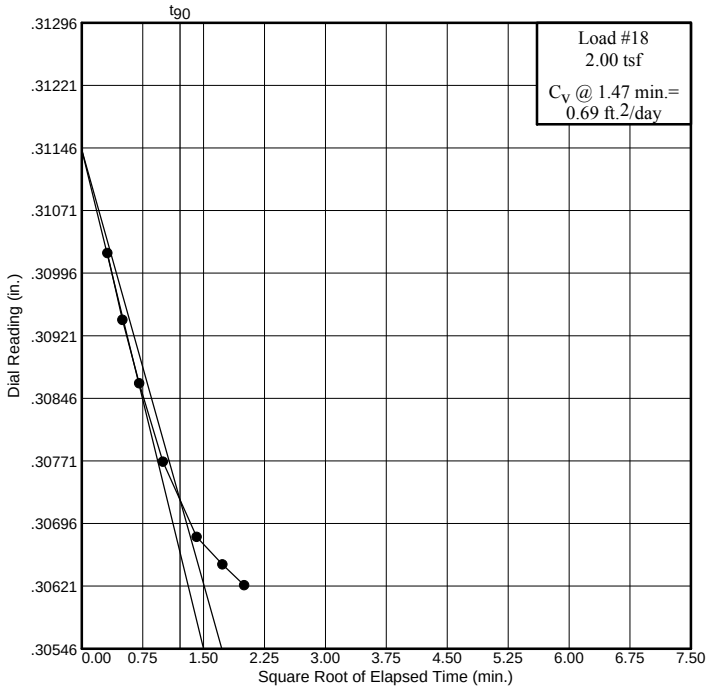
Bainbridge Island, WA

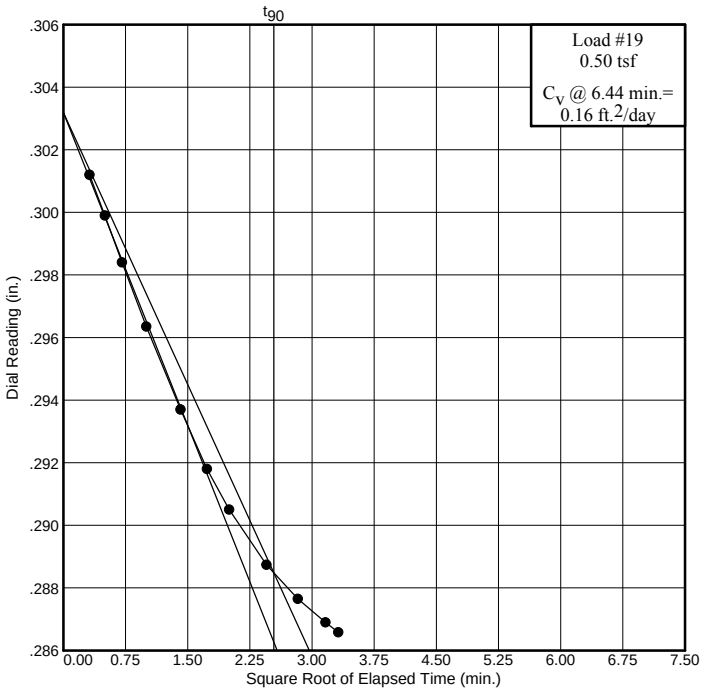
Figure 3.5

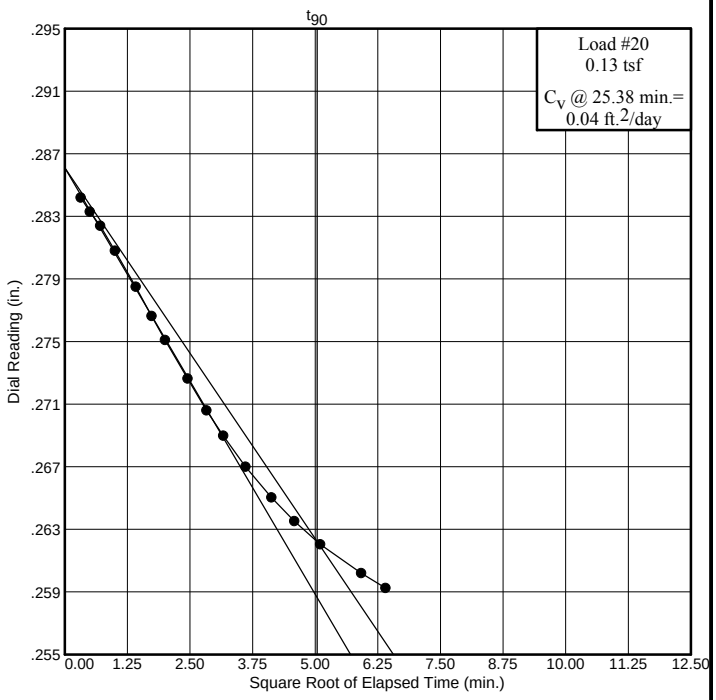
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-29-SW-08 Sample No.: S-1 Elev./Depth: 15.9-16.0







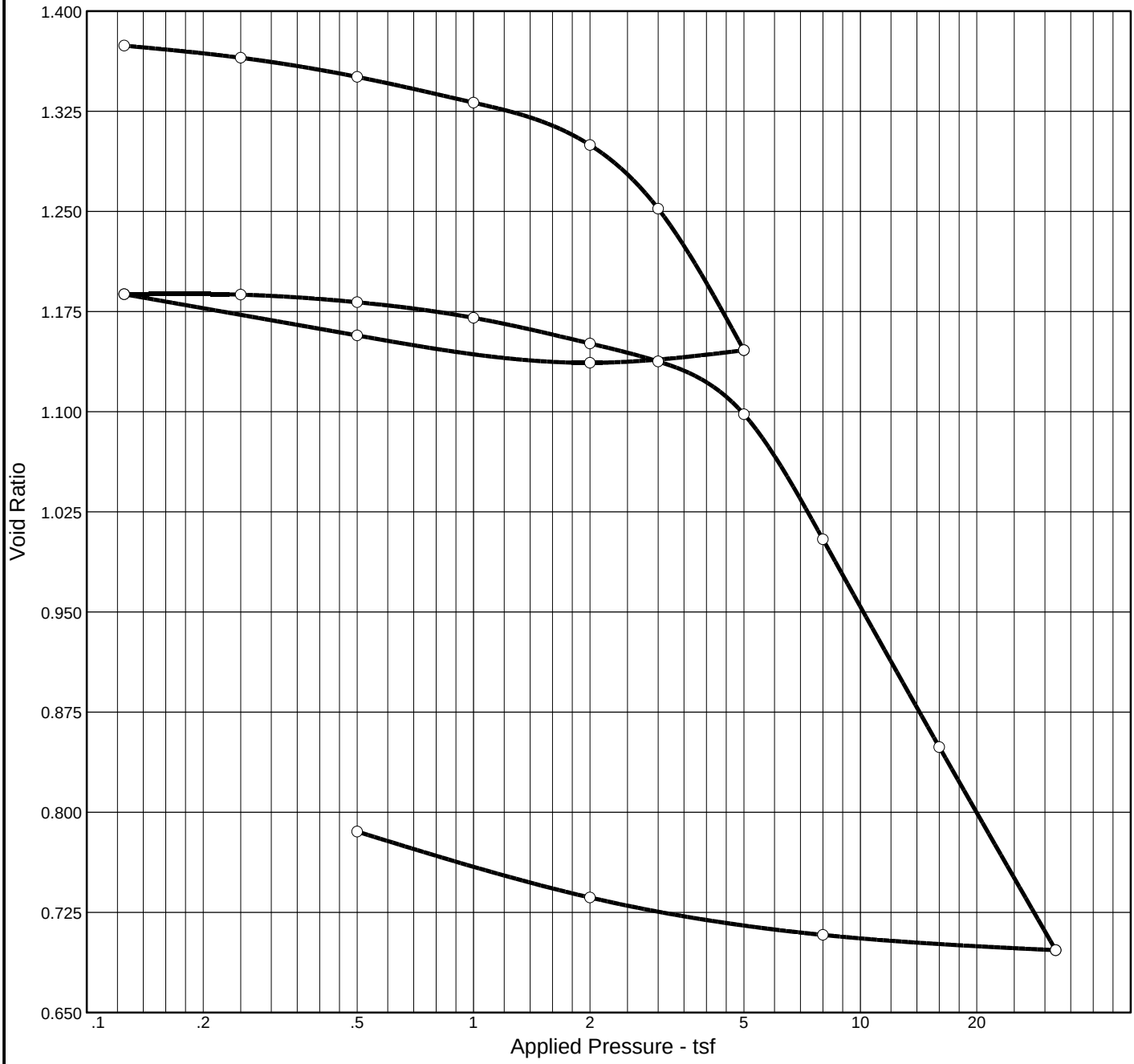


SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 3.6

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.0 %	53.9	67.4	59	25	2.58	2.51	3.00	0.55	0.036	1.392

MATERIAL DESCRIPTION	USCS	AASHTO
M-stiff, wet, grey, Organic SILT	OH	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-29-SW-08 **Sample No.:** S-10 **Elev./Depth:** 105.1-105.2

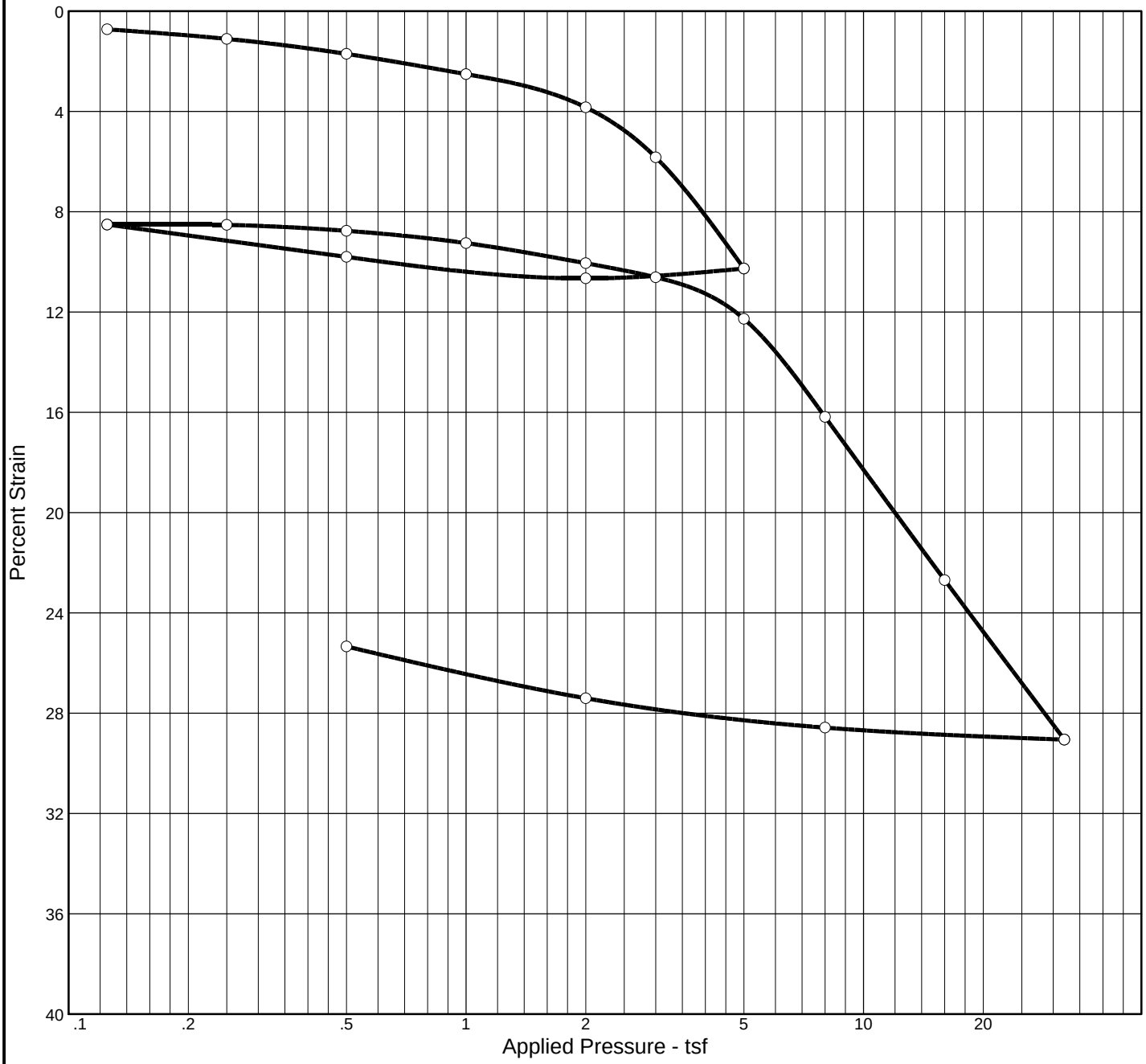
Remarks:
Specific gravity estimated

SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 4.0

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.0 %	53.9	67.4	59	25	2.5	2.51	3.00	0.55	0.036	1.392

MATERIAL DESCRIPTION	USCS	AASHTO
M-stiff, wet, grey, Organic SILT	OH	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-29-SW-08 **Sample No.:** S-10 **Elev./Depth:** 105.1-105.2

Remarks:
Specific gravity estimated

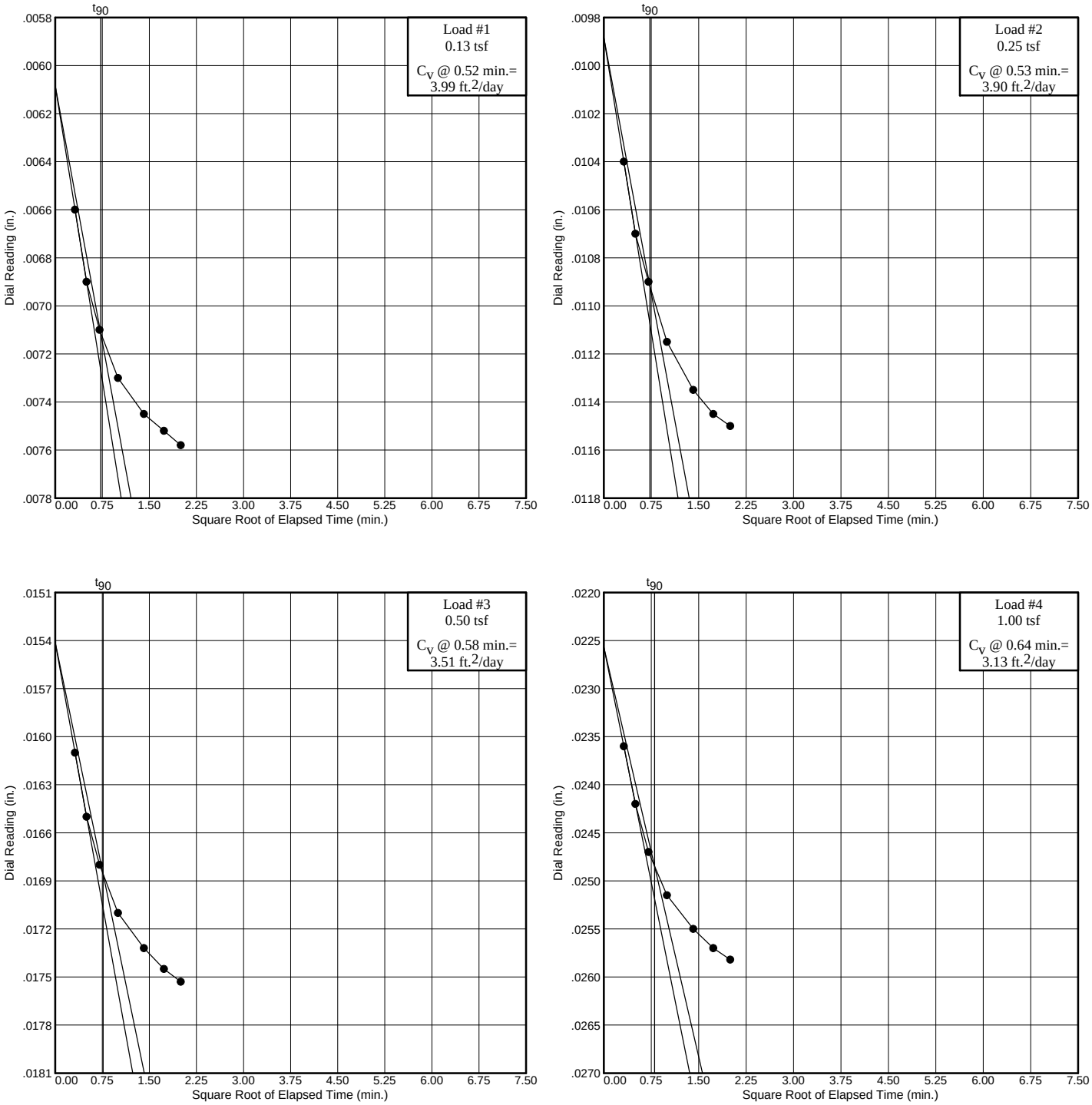
SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 4.1

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-29-SW-08 Sample No.: S-10 Elev./Depth: 105.1-105.2



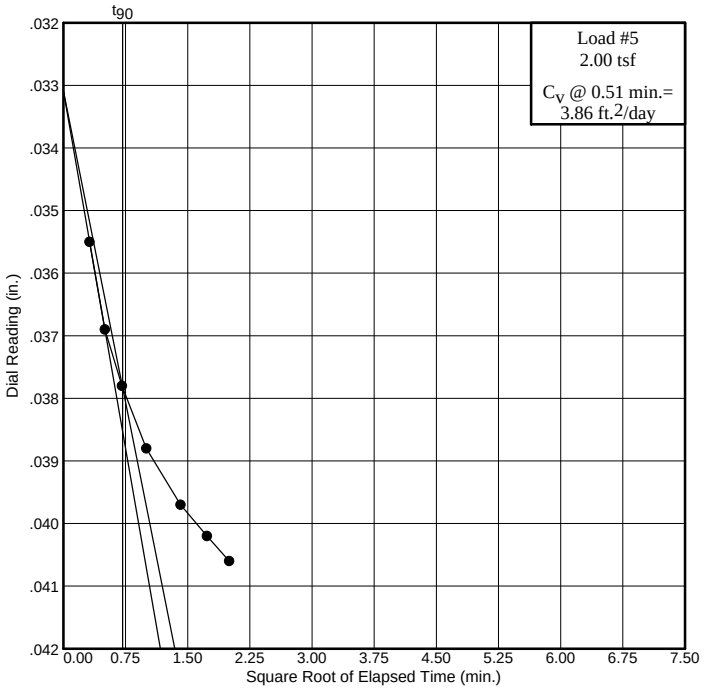
SOIL TECHNOLOGY

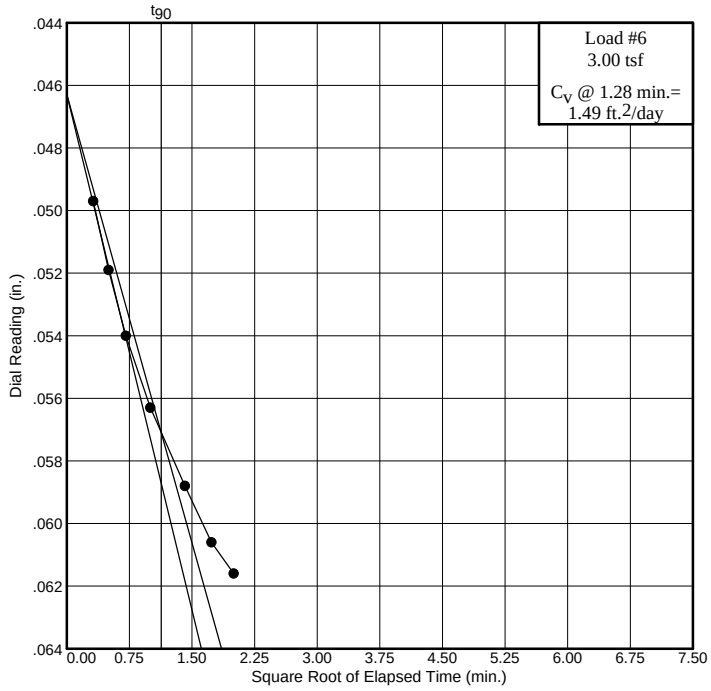
Bainbridge Island, WA

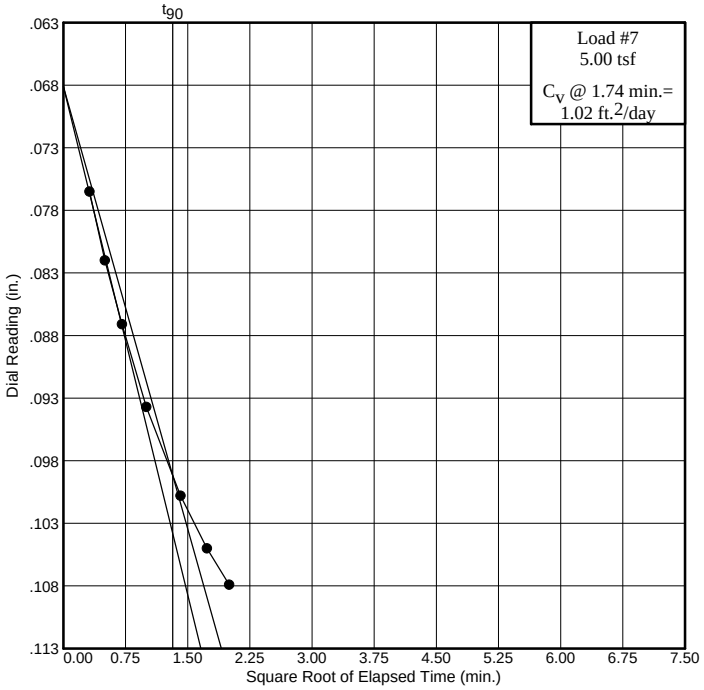
Figure 4.2

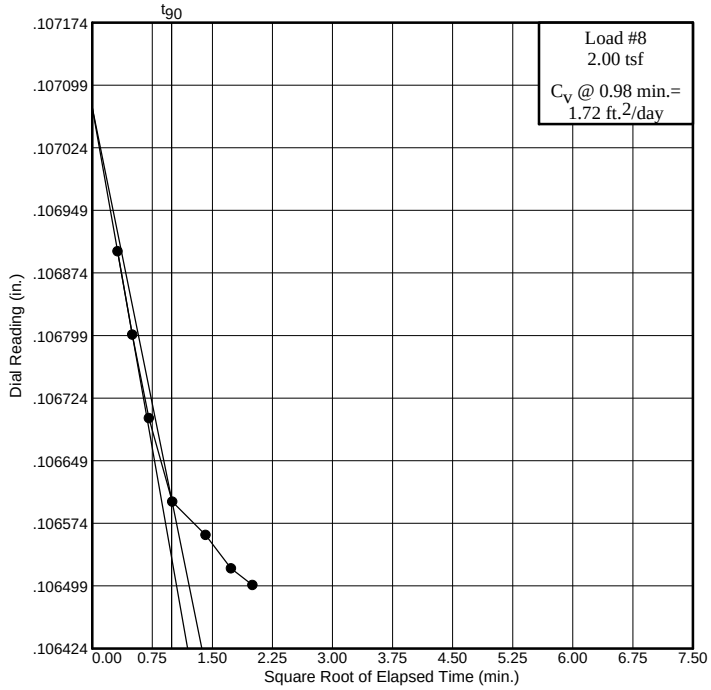
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-29-SW-08 Sample No.: S-10 Elev./Depth: 105.1-105.2









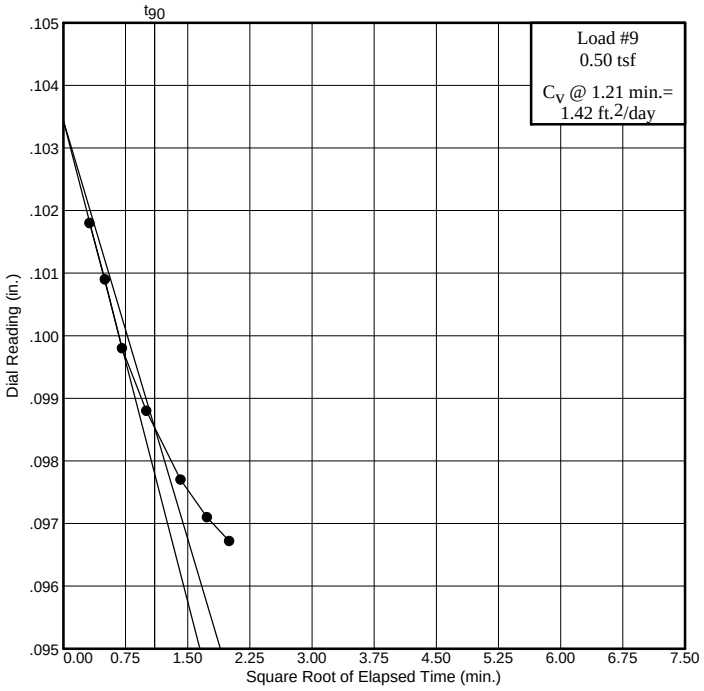
SOIL TECHNOLOGY

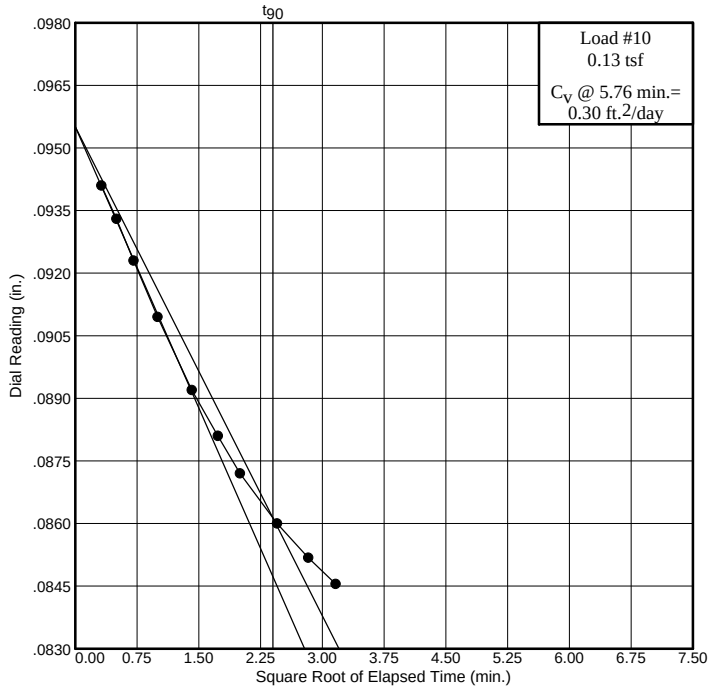
Bainbridge Island, WA

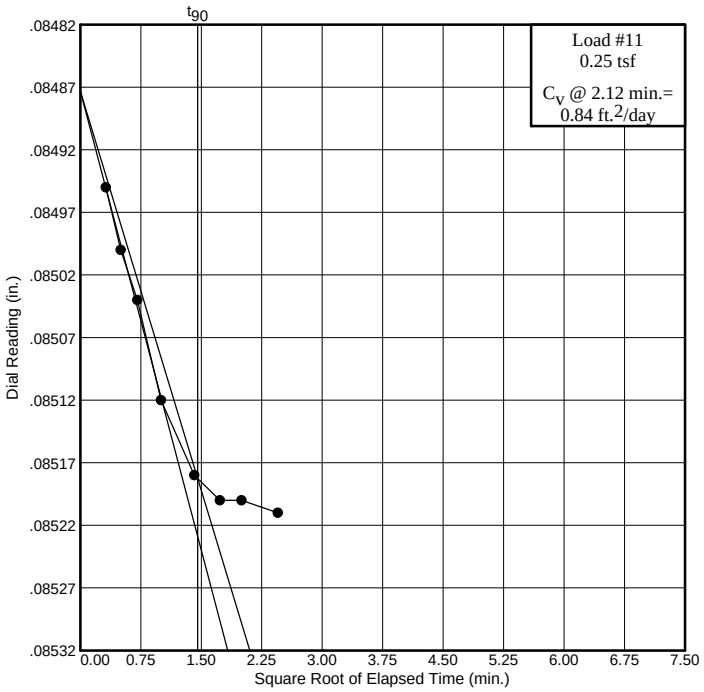
Figure 4.3

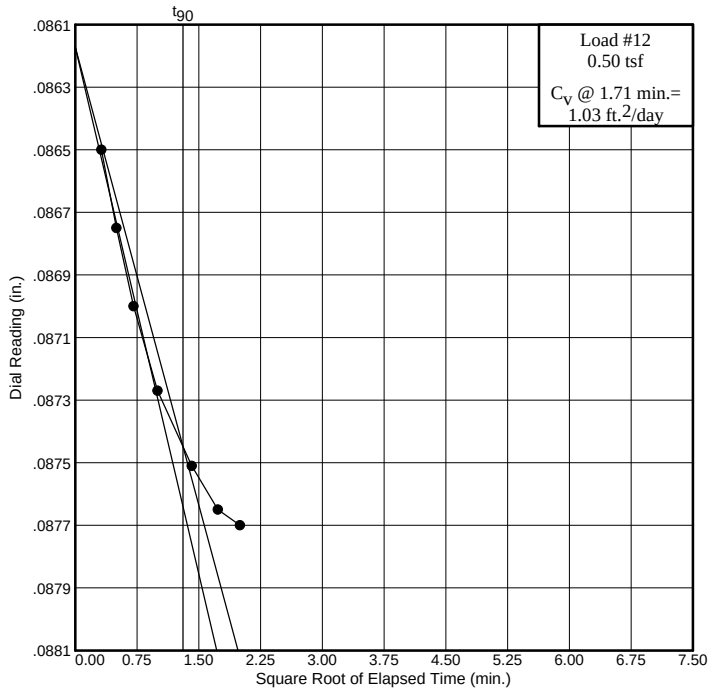
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-29-SW-08 Sample No.: S-10 Elev./Depth: 105.1-105.2









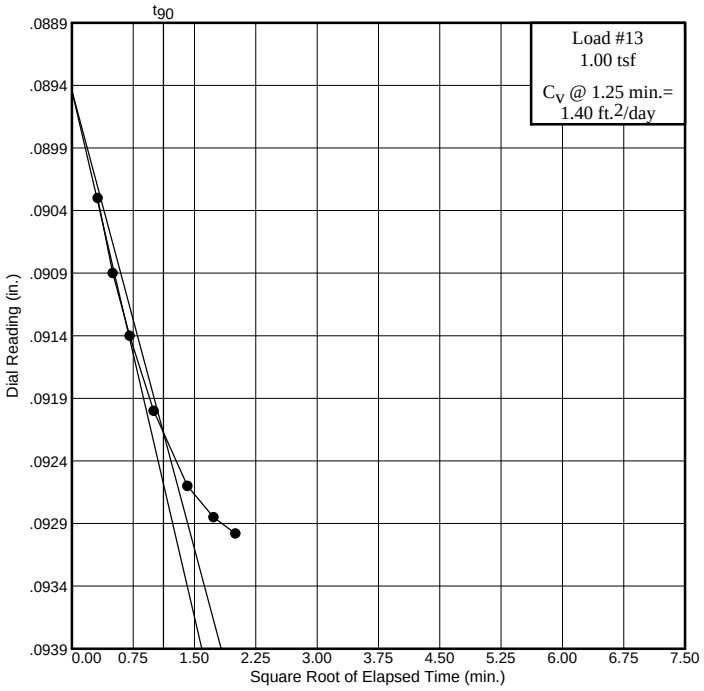
SOIL TECHNOLOGY

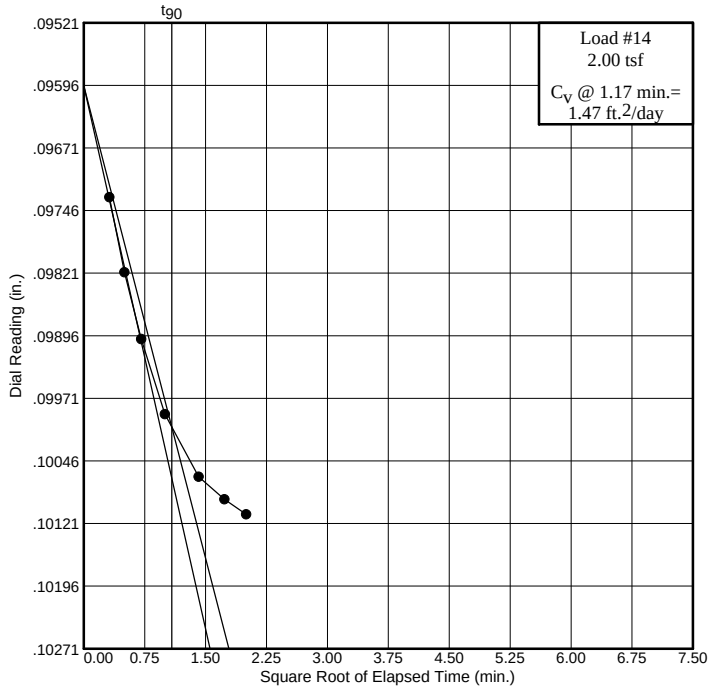
Bainbridge Island, WA

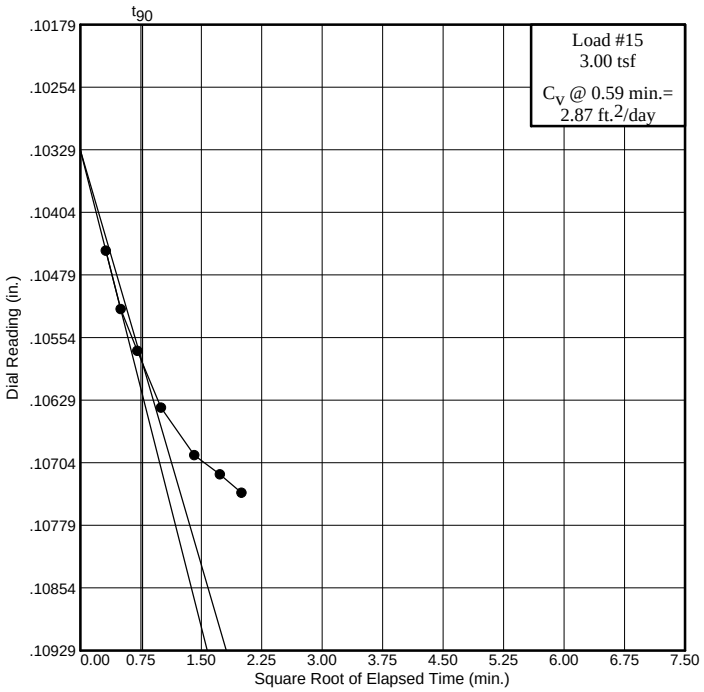
Figure 4.4

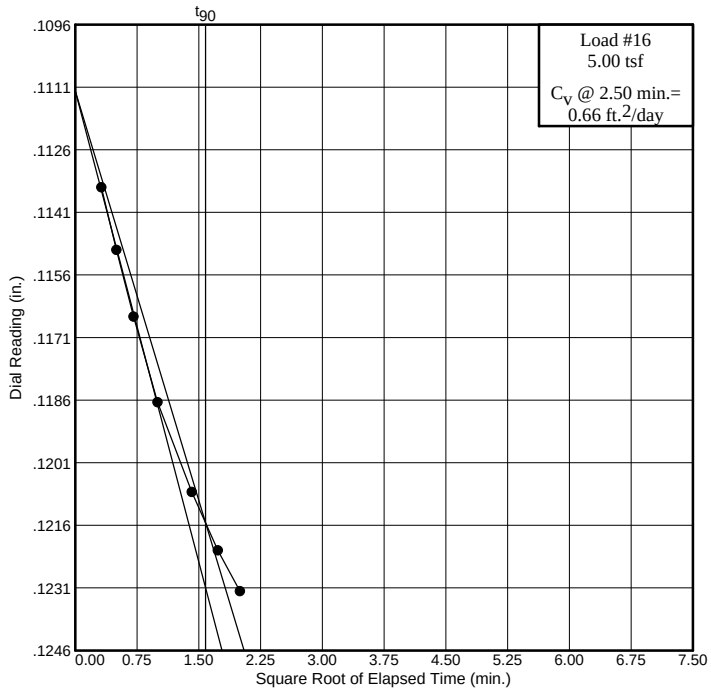
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-29-SW-08 Sample No.: S-10 Elev./Depth: 105.1-105.2









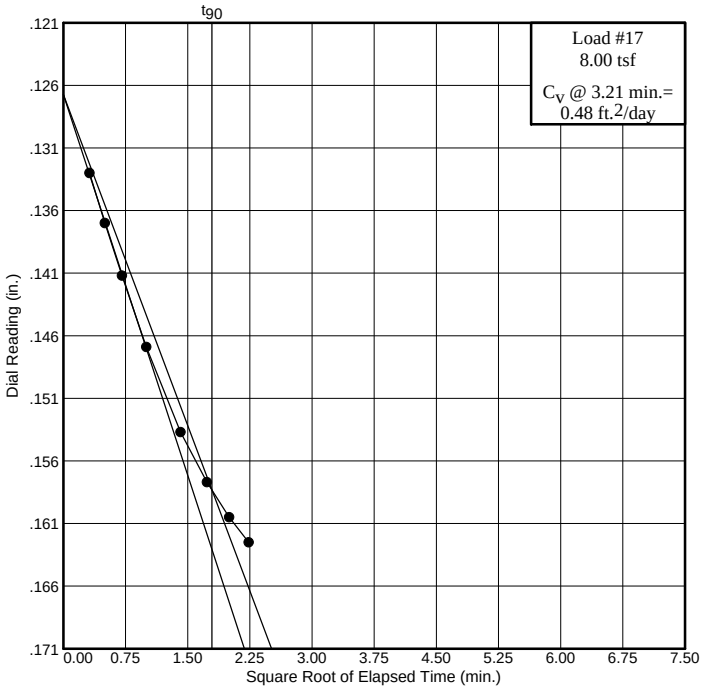
SOIL TECHNOLOGY

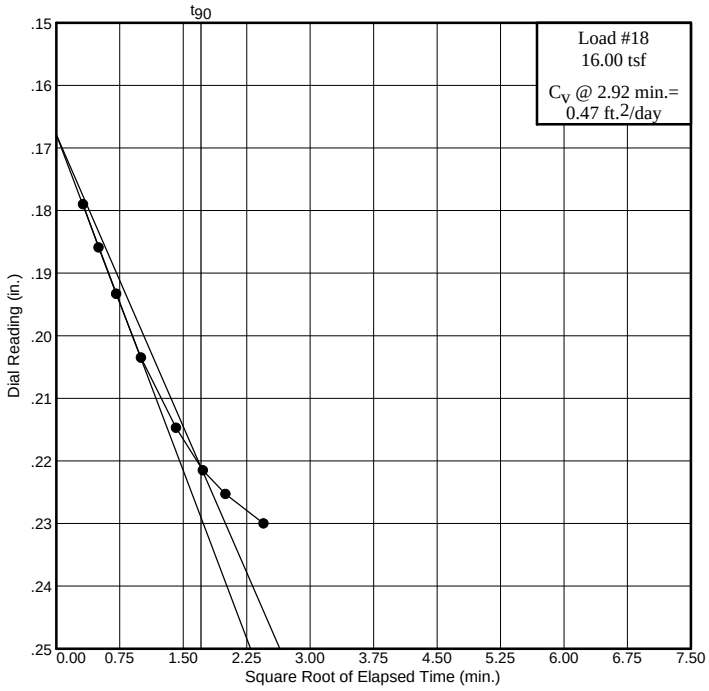
Bainbridge Island, WA

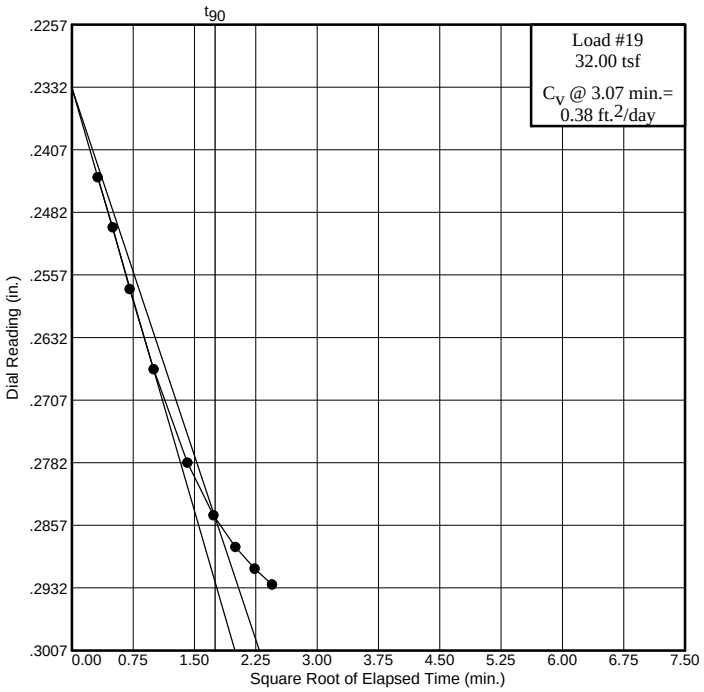
Figure 4.5

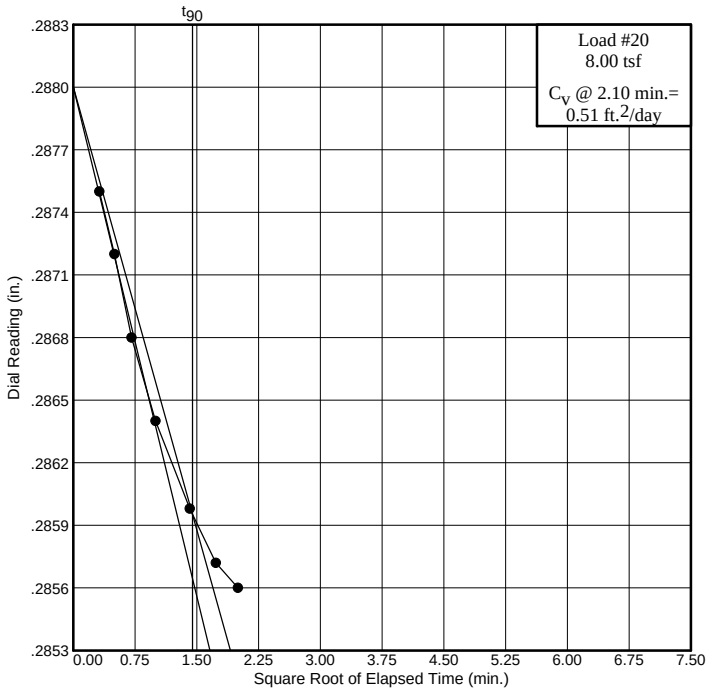
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-29-SW-08 Sample No.: S-10 Elev./Depth: 105.1-105.2









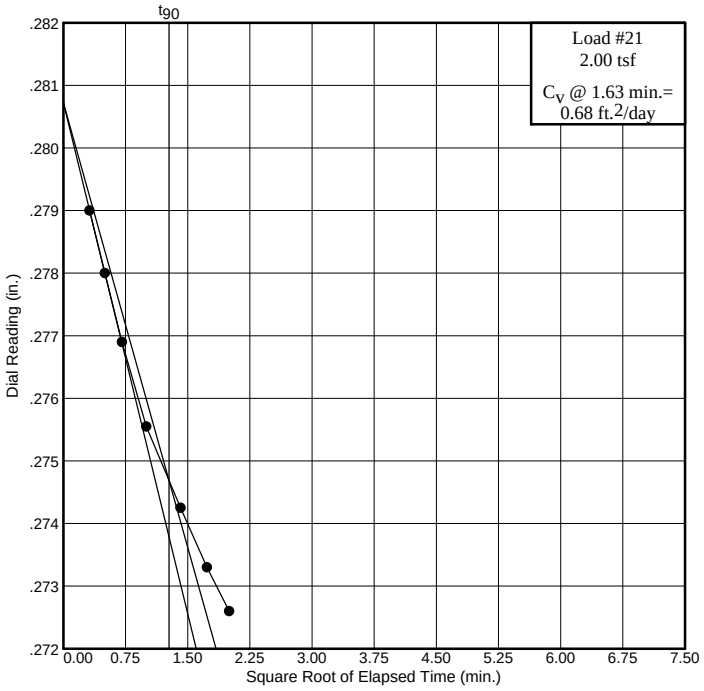
SOIL TECHNOLOGY

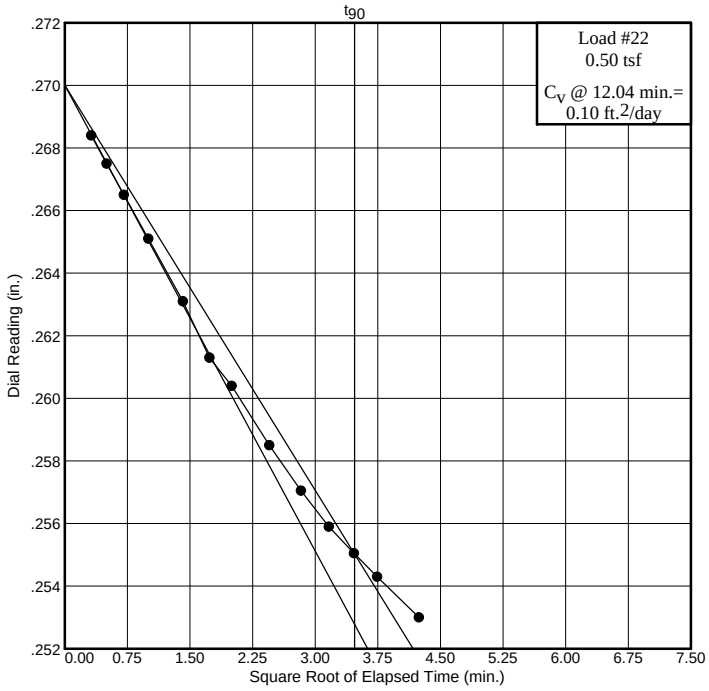
Bainbridge Island, WA

Figure 4.6

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-29-SW-08 Sample No.: S-10 Elev./Depth: 105.1-105.2



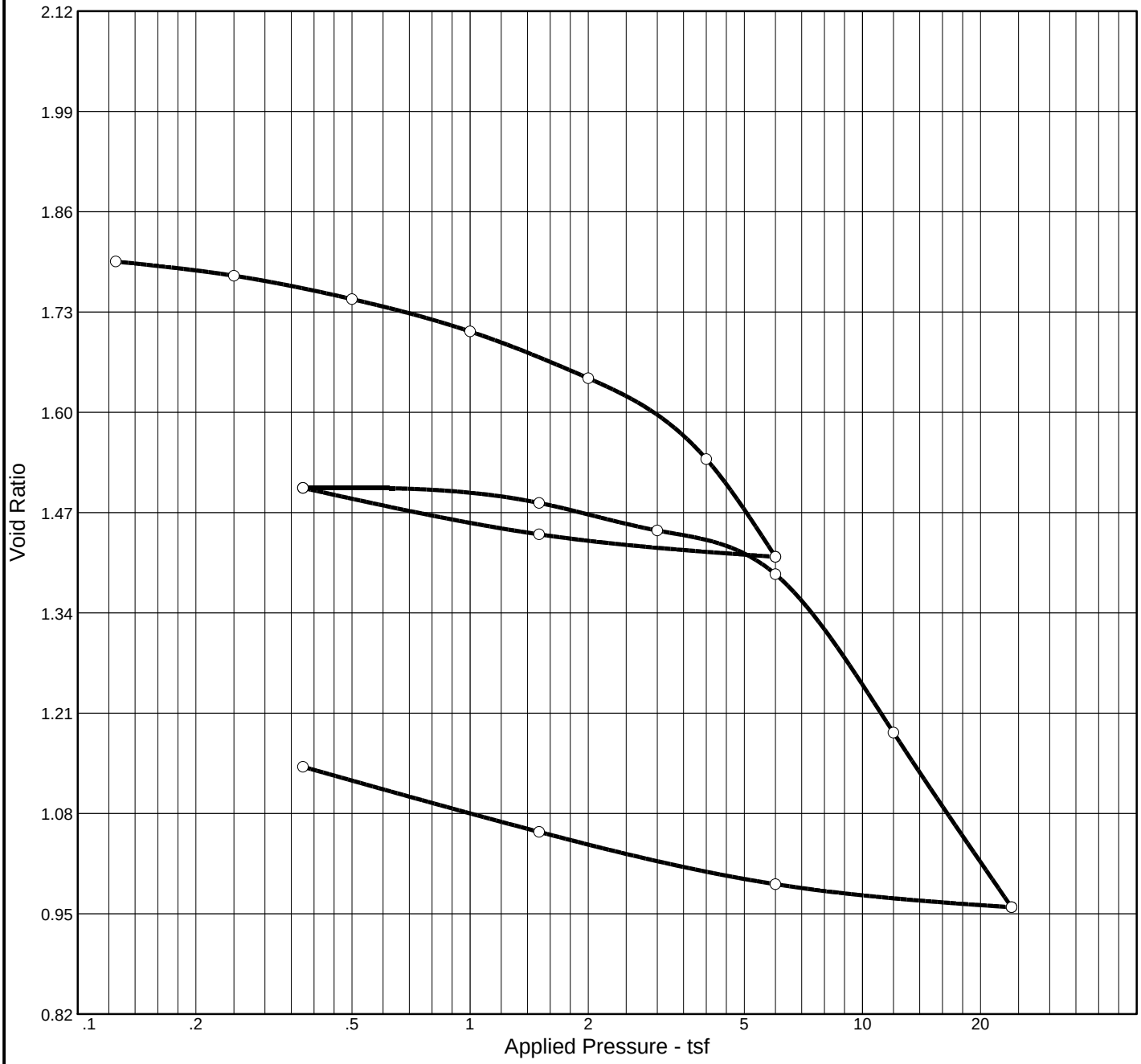


SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 4.7

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.1 %	70.7 %	56.6	74	37	2.55	2.86	3.50	0.73	0.09	1.819

MATERIAL DESCRIPTION	USCS	AASHTO
M-Stiff, wet, grey, Organic SILT	MH	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-30-SW-08 **Sample No.:** S-15 **Elev./Depth:** 124.5-124.6

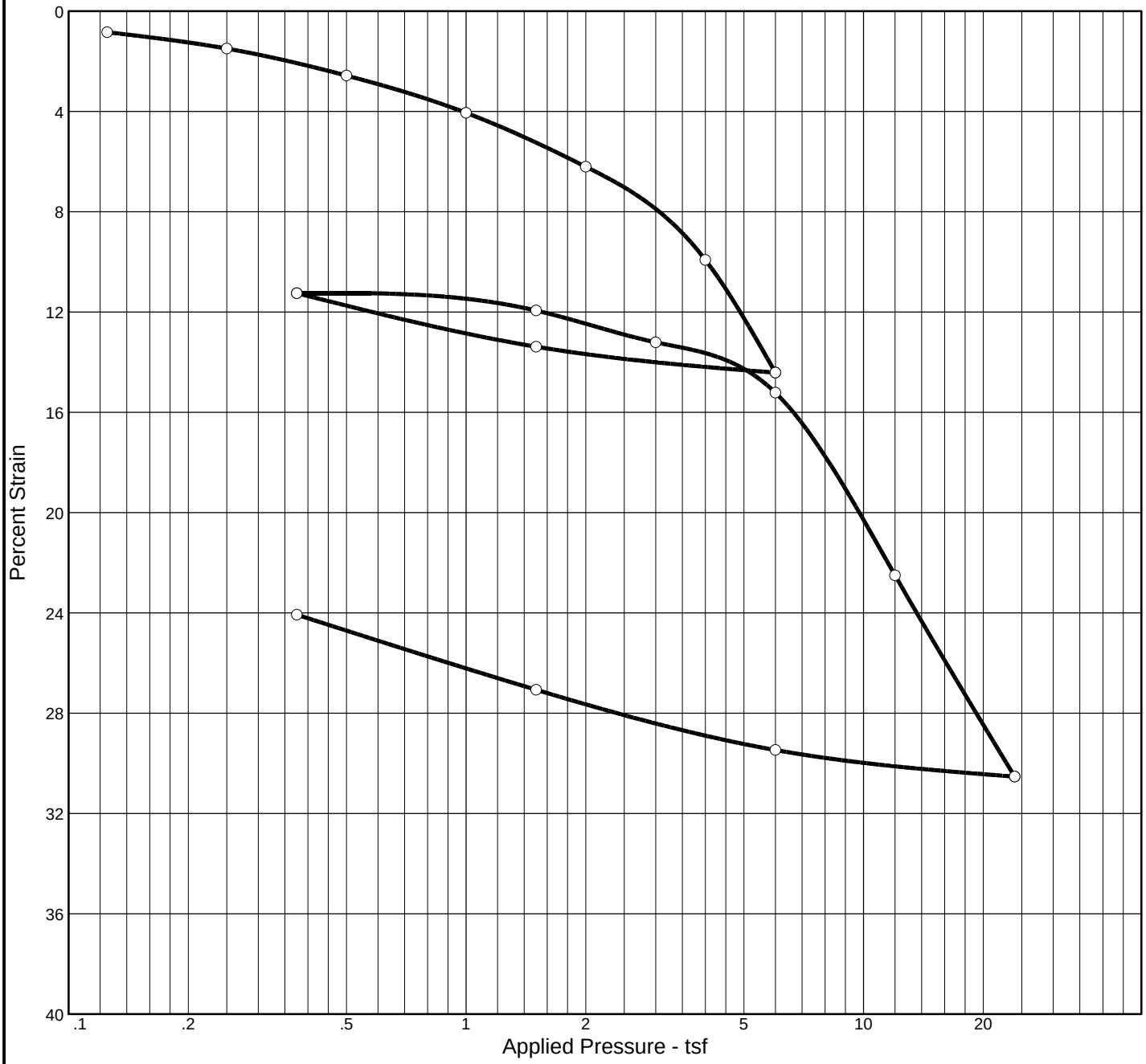
Remarks:
Specific gravity estimated

SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 5.0

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.1 %	70.7 %	56.6	74	37	2.55	2.86	3.50	0.73	0.09	1.819

MATERIAL DESCRIPTION	USCS	AASHTO
M-Stiff, wet, grey, Organic SILT	MH	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-30-SW-08 **Sample No.:** S-15 **Elev./Depth:** 124.5-124.6

Remarks:
Specific gravity estimated

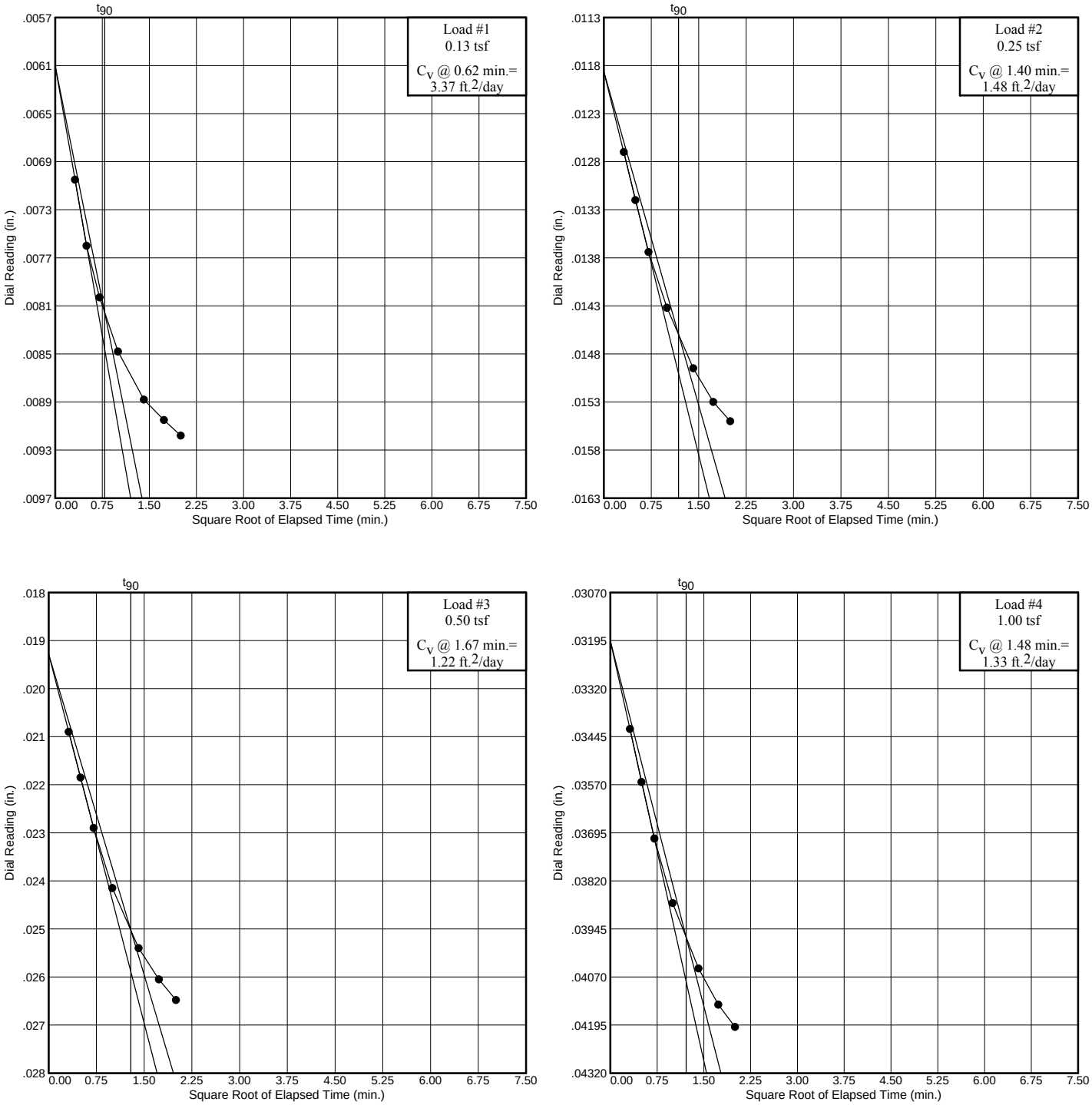
SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 5.1

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-30-SW-08 Sample No.: S-15 Elev./Depth: 124.5-124.6



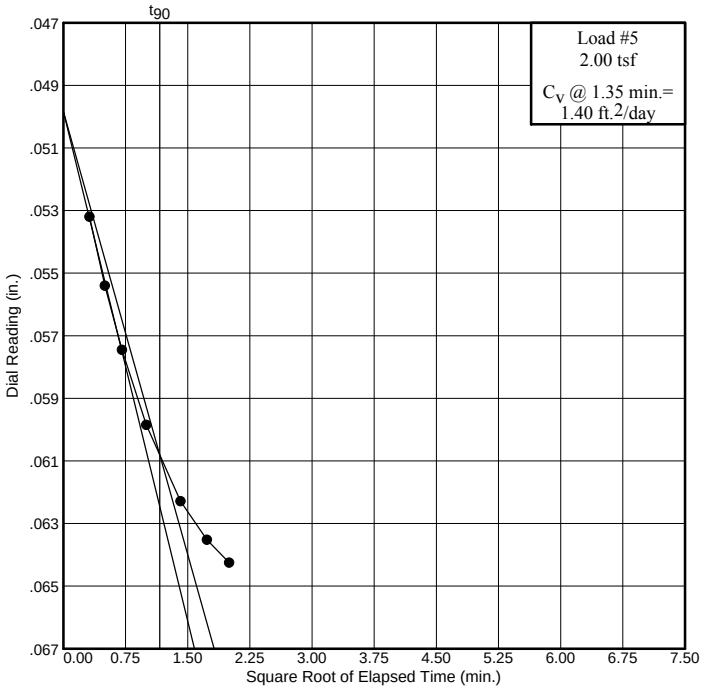
SOIL TECHNOLOGY

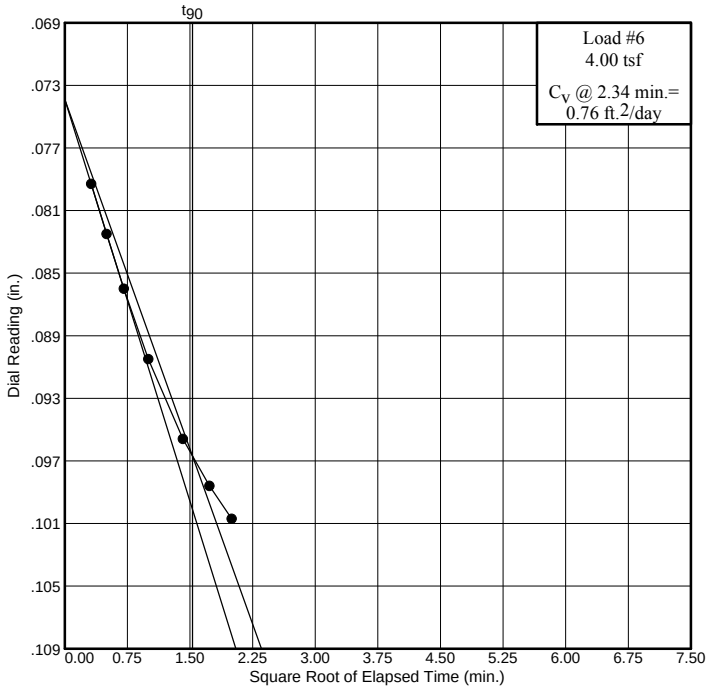
Bainbridge Island, WA

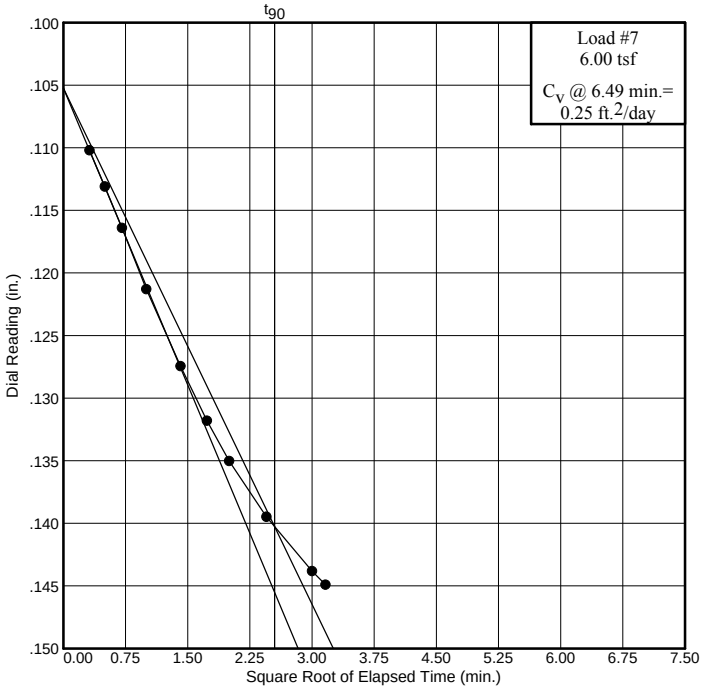
Figure 5.2

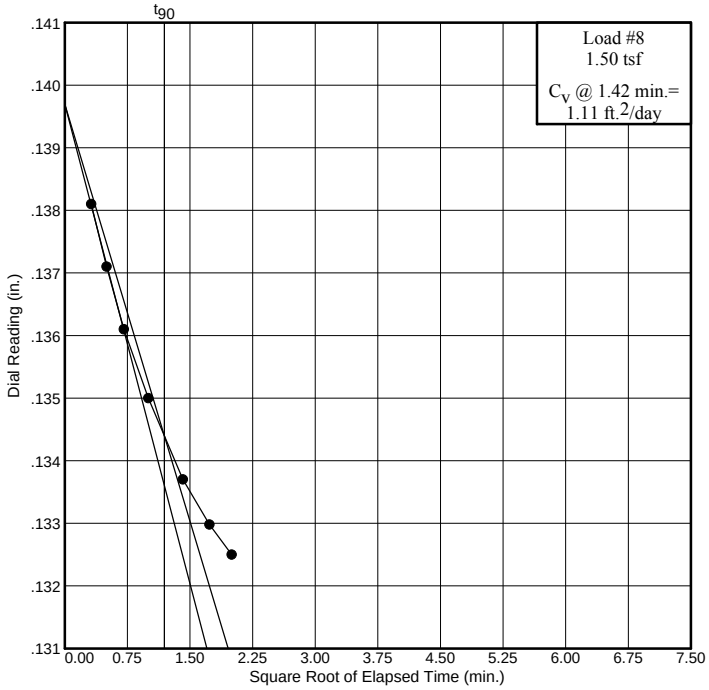
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-30-SW-08 Sample No.: S-15 Elev./Depth: 124.5-124.6









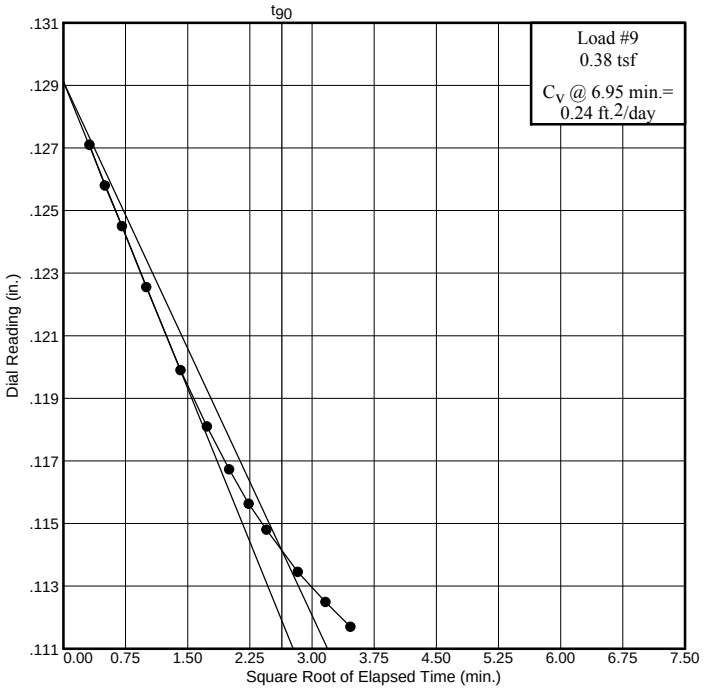
SOIL TECHNOLOGY

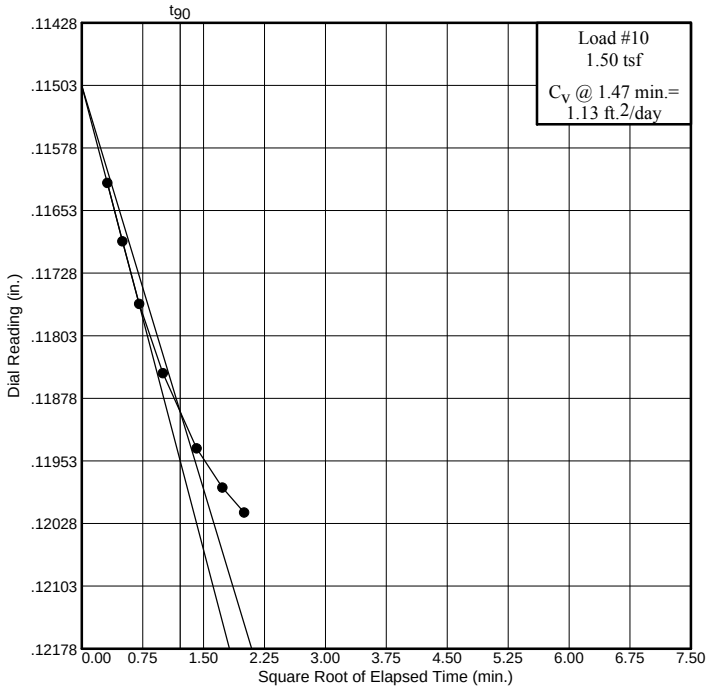
Bainbridge Island, WA

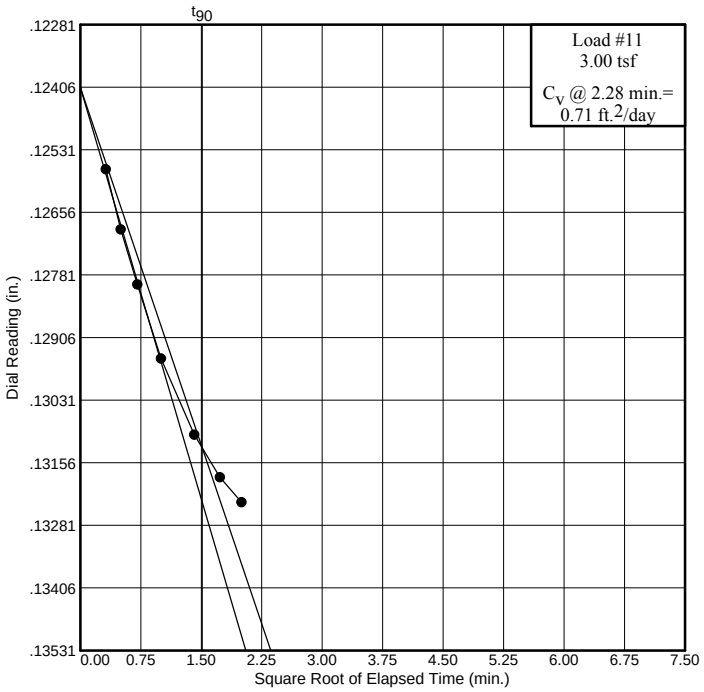
Figure 5.3

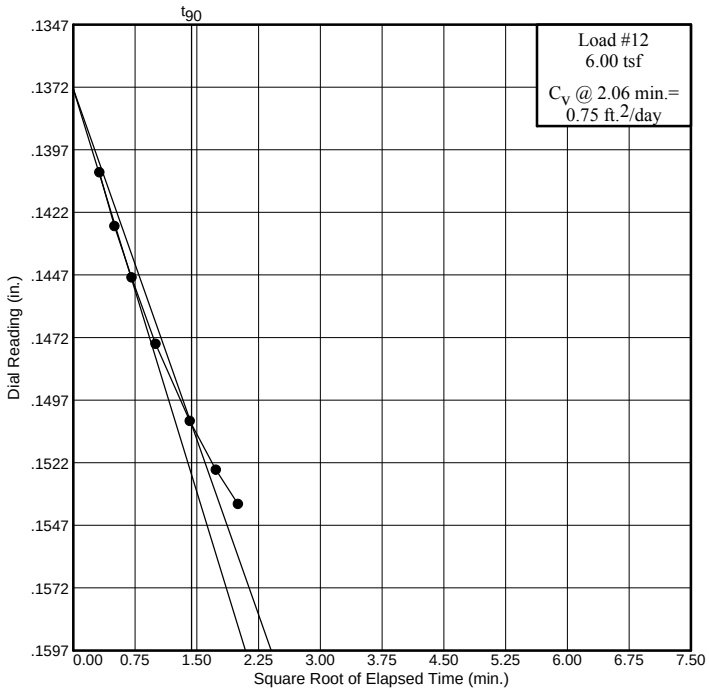
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-30-SW-08 Sample No.: S-15 Elev./Depth: 124.5-124.6









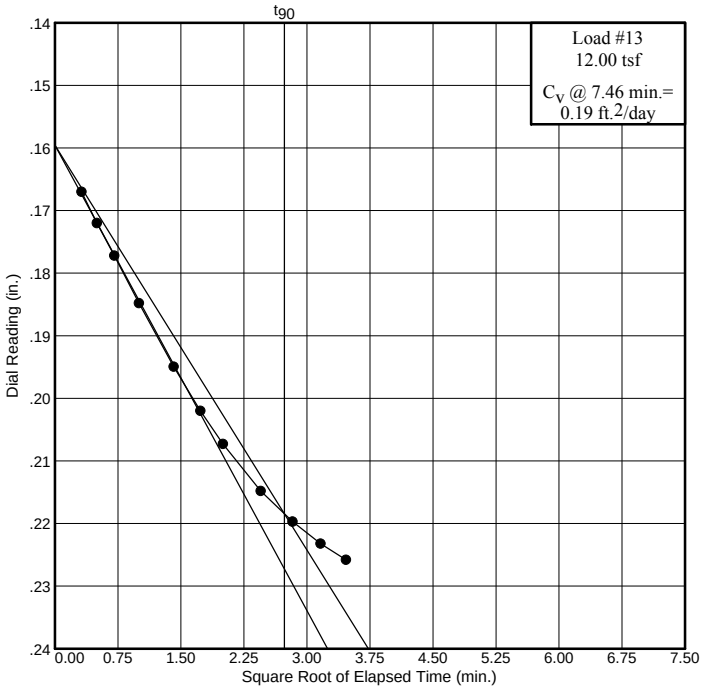
SOIL TECHNOLOGY

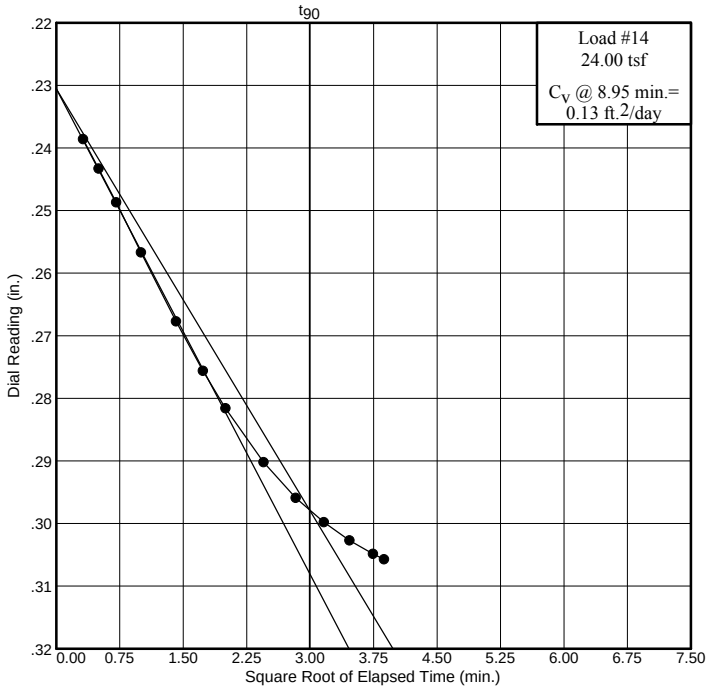
Bainbridge Island, WA

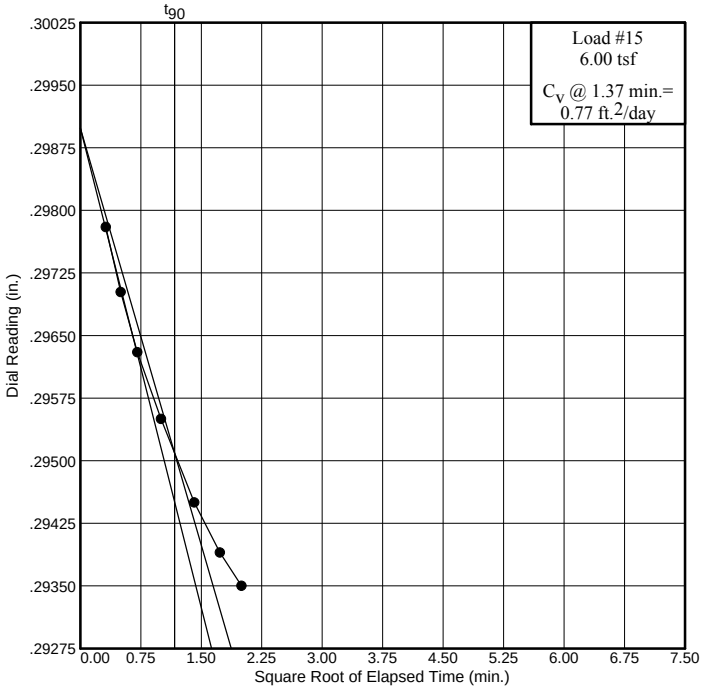
Figure 5.4

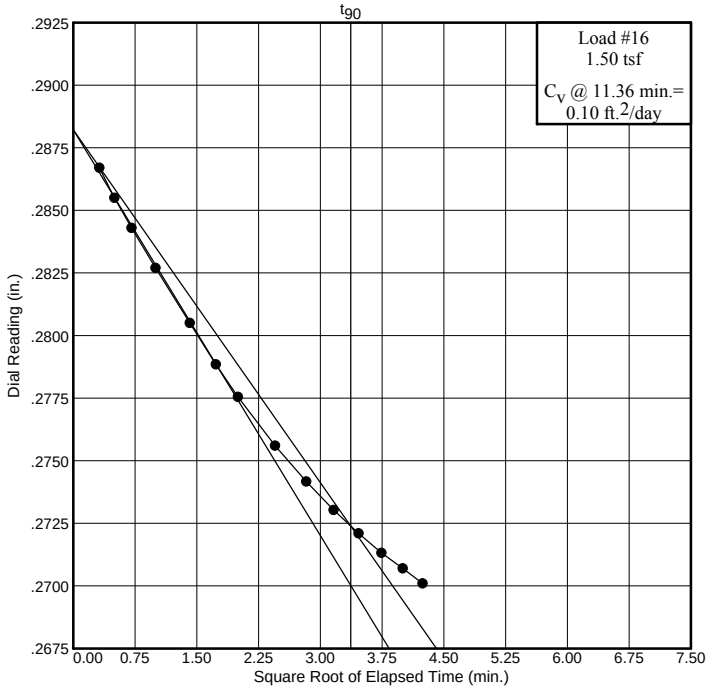
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-30-SW-08 Sample No.: S-15 Elev./Depth: 124.5-124.6









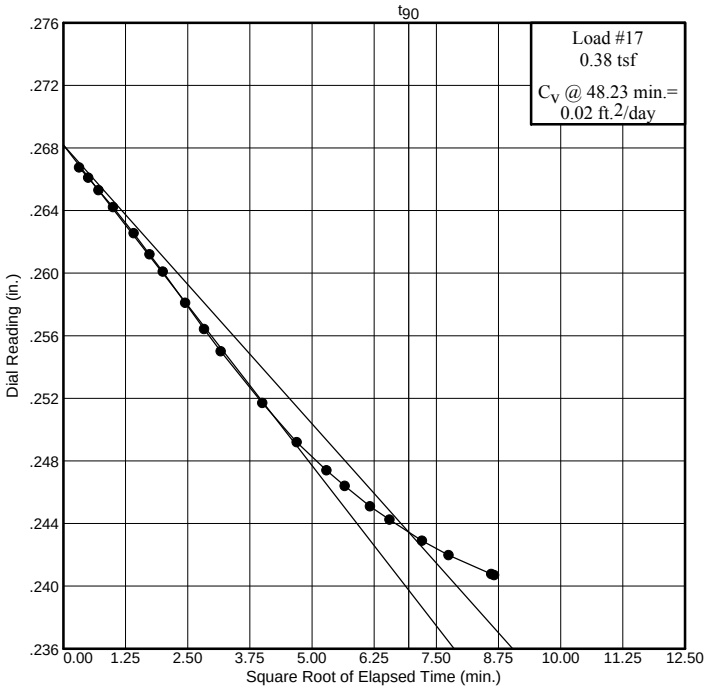
SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 5.5

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-30-SW-08 Sample No.: S-15 Elev./Depth: 124.5-124.6

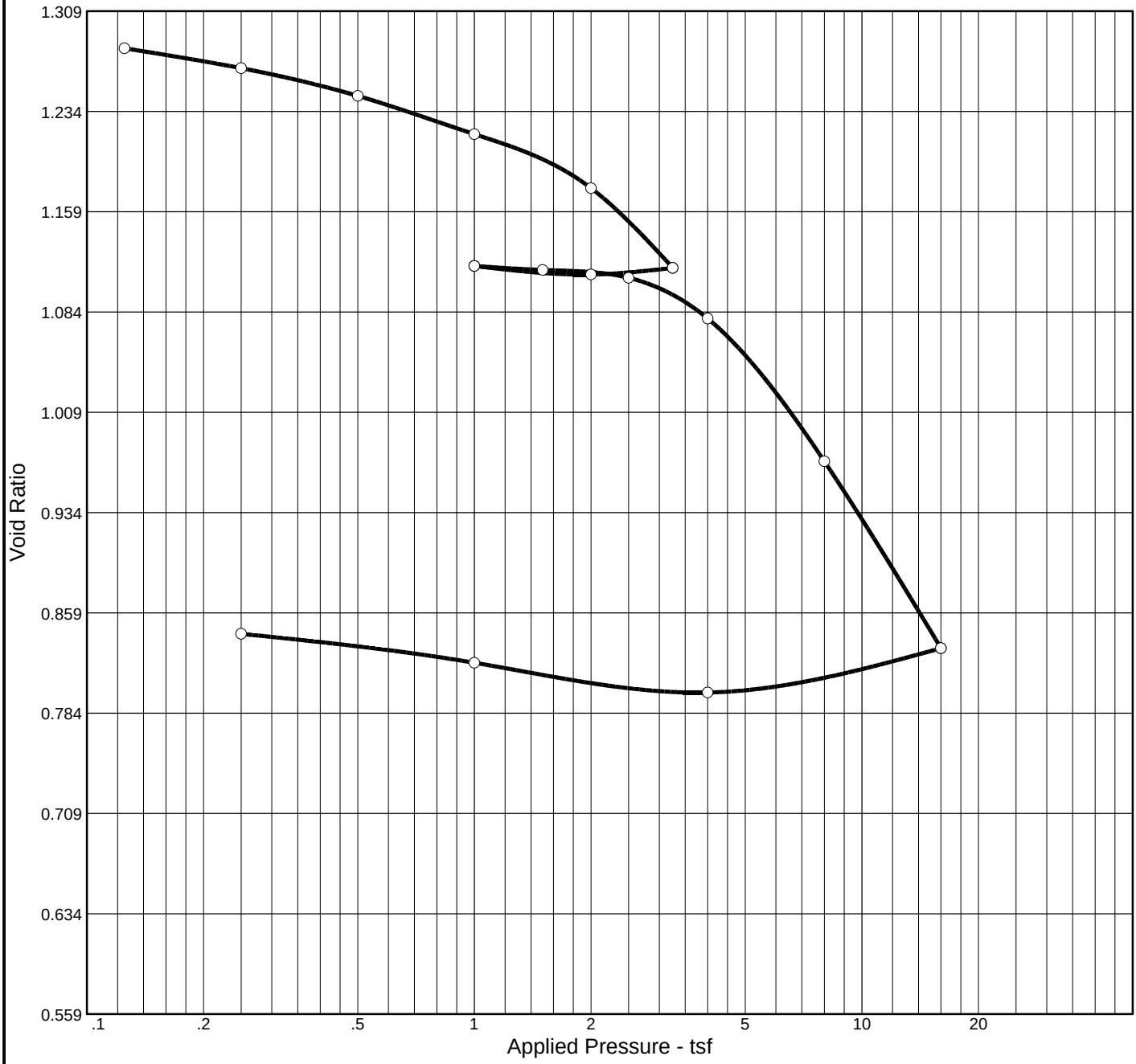


SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 5.6

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.0 %	50.7 %	69.2	43	13	2.55	2.13	3.20	0.55	0.35	1.306

MATERIAL DESCRIPTION	USCS	AASHTO
M-stiff, wet, grey, Organic SILT	ML	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-30-SW-08 **Sample No.:** S-5 **Elev./Depth:** 85.8-85.9

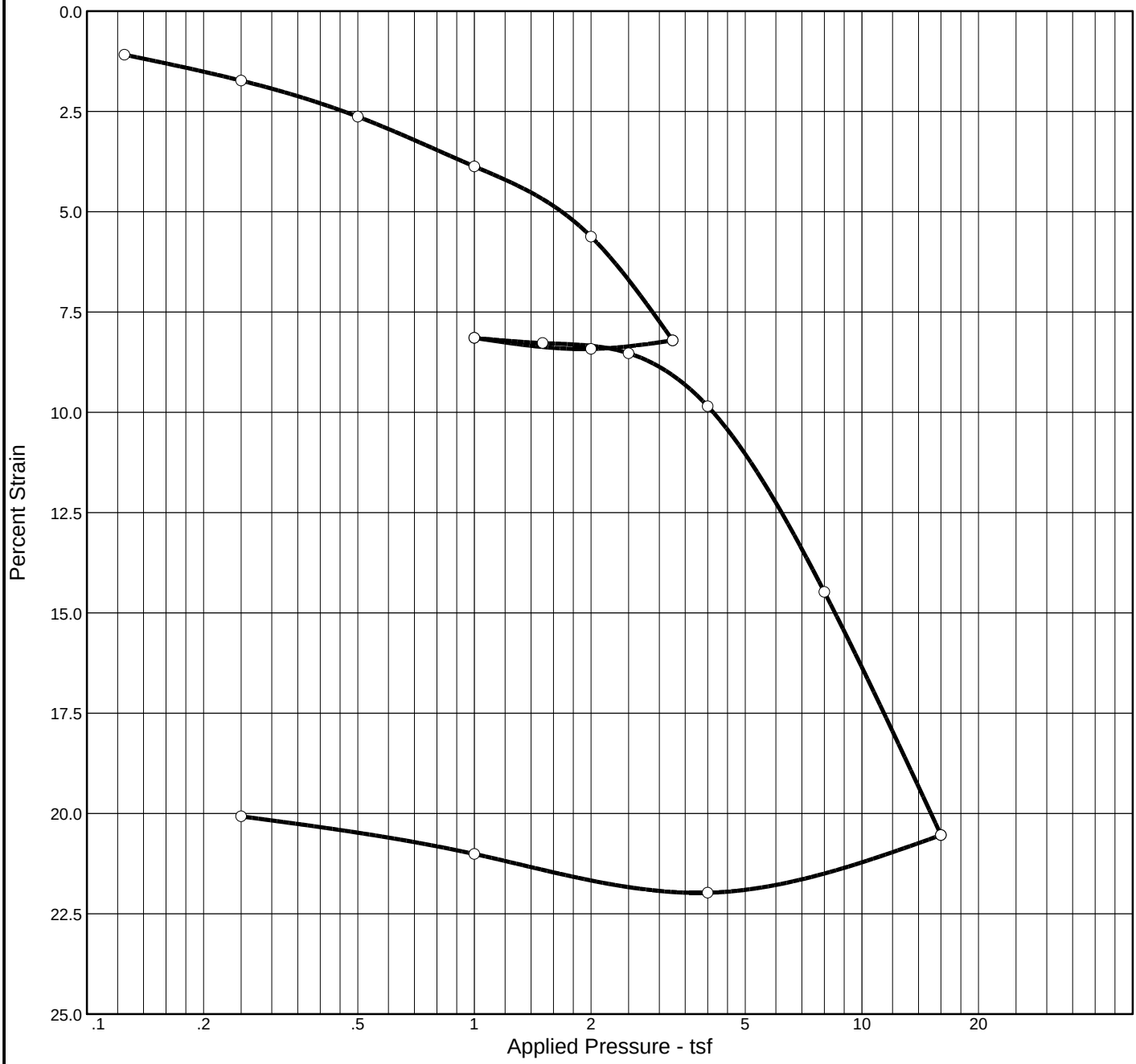
Remarks:
Specific gravity estimated

SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 6.0

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.0 %	50.7 %	69.2	43	13	2.55	2.13	3.20	0.55	0.035	1.306

MATERIAL DESCRIPTION	USCS	AASHTO
M-stiff, wet, grey, Organic SILT	ML	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-30-SW-08 **Sample No.:** S-5 **Elev./Depth:** 85.8-85.9

Remarks:
Specific gravity estimated

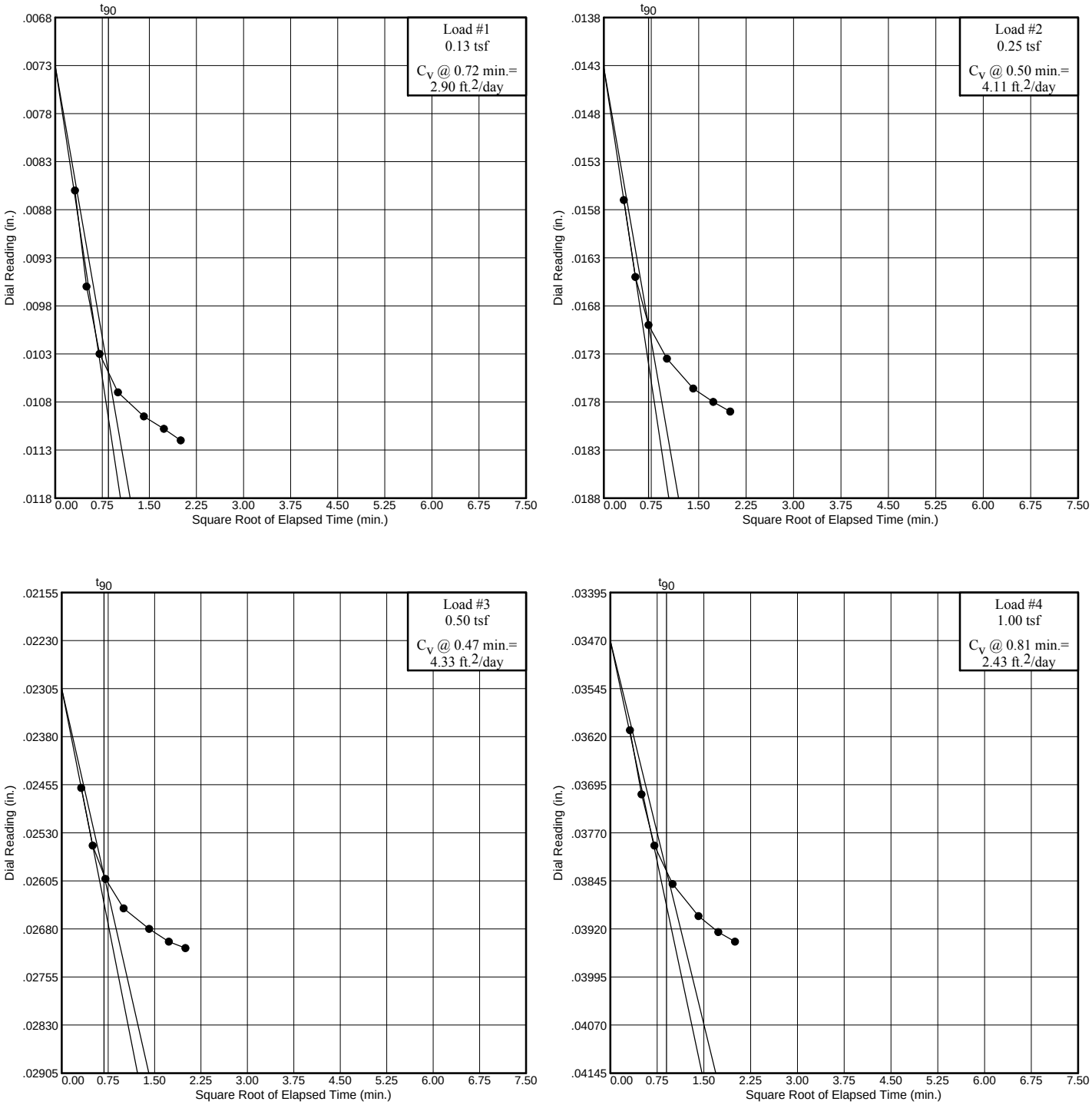
SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 6.1

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-30-SW-08 Sample No.: S-5 Elev./Depth: 85.8-85.9



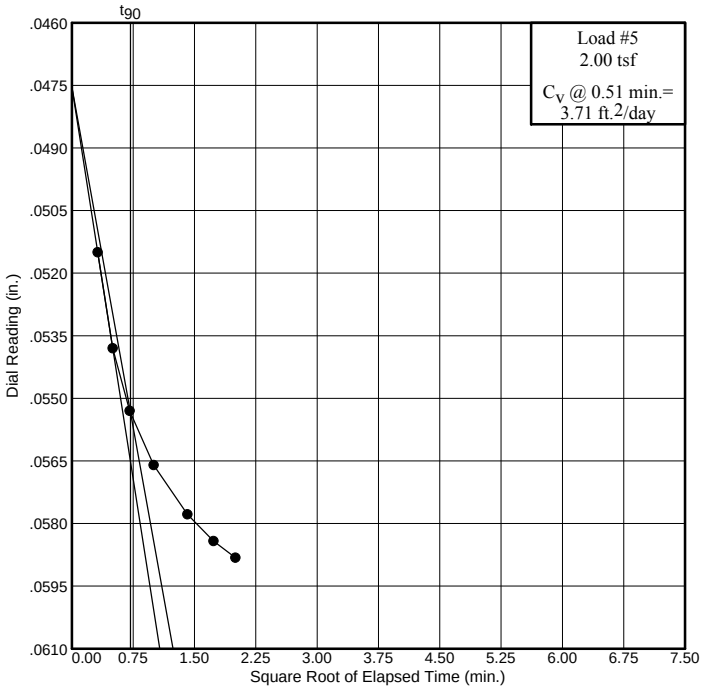
SOIL TECHNOLOGY

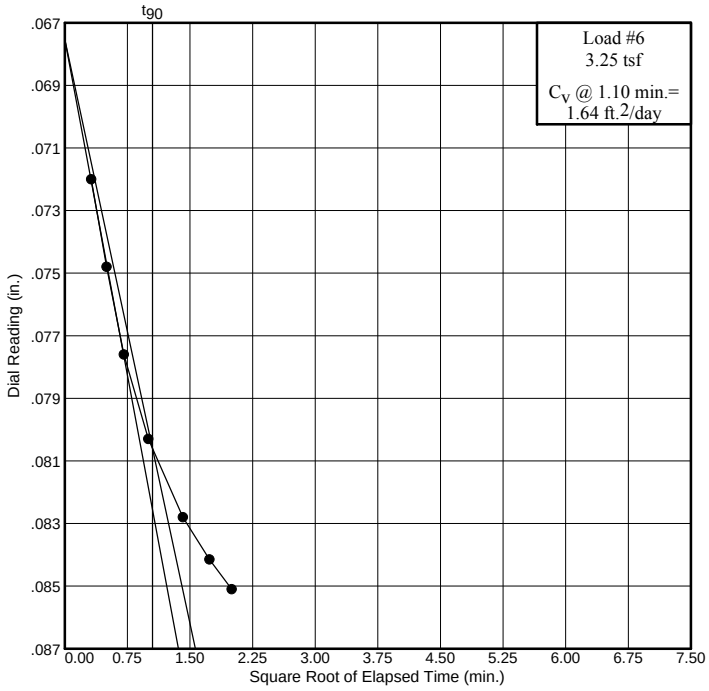
Bainbridge Island, WA

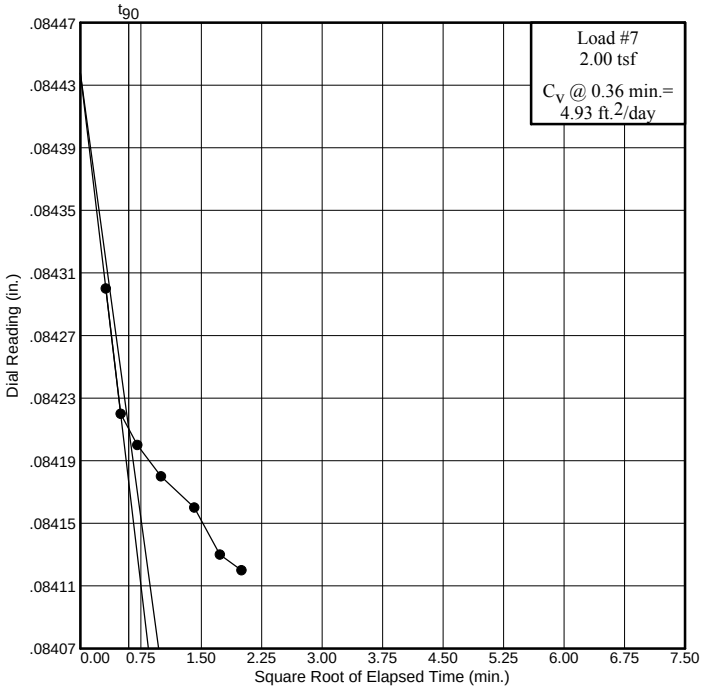
Figure 6.2

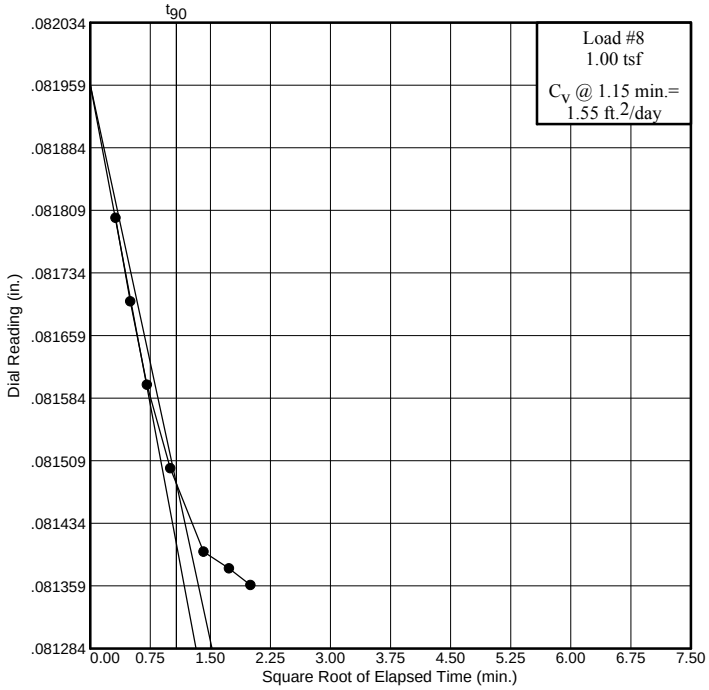
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-30-SW-08 Sample No.: S-5 Elev./Depth: 85.8-85.9









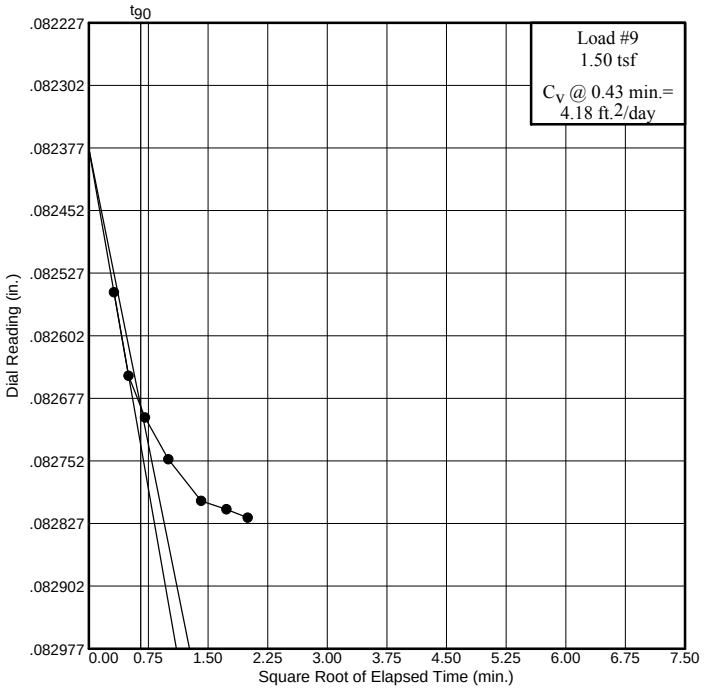
SOIL TECHNOLOGY

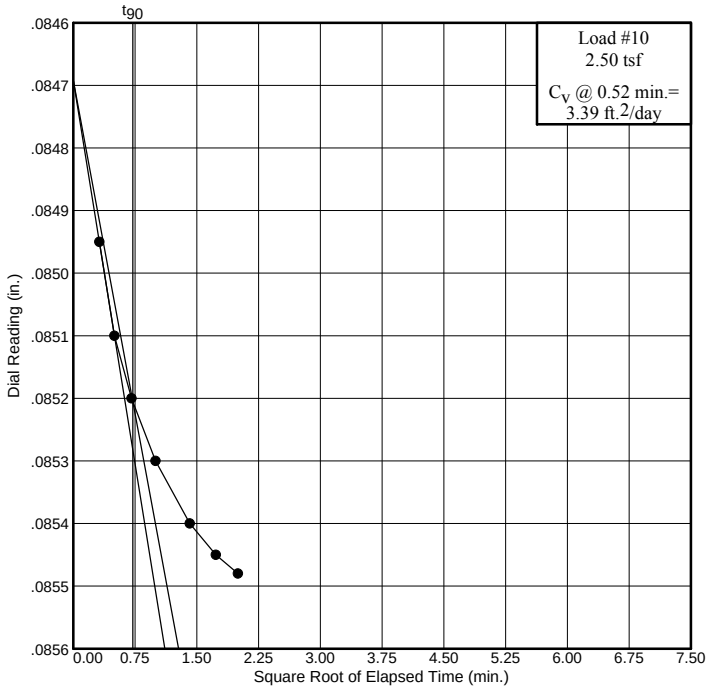
Bainbridge Island, WA

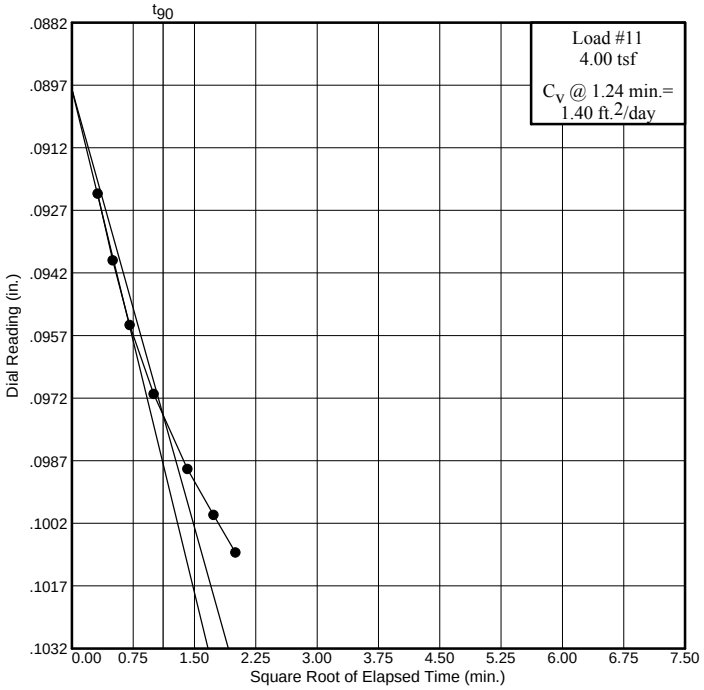
Figure 6.3

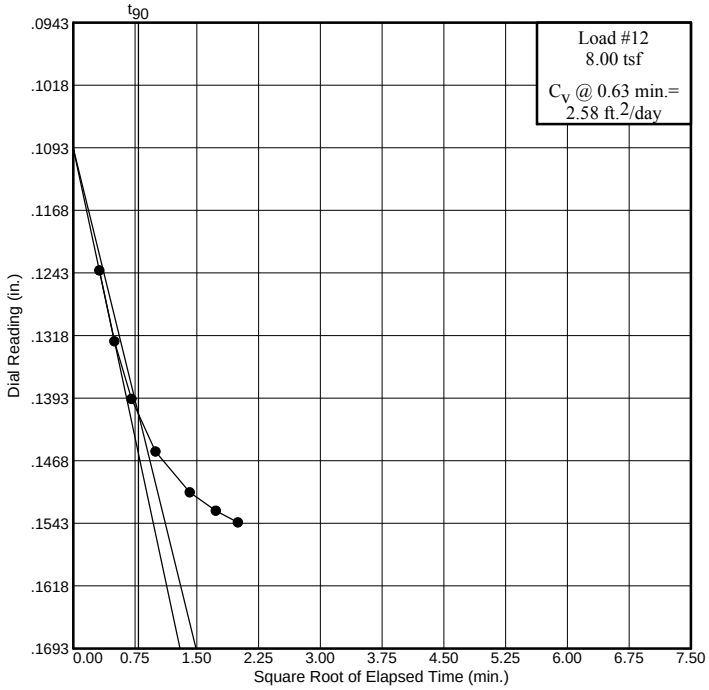
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-30-SW-08 Sample No.: S-5 Elev./Depth: 85.8-85.9









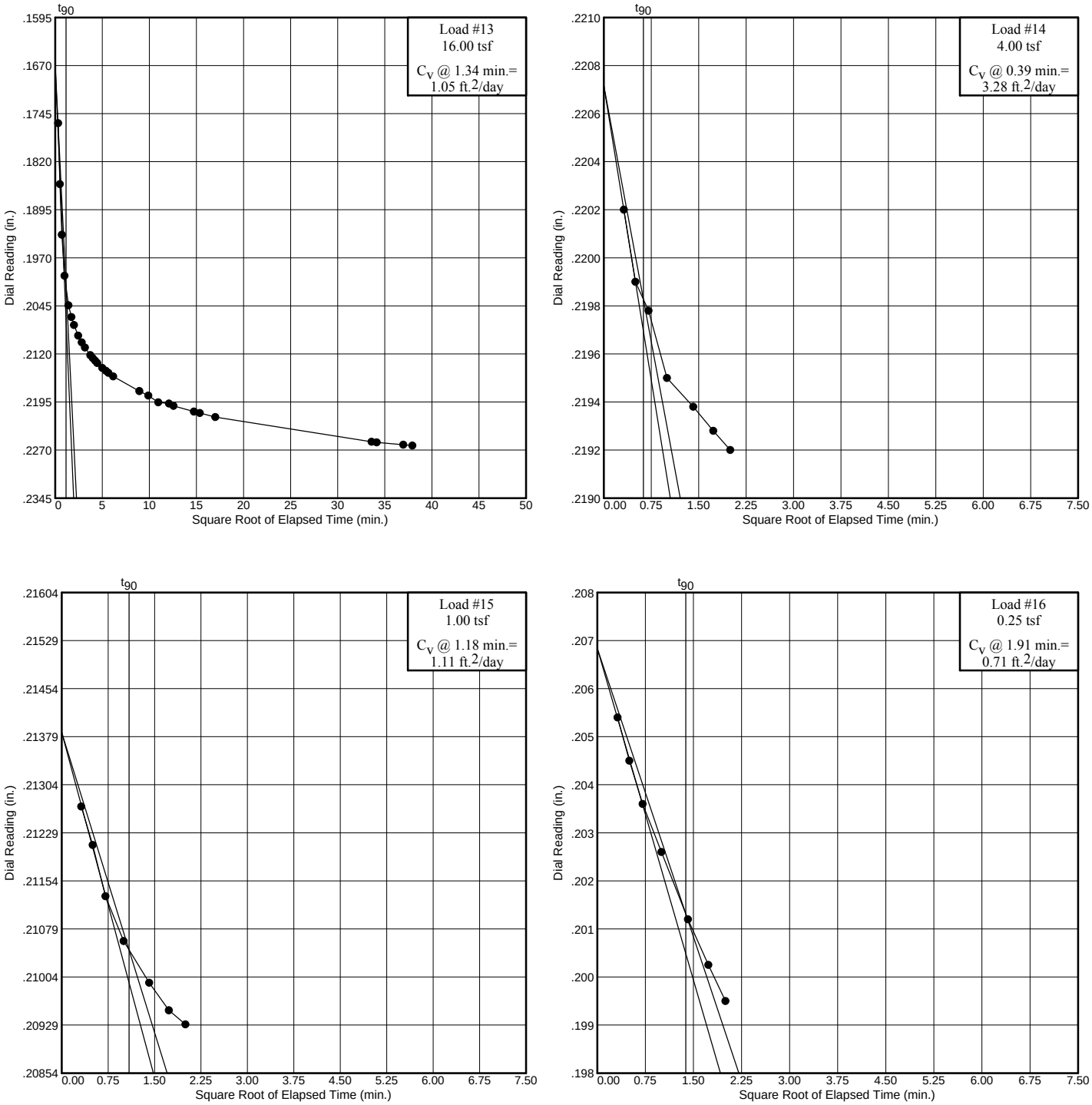
SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 6.4

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-30-SW-08 Sample No.: S-5 Elev./Depth: 85.8-85.9

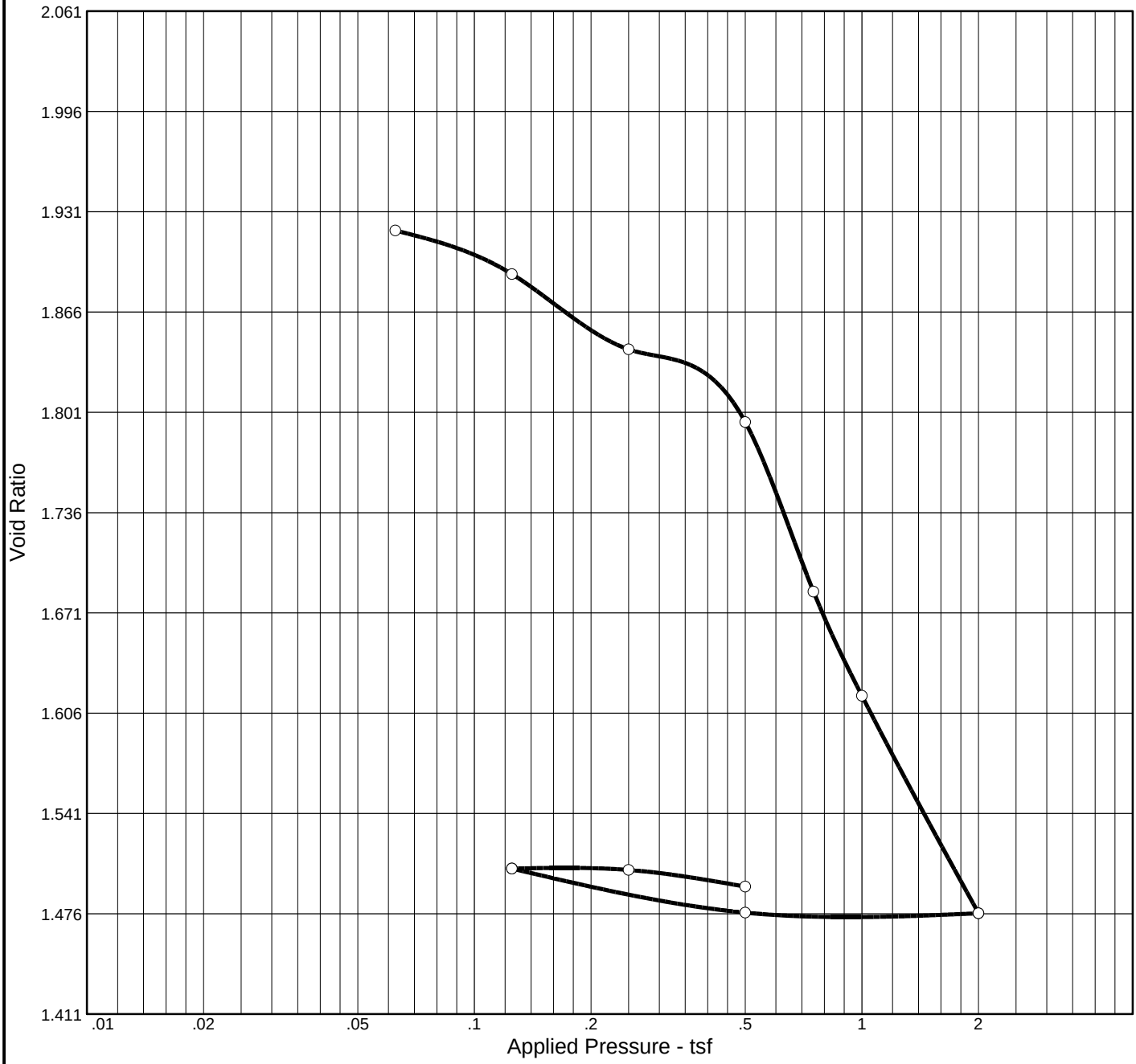


SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 6.5

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
96.2 %	72.5 %	54.9	53	27	2.6	___	___	0.47	0.02	1.959

MATERIAL DESCRIPTION	USCS	AASHTO
Soft, grey-green, wet, silty CLAY	CH	----

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-31-PMT-SW-08 **Sample No.:** S-3 **Elev./Depth:** 15.7-15.8

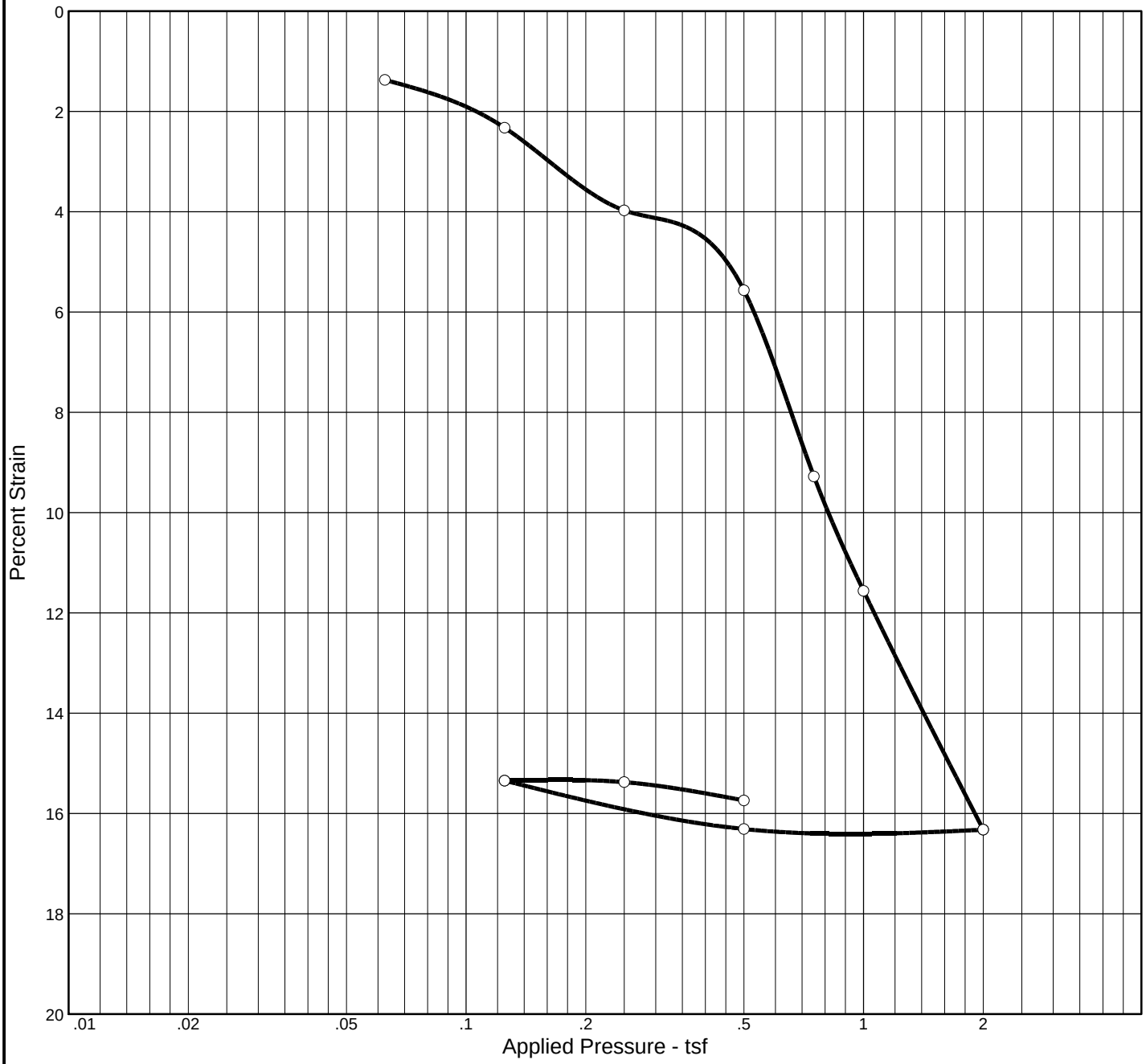
Remarks:
Specific gravity estimated, (soft sample)

SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 7.0

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
96.2%	72.5%	54.9	53	27	2.6					1.959

MATERIAL DESCRIPTION	USCS	AASHTO
Soft, grey-green, wet, Silty CLAY	CH	----

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-31-PMT-SW-08 **Sample No.:** S-3 **Elev./Depth:** 15.7-15.8

Remarks:
Specific gravity estimated
(Soft sample)

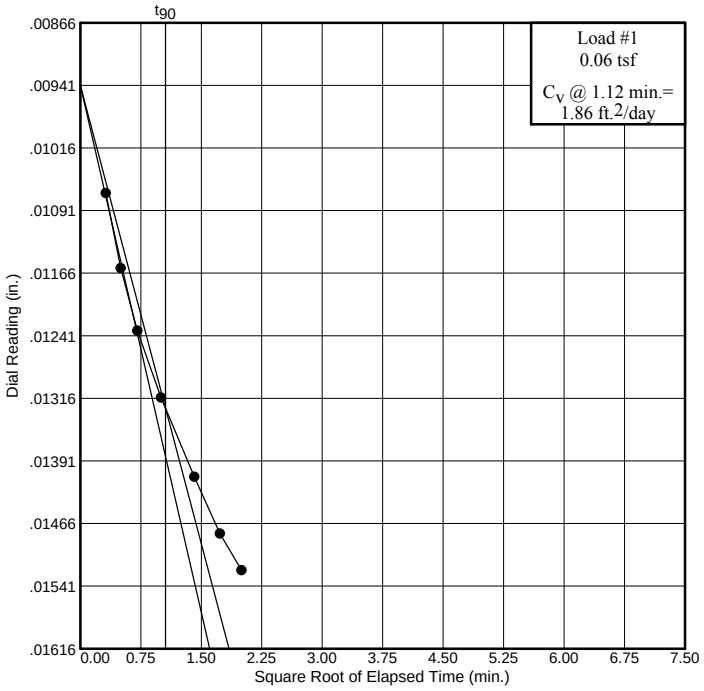
SOIL TECHNOLOGY

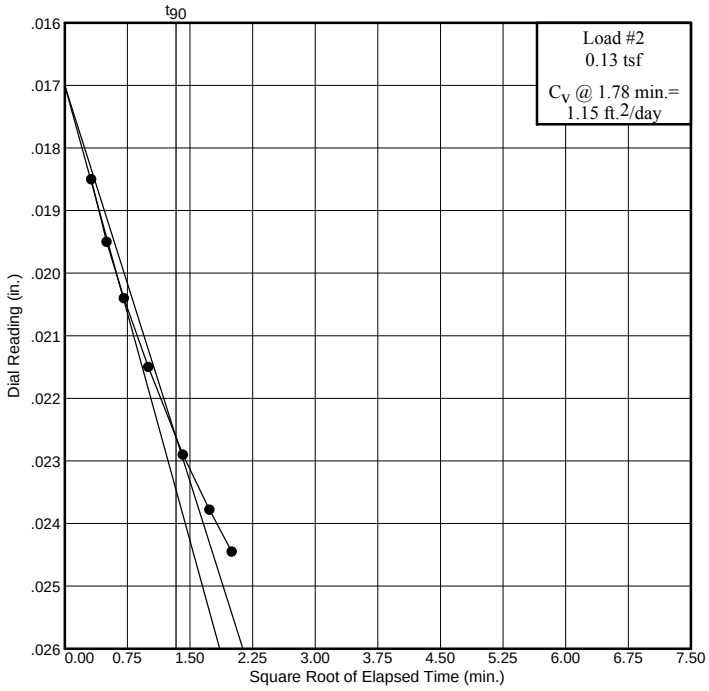
Bainbridge Island, WA

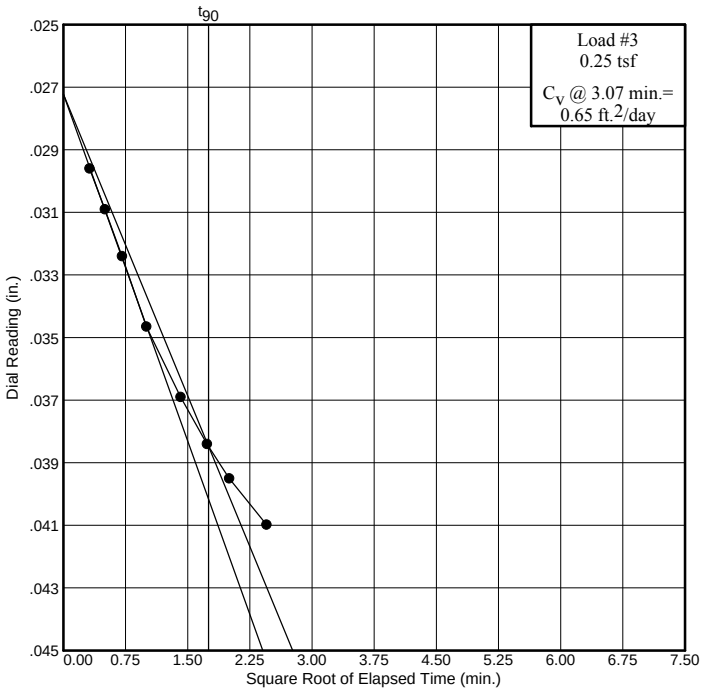
Figure 7.1

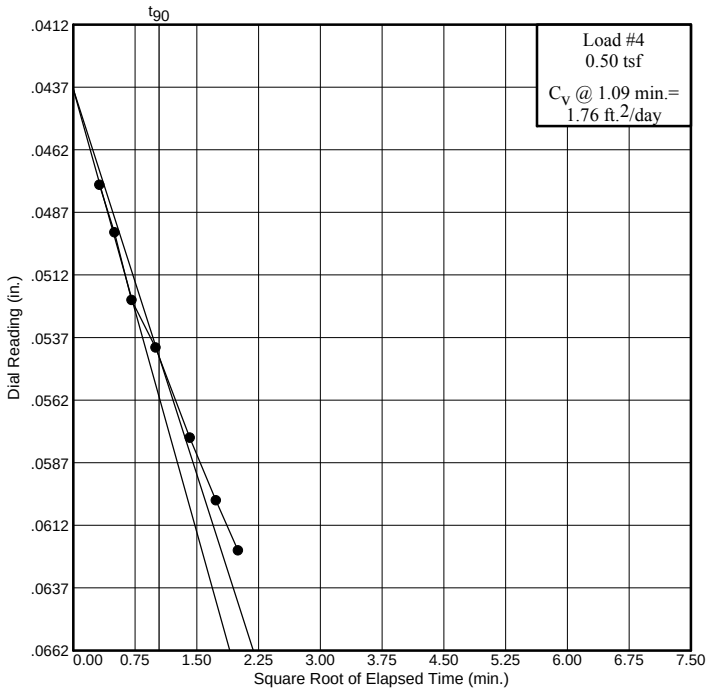
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-31-PMT-SW-08 Sample No.: S-3 Elev./Depth: 15.7-15.8









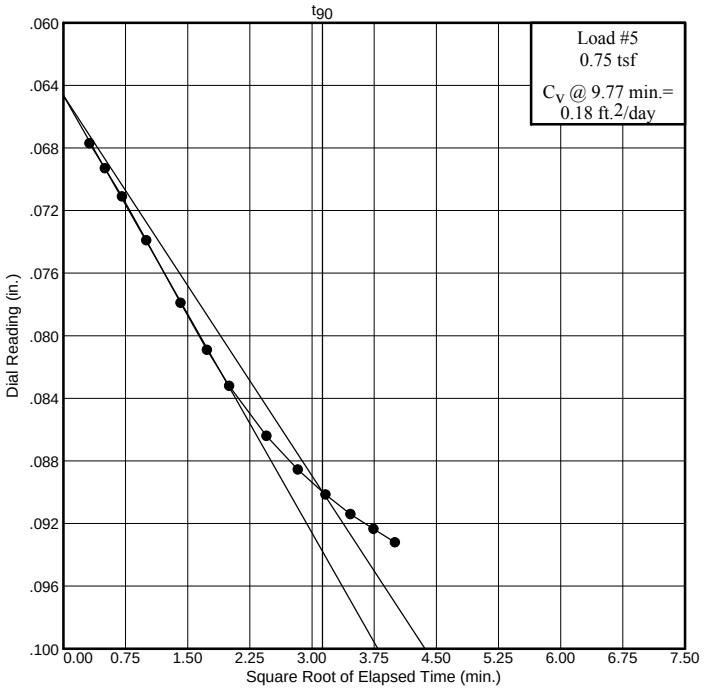
SOIL TECHNOLOGY

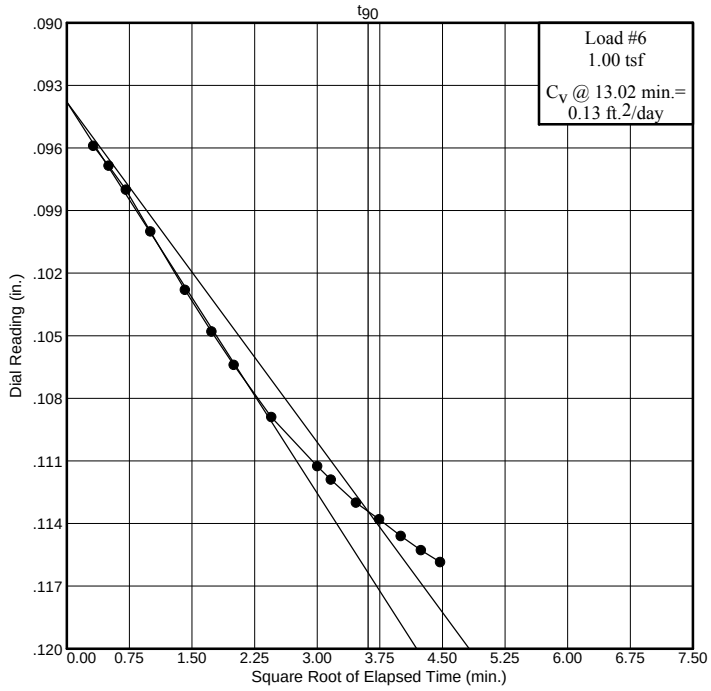
Bainbridge Island, WA

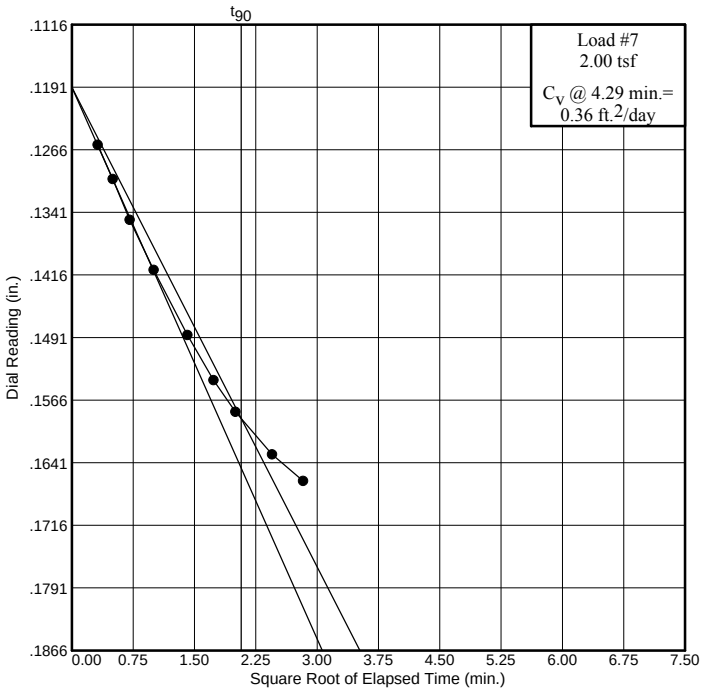
Figure 7.2

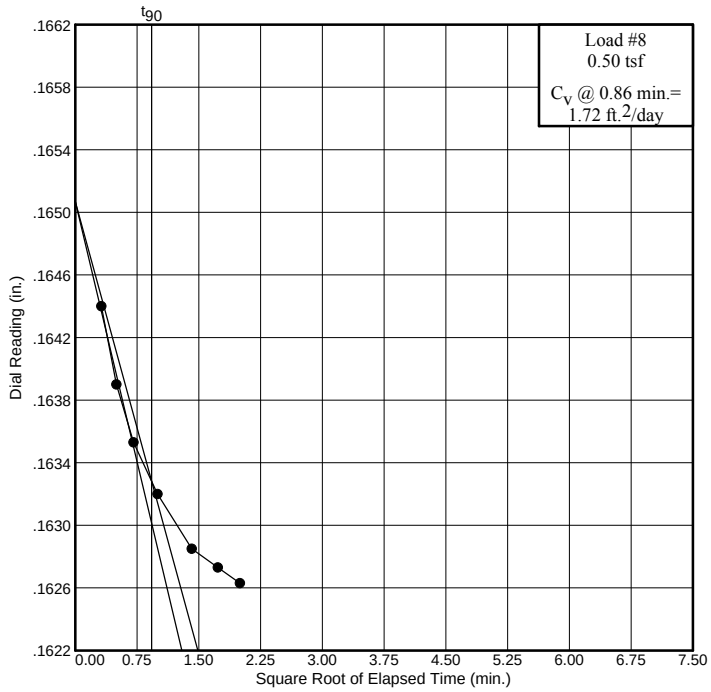
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-31-PMT-SW-08 Sample No.: S-3 Elev./Depth: 15.7-15.8









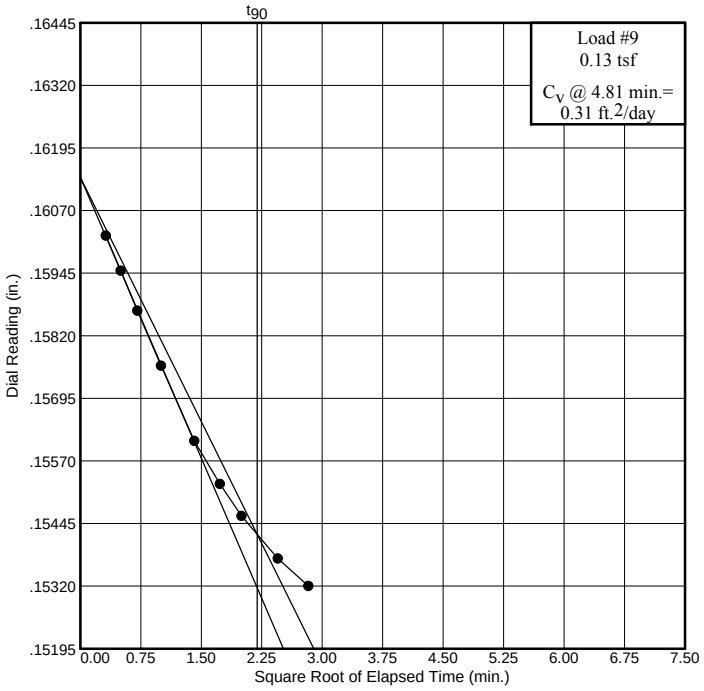
SOIL TECHNOLOGY

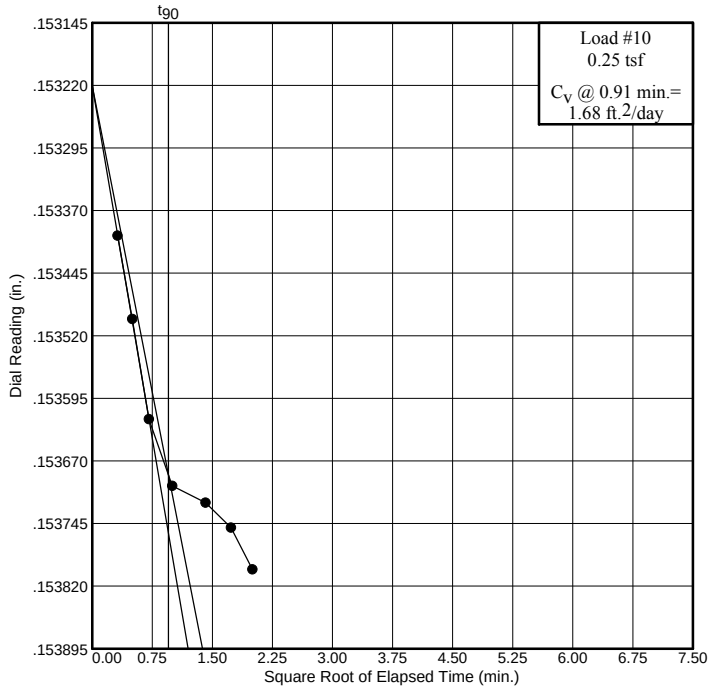
Bainbridge Island, WA

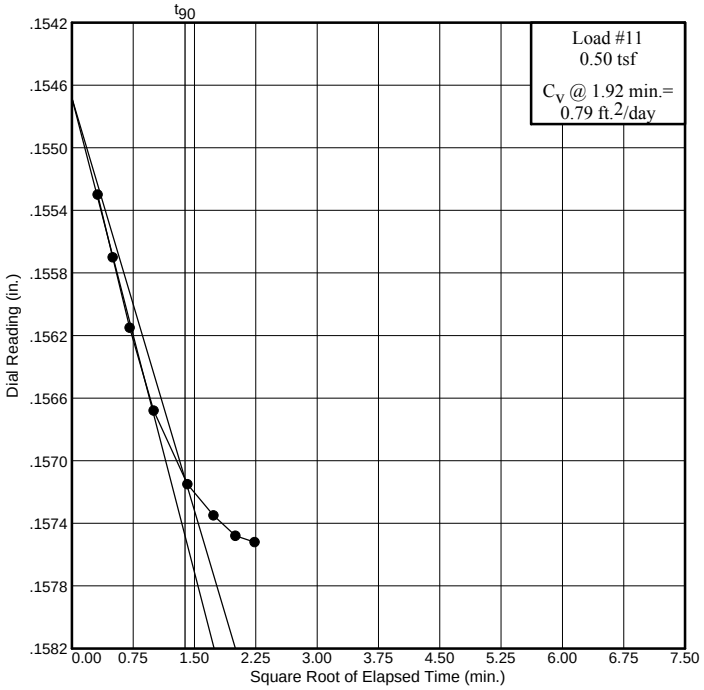
Figure 7.3

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-31-PMT-SW-08 Sample No.: S-3 Elev./Depth: 15.7-15.8





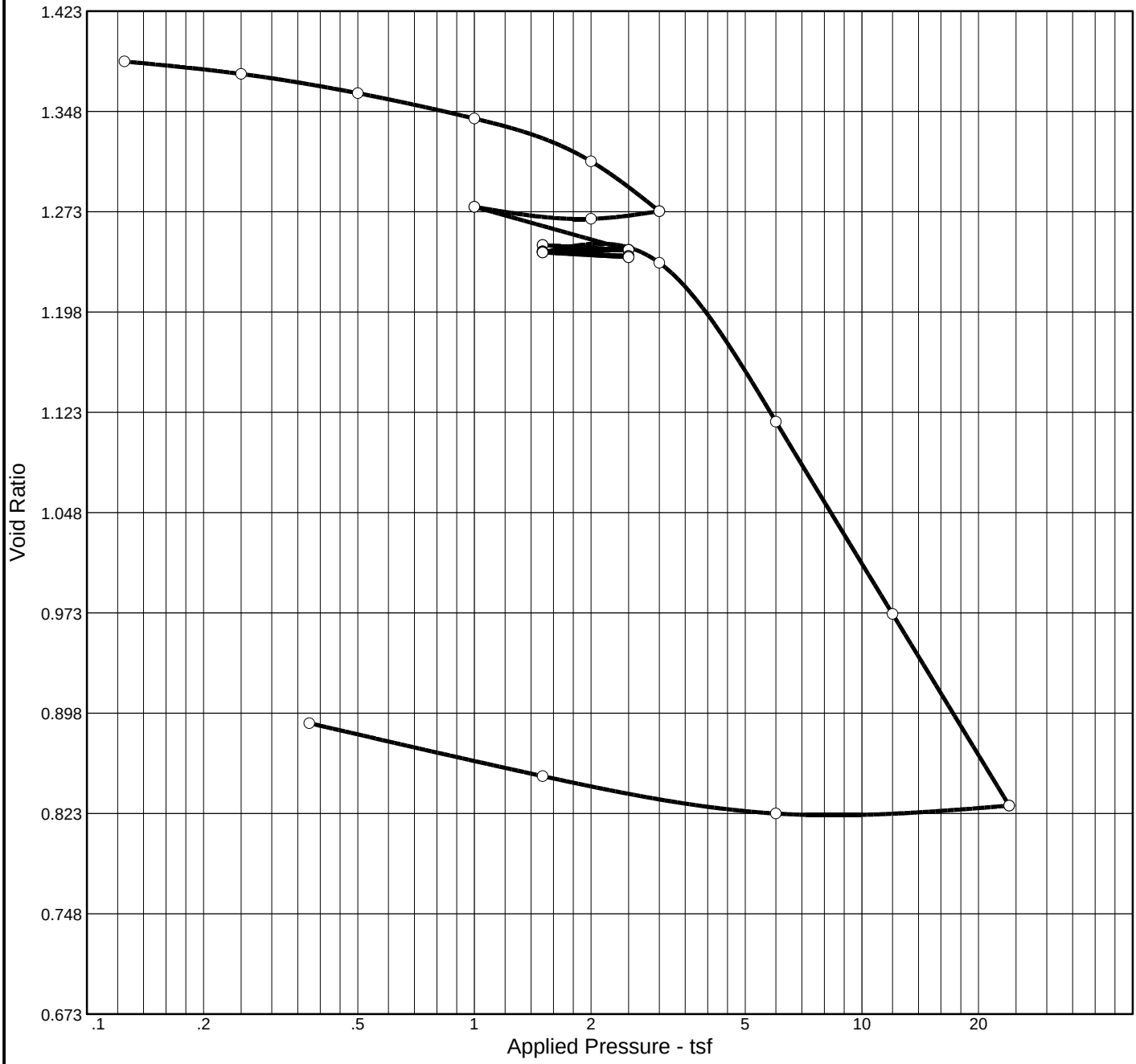


SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 7.4

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)8	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.1 %	53.2 %	67.8	59	31	2.6	3.40	3.19	0.52	0.03	1.397

MATERIAL DESCRIPTION	USCS	AASHTO
M-Stiff to Stiff, grey, wet, CLAY	CH	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-31-PMT-SW-08 **Sample No.:** S-9 **Elev./Depth:** 85.0-85.1

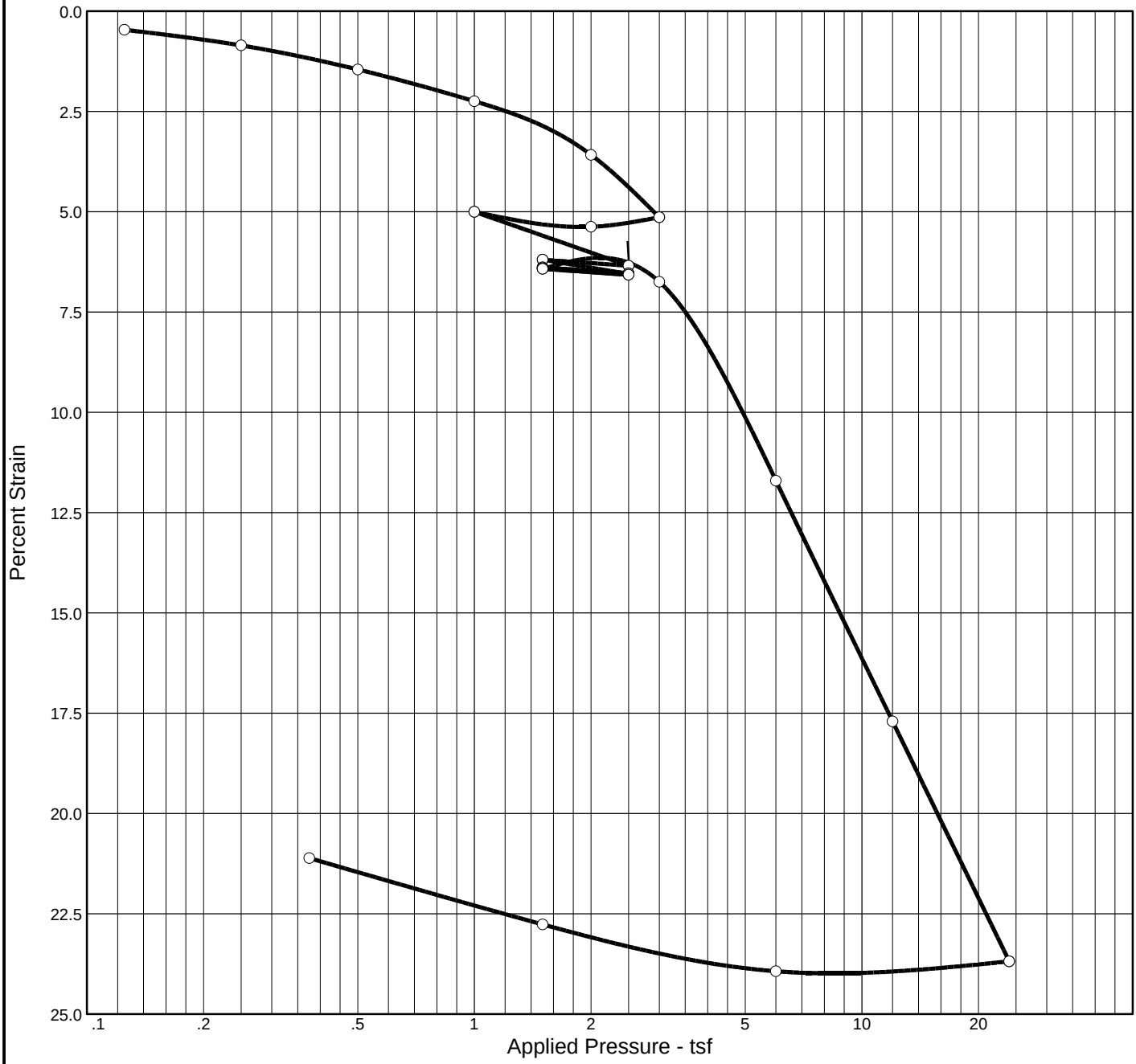
Remarks:
Specific gravity estimated

SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 8.0

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
99.1 %	53.2 %	67.8	59	31	2.6	3.40	3.19	0.52	0.03	1.397

MATERIAL DESCRIPTION	USCS	AASHTO
M-Stiff to Stiff, grey, wet, CLAY	CH	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-31-PMT-SW-08 **Sample No.:** S-9 **Elev./Depth:** 85.0-85.1

Remarks:
Specific gravity estimated

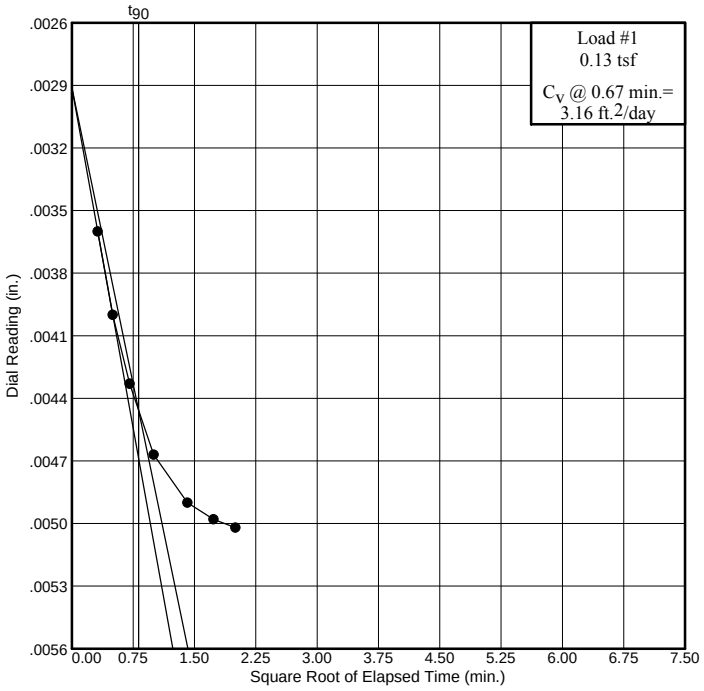
SOIL TECHNOLOGY

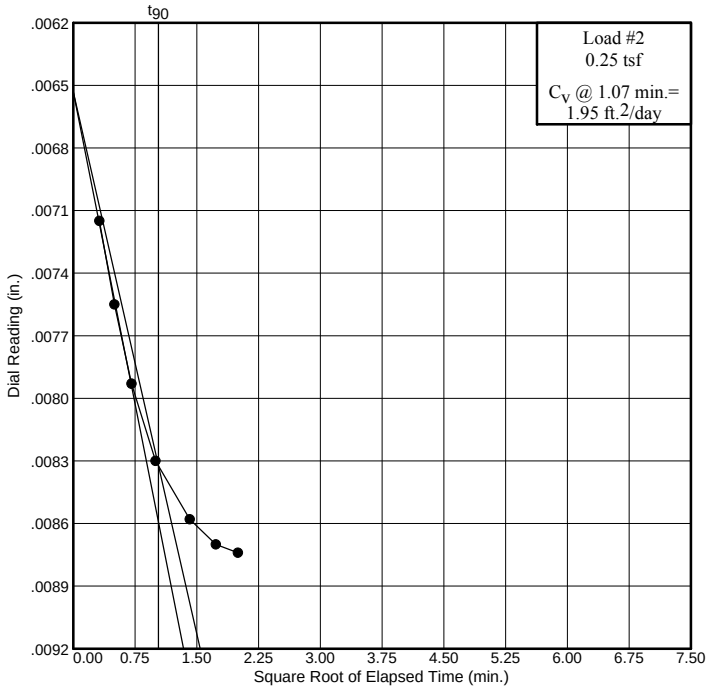
Bainbridge Island, WA

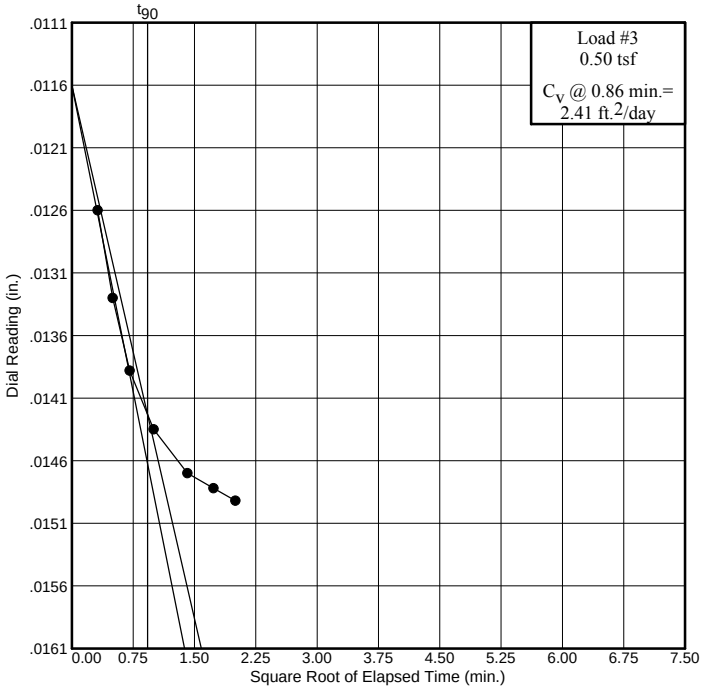
Figure 8.1

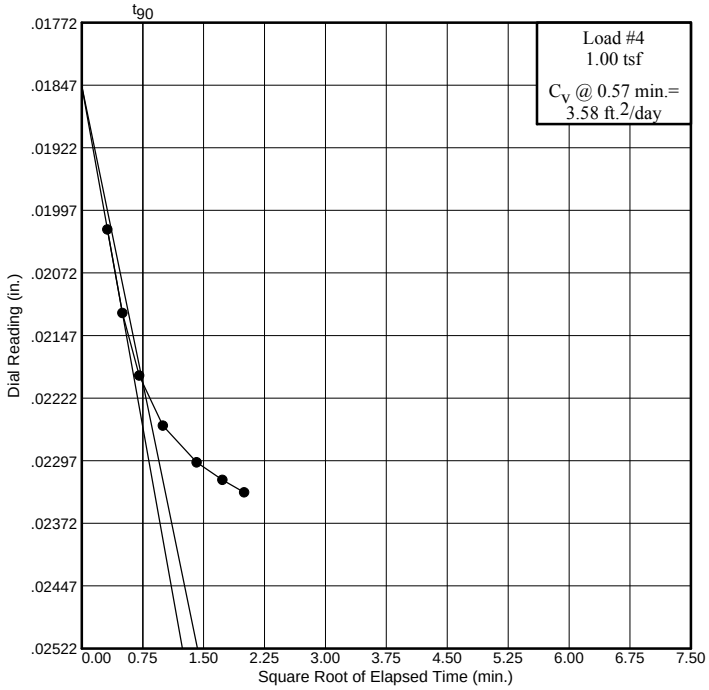
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-31-PMT-SW-08 Sample No.: S-9 Elev./Depth: 85.0-85.1









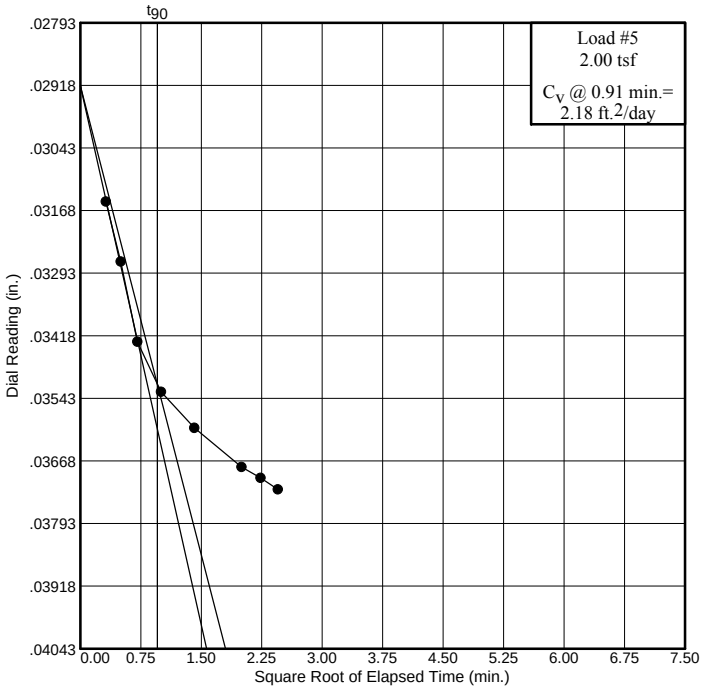
SOIL TECHNOLOGY

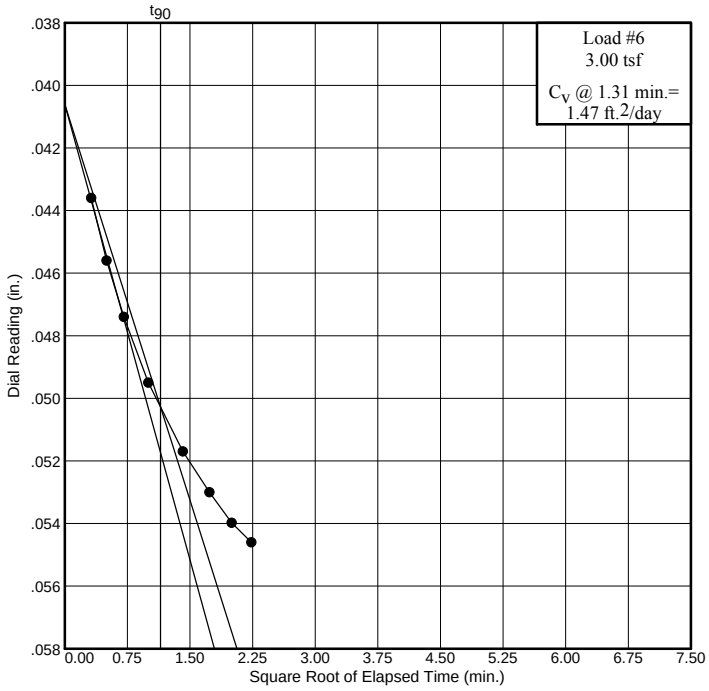
Bainbridge Island, WA

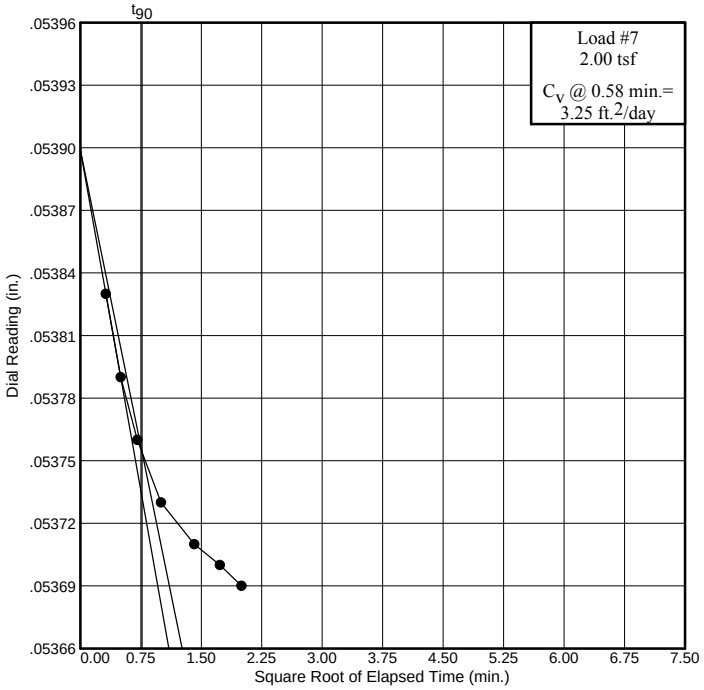
Figure 8.2

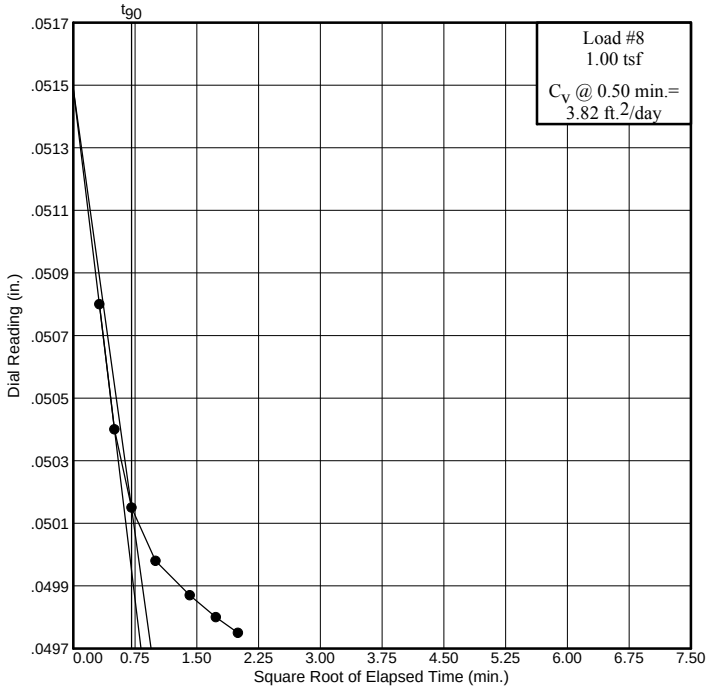
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-31-PMT-SW-08 Sample No.: S-9 Elev./Depth: 85.0-85.1









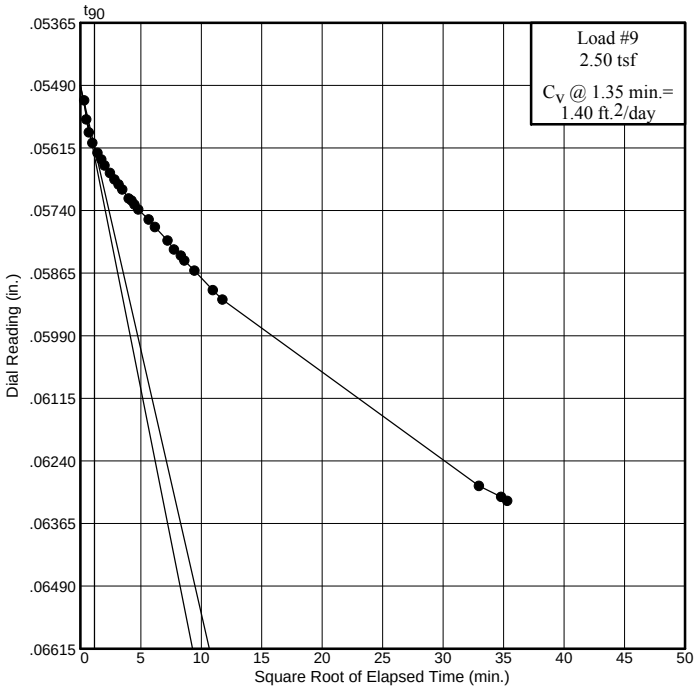
SOIL TECHNOLOGY

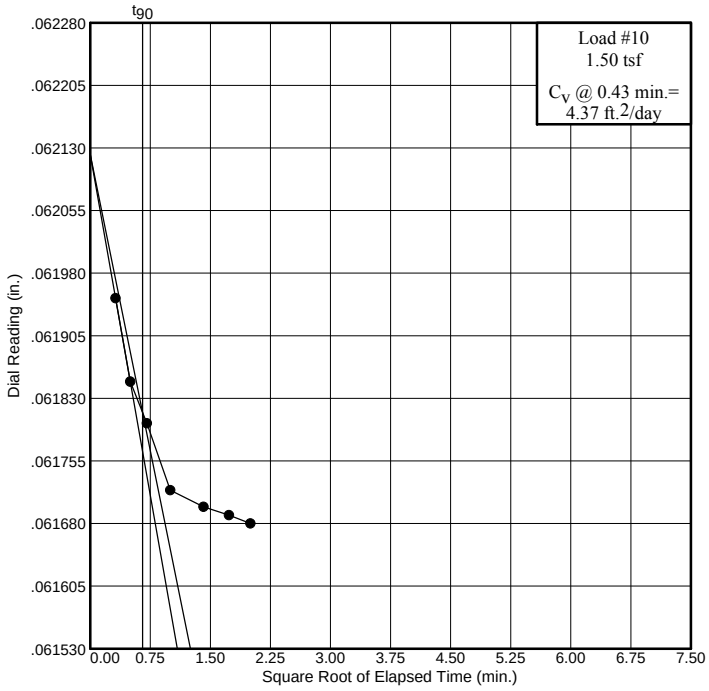
Bainbridge Island, WA

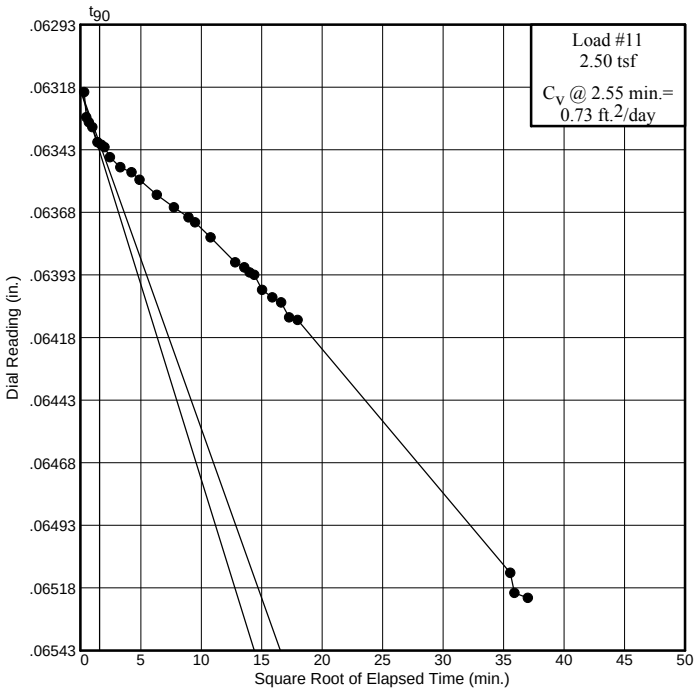
Figure 8.3

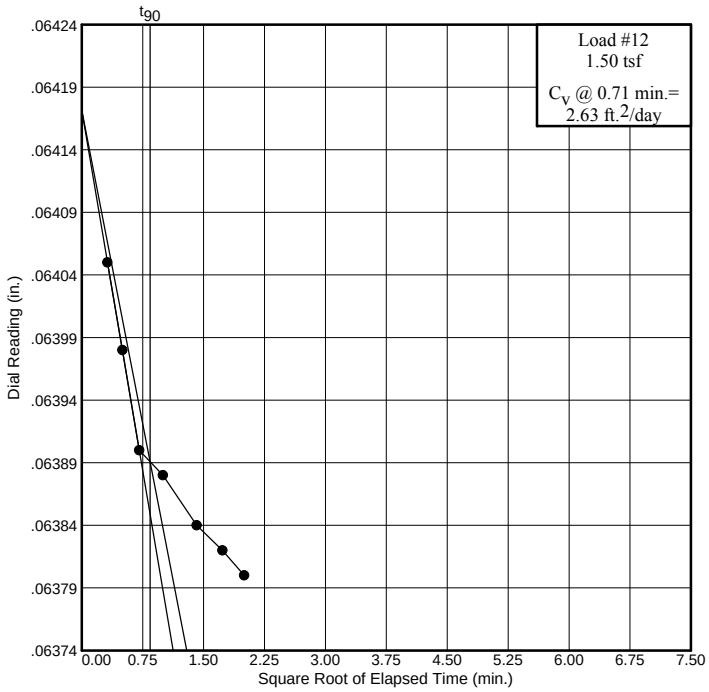
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-31-PMT-SW-08 Sample No.: S-9 Elev./Depth: 85.0-85.1









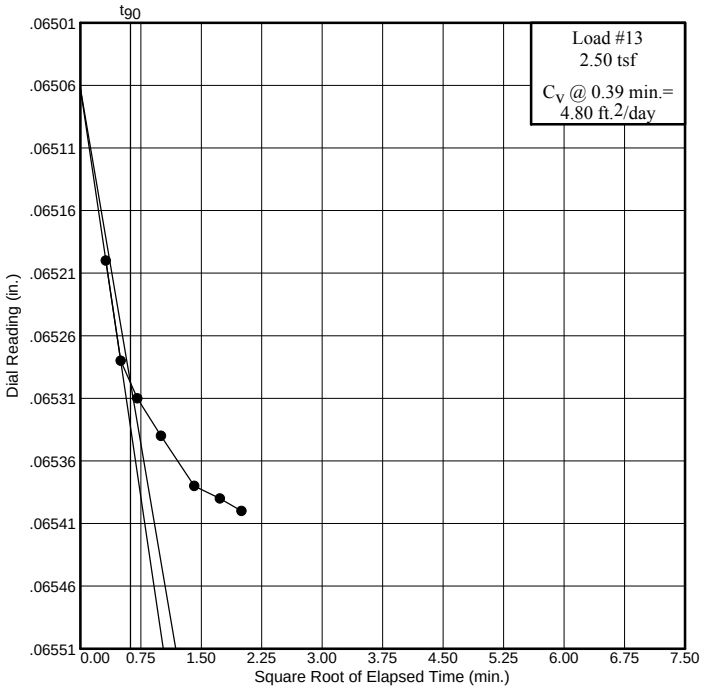
SOIL TECHNOLOGY

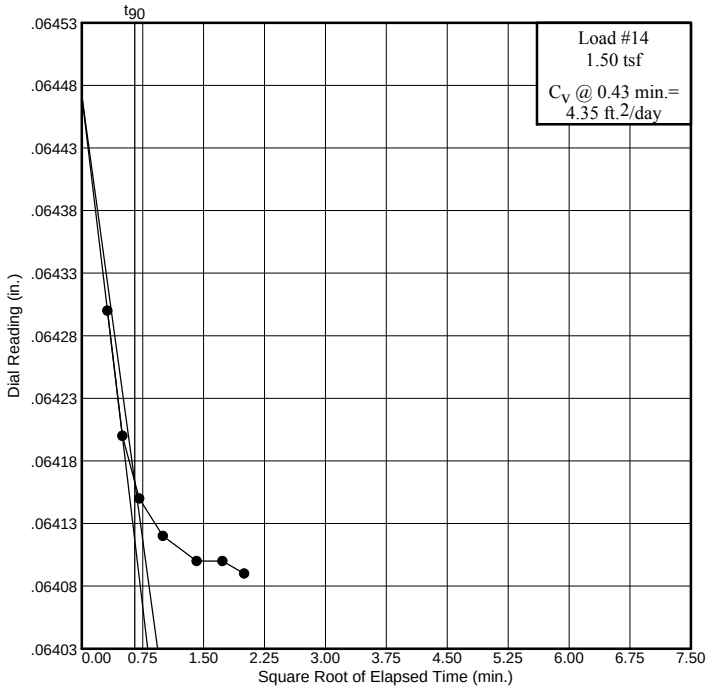
Bainbridge Island, WA

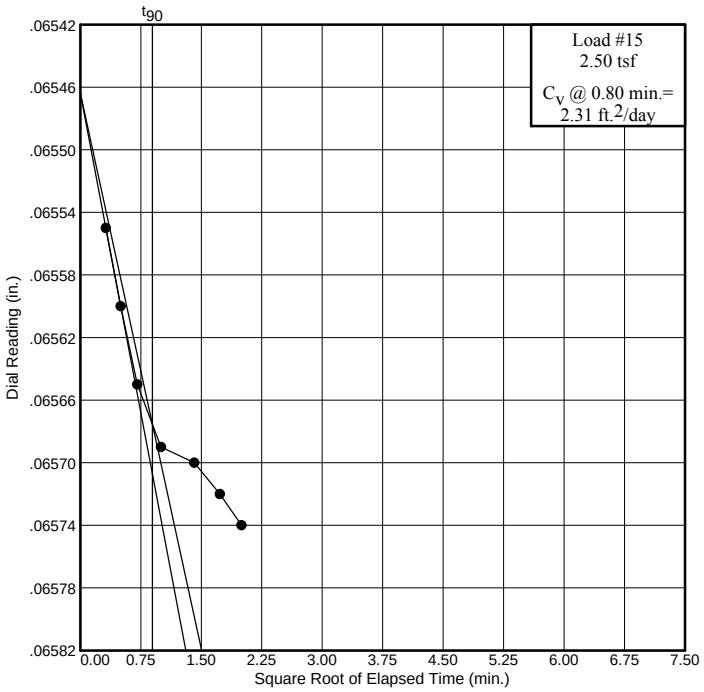
Figure 8.4

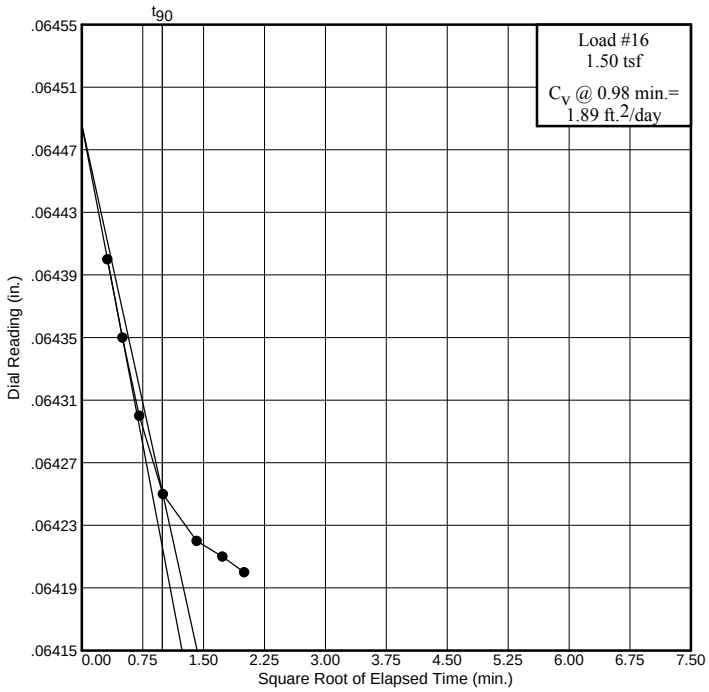
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-31-PMT-SW-08 Sample No.: S-9 Elev./Depth: 85.0-85.1









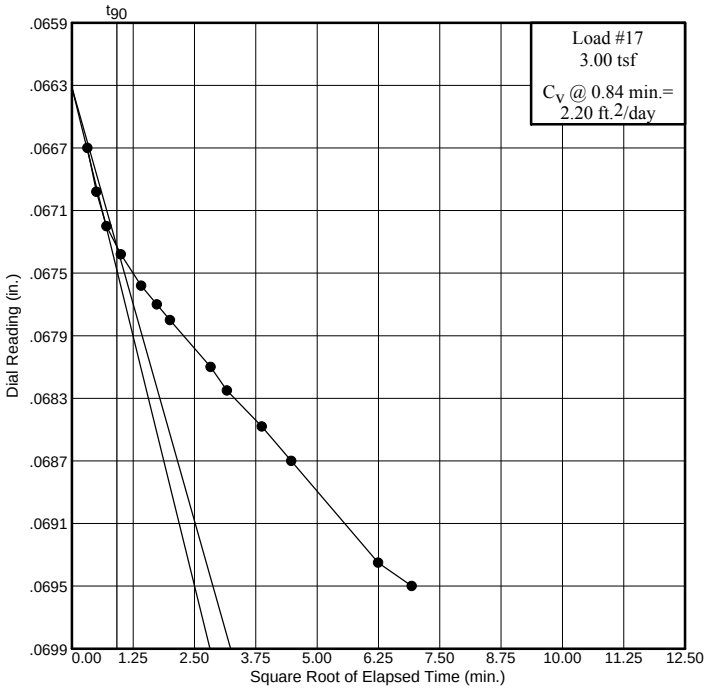
SOIL TECHNOLOGY

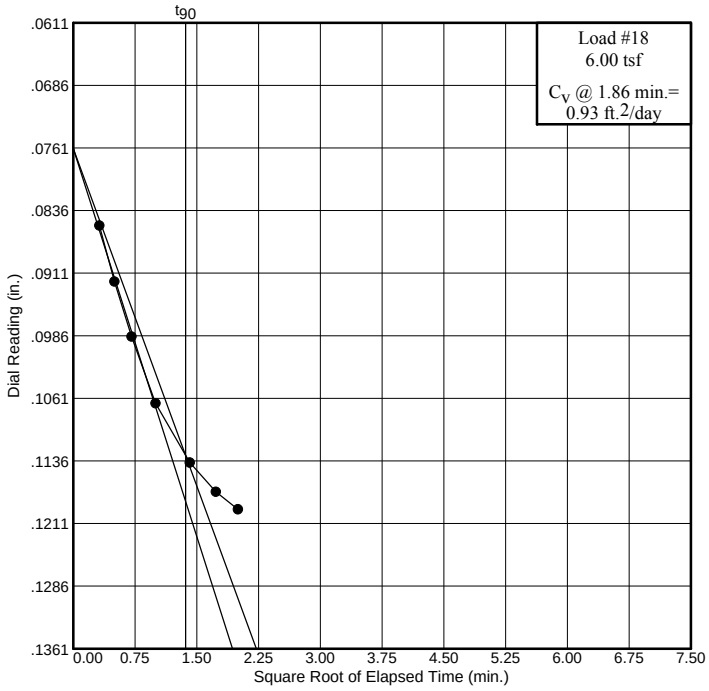
Bainbridge Island, WA

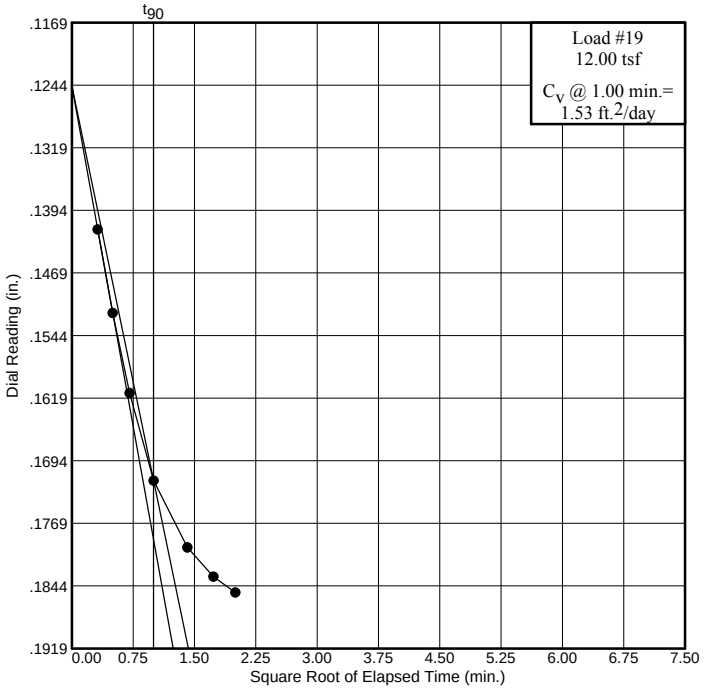
Figure 8.5

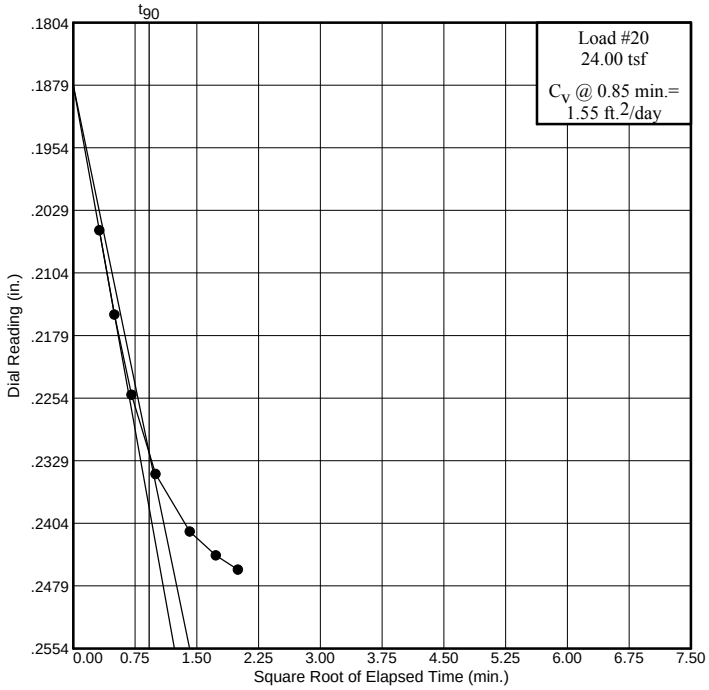
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-31-PMT-SW-08 Sample No.: S-9 Elev./Depth: 85.0-85.1









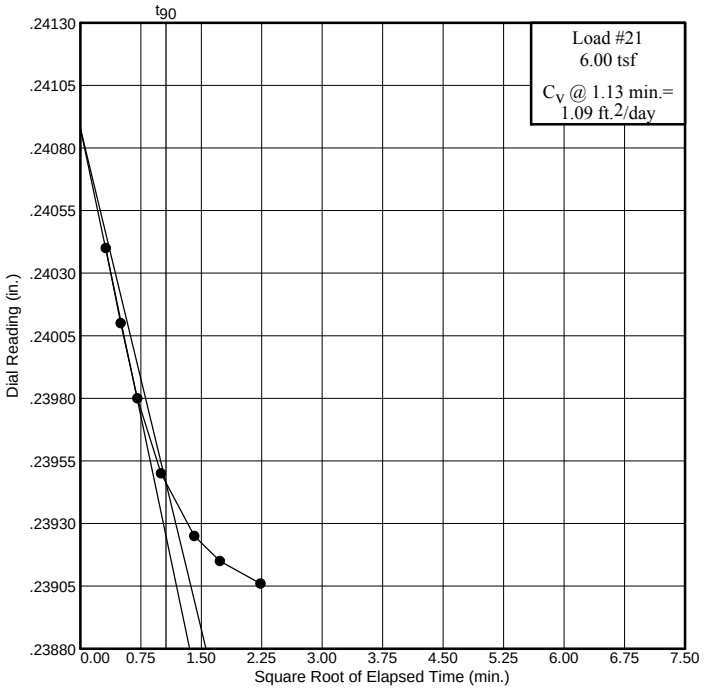
SOIL TECHNOLOGY

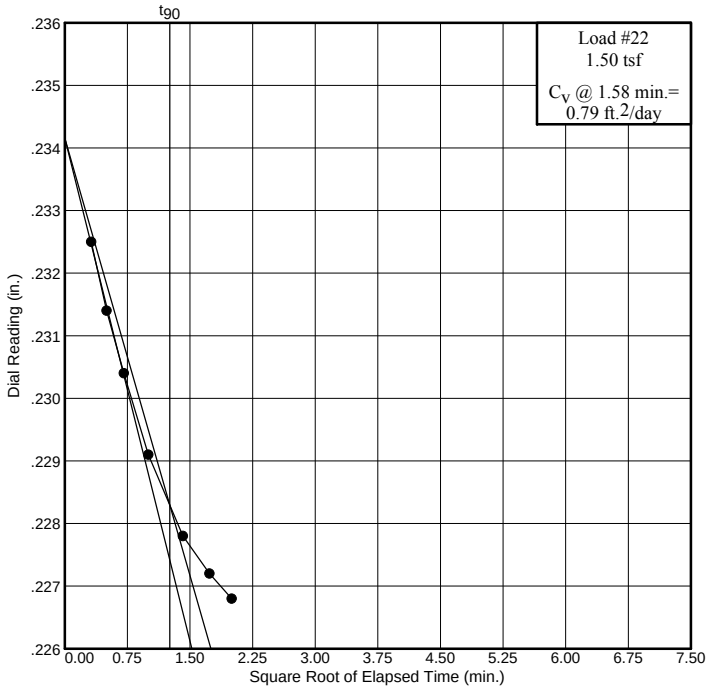
Bainbridge Island, WA

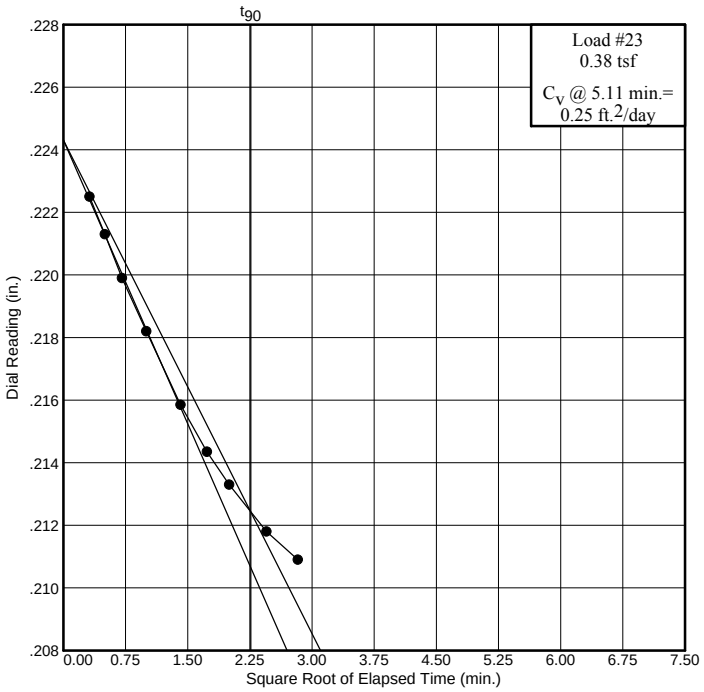
Figure 8.6

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-31-PMT-SW-08 Sample No.: S-9 Elev./Depth: 85.0-85.1





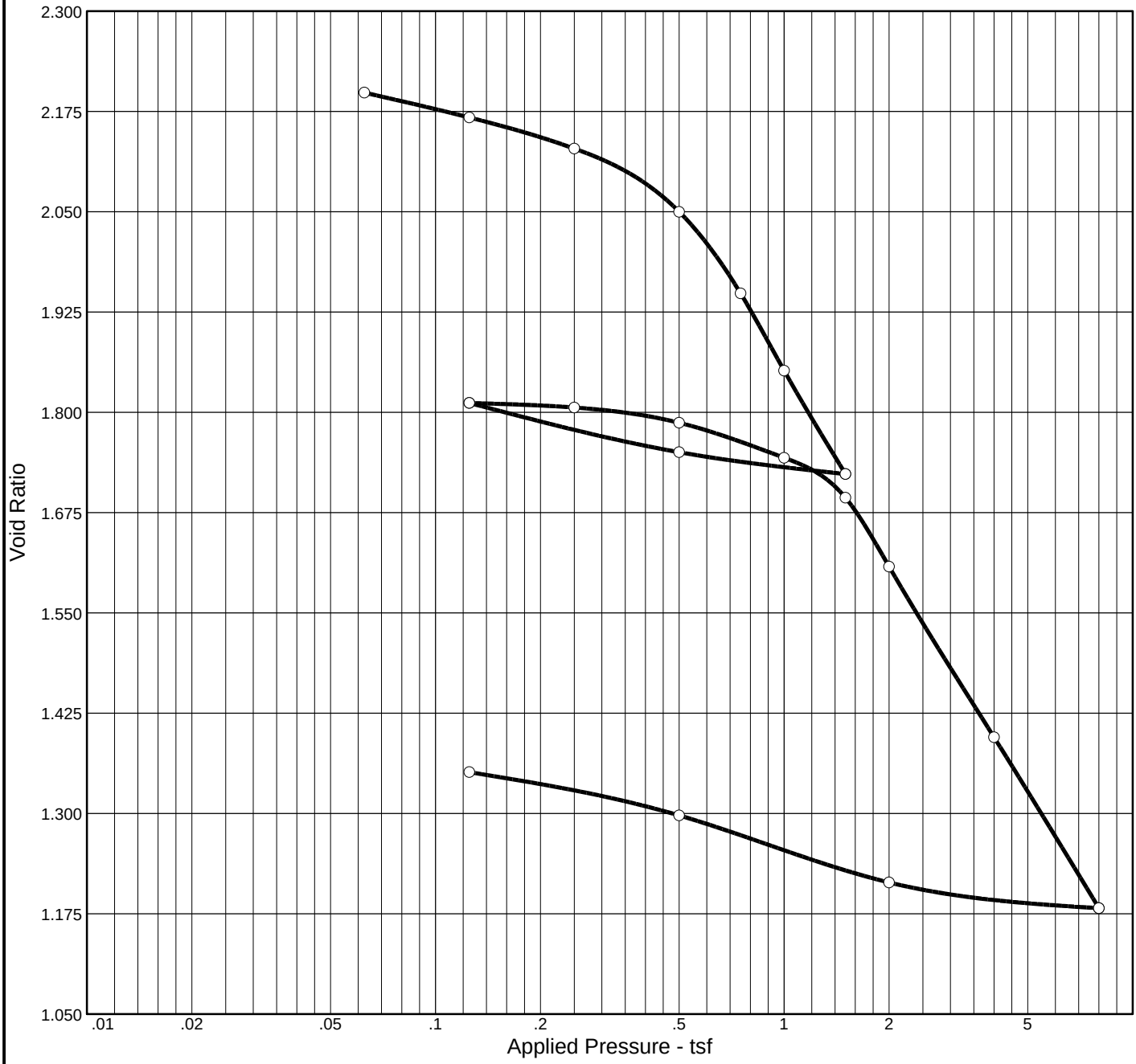


SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 8.7

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.0 %	85.7%	50.3	91	48	2.6	0.40	0.53	0.75	0.083	2.228

MATERIAL DESCRIPTION	USCS	AASHTO
Very soft, wet, grey Organic SILT	MH	----

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-32-08 **Sample No.:** S-4 **Elev./Depth:** 13.2-13.3

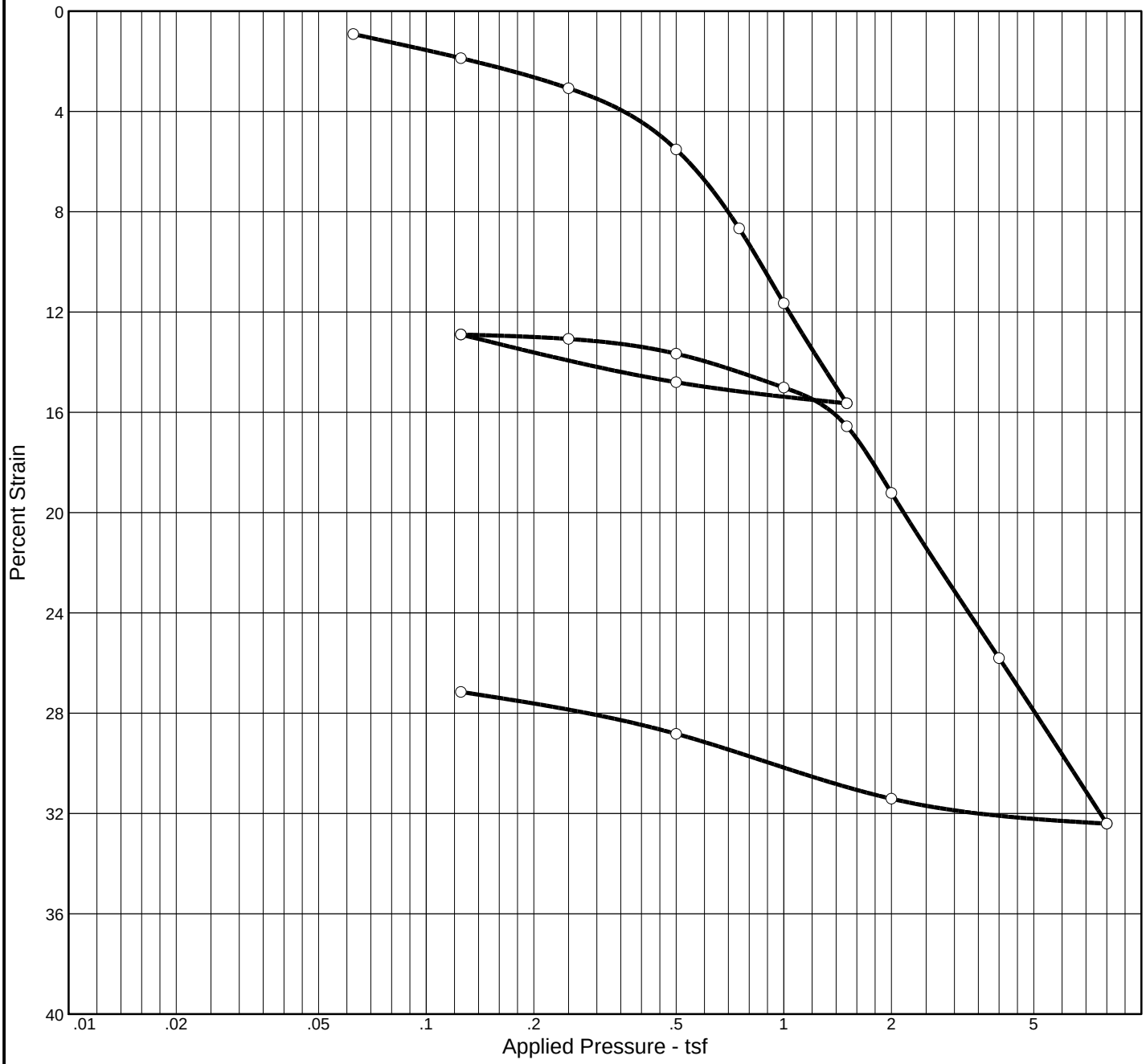
SOIL TECHNOLOGY

Bainbridge Island, WA

Remarks:
Specific gravity estimated

Figure 9.0

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.0 %	85.7 %	50.3	91	48	2.6	0.40	0.53	0.75	0.083	2.228

MATERIAL DESCRIPTION	USCS	AASHTO
Very soft, wet, grey Organic SILT	MH	----

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-32-08 **Sample No.:** S-4 **Elev./Depth:** 13.2-13.3

Remarks:
Specific gravity estimated

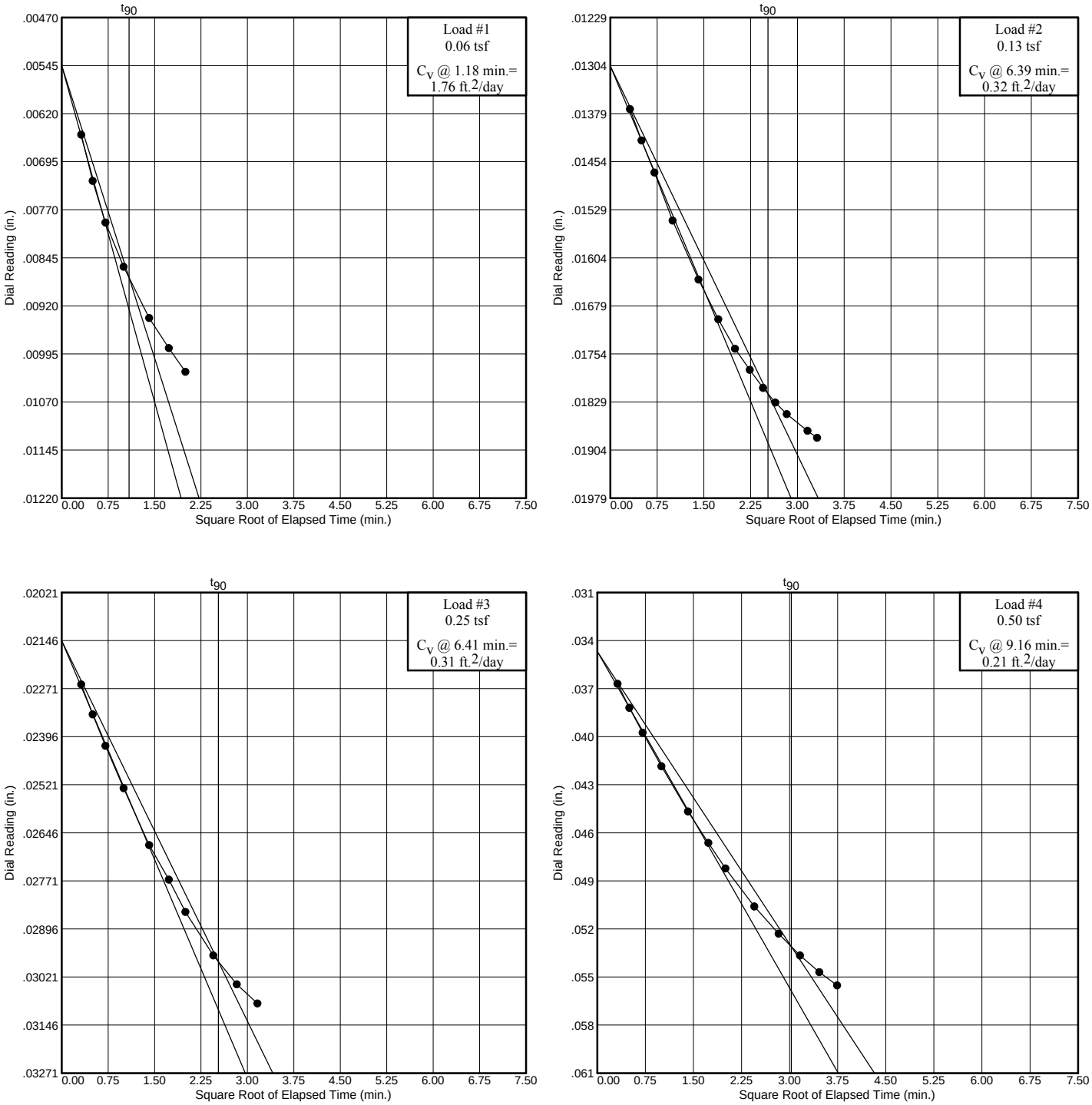
SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 9.1

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-32-08 Sample No.: S-4 Elev./Depth: 13.2-13.3



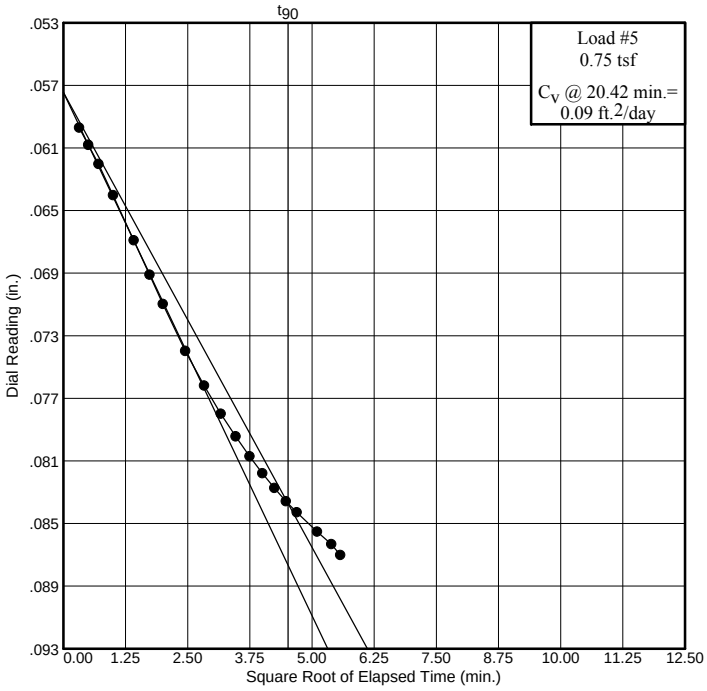
SOIL TECHNOLOGY

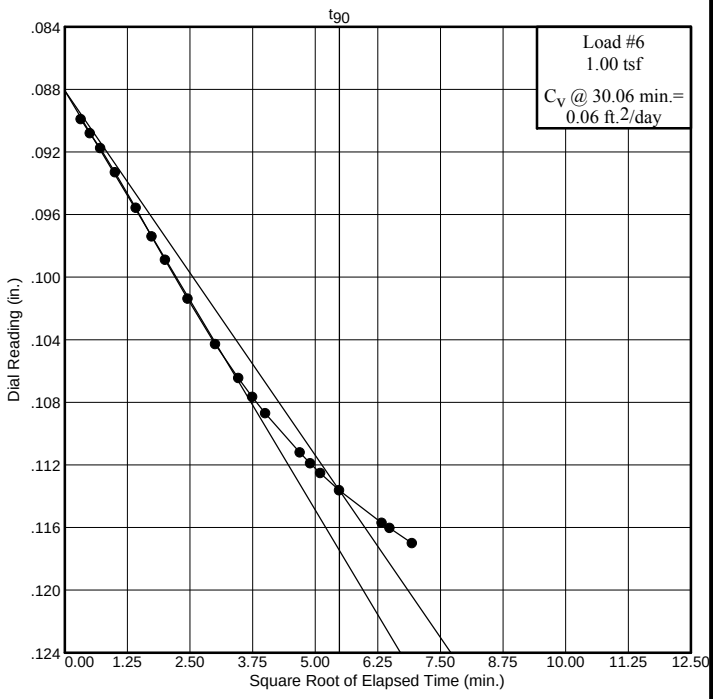
Bainbridge Island, WA

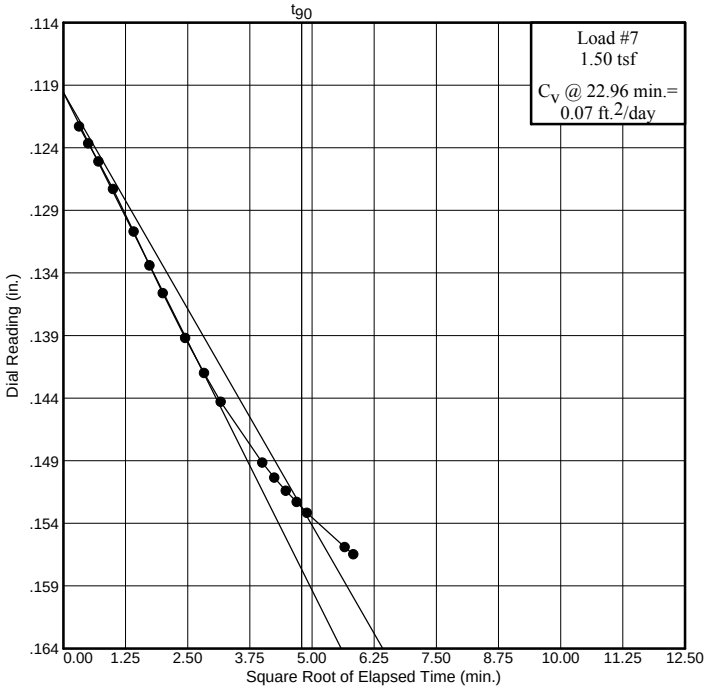
Figure 9.2

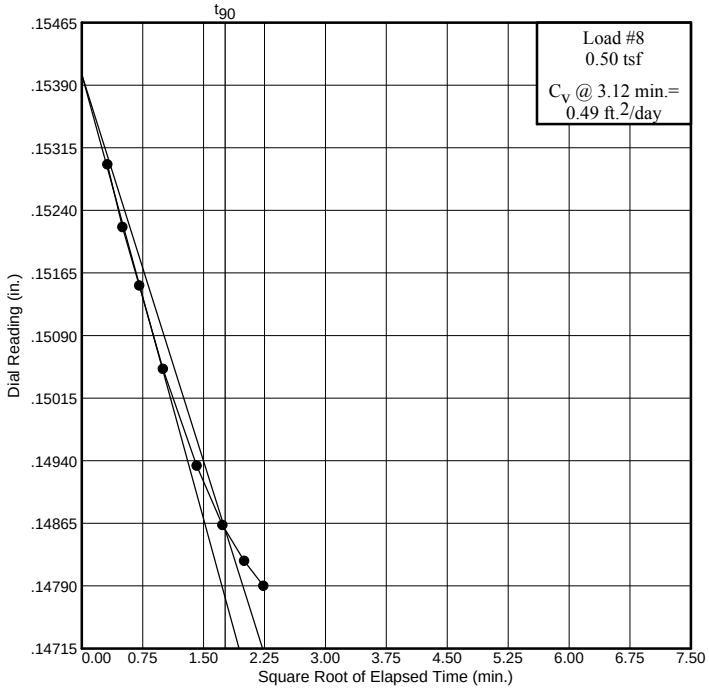
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-32-08 Sample No.: S-4 Elev./Depth: 13.2-13.3









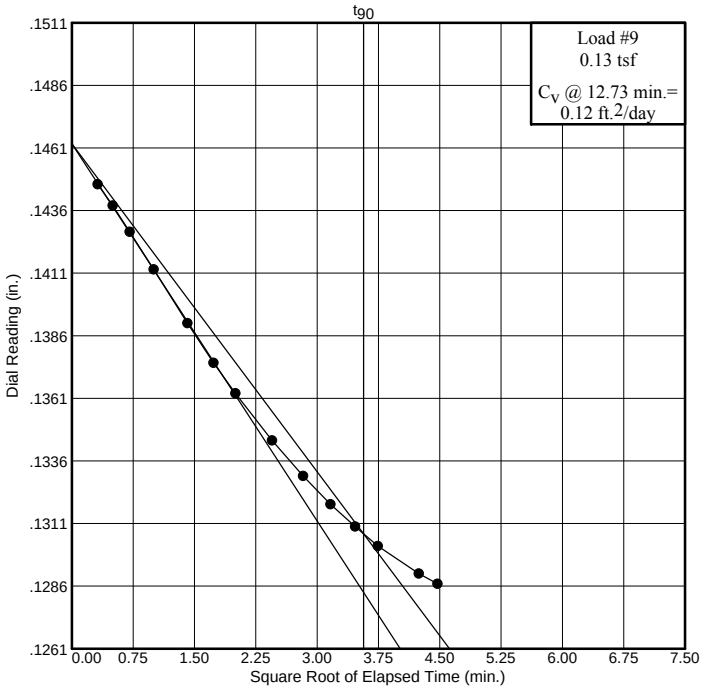
SOIL TECHNOLOGY

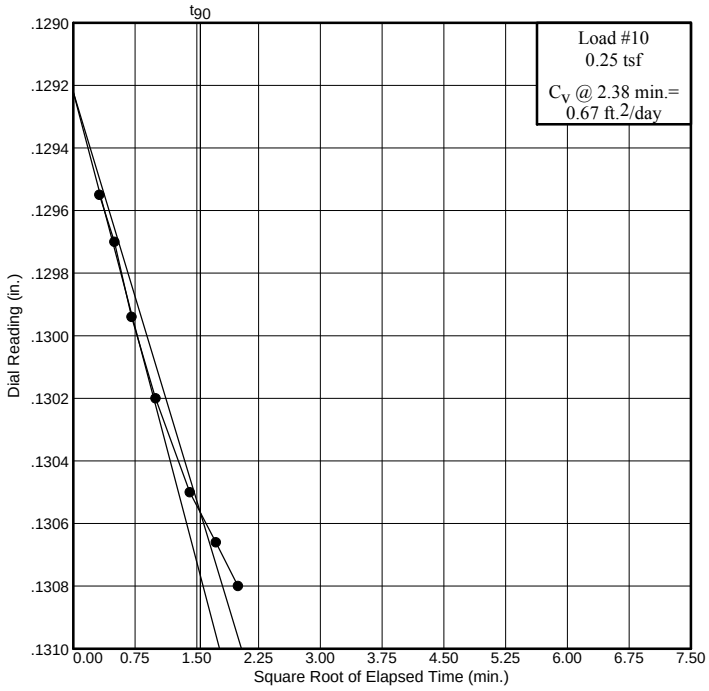
Bainbridge Island, WA

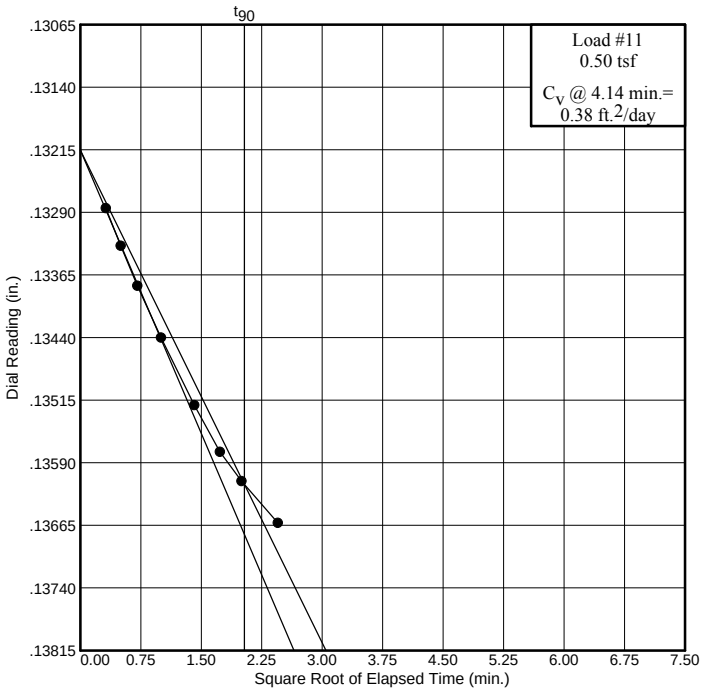
Figure 9.3

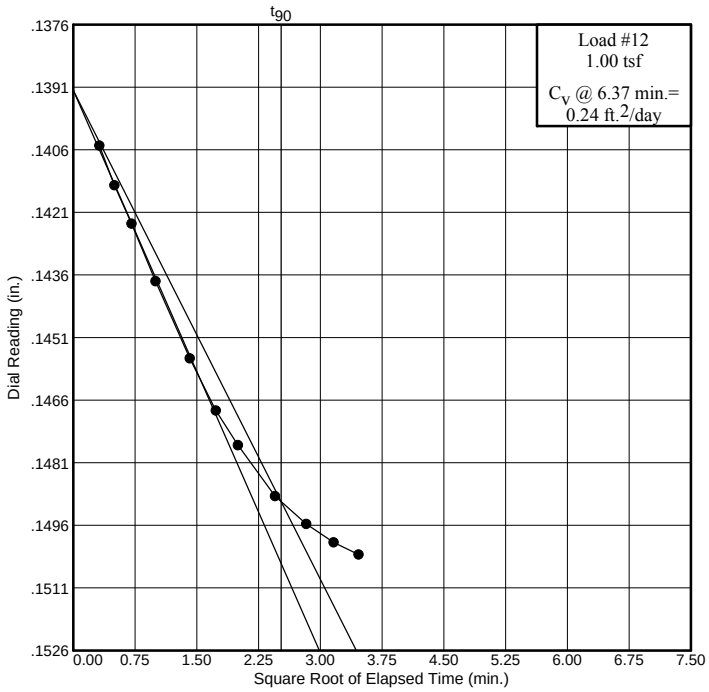
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-32-08 Sample No.: S-4 Elev./Depth: 13.2-13.3









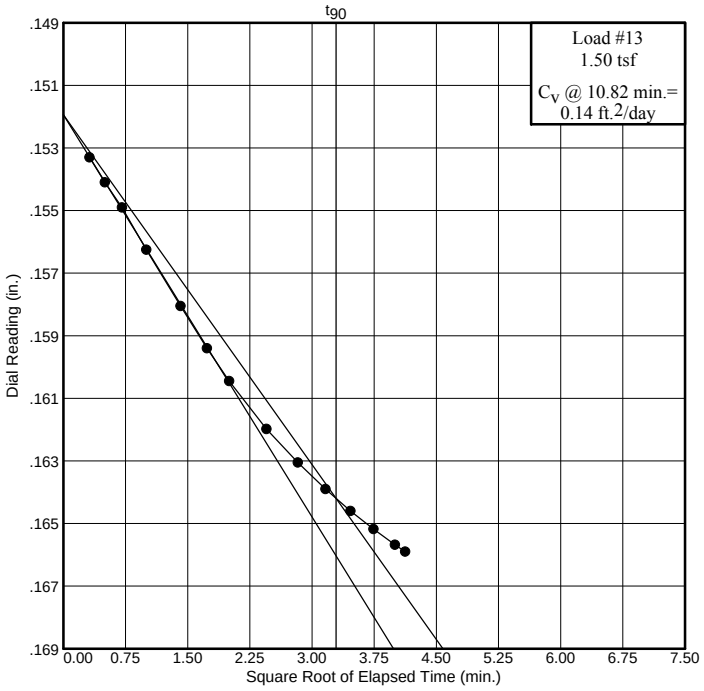
SOIL TECHNOLOGY

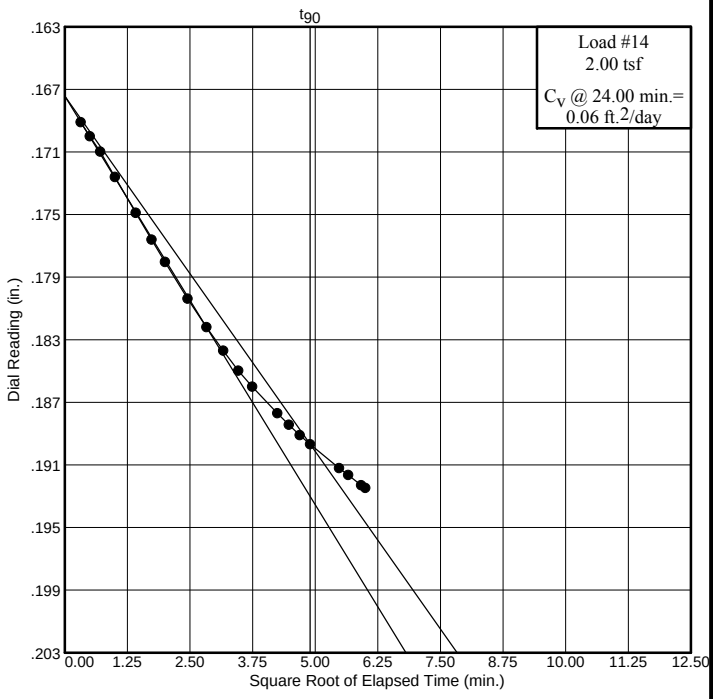
Bainbridge Island, WA

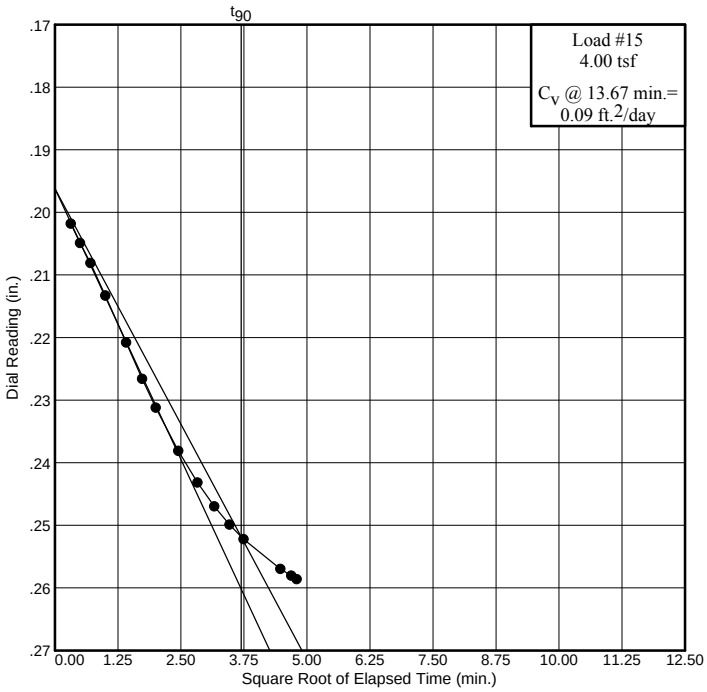
Figure 9.4

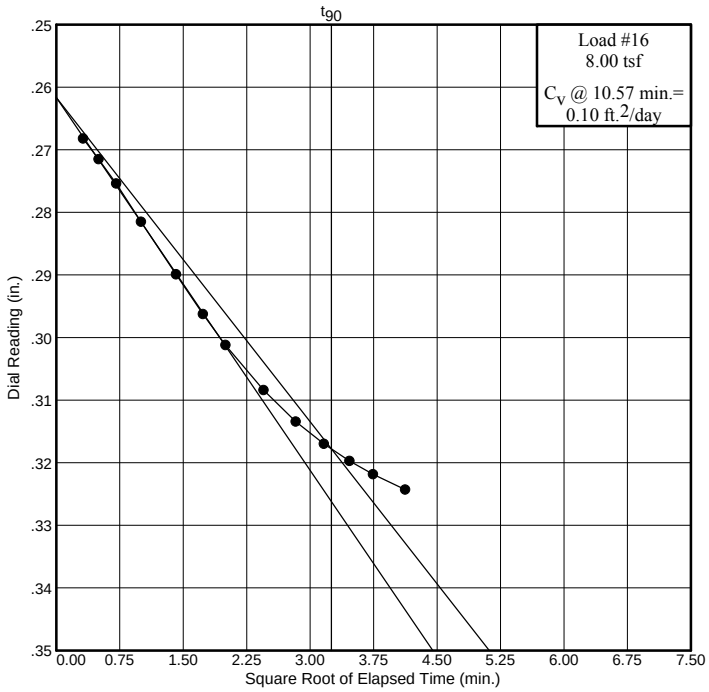
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-32-08 Sample No.: S-4 Elev./Depth: 13.2-13.3









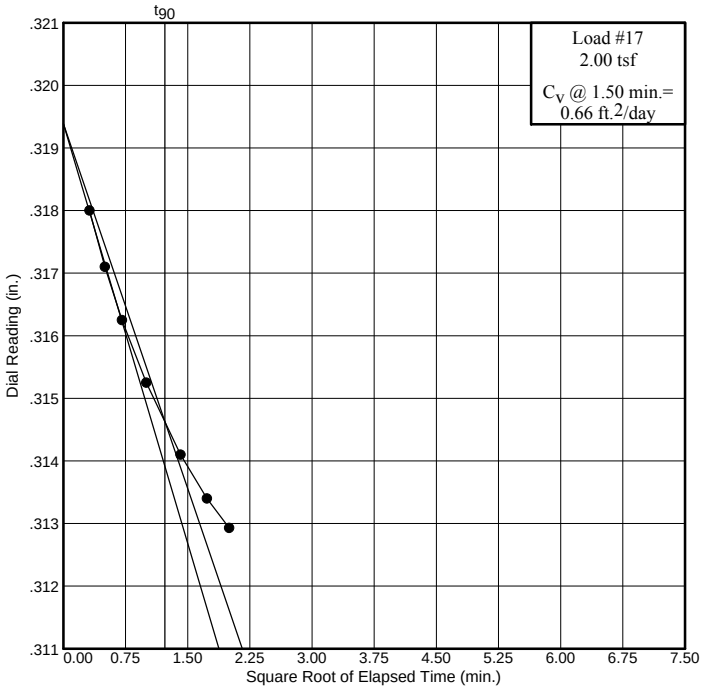
SOIL TECHNOLOGY

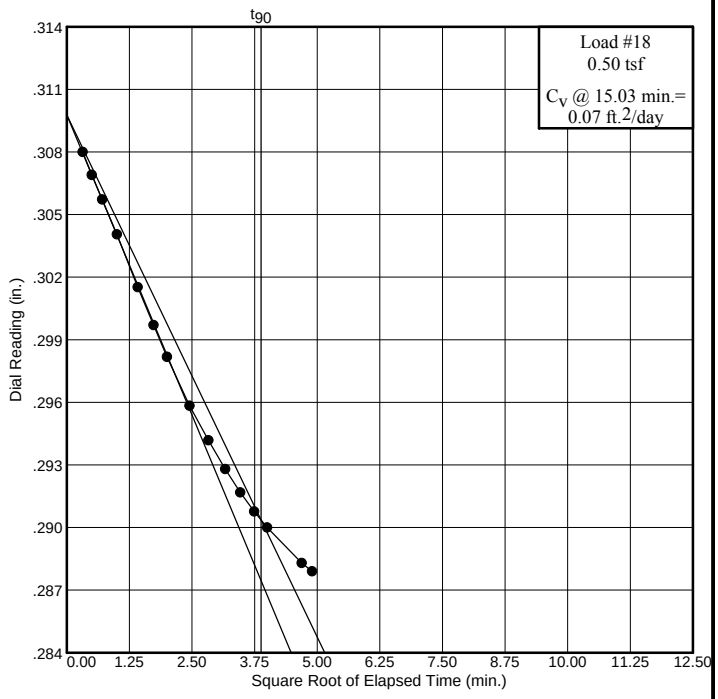
Bainbridge Island, WA

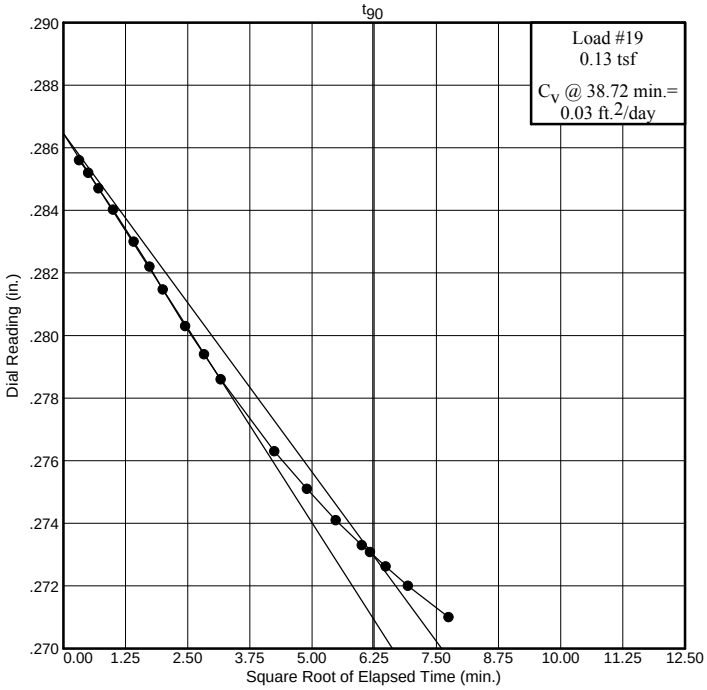
Figure 9.5

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-32-08 Sample No.: S-4 Elev./Depth: 13.2-13.3





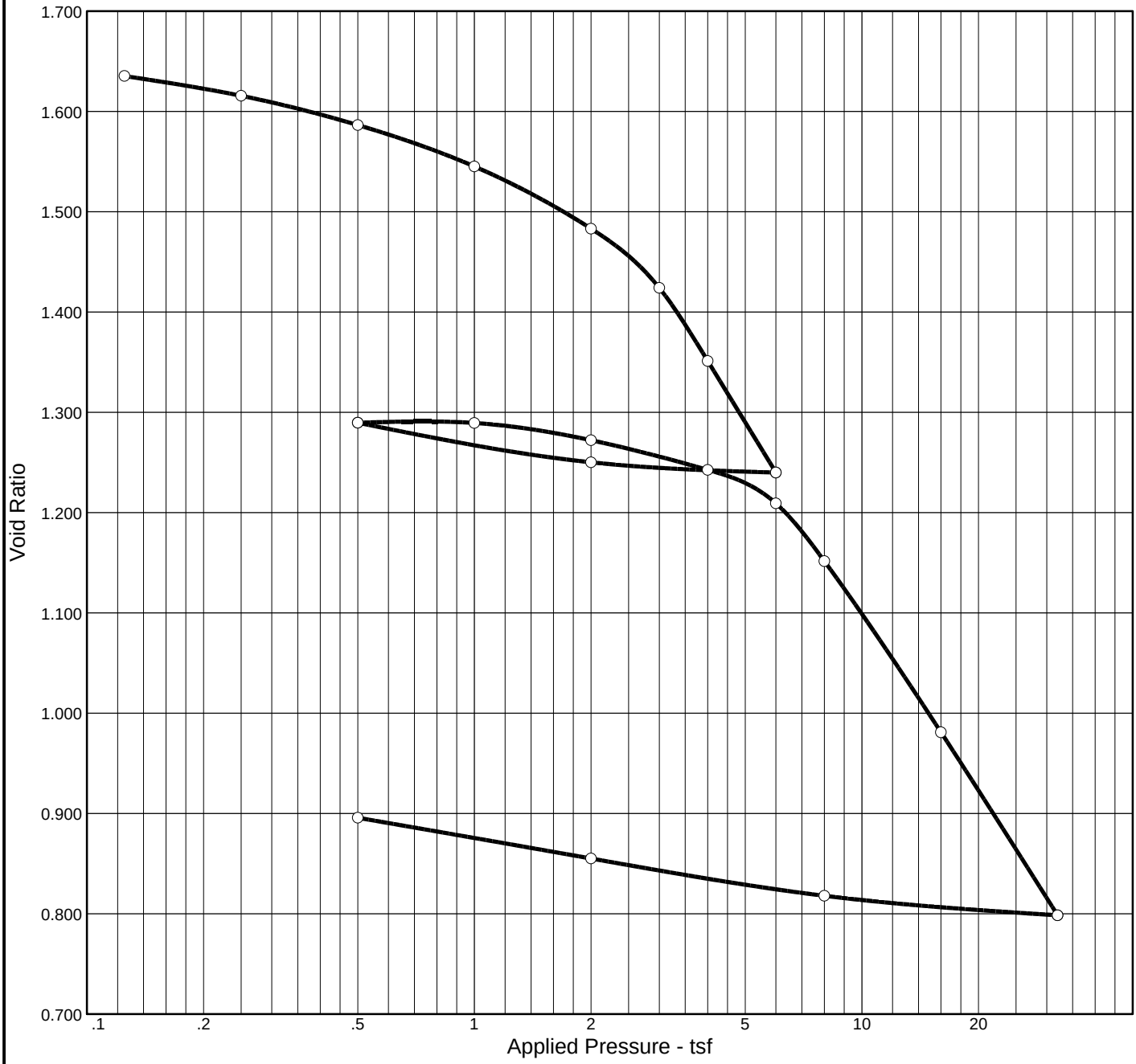


SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 9.6

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.1 %	64.4 %	60.8	79	42	2.6	2.51	2.70	0.61	0.053	1.671

MATERIAL DESCRIPTION	USCS	AASHTO
M-Stiff, wet grey Organic Silt	OH	----

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-33-08 **Sample No.:** S-31 **Elev./Depth:** 105.3-105.4

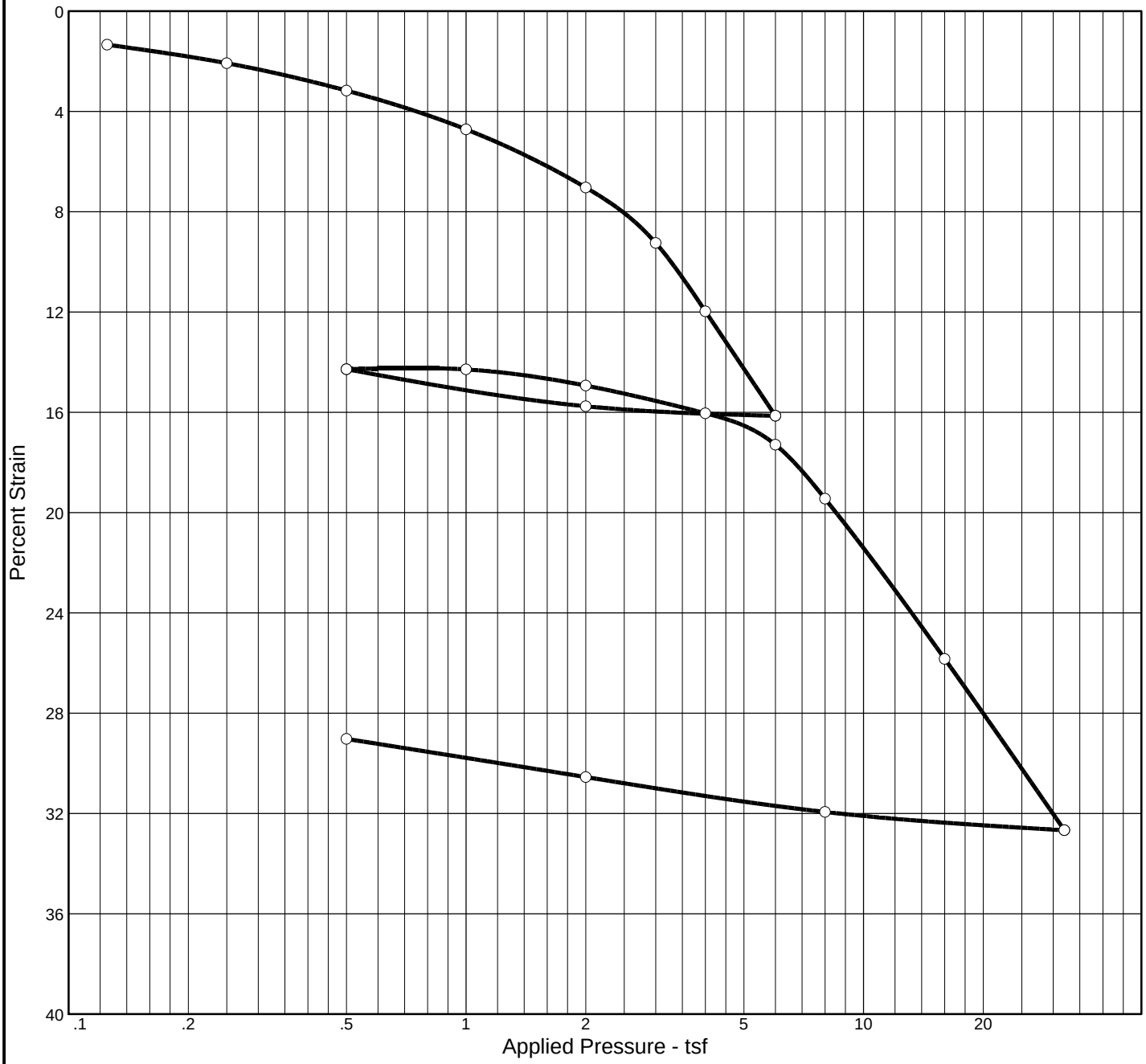
Remarks:
Specific gravity estimated

SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 10.0

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.1 %	64.4 %	60.8	79	42	2.6	2.51	2.70	0.61	0.053	1.671

MATERIAL DESCRIPTION	USCS	AASHTO
M-Stiff, wet grey Organic Silt	OH	----

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-33-08 **Sample No.:** S-31 **Elev./Depth:** 105.3-105.4

Remarks:
Specific gravity estimated

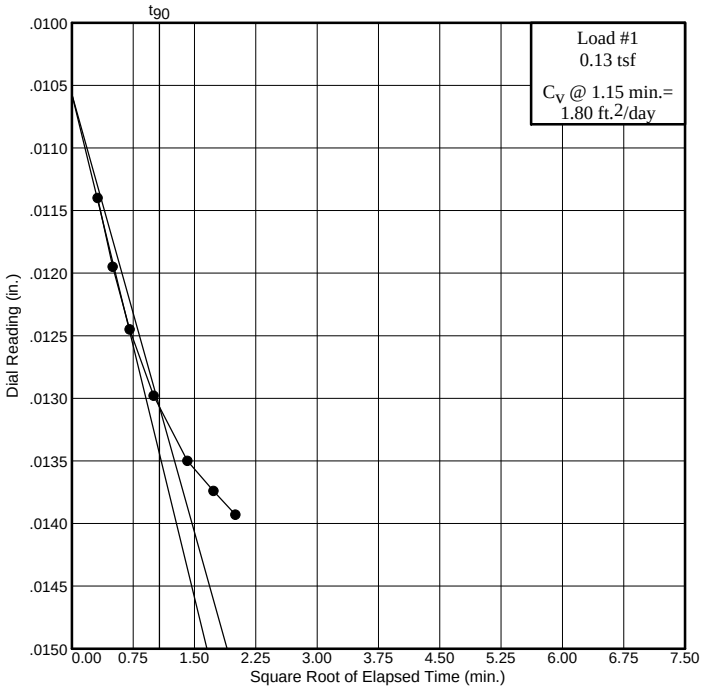
SOIL TECHNOLOGY

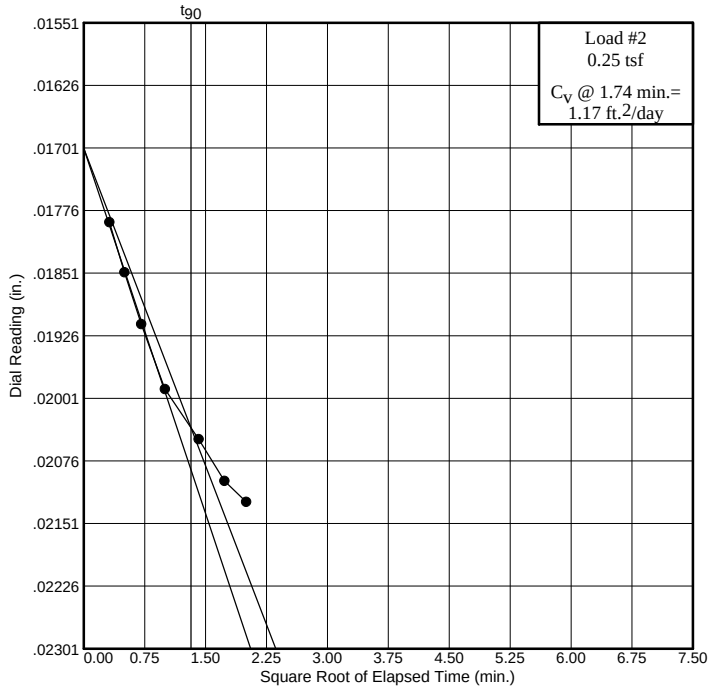
Bainbridge Island, WA

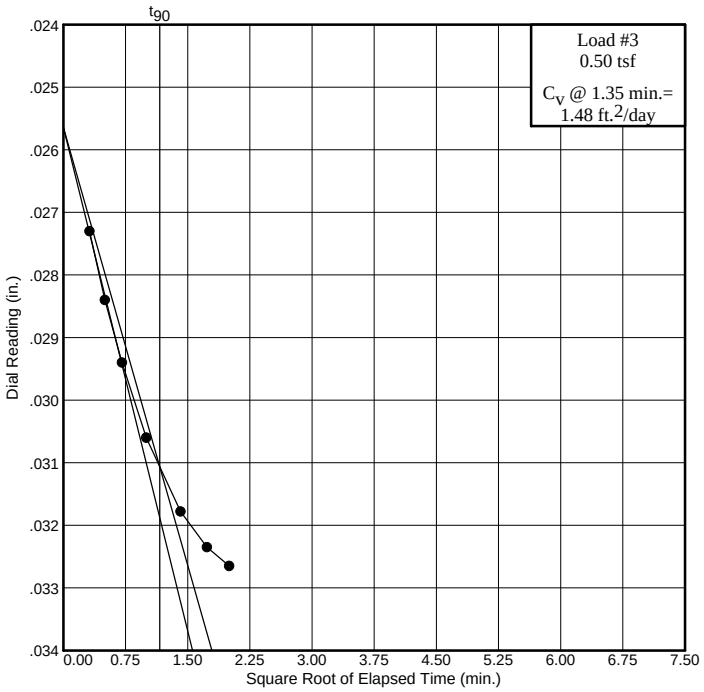
Figure 10.1

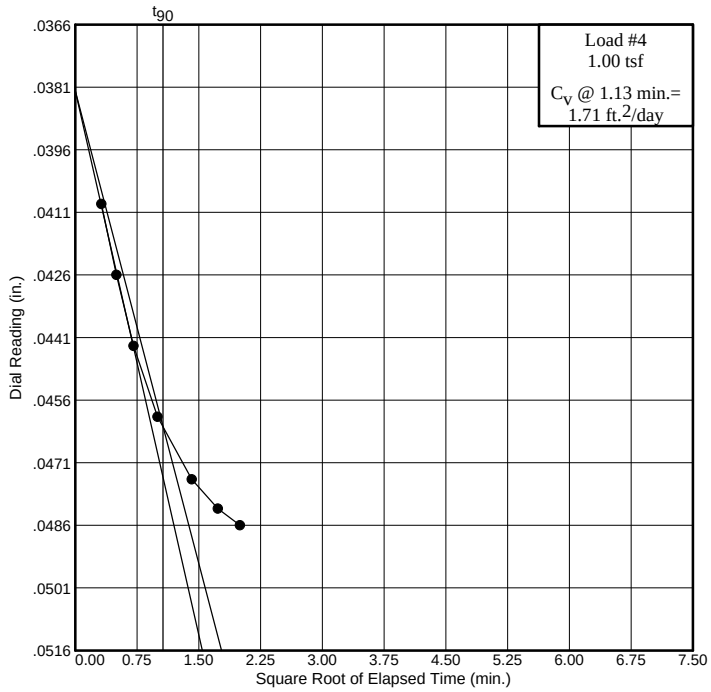
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-33-08 Sample No.: S-31 Elev./Depth: 105.3-105.4









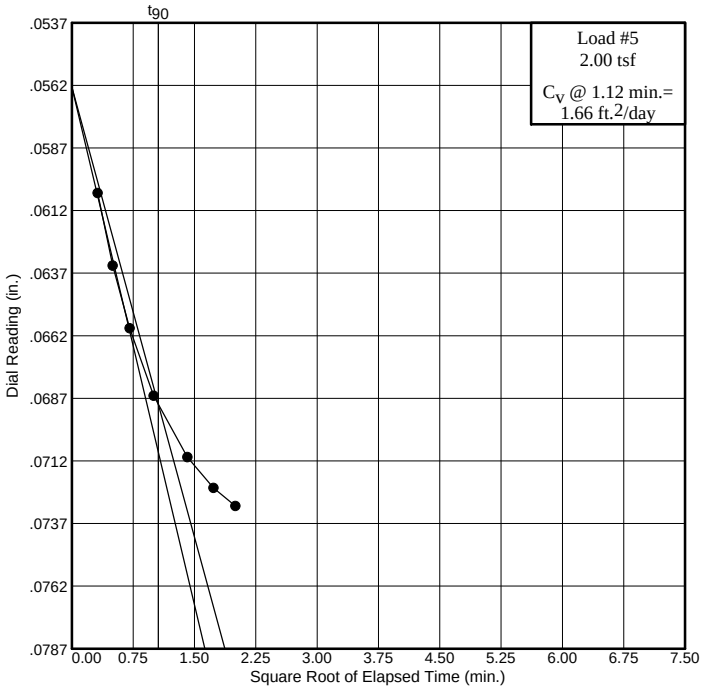
SOIL TECHNOLOGY

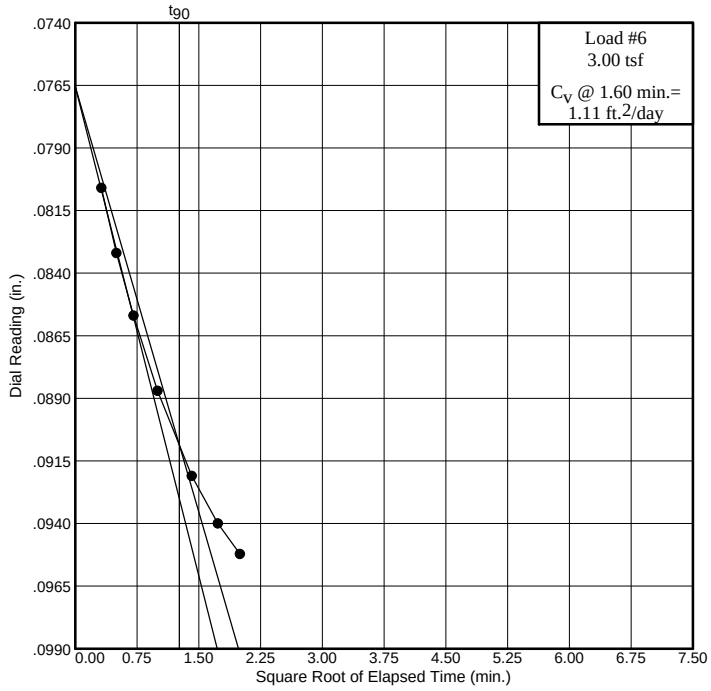
Bainbridge Island, WA

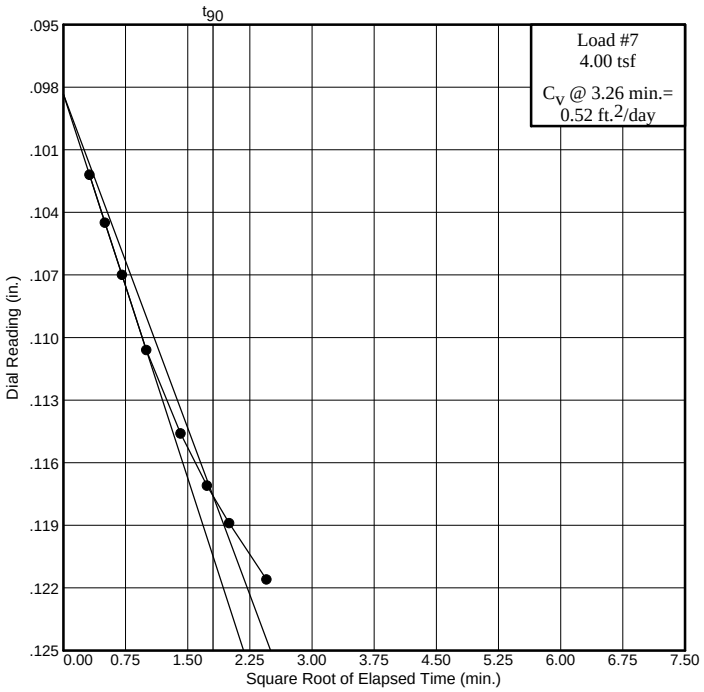
Figure 10.2

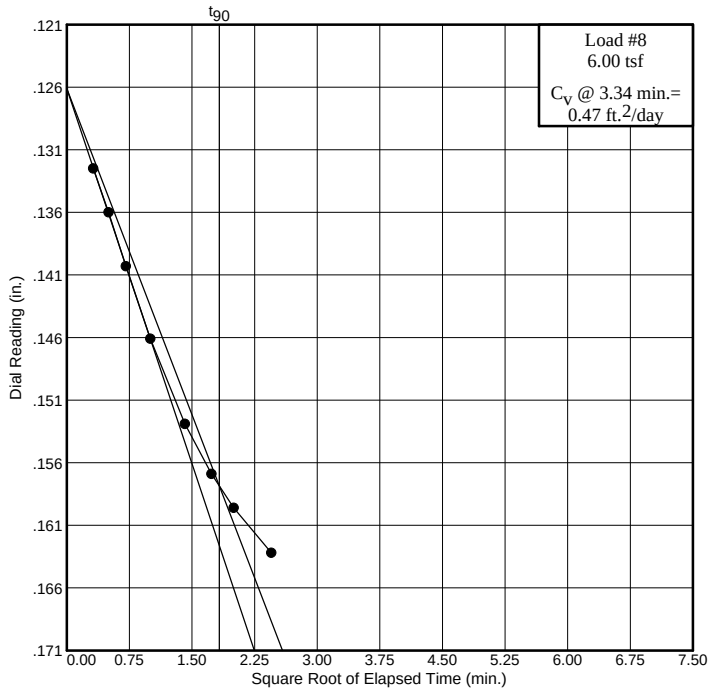
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-33-08 Sample No.: S-31 Elev./Depth: 105.3-105.4









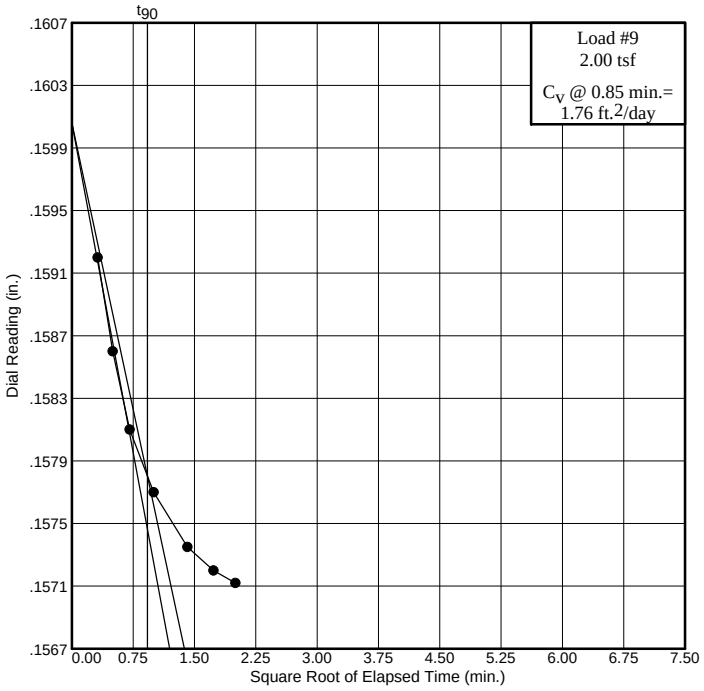
SOIL TECHNOLOGY

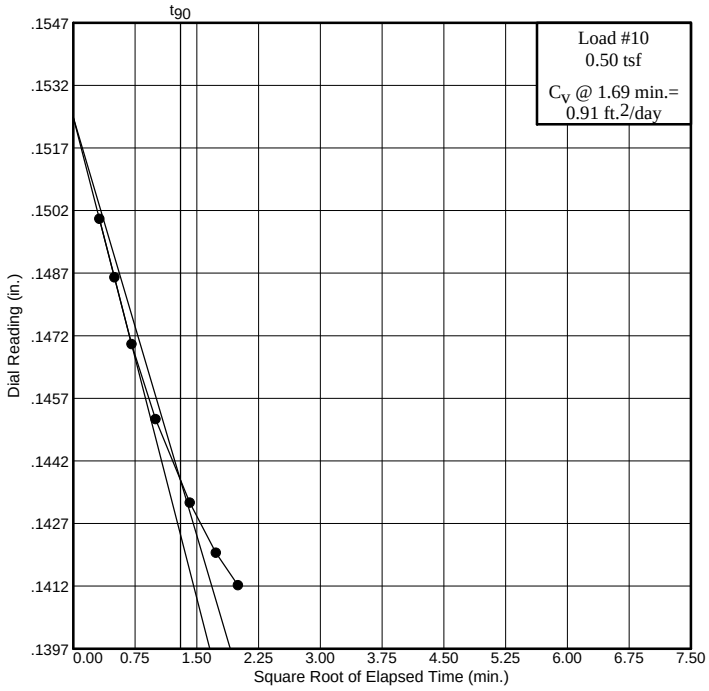
Bainbridge Island, WA

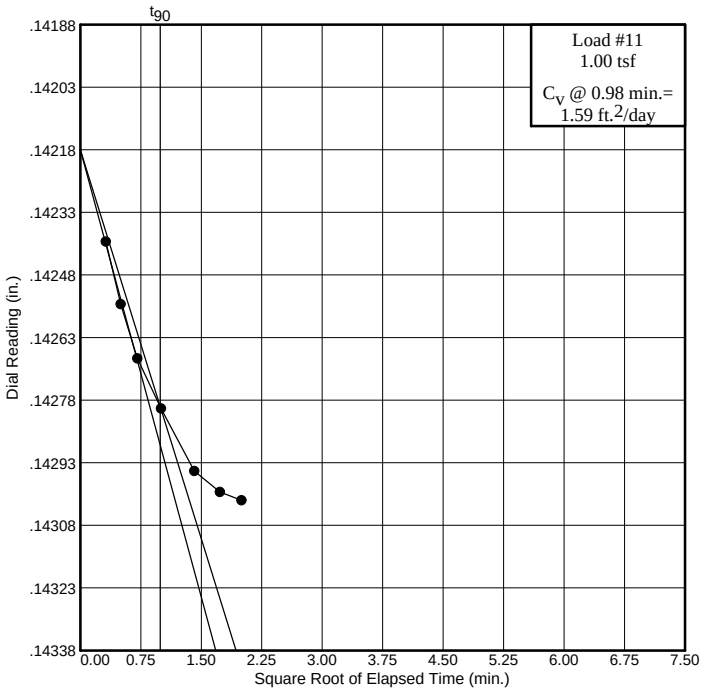
Figure 10.3

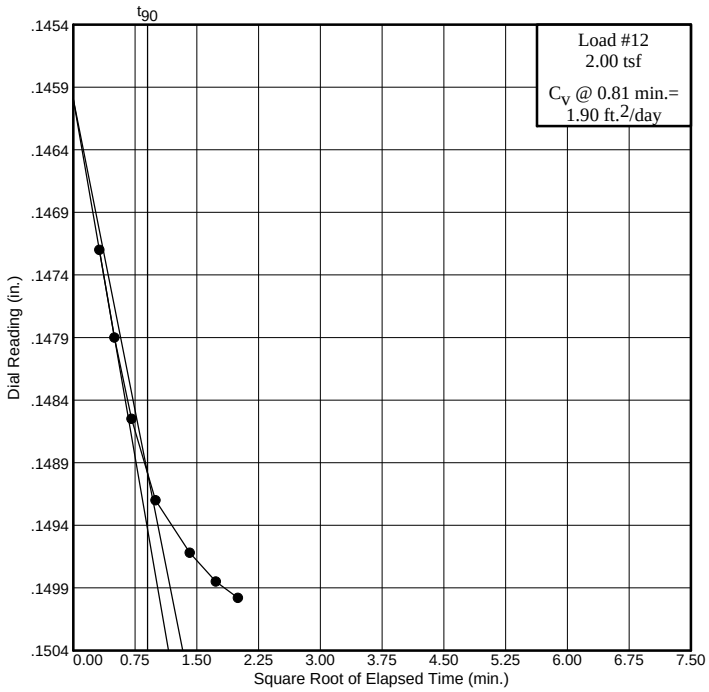
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-33-08 Sample No.: S-31 Elev./Depth: 105.3-105.4









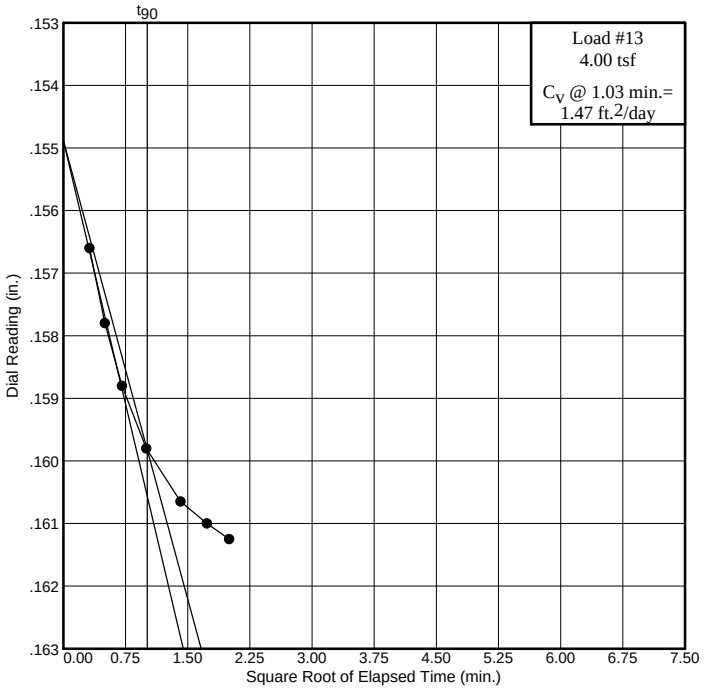
SOIL TECHNOLOGY

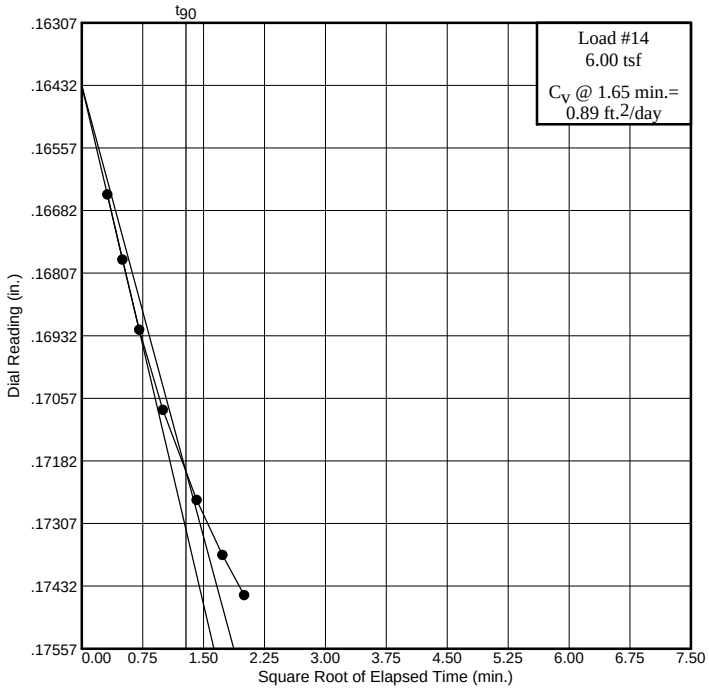
Bainbridge Island, WA

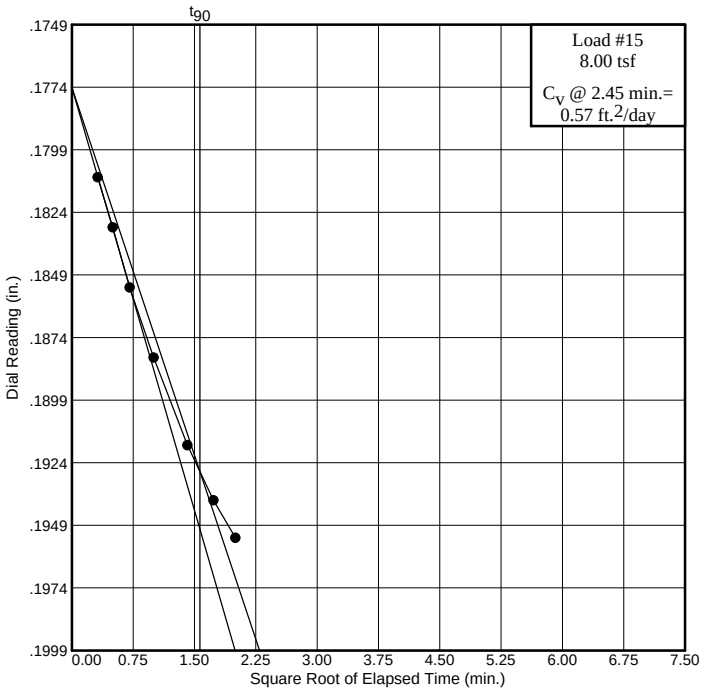
Figure 10.4

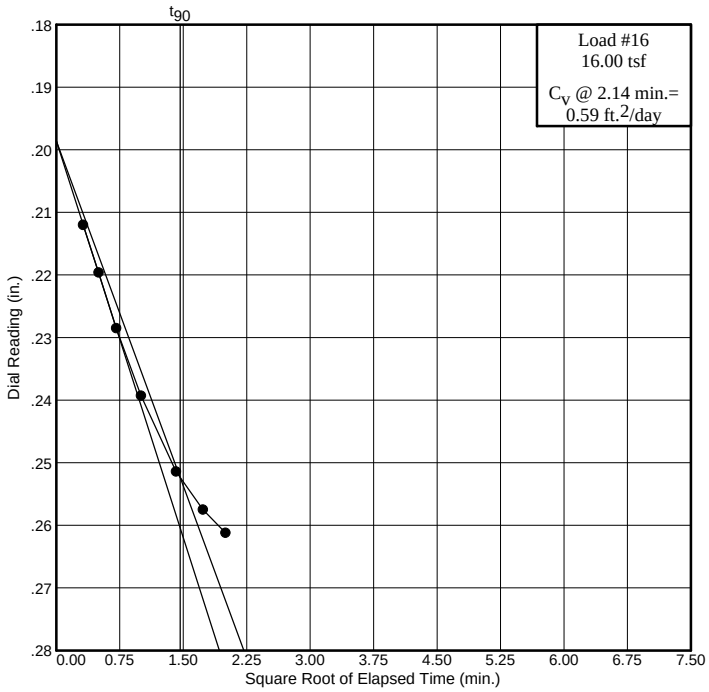
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-33-08 Sample No.: S-31 Elev./Depth: 105.3-105.4









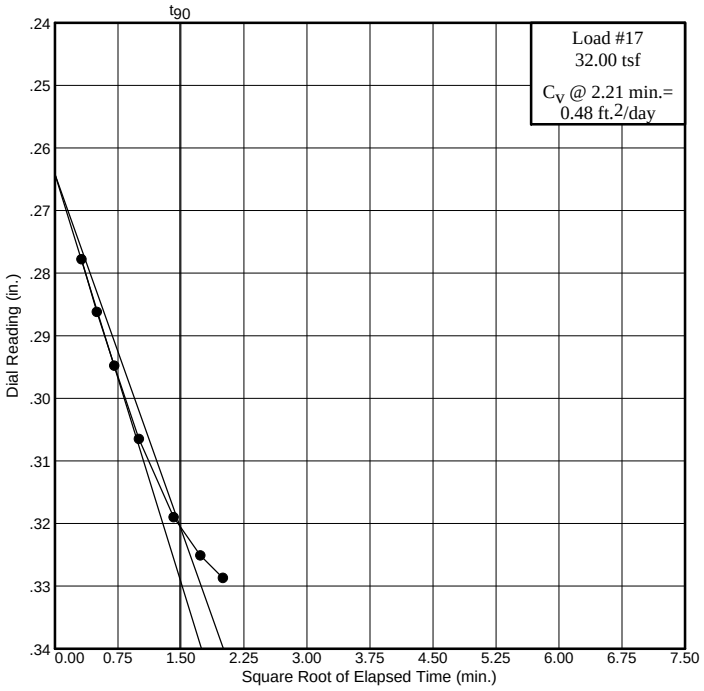
SOIL TECHNOLOGY

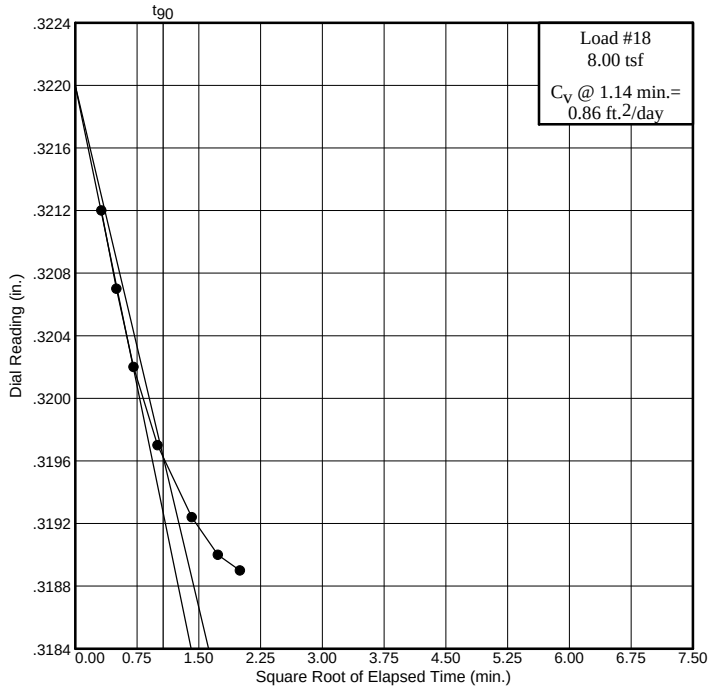
Bainbridge Island, WA

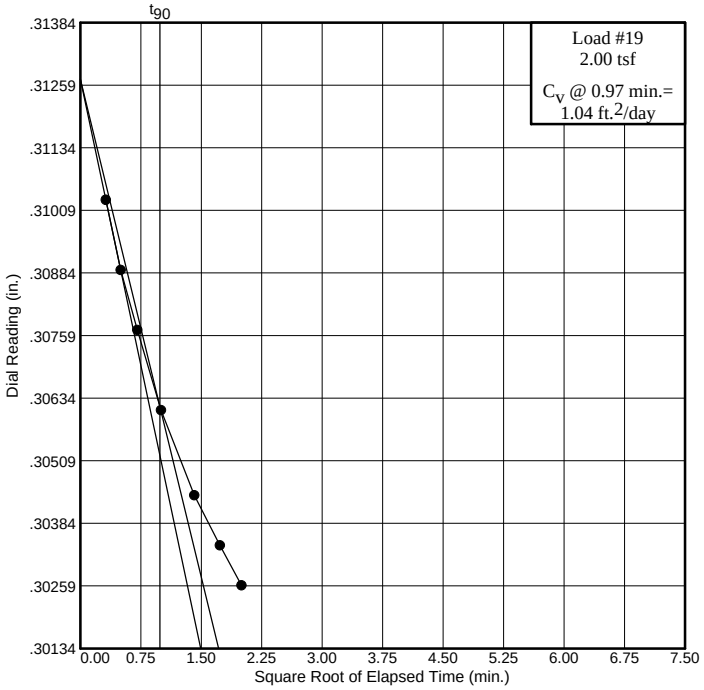
Figure 10.5

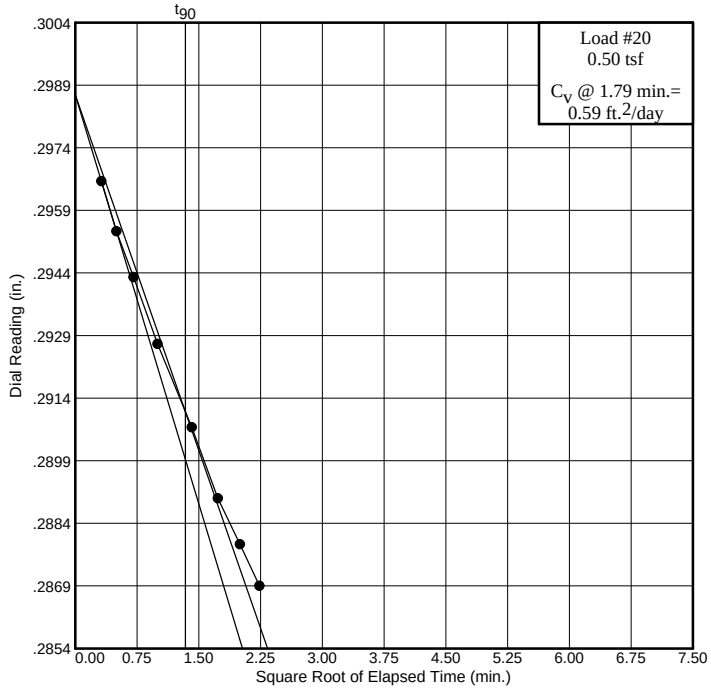
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-33-08 Sample No.: S-31 Elev./Depth: 105.3-105.4







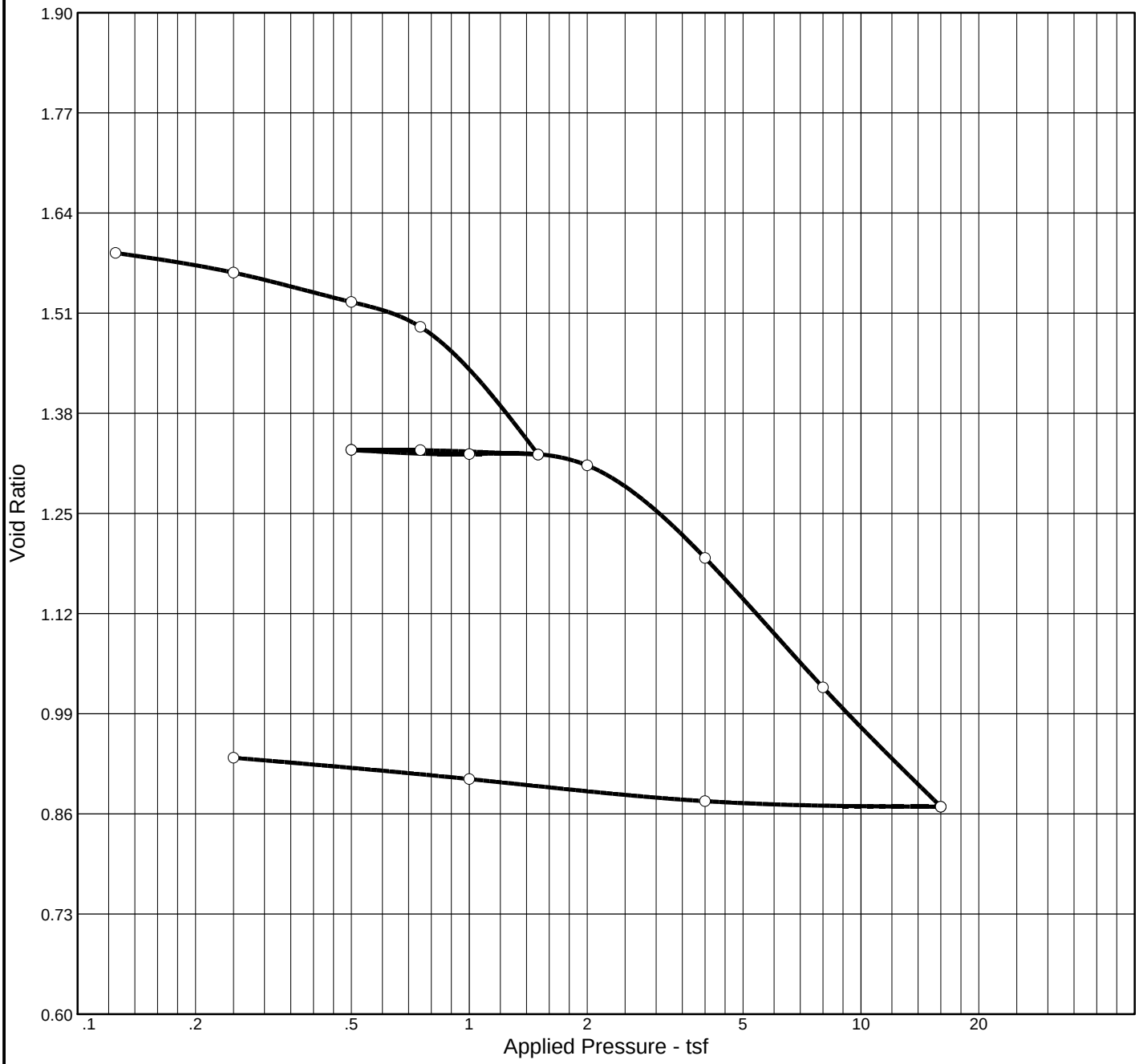


SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 10.6

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.1 %	65.1 %	59.6	77	37	2.5	0.49	1.20	0.54	0.036	1.625

MATERIAL DESCRIPTION	USCS	AASHTO
Soft, wet, grey, organic SILT	OH	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-67P-08 **Sample No.:** S-2 **Elev./Depth:** 17.8-17.9

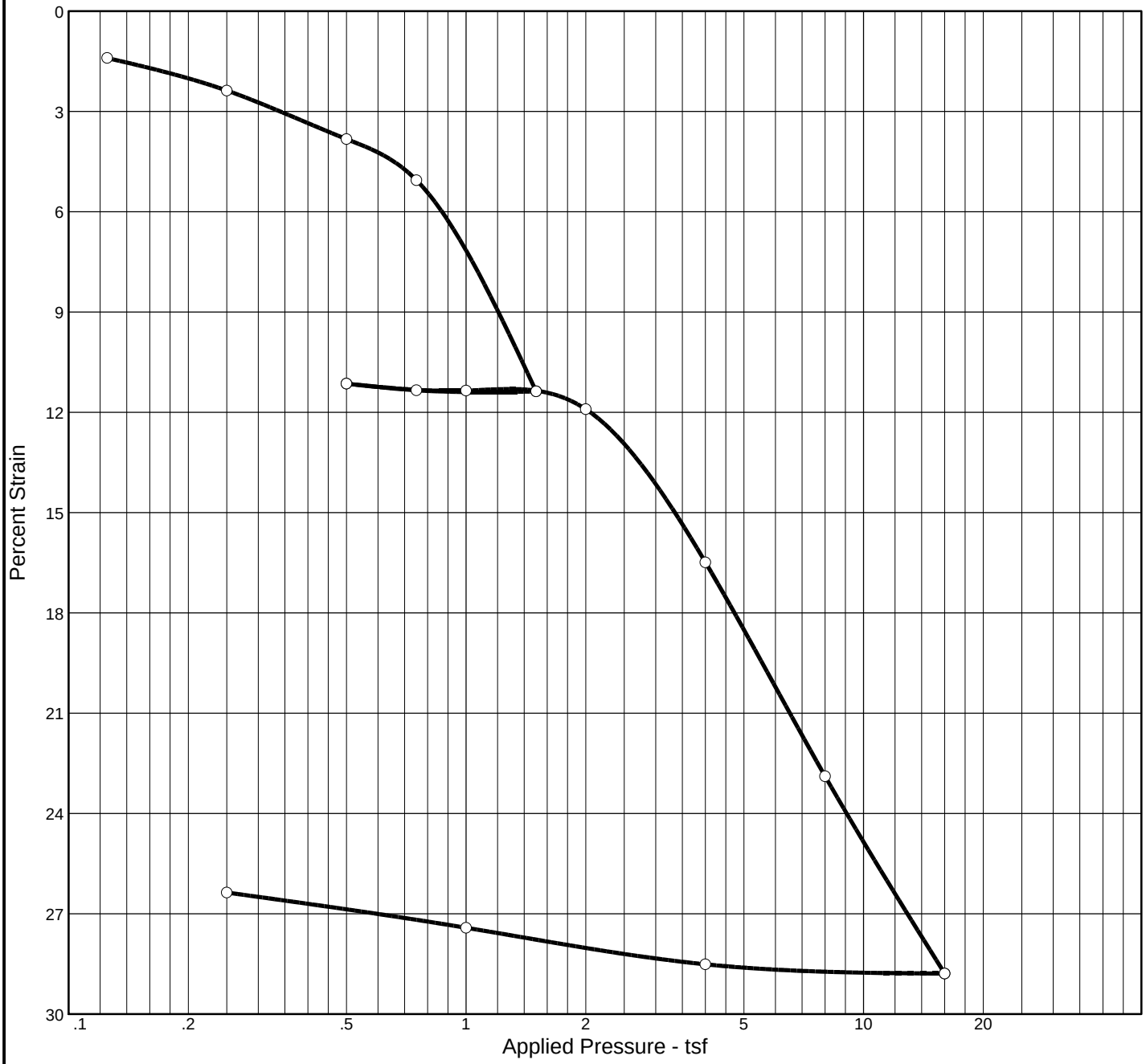
Remarks:
Specific gravity estimated

SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 11.0

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.1 %	65.1 %	59.6	77	37	2.5	0.49	1.20	0.54	0.036	1.625

MATERIAL DESCRIPTION	USCS	AASHTO
Soft, wet, grey, organic SILT	OH	---

Project No. J-08-2275 **Client:** Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Source: TH-67P-08 **Sample No.:** S-2 **Elev./Depth:** 17.8-17.9

Remarks:
Specific gravity estimated

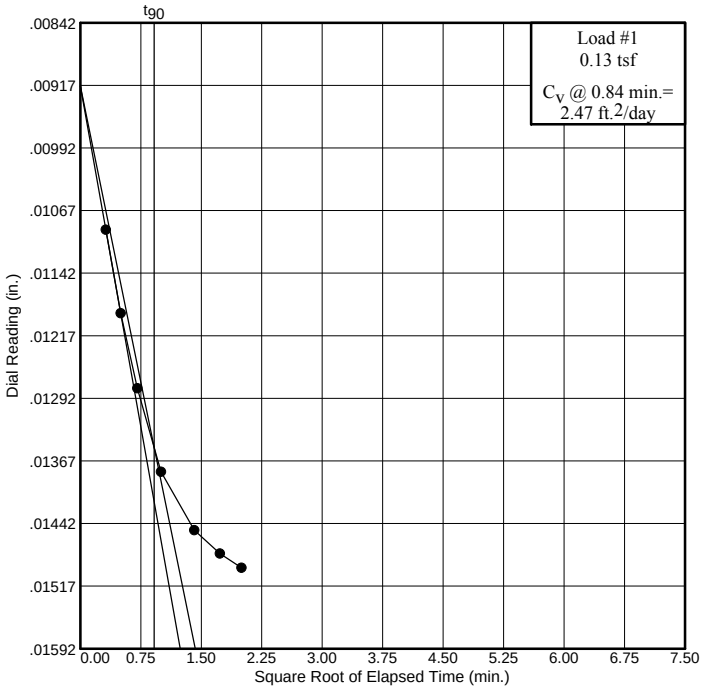
SOIL TECHNOLOGY

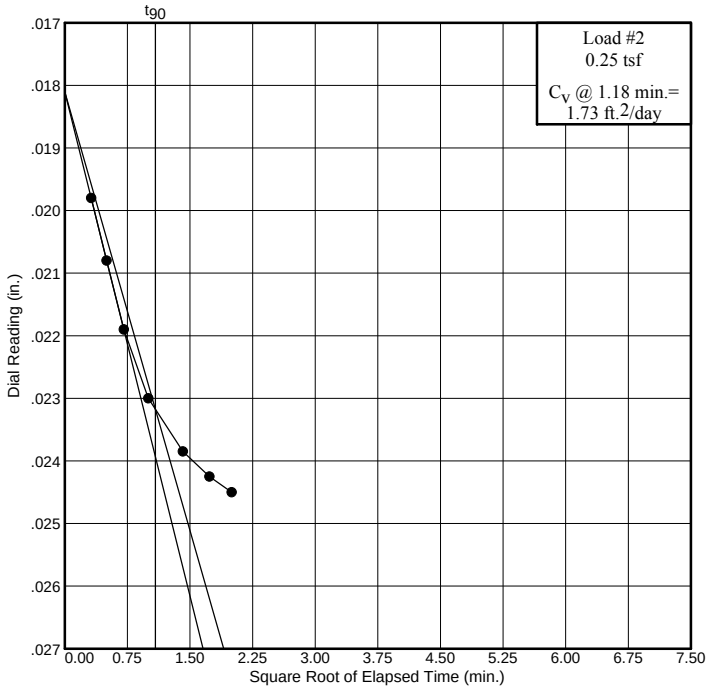
Bainbridge Island, WA

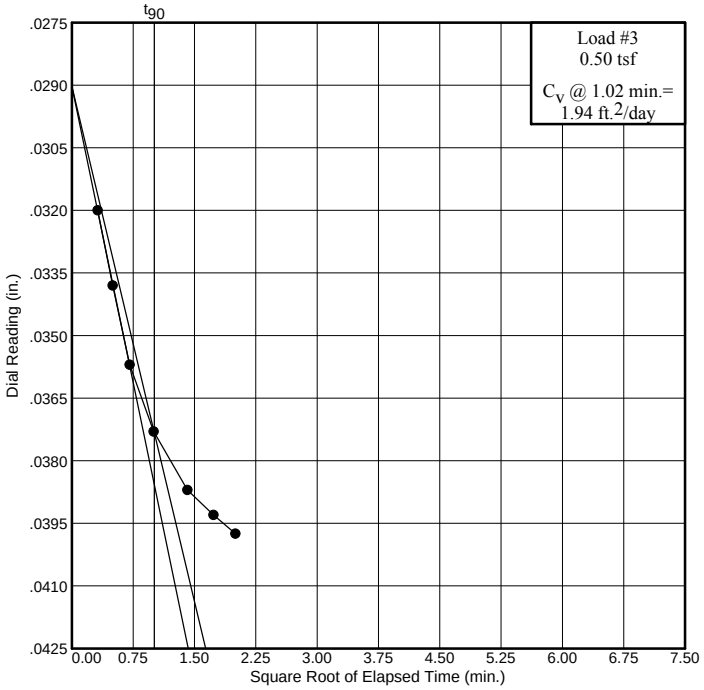
Figure 11.1

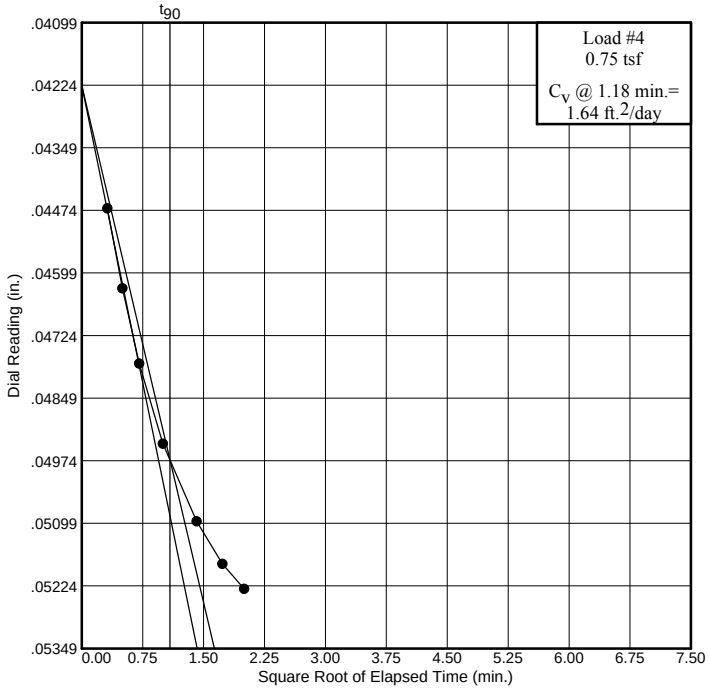
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-67P-08 Sample No.: S-2 Elev./Depth: 17.8-17.9









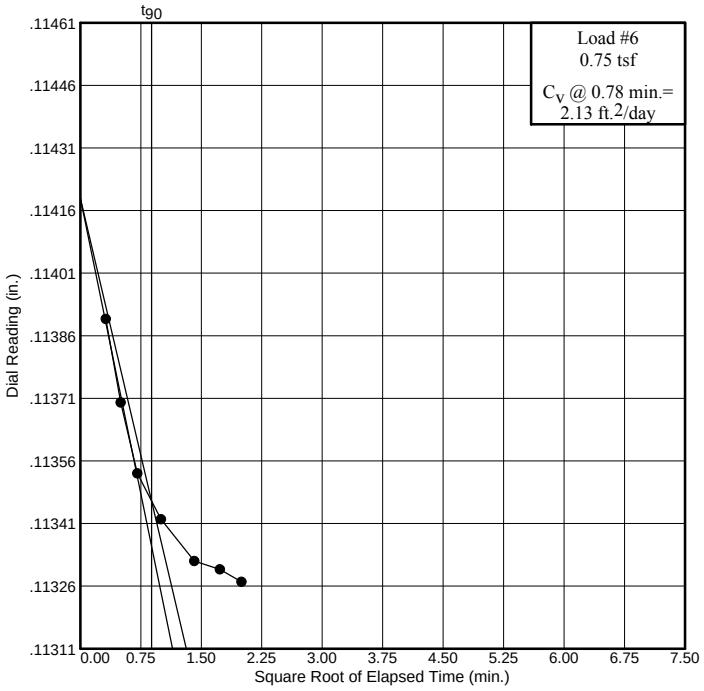
SOIL TECHNOLOGY

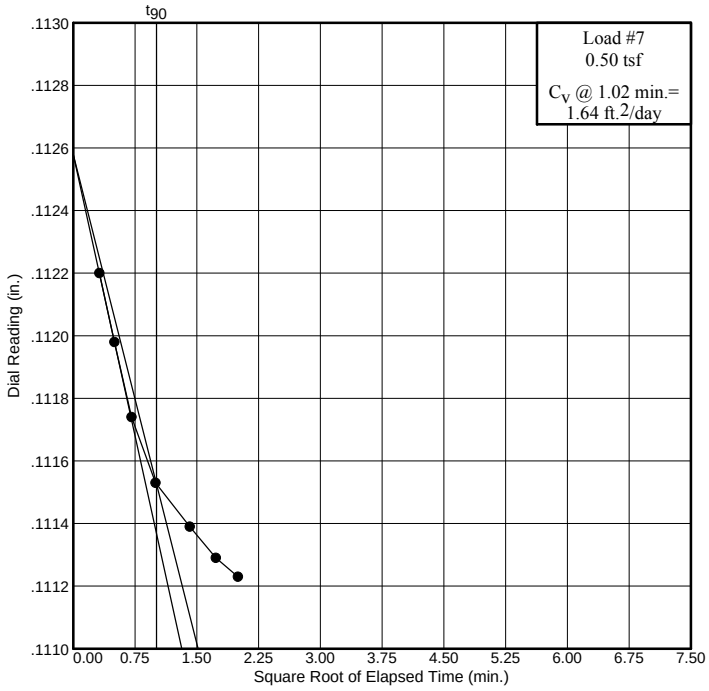
Bainbridge Island, WA

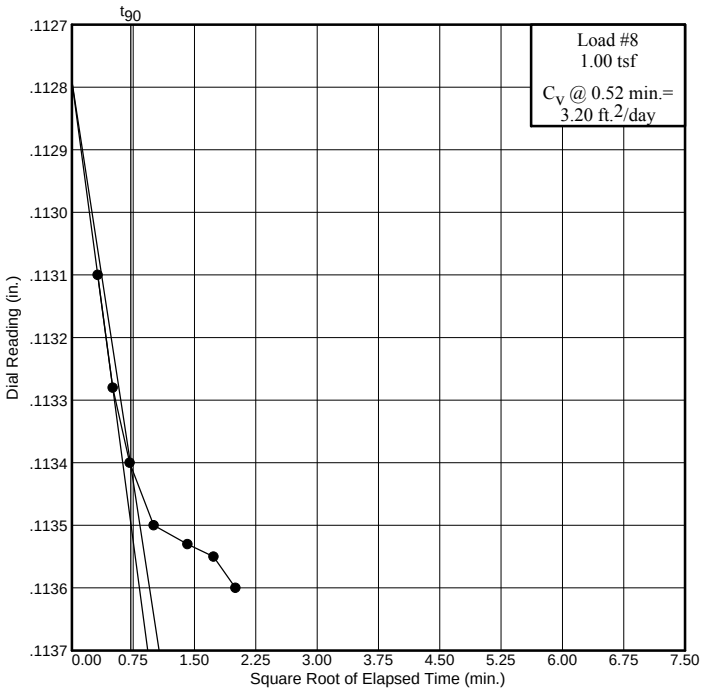
Figure 11.2

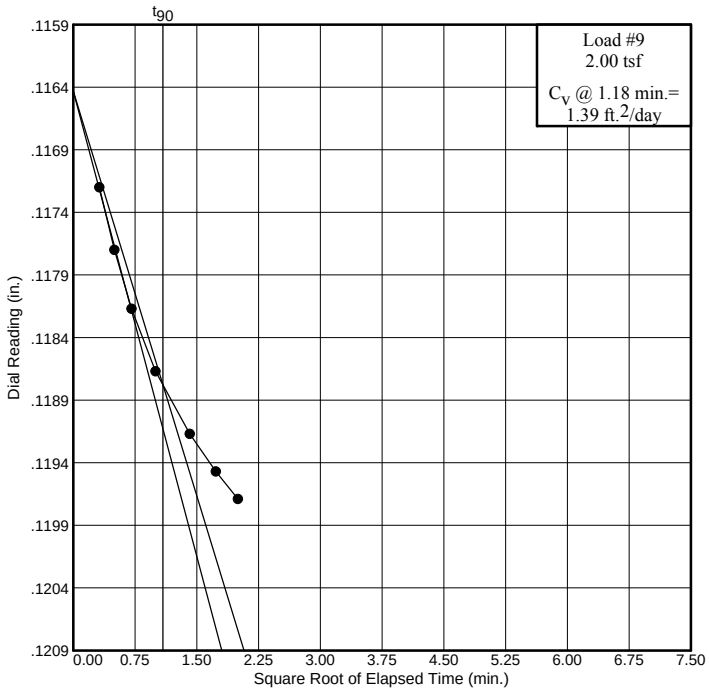
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-67P-08 Sample No.: S-2 Elev./Depth: 17.8-17.9









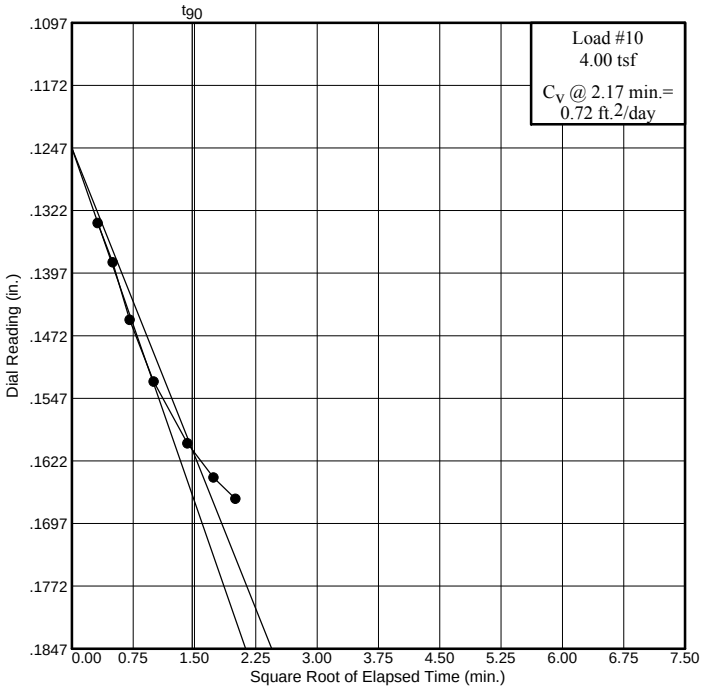
SOIL TECHNOLOGY

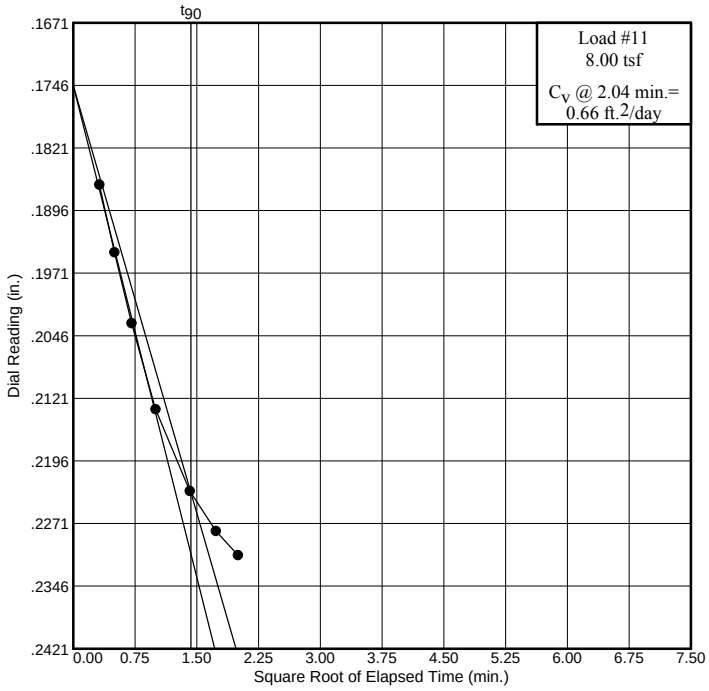
Bainbridge Island, WA

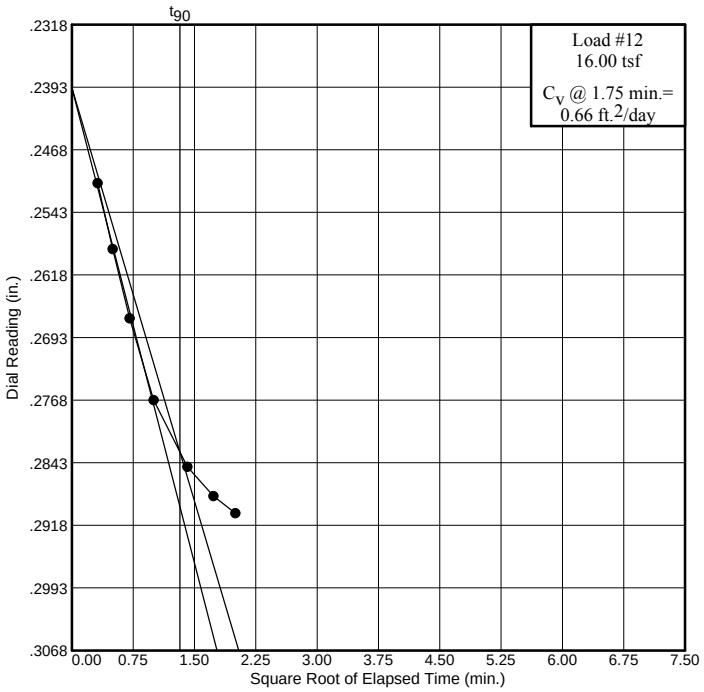
Figure 11.3

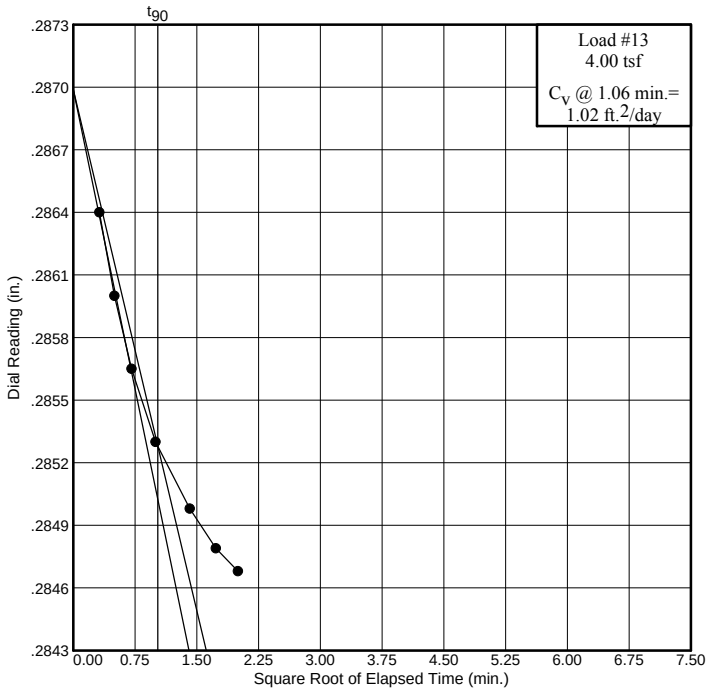
Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-67P-08 Sample No.: S-2 Elev./Depth: 17.8-17.9









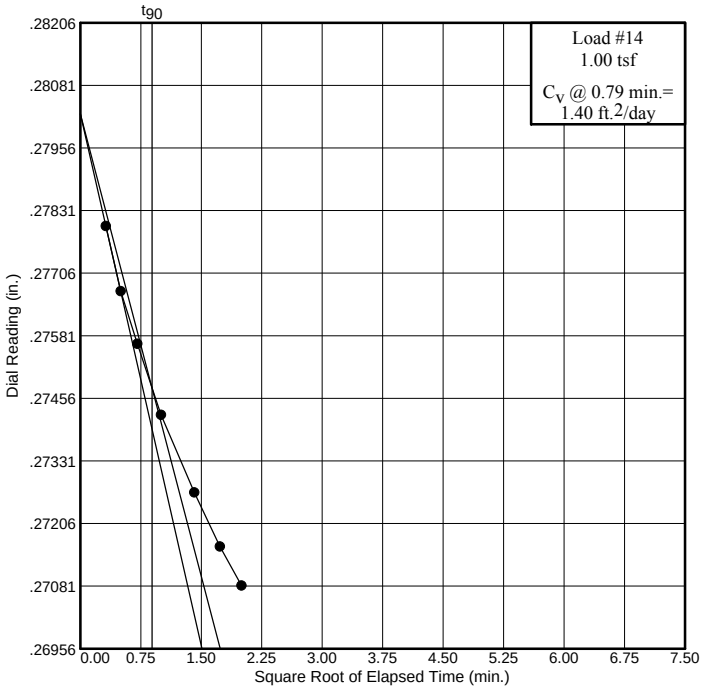
SOIL TECHNOLOGY

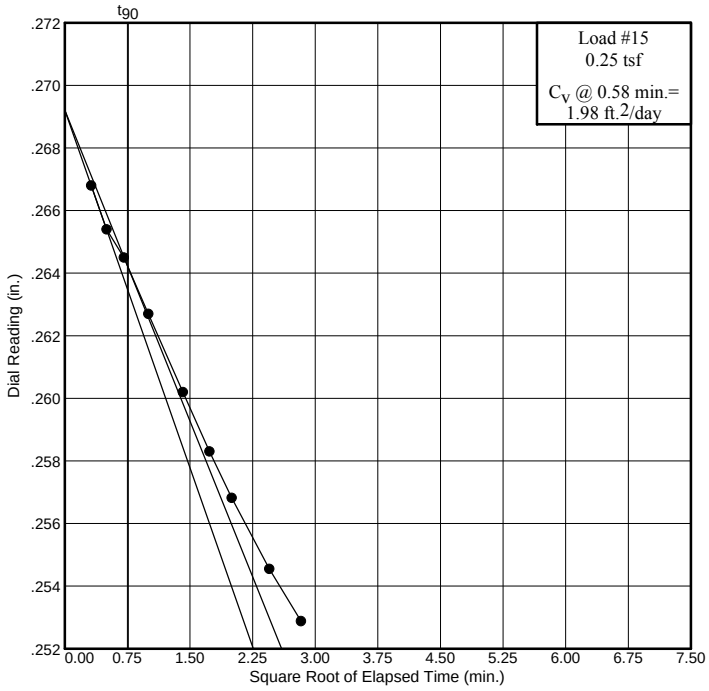
Bainbridge Island, WA

Figure 11.4

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-67P-08 Sample No.: S-2 Elev./Depth: 17.8-17.9





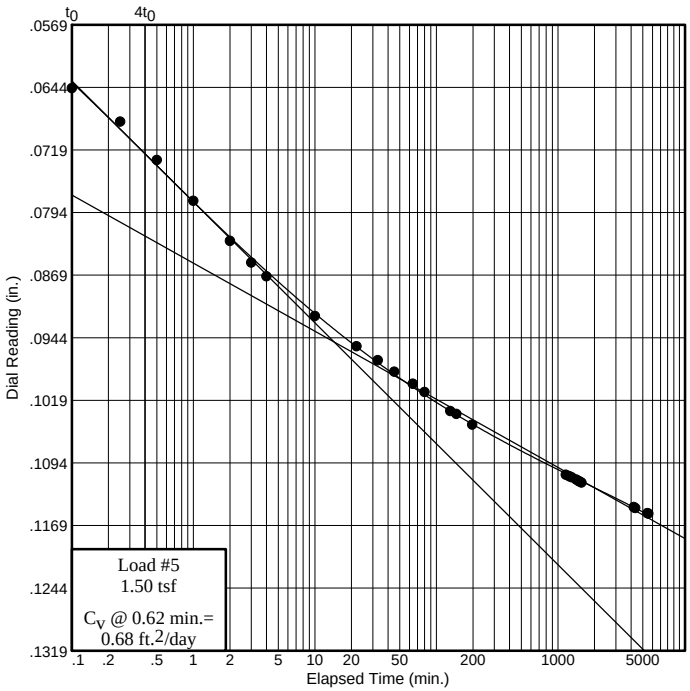
SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 11.5

Dial Reading vs. Time

Project No.: J-08-2275
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Source: TH-67P-08 Sample No.: S-2 Elev./Depth: 17.8-17.9

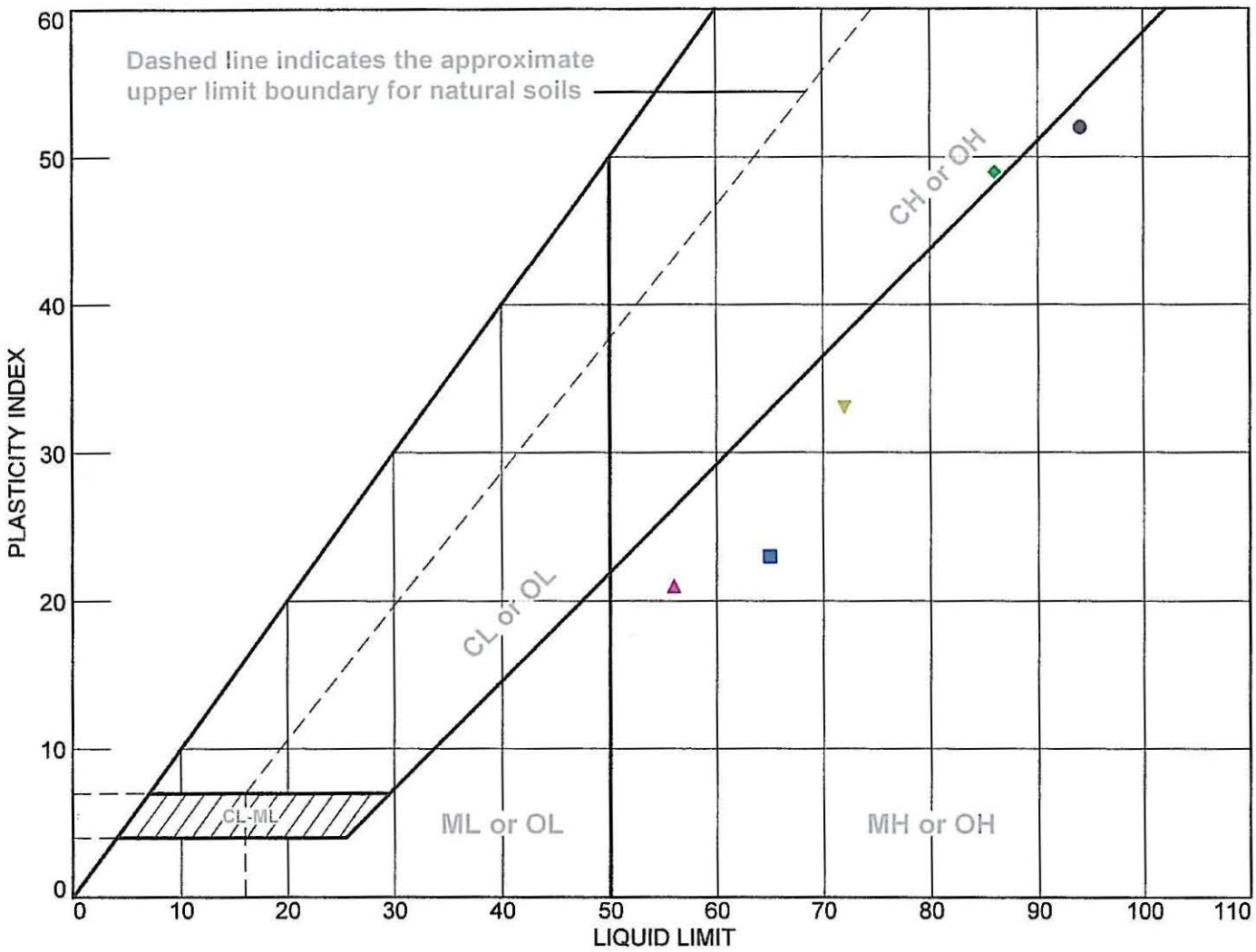


SOIL TECHNOLOGY

Bainbridge Island, WA

Figure 11.6

ATTERBERG LIMITS (ASTM D-4318)



SOIL DATA

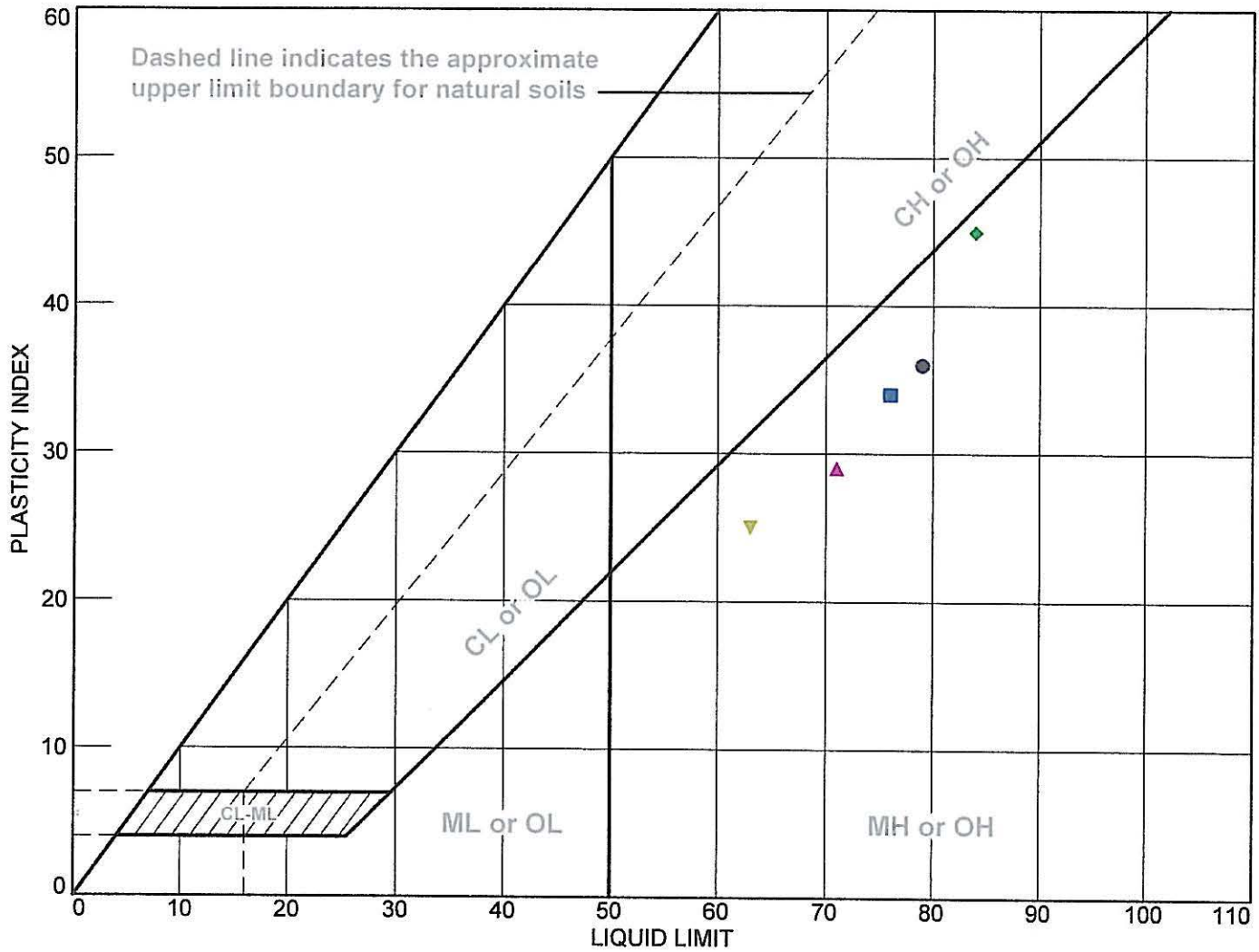
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	B-8	S-26	96.6-97.2	74.3	42	94	52	MH
■	B-9	S-27	100.3-100.8	59.3	42	65	23	MH
▲	B-10	S-28	106.1-106.2	55.3	35	56	21	MH
◆	B-12	S-27	100.6'-100.7'	74.6	37	86	49	CH
▼	B-13	S-6	16.6-16.7 ft.	66.3	39	72	33	MH

SOIL TECHNOLOGY

Client: Landau Associates, Inc.
Project: WSDOT Special Projects Facility
Job No.: 06-2154
Project No.: 244039.020 **Figure** 1

Tested By: ○ Kristin Sheets □ KAS △ Kristin A. Sheets **Checked By:** RGS

ATTERBERG LIMITS (ASTM D-4318)



SOIL DATA

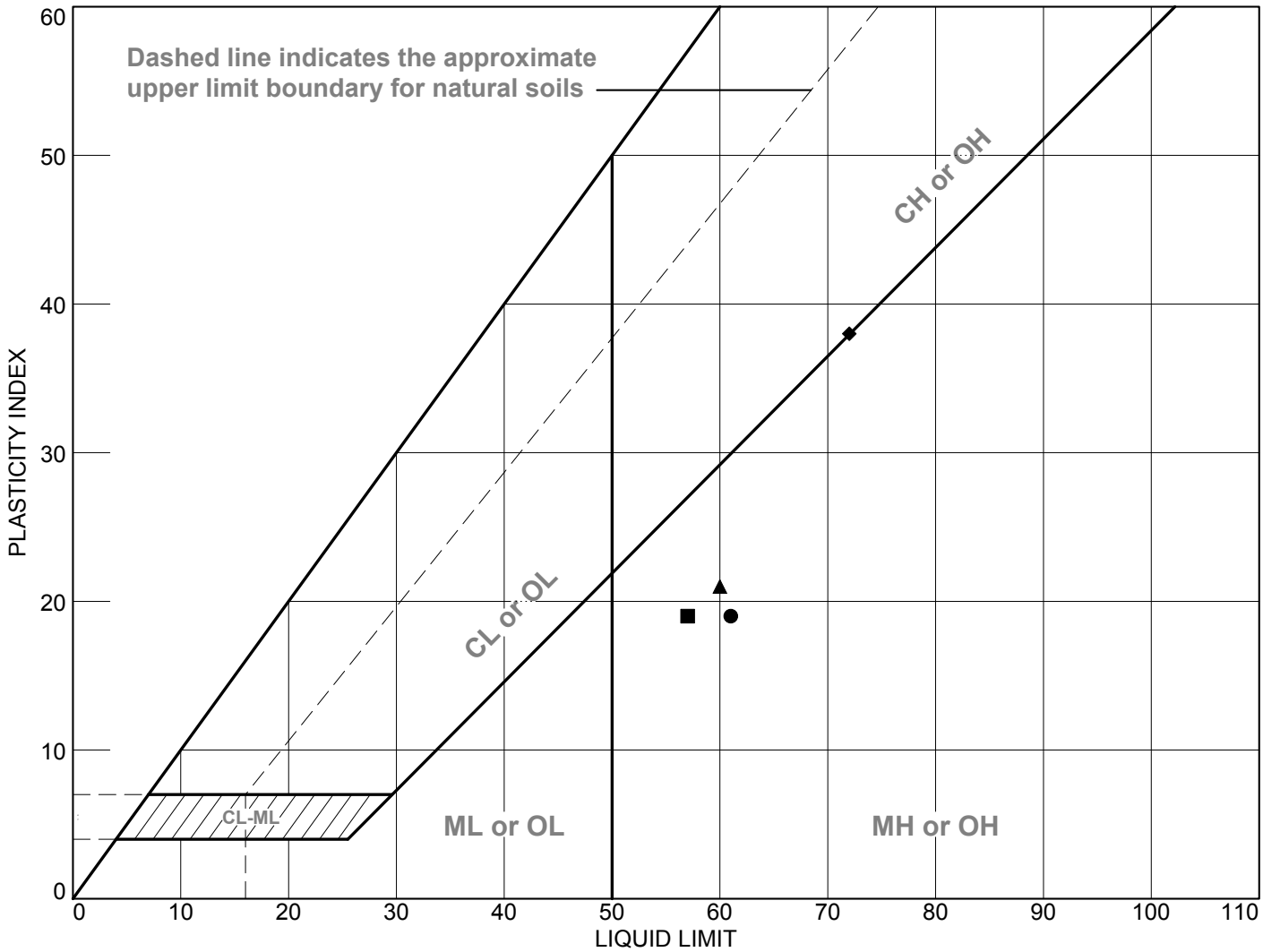
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	B-13	S-25	100.5-101.0	71.0	43	79	36	MH
■	B-15	S-8	23.3'-23.4'	72	42	76	34	MH
▲	B-16	S-7	20.8'-20.9'	72.9	42	71	29	MH
◆	B-17	S-8	23.0-23.1	78.7	39	84	45	MH
▼	B-18	S-23	86.4-86.7	58.6	38	63	25	MH

SOIL TECHNOLOGY

Client: Landau Associates, Inc.
Project: WSDOT Special Projects Facility J-06-2154
Project No.: 244039.020 **Figure** 2

Tested By: ● KAS ◆ Kristin A. Sheets ▼ KAS **Checked By:** RGS

Atterberg Limits Test Report ASTM D-4318



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	TH-27-08	S-3	15.1-15.2	62	42	61	19	OH
■	TH-27-08	S-3	14.6-15.1	65	38	57	19	OH
▲	TH-27-08	S-3	14.1-14.6	61	39	60	21	OH
◆	TH-27-08	S-23	99.7-99.8	69	34	72	38	OH

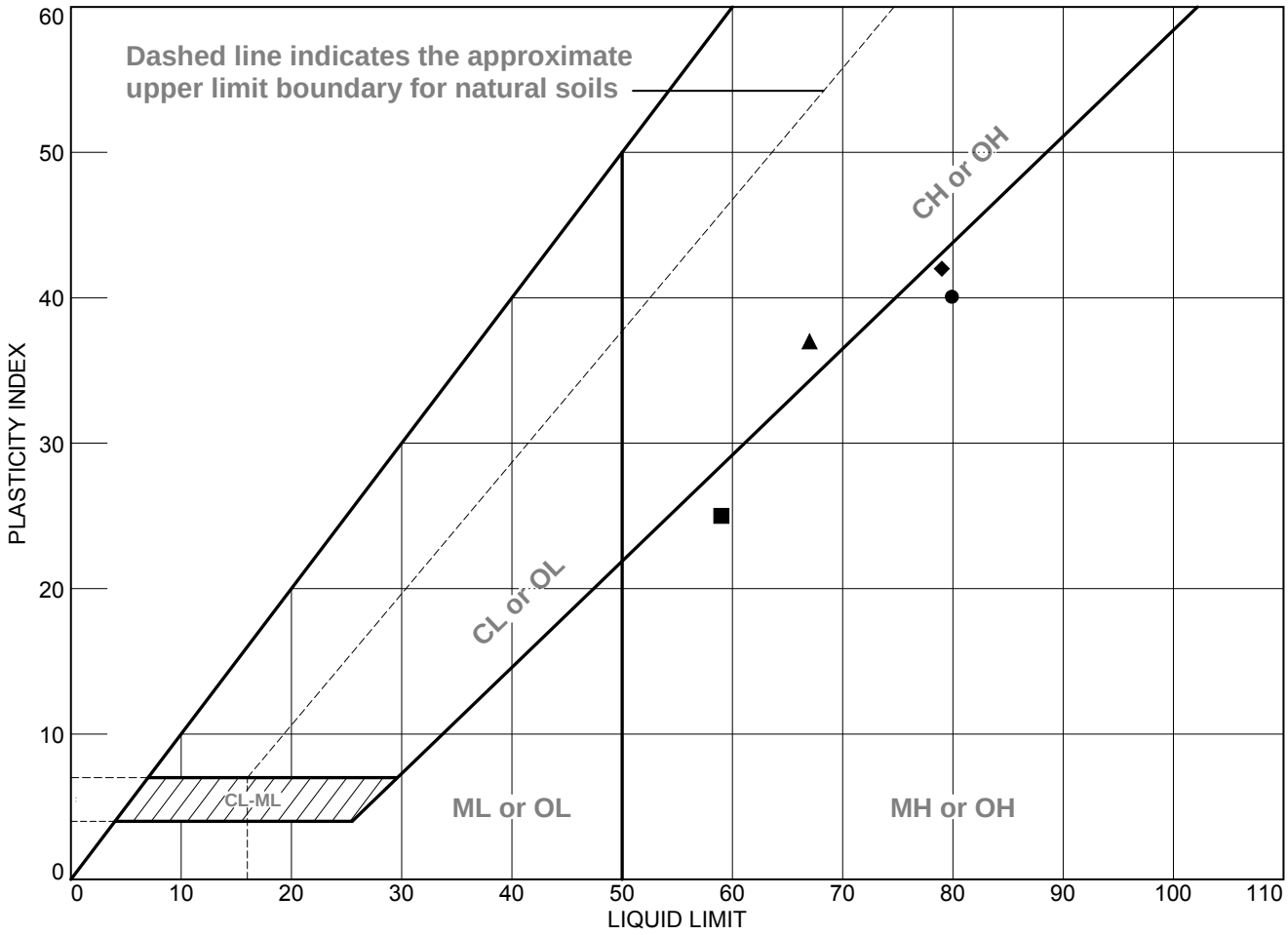
SOIL TECHNOLOGY

Bainbridge Island, WA

Client: Landau Associates
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Project No.: J-08-2275 **Figure 1**

Tested By: ● AJA ■ CJE ▲ CJE ◆ CJE **Checked By:** AJA

Atterberg Limits Test Report ASTM D-4318



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	TH-29-SW-08	S-1	15.9-16.0	84	40	80	40	OH
■	TH-29-SW-08	S-10	105.1-105.2	54	34	59	25	OH
▲	TH-29-SW-08	S-10	105.3-150.8	61	30	67	37	OH
◆	TH-29-SW-08	S-3	19.6-20.1	74	37	79	42	OH

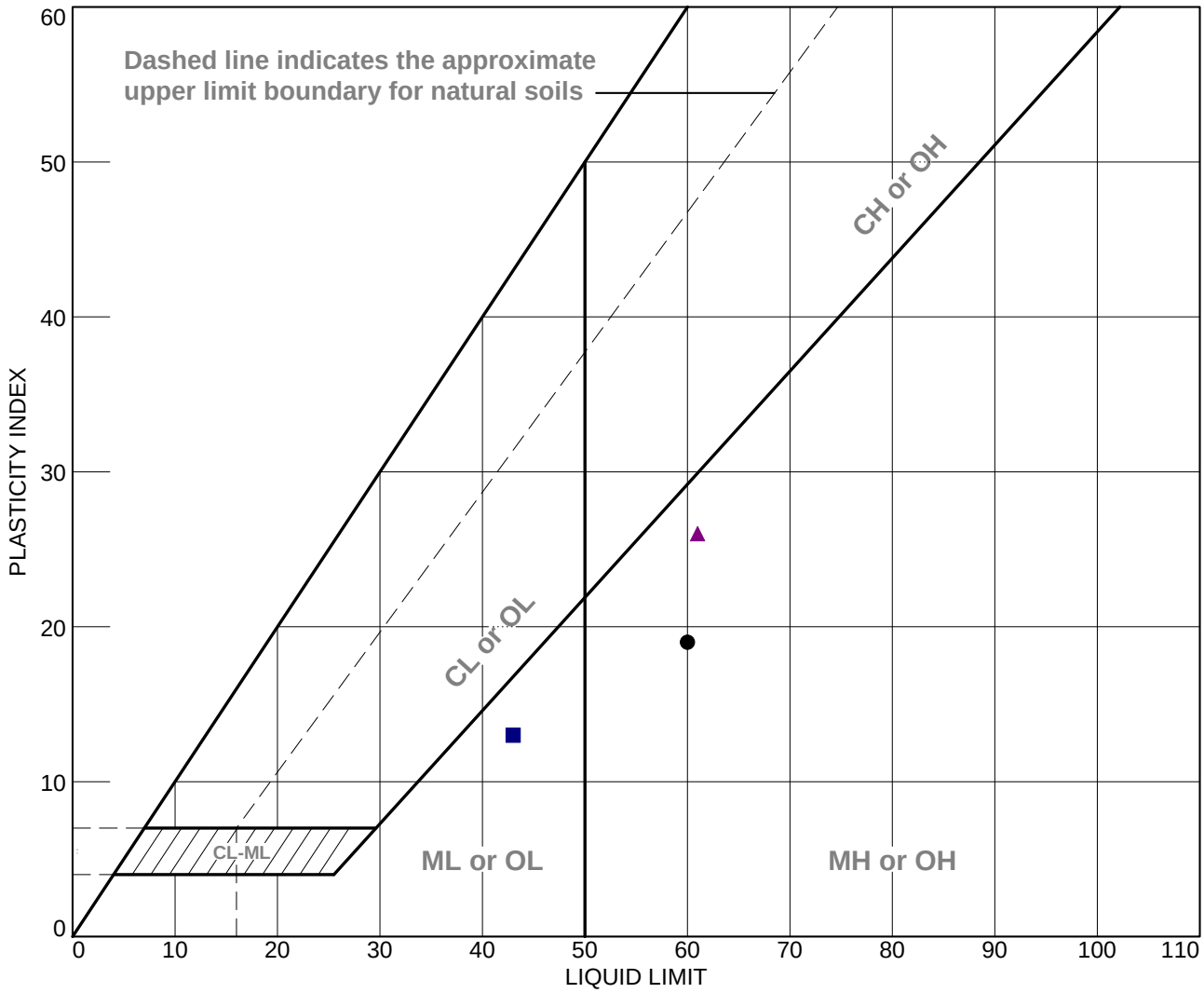
SOIL TECHNOLOGY

Bainbridge Island, WA

Client: Landau Associates
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Project No.: J-08-2275 **Figure 2**

Tested By: CJE **Checked By:** AJA

Atterberg Limits Test Report ASTM D-4318



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	TH-30-SW-08	S-1	14.7-14.8	63	41	60	19	MH
■	TH-30-SW-08	S-5	85.8-85.9	51	30	43	13	ML
▲	TH-30-SW-	S-10	105.0-105.1	59	35	61	26	MH

SOIL TECHNOLOGY

Bainbridge Island, WA

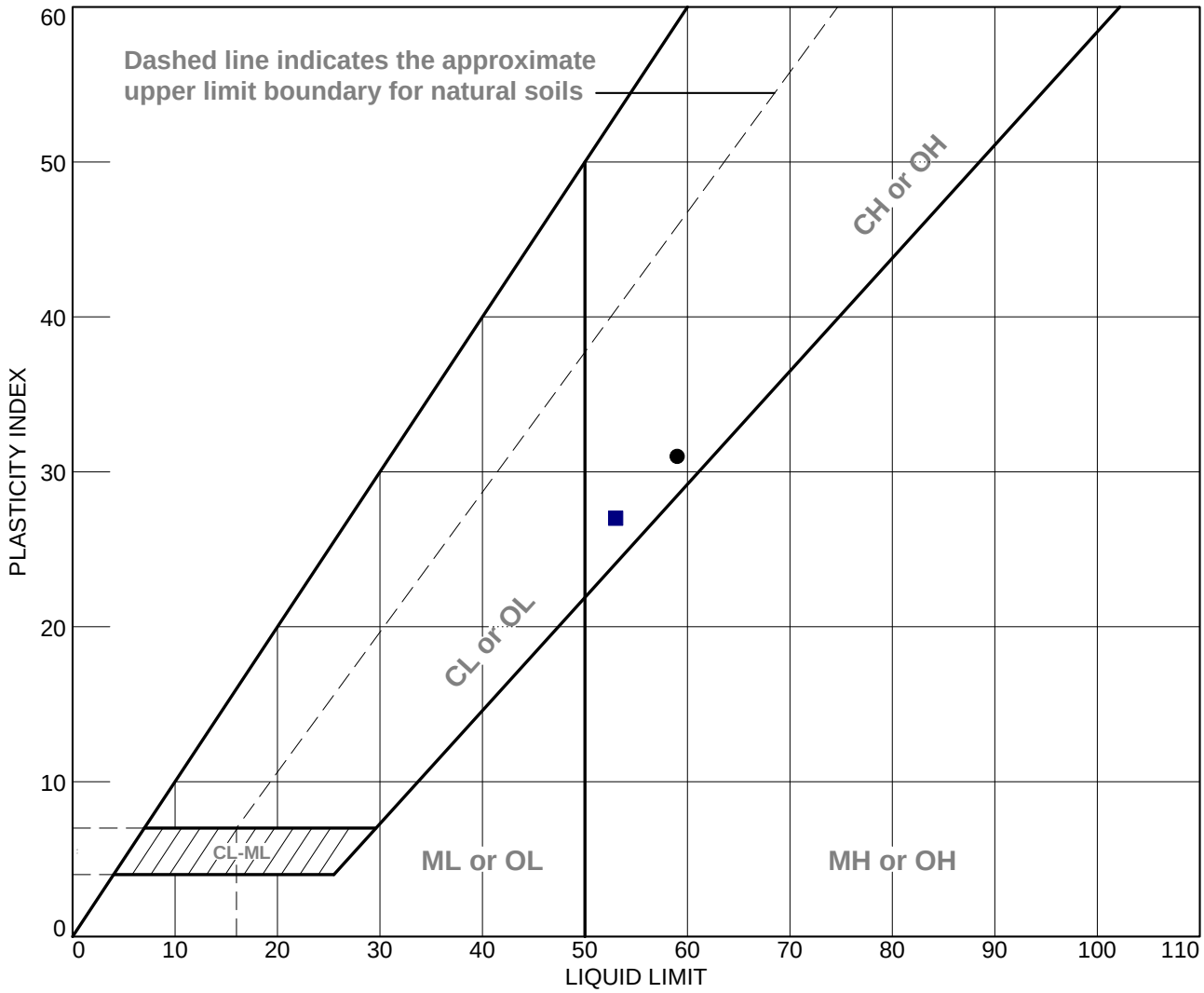
Client: Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Project No.: J-08-2275 **Figure 3**

Tested By: ● AJA ■ AJA ▲ CJE **Checked By:** RGS

Atterberg Limits Test Report ASTM D-4318



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	TH-31-PMT-SW-08	S-9	85.0-85.1	53	28	59	31	CH
■	TH-31-PMT-SW-08	S-3	15.7-15.8	72	26	53	27	CH

SOIL TECHNOLOGY

Bainbridge Island, WA

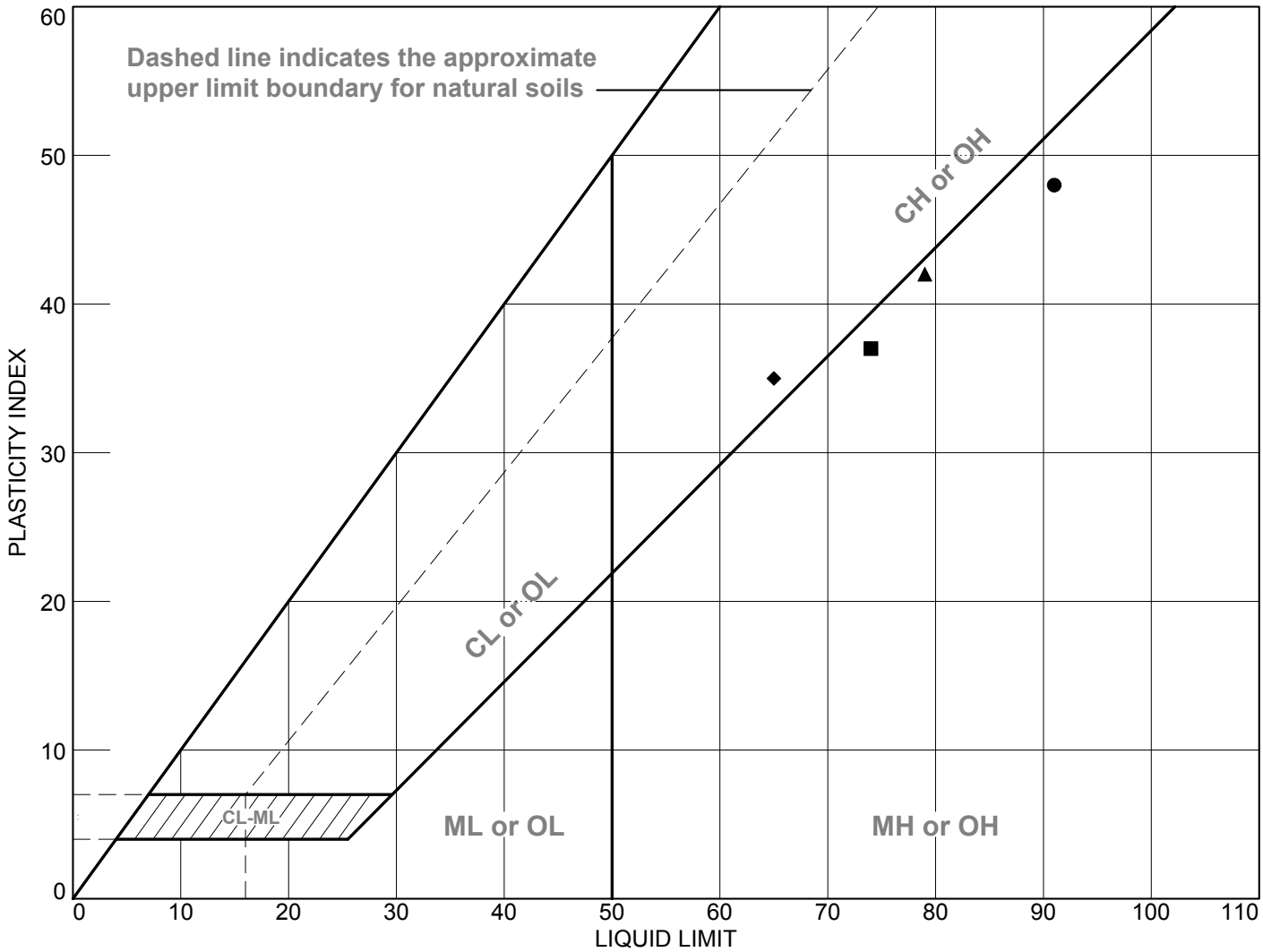
Client: Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Project No.: J-08-2275 **Figure 4**

Tested By: ○ AJA □ CEJ

Atterberg Limits Test Report ASTM D-4318



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	TH-32-08	S-4	13.2-13.3	86	43	91	48	MH
■	TH-30-SW-08	S-15	124.5-124.6	71	37	74	37	MH
▲	TH-33-08	S-31	105.3-105.4	78	37	79	42	OH
◆	TH-33-08	S-7	15.3-15.8	78	30	65	35	OH

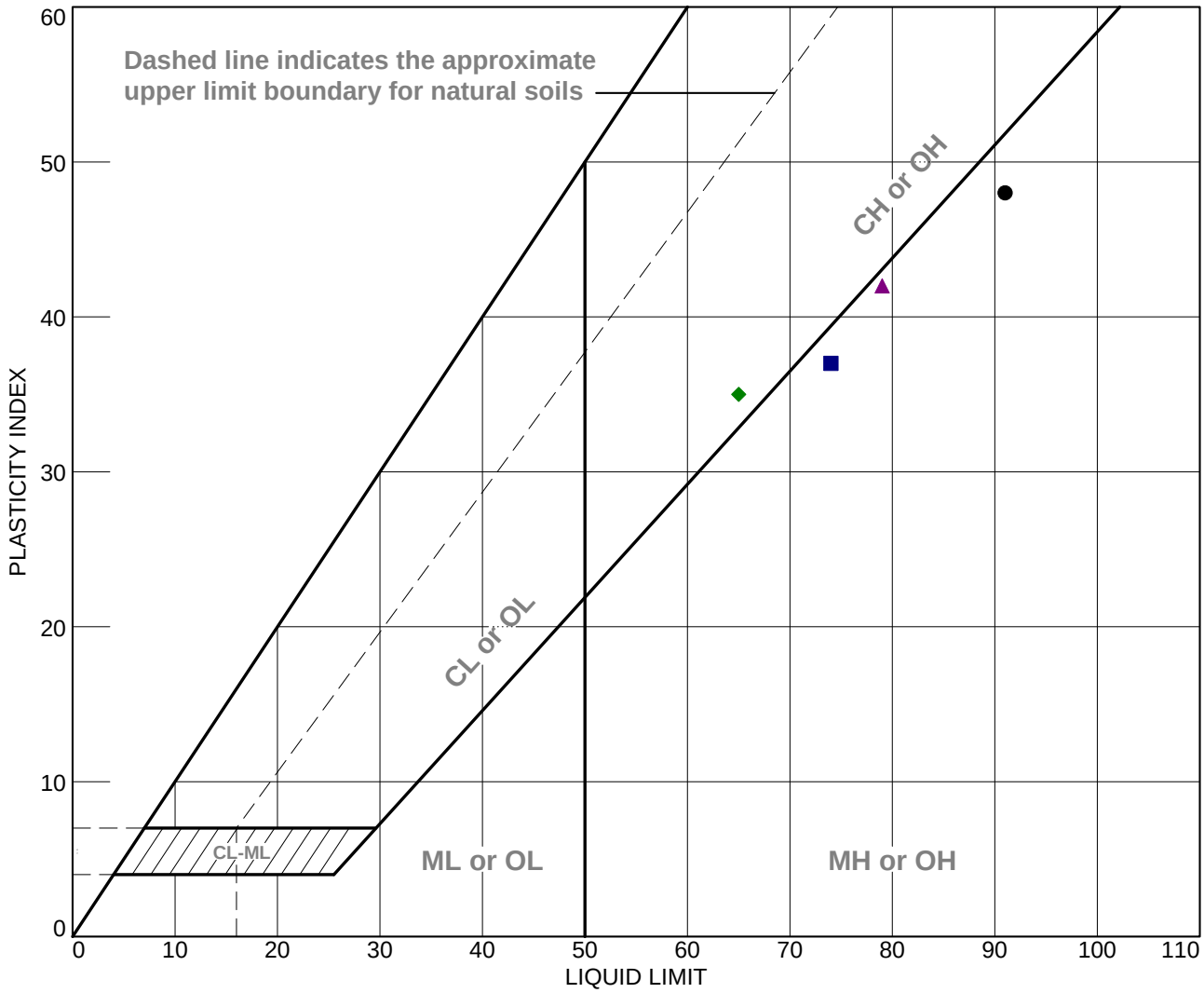
SOIL TECHNOLOGY

Bainbridge Island, WA

Client: Landau Associates
Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020
Project No.: J-08-2275 **Figure 5**

Tested By: CJE

Atterberg Limits Test Report ASTM D-4318



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	TH-32-08	S-4	13.2-13.3	86	43	91	48	MH
■	TH-30-SW-08	S-15	124.5-124.6	71	37	74	37	MH
▲	TH-33-08	S-31	105.3-105.4	64	37	79	42	OH
◆	TH-33-08	S-7	15.3-15.8	78	30	65	35	OH

SOIL TECHNOLOGY

Bainbridge Island, WA

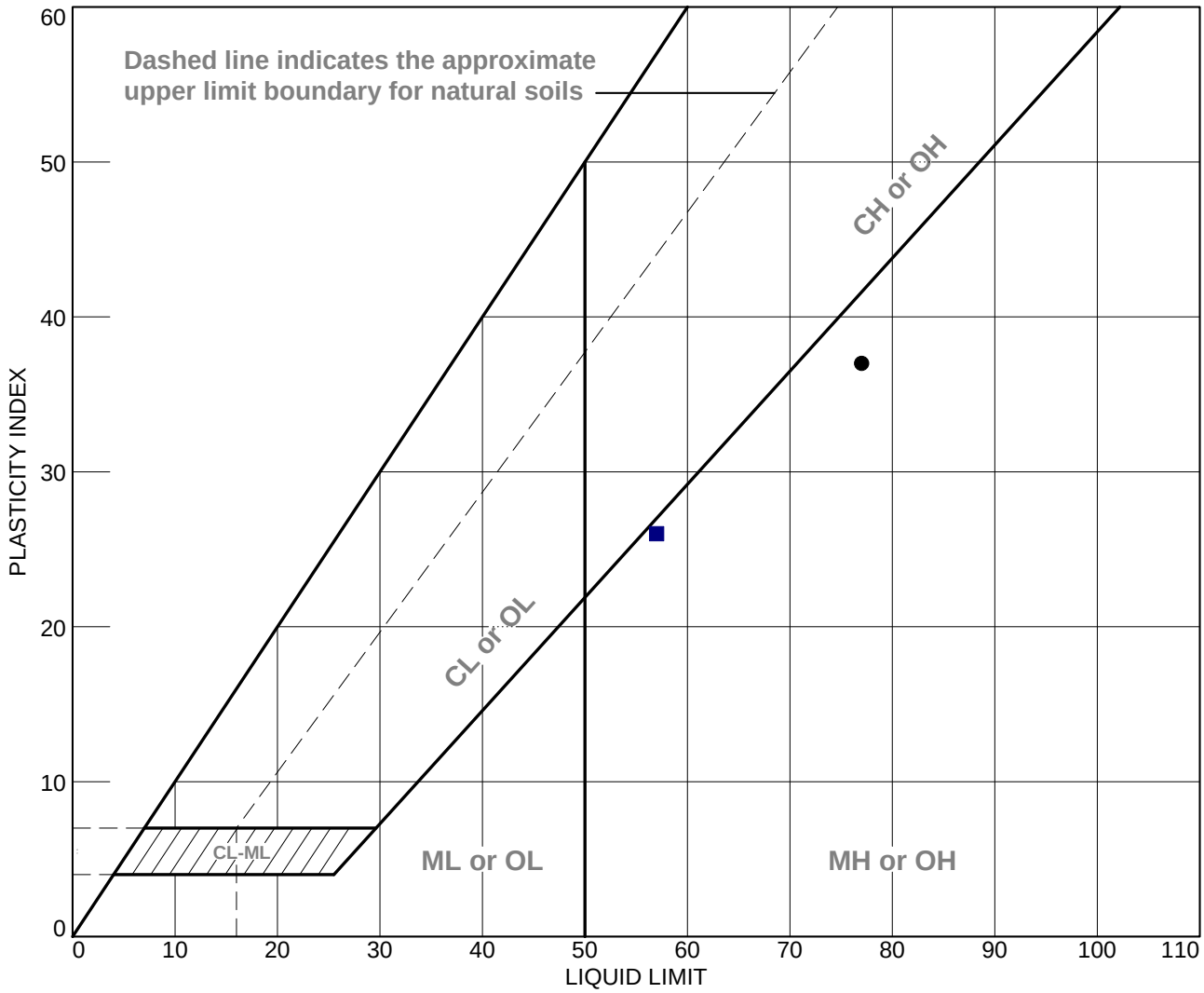
Client: Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Project No.: J-08-2275 **Figure** 6

Tested By: CJE

Atterberg Limits Test Report ASTM D-4318



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	TH-67P-08	S-2	17.8-17.9	65	40	77	37	OH
■	TH-67P-08	S-2	17.3-17.8	64	31	57	26	OH

SOIL TECHNOLOGY

Bainbridge Island, WA

Client: Landau Associates

Project: WSDOT Grays Harbor Pontoon Construction Facility
Project No. 122025.020

Project No.: J-08-2275 **Figure 7**

Tested By: AJA

Landau Associates, Inc.
WSDOT Special Projects Facility
Project No. 244039.020

Moisture Content and Percent Passing 75 micron
Table 1

Exploration Number	Sample Number	Sample Depth (ft)	Moisture Content %	Percent Passing U.S. Sieve No. 200
B-15	S-8	21.6-22.1	76	96

Landau Associates
WSDOT Potoon Construction Facility
Project No. 122025.020

pH by ASTM D-4972 and Resistivity by ASTM G-57-06

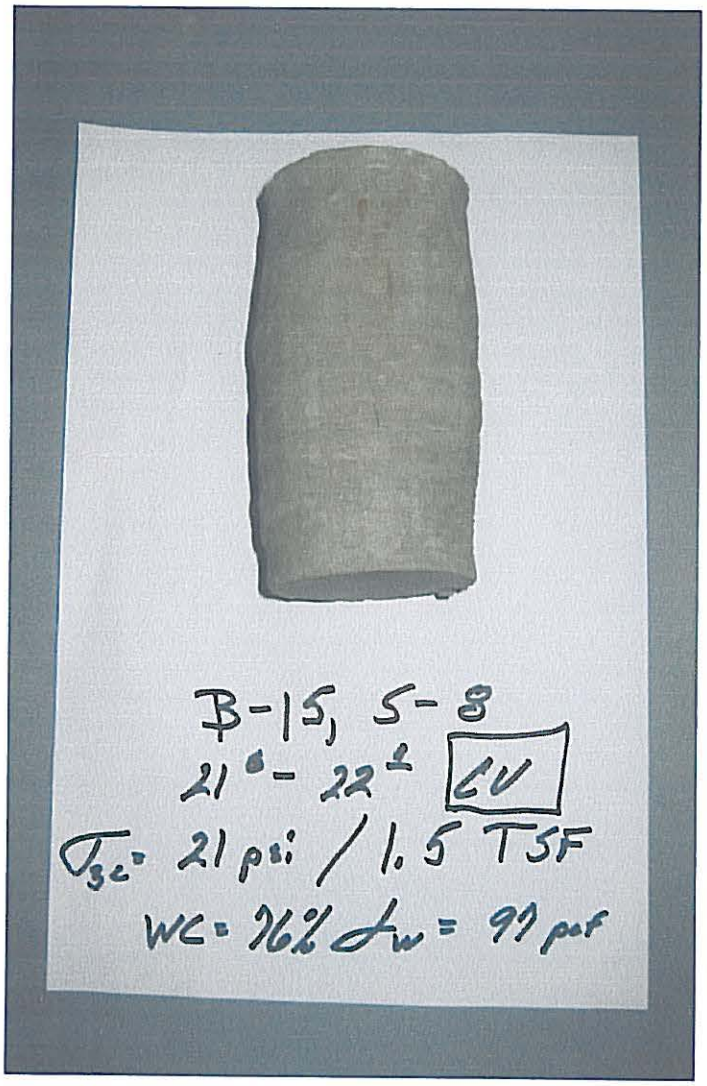
Table 1.0

Exploration Number	Sample Number	Sample Depth (ft)	pH	Resistivity as Received (ohm-cm)	Minimum (saturated) Resistivity (ohm-cm)
TH-36-08	S-5	14.0-15.5	7.5	305.3	305.3
TP-6-08	S-2	3.5-4.0	4.1	5530	1350
TH-48-08	S-6	12.0-14.0	7.9	423	414.9
TP-2-08	S-2	4.5-5.0	4.5	4633	4633

Landau Associates
WSDOT Special Projects Facility
Selected Pictures of Testing Performed
Project No. 244039.020

Soil Technology
Job No. 06-2154

Landau Associates
WSDOT Special Projects Facility
Selected Pictures of Testing Performed
Project No. 244039.020



Soil Technology
Job No. 06-2154

APPENDIX C

Geotechnical In-Situ Testing

APPENDIX C
GEOTECHNICAL *IN SITU* TESTING

As part of the exploration effort, engineering behavior of soils at the project site was estimated by performing *in situ* tests. The recent exploration program included pressuremeter tests and down-hole shearwave suspension logging. These tests were performed at the following borings and depth intervals:

	Test Type	
Boring	**Pressuremeter depth interval(s)*, ft**	**Shearwave Logging depth interval, ft**
TH-28-SW-08	33 to 90, 82 to 129	2 to 161
TH-29-SW-08	4 to 90, 92 to 131	10 to 128**
TH-30-SW-08	8 to 89, 92 to 140	2 to 215
TH-31-SW-08	33 to 89, 92 to 138	2 to 195

* Pressuremeter testing was conducted in two phases. Testing of the deeper depth interval was completed subsequent to testing of the shallower interval.

** Shearwave logging at TH-29-SW-08 was performed using uncased methods. Logging was accomplished in four subintervals spanning the depths indicated above.

The locations of these borings are shown on Figure 3 of the report.

The *in situ* testing program conducted for earlier phases of the project consisted of field vane shear tests, pore water dissipation tests during the cone penetration testing (CPT), and shear wave velocity measurements in five CPTs (CPT-13, CPT-15, CPT-17, CPT-18, and CPT-19). Discussion about *in situ* testing and measurements are presented below and the results of the *in situ* testing are included in this appendix.

PRESSUREMETER TESTING

Pressuremeter tests (PMTs) were accomplished by In Situ Engineering, under subcontract to Landau Associates. PMTs were conducted in two phases using a self-boring pressuremeter device to characterize Soil Units 1, 2 and 3. In Situ Engineering was assisted by a WSDOT drilling crew during field operations, which provided pressurized drilling fluid and a hoist line for device advancement and retrieval. A Landau Associates field representative was on site at all times during PMT operations.

A report prepared by In Situ Engineering summarizing their field operations, data reduction, and conclusions is included in this appendix.

DOWNHOLE SHEARWAVE SUSPENSION LOGGING

Downhole shearwave suspension logging was accomplished by GEOVision under subcontract to Landau Associates. Shearwave logging was performed inside 3-inch diameter PVC casing at borings TH-28-SW-08, TH-30-SW-08, and TH-31-SW-08. Casing was installed upon completion of drilling at each boring, and the annulus between the borehole wall and the casing was backfilled with a tremied bentonite-Portland cement grout proportioned and placed in accordance with recommendations from GEOVision.

At TH-29-SW-08, logging was accomplished using an uncased method. Upon reaching the maximum depth, the 4-inch diameter steel drilling casing was removed in 15 to 60 foot intervals. This was done to reduce the standing-time of the borehole wall to improve logging data quality and to reduce the likelihood of loss of the logging equipment in the event of borehole collapse. Following removal of casing for each interval, GEOVision installed the logging device and performed shearwave measurements along the newly exposed depth interval. Overlapping of logged intervals was used to assess measurement repeatability and to estimate the extent of borehole collapse. GEOVision was assisted by the Washington State Department of Transportation (WSDOT) drilling crew during shearwave logging of TH-29-SW-08.

Shearwave logging was performed at each of the four borings to characterize Soil Units 1, 2, 3, and 4. A Landau Associates field representative was on site at all times during shearwave logging operations.

A report prepared by GEOVision summarizing their field operations, data reduction, and conclusions is included in this appendix.

VANE SHEAR TESTS

WSDOT drill crews conducted 25 vane shear tests (VSTs) in general accordance with ASTM D2573, *Standard Test Method for Field Vane Shear Test in Cohesive Soils* and the *Vane Shear Tests – Assembly and Operating Manual* prepared by Christensen Boyles Corporation. The vane was torqued at a rate of 0.1 degree per second by WSDOT drill crews until failure (dial gauge reading no longer increased) occurred at the ultimate shear strength. Remolded tests were completed 1 minute, 5 minutes, and 10 minutes after completion of the undisturbed tests. The undrained shear strength was determined using the torque charts provided in the assembly and operating manual. To correct for the influence of soil plasticity read by the VST, the undrained shear strength was corrected according to Chandler (1988). The results of the VST are presented in Table C-1, followed by field data sheets are included at the end of this appendix.

DISSIPATION TESTS

During the advancement of the CPT soundings, WSDOT drill crews performed 24 pore water dissipation tests. The horizontal coefficient of consolidation was determined from these tests based on a method described in the Federal Highway Administration (FHWA) *Geotechnical Engineering Circular No. 5 – Evaluation of Soil and Rock Properties* (FHWA 2002). The results of the horizontal coefficient of consolidation determined from the dissipation test results are presented in Table C-2, followed by the raw data from the dissipation tests.

SHEAR WAVE VELOCITY FROM CPT

During the advancement of the CPT soundings, WSDOT drill crews performed shear wave velocity tests at 1-meter intervals (3.28-ft) at CPT-13, CPT-15, CPT-17, CPT-18, and CPT-19 to depths not exceeding 26 meters (85.30 ft). The data from the shear wave velocity tests taken during the CPT soundings are summarized on Figure C-1 at the end of this appendix.

REFERENCES

Chandler, R.J. 1988. *The In situ Measurement of the Undrained Shear Strength of Clays Using the Field Vane*. Vane Shear Strength Testing in Soils: Field and Laboratory Studies, ASTM, Special Publication No. 1014. Philadelphia, PA, pp. 13-44.

FHWA. 2002. *Geotechnical Engineering Circular No. 5 – Evaluation of Soil and Rock Properties.* Report Number FHWA-IF-02-034. Federal Highway Administration.

Attachments:

- **Pressuremeter Testing.** Report prepared by In Situ Engineering, Final Report of In Situ Pressuremeter Geotechnical Testing, Conducted at Hoquiam, Washington for the Proposed Pontoon Bridge Facility, Washington State Department of Transportation. Submitted to Landau Associates, Inc., Edmonds, Washington. December 5, 2008.

- **Downhole Shearwave Suspension Logging.** Report prepared by GEOVision Geophysical Services, Suspension PS Velocities, Borings TH-28-SW-08, TH-29-SW-08, TH-30-SW-08, and TH-31-SW-08, Grays Harbor, Washington. September 26, 2008.

- **Vane Shear Tests.** Table C-1, Vane Shear Test Results; Vane Shear Test Data from WSDOT.

- **Dissipation Tests.** Table C-2, CPT Dissipation Test Results; Dissipation Test Data from WSDOT.

- **Shearwave Velocity from CPT.** Figure C-1, Shear Wave Velocity from CPT.

Pressuremeter Testing

Final Report of In Situ Pressuremeter Geotechnical Testing

Conducted at

Hoquiam, Washington

for the

Proposed Pontoon Bridge Facility
Washington State Department of Transportation

Submitted to

Landau Associates, Inc.
Edmonds, WA

In Situ Engineering Project Number 771 & 787

December 5, 2008

Testing conducted and report prepared by

In Situ Engineering

6232 195th Avenue SE

Snohomish, WA 98290 360-568-2807

nwcone@verizon.net

TABLE OF CONTENTS

1.0 INTRODUCTION 3
2.0 PURPOSE 3
3.0 PRESSUREMETER 3
4.0 HOLE FORMATION 5
5.0 TEST PROCEDURE 12
6.0 QUALITY OF THE DATA 13
7.0 STANDARD METHOD OF ANALYSIS OF THE SHEAR MODULUS 14
8.0 DETERMINATION OF THE LIMIT PRESSURE 15
9.0 DETERMINATION OF THE STRENGTH PROPERTIES 25
10.0 CONCLUSIONS 35
11.0 REFERENCES 35

FIGURES

Fig. 1. Schematic details of the pressuremeter 4
Fig. 2. Test Dot74 in hole TH-29-PMT-SW-08 at 59 ft 13
Fig. 3. Adjacent pressuremeter tests at Hole TH-30-PMT-SW-08 14
Fig. 4. Modulus determination for Test Dot74 15
Fig. 5. Limit Pressure determination for Test Dot74 17
Fig. 6. Simple constant shear strength model analysis for test Dot74 26
Fig. 7. Frictional Model for Test Dot75 27

TABLES

Table 1-31 Pressuremeter Test depth and Material Description: TH-31-PMT-SW-08 5
Table 1-31 (cont) Pressuremeter Test depth and Material Description: TH-31B-PMT-SW-08 ... 6
Table 1-30 Pressuremeter Test depth and Material Description: TH-30-PMT-SW-08 7
Table 1-30 (cont) Pressuremeter Test depth and Material Description: TH-30B-PMT-SW-08 ... 8
Table 1-28 Pressuremeter Test depth and Material Description: TH-28-PMT-SW-08 9
Table 1-28 (cont) Pressuremeter Test depth and Material Description: TH-28B-PMT-SW-08 . 10
Table 1-29 Pressuremeter Test depth and Material Description: TH-29-PMT-SW-08 11
Table 1-29 (cont) Pressuremeter Test depth and Material Description: TH-29B-PMT-SW-08 . 12
Table 2-31 Limit Pressure shear modulus and Shear strength (log method) TH-31 18
Table 2-31 Limit Pressure shear modulus and Shear strength (log method) TH-31B 19
Table 2-30 Limit Pressure, shear modulus and Shear strength (log method) TH-30 20
Table 2-30 (cont) Limit Pressure, shear modulus and Shear strength (log method) TH-30B 21
Table 2-28 Limit Pressure Shear modulus and Shear strength (log method) TH-28 22
Table 2-28 (Cont) Limit Pressure Shear modulus and Shear strength (log method) TH-28B ... 23
Table 2-29 Limit Pressure, Shear modulus and Shear strength (log method) TH-29 24
Table 2-29 (Cont) Limit Pressure, Shear modulus and Shear strength (log method) TH-29B ... 25
Table 3-31 Material properties from Model Analysis TH-31-PMT-SW-08 28
Table 3-31 (cont) Material properties from Model Analysis TH-31B-PMT-SW-08 29
Table 3-30 Material properties from Model Analysis TH-30-PMT-SW-08 30

Table 3-30 (cont) Material properties from Model Analysis TH-30B-PMT-SW-08 31
Table 3-28 Material properties from Model Analysis TH-28-PMT-SW-08 32
Table 3-28 (Cont) Material properties from Model Analysis TH-28B-PMT-SW-08 33
Table 3-29 Material properties from Model Analysis TH-29-PMT-SW-08 34
Table 3-29 (Cont) Material properties from Model Analysis TH-29B-PMT-SW-08 35

APPENDICES

I Plots of Shear Modulus, Limit Pressure, model shear strength and model friction angle

II Pressuremeter Data and Standard Interpretation

III Pressuremeter Model Interpretation.

1.0 INTRODUCTION

This report presents the results of a pressuremeter study, conducted from 7th to 14th July, and 5th to 9th September 2008, in eight boreholes, TH28PMT to TH31-PMT and TH28PMTB to TH31PMTB. The "B" series reflect an effort to gain information on the soft materials below the depth of that tested in the first exploration phase. The "B" series were immediately adjacent to the original test hole and also adjacent to a test hole where soil samples were obtained. The pressuremeter testing (PMT) was conducted by In Situ Engineering, Snohomish, WA under contract to Landau Associates, Edmonds, Washington. The drilling and deployment of the pressuremeter for the boreholes was accomplished by The Washington Department of Transportation drill crew from Olympia, Washington. In all 167 pressuremeter tests were attempted, of which 154 produced useful PMT data. The borehole name, test depths and preliminary material descriptions are presented in Table 1.

2.0 PURPOSE

The purpose of this study was to evaluate *in-situ* the material properties of the sands, silty-sands and silt encountered along the walls of the proposed dry dock.

3.0 PRESSUREMETER

The pressuremeter used for this study was a self-boring pressuremeter. Three electronic displacement sensors, spaced 120 degrees apart are located at the center of the pressuremeter. The flexible membrane is placed over the sensors, clamped at each end. The membrane is covered by a protective sheet of stainless steel strips. The unit is pressurized using compressed nitrogen to deform the adjacent material. The electronic signals from displacement sensors and the pressure sensor are transmitted by cable to the surface. During the test, the average expansion versus pressure is displayed on a computer screen. The pressuremeter is expanded by regulating the flow of compressed nitrogen to the PMT unit.

Fig. 1 presents the essential details of the self-boring pressuremeter.

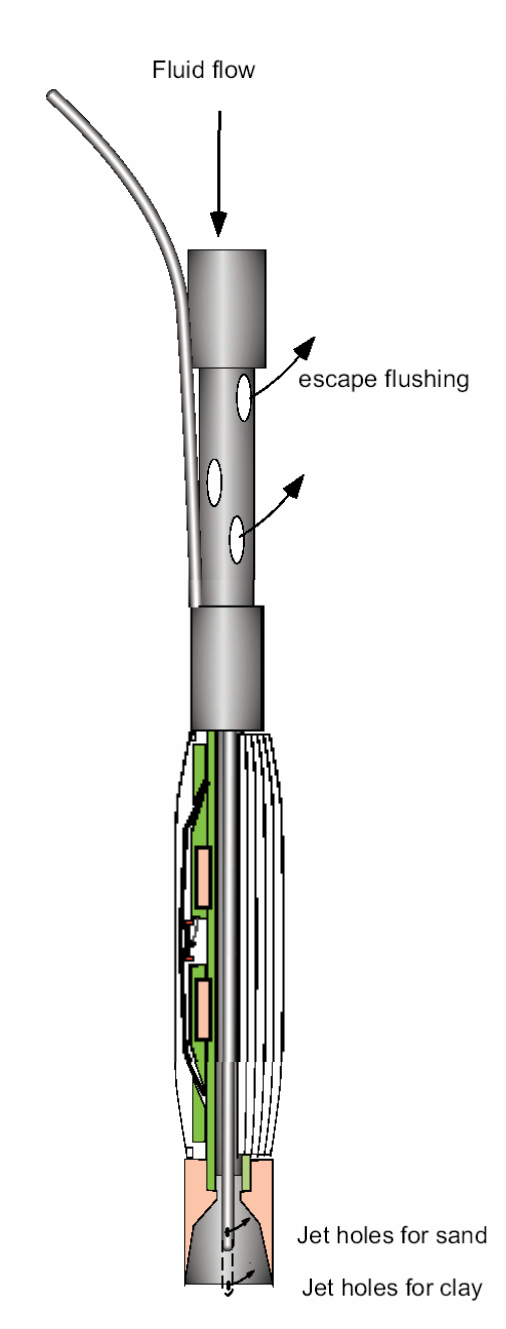


Fig. 1. Schematic details of the pressuremeter

4.0 HOLE FORMATION

The pressuremeter was jetted into the test location by the washing action provided by the drill rig and the vertical down pressure force. For most of the tests this system worked to produce a satisfactory installation of the pressuremeter. In a few instances the holes were washed oversize or the hole was enlarged oversize by pushing wood fragments, stuck in the cutting shoe, in advance of the pressuremeter. In general about four tests were performed continuously down the hole before the instrument was withdrawn from the hole and the cutting shoe examined for wood fragments and blockage. Before proceeding to the next level the hole was opened out with a 4 inch casing advancer.

The date of the test and respective depths are given in Tables 1-31, 1-30, 1-29 & 1-28. Soil descriptions, N values and other information can be found in boring logs compiled by Landau Associates. The information in those logs was from test holes which were generally about ten feet away from the pressuremeter holes.

Test	Date	Test depth
dot1	7-7-08	33.2
dot2	7-7-08	36.2
dot3	7-7-08	43
dot4	7-7-08	45.8
dot5	7-7-08	48.8
dot6	7-8-08	52.1
dot7	7-8-08	55.1
dot8	7-8-08	58.8
dot9	7-8-08	61.8
dot10	7-8-08	64.8
dot11	7-8-08	67.8
dot12	7-8-08	73.3
dot13	7-8-08	76.3
dot14	7-8-08	79.3
dot15	7-8-08	82.3
dot16	7-8-08	86.3
dot17	7-8-08	89.3

Table 1-31 Pressuremeter Test depth and Material Description: TH-31-PMT-SW-08

Test	Date	Test depth
dot122	7-Sep-08	92
dot123	7-Sep-08	94
dot124	7-Sep-08	96
dot125	7-Sep-08	98
dot126	7-Sep-08	100
dot127	7-Sep-08	102
dot128	7-Sep-08	104
dot129	8-Sep-08	107
dot130	8-Sep-08	109
dot131	8-Sep-08	111
dot132	8-Sep-08	113
dot133	8-Sep-08	115
dot134	8-Sep-08	117
dot135	8-Sep-08	119
dot136	8-Sep-08	122
dot137	8-Sep-08	124
dot138	8-Sep-08	126
dot139	8-Sep-08	128
dot140	8-Sep-08	130
dot141	8-Sep-08	132
dot142	8-Sep-08	134
dot143	8-Sep-08	136
dot144	8-Sep-08	138

Table 1-31 (cont) Pressuremeter Test depth and Material Description: TH-31B-PMT-SW-08

Test	Date	Test depth
dot18	7-9-08	8.3
dot19	7-9-08	11.3
dot20	7-9-08	14.3
dot21	7-9-08	17.3
dot22	7-9-08	23.5
dot23	7-9-08	26.5
dot24	7-9-08	29.5
dot25	7-9-08	32.5
dot26	7-9-08	35.5
dot27	7-9-08	38.3
dot28	7-9-08	48.3
dot29	7-9-08	51.3
dot30	7-9-08	54.3
dot31	7-9-08	57.3
dot32	7-10-08	63.3
dot33	7-10-08	66.3
dot34	7-10-08	69.3
dot35	7-10-08	73.3
dot36	7-10-08	75.3
dot37	7-10-08	83.3
dot38	7-10-08	86.3
dot39	7-10-08	89.3

Table 1-30 Pressuremeter Test depth and Material Description: TH-30-PMT-SW-08

Test	Date	Test depth
dot100	6-Sep-08	92
dot101	6-Sep-08	94
dot102	6-Sep-08	96
dor103	6-Sep-08	98
dot104	6-Sep-08	100
dot105	6-Sep-08	102
dot106	6-Sep-08	104
dot107	6-Sep-08	107
dot108	6-Sep-08	110
dot109	6-Sep-08	112
dot110	6-Sep-08	114
dot111	6-Sep-08	116
dot112	6-Sep-08	118
dot113	6-Sep-08	122
dot114	6-Sep-08	124
dot115	6-Sep-08	126
dot116	6-Sep-08	128
dot117	7-Sep-08	132
dot118	7-Sep-08	134
dot119	7-Sep-08	136
dot120	7-Sep-08	138
dot121	7-Sep-08	140

Table 1-30 (cont) Pressuremeter Test depth and Material Description: TH-30B-PMT-SW-08

Test	Date	Test depth
dot40	7-11-08	33.3
dot41	7-11-08	36.3
dot42	7-11-08	39.3
dot43	7-11-08	42.3
dot44	7-11-08	48.3
dot45	7-11-08	50.3
dot46	7-11-08	54
dot47	7-11-08	58.3
dot48	7-12-08	63.3
dot49	7-12-08	66.3
dot50	7-12-08	69.3
dot51	7-12-08	72.3
dot52	7-12-08	78.2
dot53	7-12-08	81.2
dot54	7-12-08	84.2
dot55	7-12-08	87.2
dot56	7-12-08	90.2

Table 1-28 Pressuremeter Test depth and Material Description: TH-28-PMT-SW-08

Test	Date	Test depth
dot145	9-Sep-08	82
dot146	9-Sep-08	84
dot147	9-Sep-08	86
dot148	9-Sep-08	88
dot149	9-Sep-08	90
dot150	9-Sep-08	92
dot151	9-Sep-08	94
dot152	9-Sep-08	97
dot153	9-Sep-08	99
dot154	9-Sep-08	101
dot155	9-Sep-08	103
dot156	9-Sep-08	105
dot157	9-Sep-08	107
dot158	9-Sep-08	109
dot159	9-Sep-08	111
dot160	9-Sep-08	113
dot161	9-Sep-08	117
dot162	9-Sep-08	119
dot163	9-Sep-08	121
dot164	9-Sep-08	123
dot165	9-Sep-08	125
dot166	9-Sep-08	127
dot167	9-Sep-08	129

Table 1-28 (cont) Pressuremeter Test depth and Material Description: TH-28B-PMT-SW-08

Test	Date	Test depth
dot57	7-12-08	3.8
dot58	7-12-08	6.8
dot59	7-12-08	9.8
dot60	7-12-08	13.4
dot61	7-13-08	18.2
dot62	7-13-08	21.2
dot63	7-13-08	24.2
dot64	7-13-08	28.2
dot65	7-13-08	31.2
dot66	7-13-08	34.2
dot67	7-13-08	38.2
dot68	7-13-08	41.2
dot69	7-13-08	44.2
dot70	7-13-08	47.2
dot71	7-13-08	50.2
dot72	7-13-08	53.2
dot73	7-13-08	56.2
dot74	7-13-08	59.2
dot75	7-13-08	62.2
dot76	7-14-08	68.2
dot77	7-14-08	71.2
dot78	7-14-08	74.2
dot79	7-14-08	78.2
dot80	7-14-08	81.2
dot81	7-14-08	84.2
dot82	7-14-08	87.2
dot83	7-14-08	90.2

Table 1-29 Pressuremeter Test depth and Material Description: TH-29-PMT-SW-08

Test	Date	Test depth
dot84	4-Sep-08	92
dot85	5-Sep-08	98
dot86	5-Sep-08	100
dot87	5-Sep-08	102
dot88	5-Sep-08	104
dot89	5-Sep-08	106
dot90	5-Sep-08	108
dot91	5-Sep-08	113
dot92	5-Sep-08	115
dot93	5-Sep-08	117
dot94	5-Sep-08	119
dot95	5-Sep-08	121
dot96	5-Sep-08	123
dot97	5-Sep-08	127
dot98	5-Sep-08	129
dot99	5-Sep-08	131

Table 1-29 (cont) Pressuremeter Test depth and Material Description: TH-29B-PMT-SW-08

5.0 TEST PROCEDURE

The membrane was expanded by controlling the flow of compressed nitrogen into the pressuremeter, increasing the pressure in small steps until the membrane starts to expand against the borehole wall. Once the average strain of the wall was greater than about 1.5% the pressure the pressure is reduced to no more than 40% of the maximum past pressure, then increased again.

The resulting unload-reload loop can be used to evaluate the elastic behavior of the material. In materials which behave in a linear manner, the loops will exhibit little hysteretic behavior. That is, the linear unloading path will follow the reloading path. The loops will be very tight.

The pressure is then advanced in steps until the strain is increased a further 2% before completing a second unload-reload cycle. In many tests the procedure is repeated until three or four unload reload loops are completed. If the disturbance is small, the slope of the loops will tend to be parallel. Figure 2 is a typical example.

After the strain exceeds 12%, the pressure is reduced to zero.

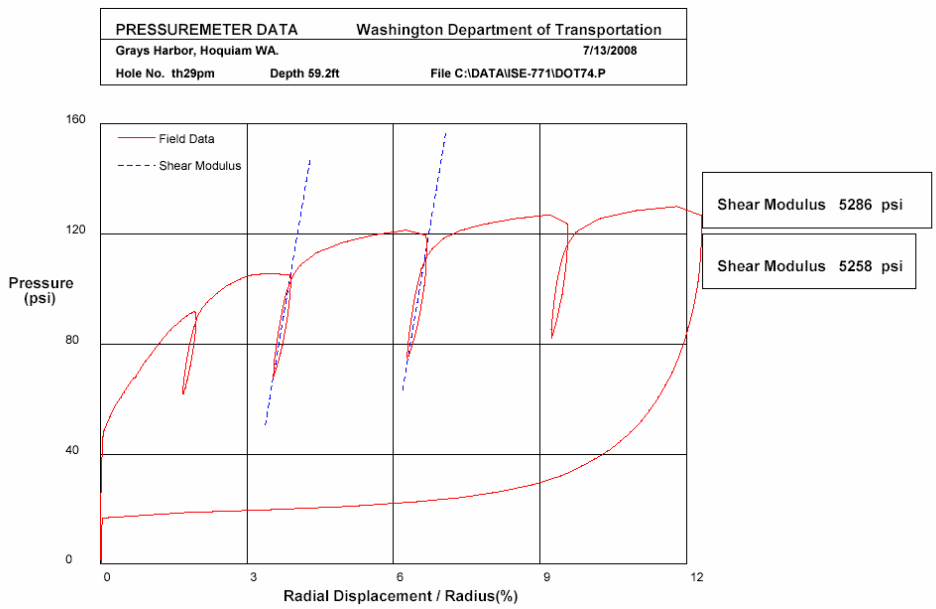


Fig. 2. Test Dot74 in hole TH-29-PMT-SW-08 at 59 ft

6.0 QUALITY OF THE DATA

In general, the pressuremeter testing should reflect the material being tested. If the materials are relatively uniform, then adjacent tests should be similar in form. If adjacent tests are distinctly different then either the material has changed or there is a problem with the test.

Hence in a qualitative manner the results can be assessed as to whether the data reflects the *in-situ* material properties. In Figure 3 are two adjacent tests in Hole TH-30-PMT-SW-08. As both look relatively similar and follow the expected geometric form. One aspect of the expected geometric form of the tests, not influenced by disturbance, is that the slope of the unload-reload loops second and subsequent loops should be parallel.

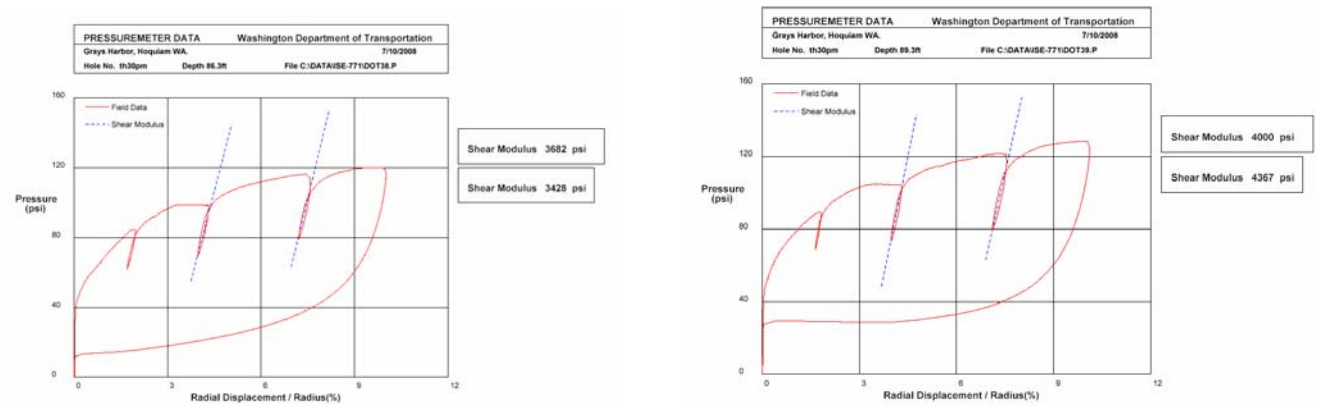


Fig. 3. Adjacent pressuremeter tests at Hole TH-30-PMT-SW-08

(Dot38 at 44.8 ft and Dot39 at 46.4 ft)

The pair of test, shown in Fig. 3, are geometrically very similar. The slopes of the unload-reload loops are reasonably parallel. Hence these tests probably reflect the *in-situ* material behavior.

7.0 STANDARD METHOD OF ANALYSIS OF THE SHEAR MODULUS

If the material surrounding the pressuremeter is assumed to extend to infinity, and assumed to behave as an idealized linear elastic, homogeneous material, which does not fail under shear or tension, then the displacement on the boundary of the pressuremeter, u_a, for a given pressure, P, is given by:

$$u_a = P(a)\,(1+\mu) / E \qquad 1)$$

where "E" is the Young's Modulus, "a" the radius of the pressuremeter cavity, and "μ" the Poisson's ratio. As the shear modulus, "G", and the Young's modulus, "E", are related by the following relationship:

$$E=2(G)(1+\mu) \qquad 2)$$

Equation 1 reduces to:

$$u_a = 0.5P(a) / G \qquad 3)$$

Hence, the shear modulus G is given by:

$$G = 0.5 * \Delta \text{ Pressure} / \Delta(\text{radial displacement/radius}) \qquad 4)$$

The modulus for the average slope of the initial part of the pressuremeter curve (A-B in Fig.4) expressed as a Young's modulus (assuming a Poisson's ratio of 0.33) is the same as the "pressuremeter modulus" defined in the American Society for Testing and Materials (ASTM) D4719, Section 9.5. However, the modulus determined from the unload-reload loops, which is often higher than the initial loading modulus, is probably more representative of the modulus for the *in-situ* material. This data is summarized in Table 2.

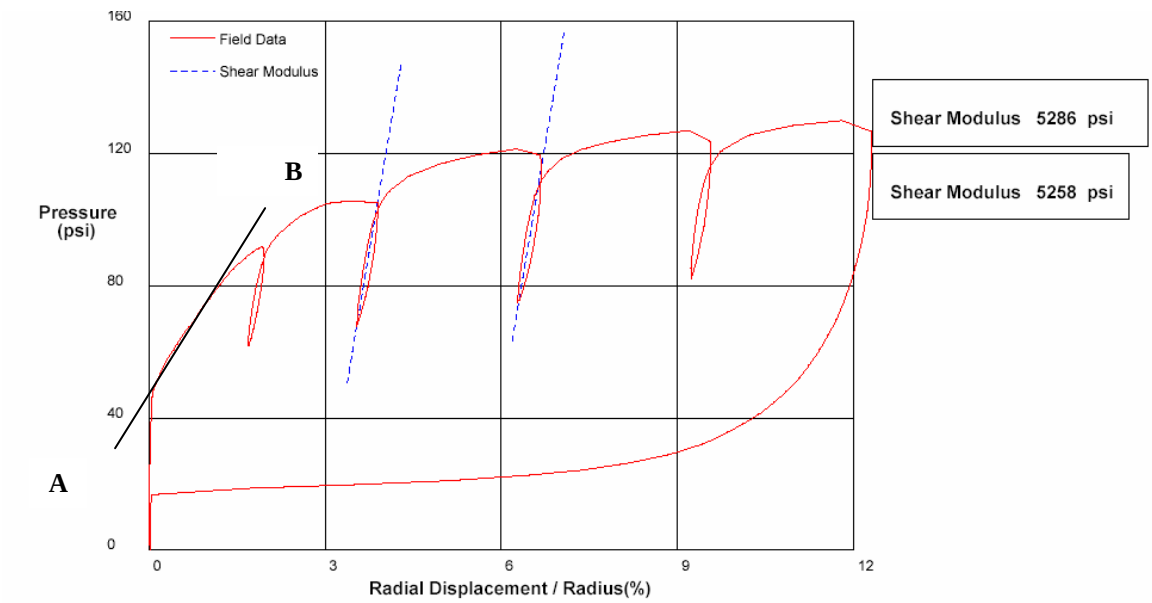


Fig. 4. Modulus determination for Test Dot74

8.0 DETERMINATION OF THE LIMIT PRESSURE

From a visual inspection of the typical pressuremeter curve in the silts/sands shown in Fig. 3, the pressure tends to a limit. For Test Dot74 this limit pressure is in the range of 130 psi. However, to make this limit pressure a quantitative measurement, the limit pressure is defined as that pressure which occurs when the volume of the pressuremeter has doubled. However, few pressuremeter tests ever actually expand this far before reaching the limit of the strain sensing system. The pressuremeters used in this investigation will only expand to about 20% before the displacement limit is reached.

If the material being tested is assumed to behave as an elastic cohesive material, then the equation governing the pressure-displacement curve is given by:

$$P = P_L + (c)\log_e (u_a/_a) \qquad 5)$$

$$P_L = P_o + c + (c)\log_e [G/c] \qquad 6)$$

Where:

P_L" is the theoretical limit pressure at infinite expansion

"c" is the undrained cohesive strength,

"P_O" is the total *in-situ* lateral stress, and "G" is the shear modulus.

For typical values of G and c, the ratio of G/c lies between 50 to 100. Hence, the limit pressure is approximately 5 times the shear strength (assuming P_o is small relative to c) of the soil.

From Equation 5, a plot of pressure P against the log of u_a/a will be a straight line, provided the shear strength remains constant with strain. The slope of this line will provide a measure of the undrained shear strength, c. The Limit Pressure, as defined by the ASTM code D4719, Section 10.6, is the pressure at which the cavity has doubled in size. This doubling in size occurs when u_a/a is equal to 41%. (The origin of the strain used in the log/normal plots is the assumed origin at the *in-situ* stress state). If any disturbance is present, the above method of determining the cohesive strength usually provides an overly optimistic value. In Fig. 5, Test Dot74 is plotted in the above manner. The above method applies to cohesive materials. However it can be used in granular materials to give an indication of the maximum or limit pressure that can be applied to the ground for the design of foundations. The shear strength determined by this method is not appropriate in granular materials.

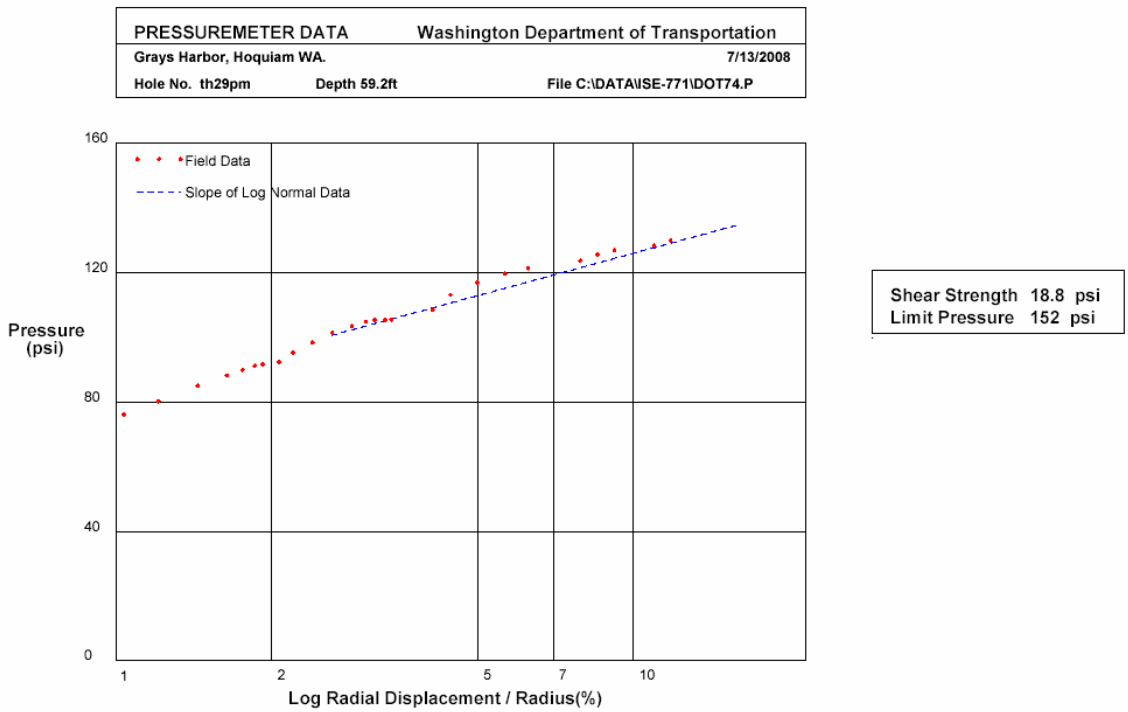


Fig. 5. Limit Pressure determination for Test Dot74

Test	Depth (ft)	Limit Pressure (psi)	Shear modulus (psi)	Shear strength (log method) (psi)
dot1	33.2	69	1,300	10.8
dot2	36.2	95	2,900	15.1
dot3	43	78	1,100	13.3
dot4	45.8	*	1,050	*
dot5	48.8	78	1,500	10.8
dot6	52.1	82	1,000	13.3
dot7	55.1	*	*	*
dot8	58.8	91	1,100	15.1
dot9	61.8	95	1,600	15.1
dot10	64.8	*	*	*
dot11	67.8	*	3,100	*
dot12	73.3	189	3,400	*
dot13	76.3	185	4,300	*
dot14	79.3	161	4,300	8
dot15	82.3	115	3,100	12.5
dot16	86.3	123	2,200	12.5
dot17	89.3	135	2,700	15.1

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 2-31 Limit Pressure shear modulus and Shear strength (log method) TH-31

Test	Depth (ft)	Limit Pressure (psi)	Shear modulus (psi)	Shear strength (log method) (psi)
dot122	92	182	7,000	31
dot123	94	181	6,000	27.3
dot124	96	137	1,500	15.1
dot125	98	136	1,600	10.8
dot126	100	149	2,200	14.2
dot127	102	141	1,250	12.5
dot128	104	146	1,200	13.3
dot129	107	147	3,900	14.2
dot130	109	139	2,100	12.5
dot131	111	136	2,400	10
dot132	113	154	4,300	13.3
dot133	115	148	2,400	12.5
dot134	117	156	3,000	11.6
dot135	119	170	3,850	17.9
dot136	122	166	4,500	16
dot137	124	168	2,700	14.2
dot138	126	177	2,900	13.3
dot139	128	180	4,000	17.9
dot140	130	189	4,000	18.8
dot141	132	194	4,700	21
dot142	134	199	6,300	21.8
dot143	136	235	16,000	23.5
dot144	138	222	16,500	20

Table 2-31 Limit Pressure shear modulus and Shear strength (log method) TH-31B

Test	Depth (ft)	Limit Pressure (psi)	Shear modulus (psi)	Shear strength (log method) (psi)
dot18	8.3	*	*	*
dot19	11.3	24	450	5.6
dot20	14.3	50	730	9.3
dot21	17.3	29	330	4.2
dot22	23.5	40	580	6.3
dot23	26.5	41	630	4.9
dot24	29.5	48	780	5.6
dot25	32.5	56	1,450	8.5
dot26	35.5	*	*	*
dot27	38.3	81	1,800	15.1
dot28	48.3	126	3,000	29
dot29	51.3	96	2,100	16
dot30	54.3	103	1,600	18.8
dot31	57.3	*	4,300	*
dot32	63.3	82	1,500	15.1
dot33	66.3	108	2,200	19.8
dot34	69.3	154	3,700	28.6
dot35	73.3	*	4,000	*
dot36	75.3	*	*	*
dot37	83.3	139	2,500	19.8
dot38	86.3	149	3,600	20.8
dot39	89.3	159	4,000	21.8

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 2-30 Limit Pressure, shear modulus and Shear strength (log method) TH-30

Test	Depth (ft)	Limit Pressure (psi)	Shear modulus (psi)	Shear strength (log method) (psi)
dot100	92	189	6,300	30
dot101	94	195	4,500	35
dot102	96	196	5,300	32
dor103	98	208	8,700	36
dot104	100	174	3,400	25
dot105	102	151	1,630	12
dot106	104	142	1,400	13.3
dot107	107	149	1,700	13.5
dot108	110	151	2,000	15.1
dot109	112	143	1,700	10.8
dot110	114	146	2,200	9.3
dot111	116	158	2,200	12.5
dot112	118	165	3,100	14.2
dot113	122	163	*	15.1
dot114	124	169	3,400	16.9
dot115	126	160	2,400	10
dot116	128	183	6,000	17.9
dot117	132	166	3,200	18.8
dot118	134	227	6,500	39.2
dot119	136	182	1,800	19.8
dot120	138	197	6,600	26.2
dot121	140	212	5,900	29.8

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 2-30 (cont) Limit Pressure, shear modulus and Shear strength (log method) TH-30B

Test	Depth (ft)	Limit Pressure (psi)	Shear modulus (psi)	Shear strength (log method) (psi)
dot40	33.3	*	*	*
dot41	36.3	*	*	*
dot42	39.3	*	*	*
dot43	42.3	*	*	*
dot44	48.3	76	1,100	12.6
dot45	50.3	*	1,050	*
dot46	54	*	*	*
dot47	58.3	*	*	*
dot48	63.3	157	4,000	33.6
dot49	66.3	189	5,300	35
dot50	69.3	162	4,400	26.2
dot51	72.3	195	4,800	39.2
dot52	78.2	149	4,000	29.8
dot53	81.2	135	2,400	19.8
dot54	84.2	135	2,700	18.8
dot55	87.2	169	4,000	28.8
dot56	90.2	159	3,800	22.9

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 2-28 Limit Pressure Shear modulus and Shear strength (log method) TH-28

Test	Depth (ft)	Limit Pressure (psi)	Shear modulus (psi)	Shear strength (log method) (psi)
dot145	82	128	1,350	15
dot146	84	150	3,700	16
dot147	86	145	4,000	15
dot148	88	194	8,800	19
dot149	90	194	7,000	20
dot150	92	201	11,000	20
dot151	94	155	3,000	10
dot152	97	152	2,000	10
dot153	99	131	1,500	10
dot154	101	151	4,100	13
dot155	103	168	5,500	15
dot156	105	172	3,200	15
dot157	107	154	1,800	14
dot158	109	168	5,000	13
dot159	111	201	10,000	16
dot160	113	227	12,300	*
dot161	117	232	16,500	*
dot162	119	224	8,100	*
dot163	121	196	2,900	15
dot164	123	416	27,000	*
dot165	125	202	2,500	16
dot166	127	199	2,500	16
dot167	129	197	2,100	16

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 2-28 (Cont) Limit Pressure Shear modulus and Shear strength (log method) TH-28B

Test	Depth (ft)	Limit Pressure (psi)	Shear modulus (psi)	Shear strength (log method) (psi)
dot57	3.8	29	800	6.3
dot58	6.8	15	200	2.2
dot59	9.8	26	270	4.9
dot60	13.4	22	300	2.2
dot61	18.2	25	330	2.2
dot62	21.2	30	370	2.8
dot63	24.2	34	400	3.5
dot64	28.2	37	630	3.5
dot65	31.2	82	2,500	16.9
dot66	34.2	40	600	7
dot67	38.2	98	3,400	14
dot68	41.2	100	3,200	16
dot69	44.2	120	4,300	18
dot70	47.2	127	3,700	22
dot71	50.2	162	4,000	31
dot72	53.2	107	2,400	15
dot73	56.2	80	1,500	10
dot74	59.2	152	5,200	19
dot75	62.2	147	4,500	26
dot76	68.2	160	4,800	32
dot77	71.2	*	*	*
dot78	74.2	*	5,000	*
dot79	78.2	*	*	*
dot80	81.2	148	1,850	32
dot81	84.2	132	1,900	21
dot82	87.2	163	2,300	32
dot83	90.2	169	3,400	27

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 2-29 Limit Pressure, Shear modulus and Shear strength (log method) TH-29

Test	Depth (ft)	Limit Pressure (psi)	Shear modulus (psi)	Shear strength (log method) (psi)
dot84	92	226	39,000	35
dot85	98	130	1,600	14
dot86	100	144	2,600	14
dot87	102	152	2,100	15
dot88	104	145	2,300	12.5
dot89	106	149	2,900	14.2
dot90	108	152	3,700	15.1
dot91	113	153	3,200	12.5
dot92	115	150	1,820	10.8
dot93	117	159	2,500	15.1
dot94	119	179	5,600	19.8
dot95	121	157	3,200	13.3
dot96	123	163	5,200	16
dot97	127	189	1,920	17
dot98	129	182	2,900	19.8
dot99	131	191	5,600	20.8

Table 2-29 (Cont) Limit Pressure, Shear modulus and Shear strength (log method) TH-29B

9.0 DETERMINATION OF THE STRENGTH PROPERTIES

The PMT data can some times be used directly to determine the *in-situ* material properties such as the cohesive strength and the friction angle. To do so, a material model and failure mechanism must be assumed. If it is assumed that the material behaves in an ideal manner, in that the material deforms at constant volume throughout the test, i.e. it does not consolidate or dilate, and the shear strength remains constant the pressuremeter curve can be interpreted by simple analytical means. The slope of the plot of pressure against the log of the strain can be used to give a direct measure of the shear strength, as discussed in Section 8. Unfortunately, real materials do not quite behave in this manner, and the shear strength determined by this method may not be accurate, particularly in disturbed material, materials which degrade or partial tests in an enlarged hole. The shear strength determined by this method is not appropriate in frictional materials. However, this method of analysis often forms a basis of rating all materials.

A more realistic method of determining the shear strength in clays is to compare the field PMT data with an ideal model pressuremeter curve based on an assumed set of material parameters. If, for instance, the material is assumed to be cohesive and fails at a constant shear strength and at

constant volume, then the material parameters required for this model are the shear strength, lateral stress, and shear modulus. Adjustments can be made to those three parameters until a mathematical curve can be fitted to the field data. (Fig. 6 is and example for test Dot74) Judgment is required to adjust these three parameters to determine the best fit to the data, particularly if there is disturbance present.

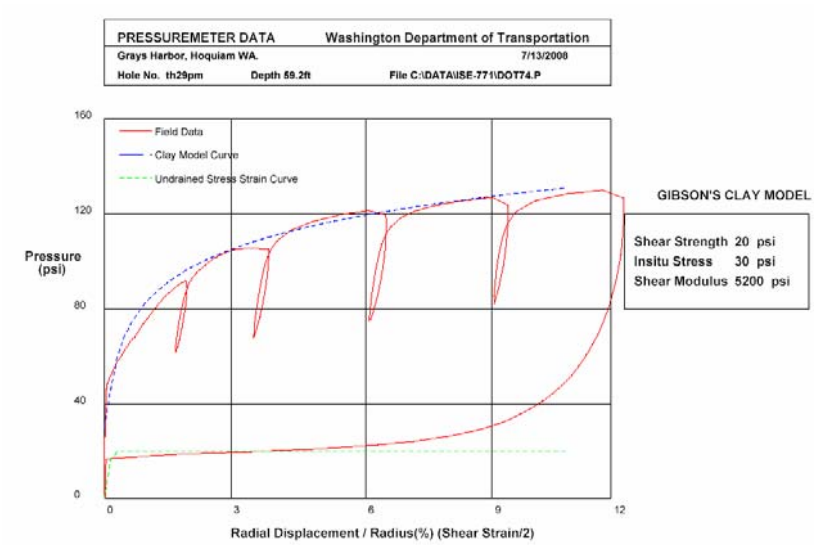


Fig. 6. Simple constant shear strength model analysis for test Dot74

In the frictional materials if it is assumed that the material has a constant friction angle and no cohesion then a simple model can be used to compare the data. Test Dot74 is analyzed in this manner in Fig. 7.

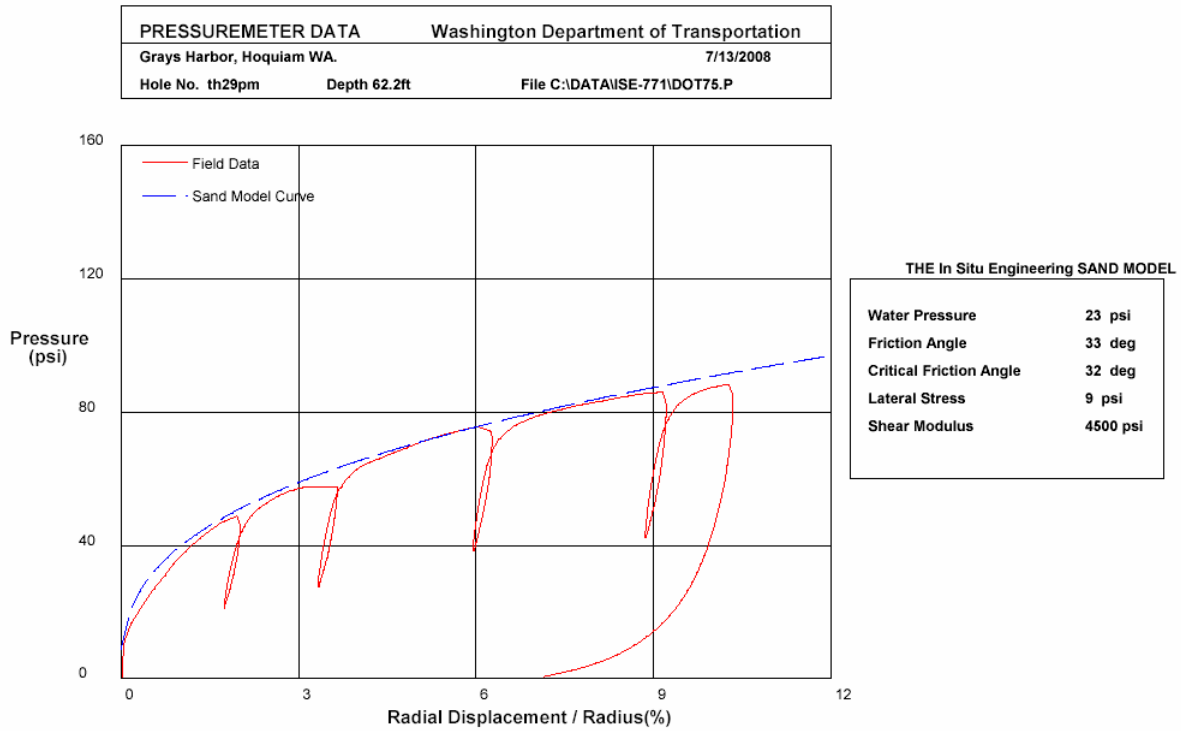


Fig. 7. Frictional Model for Test Dot75

In order to get an overview of the data the effective lateral stress is assumed to be 0.3 times the vertical effective stress. (The water table is assumed to be at 10 ft depth and the density is assumed to be 120 pcf). Most of the tests have been analyzed by both methods. In the tests in which the friction angle is above 32 degrees the material is behaving as a frictional material. However the high silt content will have a significant influence on the behavior. In the materials with a lower fiction angle the cohesive component dominates.

Test	Depth (ft)	Shear strength (model) (psi)	Friction angle (model)
dot1	33.2	9	35
dot2	36.2	12	36
dot3	43	9	36
dot4	45.8	*	*
dot5	48.8	8	32
dot6	52.1	8	32
dot7	55.1	*	*
dot8	58.8	11	33
dot9	61.8	11	32
dot10	64.8	*	*
dot11	67.8	*	25
dot12	73.3	18	36
dot13	76.3	19	34
dot14	79.3	16	32
dot15	82.3	12	26
dot16	86.3	14	30
dot17	89.3	16	32

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 3-31 Material properties from Model Analysis TH-31-PMT-SW-08

Test	Depth (ft)	Shear strength (model) (psi)	Friction angle (model)
dot122	92	20	*
dot123	94	17	*
dot124	96	11	*
dot125	98	11	*
dot126	100	12	*
dot127	102	11	*
dot128	104	12	*
dot129	107	12	*
dot130	109	12	*
dot131	111	10	*
dot132	113	12	*
dot133	115	12	*
dot134	117	13	*
dot135	119	13	*
dot136	122	13	*
dot137	124	15	*
dot138	126	12	*
dot139	128	15	*
dot140	130	17	*
dot141	132	17	*
dot142	134	17	*
dot143	136	20	*
dot144	138	20	*

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 3-31 (cont) Material properties from Model Analysis TH-31B-PMT-SW-08

Test	Depth (ft)	Shear strength (model) (psi)	Friction angle (model)
dot18	8.3	*	*
dot19	11.3	3	30
dot20	14.3	8	35
dot21	17.3	5	25
dot22	23.5	5	32
dot23	26.5	6	35
dot24	29.5	5	32
dot25	32.5	6	30
dot26	35.5	*	*
dot27	38.3	9	33
dot28	48.3	13	34
dot29	51.3	11	32
dot30	54.3	11	32
dot31	57.3	*	33
dot32	63.3	6	23
dot33	66.3	10	29
dot34	69.3	16	33
dot35	73.3	10	30
dot36	75.3	*	*
dot37	83.3	15	32
dot38	86.3	16	32
dot39	89.3	17	32

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 3-30 Material properties from Model Analysis TH-30-PMT-SW-08

Test	Depth (ft)	Shear strength (model) (psi)	Friction angle (model)
dot100	92	*	*
dot101	94	*	*
dot102	96	22	*
dor103	98	18	*
dot104	100	18	*
dot105	102	11	*
dot106	104	13	*
dot107	107	13	*
dot108	110	13	*
dot109	112	12	*
dot110	114	12	*
dot111	116	13	*
dot112	118	13	*
dot113	122	14	*
dot114	124	15	*
dot115	126	12	*
dot116	128	14	*
dot117	132	14	*
dot118	134	*	*
dot119	136	17	*
dot120	138	*	*
dot121	140	*	*

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 3-30 (cont) Material properties from Model Analysis TH-30B-PMT-SW-08

Test	Depth (ft)	Shear strength (model) (psi)	Friction angle (model)
dot40	33.3	*	*
dot41	36.3	*	*
dot42	39.3	*	*
dot43	42.3	*	*
dot44	48.3	8	32
dot45	50.3	5	23
dot46	54	*	*
dot47	58.3	*	*
dot48	63.3	15	34
dot49	66.3	22	36
dot50	69.3	18	34
dot51	72.3	22	36
dot52	78.2	14	30
dot53	81.2	15	33
dot54	84.2	15	32
dot55	87.2	17	34
dot56	90.2	17	34

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 3-28 Material properties from Model Analysis TH-28-PMT-SW-08

Test	Depth (ft)	Shear strength (model) (psi)	Friction angle (model)
dot145	82	15	*
dot146	84	16	*
dot147	86	15	*
dot148	88	19	*
dot149	90	20	*
dot150	92	20	*
dot151	94	10	*
dot152	97	10	*
dot153	99	10	*
dot154	101	13	*
dot155	103	15	*
dot156	105	15	*
dot157	107	14	*
dot158	109	13	*
dot159	111	16	*
dot160	113	*	*
dot161	117	*	*
dot162	119	*	*
dot163	121	15	*
dot164	123	*	*
dot165	125	16	*
dot166	127	16	*
dot167	129	16	*

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 3-28 (Cont) Material properties from Model Analysis TH-28B-PMT-SW-08

Test	Depth (ft)	Shear strength (model) (psi)	Friction angle (model)
dot57	3.8	4	40
dot58	6.8	3	38
dot59	9.8	5	40
dot60	13.4	4	32
dot61	18.2	4	32
dot62	21.2	5	34
dot63	24.2	5	34
dot64	28.2	5	30
dot65	31.2	8	34
dot66	34.2	4	24
dot67	38.2	12	34
dot68	41.2	12	34
dot69	44.2	14	34
dot70	47.2	15	35
dot71	50.2	20	37
dot72	53.2	13	34
dot73	56.2	8	30
dot74	59.2	20	36
dot75	62.2	15	33
dot76	68.2	15	32
dot77	71.2	*	*
dot78	74.2	*	32
dot79	78.2	*	*
dot80	81.2	15	32
dot81	84.2	14	32
dot82	87.2	15	32
dot83	90.2	18	33

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 3-29 Material properties from Model Analysis TH-29-PMT-SW-08

Test	Depth (ft)	Shear strength (model) (psi)	Friction angle (model)
dot84	92		*
dot85	98	15	*
dot86	100	14	*
dot87	102	15	*
dot88	104	14	*
dot89	106	14	*
dot90	108	14	*
dot91	113	14	*
dot92	115	13	*
dot93	117	14	*
dot94	119	16	*
dot95	121	14	*
dot96	123	15	*
dot97	127	17	*
dot98	129	18	*
dot99	131	18	*

* denotes that this property was not obtainable from the test information, not applicable to the soil type or that the calculated property was obviously not representative of the material.

Table 3-29 (Cont) Material properties from Model Analysis TH-29B-PMT-SW-08

10.0 CONCLUSIONS

In the above study the material grades between a silt, with some sand, to a sand with some silt. There are few locations where the material is a silt free sand. Much of the material is in a loose state in that it could shear at constant volume. However the high silt content should give it some stability.

The upper fill is in a normally consolidated state and the upper silts are probably in the same state. The lower silts, as identified from the cone traces, are probably different series of deposition. However, the lower material is probably also normally consolidated.

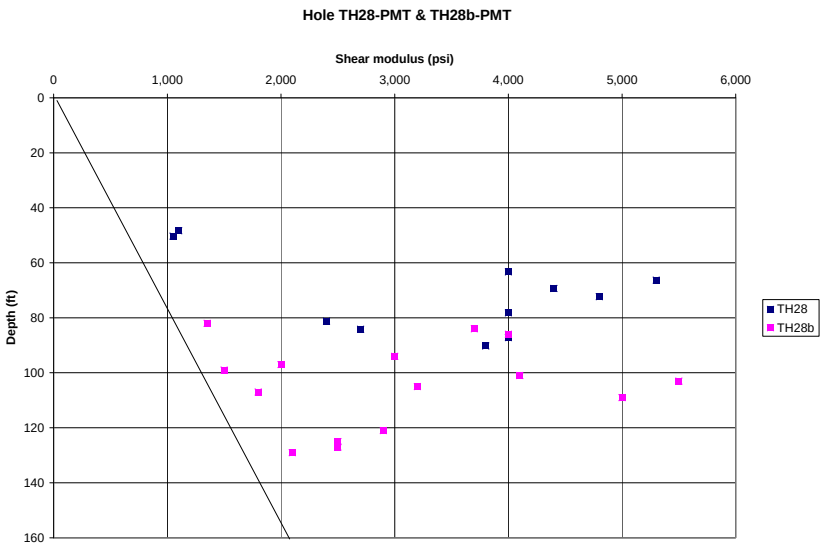
11.0 REFERENCES

Mair, R.J. and Wood, D.M. 1987. Pressuremeter testing: methods and interpretation. CIRIA Ground Engineering Report. Butterworths, London.

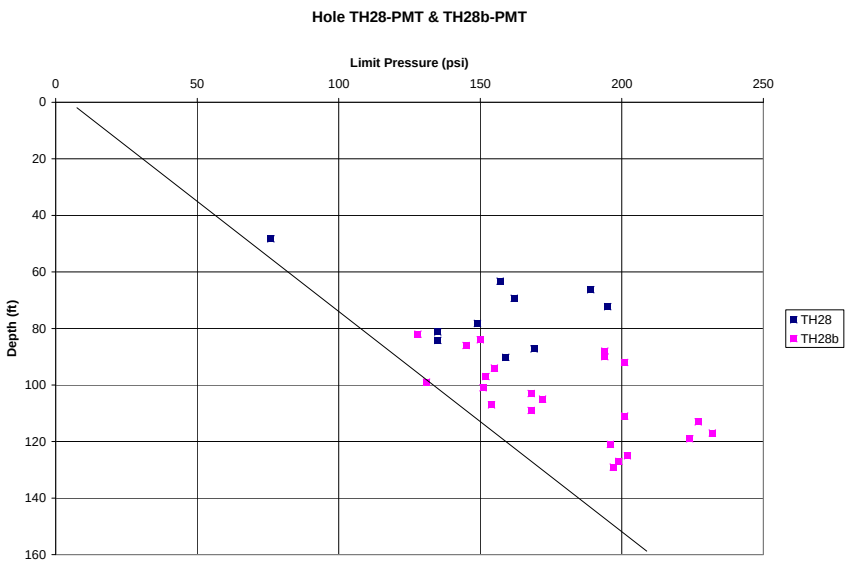
ASTM D4719. 2007. Standard tests method for pressuremeter testing in soils.

APPENDIX I

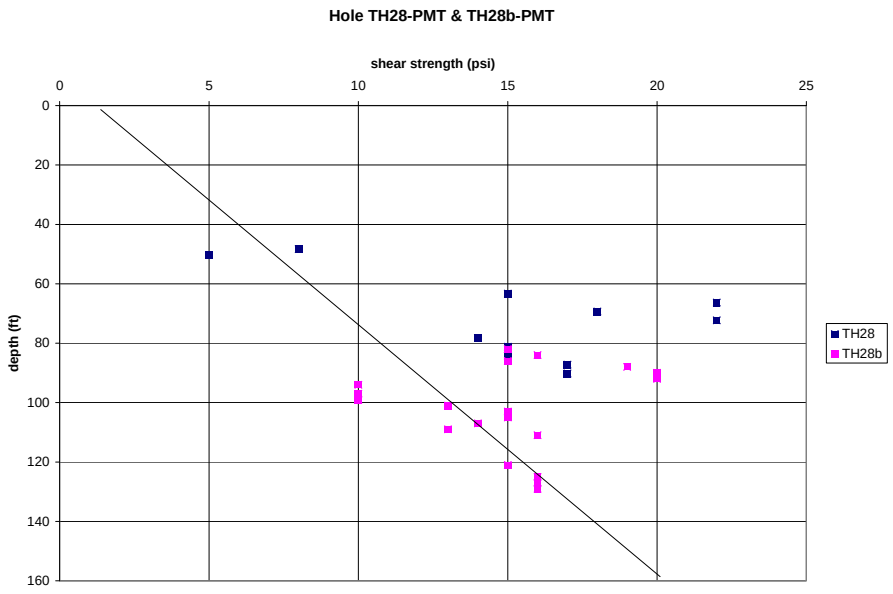
Plots of Shear modulus, Limit Pressure, model shear strength and model friction angle



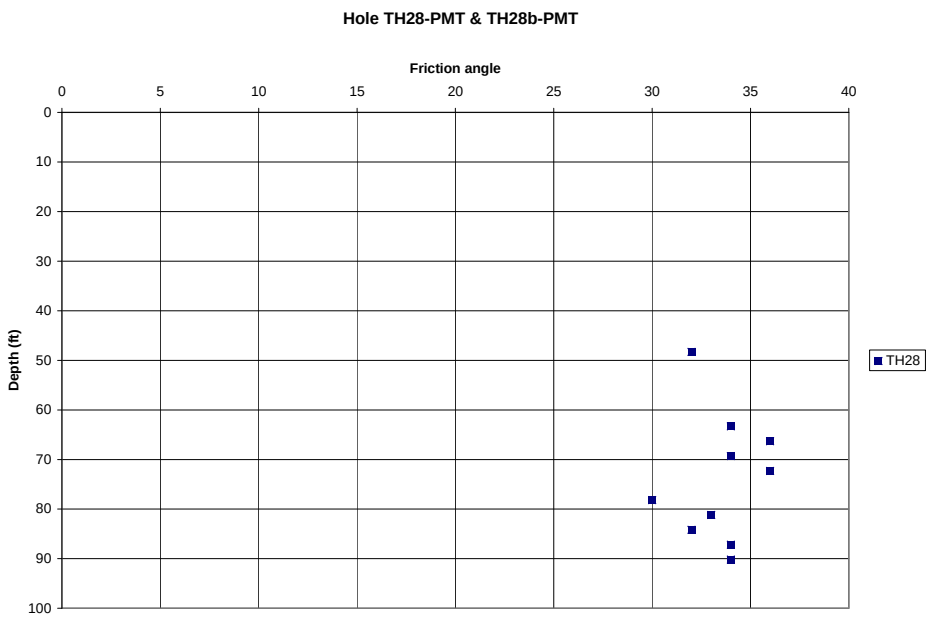
Unload-reload Shear Modulus: Hole TH-28-PMT-SW-08 & TH-28b



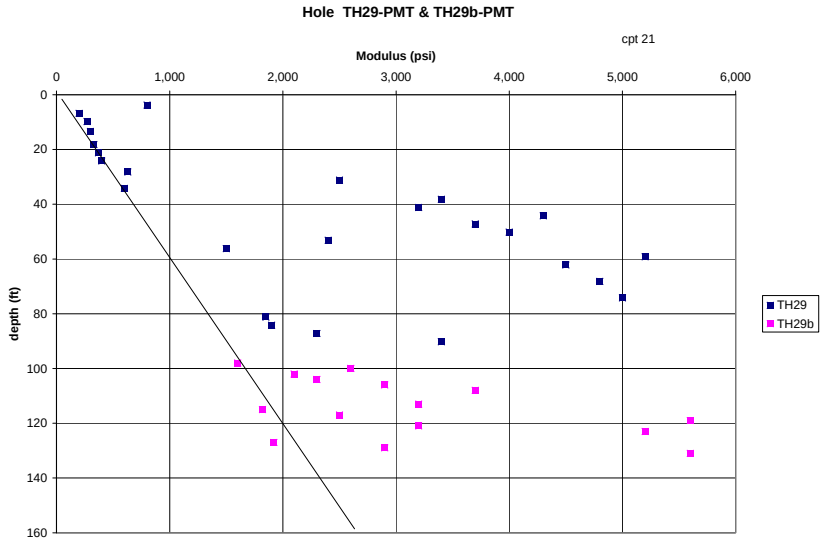
Limit Pressure : Hole TH-28-PMT-SW-08 & TH-28b



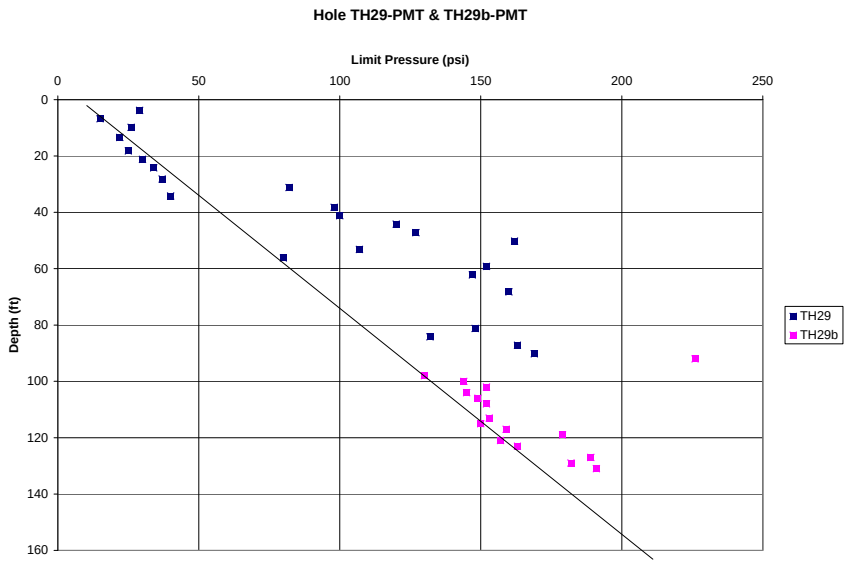
Shear strength (Model analysis): Hole TH-28-PMT-SW-08 & TH28b



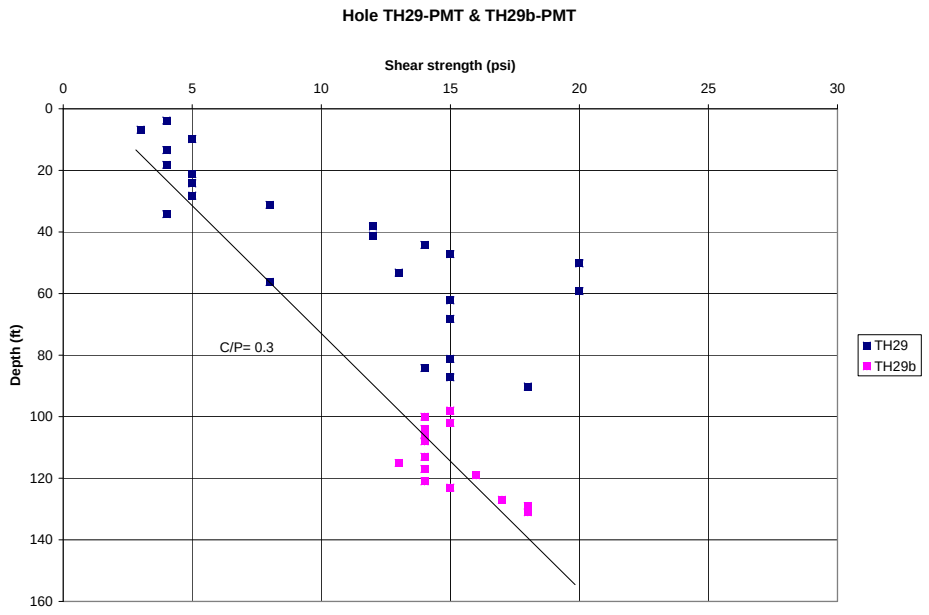
Friction angle: Hole TH-28-PMT-SW-08



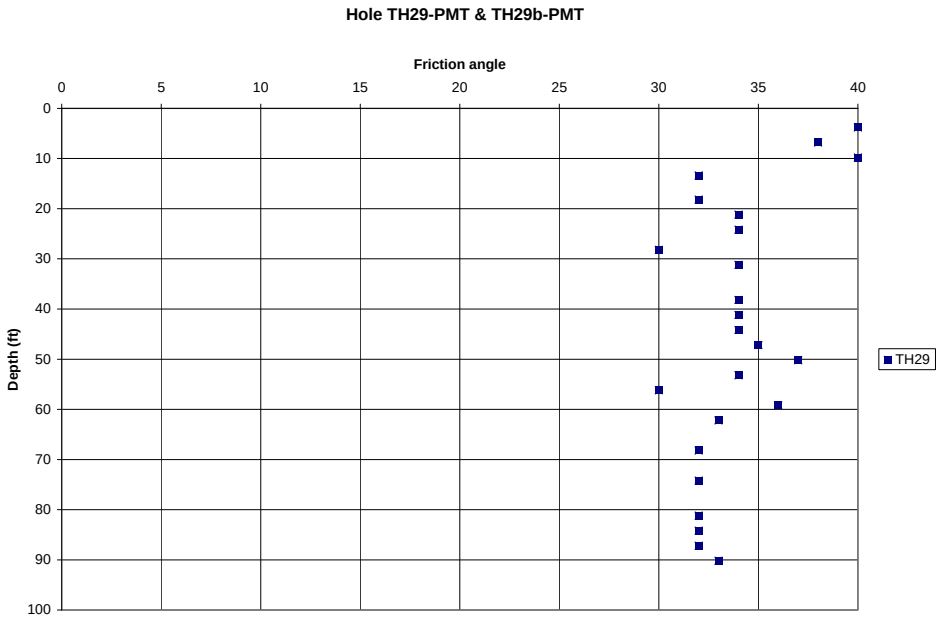
Unload-reload Shear Modulus: Hole TH-29-PMT-SW-08 &TH-29b



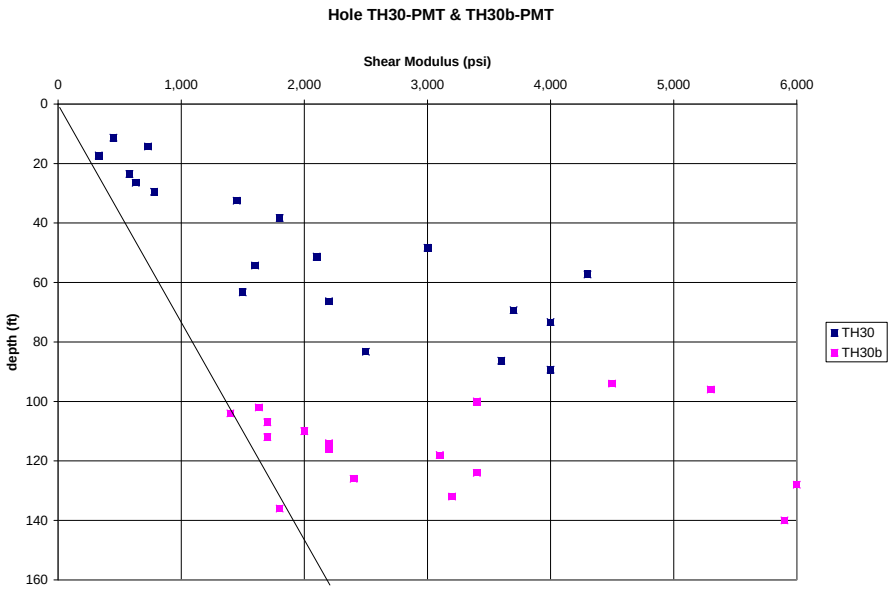
Limit Pressure : Hole TH-29-PMT-SW-08 & TH29b



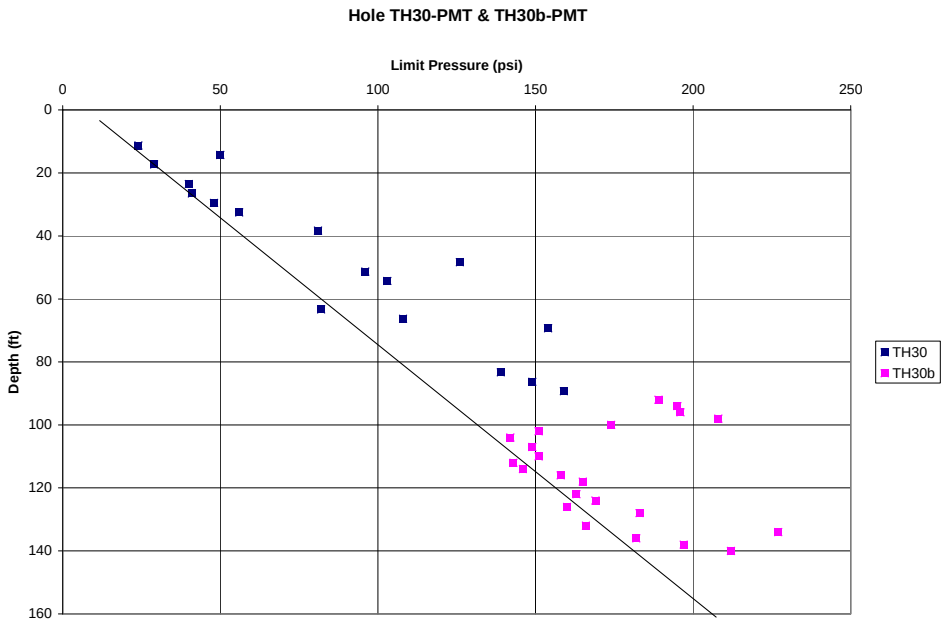
Shear strength (Model analysis): Hole TH-29-PMT-SW-08 & TH-29b



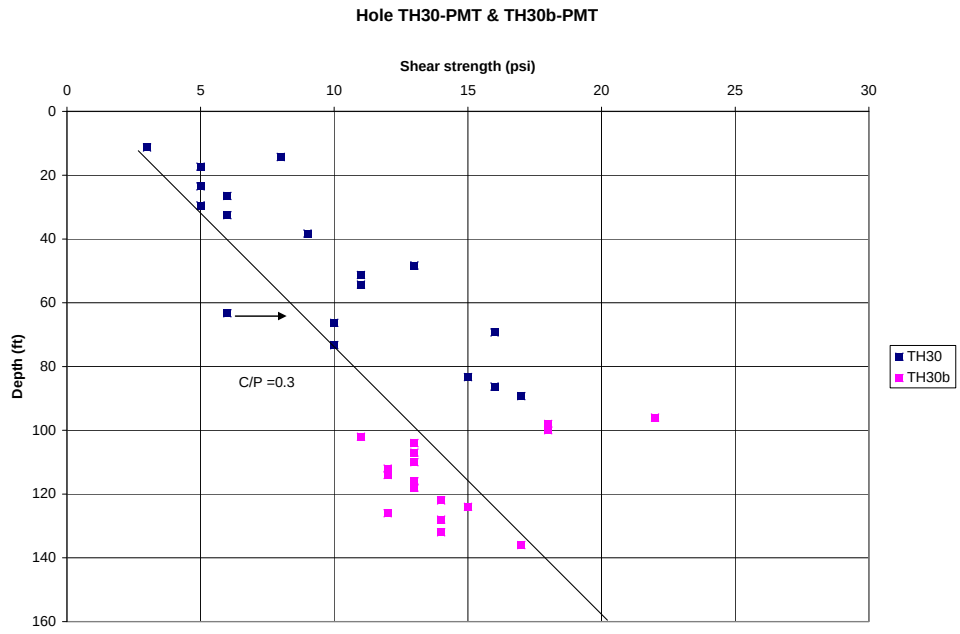
Friction angle: Hole TH-29-PMT-SW-08



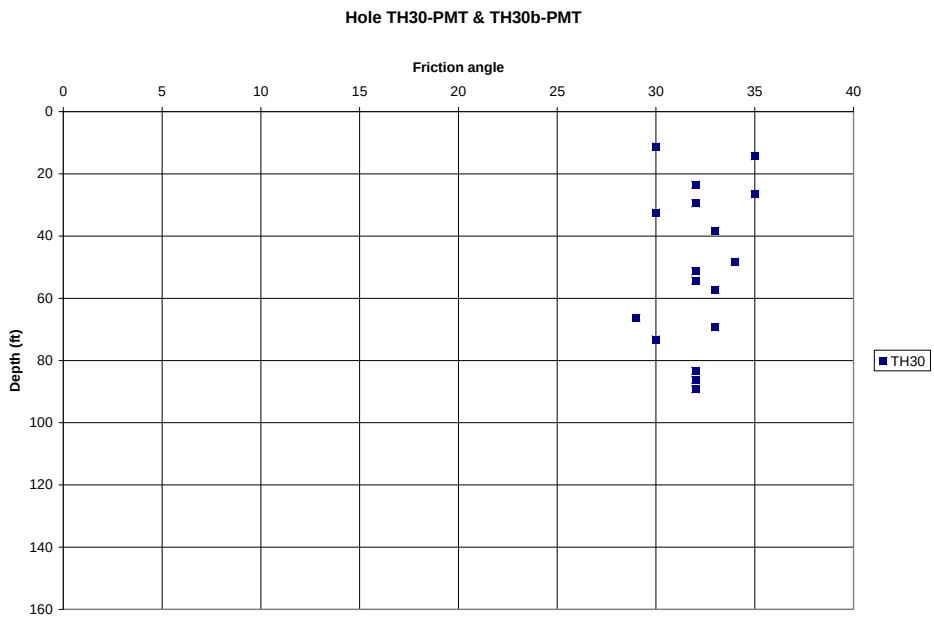
Unload-reload Shear Modulus: Hole TH-30-PMT-SW-08 & TH-30b



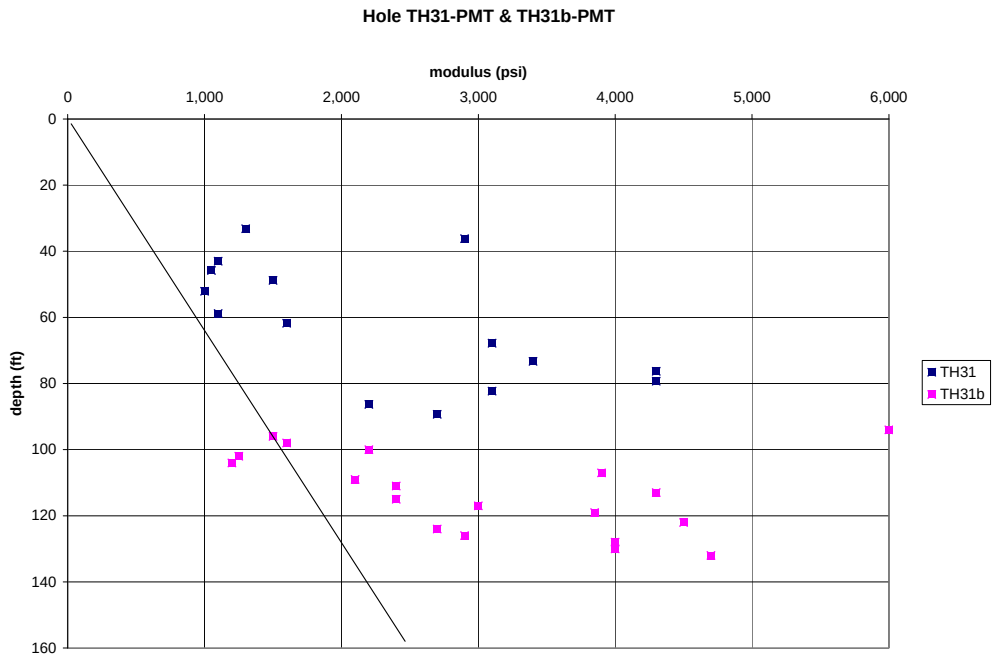
Limit Pressure : Hole TH-30-PMT-SW-08 & TH-30b



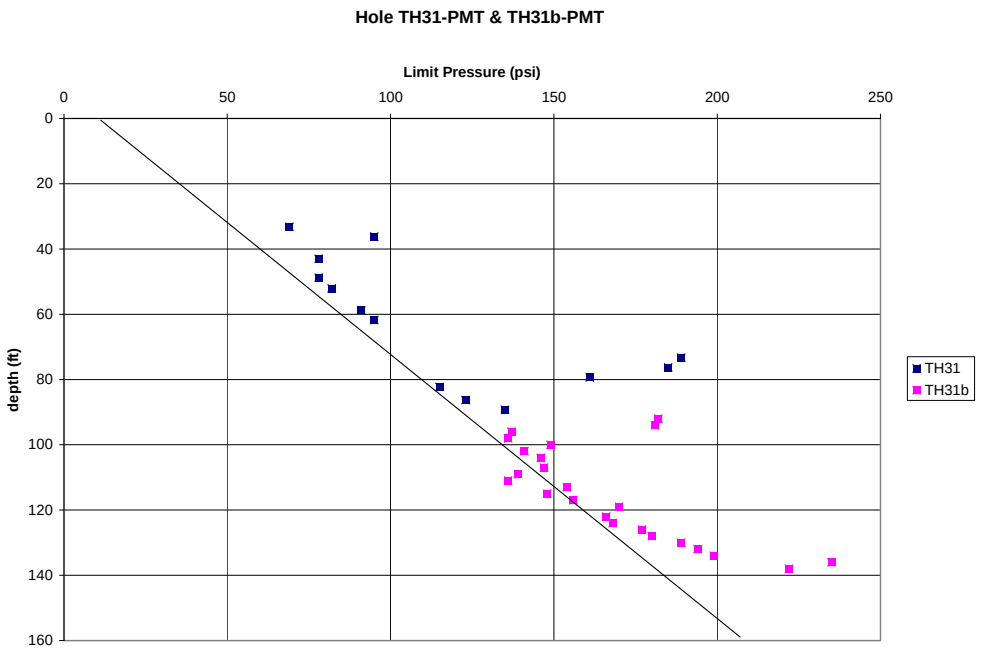
Shear strength (Model analysis): Hole TH-30-PMT-SW-08 & TH-30b



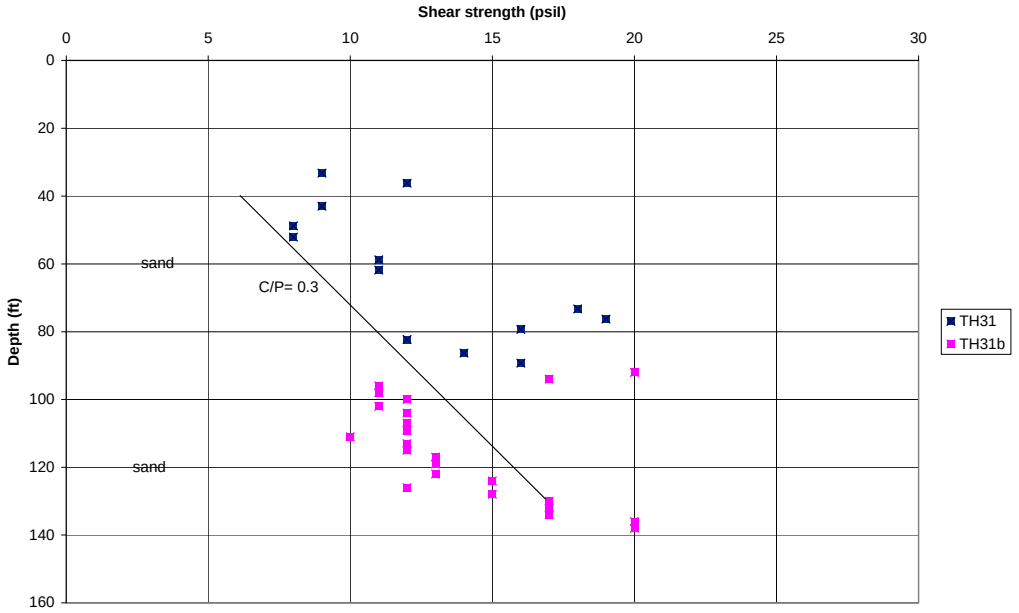
Friction angle: Hole TH-30-PMT-SW-08 & TH-30b



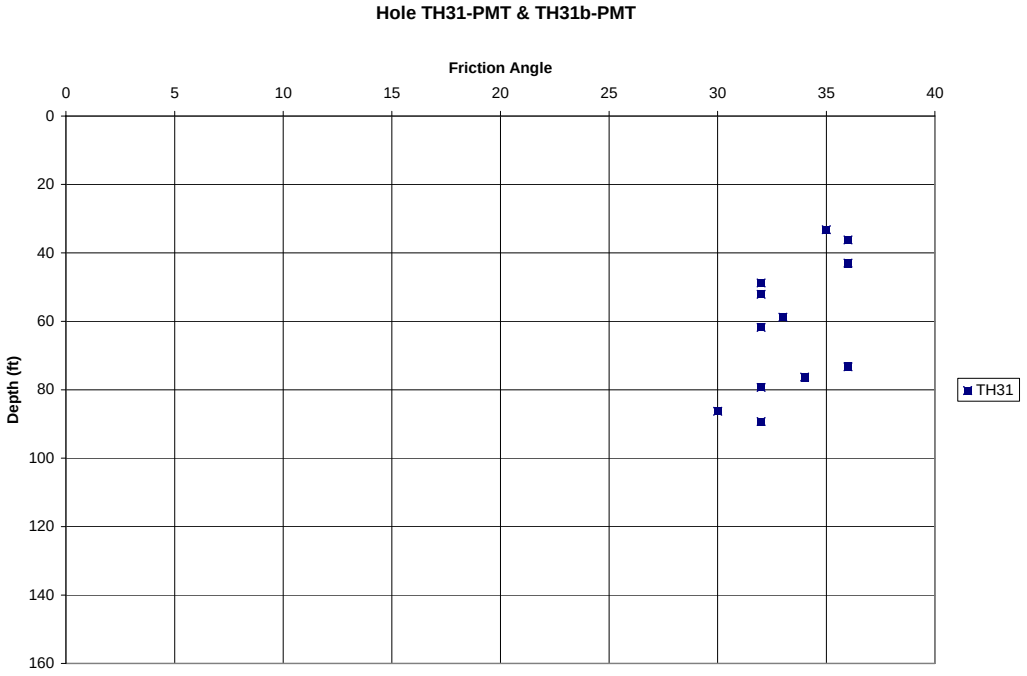
Unload-reload Shear Modulus: Hole TH-31-PMT-SW-08 & TH31b



Limit Pressure : Hole TH-31-PMT-SW-08 & TH-31b

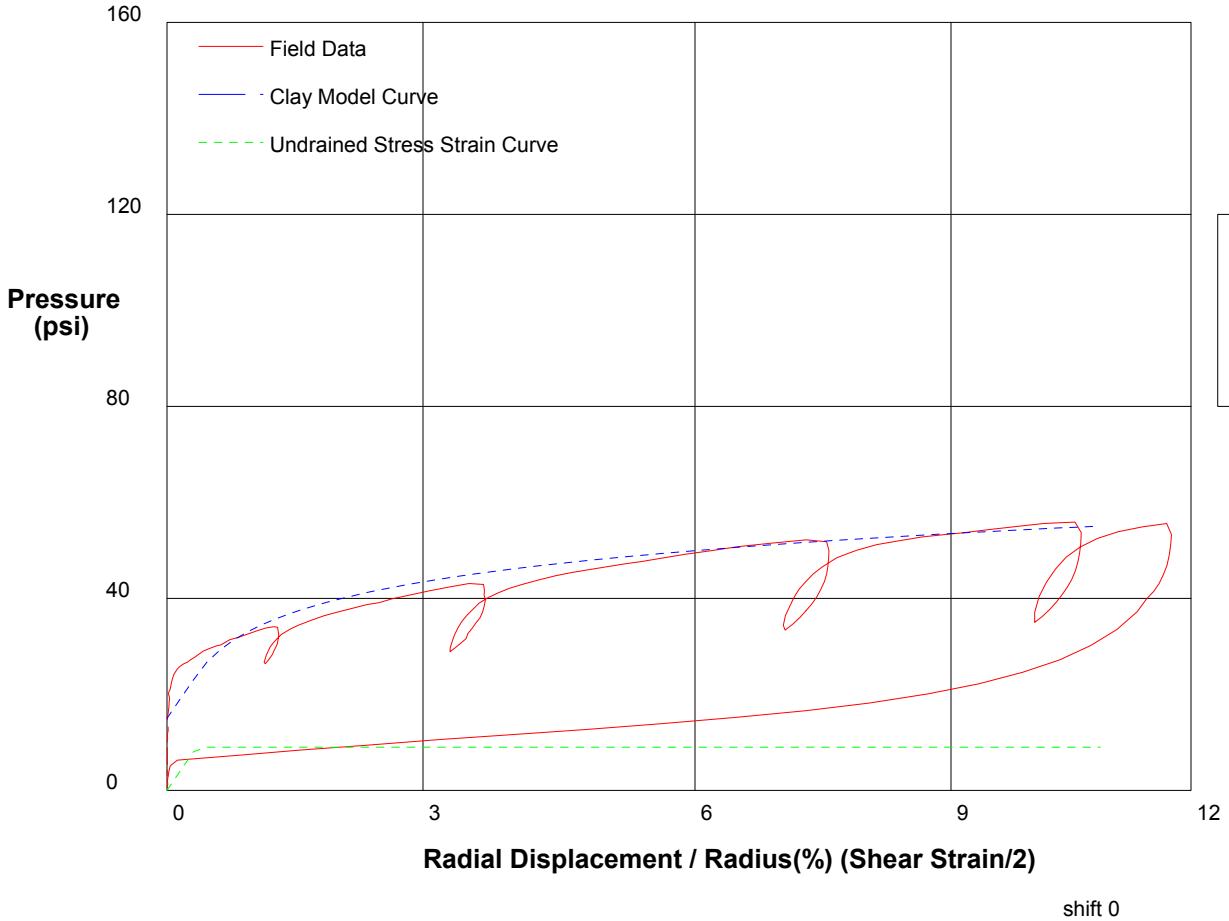


Shear strength (Model analysis): Hole TH-31-PMT-SW-08 &TH-31b



Friction angle: Hole TH-31-PMT-SW-08 & TH-31b

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/7/2008
Hole No. th31pm	Depth 33.2ft	File C:\DATA\ISE-771\DOT01.P

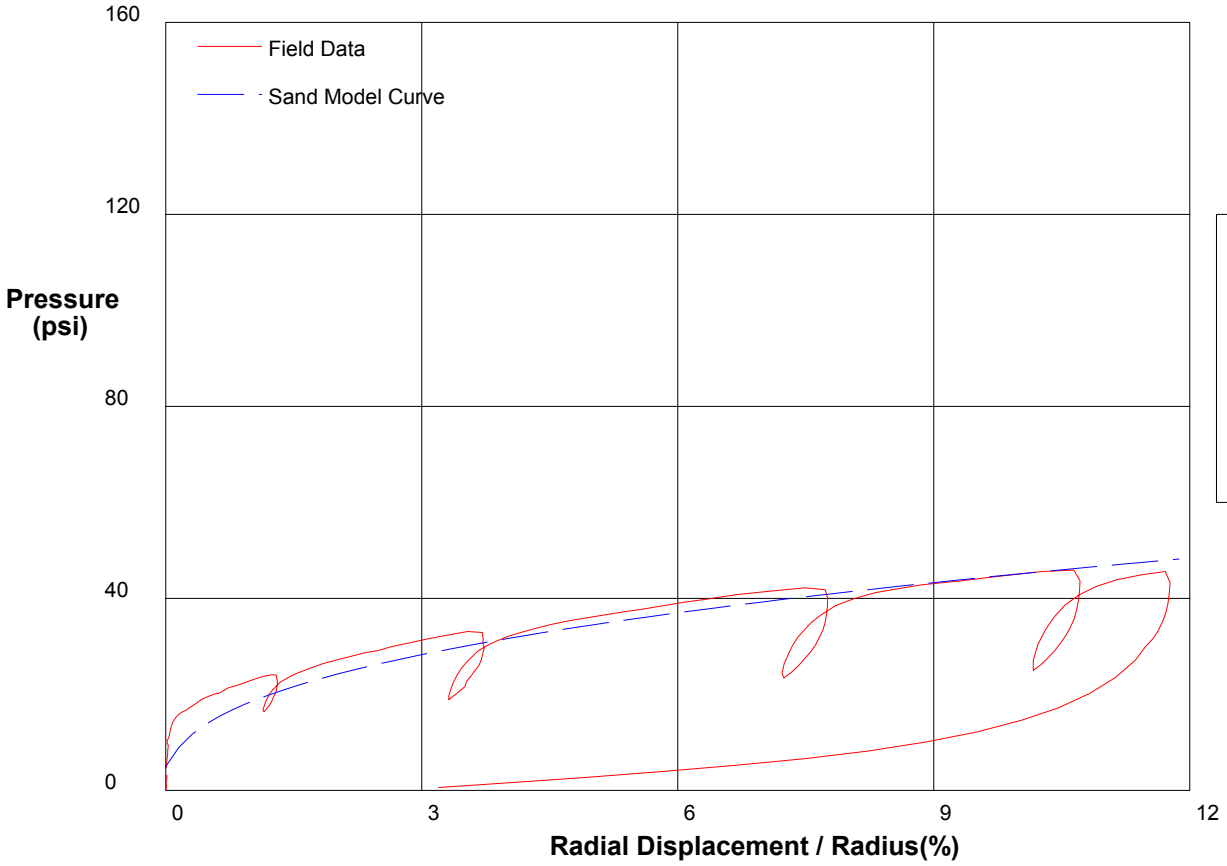


GIBSON'S CLAY MODEL

Shear Strength	9 psi
Insitu Stress	15 psi
Shear Modulus	1300 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/7/2008
Hole No. th31pm	Depth 33.2ft	File C:\DATA\ISE-771\DOT01.P



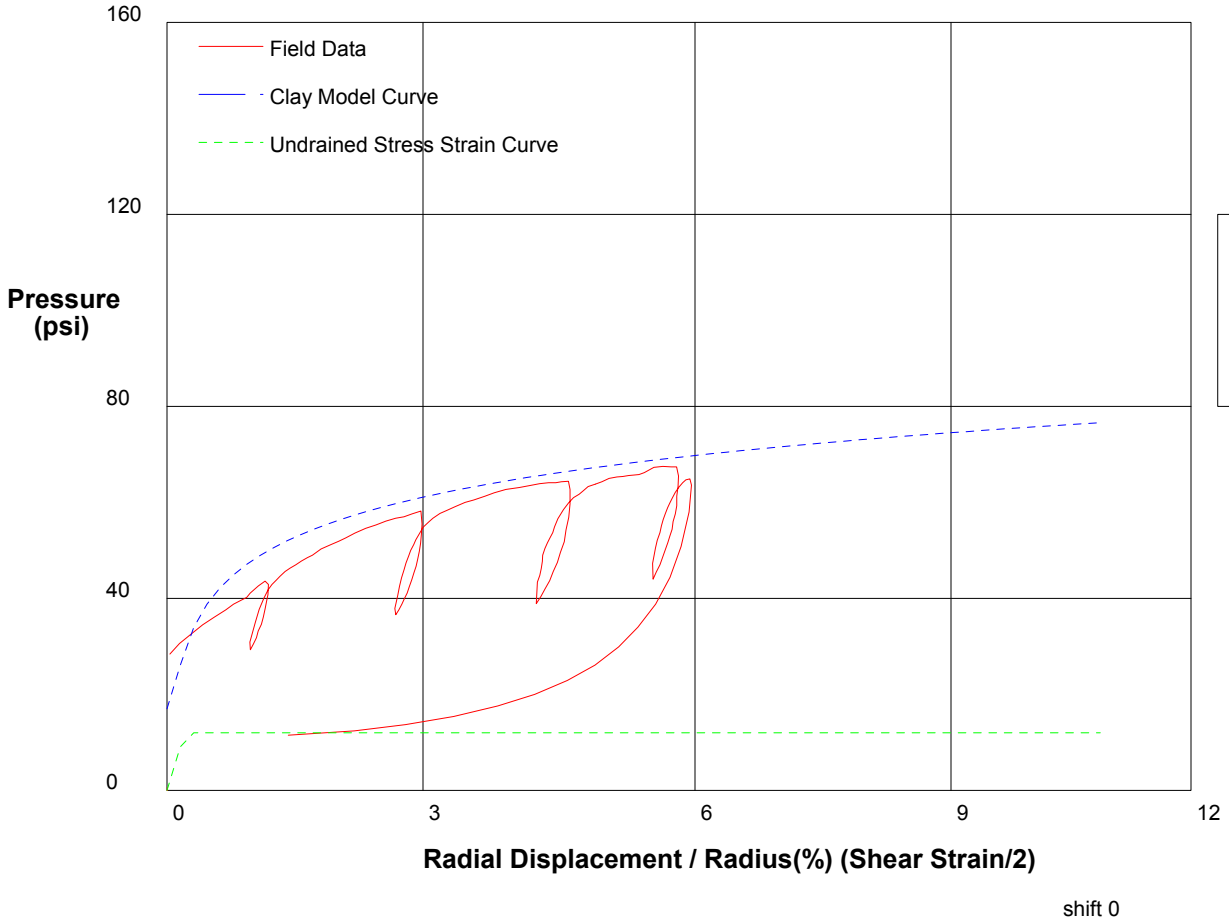
shift 0

THE In Situ Engineering SAND MODEL

Water Pressure	10 psi
Friction Angle	35 deg
Critical Friction Angle	32 deg
Lateral Stress	5 psi
Shear Modulus	1300 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/7/2008
Hole No. th31pm	Depth 36.2ft	File C:\DATA\ISE-771\DOT02.P

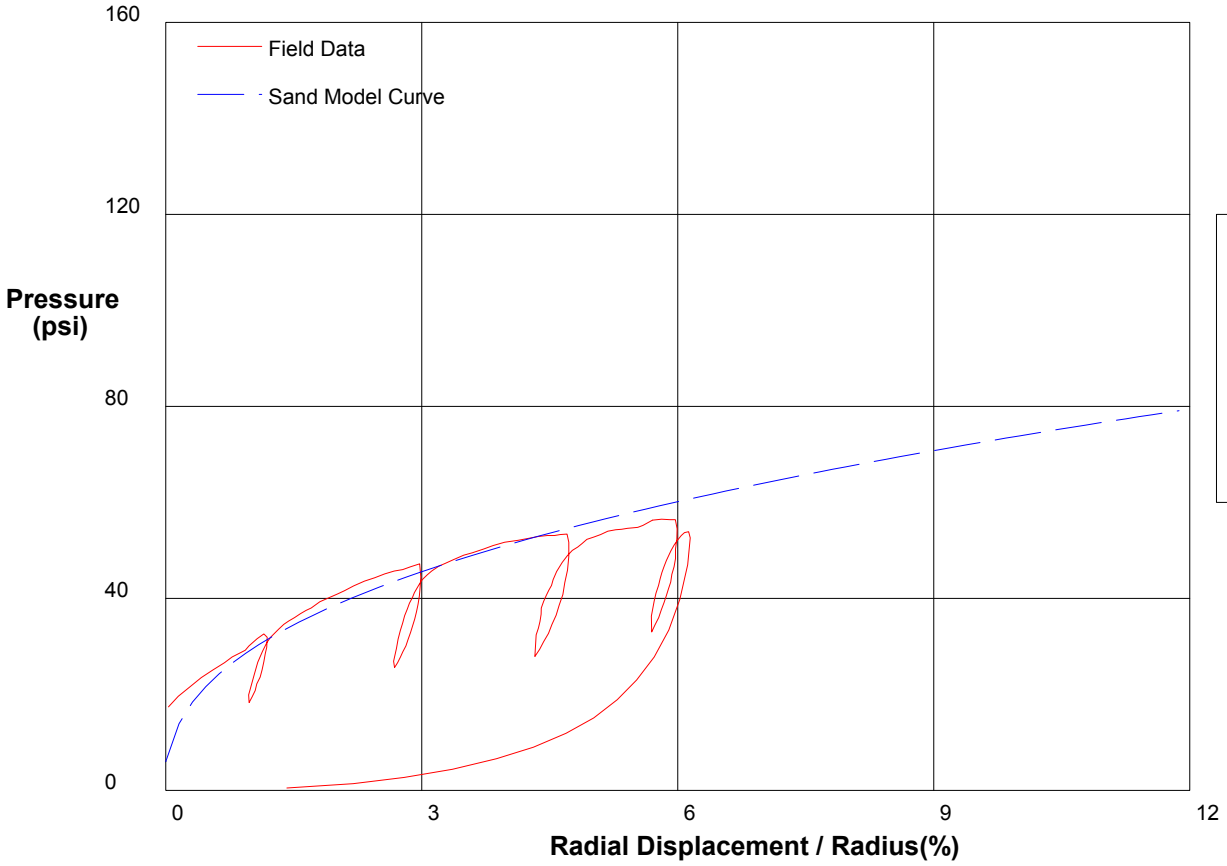


GIBSON'S CLAY MODEL

Shear Strength	12	psi
Insitu Stress	17	psi
Shear Modulus	2900	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/7/2008
Hole No. th31pm	Depth 36.2ft	File C:\DATA\ISE-771\DOT02.P



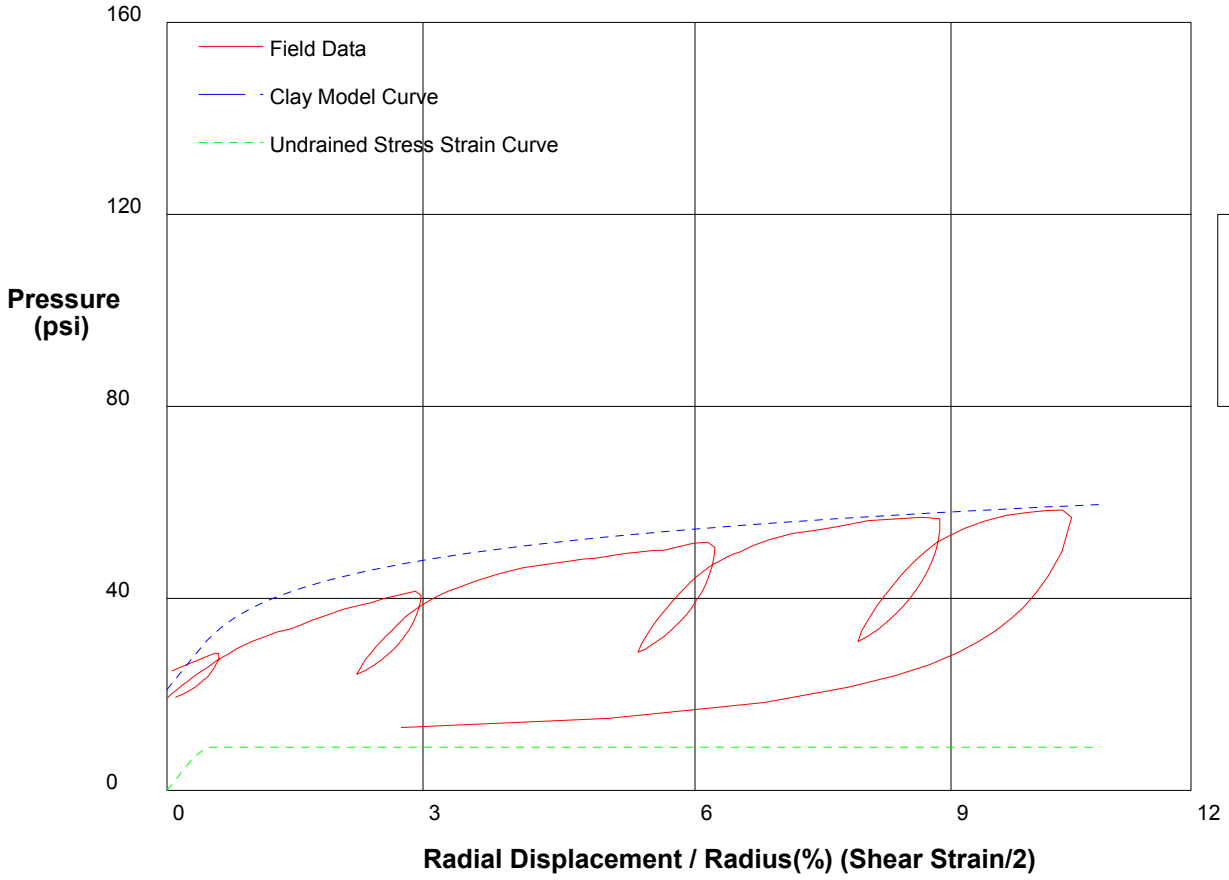
THE In Situ Engineering SAND MODEL

Water Pressure	11 psi
Friction Angle	36 deg
Critical Friction Angle	32 deg
Lateral Stress	6 psi
Shear Modulus	2900 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/7/2008
Hole No. TH31PM	Depth 43ft	File C:\DATA\ISE-771\DOT03.P



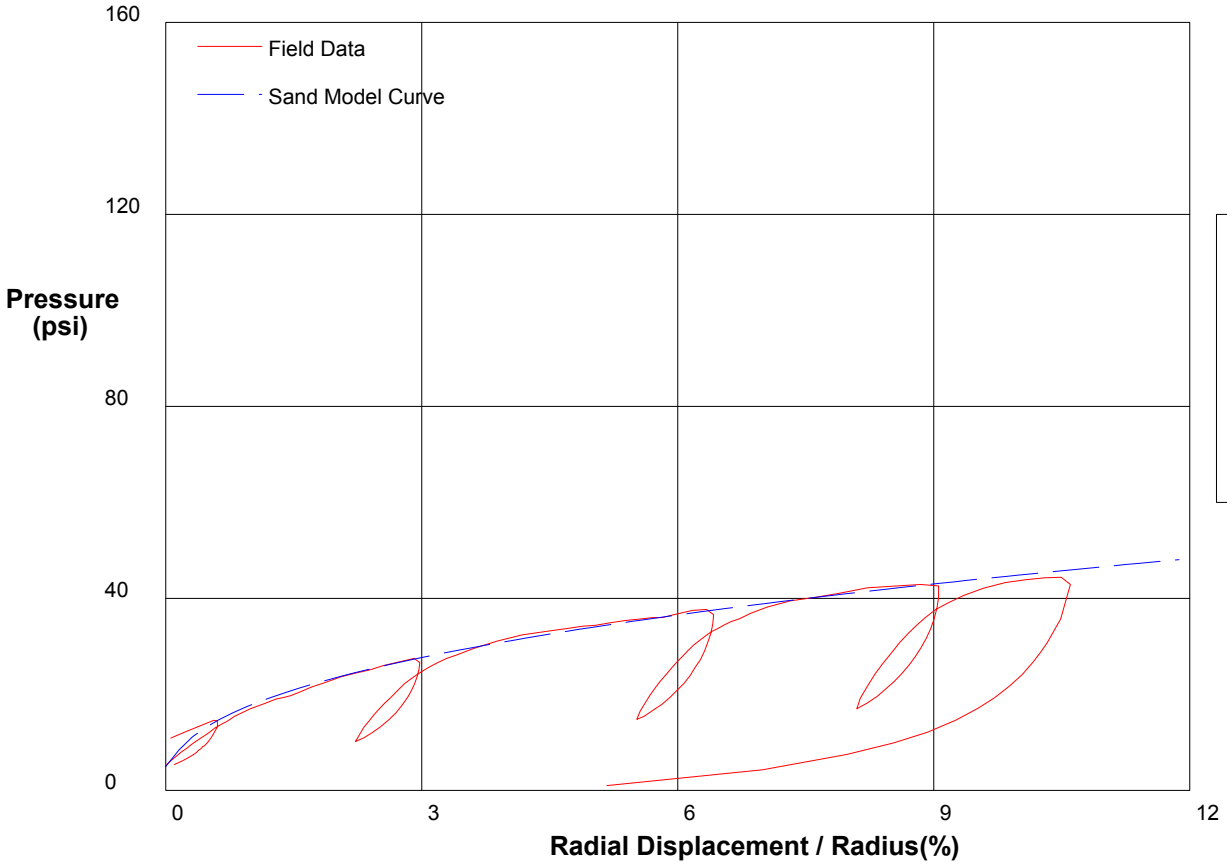
GIBSON'S CLAY MODEL

Shear Strength	9 psi
Insitu Stress	21 psi
Shear Modulus	1100 psi

shift 1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/7/2008
Hole No. TH31PM	Depth 43ft	File C:\DATA\ISE-771\DOT03.P



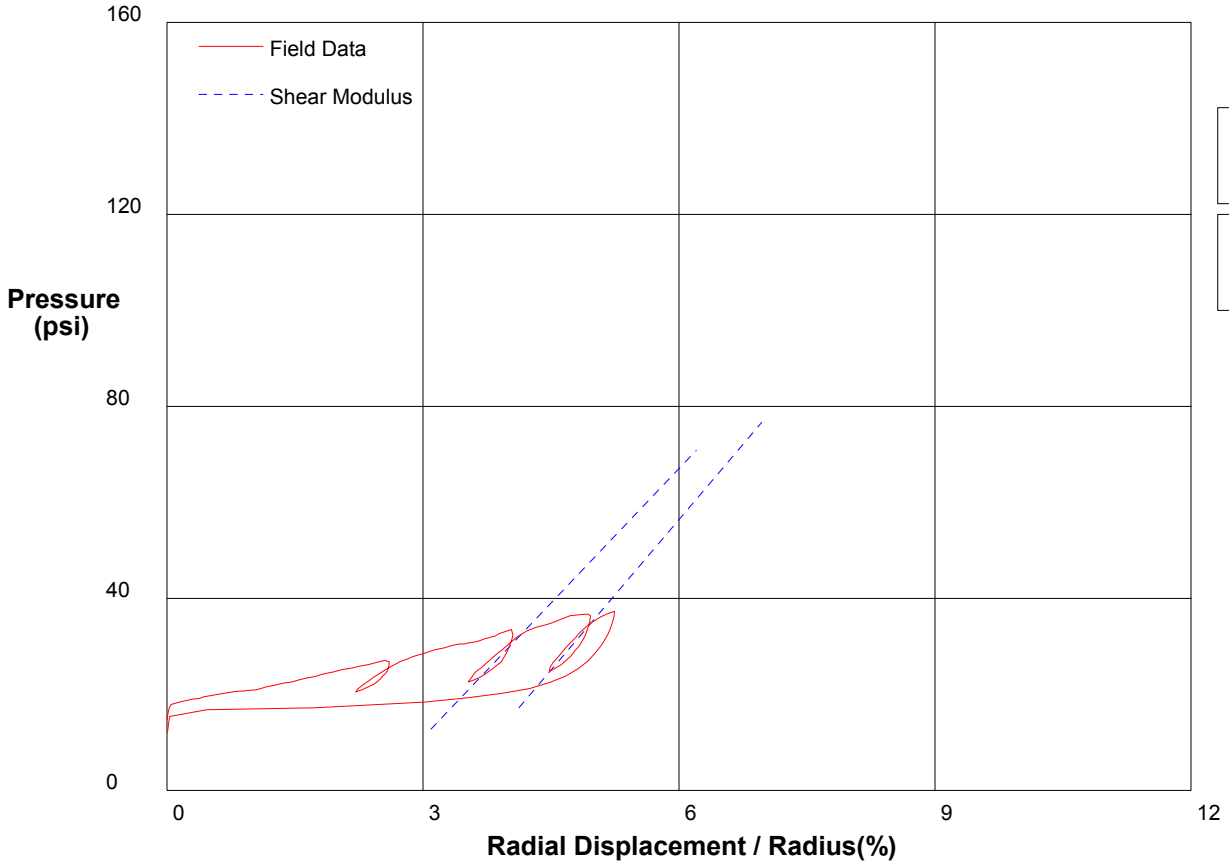
THE In Situ Engineering SAND MODEL

Water Pressure	14 psi
Friction Angle	36 deg
Critical Friction Angle	32 deg
Lateral Stress	5 psi
Shear Modulus	1100 psi

shift 1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/7/2008
Hole No. TH31PM	Depth 45.8ft	File C:\DATA\ISE-771\DOT04.P



Shear Modulus 1045 psi

Shear Modulus 933 psi

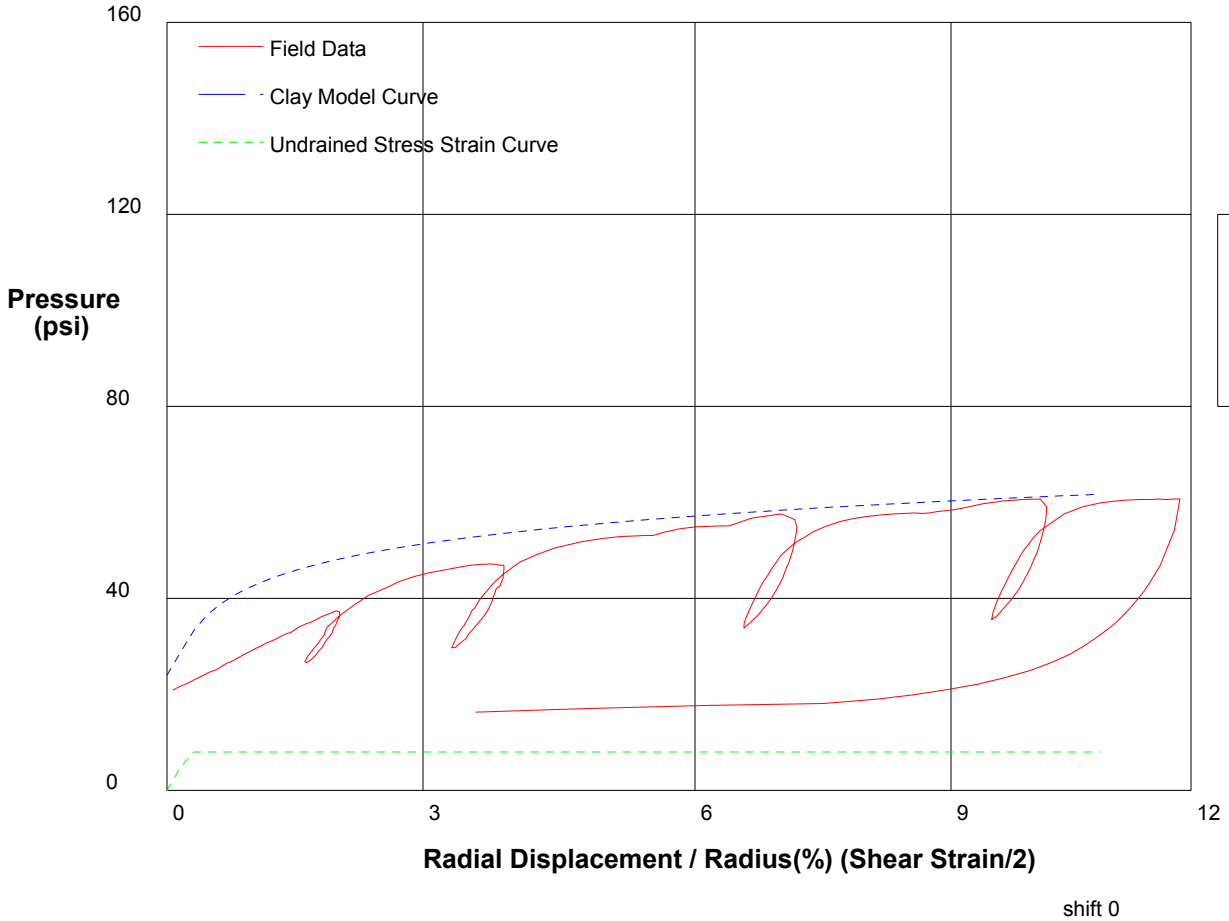
shift 0

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/7/2008**

Hole No. TH31PM **Depth 48.8ftft** **File C:\DATA\ISE-771\DOT05.P**

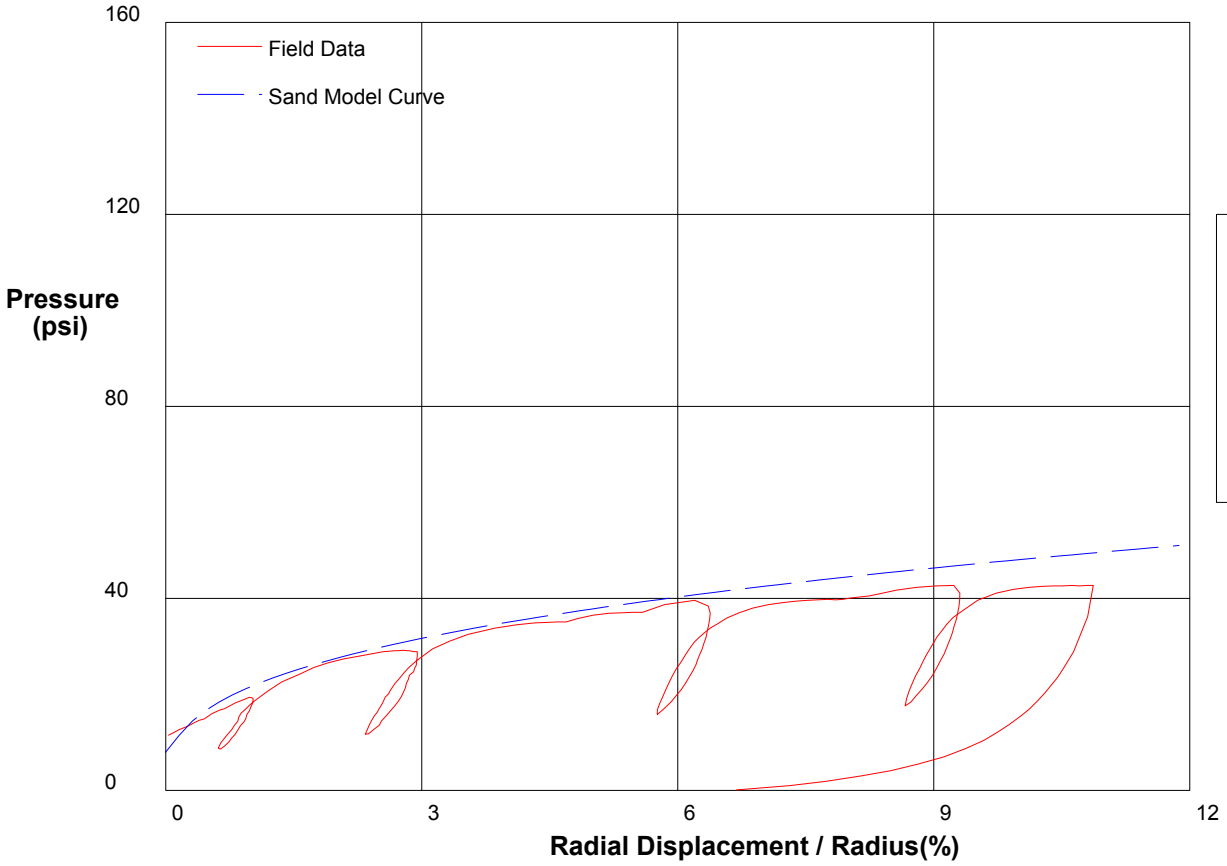


GIBSON'S CLAY MODEL

Shear Strength	**8**	**psi**
Insitu Stress	**24**	**psi**
Shear Modulus	**1500**	**psi**

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/7/2008
Hole No. TH31PM	Depth 48.8ft	File C:\DATA\ISE-771\DOT05.P



THE In Situ Engineering SAND MODEL

Water Pressure	18 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	8 psi
Shear Modulus	1100 psi

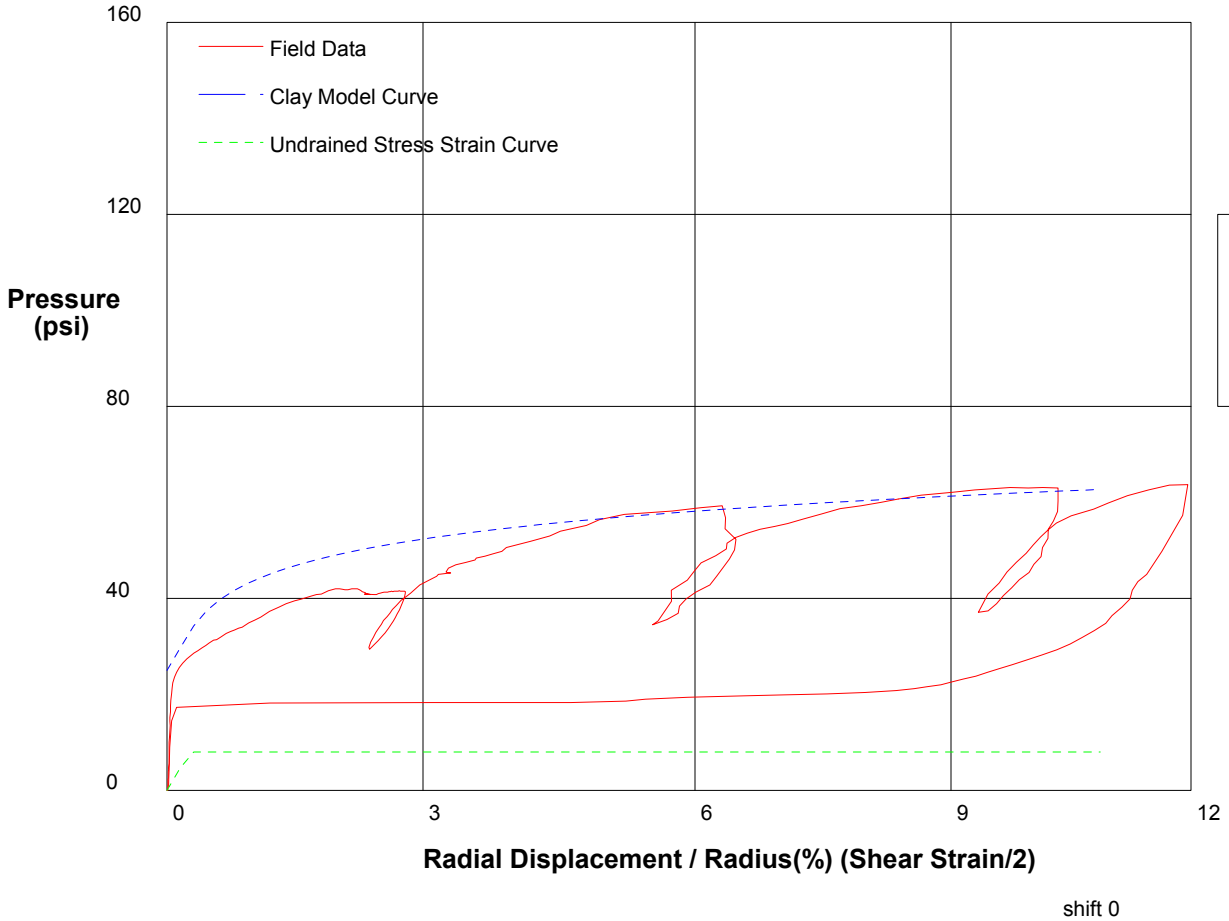
shift 1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/8/2008**

Hole No. TH31PM **Depth 52.1ft** **File C:\DATA\ISE-771\DOT06.P**

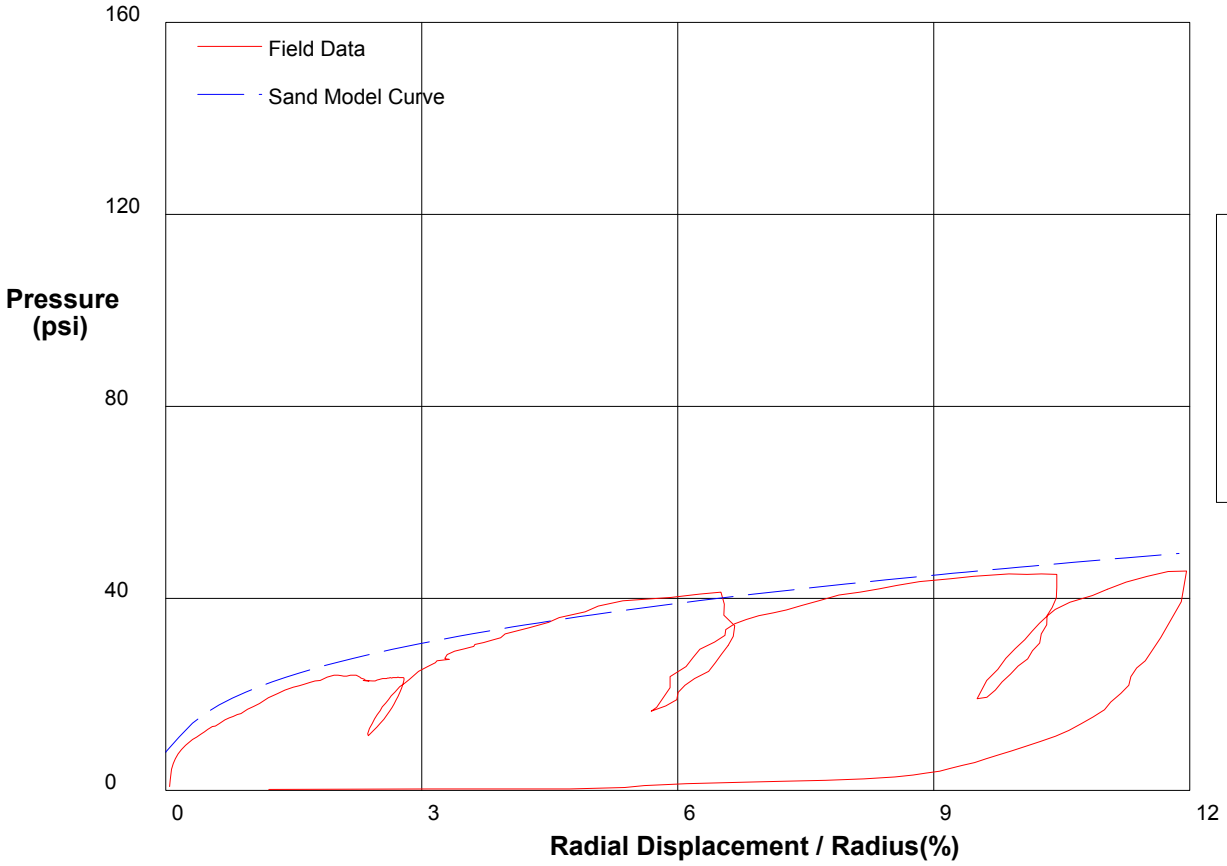


GIBSON'S CLAY MODEL

Shear Strength 8 psi
Insitu Stress 25 psi
Shear Modulus 1500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 52.1ft	File C:\DATA\ISE-771\DOT06.P



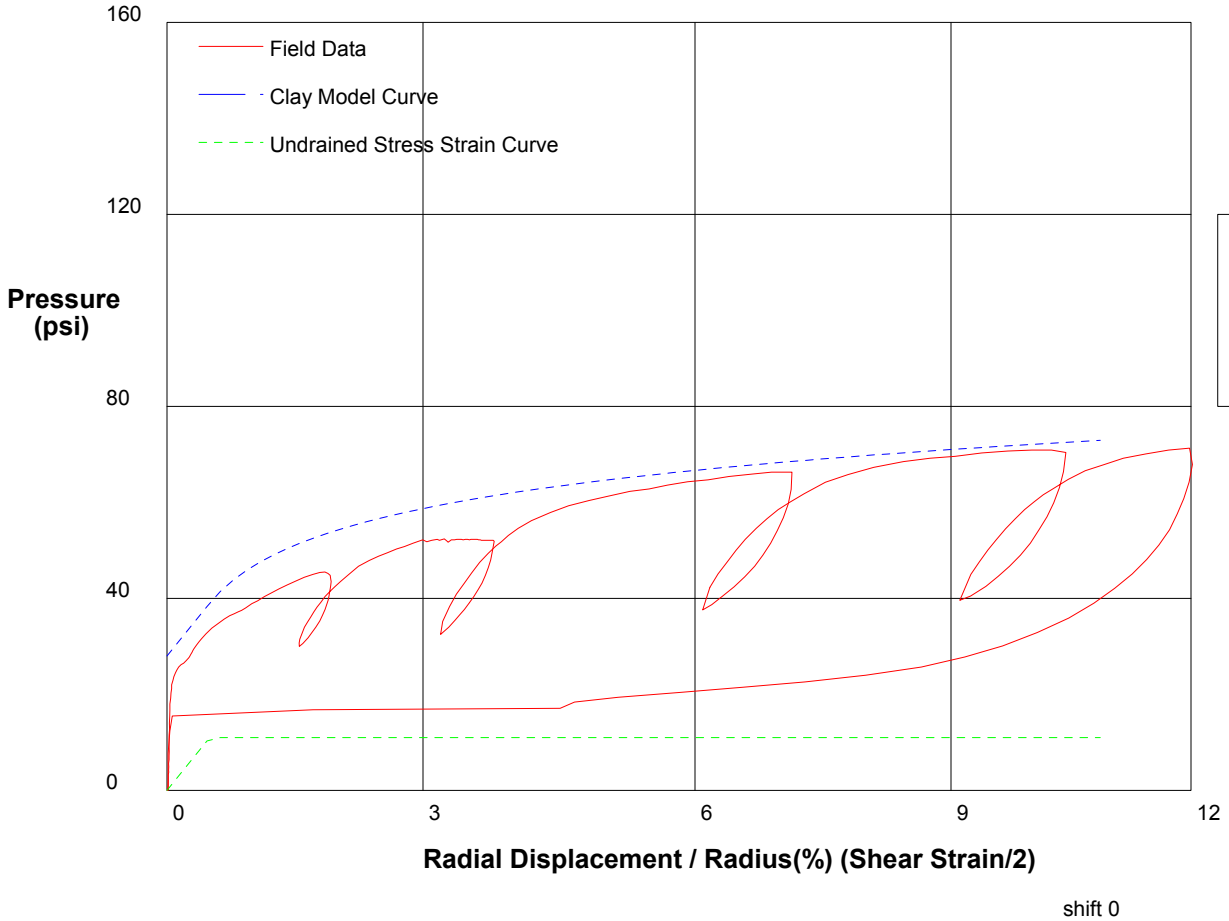
THE In Situ Engineering SAND MODEL

Water Pressure	18 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	8 psi
Shear Modulus	1000 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 58.8ft	File C:\DATA\ISE-771\DOT08.P

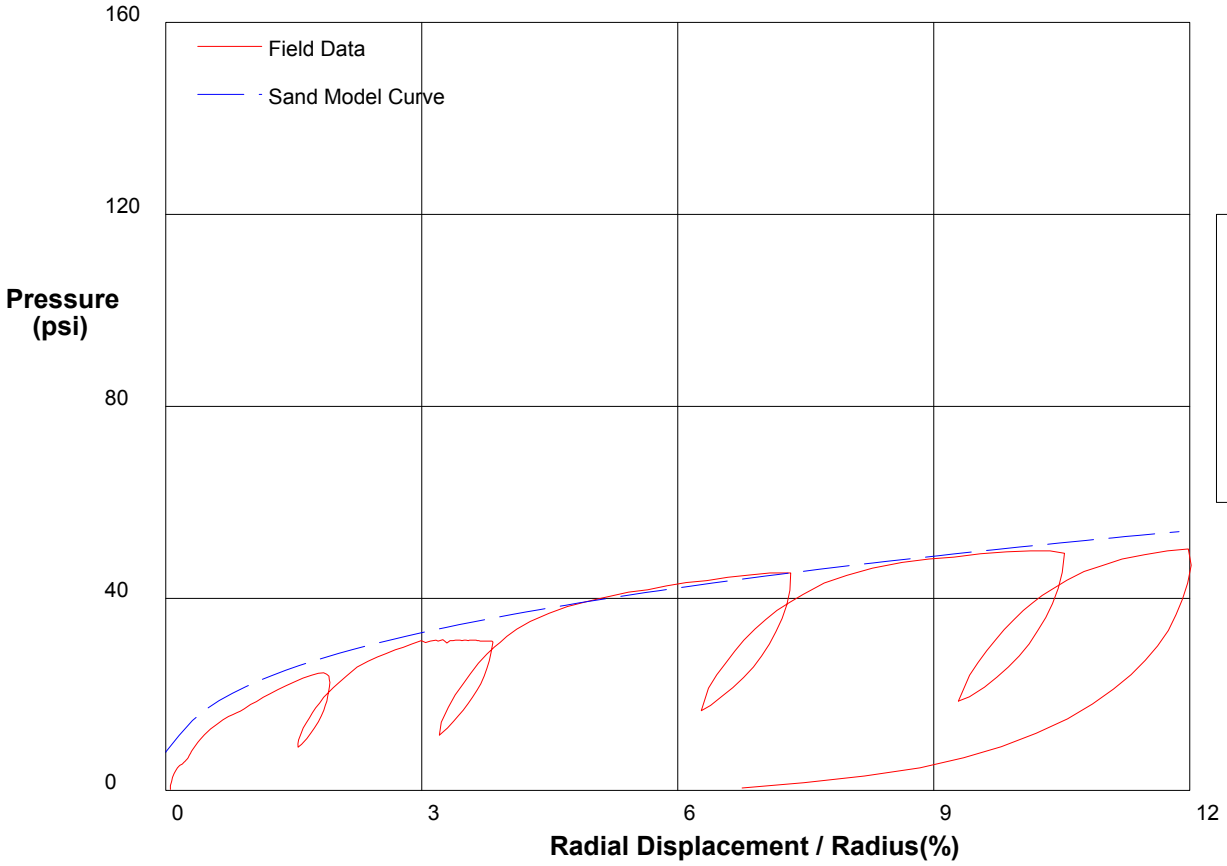


GIBSON'S CLAY MODEL

Shear Strength	11	psi
Insitu Stress	28	psi
Shear Modulus	1100	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 58.8ft	File C:\DATA\ISE-771\DOT08.P



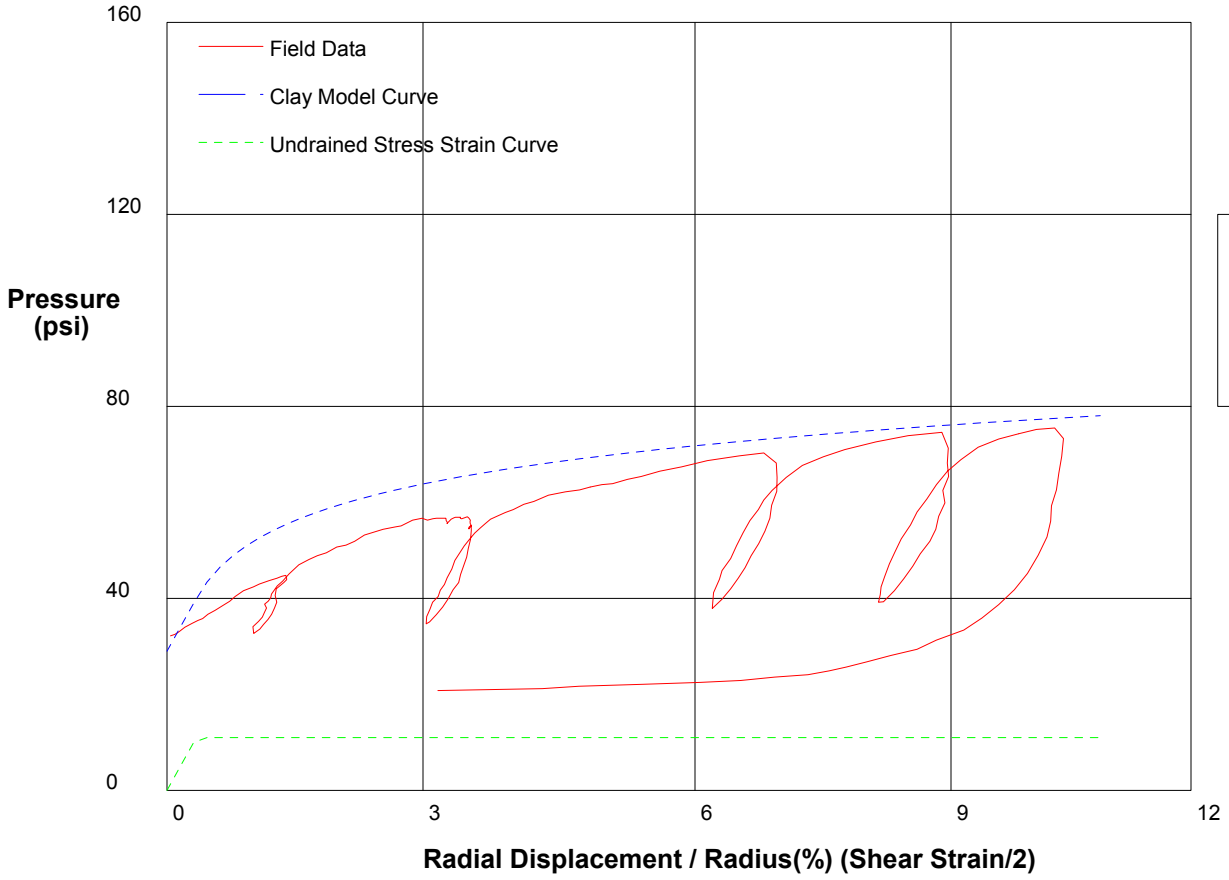
THE In Situ Engineering SAND MODEL

Water Pressure	21 psi
Friction Angle	33 deg
Critical Friction Angle	32 deg
Lateral Stress	8 psi
Shear Modulus	1100 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 61.8ft	File C:\DATA\ISE-771\DOT09.P



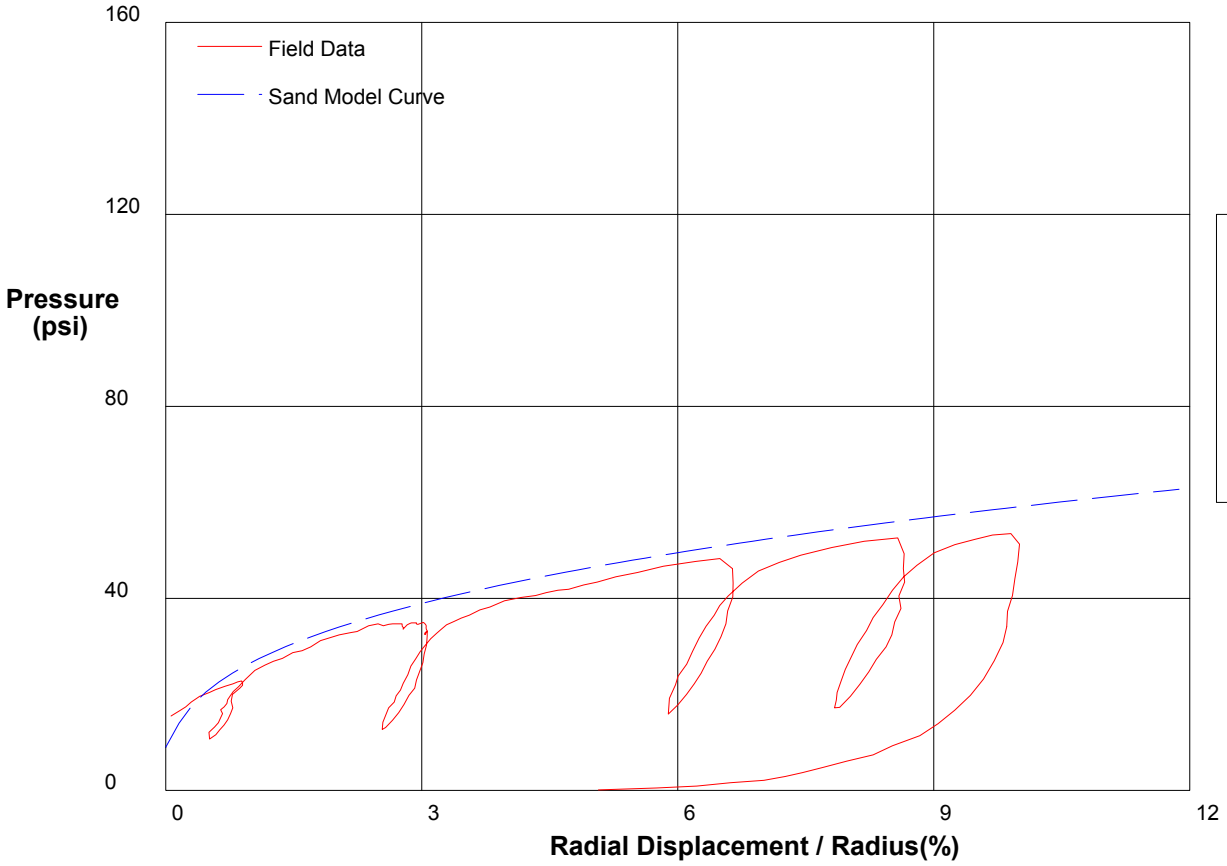
shift .5

GIBSON'S CLAY MODEL

Shear Strength	11	psi
Insitu Stress	29	psi
Shear Modulus	1600	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 61.8ft	File C:\DATA\ISE-771\DOT09.P



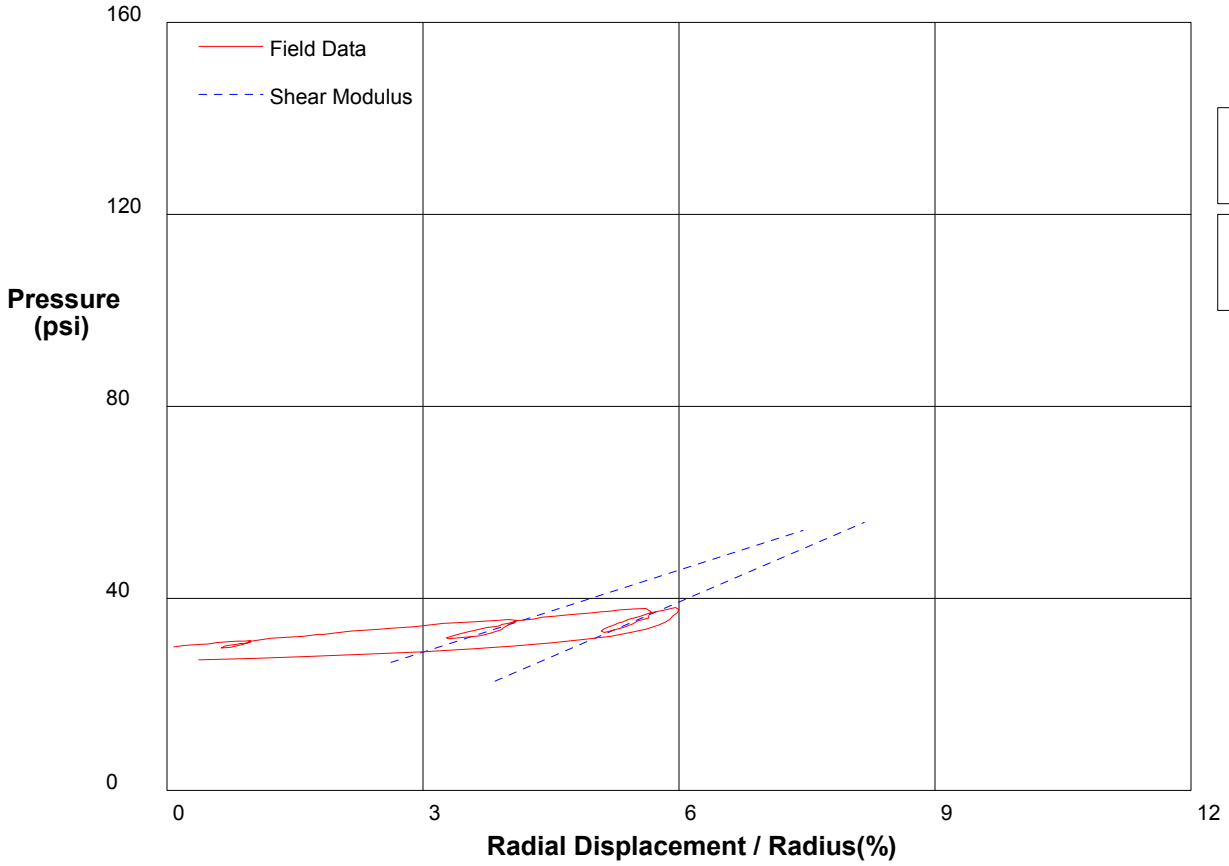
THE In Situ Engineering SAND MODEL

Water Pressure	22 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	9 psi
Shear Modulus	1600 psi

shift 1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 64.8ft	File C:\DATA\ISE-771\DOT10.P



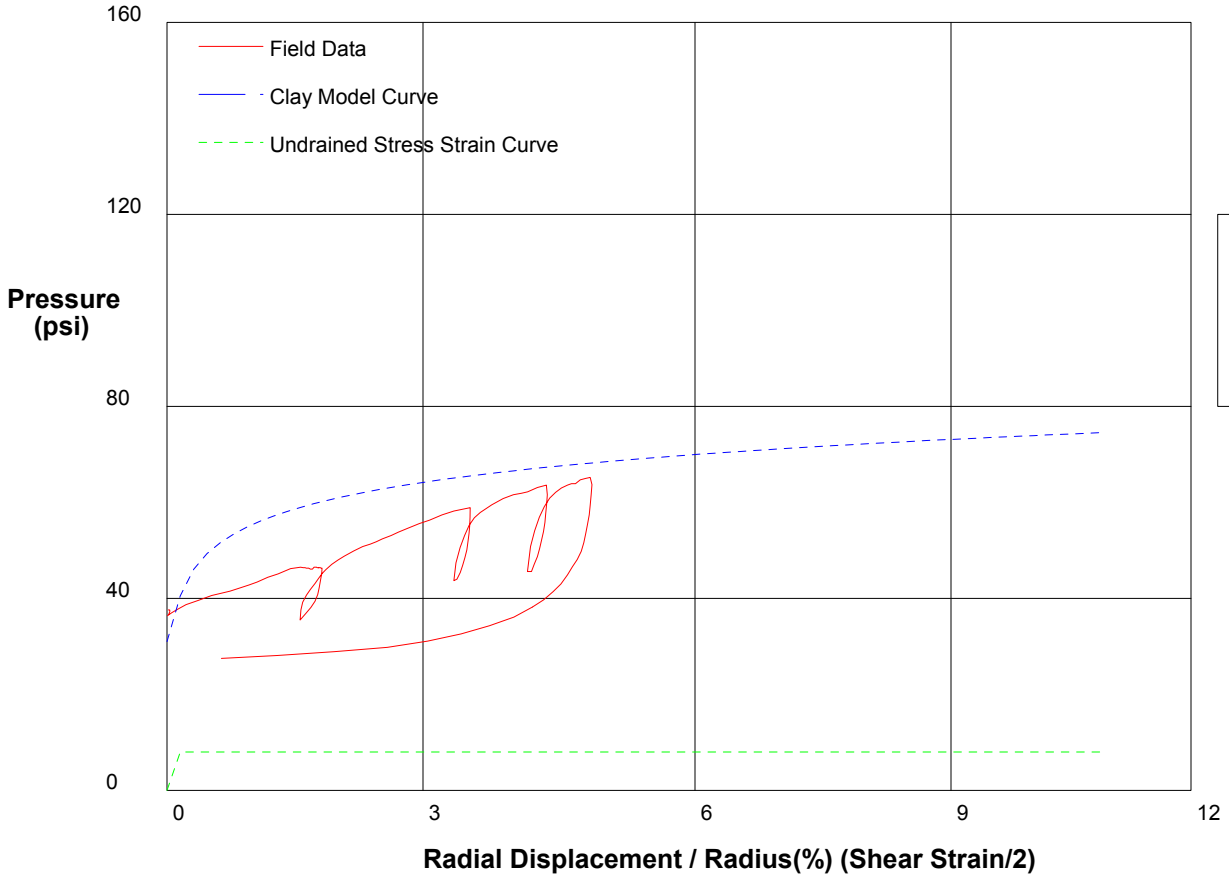
Shear Modulus 381 psi

Shear Modulus 284 psi

shift 1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 67.8ft	File C:\DATA\ISE-771\DOT11.P



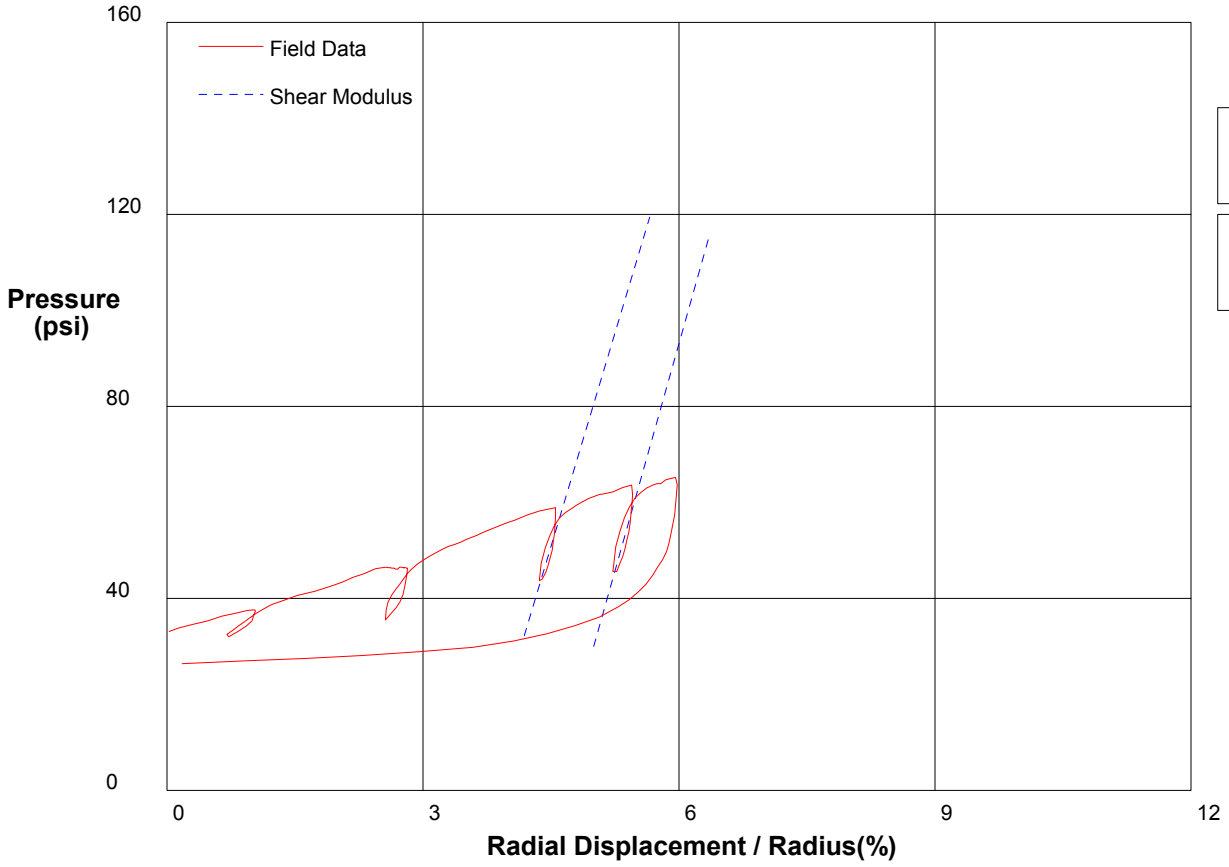
shift 2

GIBSON'S CLAY MODEL

Shear Strength	8 psi
Insitu Stress	31 psi
Shear Modulus	3100 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 67.8ft	File C:\DATA\ISE-771\DOT11.P



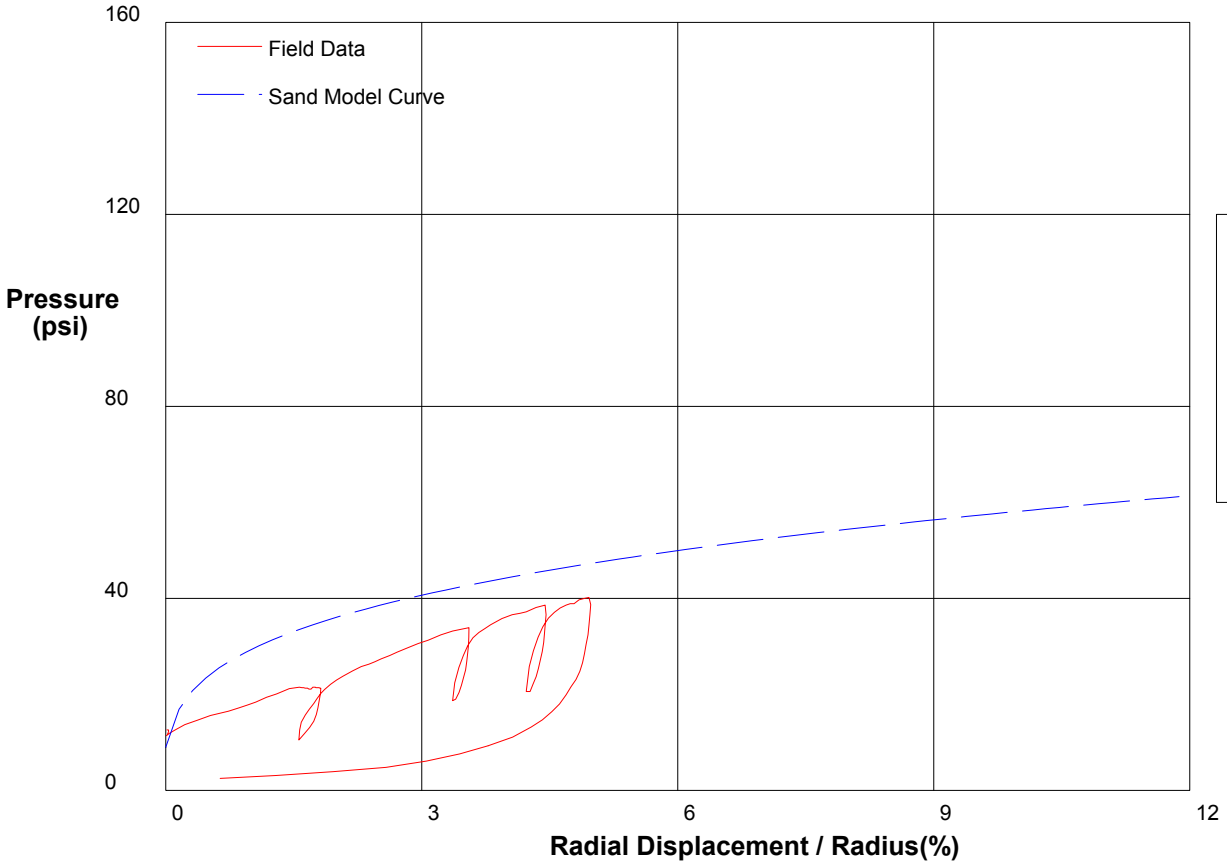
Shear Modulus 3157 psi

Shear Modulus 2969 psi

shift 1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 67.8ft	File C:\DATA\ISE-771\DOT11.P



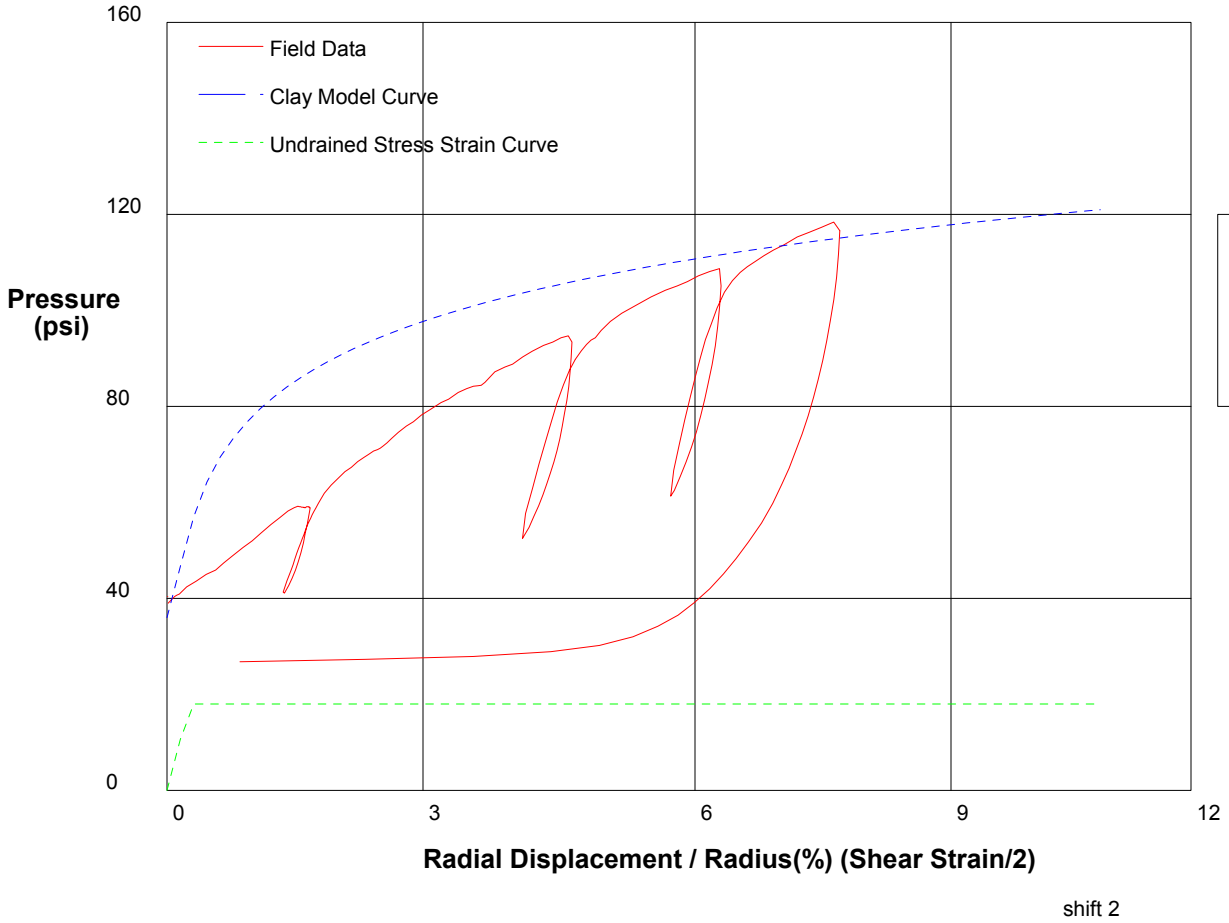
THE In Situ Engineering SAND MODEL

Water Pressure	25 psi
Friction Angle	25 deg
Critical Friction Angle	25 deg
Lateral Stress	9 psi
Shear Modulus	3100 psi

shift 2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 73.3ft	File C:\DATA\ISE-771\DOT12.P

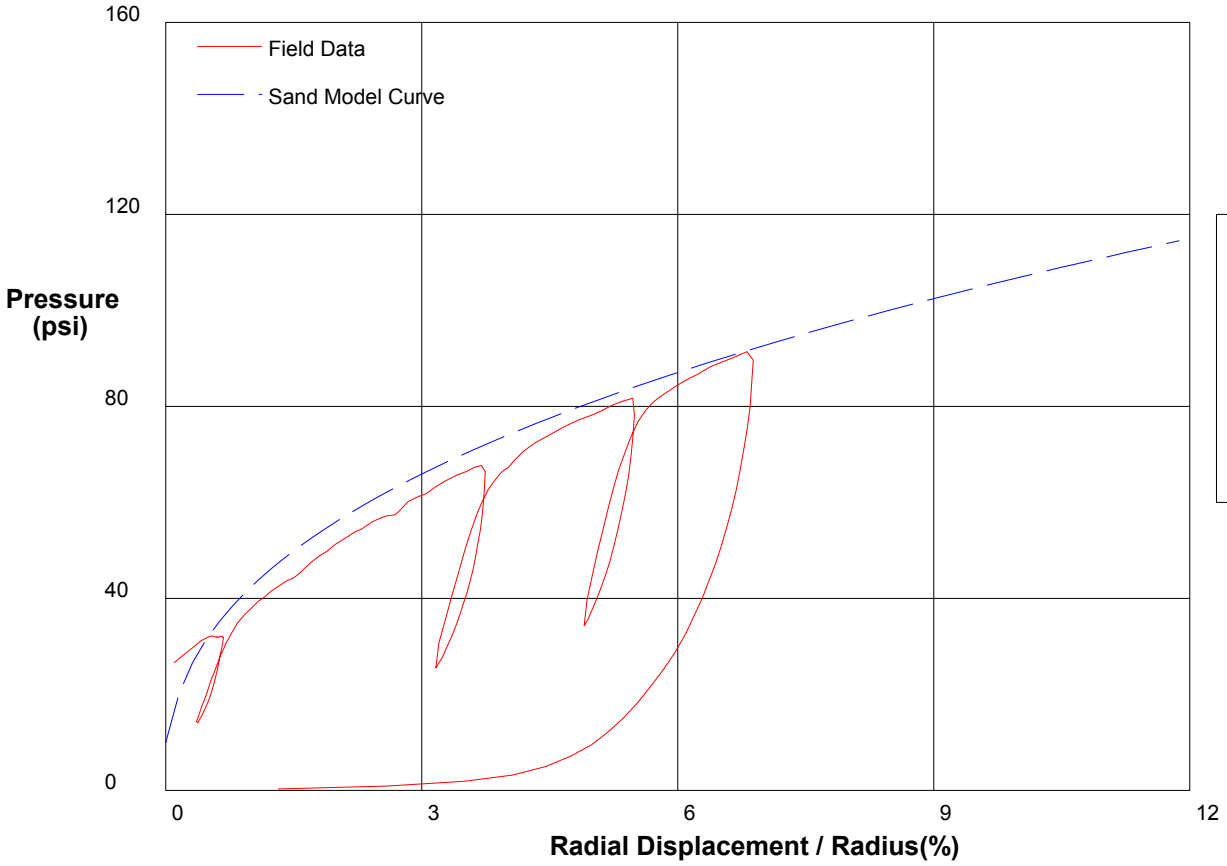


GIBSON'S CLAY MODEL

Shear Strength	18 psi
Insitu Stress	36 psi
Shear Modulus	3400 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 73.3ft	File C:\DATA\ISE-771\DOT12.P



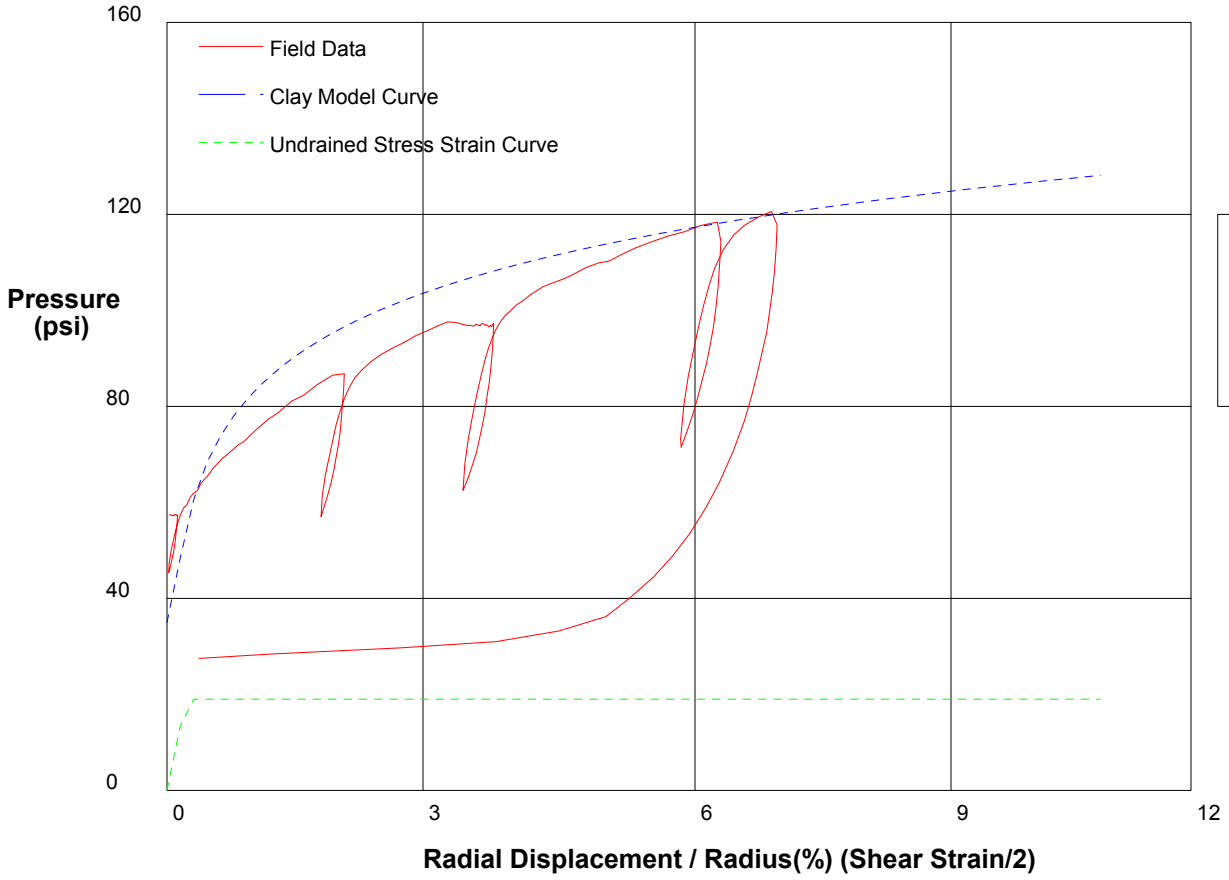
THE In Situ Engineering SAND MODEL

Water Pressure	27 psi
Friction Angle	36 deg
Critical Friction Angle	32 deg
Lateral Stress	10 psi
Shear Modulus	3400 psi

shift 3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 76.3ft	File C:\DATA\ISE-771\DOT13.P



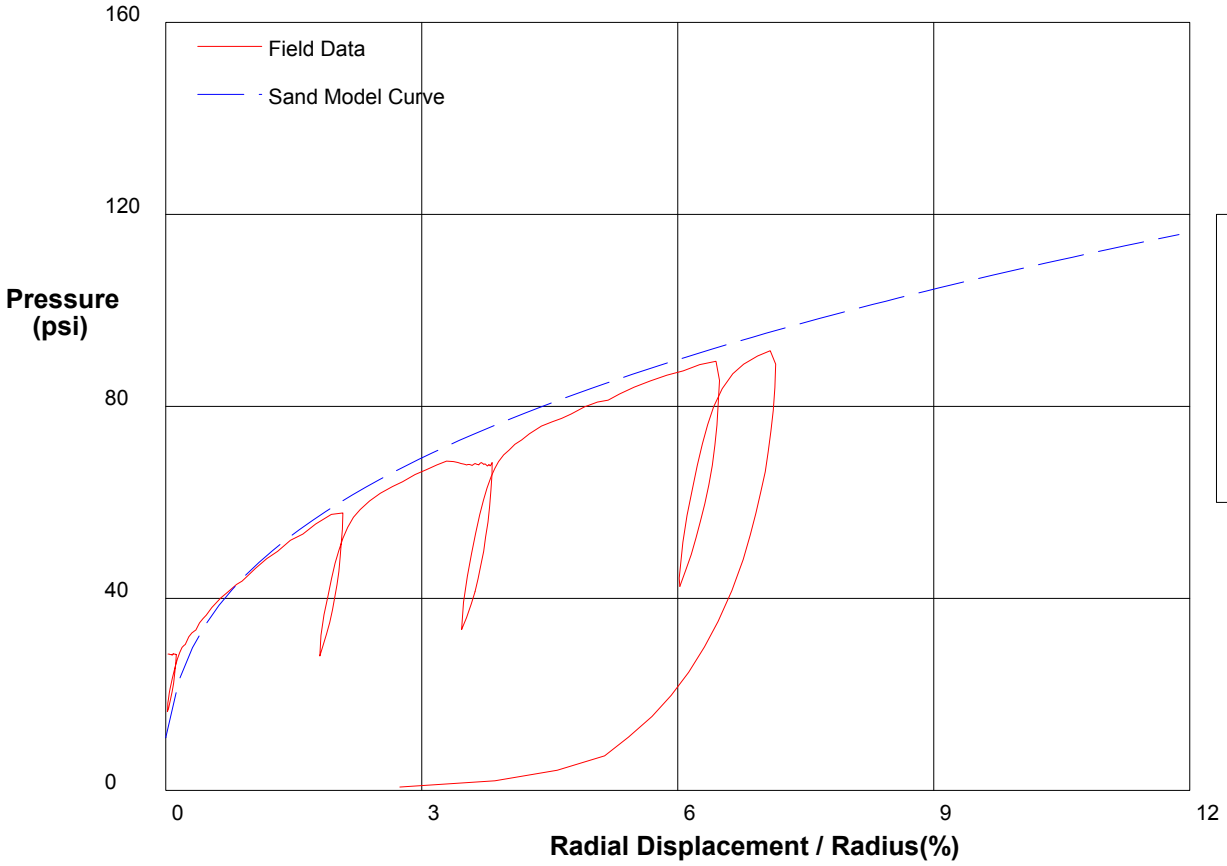
shift 3

GIBSON'S CLAY MODEL

Shear Strength	19 psi
Insitu Stress	35 psi
Shear Modulus	4300 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 76.3ft	File C:\DATA\ISE-771\DOT13.P



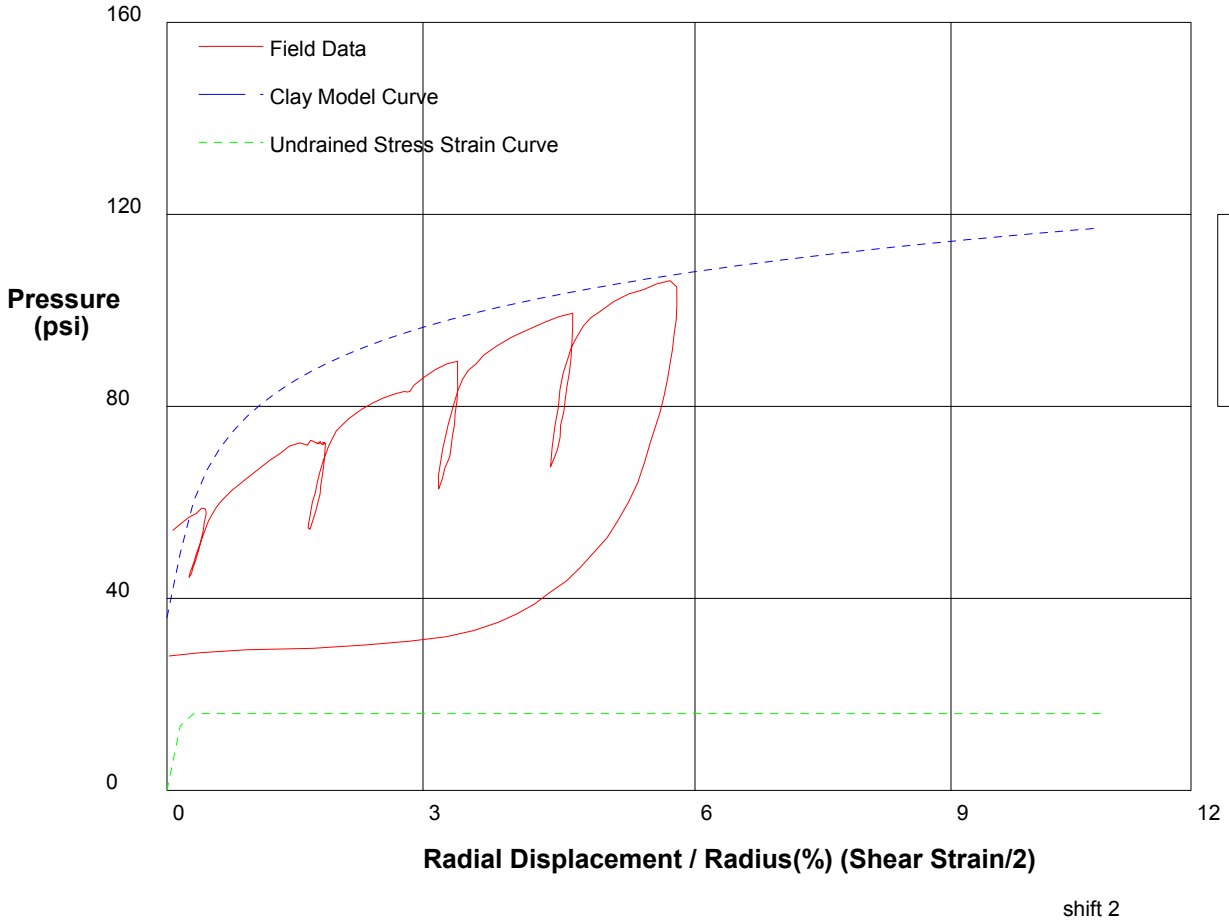
THE In Situ Engineering SAND MODEL

Water Pressure	29 psi
Friction Angle	34 deg
Critical Friction Angle	32 deg
Lateral Stress	11 psi
Shear Modulus	4300 psi

shift 3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 79.3ftft	File C:\DATA\ISE-771\DOT14.P

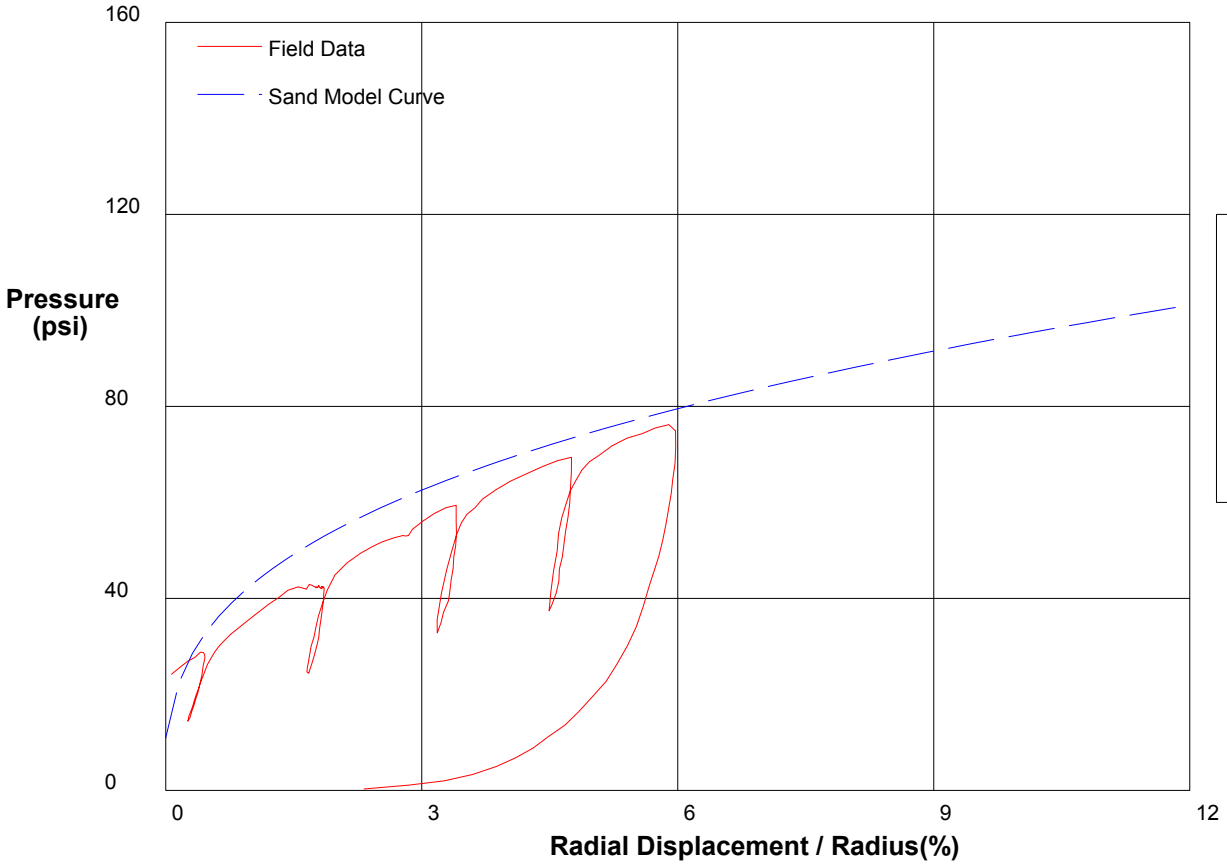


GIBSON'S CLAY MODEL

Shear Strength	16 psi
Insitu Stress	36 psi
Shear Modulus	4300 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 79.3ftft	File C:\DATA\ISE-771\DOT14.P



THE In Situ Engineering SAND MODEL

Water Pressure	30 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	11 psi
Shear Modulus	4300 psi

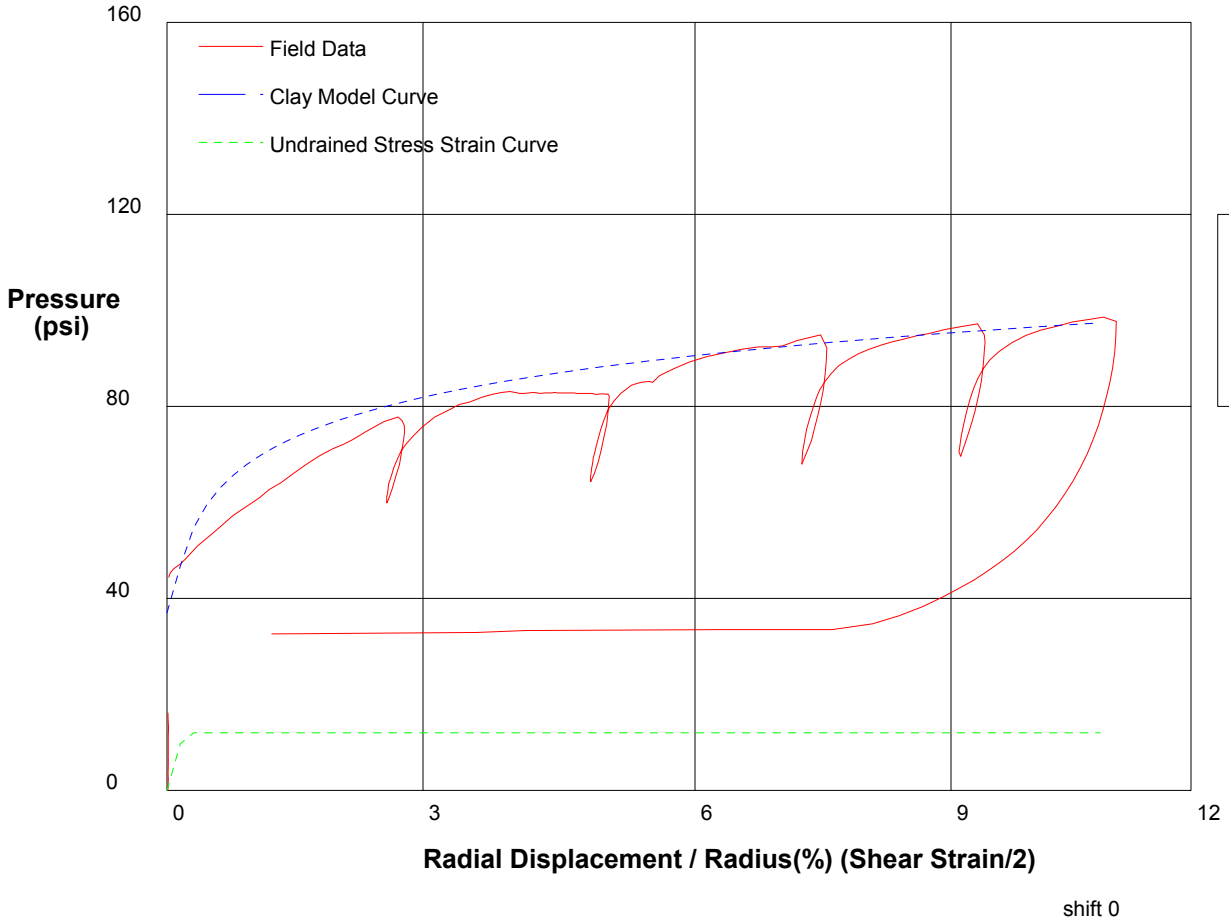
shift 2

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/8/2008**

Hole No. TH31PM **Depth 82.3ftft** **File C:\DATA\ISE-771\DOT15.P**

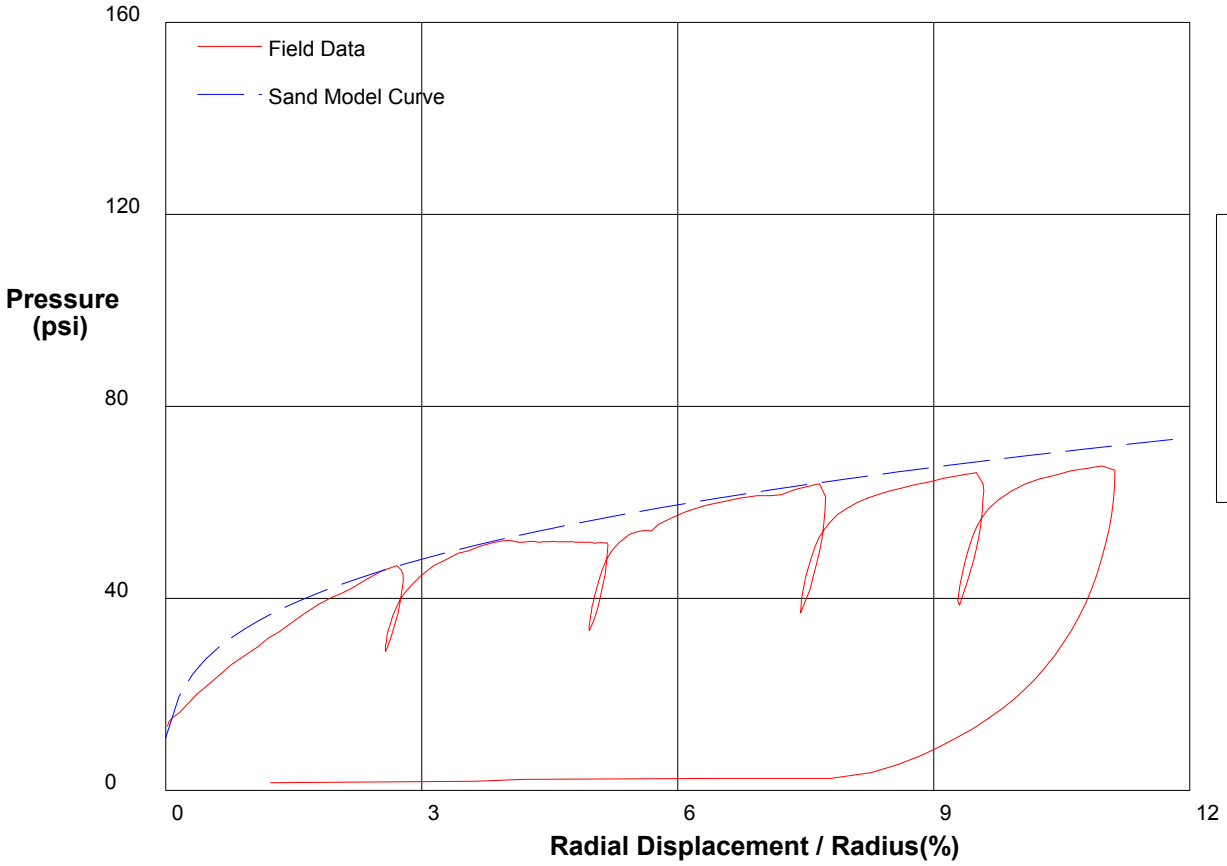


GIBSON'S CLAY MODEL

Shear Strength	**12**	**psi**
Insitu Stress	**37**	**psi**
Shear Modulus	**3100**	**psi**

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 82.3ftft	File C:\DATA\ISE-771\DOT15.P



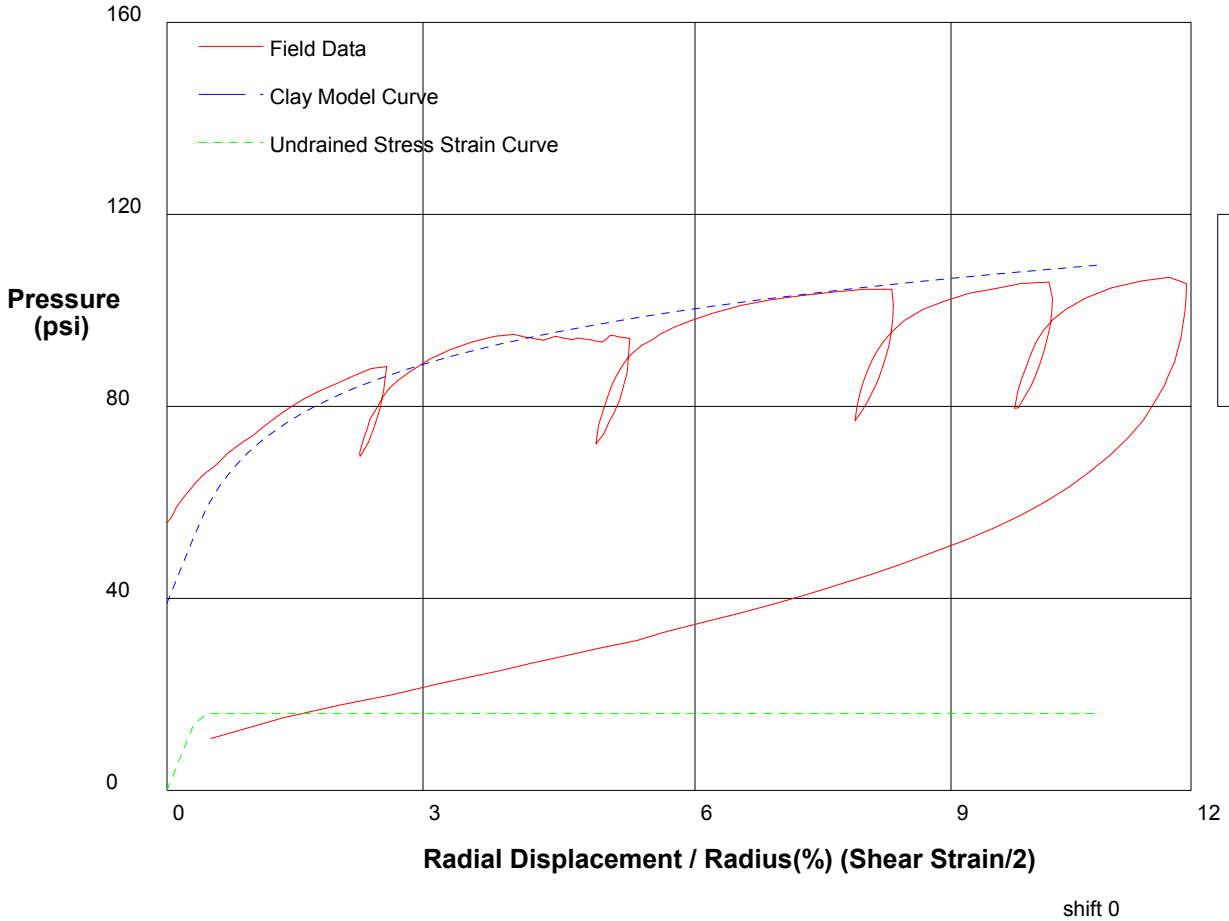
THE In Situ Engineering SAND MODEL

Water Pressure	31 psi
Friction Angle	26 deg
Critical Friction Angle	26 deg
Lateral Stress	11 psi
Shear Modulus	3100 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 86.3ftft	File C:\DATA\ISE-771\DOT16.P

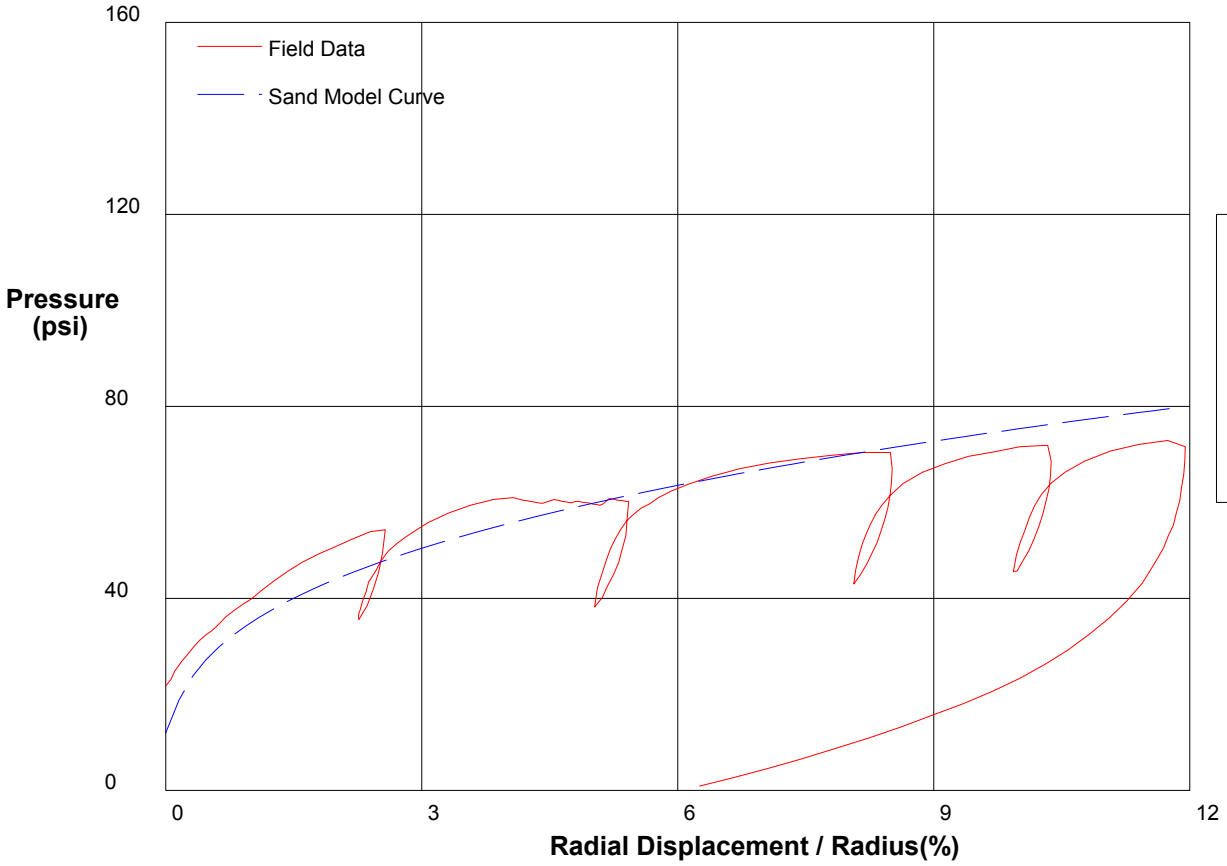


GIBSON'S CLAY MODEL

Shear Strength	16	psi
Insitu Stress	39	psi
Shear Modulus	2200	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 86.3ftft	File C:\DATA\ISE-771\DOT16.P



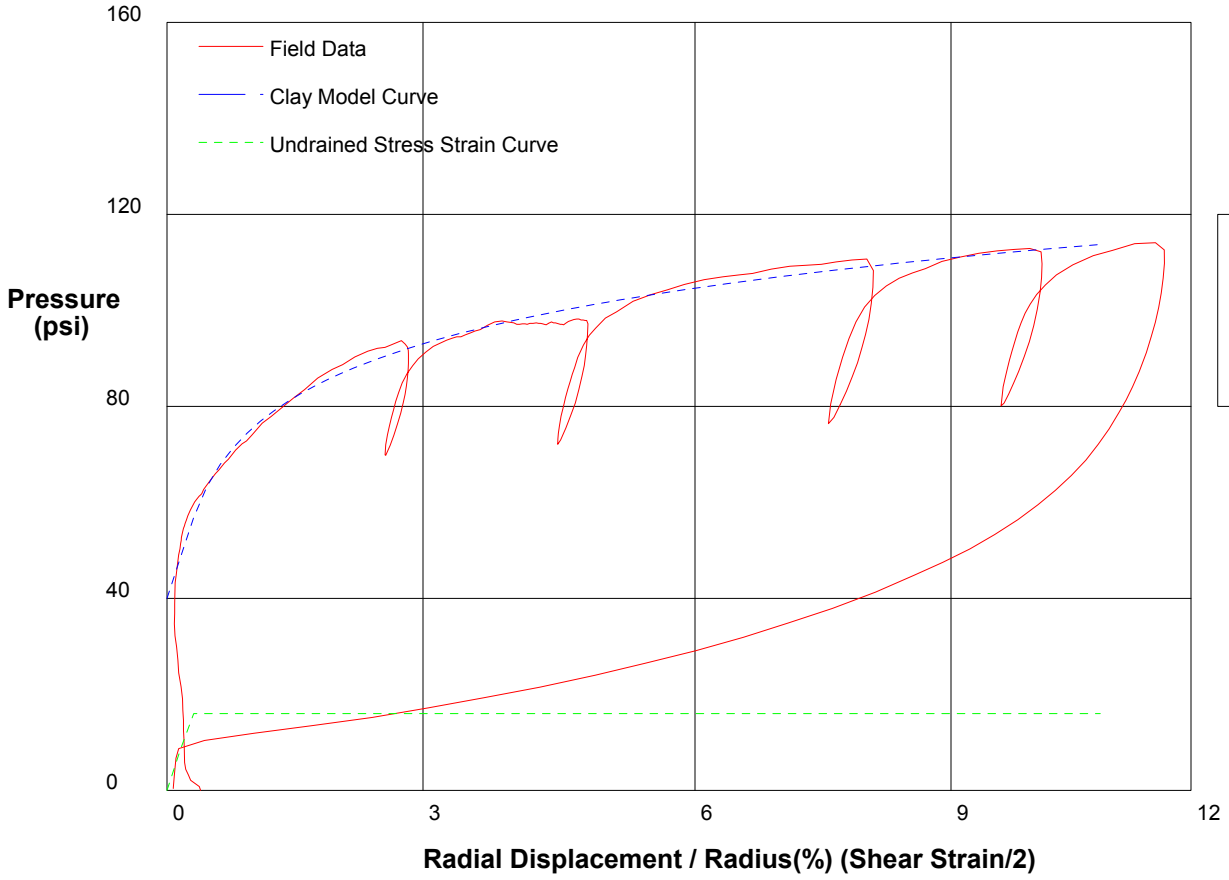
shift 0

THE In Situ Engineering SAND MODEL

Water Pressure	34 psi
Friction Angle	30 deg
Critical Friction Angle	30 deg
Lateral Stress	12 psi
Shear Modulus	2200 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 89.3ft	File C:\DATA\ISE-771\DOT17.P



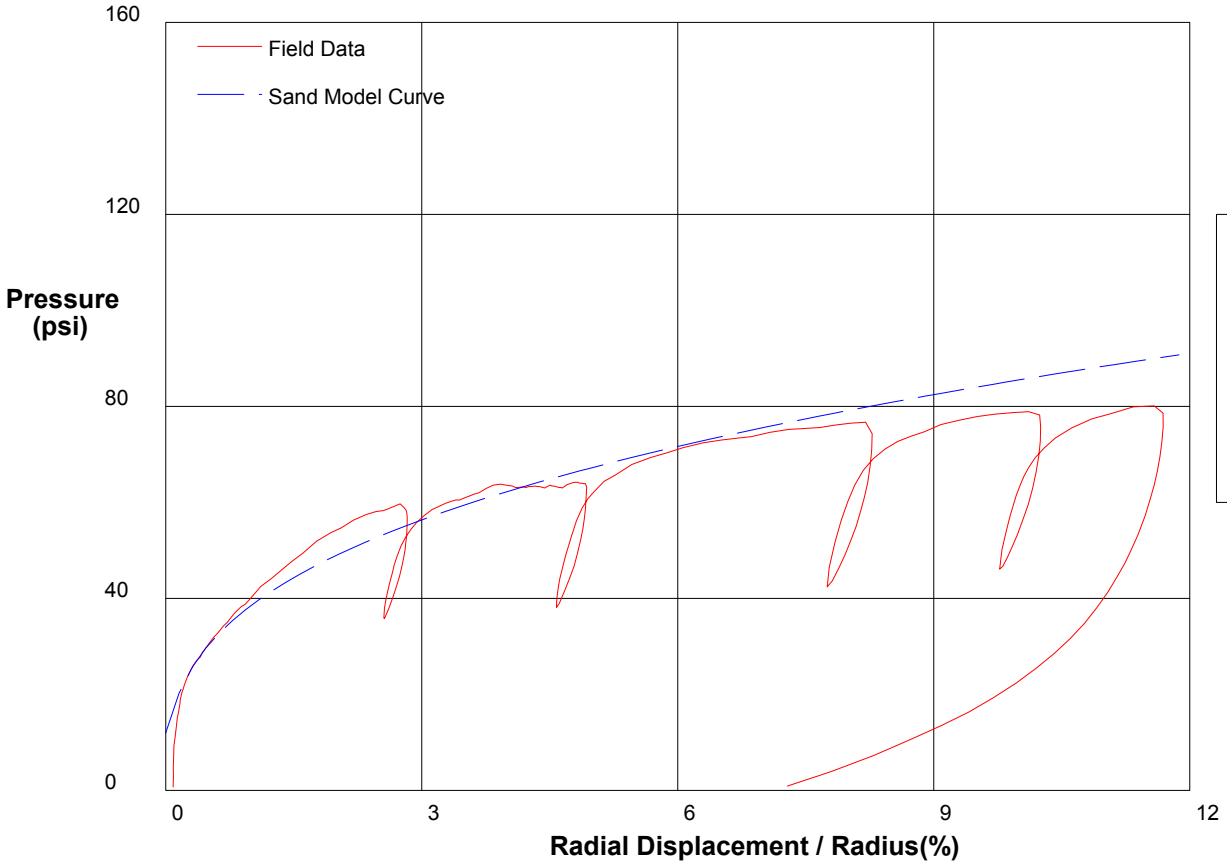
GIBSON'S CLAY MODEL

Shear Strength	16 psi
Insitu Stress	40 psi
Shear Modulus	2700 psi

shift-.4

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/8/2008
Hole No. TH31PM	Depth 89.3ft	File C:\DATA\ISE-771\DOT17.P



THE In Situ Engineering SAND MODEL

Water Pressure	34 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	12 psi
Shear Modulus	2700 psi

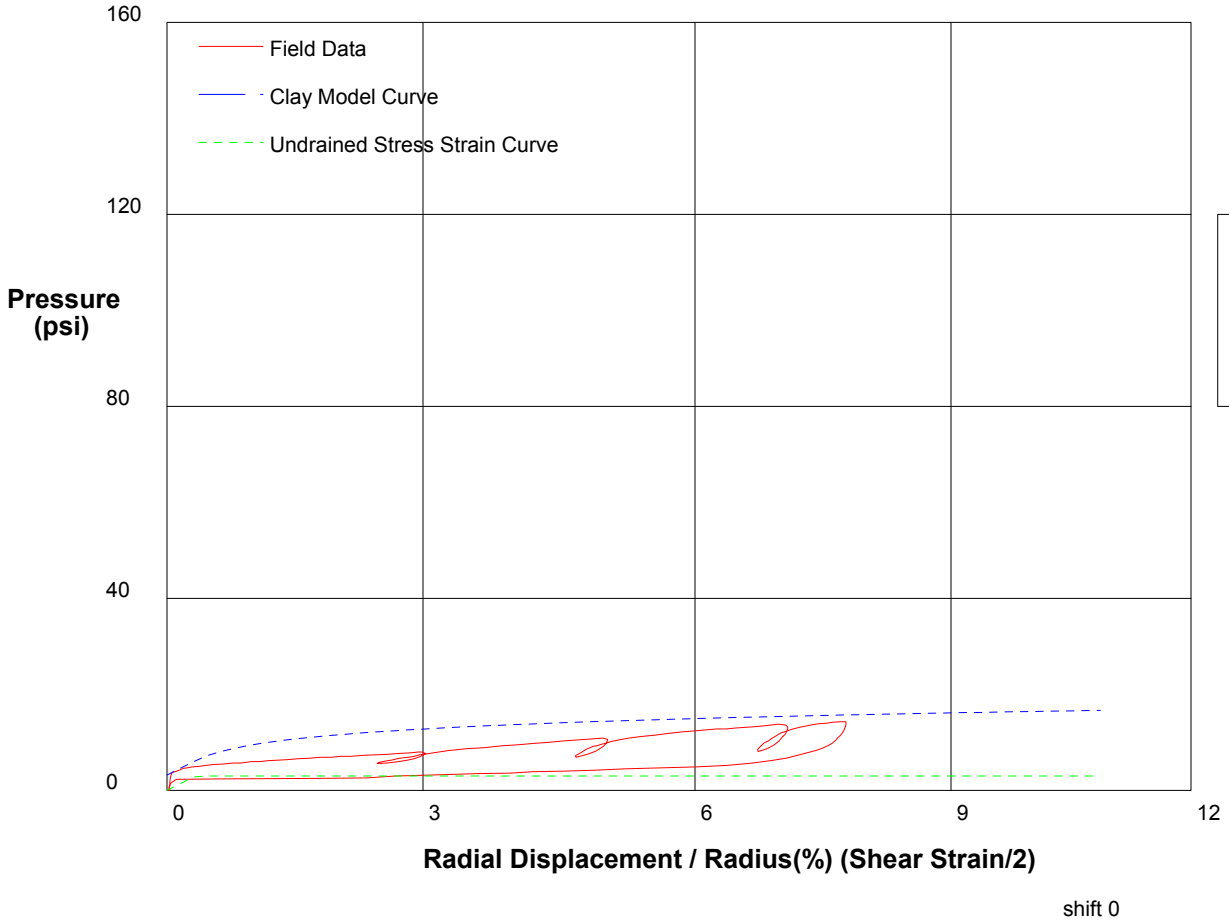
shift-.4

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/9/2008**

Hole No. TH30PM **Depth 11.3ft** **File C:\DATA\ISE-771\DOT19.P**

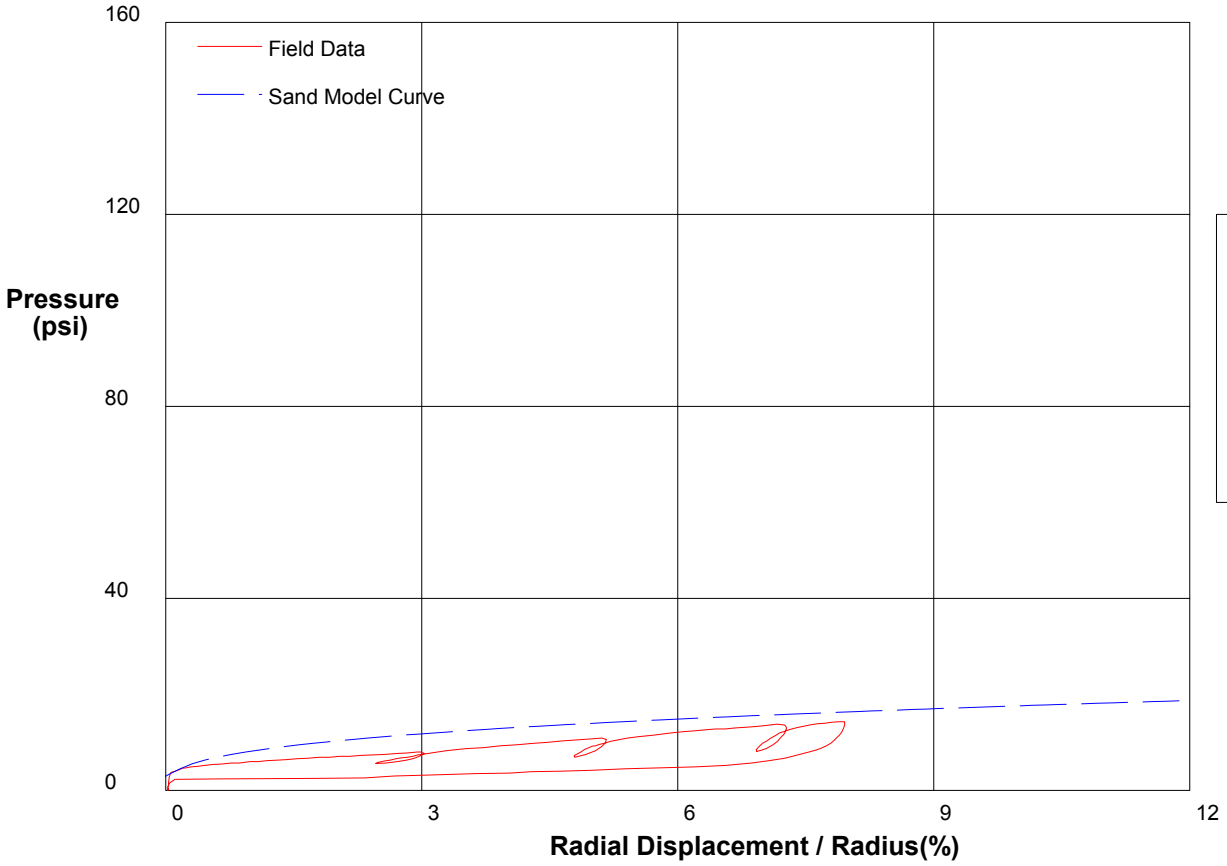


GIBSON'S CLAY MODEL

Shear Strength 3 psi
Insitu Stress 3.2 psi
Shear Modulus 450 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. TH30PM	Depth 11.3ft	File C:\DATA\ISE-771\DOT19.P



shift 0

THE In Situ Engineering SAND MODEL

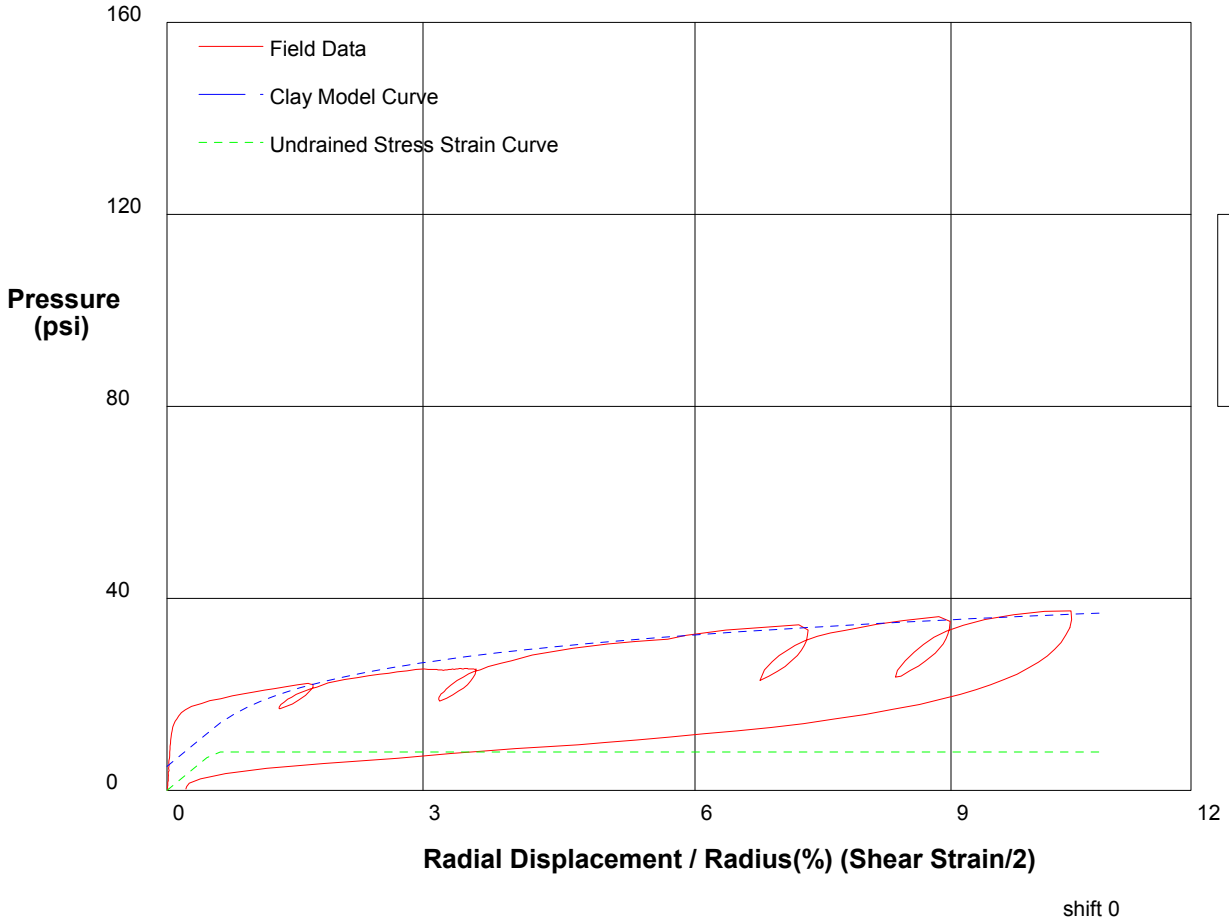
Water Pressure	0 psi
Friction Angle	30 deg
Critical Friction Angle	30 deg
Lateral Stress	3 psi
Shear Modulus	450 psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/9/2008**

Hole No. TH30PM **Depth 14.3ft** **File C:\DATA\ISE-771\DOT20.P**

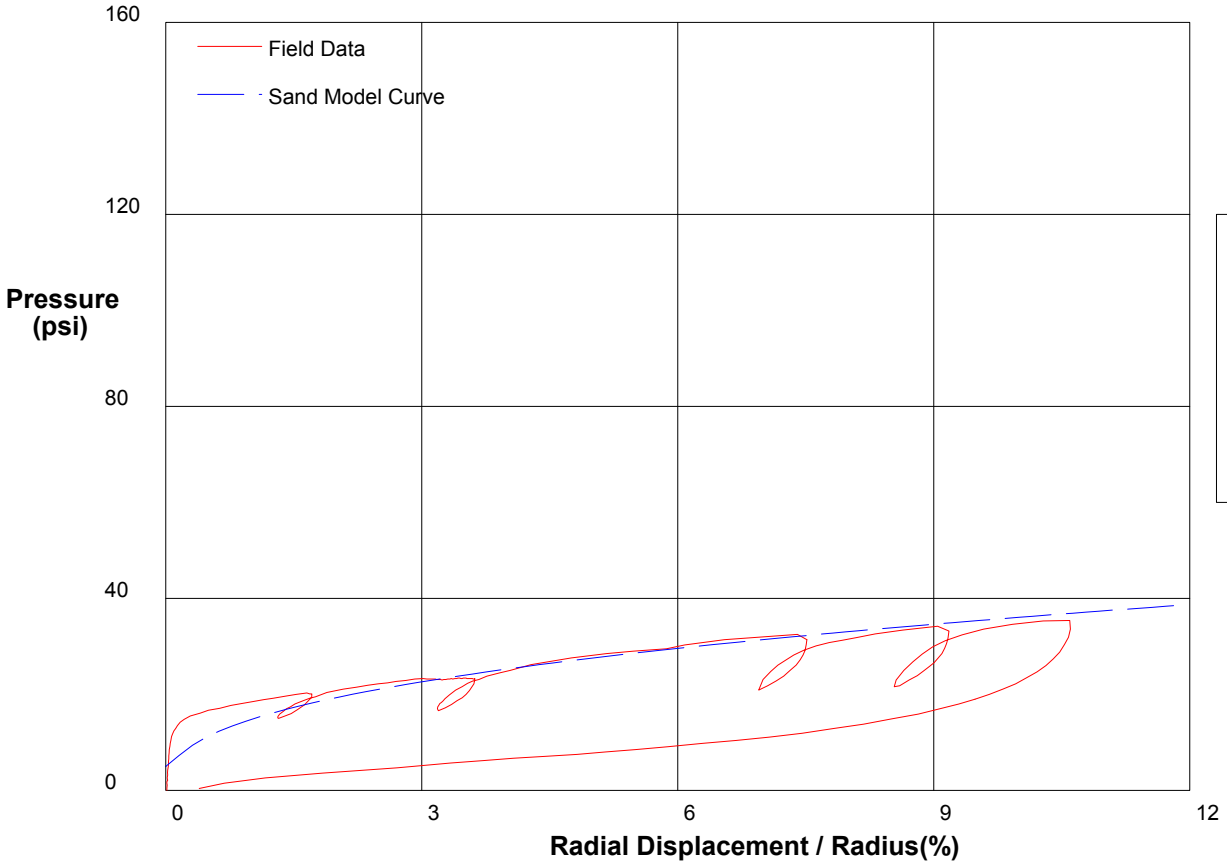


GIBSON'S CLAY MODEL

Shear Strength 8 psi
Insitu Stress 5 psi
Shear Modulus 730 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. TH30PM	Depth 14.3ft	File C:\DATA\ISE-771\DOT20.P



THE In Situ Engineering SAND MODEL

Water Pressure	2 psi
Friction Angle	35 deg
Critical Friction Angle	32 deg
Lateral Stress	5 psi
Shear Modulus	730 psi

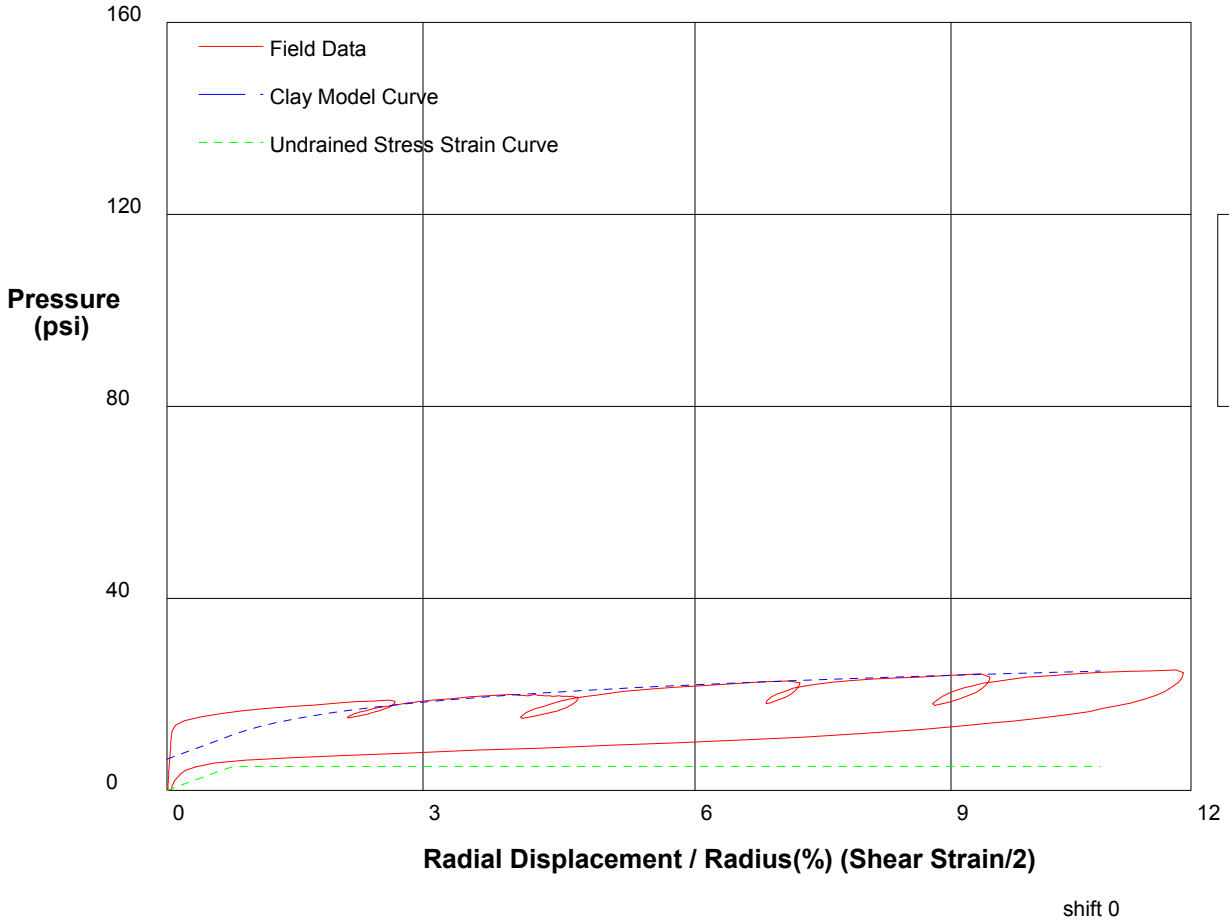
shift 0

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/9/2008**

Hole No. TH30PM **Depth 17.3ftft** **File C:\DATA\ISE-771\DOT21.P**

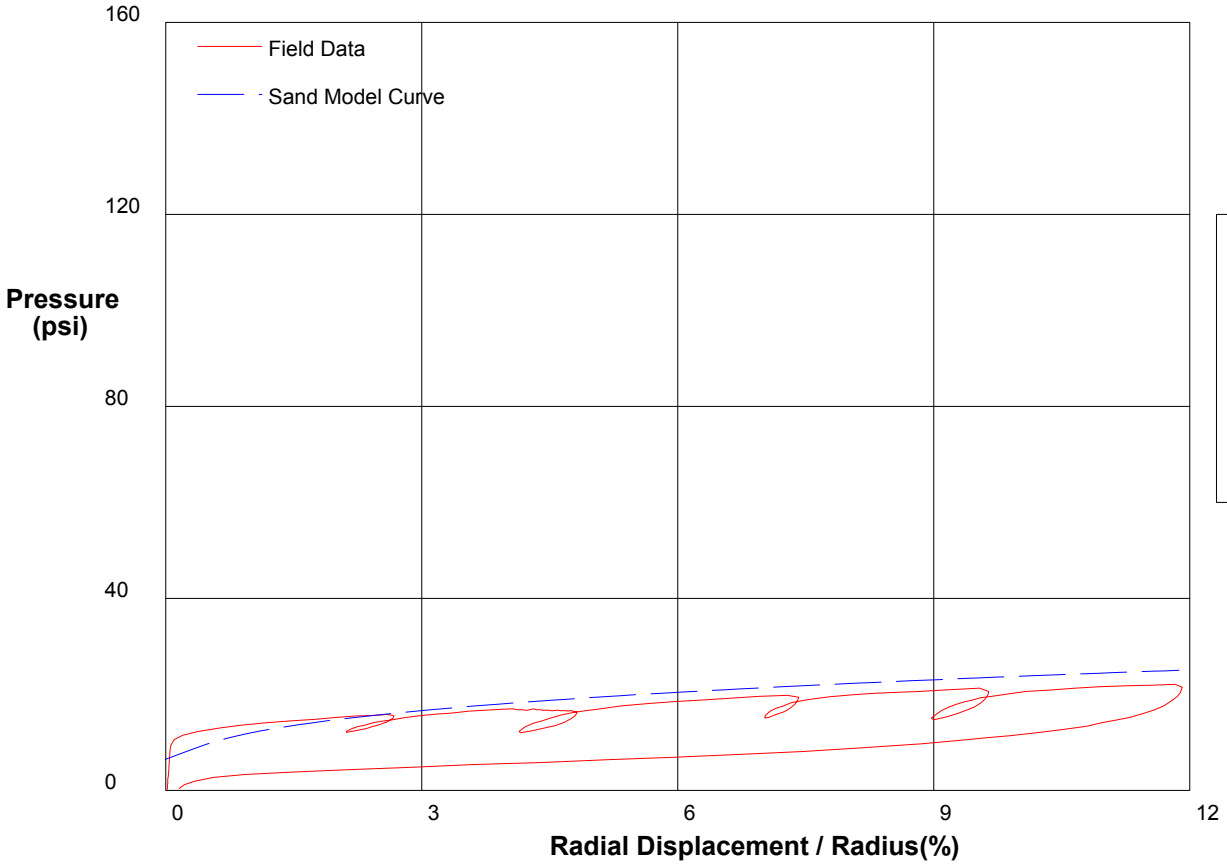


GIBSON'S CLAY MODEL

Shear Strength	**5 psi**
Insitu Stress	**6.5 psi**
Shear Modulus	**330 psi**

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. TH30PM	Depth 17.3ftft	File C:\DATA\ISE-771\DOT21.P



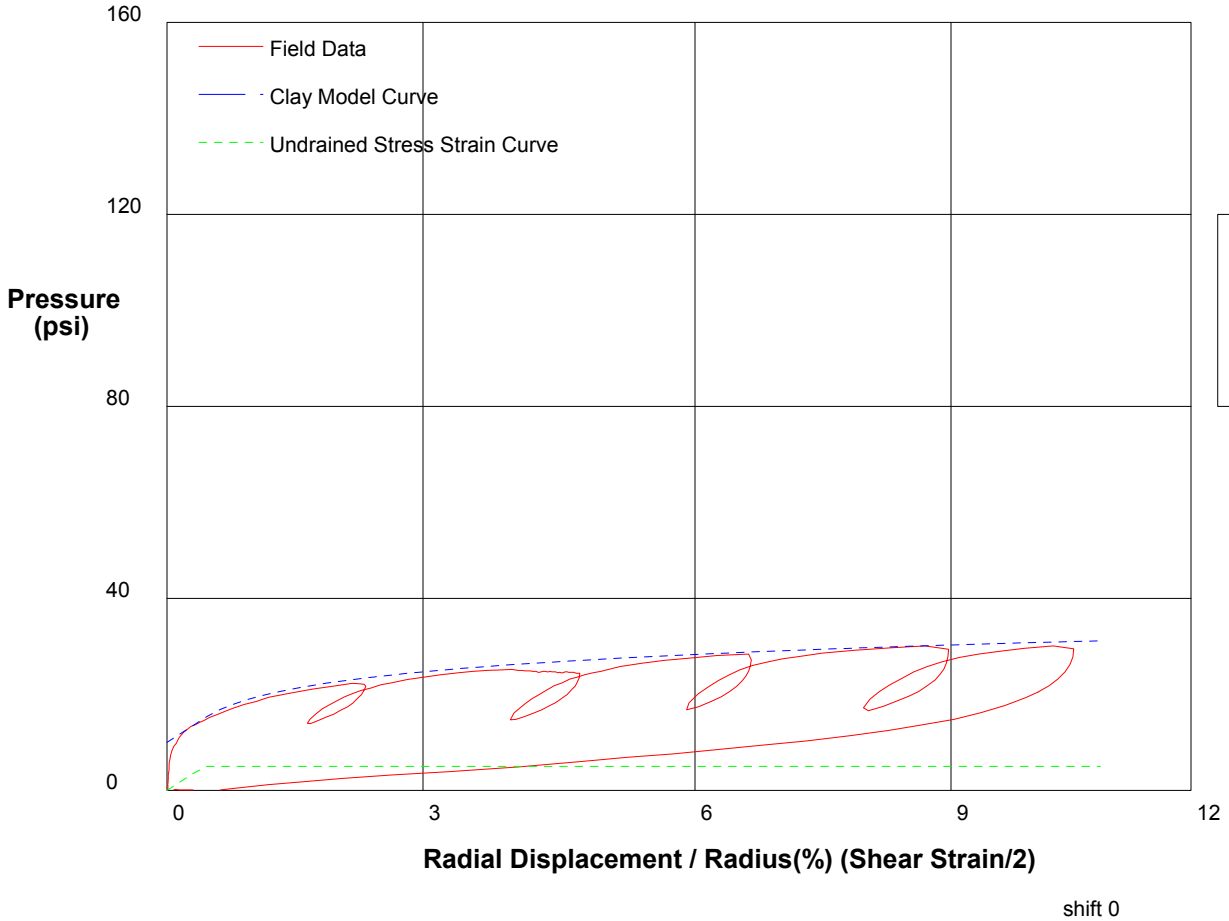
shift 0

THE In Situ Engineering SAND MODEL

Water Pressure	3 psi
Friction Angle	25 deg
Critical Friction Angle	25 deg
Lateral Stress	6.5 psi
Shear Modulus	330 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. TH30PM	Depth 23.5ft	File C:\DATA\ISE-771\DOT22.P

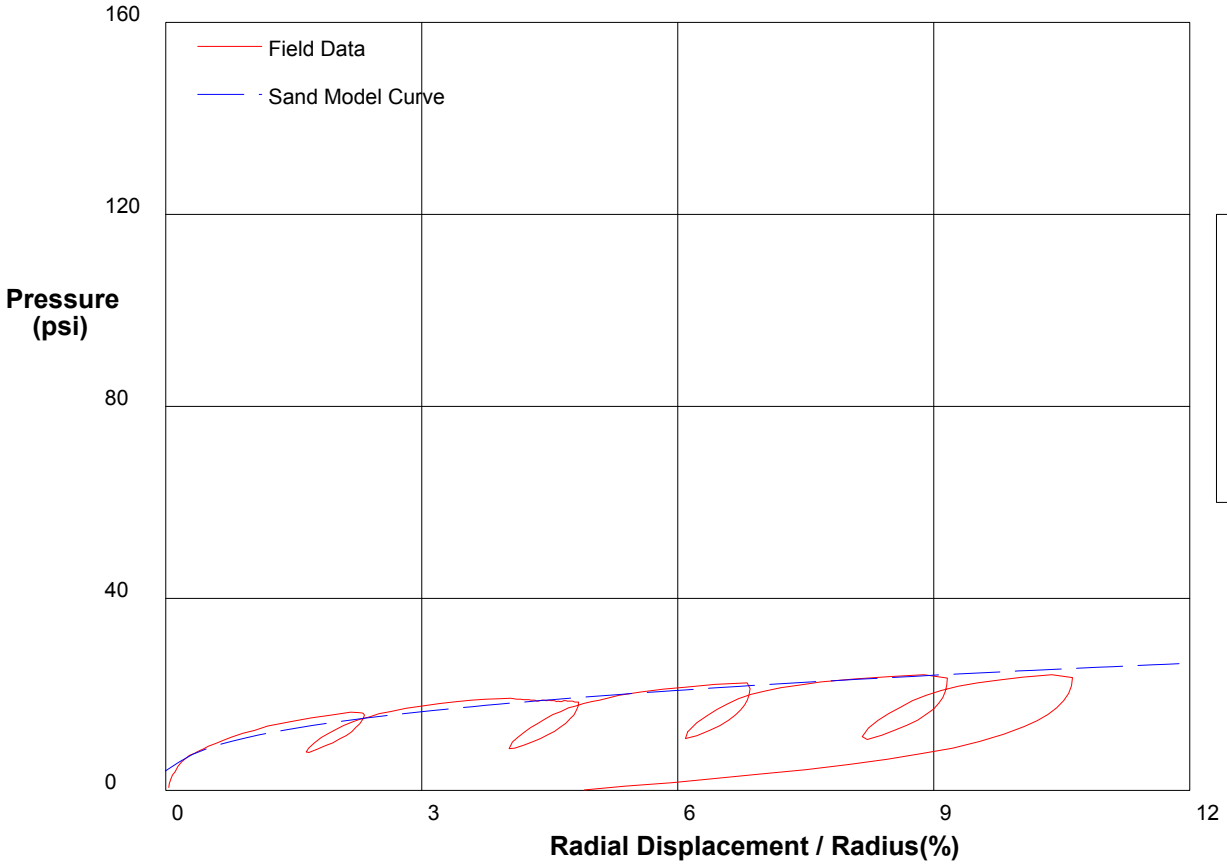


GIBSON'S CLAY MODEL

Shear Strength	5 psi
Insitu Stress	10 psi
Shear Modulus	580 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. TH30PM	Depth 23.5ft	File C:\DATA\ISE-771\DOT22.P



shift 0

THE In Situ Engineering SAND MODEL

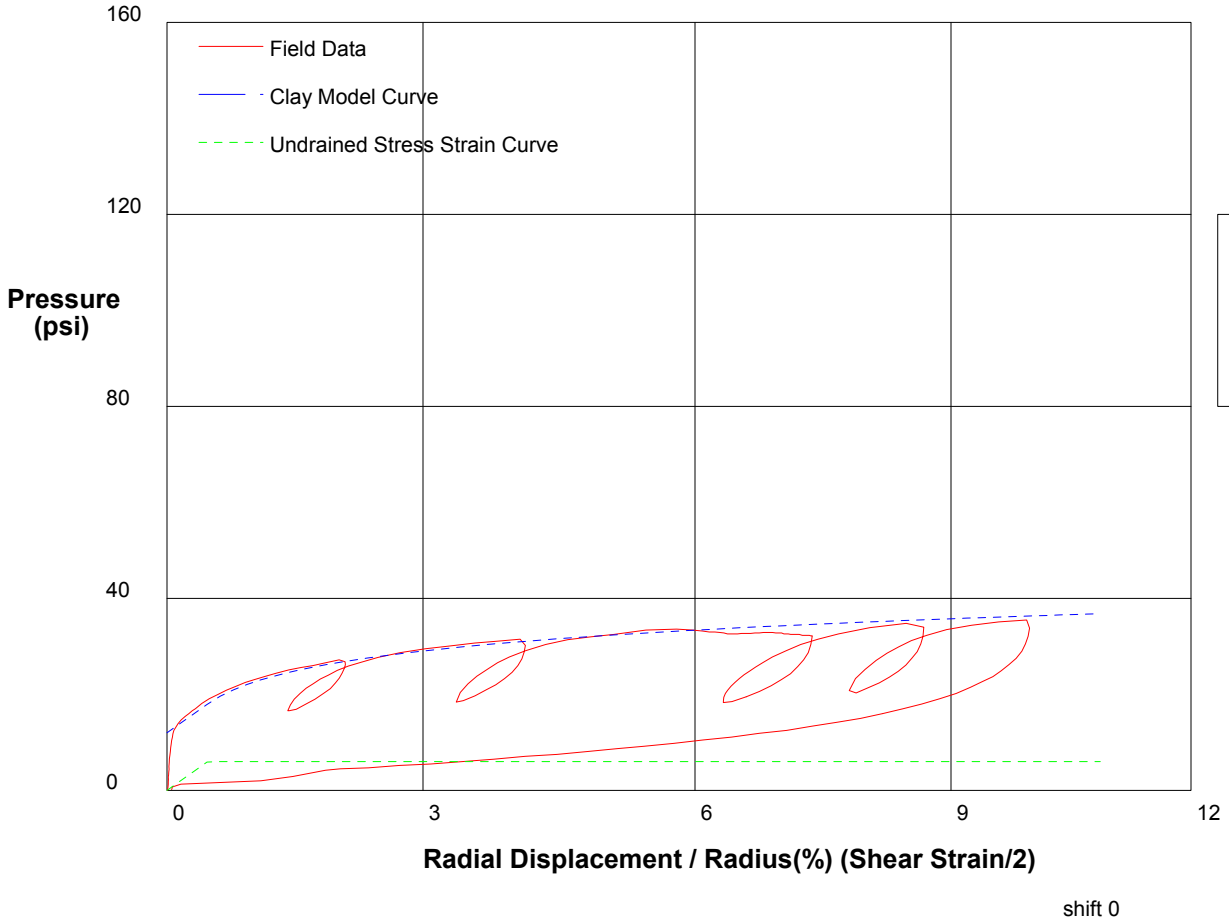
Water Pressure	6 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	4.1 psi
Shear Modulus	580 psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/9/2008**

Hole No. TH30PM **Depth 26.5ft** **File C:\DATA\ISE-771\DOT23.P**

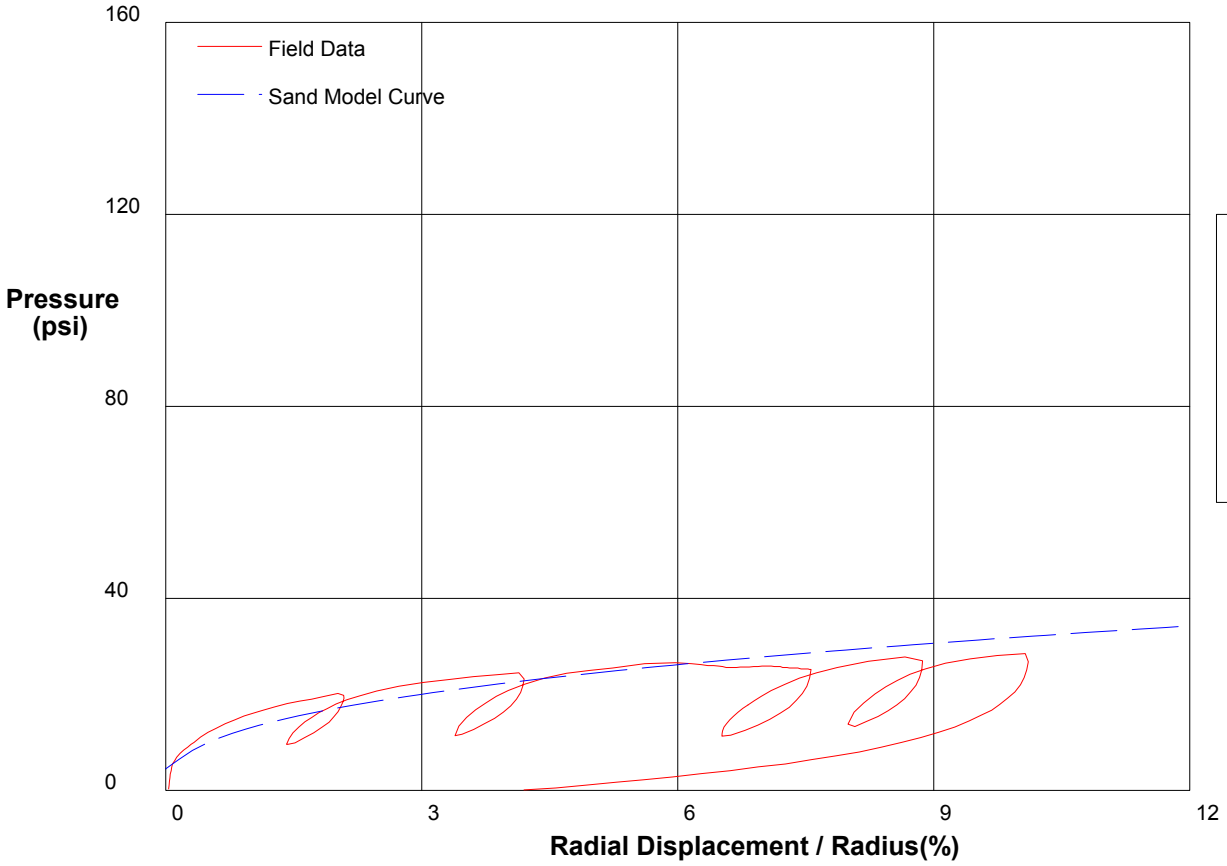


GIBSON'S CLAY MODEL

Shear Strength	**6 psi**
Insitu Stress	**12 psi**
Shear Modulus	**630 psi**

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. TH30PM	Depth 26.5ft	File C:\DATA\ISE-771\DOT23.P



shift 0

THE In Situ Engineering SAND MODEL

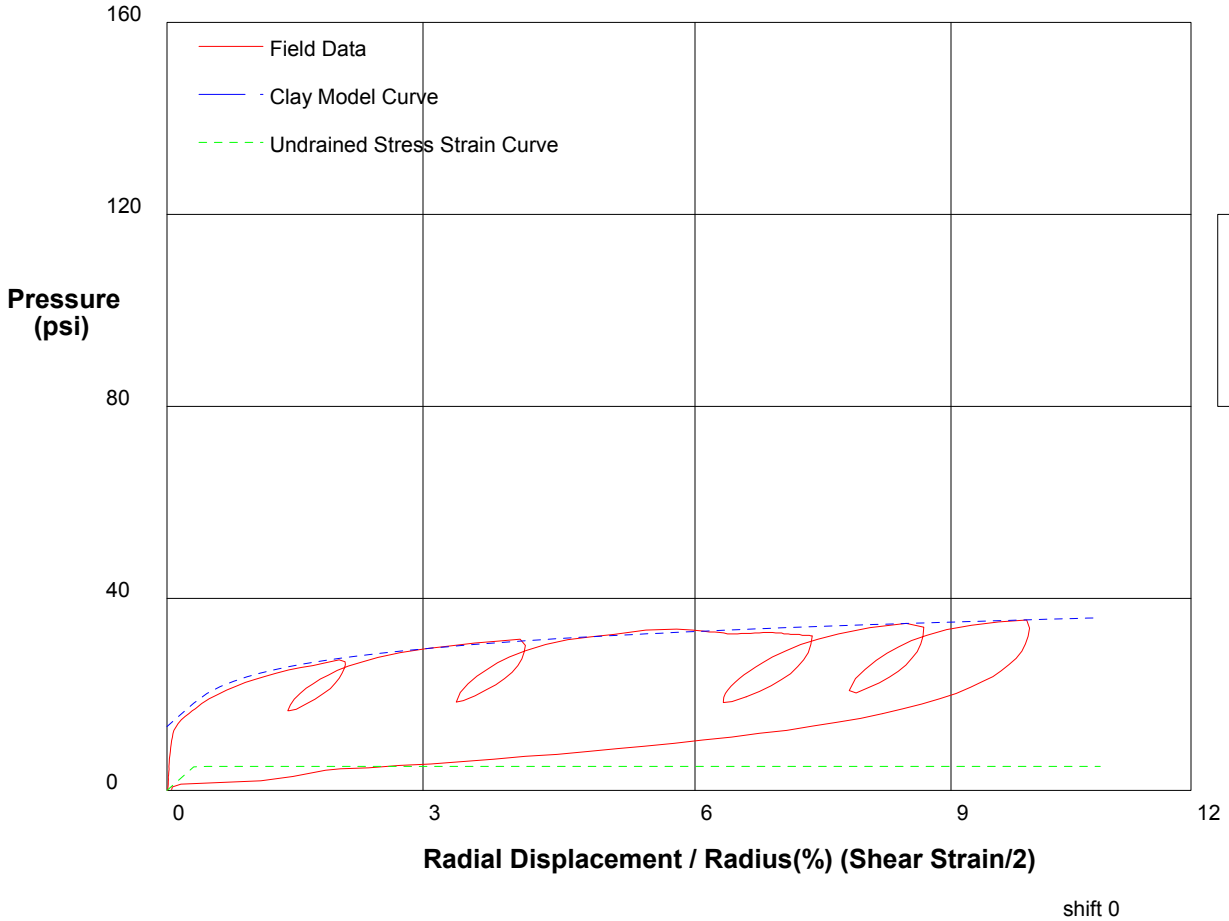
Water Pressure	7 psi
Friction Angle	35 deg
Critical Friction Angle	32 deg
Lateral Stress	4.5 psi
Shear Modulus	630 psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/9/2008**

Hole No. TH30PM **Depth 26.5ft** **File C:\DATA\ISE-771\DOT24P**

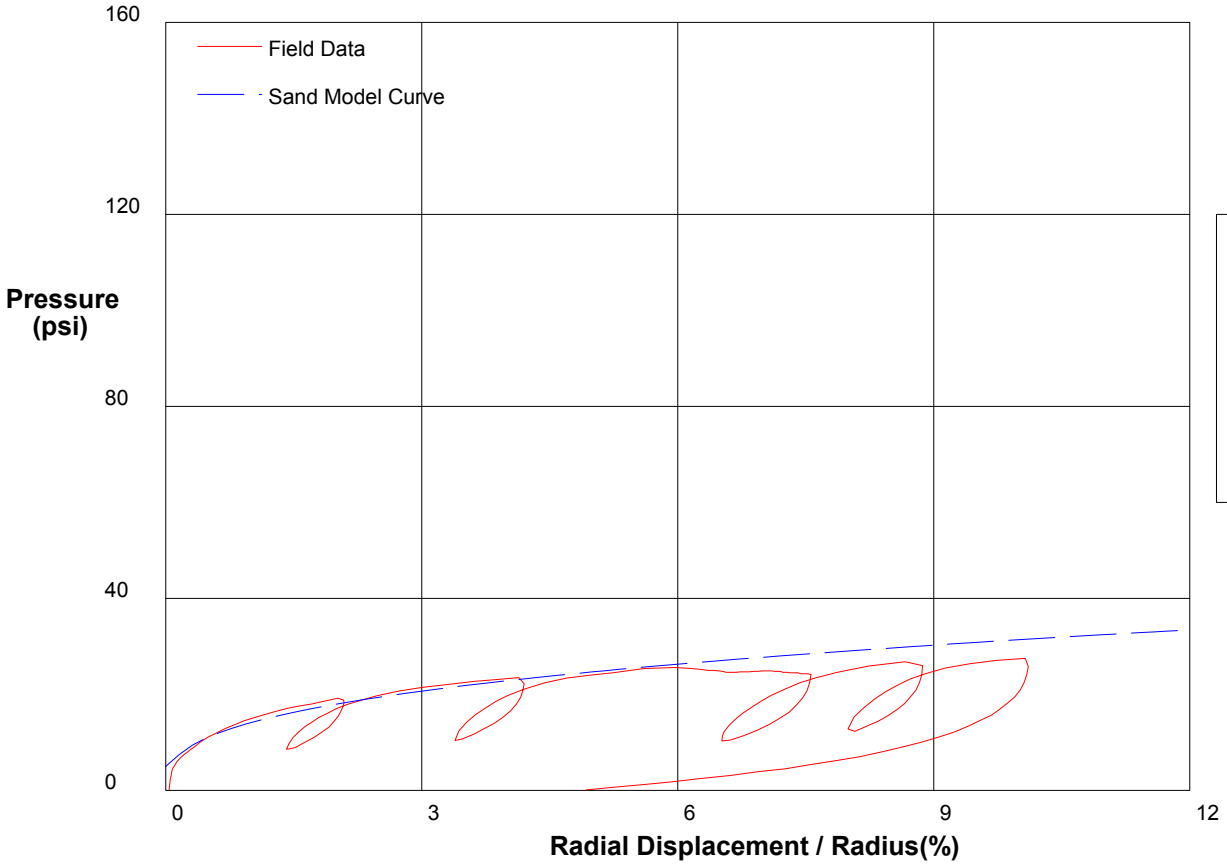


GIBSON'S CLAY MODEL

Shear Strength	**5 psi**
Insitu Stress	**13.3 psi**
Shear Modulus	**780 psi**

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. TH30PM	Depth 26.5ft	File C:\DATA\ISE-771\DOT24P



THE In Situ Engineering SAND MODEL

Water Pressure	8 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	5 psi
Shear Modulus	780 psi

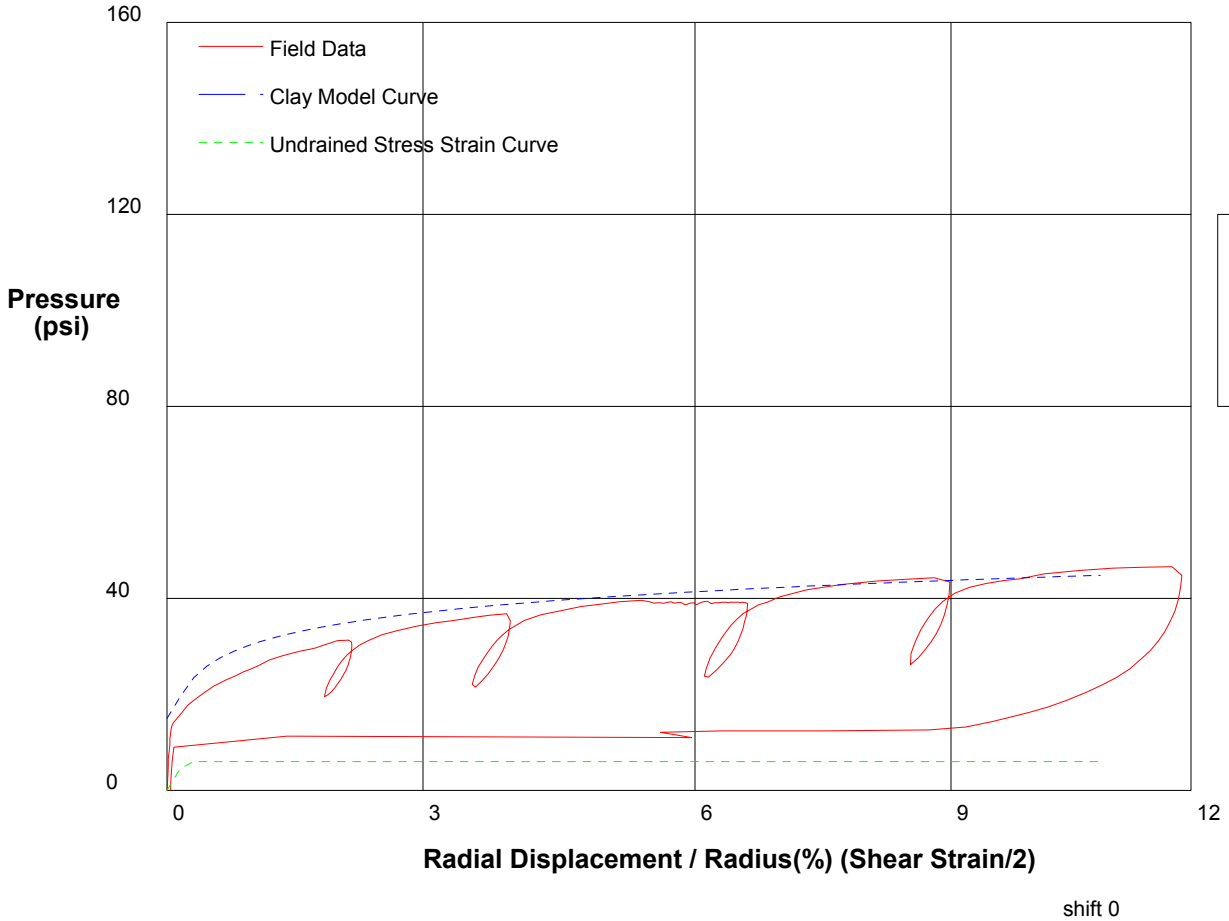
shift 0

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/9/2008**

Hole No. TH30PM **Depth 32.5ft** **File C:\DATA\ISE-771\DOT25.P**

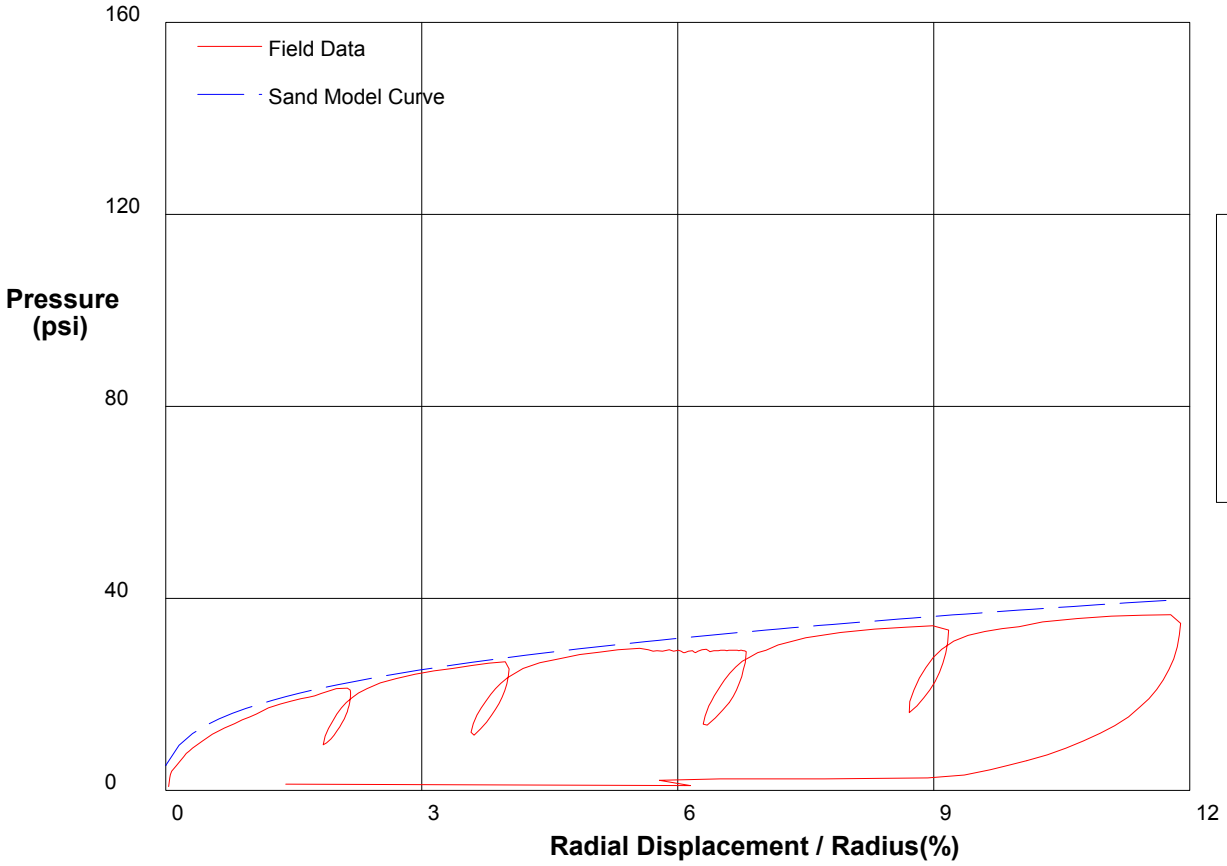


GIBSON'S CLAY MODEL

Shear Strength	**6 psi**
Insitu Stress	**15 psi**
Shear Modulus	**1450 psi**

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. TH30PM	Depth 32.5ft	File C:\DATA\ISE-771\DOT25.P



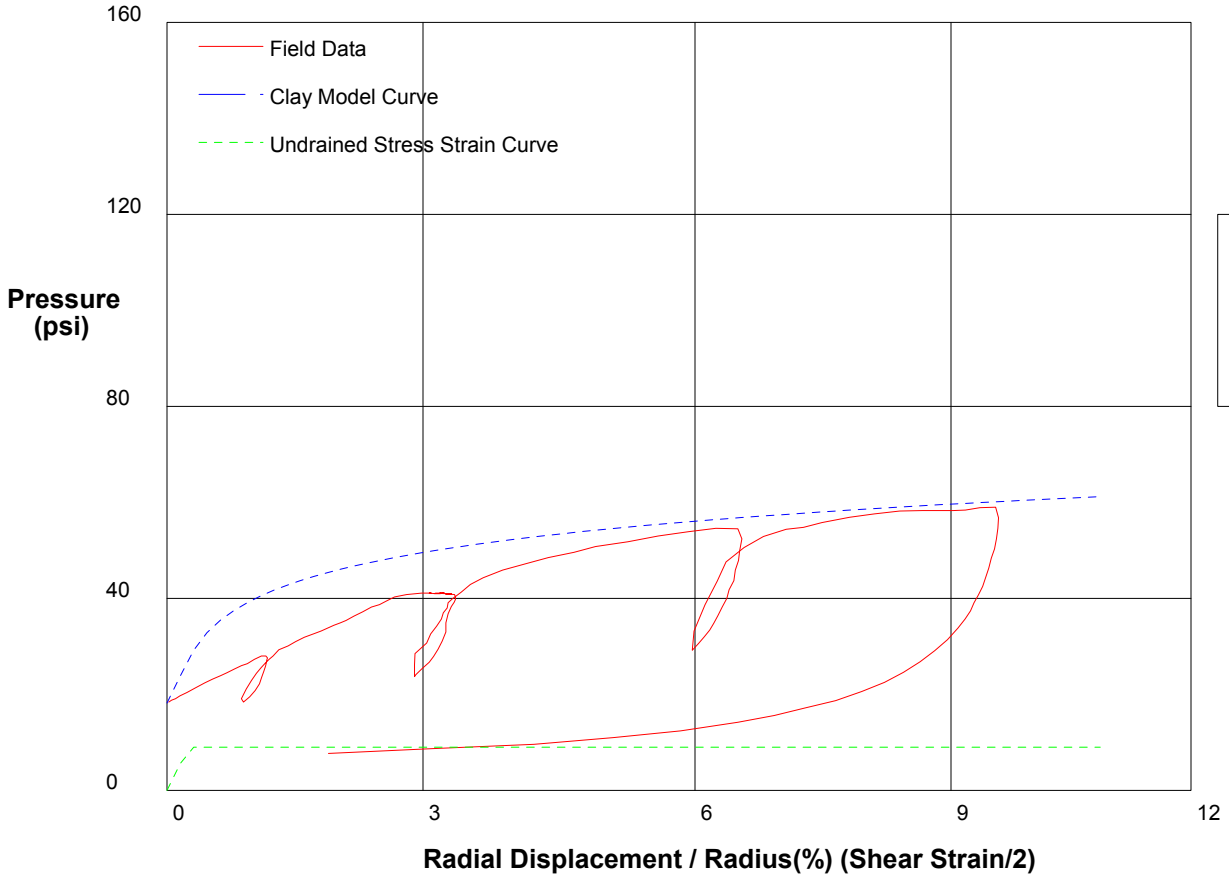
THE In Situ Engineering SAND MODEL

Water Pressure	10 psi
Friction Angle	30 deg
Critical Friction Angle	30 deg
Lateral Stress	5.2 psi
Shear Modulus	1450 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. th30pm	Depth 38.3ft	File C:\DATA\ISE-771\DOT27.P



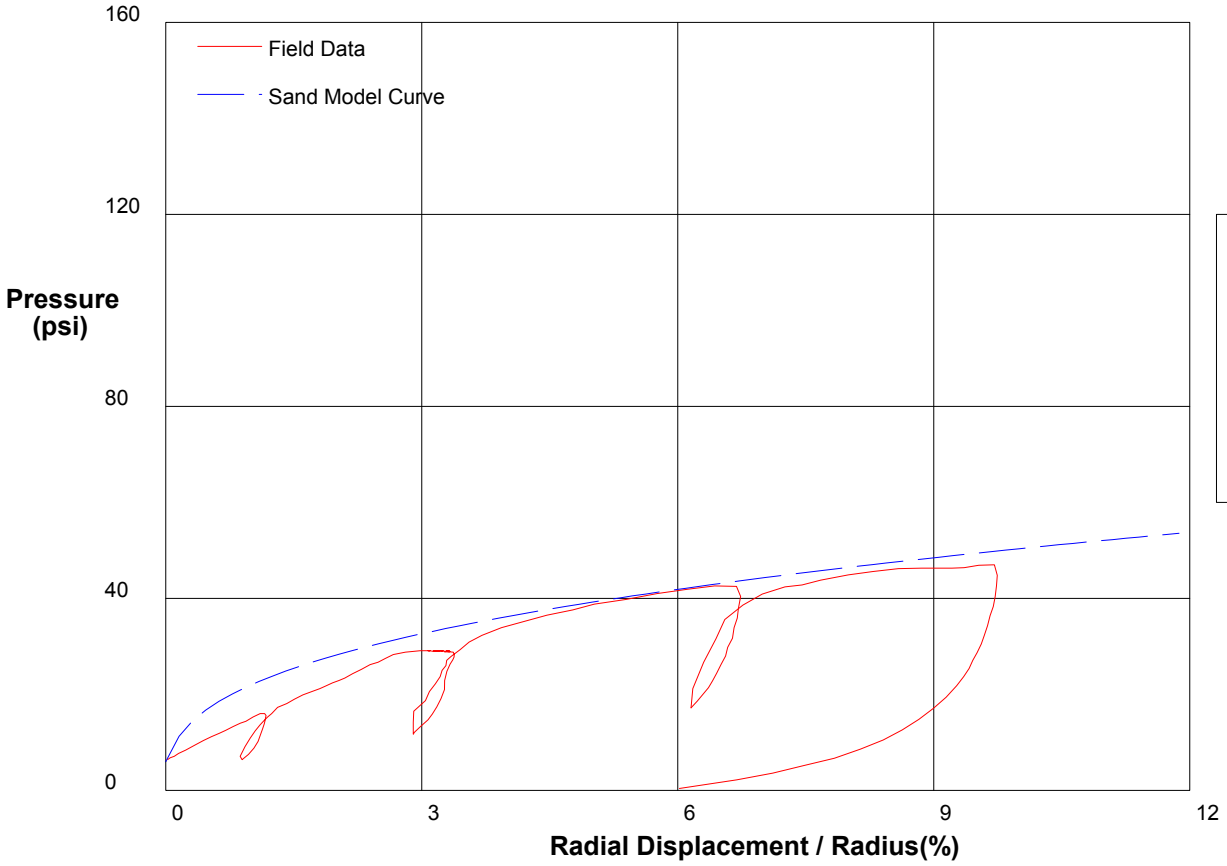
GIBSON'S CLAY MODEL

Shear Strength	9	psi
Insitu Stress	18.2	psi
Shear Modulus	1800	psi

shift 1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. th30pm	Depth 38.3ft	File C:\DATA\ISE-771\DOT27.P



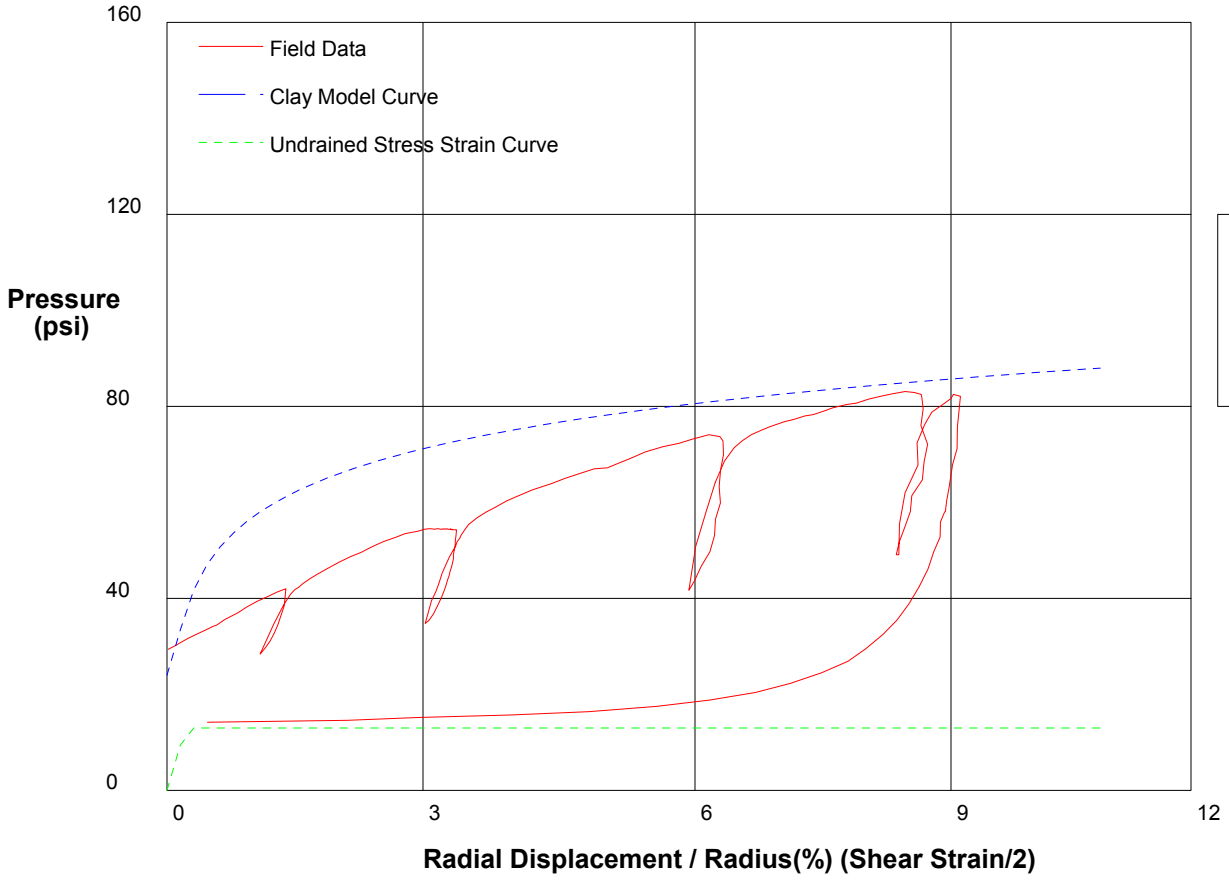
THE In Situ Engineering SAND MODEL

Water Pressure	12 psi
Friction Angle	33 deg
Critical Friction Angle	32 deg
Lateral Stress	6 psi
Shear Modulus	1800 psi

shift 1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. th30pm	Depth 48.3ft	File C:\DATA\ISE-771\DOT28.P



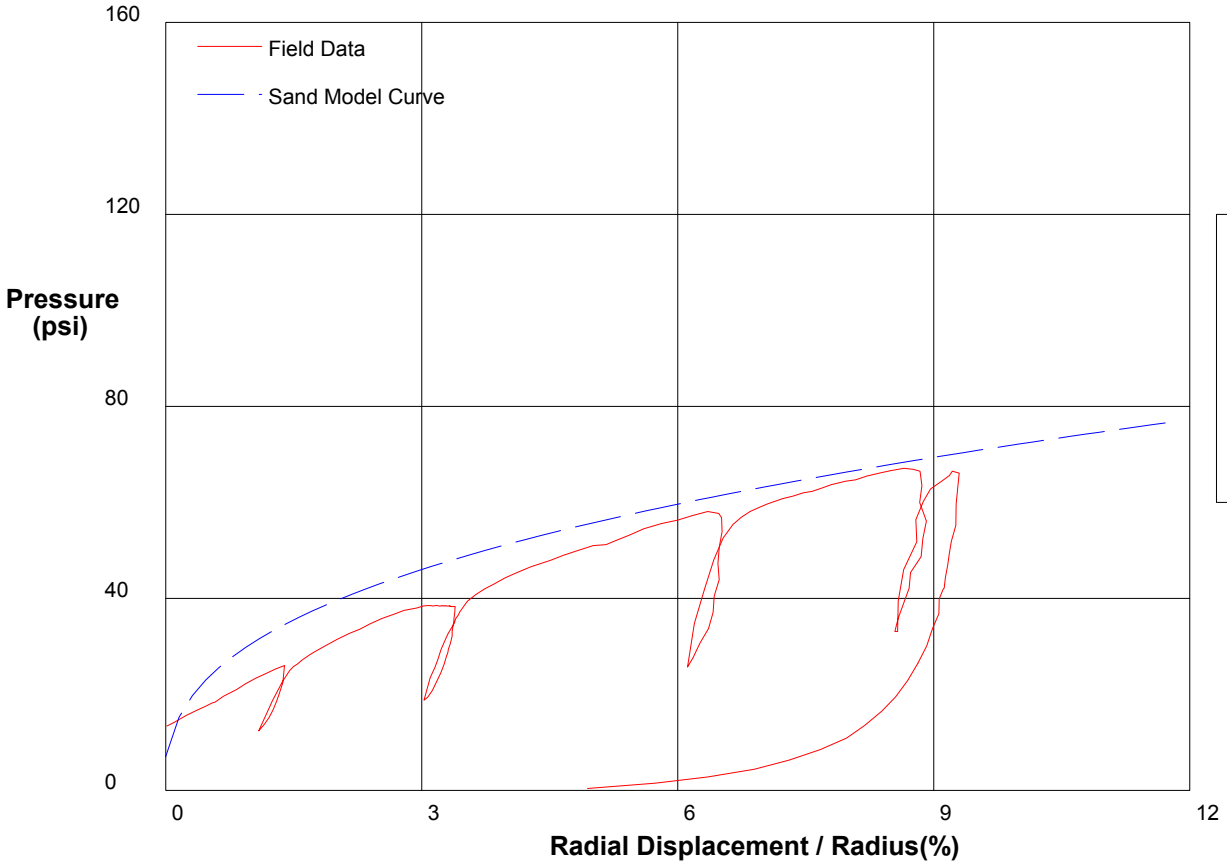
GIBSON'S CLAY MODEL

Shear Strength	13	psi
Insitu Stress	24	psi
Shear Modulus	3000	psi

shift 1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. th30pm	Depth 48.3ft	File C:\DATA\ISE-771\DOT28.P



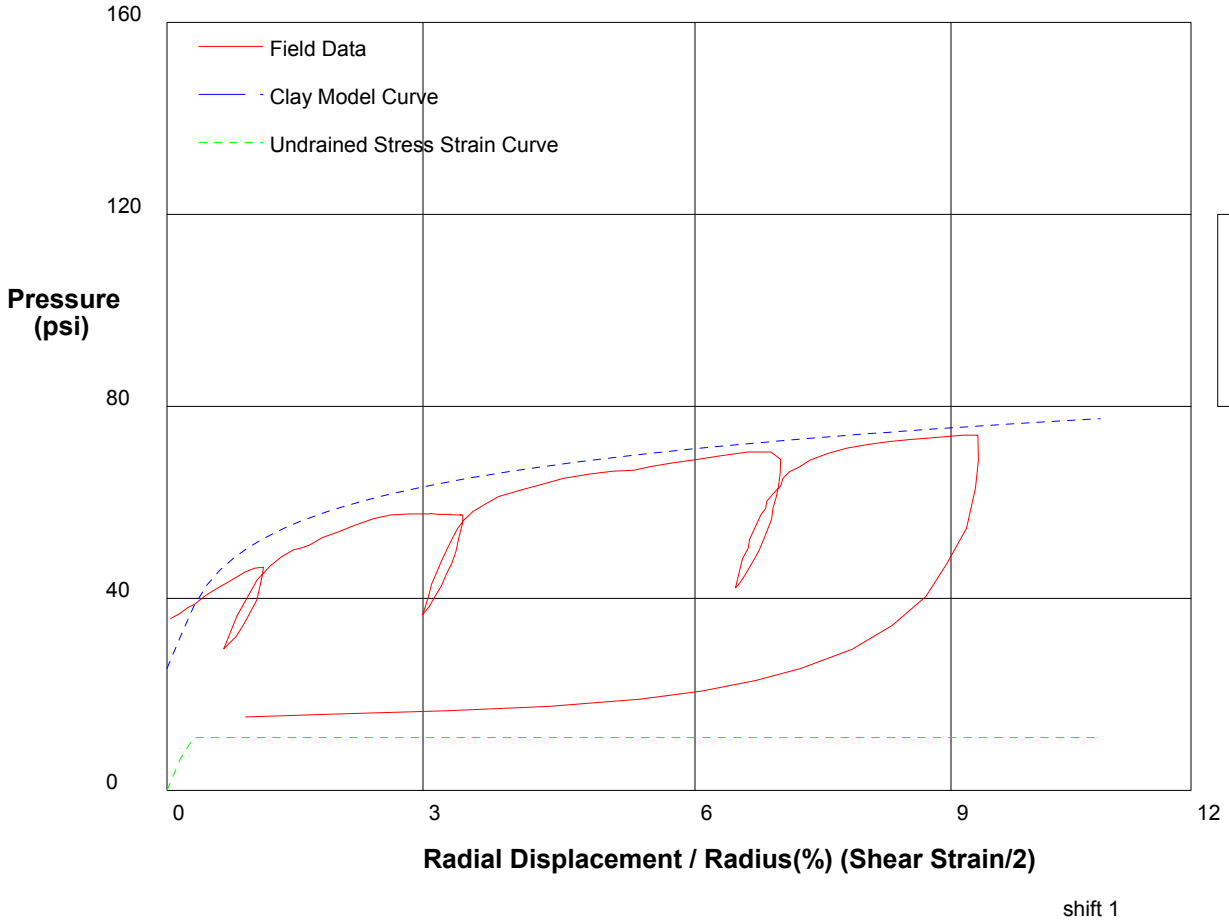
THE In Situ Engineering SAND MODEL

Water Pressure	16 psi
Friction Angle	34 deg
Critical Friction Angle	32 deg
Lateral Stress	7.1 psi
Shear Modulus	3000 psi

shift 1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. th30pm	Depth 51.3ftft	File C:\DATA\ISE-771\DOT29.P

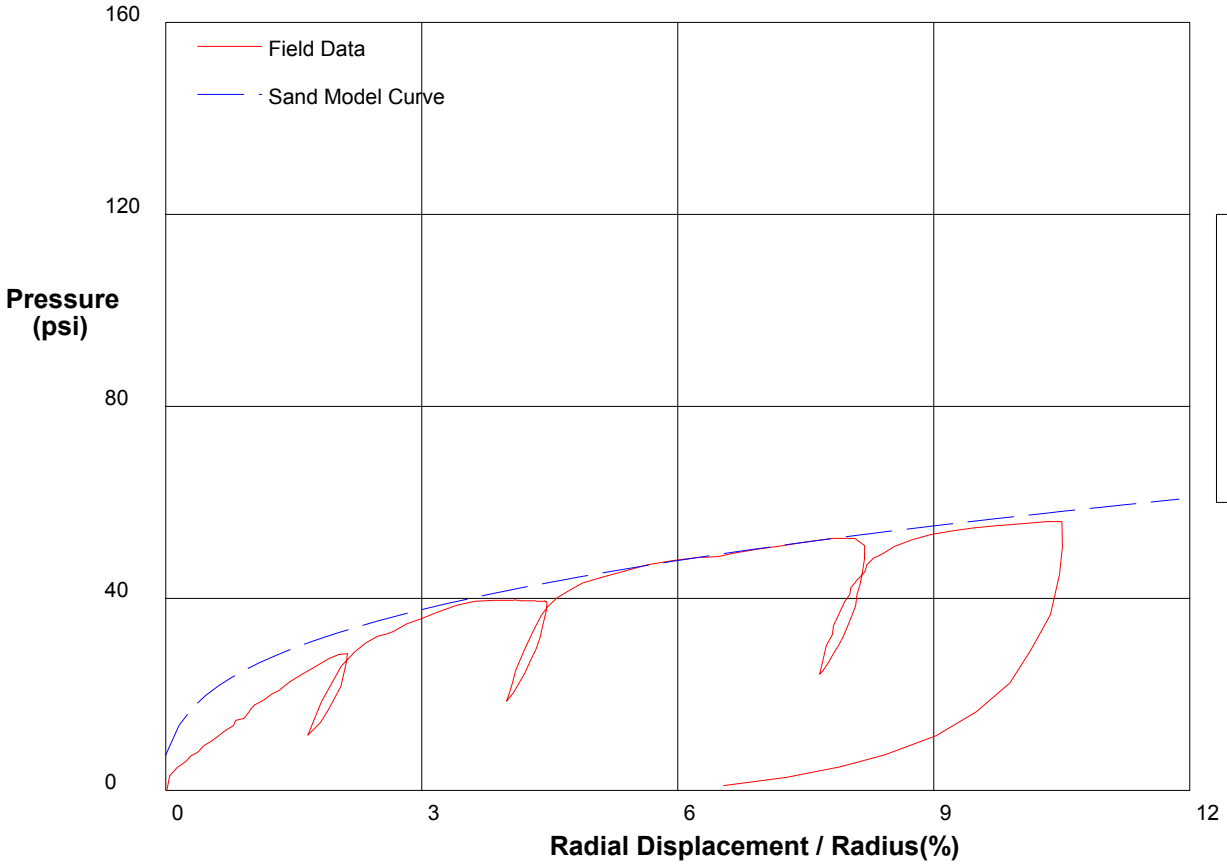


GIBSON'S CLAY MODEL

Shear Strength	11 psi
Insitu Stress	25.4 psi
Shear Modulus	2100 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. th30pm	Depth 51.3ft	File C:\DATA\ISE-771\DOT29.P



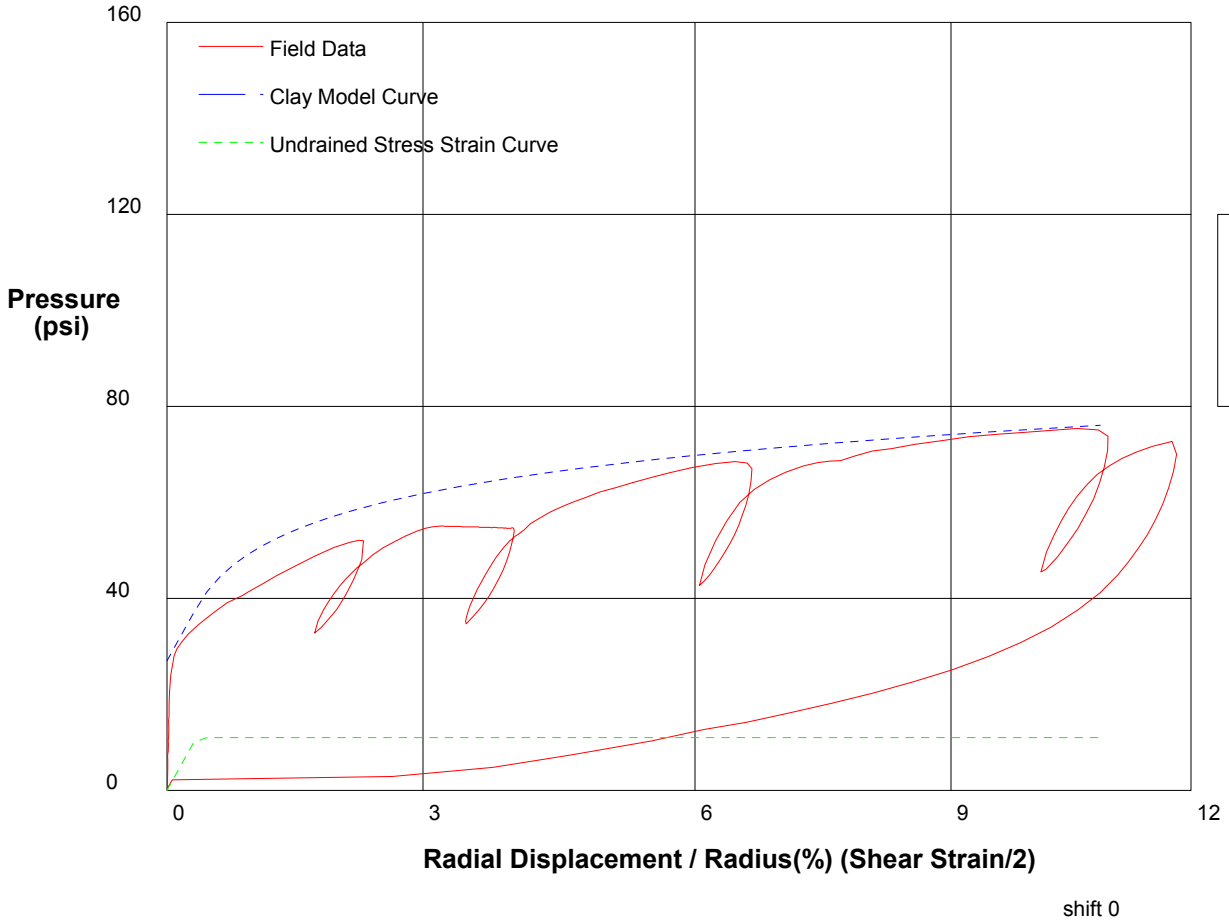
THE In Situ Engineering SAND MODEL

Water Pressure	18 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	7.4 psi
Shear Modulus	2100 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. th30pm	Depth 54.3ft	File C:\DATA\ISE-771\DOT30.P

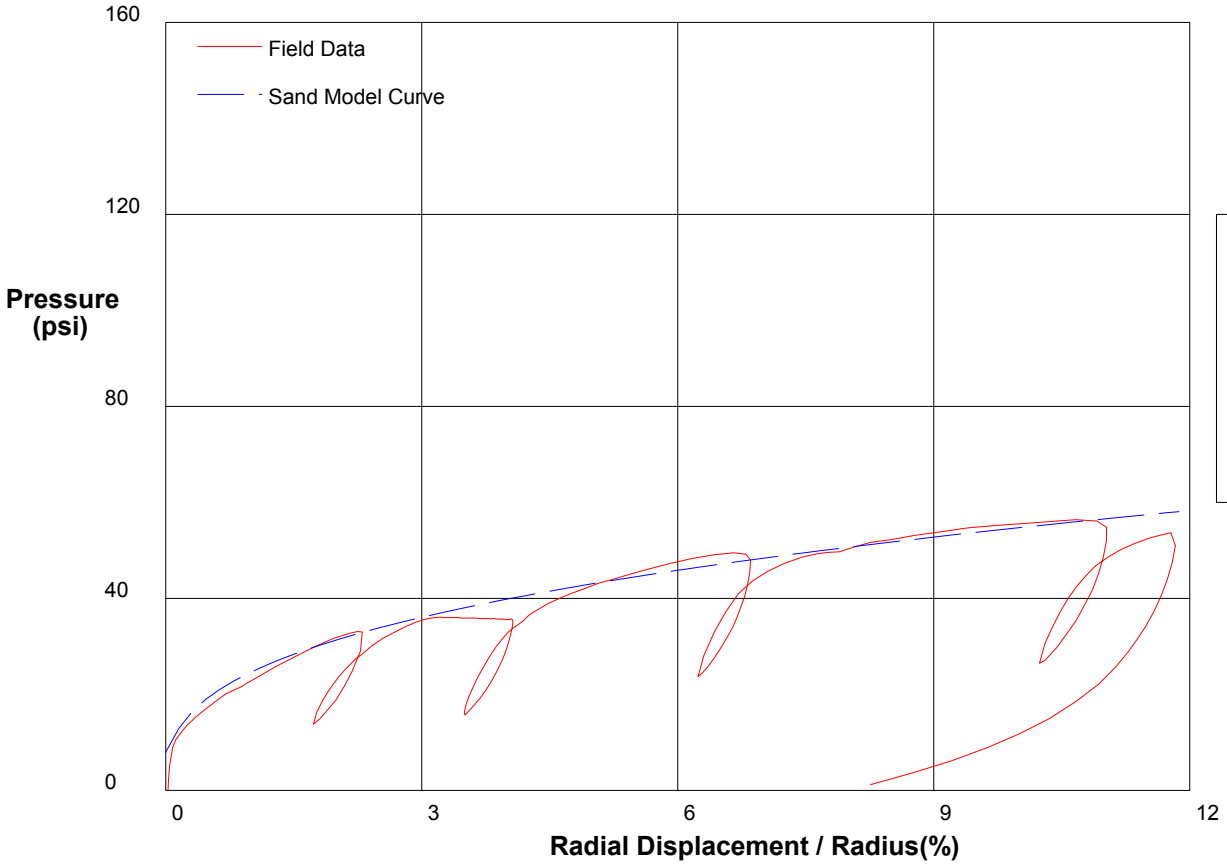


GIBSON'S CLAY MODEL

Shear Strength	11	psi
Insitu Stress	27	psi
Shear Modulus	1600	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. th30pm	Depth 54.3ft	File C:\DATA\ISE-771\DOT30.P



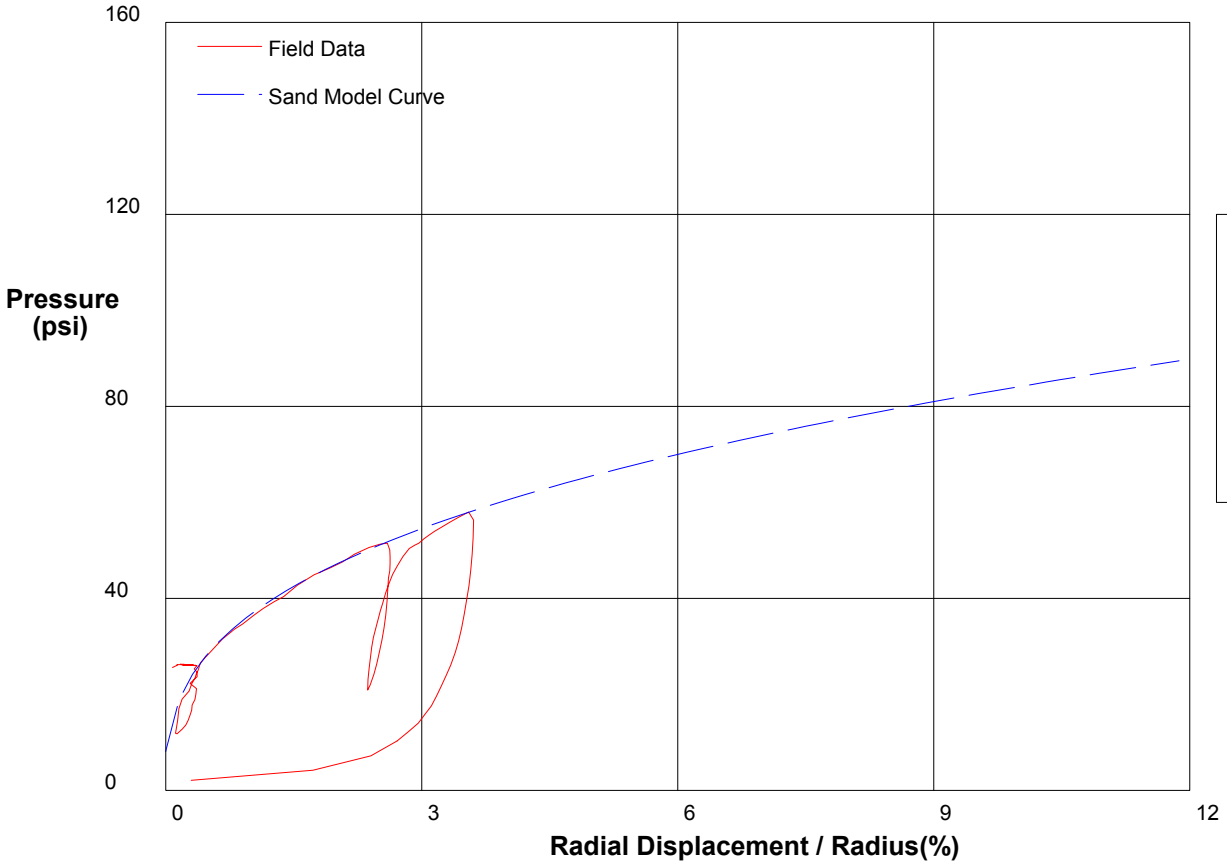
shift 0

THE In Situ Engineering SAND MODEL

Water Pressure	19 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	8 psi
Shear Modulus	1600 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/9/2008
Hole No. th30pm	Depth 57.3ft	File C:\DATA\ISE-771\DOT31.P



THE In Situ Engineering SAND MODEL

Water Pressure	20 psi
Friction Angle	33 deg
Critical Friction Angle	32 deg
Lateral Stress	8.2 psi
Shear Modulus	4300 psi

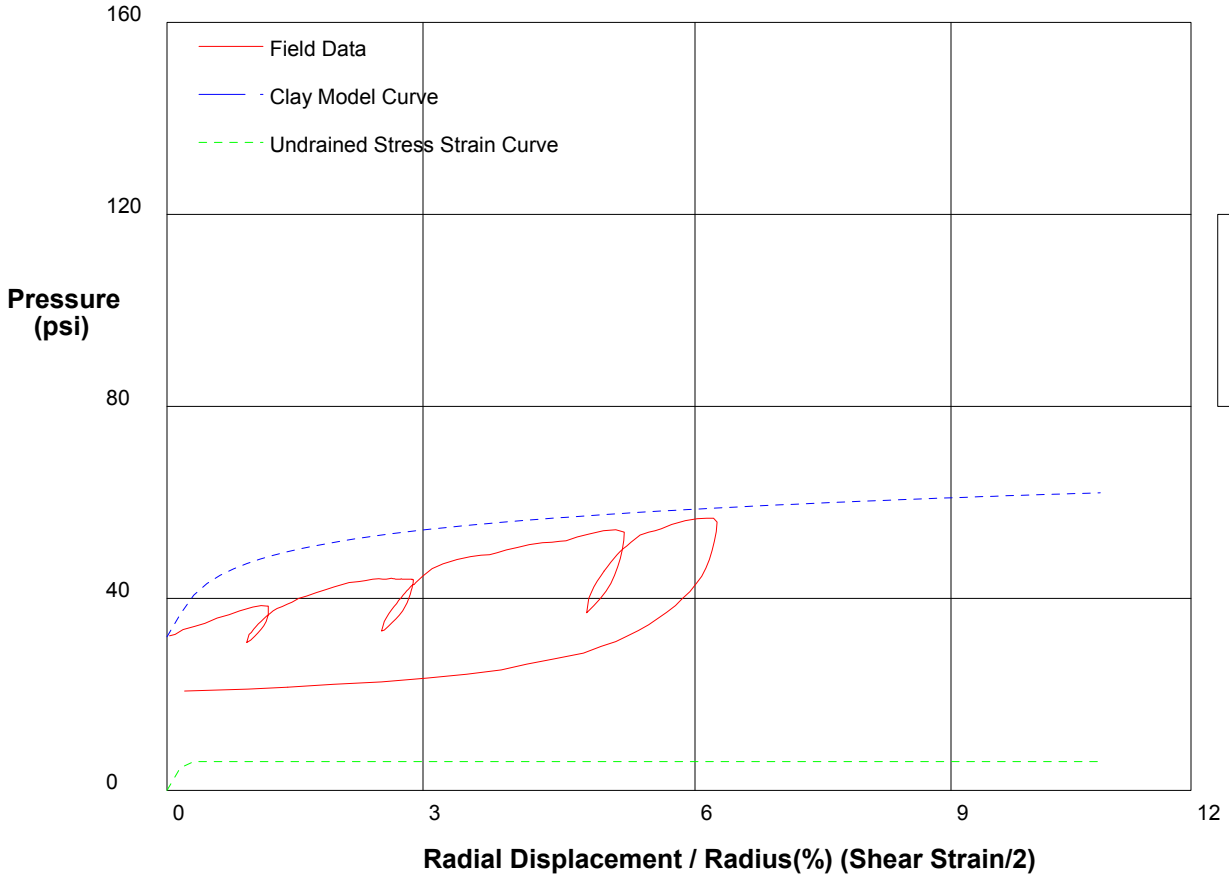
shift 3

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/10/2008**

Hole No. th30pm **Depth 63.3ftft** **File C:\DATA\ISE-771\DOT32.P**



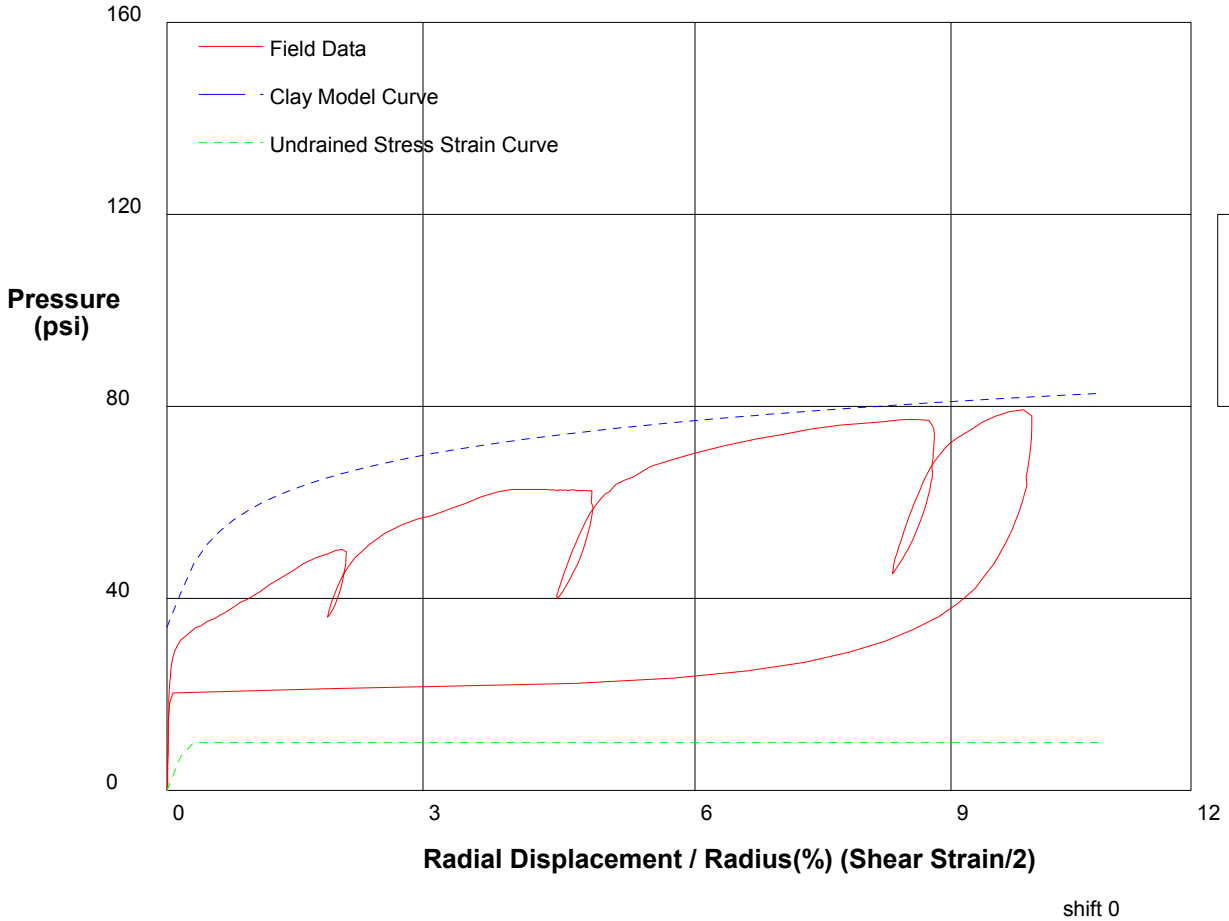
GIBSON'S CLAY MODEL

Shear Strength 6 psi
Insitu Stress 32 psi
Shear Modulus 1500 psi

shift 1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 66.3ft	File C:\DATA\ISE-771\DOT33.P

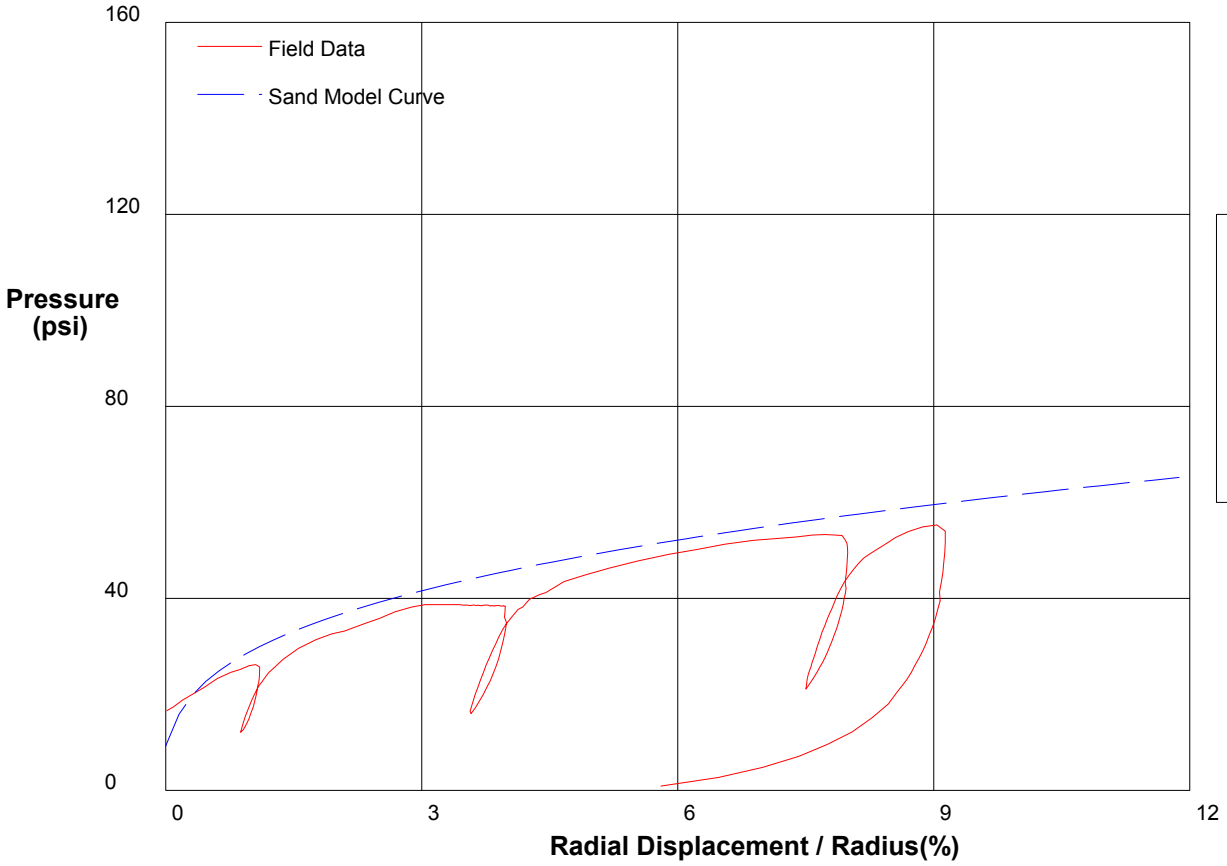


GIBSON'S CLAY MODEL

Shear Strength	10	psi
Insitu Stress	34	psi
Shear Modulus	2200	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 66.3ft	File C:\DATA\ISE-771\DOT33.P



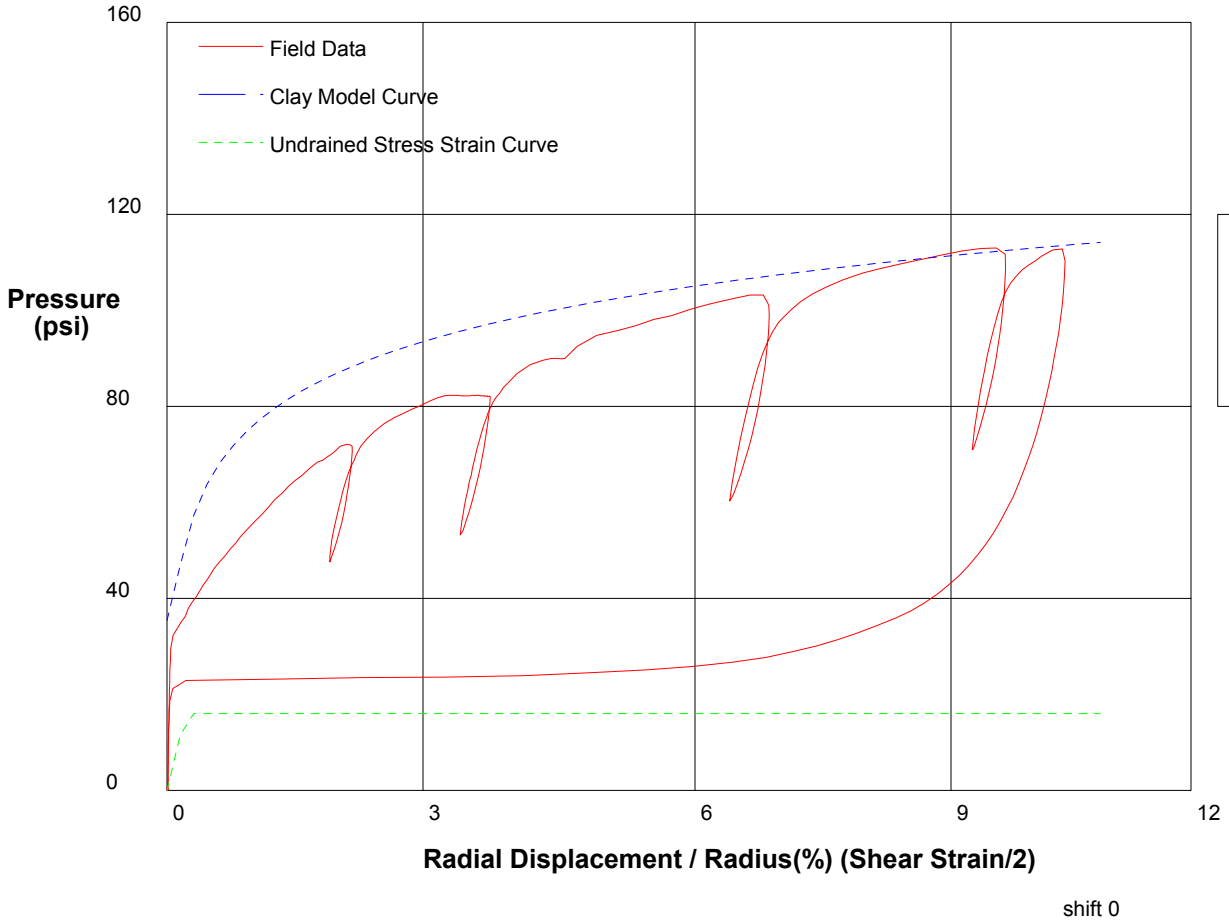
THE In Situ Engineering SAND MODEL

Water Pressure	24 psi
Friction Angle	29 deg
Critical Friction Angle	29 deg
Lateral Stress	9.3 psi
Shear Modulus	2200 psi

shift 1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 69.3ftft	File C:\DATA\ISE-771\DOT34.P

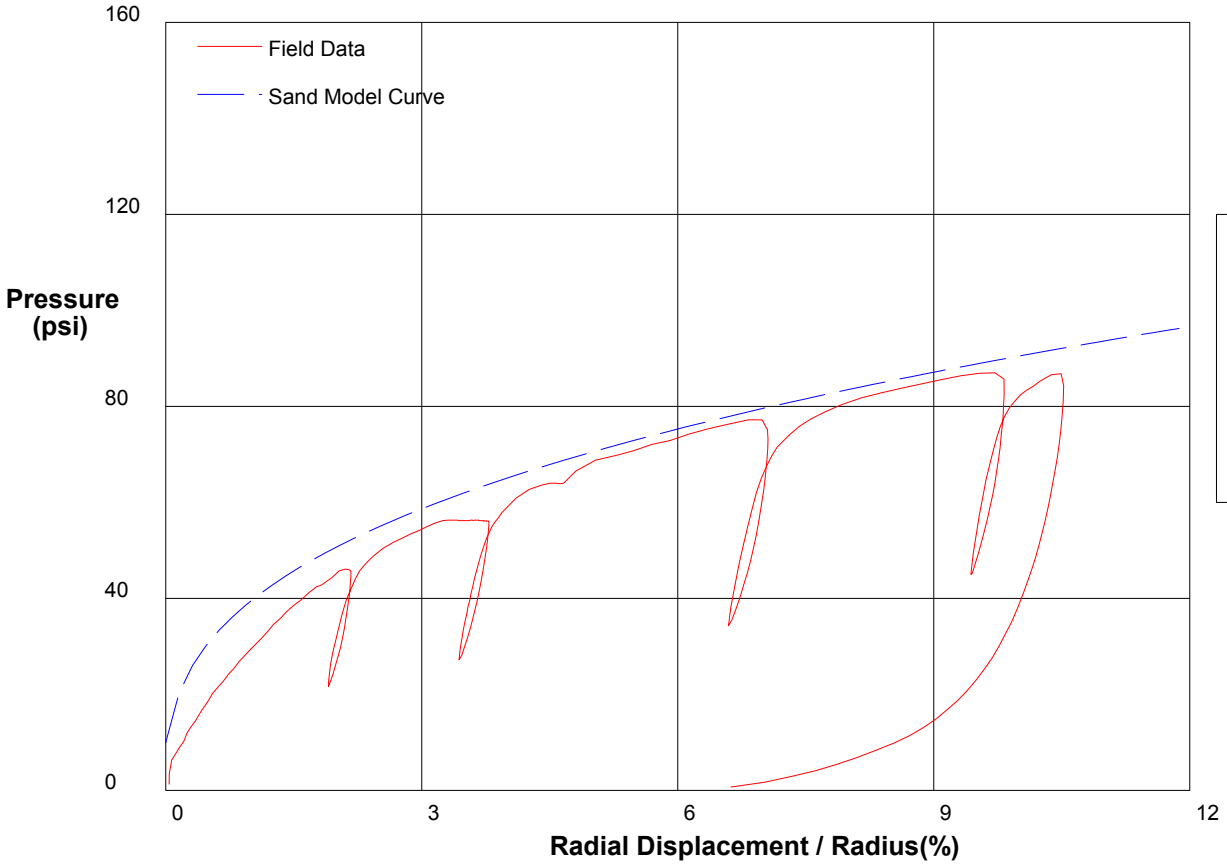


GIBSON'S CLAY MODEL

Shear Strength	16 psi
Insitu Stress	35.4 psi
Shear Modulus	3700 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 69.3ftft	File C:\DATA\ISE-771\DOT34.P



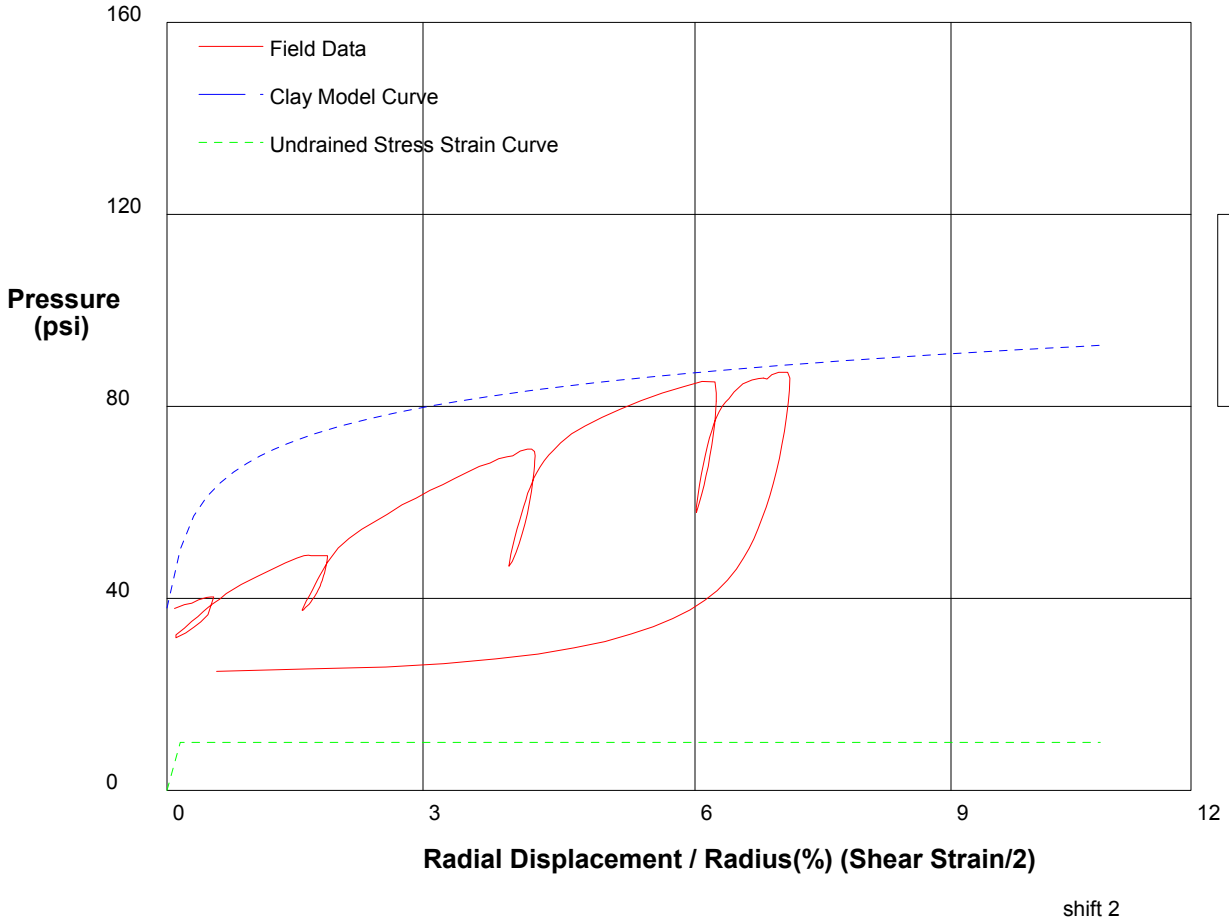
THE In Situ Engineering SAND MODEL

Water Pressure	26 psi
Friction Angle	33 deg
Critical Friction Angle	32 deg
Lateral Stress	10 psi
Shear Modulus	3700 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 73.3ft	File C:\DATA\ISE-771\DOT35.P

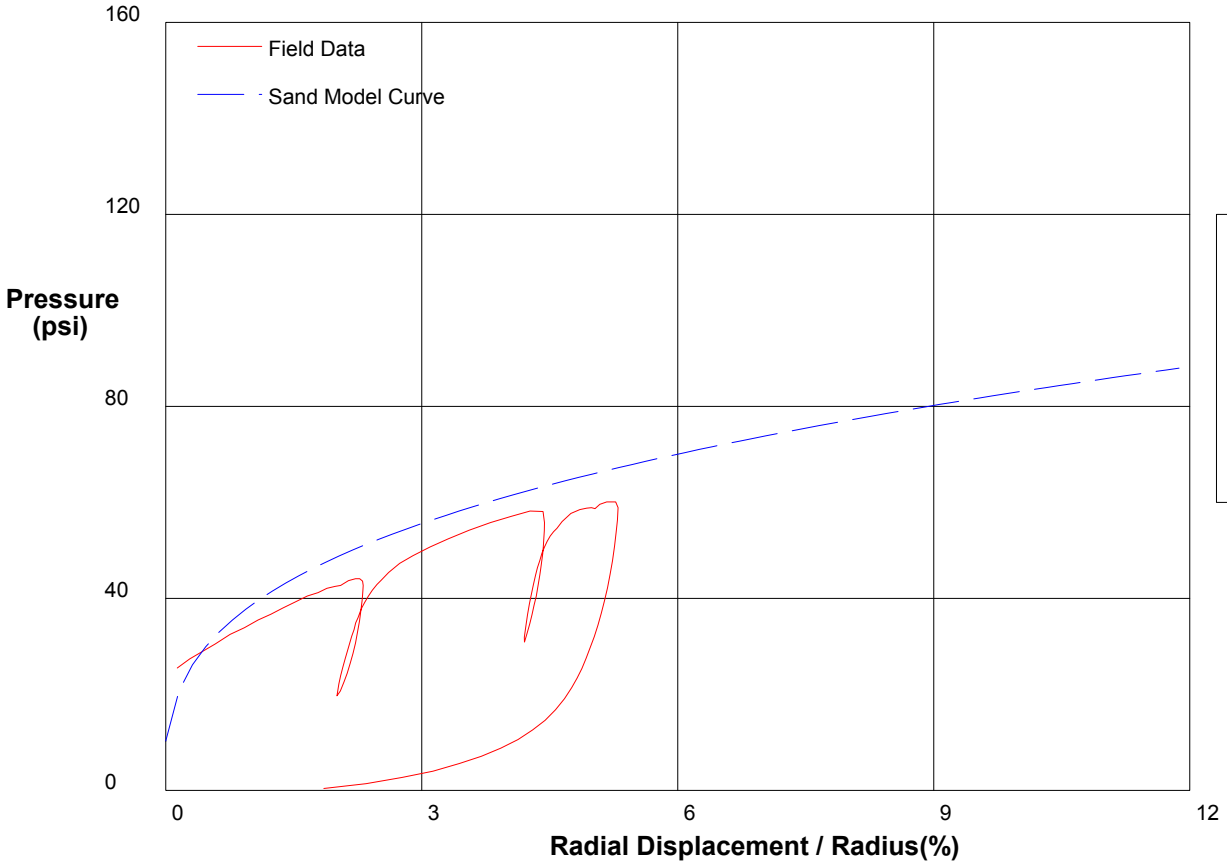


GIBSON'S CLAY MODEL

Shear Strength	10 psi
Insitu Stress	38 psi
Shear Modulus	4000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 73.3ft	File C:\DATA\ISE-771\DOT35.P



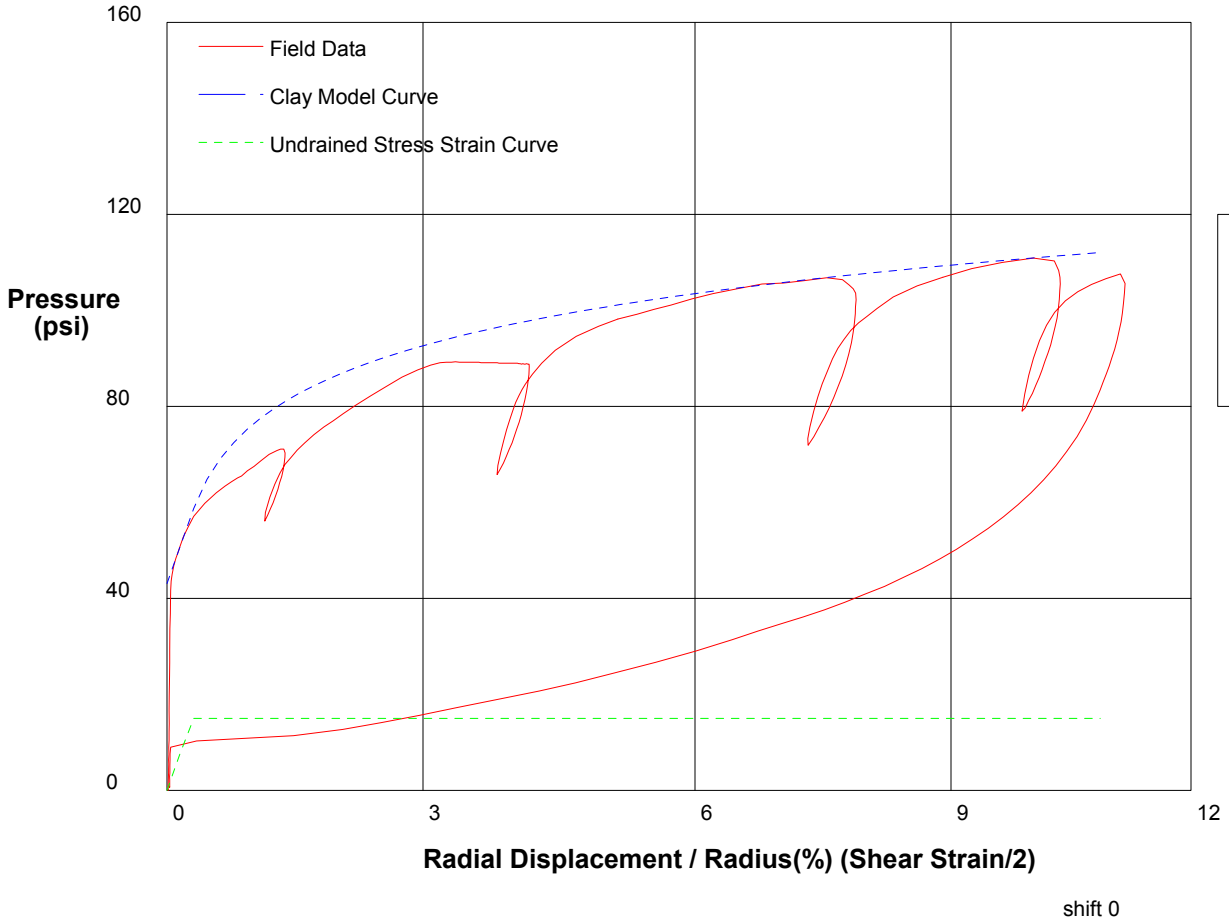
THE In Situ Engineering SAND MODEL

Water Pressure	27 psi
Friction Angle	30 deg
Critical Friction Angle	30 deg
Lateral Stress	10.3 psi
Shear Modulus	4000 psi

shift 4

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 83.3ftft	File C:\DATA\ISE-771\DOT37.P

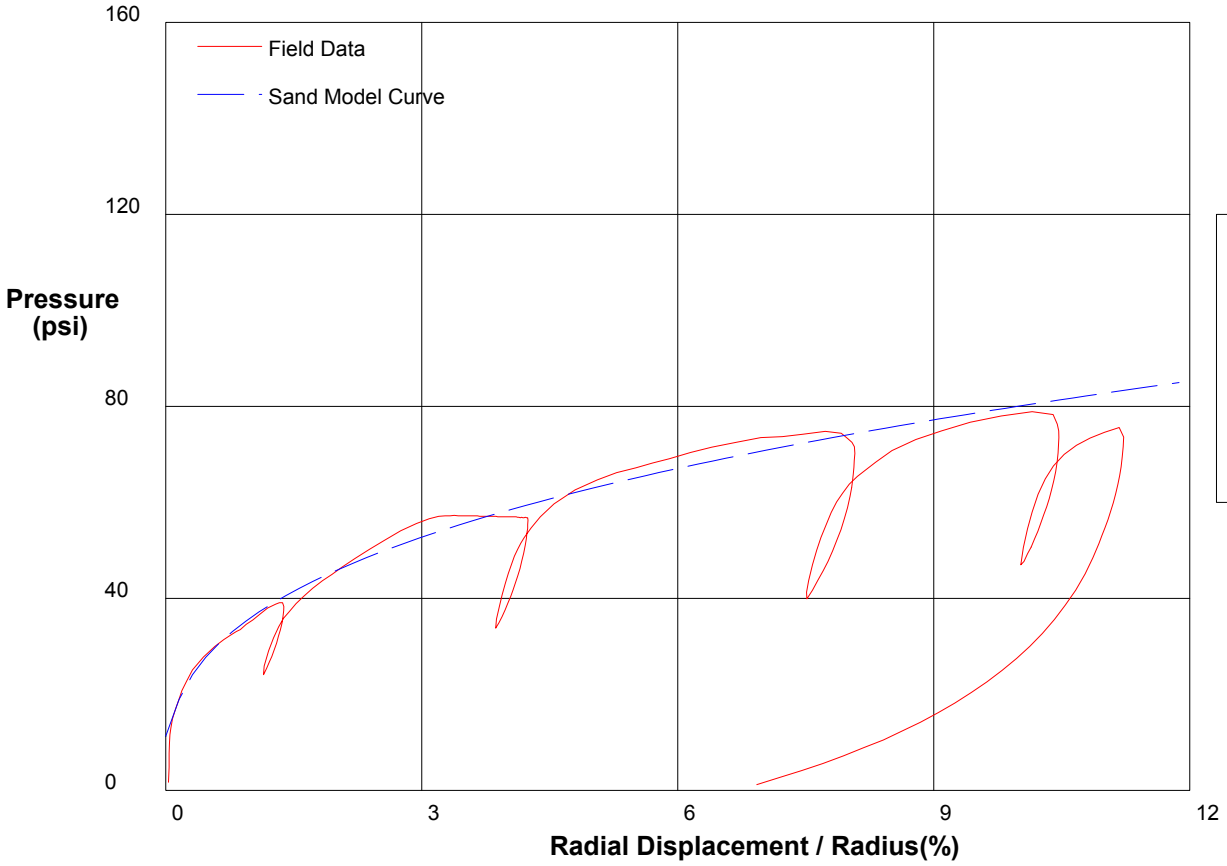


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	43.1 psi
Shear Modulus	2500 psi

In Situ Engineering

PRESSUREMETER DATA		Washington Department of Transportation
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 83.3ftft	File C:\DATA\ISE-771\DOT37.P



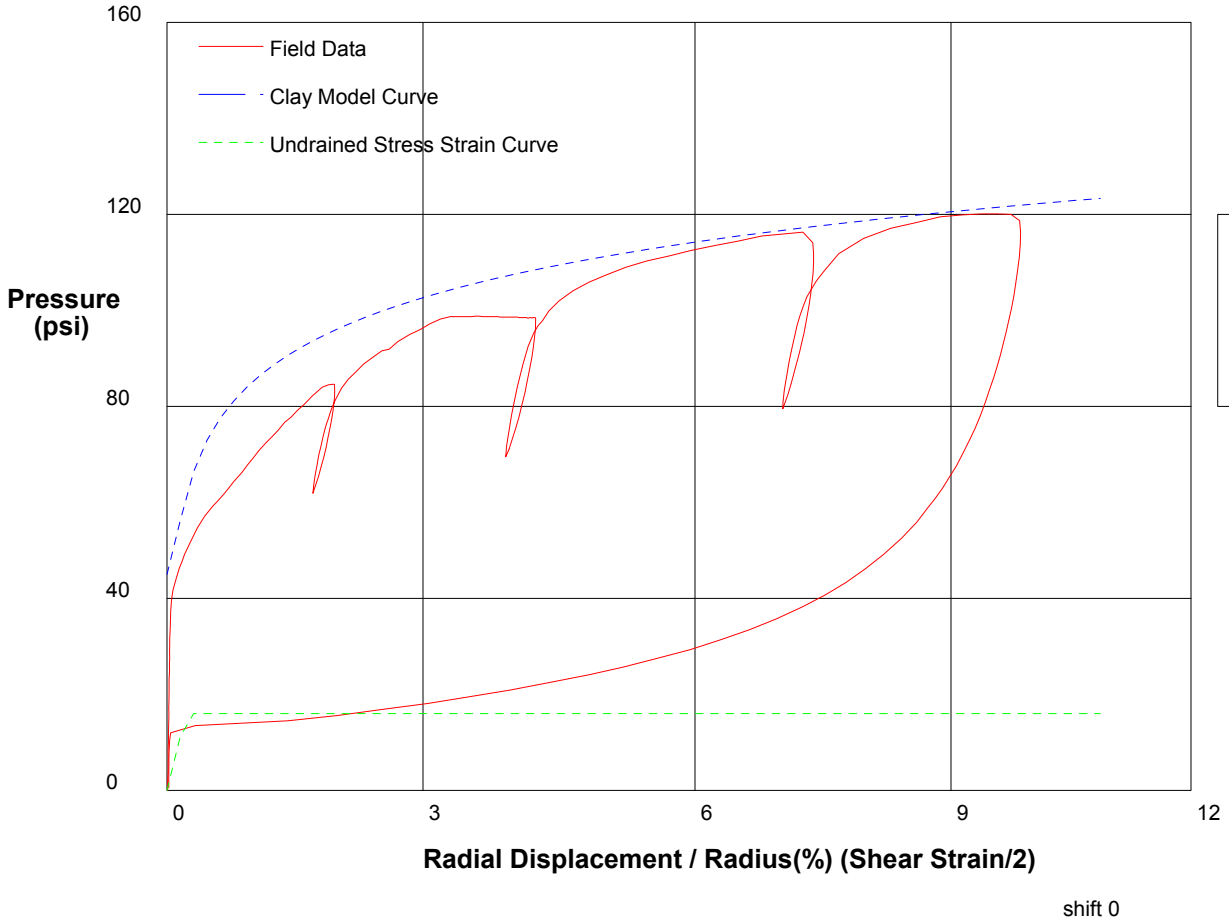
shift 0

THE In Situ Engineering SAND MODEL

Water Pressure	32 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	11.3 psi
Shear Modulus	2500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 86.3ft	File C:\DATA\ISE-771\DOT38.P

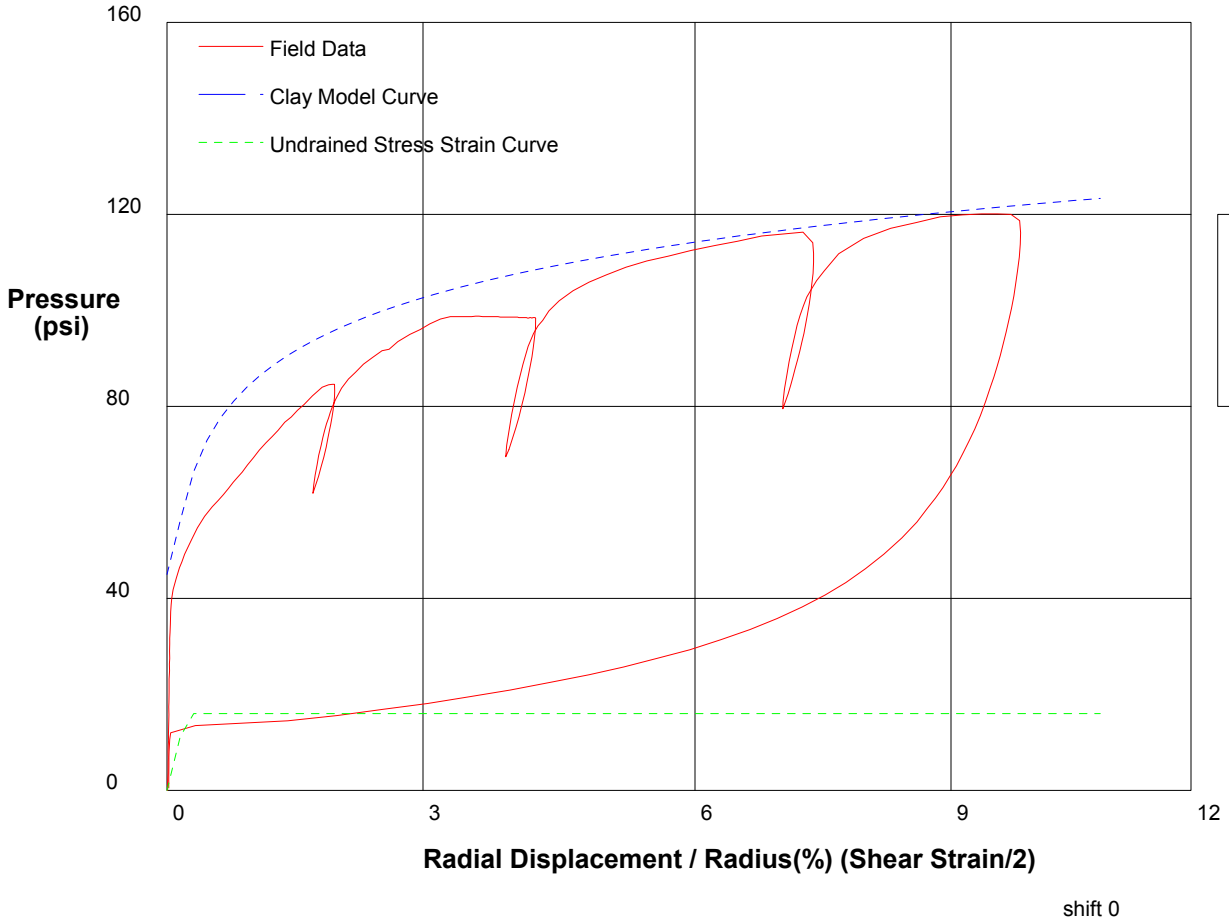


GIBSON'S CLAY MODEL

Shear Strength	16	psi
Insitu Stress	45	psi
Shear Modulus	3600	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 86.3ft	File C:\DATA\ISE-771\DOT38.P

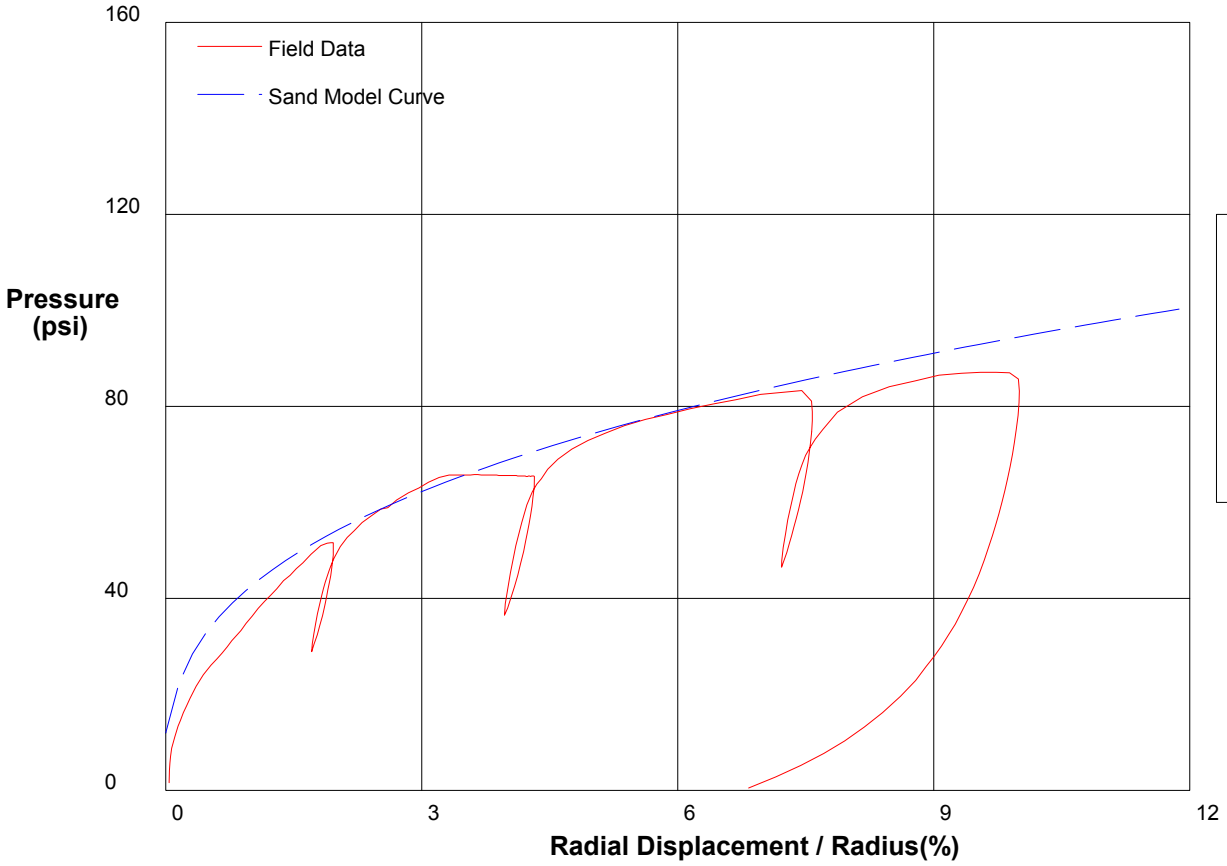


GIBSON'S CLAY MODEL

Shear Strength	16	psi
Insitu Stress	45	psi
Shear Modulus	3600	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 86.3ft	File C:\DATA\ISE-771\DOT38.P



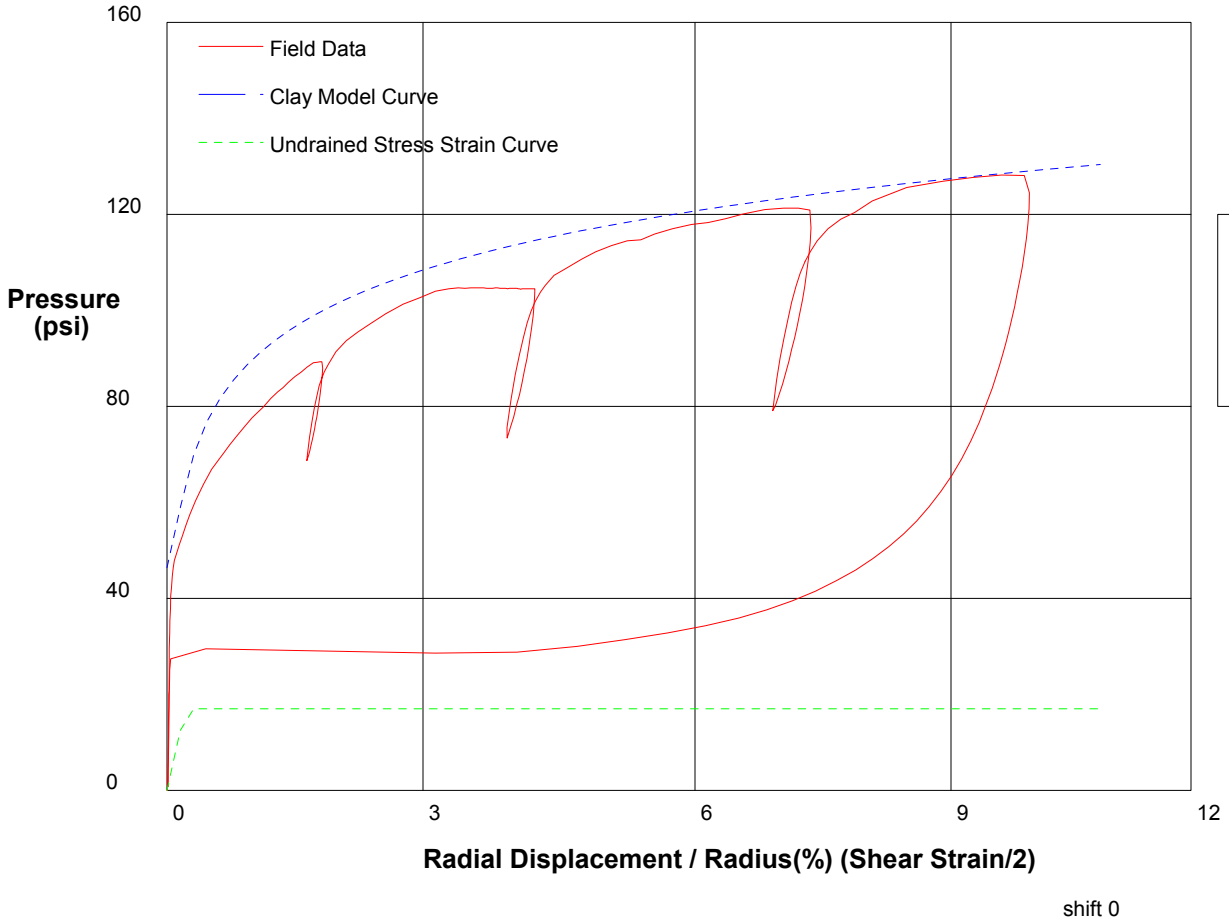
shift 0

THE In Situ Engineering SAND MODEL

Water Pressure	33 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	12 psi
Shear Modulus	3600 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 89.3ft	File C:\DATA\ISE-771\DOT39.P

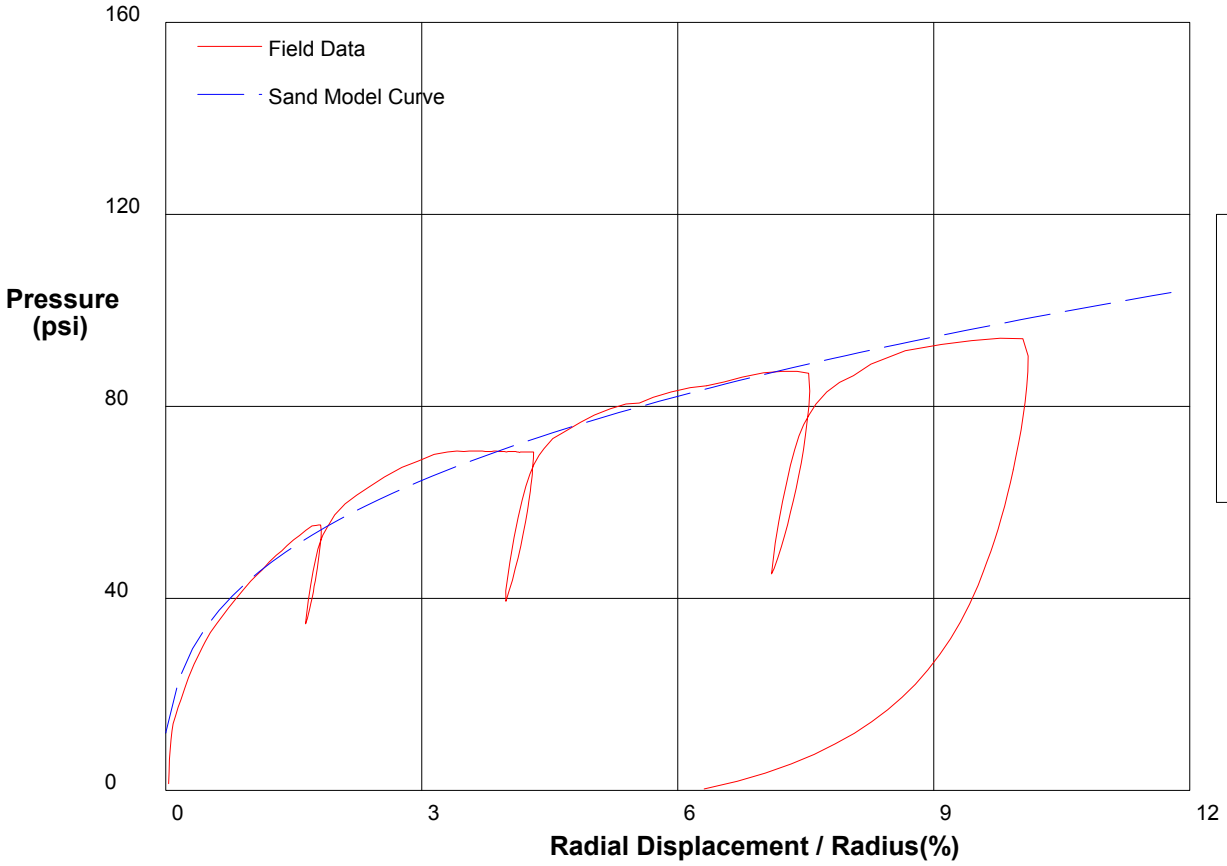


GIBSON'S CLAY MODEL

Shear Strength	17 psi
Insitu Stress	46.4 psi
Shear Modulus	4000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/10/2008
Hole No. th30pm	Depth 89.3ft	File C:\DATA\ISE-771\DOT39.P



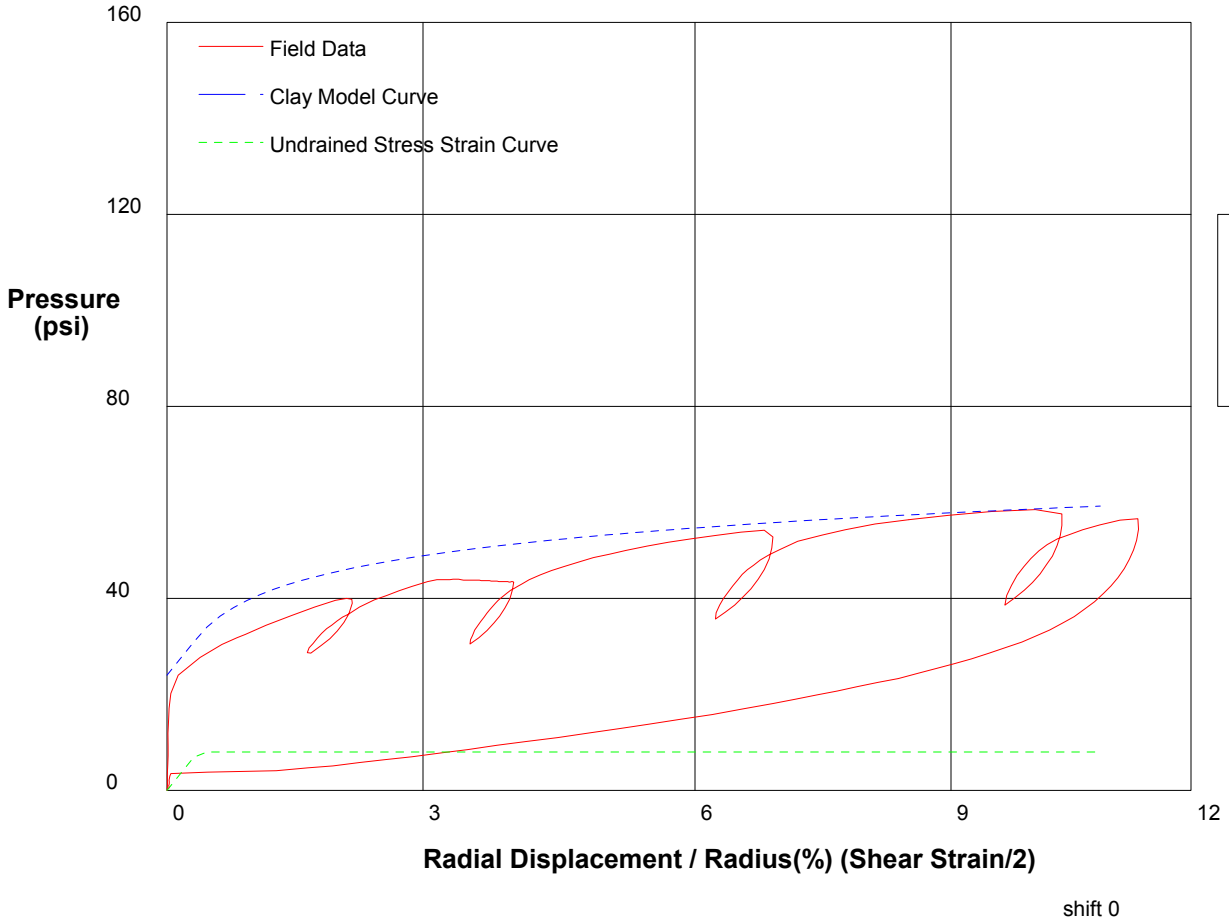
shift 0

THE In Situ Engineering SAND MODEL

Water Pressure	34 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	12 psi
Shear Modulus	4000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/11/2008
Hole No. th28pm	Depth 48.3ft	File C:\DATA\ISE-771\DOT44.P

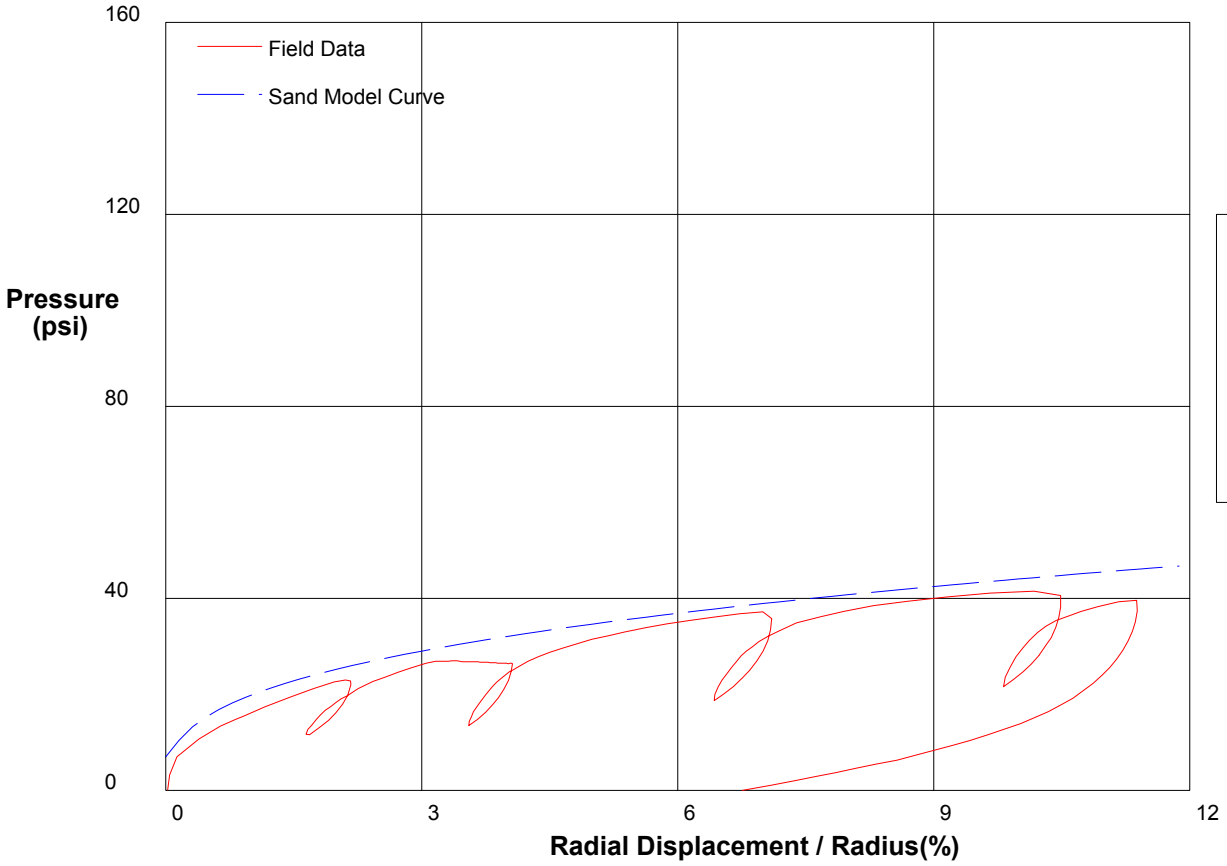


GIBSON'S CLAY MODEL

Shear Strength	8 psi
Insitu Stress	24 psi
Shear Modulus	1100 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/11/2008
Hole No. th28pm	Depth 48.3ft	File C:\DATA\ISE-771\DOT44.P



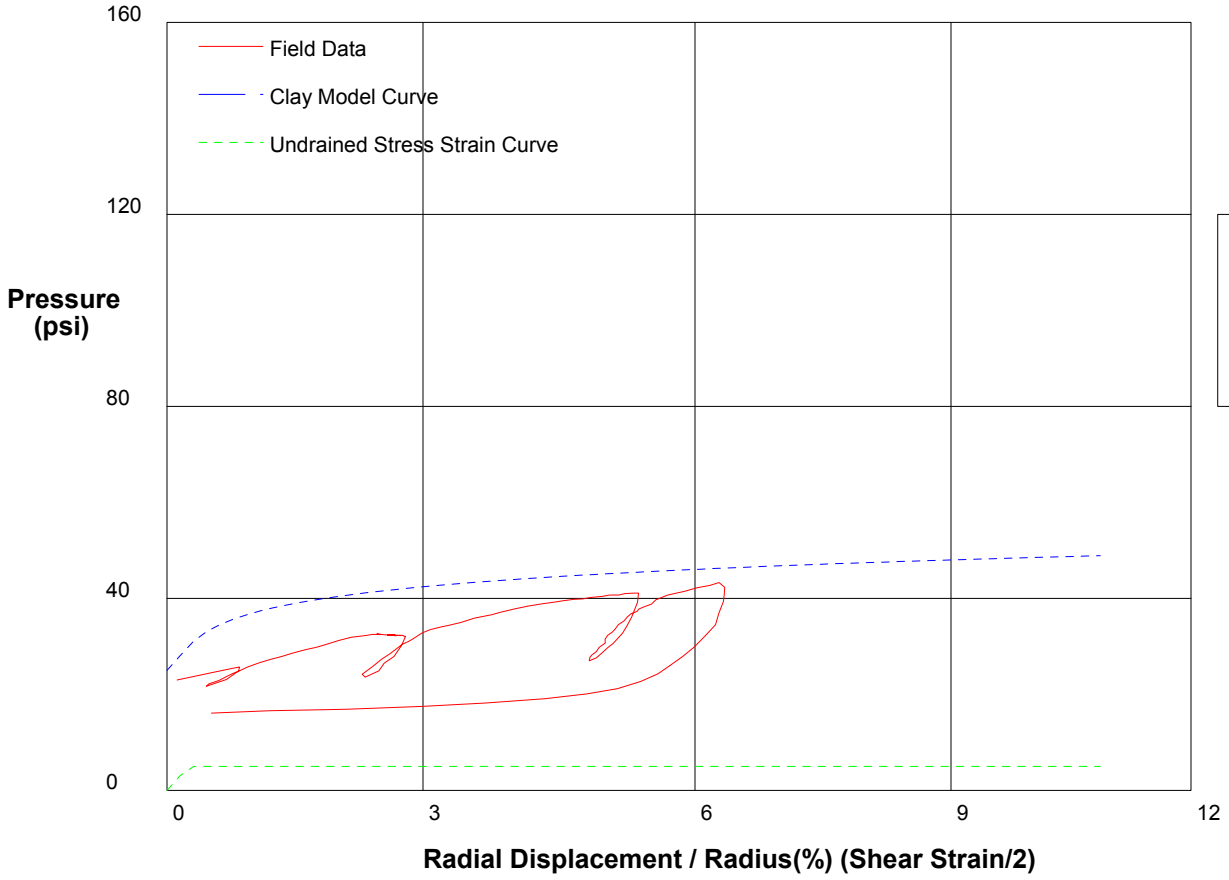
shift 0

THE In Situ Engineering SAND MODEL

Water Pressure	17 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	7 psi
Shear Modulus	1100 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/11/2008
Hole No. th28pm	Depth 51.3ft	File C:\DATA\ISE-771\DOT45.P



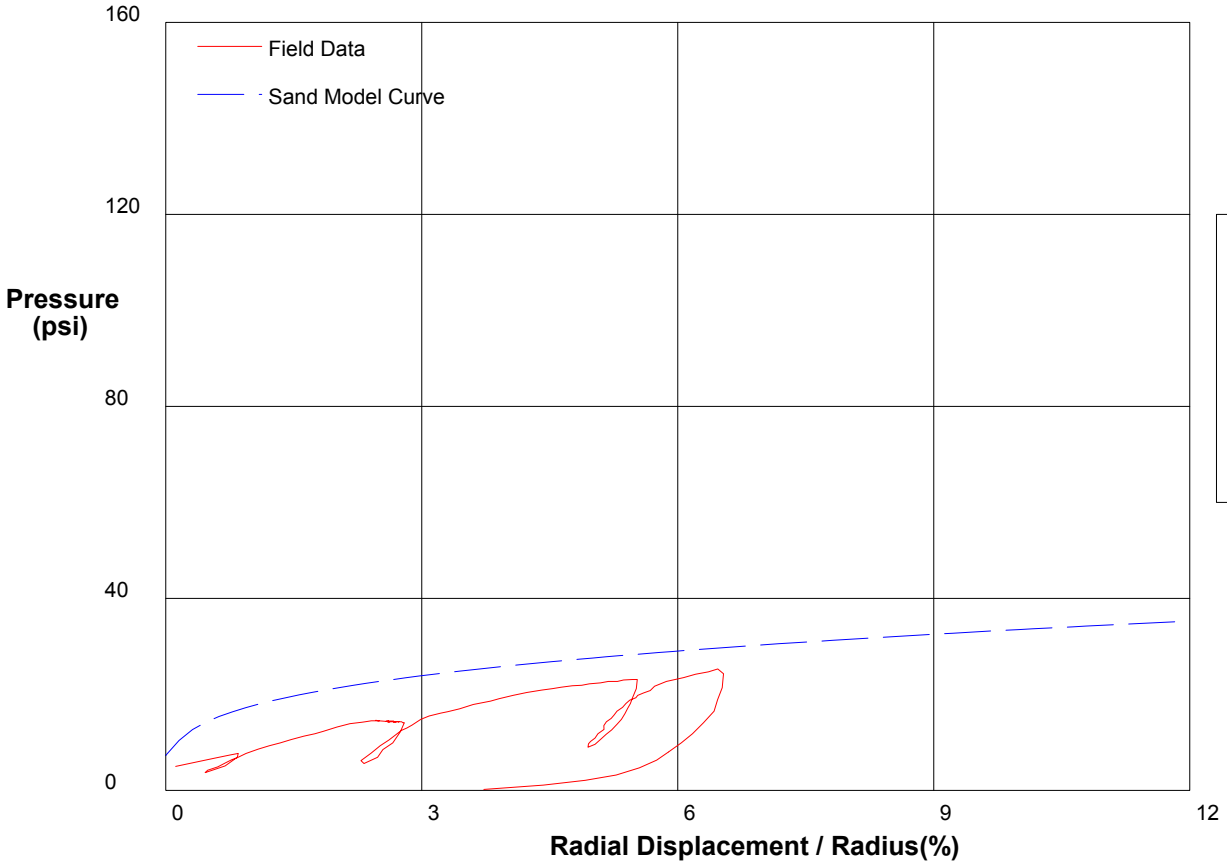
GIBSON'S CLAY MODEL

Shear Strength	5 psi
Insitu Stress	25 psi
Shear Modulus	1000 psi

shift 2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/11/2008
Hole No. th28pm	Depth 51.3ft	File C:\DATA\ISE-771\DOT45.P



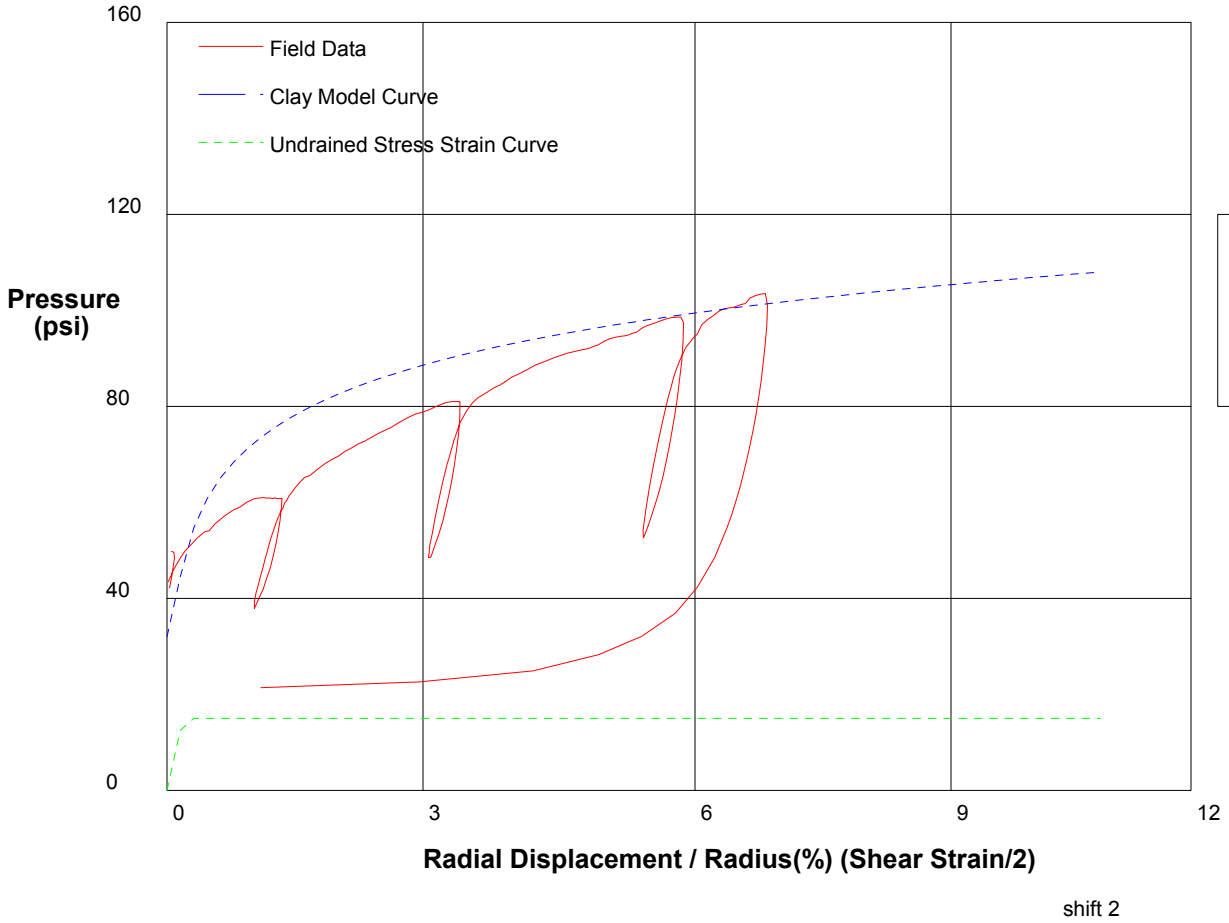
THE In Situ Engineering SAND MODEL

Water Pressure	18 psi
Friction Angle	23 deg
Critical Friction Angle	23 deg
Lateral Stress	7.3 psi
Shear Modulus	1000 psi

shift 2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 63.3ft	File C:\DATA\ISE-771\DOT48.P

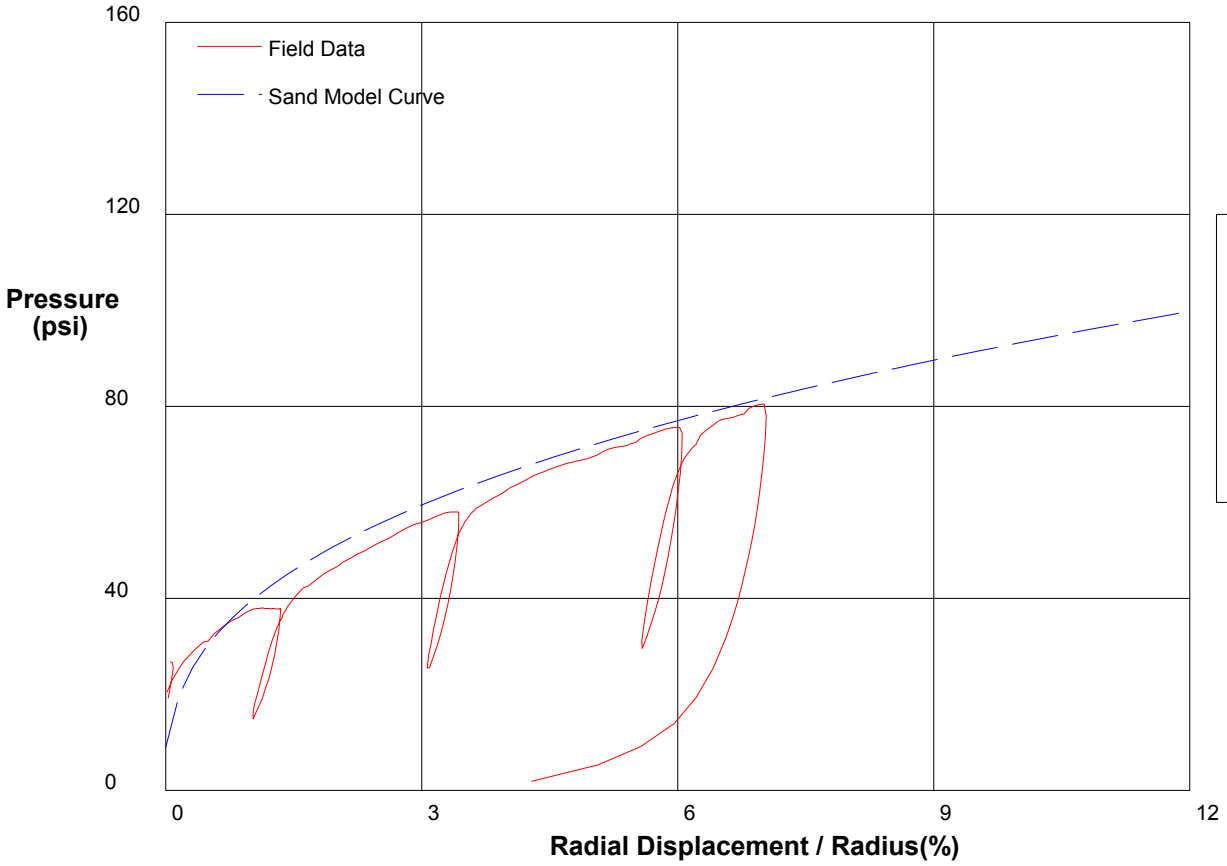


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	32 psi
Shear Modulus	4000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 63.3ft	File C:\DATA\ISE-771\DOT48.P



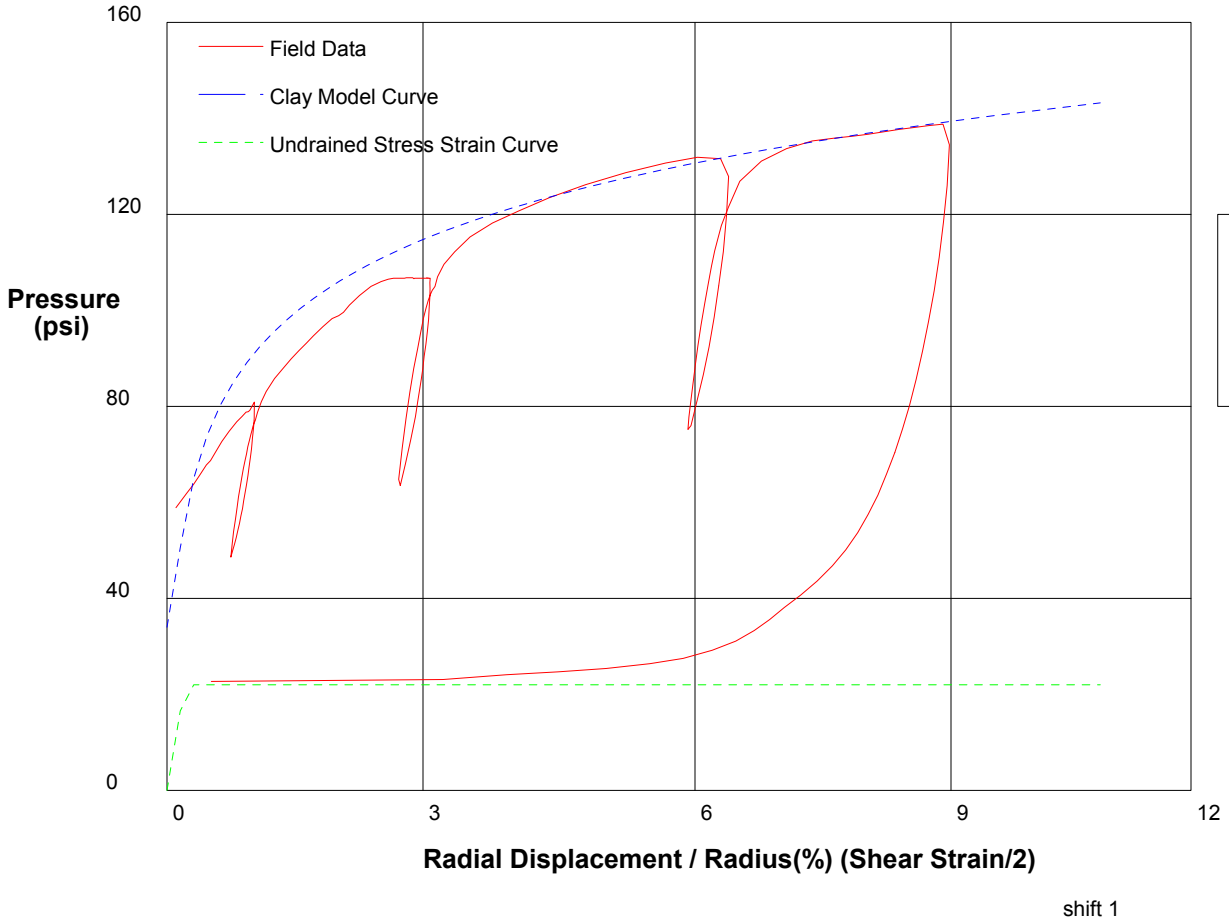
THE In Situ Engineering SAND MODEL

Water Pressure	23 psi
Friction Angle	34 deg
Critical Friction Angle	32 deg
Lateral Stress	9 psi
Shear Modulus	4000 psi

shift 2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 66.3ft	File C:\DATA\ISE-771\DOT49.P

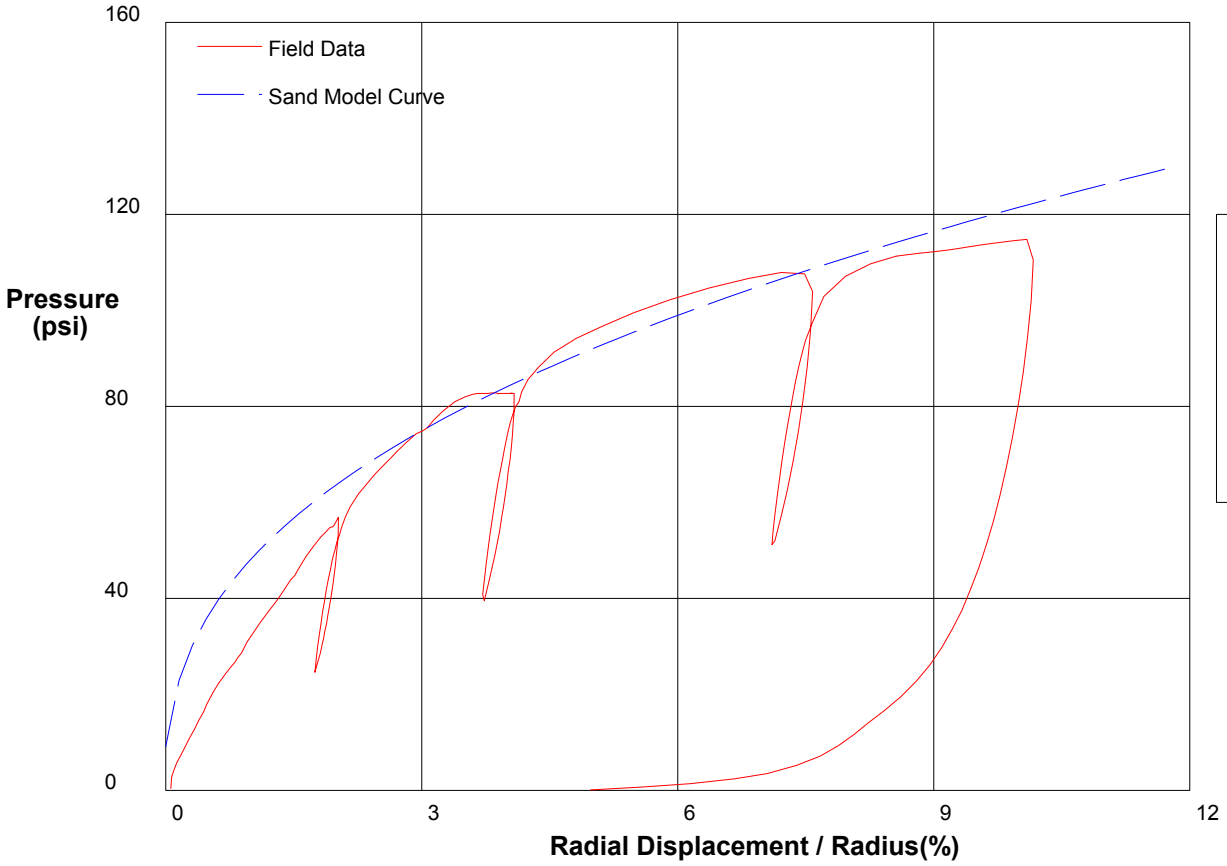


GIBSON'S CLAY MODEL

Shear Strength	22	psi
Insitu Stress	34	psi
Shear Modulus	5300	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 66.3ft	File C:\DATA\ISE-771\DOT49.P



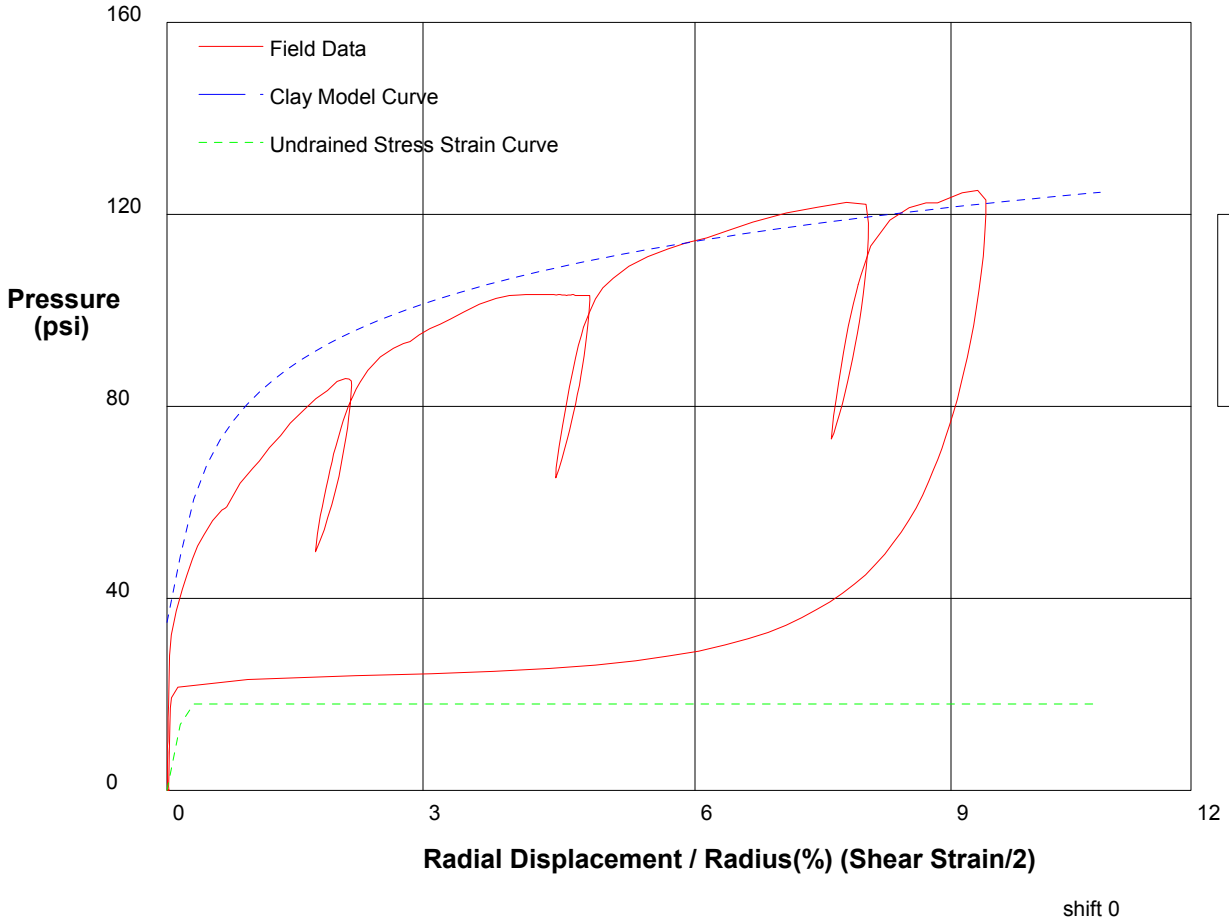
THE In Situ Engineering SAND MODEL

Water Pressure	24 psi
Friction Angle	36 deg
Critical Friction Angle	32 deg
Lateral Stress	9.2 psi
Shear Modulus	5300 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 69.3ft	File C:\DATA\ISE-771\DOT50.P

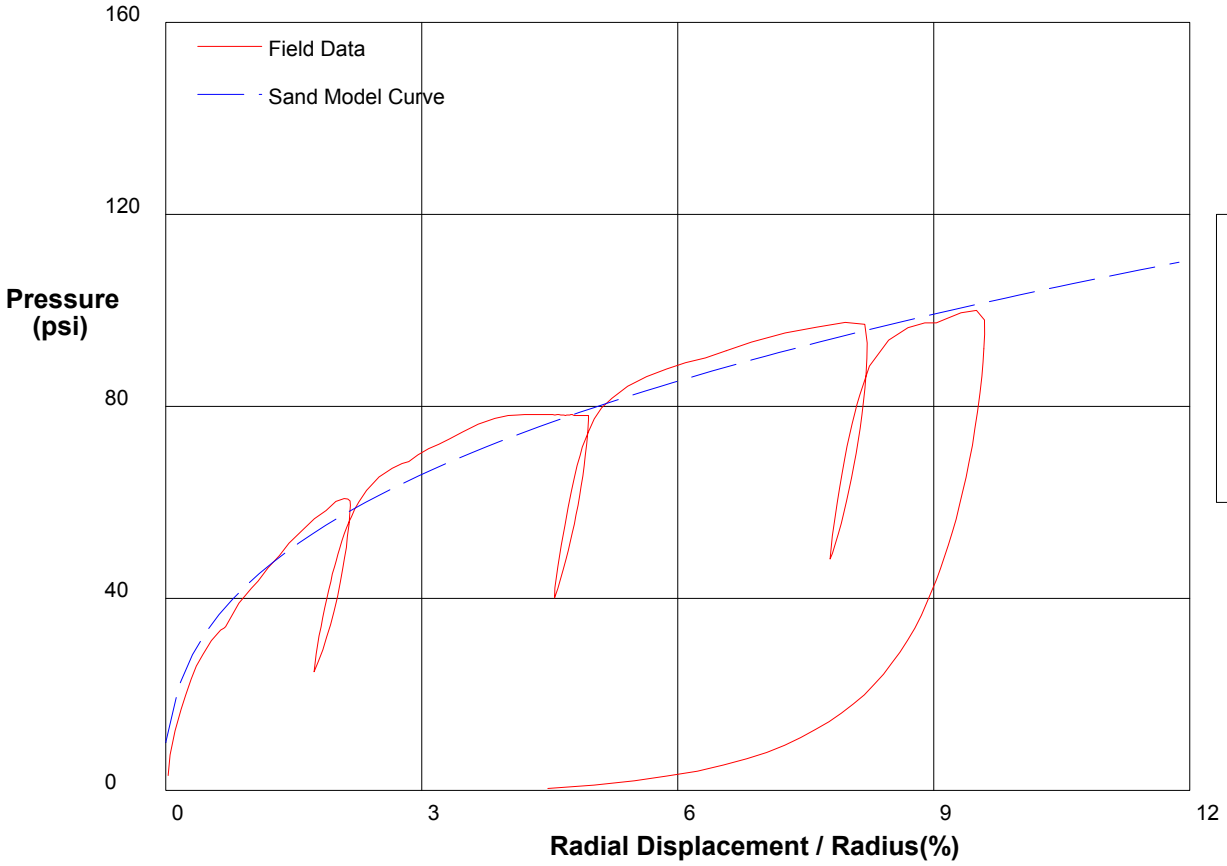


GIBSON'S CLAY MODEL

Shear Strength	18	psi
Insitu Stress	35	psi
Shear Modulus	4400	psi

In Situ Engineering

PRESSUREMETER DATA		Washington Department of Transportation
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 69.3ft	File C:\DATA\ISE-771\DOT50.P



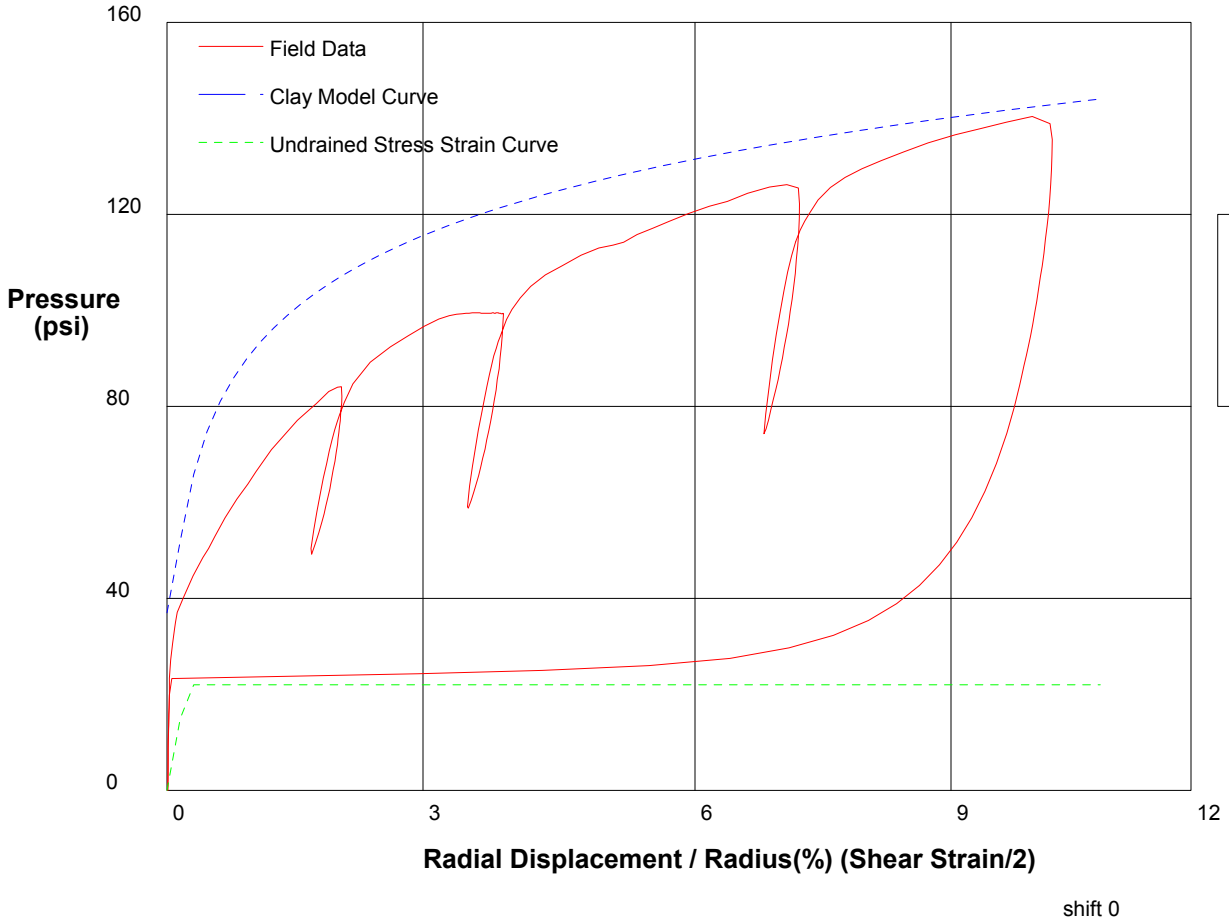
THE In Situ Engineering SAND MODEL

Water Pressure	25 psi
Friction Angle	34 deg
Critical Friction Angle	32 deg
Lateral Stress	10 psi
Shear Modulus	4400 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 72.3ft	File C:\DATA\ISE-771\DOT51.P

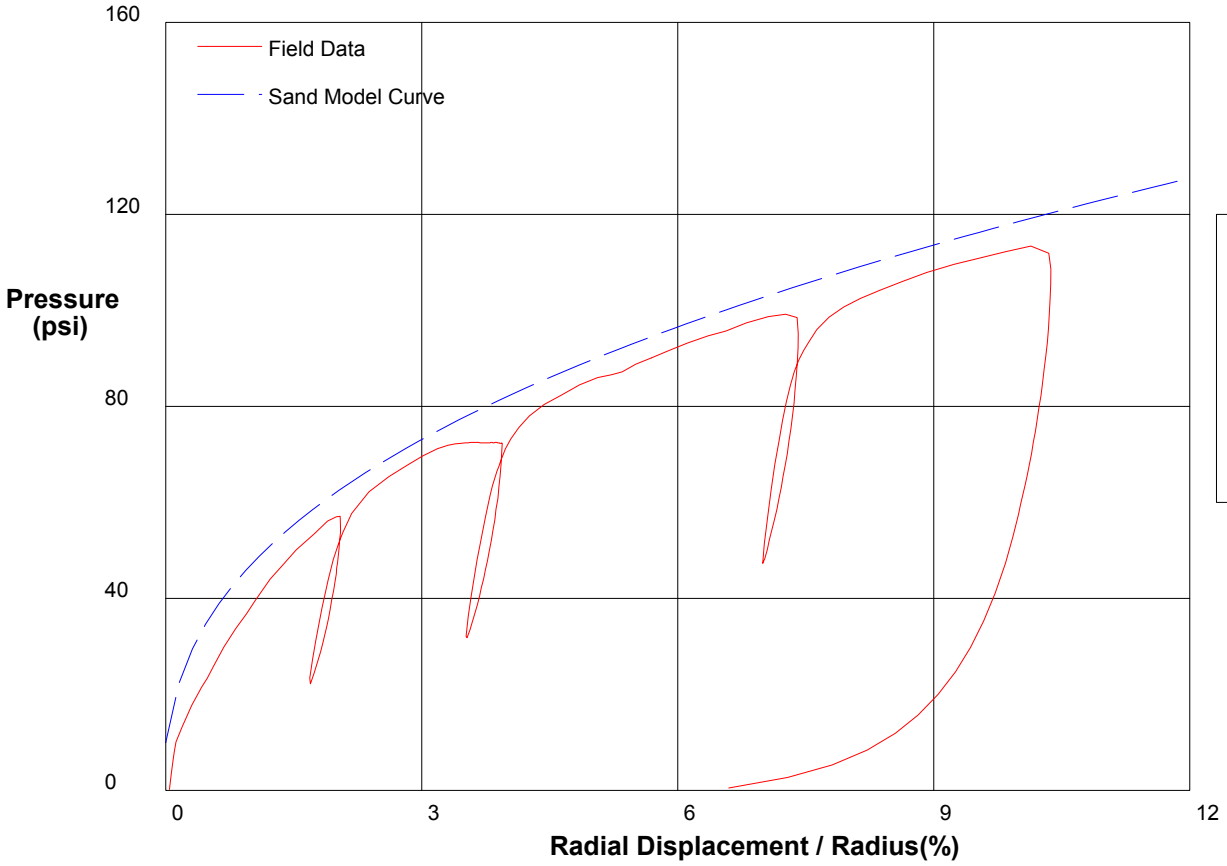


GIBSON'S CLAY MODEL

Shear Strength	22	psi
Insitu Stress	37	psi
Shear Modulus	4800	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 72.3ft	File C:\DATA\ISE-771\DOT51.P



THE In Situ Engineering SAND MODEL

Water Pressure	27 psi
Friction Angle	36 deg
Critical Friction Angle	32 deg
Lateral Stress	10 psi
Shear Modulus	4400 psi

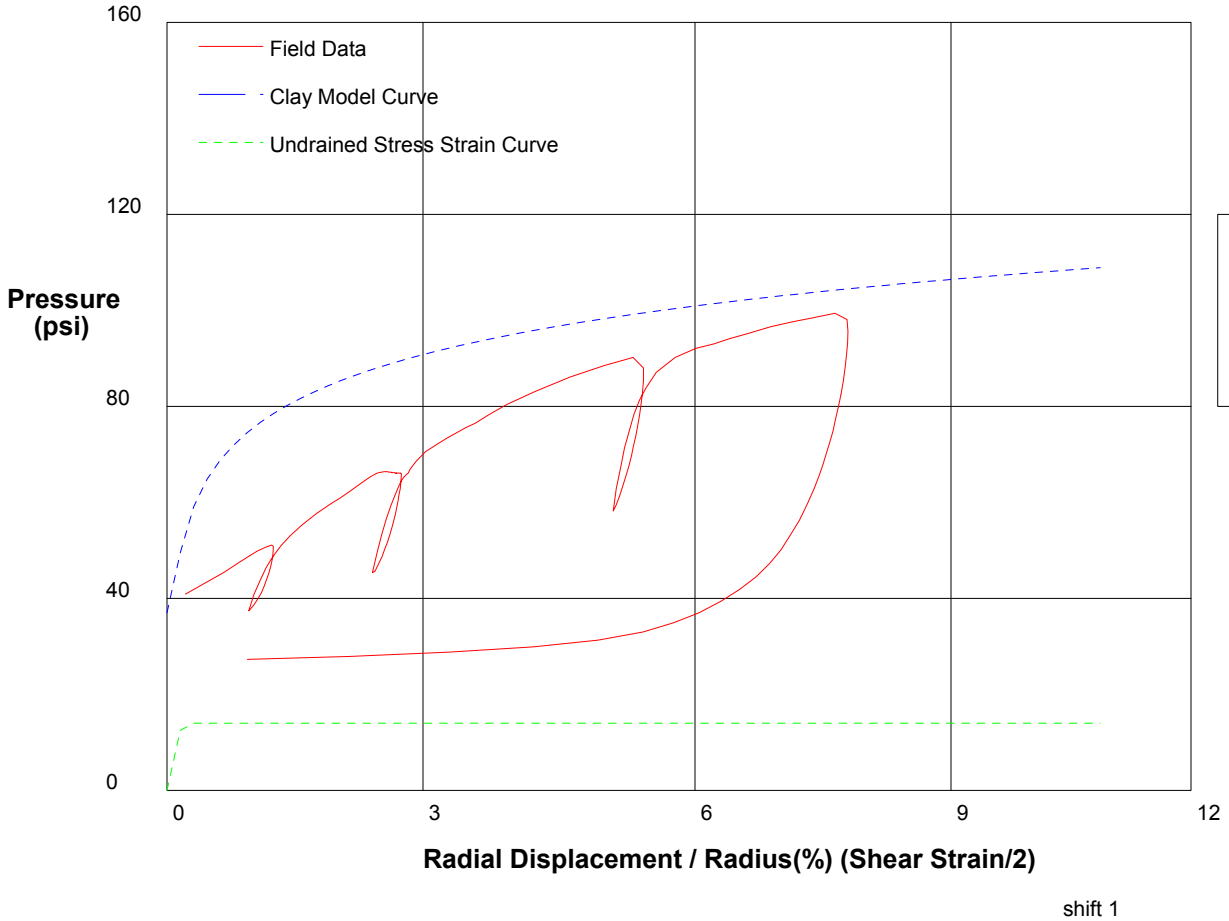
shift 0

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/12/2008**

Hole No. th28pm **Depth 78.2ft** **File C:\DATA\ISE-771\DOT52.P**

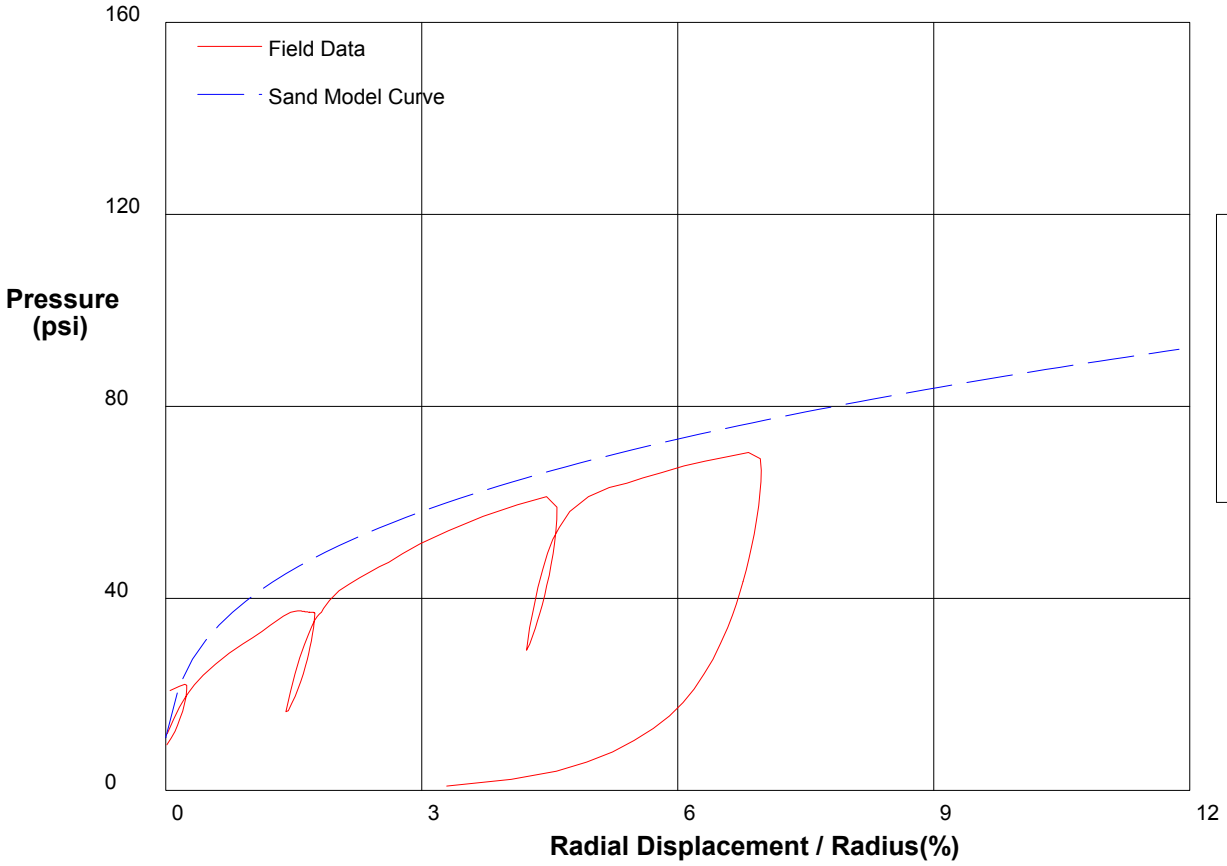


GIBSON'S CLAY MODEL

Shear Strength	**14**	**psi**
Insitu Stress	**37**	**psi**
Shear Modulus	**4000**	**psi**

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 78.2ft	File C:\DATA\ISE-771\DOT52.P



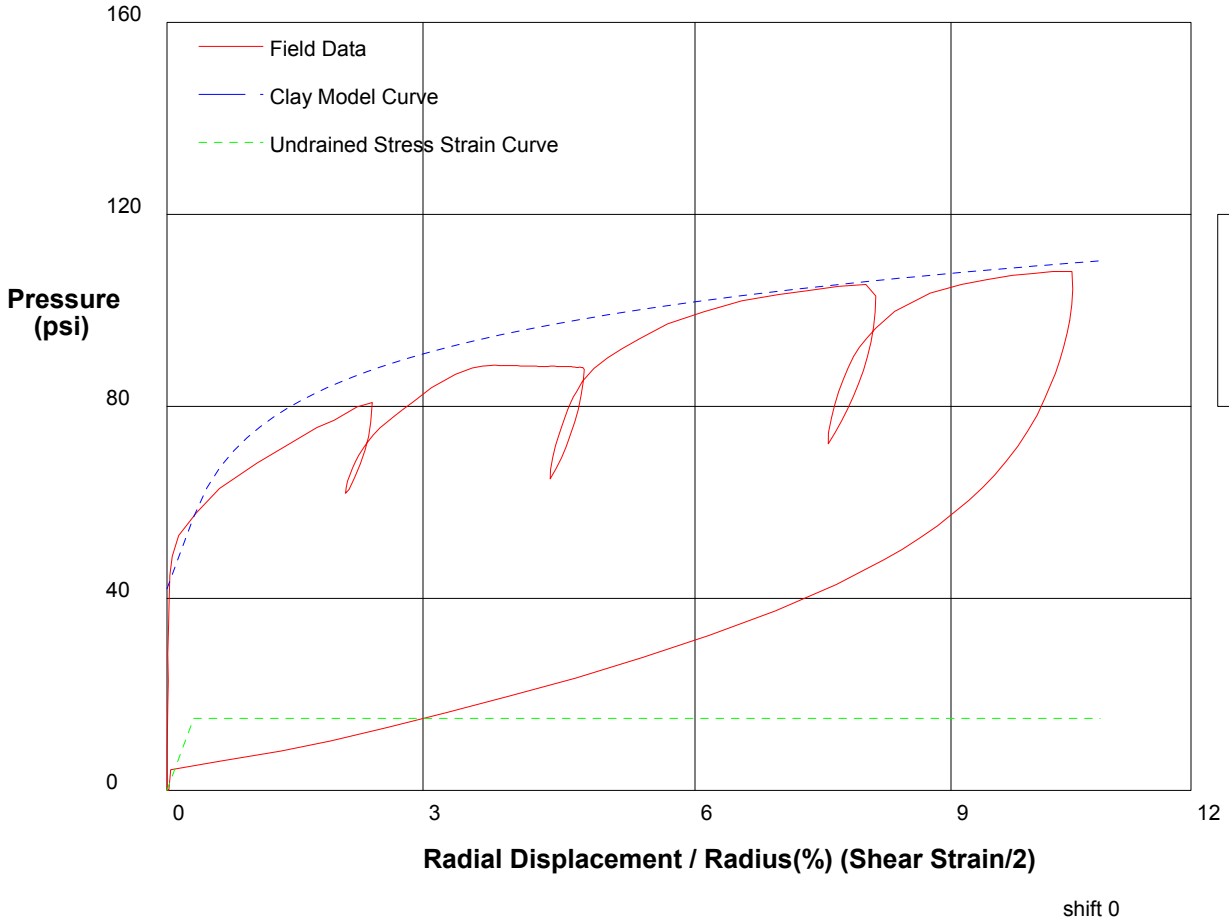
THE In Situ Engineering SAND MODEL

Water Pressure	29 psi
Friction Angle	30 deg
Critical Friction Angle	30 deg
Lateral Stress	11 psi
Shear Modulus	4000 psi

shift 2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 81.2ft	File C:\DATA\ISE-771\DOT53.P

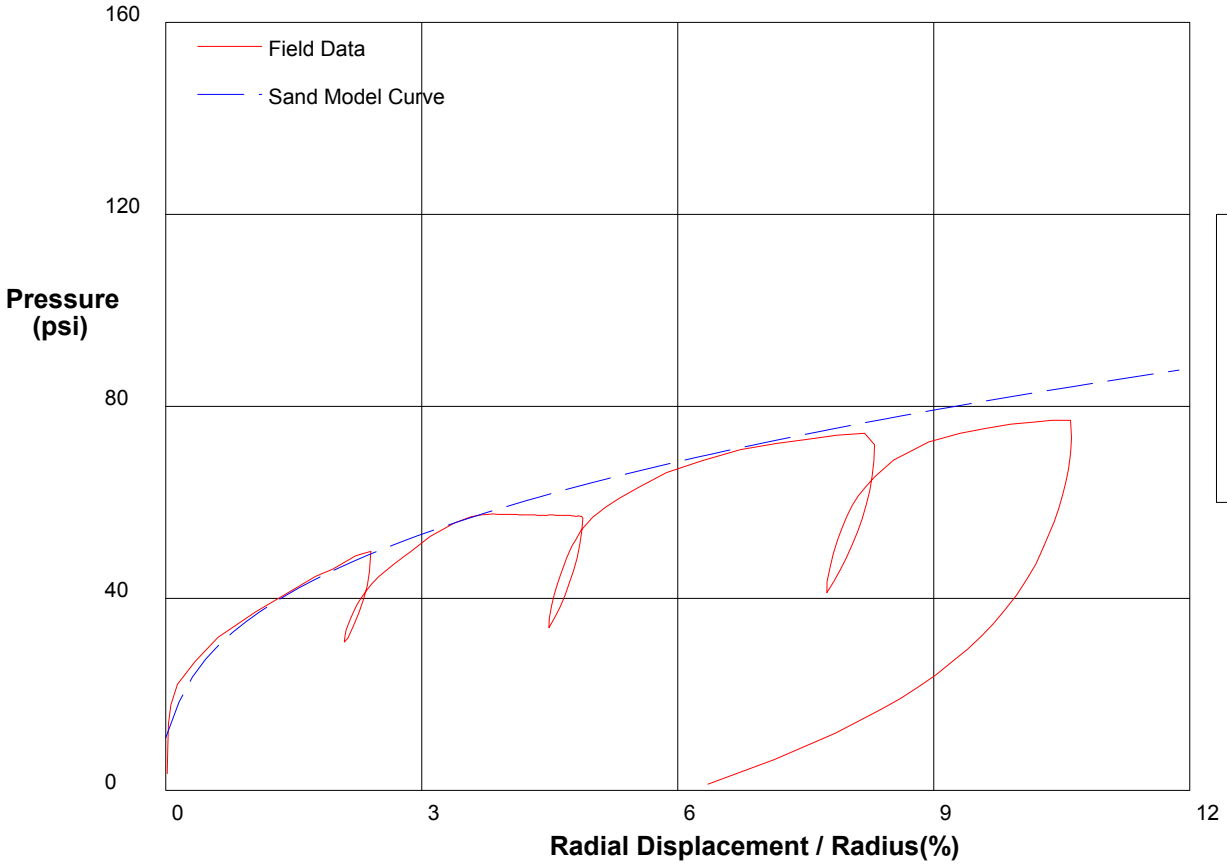


GIBSON'S CLAY MODEL

Shear Strength	15	psi
Insitu Stress	42	psi
Shear Modulus	2400	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 81.2ft	File C:\DATA\ISE-771\DOT53.P



THE In Situ Engineering SAND MODEL

Water Pressure	31 psi
Friction Angle	33 deg
Critical Friction Angle	32 deg
Lateral Stress	11 psi
Shear Modulus	2400 psi

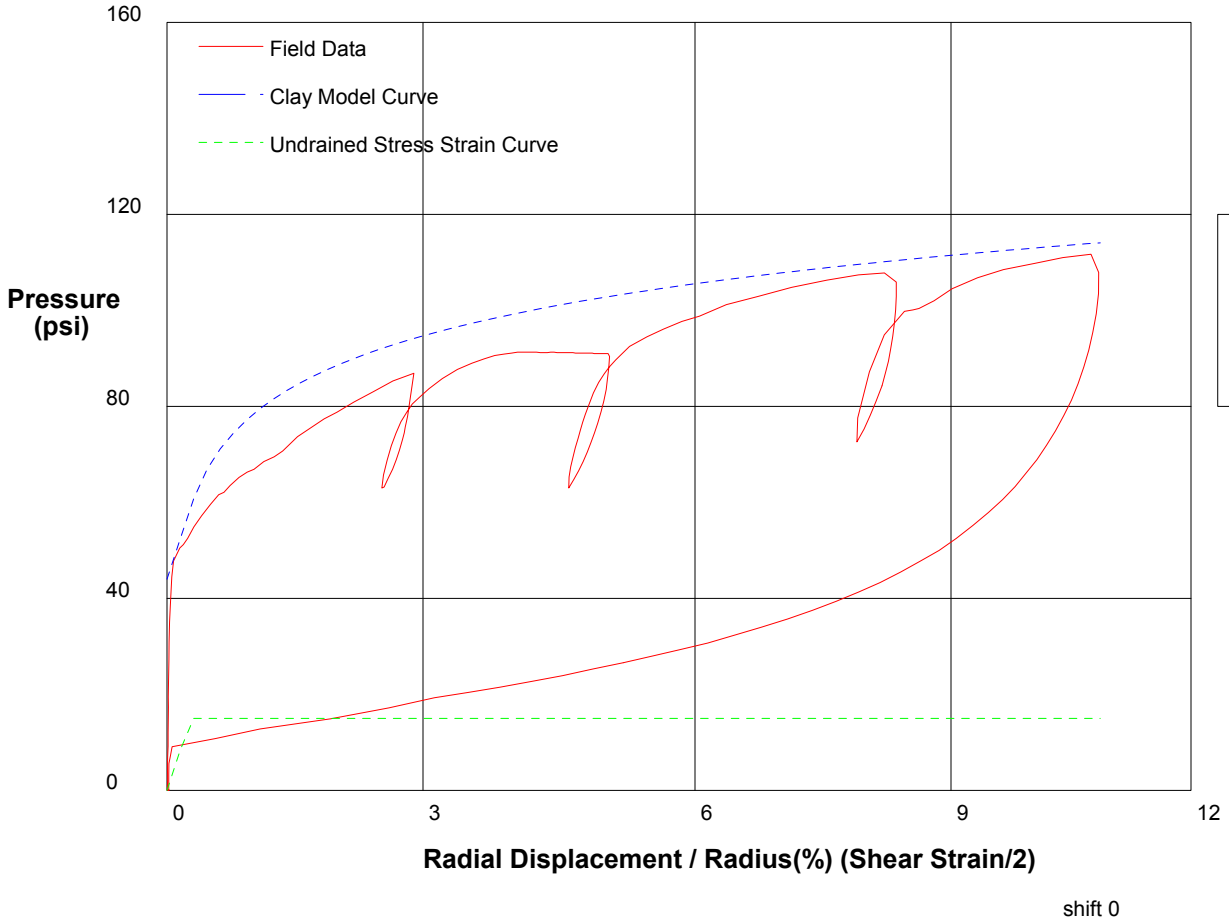
shift 0

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/12/2008**

Hole No. th28pm **Depth 84.2ft** **File C:\DATA\ISE-771\DOT54.P**

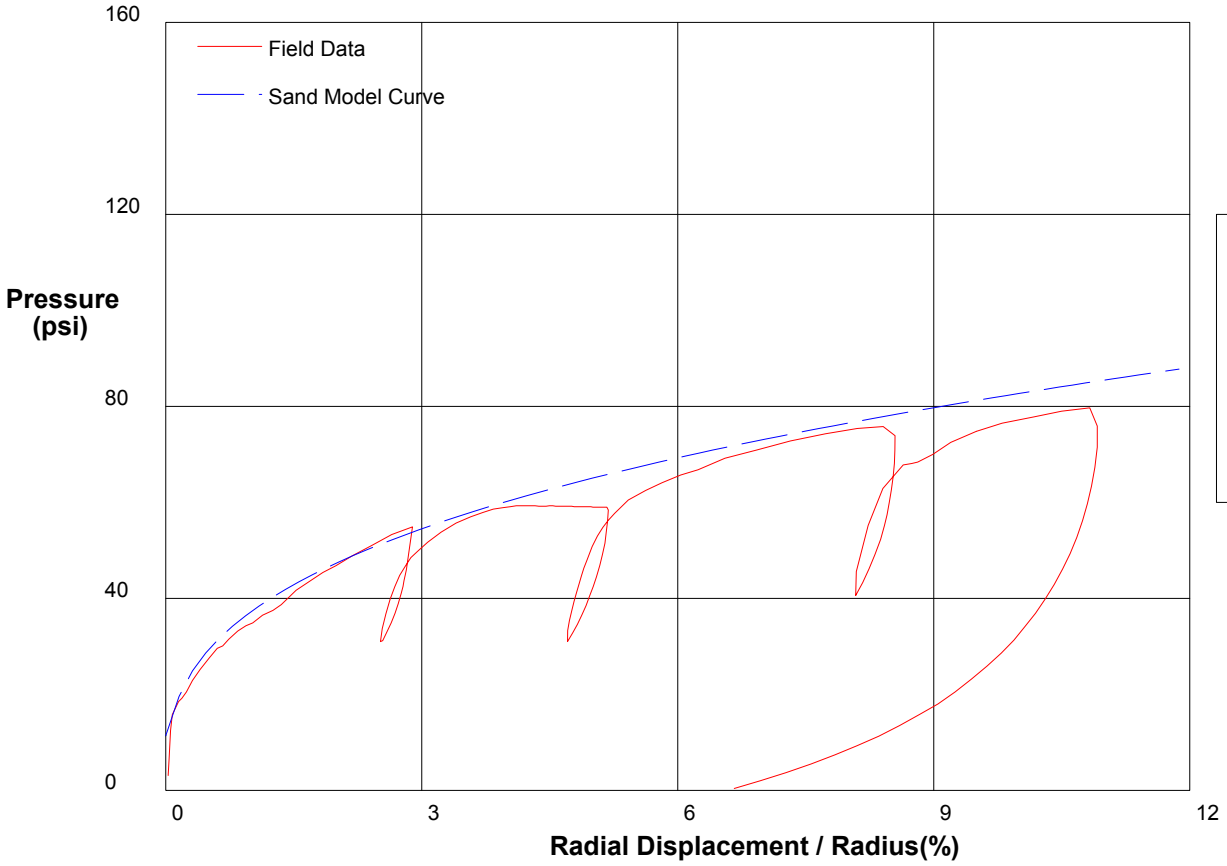


GIBSON'S CLAY MODEL

Shear Strength	**15**	**psi**
Insitu Stress	**44**	**psi**
Shear Modulus	**2700**	**psi**

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 84.2ft	File C:\DATA\ISE-771\DOT54.P



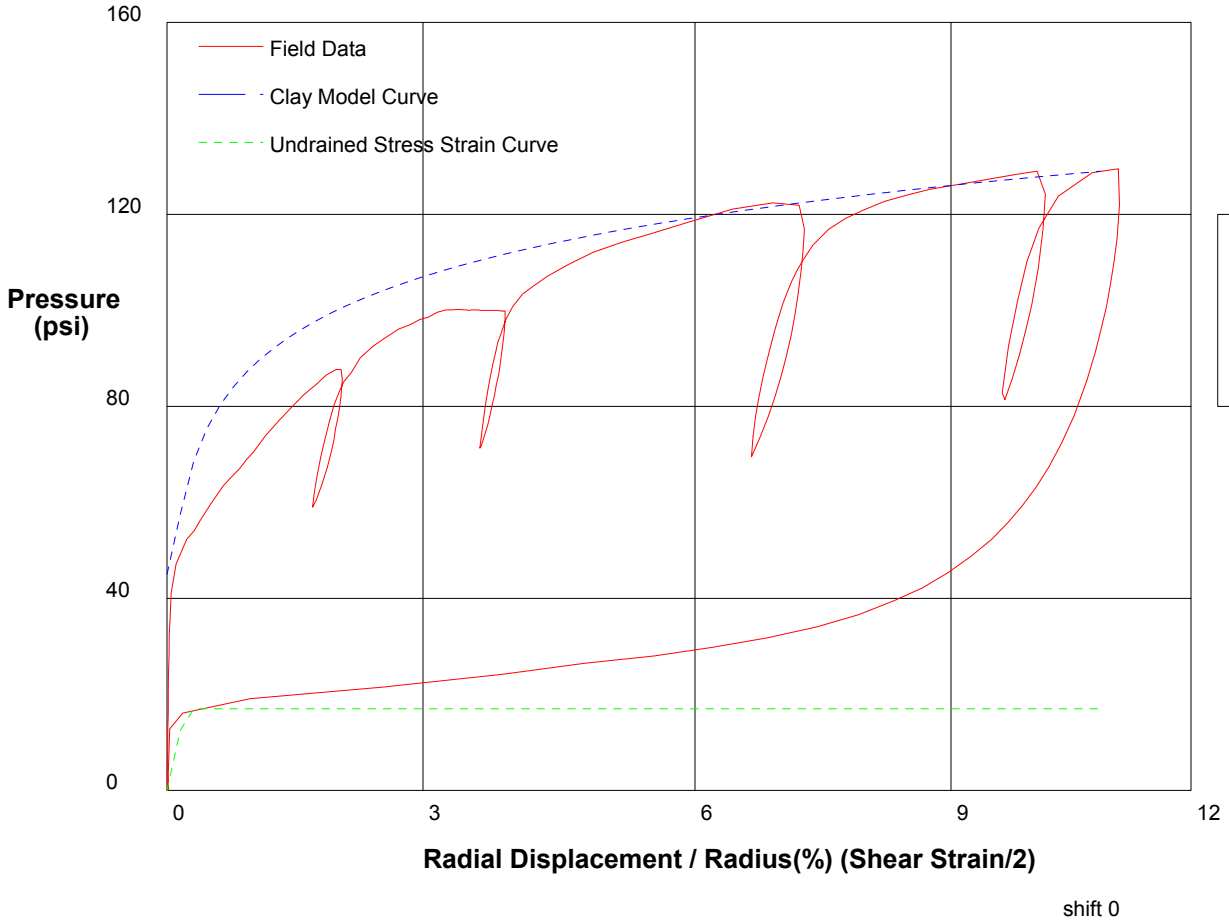
THE In Situ Engineering SAND MODEL

Water Pressure	32 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	11.4 psi
Shear Modulus	2700 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 87.2ft	File C:\DATA\ISE-771\DOT55.P

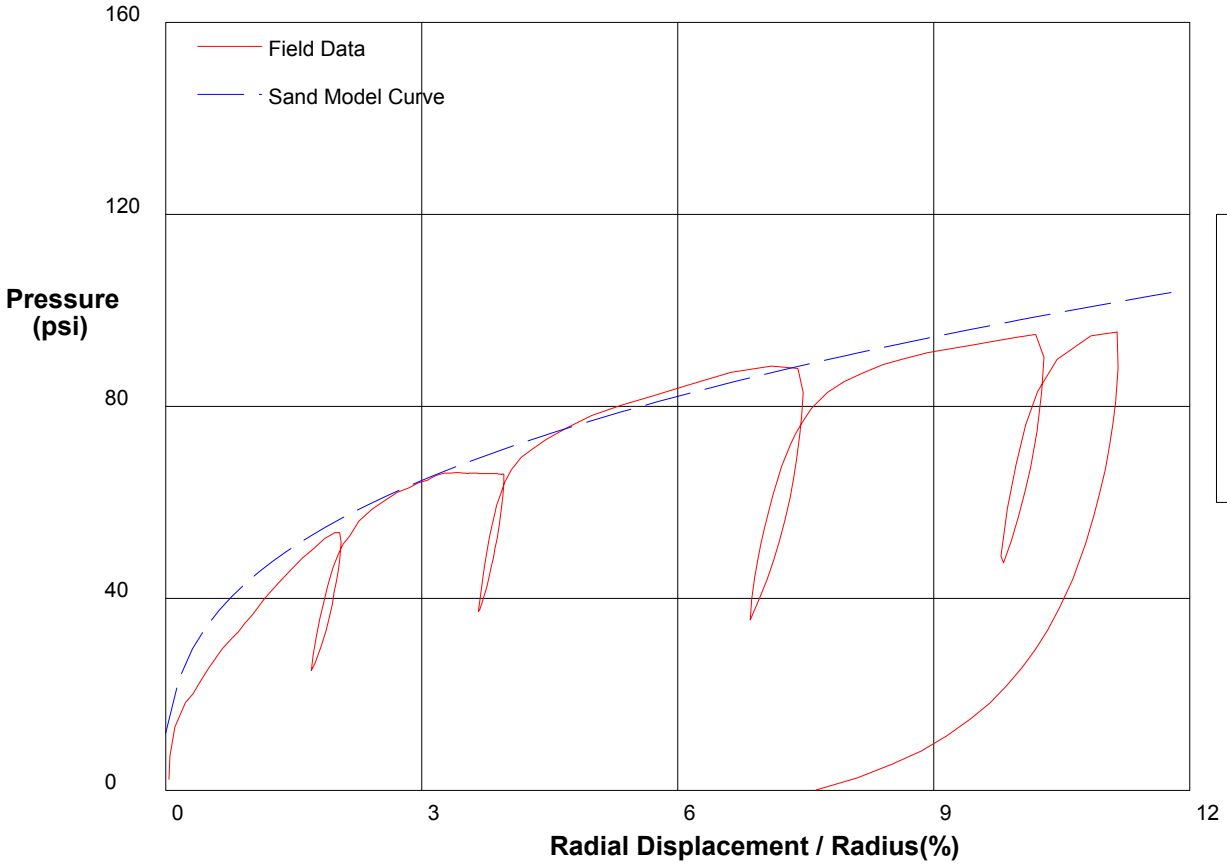


GIBSON'S CLAY MODEL

Shear Strength	17 psi
Insitu Stress	45 psi
Shear Modulus	4000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 87.2ft	File C:\DATA\ISE-771\DOT55.P



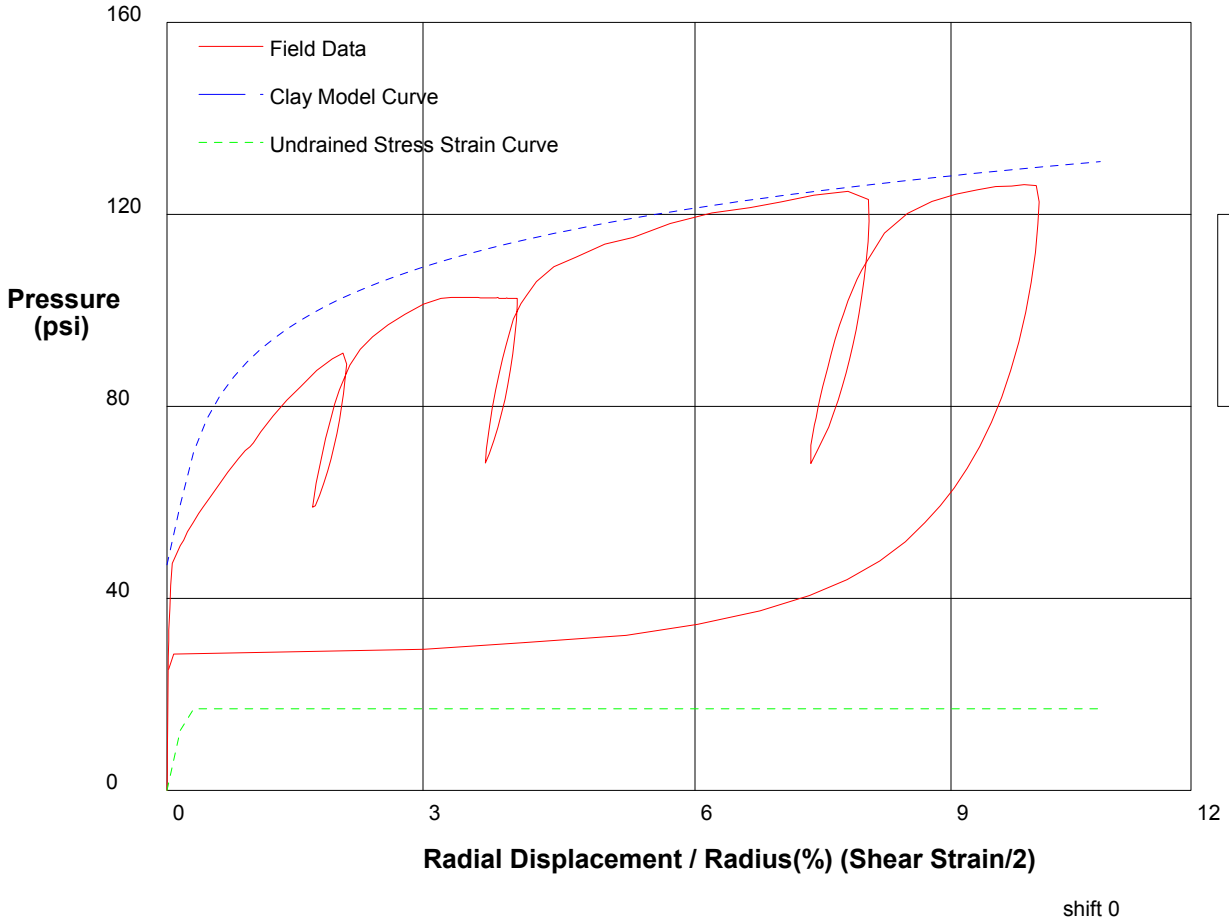
THE In Situ Engineering SAND MODEL

Water Pressure	34 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	12 psi
Shear Modulus	4000 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 90.2ft	File C:\DATA\ISE-771\DOT56.P

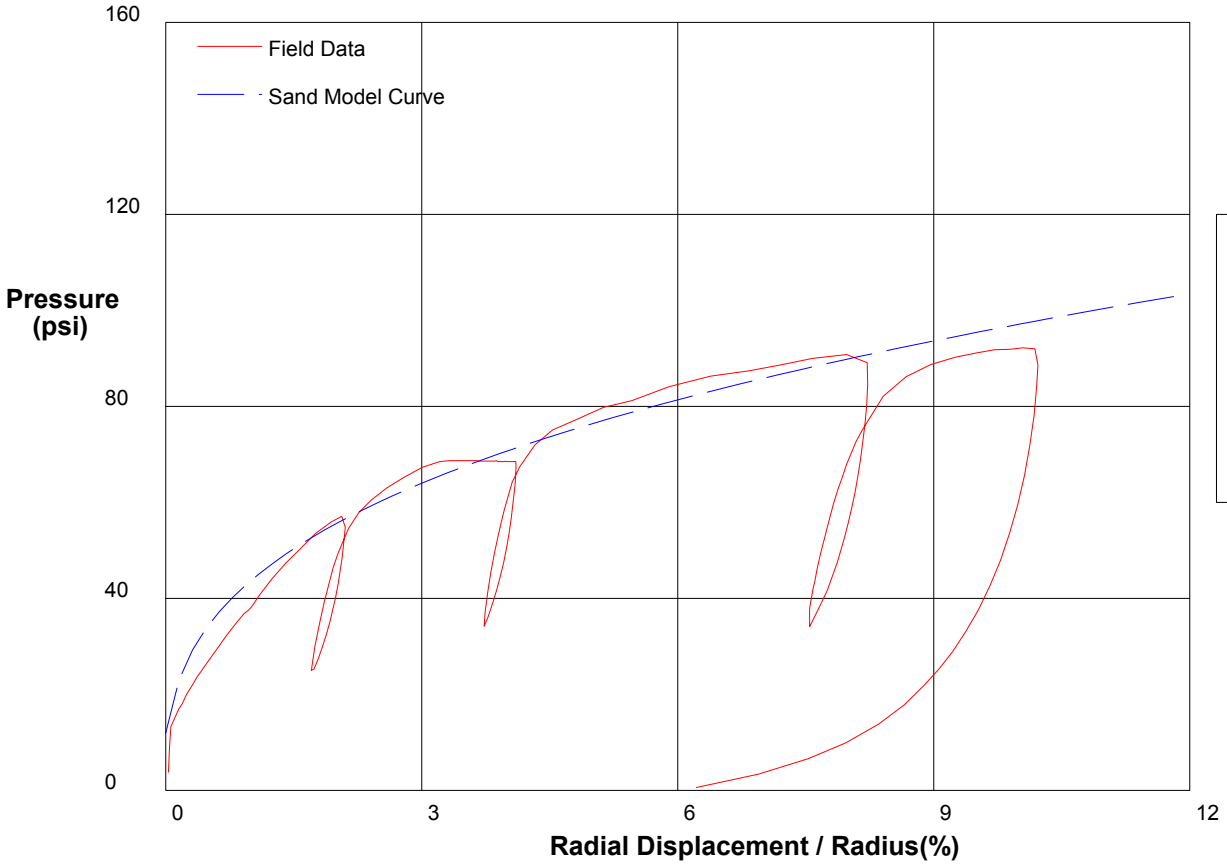


GIBSON'S CLAY MODEL

Shear Strength	17	psi
Insitu Stress	47	psi
Shear Modulus	4000	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th28pm	Depth 90.2ft	File C:\DATA\ISE-771\DOT56.P



shift 0

THE In Situ Engineering SAND MODEL

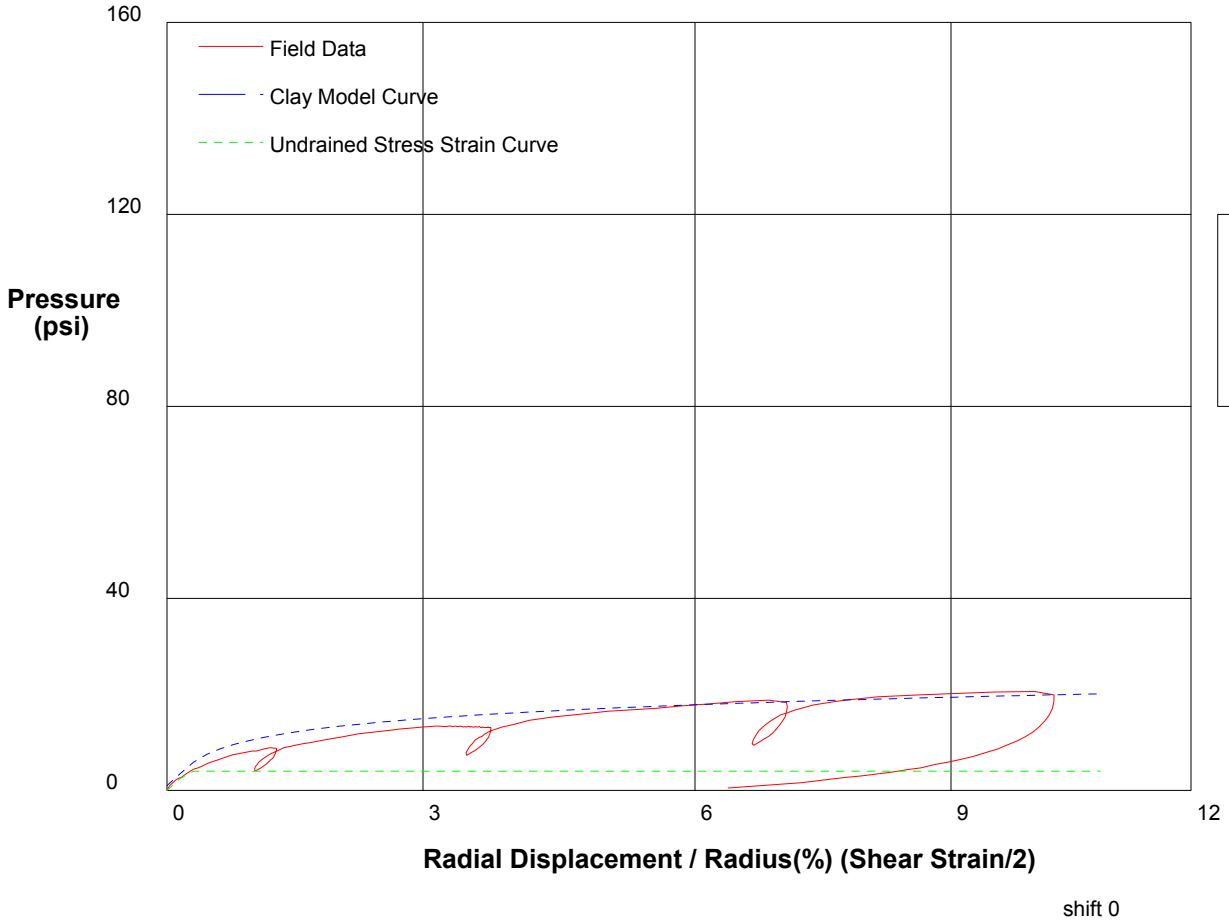
Water Pressure	34 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	12 psi
Shear Modulus	3899 psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/12/2008**

Hole No. th29pm **Depth 3.8ft** **File C:\DATA\ISE-771\DOT57.P**

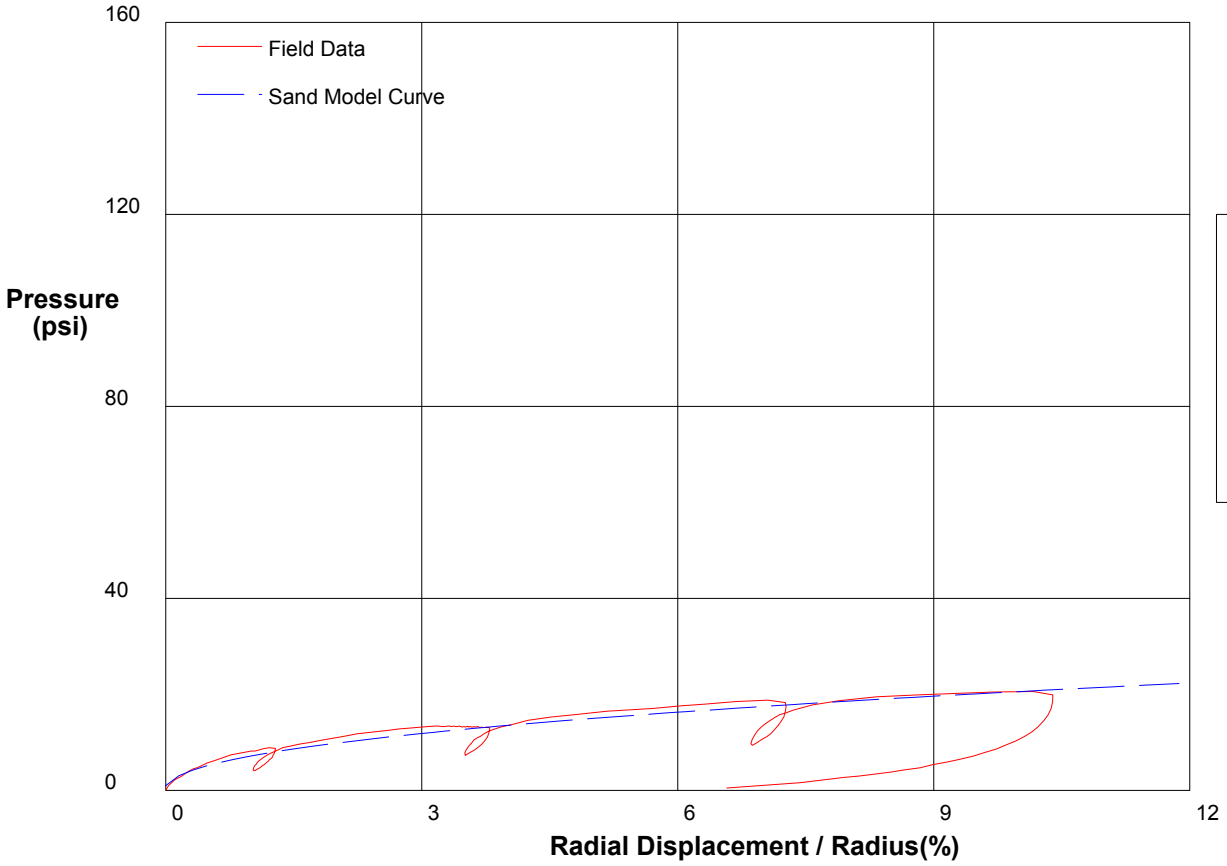


GIBSON'S CLAY MODEL

Shear Strength 4 psi
Insitu Stress 1 psi
Shear Modulus 800 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th29pm	Depth 3.8ft	File C:\DATA\ISE-771\DOT57.P



shift 0

THE In Situ Engineering SAND MODEL

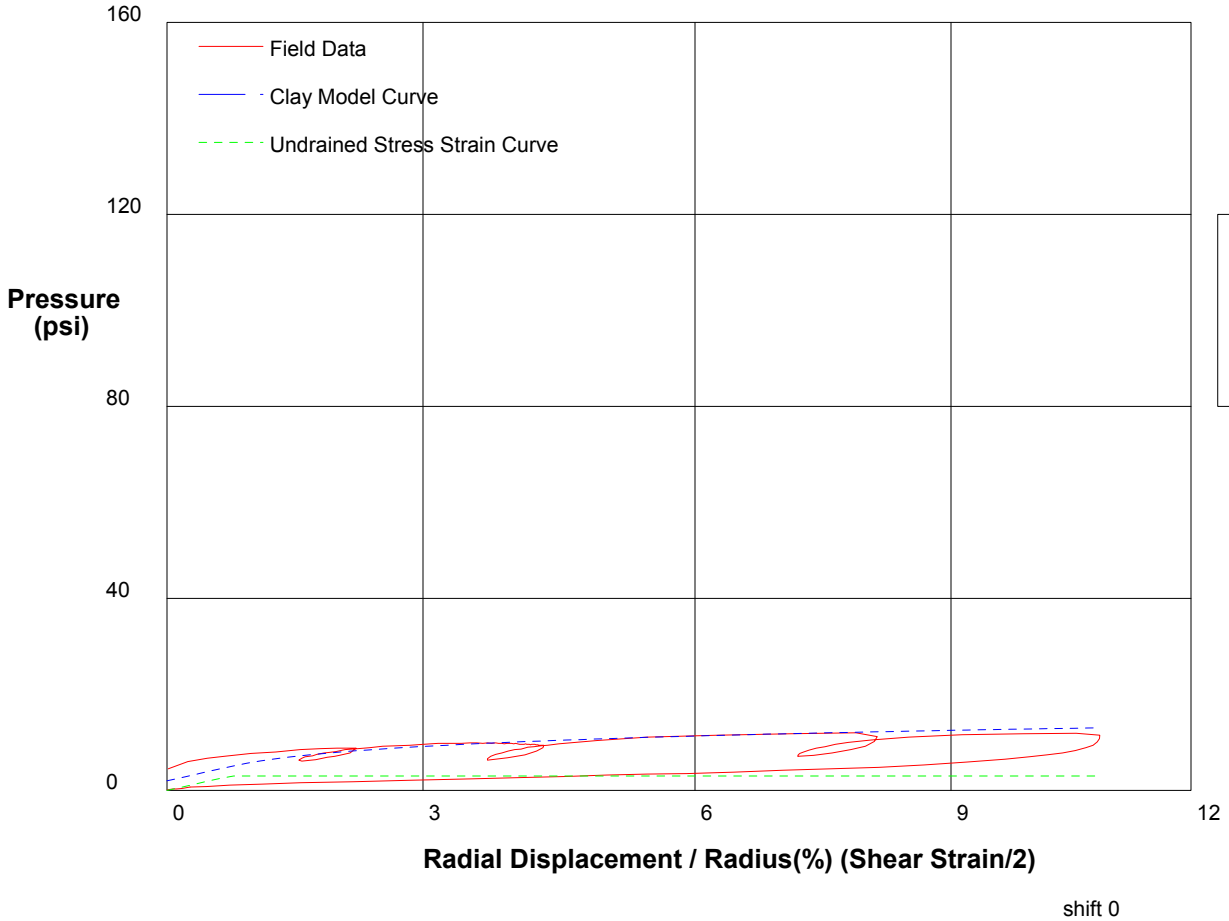
Water Pressure	0 psi
Friction Angle	40 deg
Critical Friction Angle	32 deg
Lateral Stress	1 psi
Shear Modulus	800 psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/12/2008**

Hole No. th29pm **Depth 6.8ft** **File C:\DATA\ISE-771\DOT58.P**



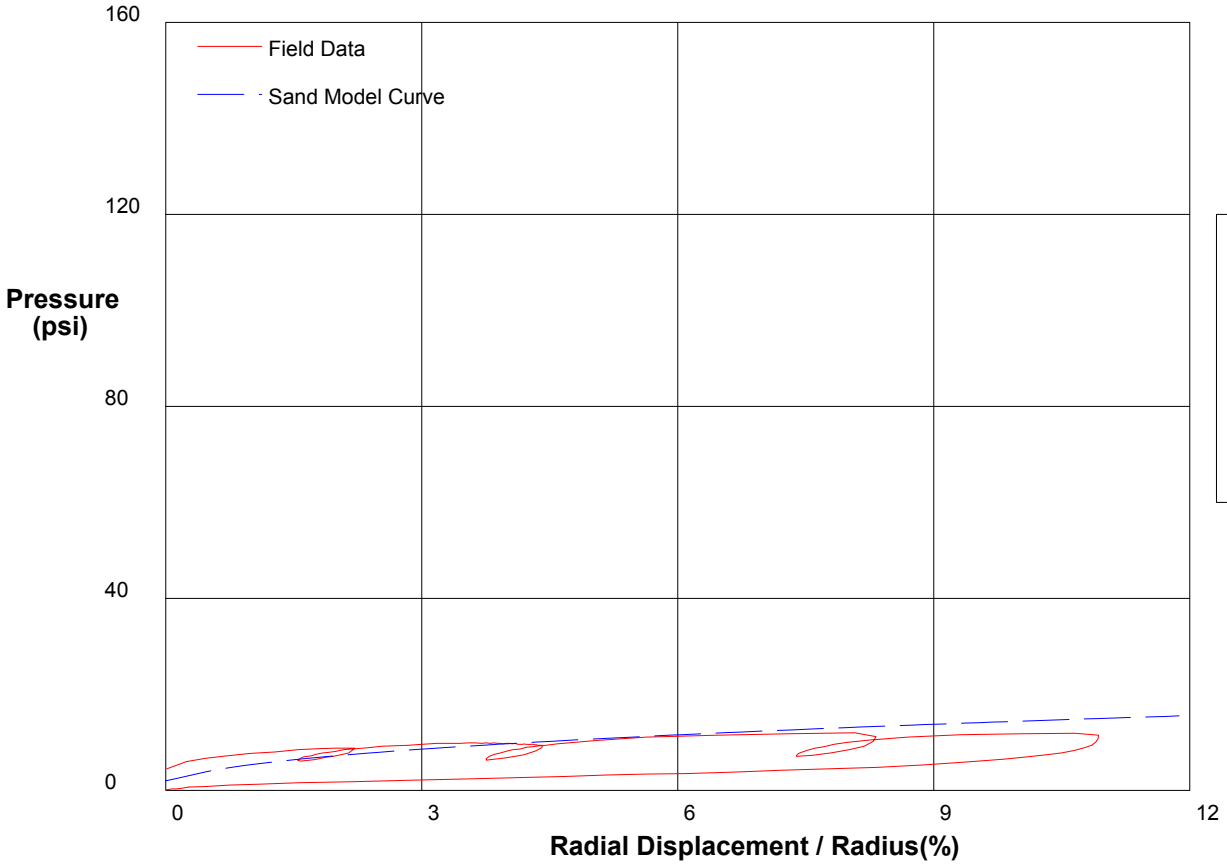
shift 0

GIBSON'S CLAY MODEL

Shear Strength 3 psi
Insitu Stress 2 psi
Shear Modulus 200 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th29pm	Depth 6.8ft	File C:\DATA\ISE-771\DOT58.P



shift 0

THE In Situ Engineering SAND MODEL

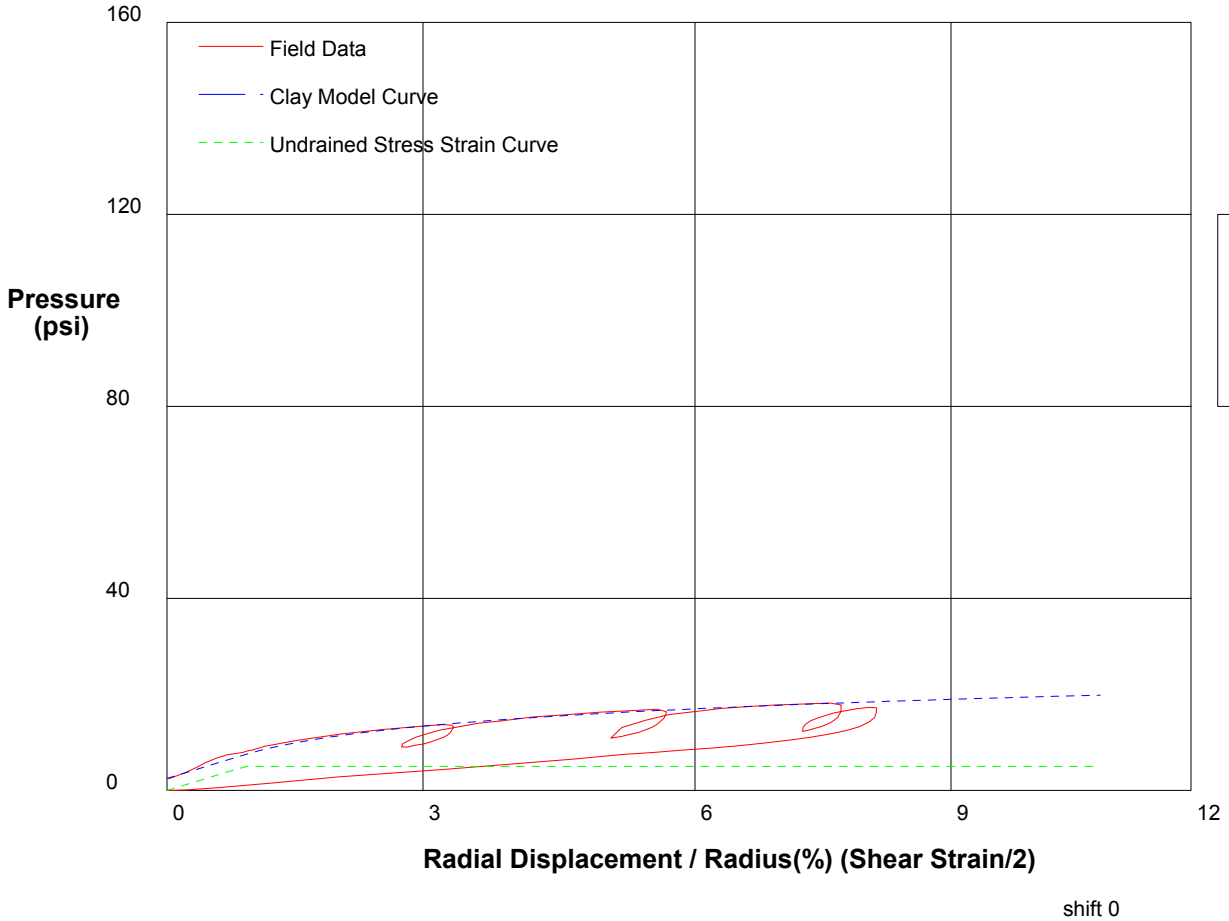
Water Pressure	0 psi
Friction Angle	38 deg
Critical Friction Angle	32 deg
Lateral Stress	2 psi
Shear Modulus	200 psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/12/2008**

Hole No. th29pm **Depth 9.8ft** **File C:\DATA\ISE-771\DOT59.P**

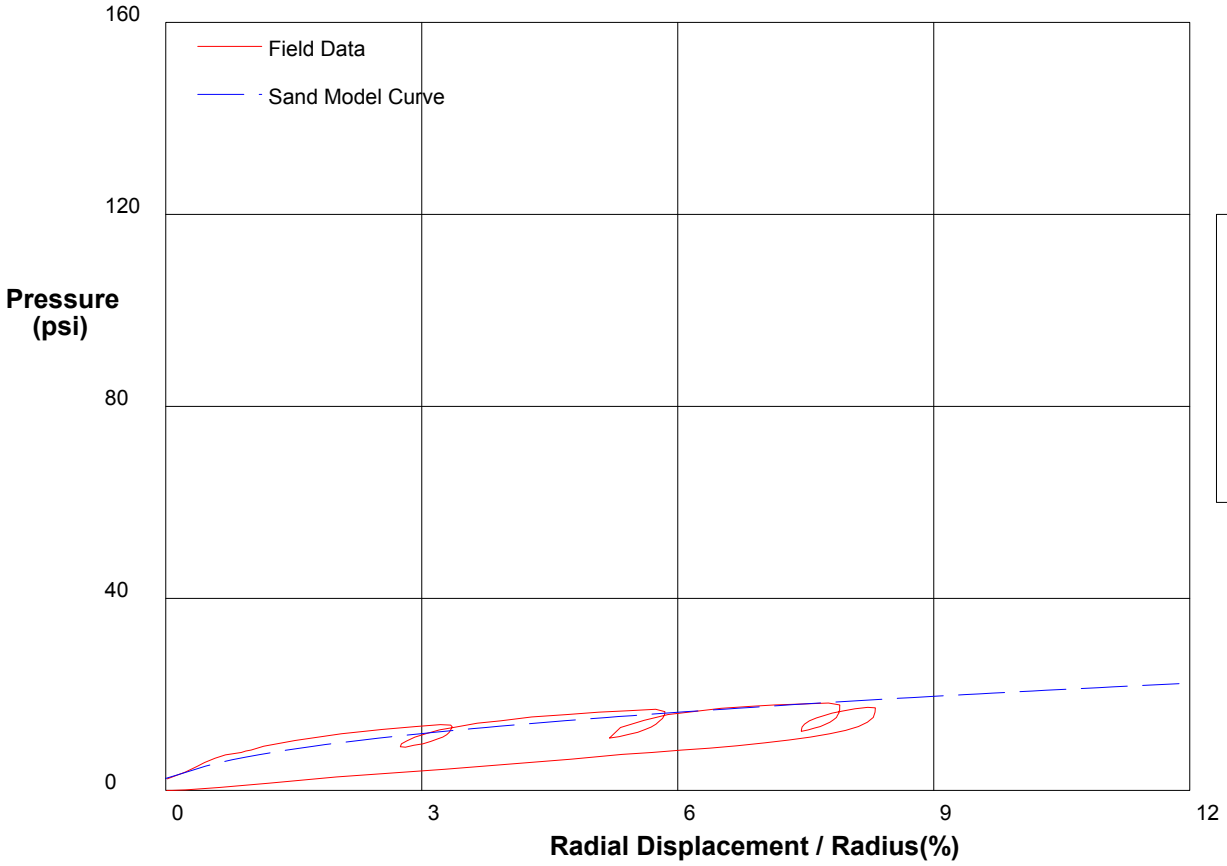


GIBSON'S CLAY MODEL

Shear Strength 5 psi
Insitu Stress 2.5 psi
Shear Modulus 270 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th29pm	Depth 9.8ft	File C:\DATA\ISE-771\DOT59.P



THE In Situ Engineering SAND MODEL

Water Pressure	0 psi
Friction Angle	40 deg
Critical Friction Angle	32 deg
Lateral Stress	2.5 psi
Shear Modulus	270 psi

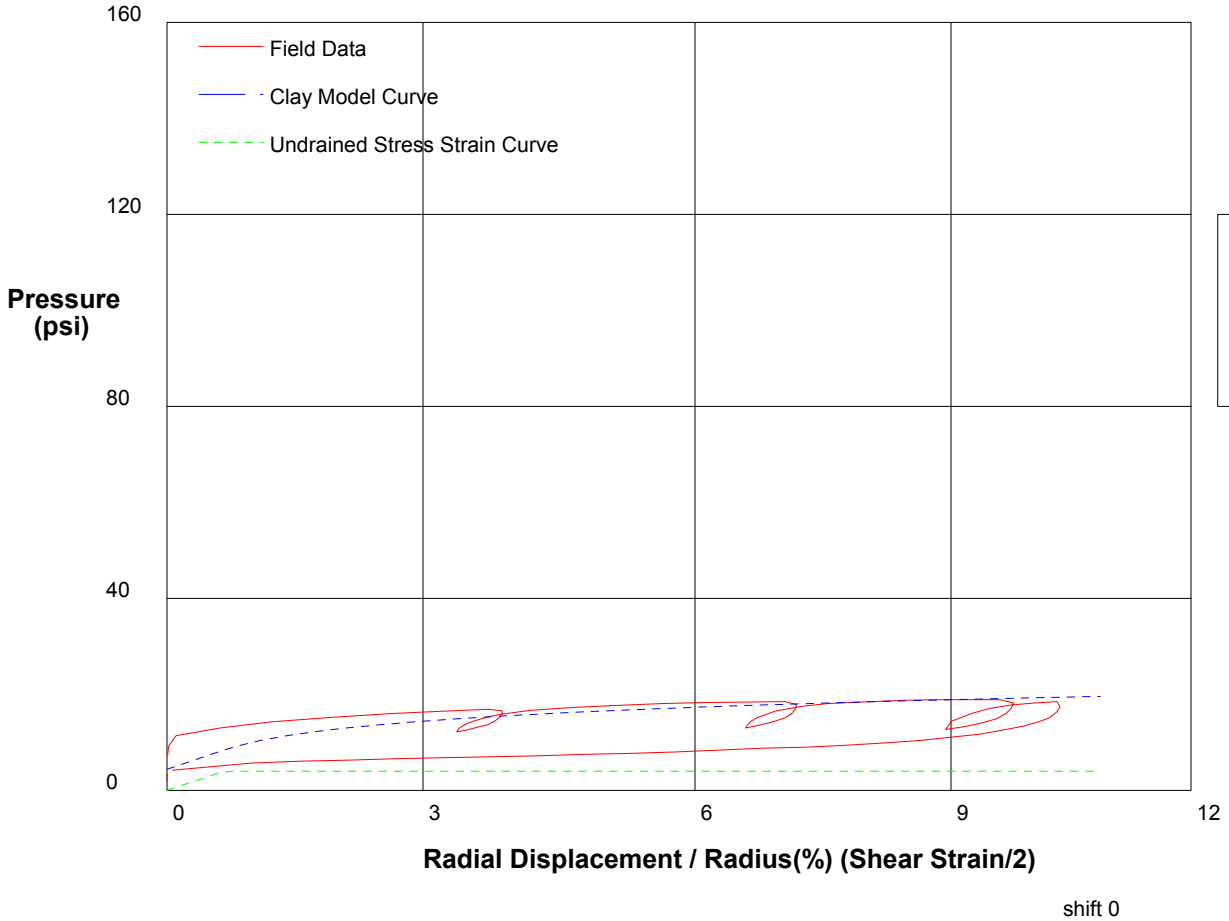
shift 0

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/12/2008**

Hole No. th29pm **Depth 13.4ft** **File C:\DATA\ISE-771\DOT60.P**

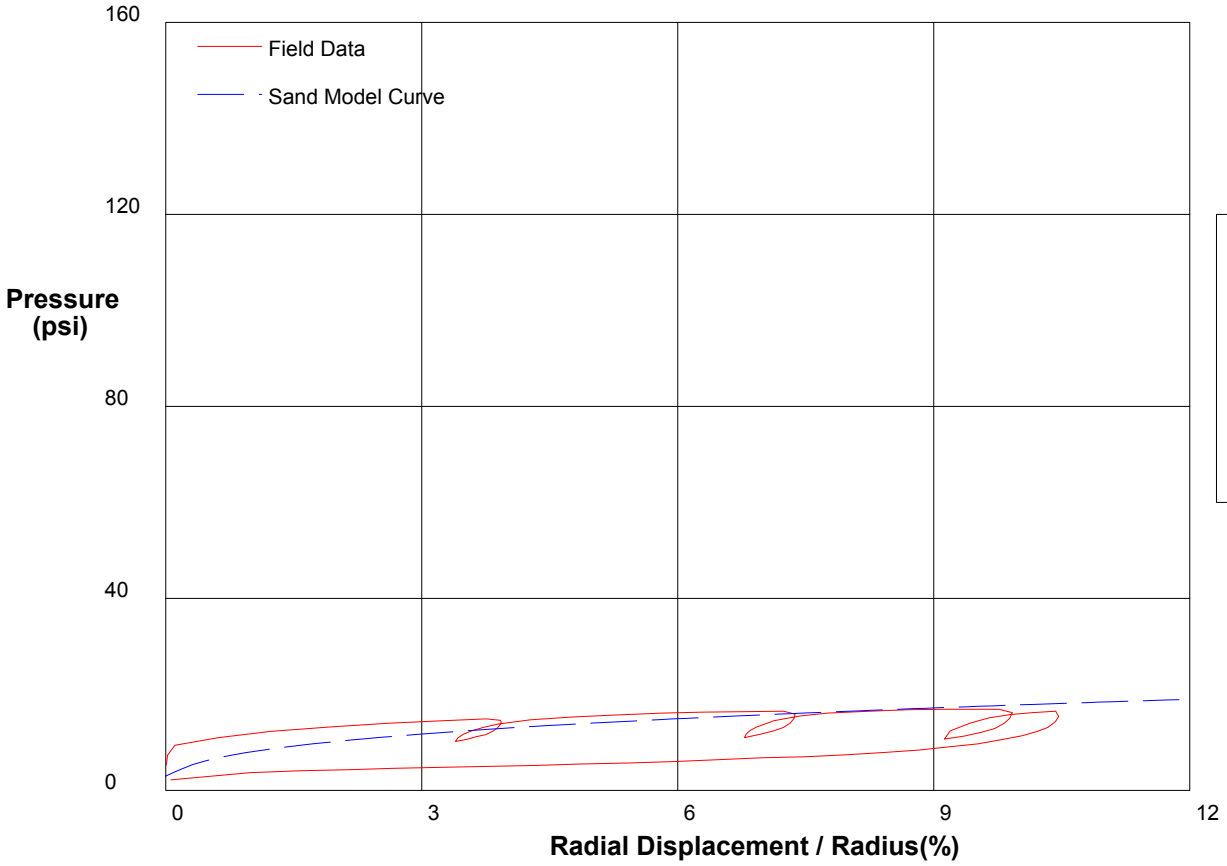


GIBSON'S CLAY MODEL

Shear Strength 4 psi
Insitu Stress 4.4 psi
Shear Modulus 300 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/12/2008
Hole No. th29pm	Depth 13.4ft	File C:\DATA\ISE-771\DOT60.P



shift 0

THE In Situ Engineering SAND MODEL

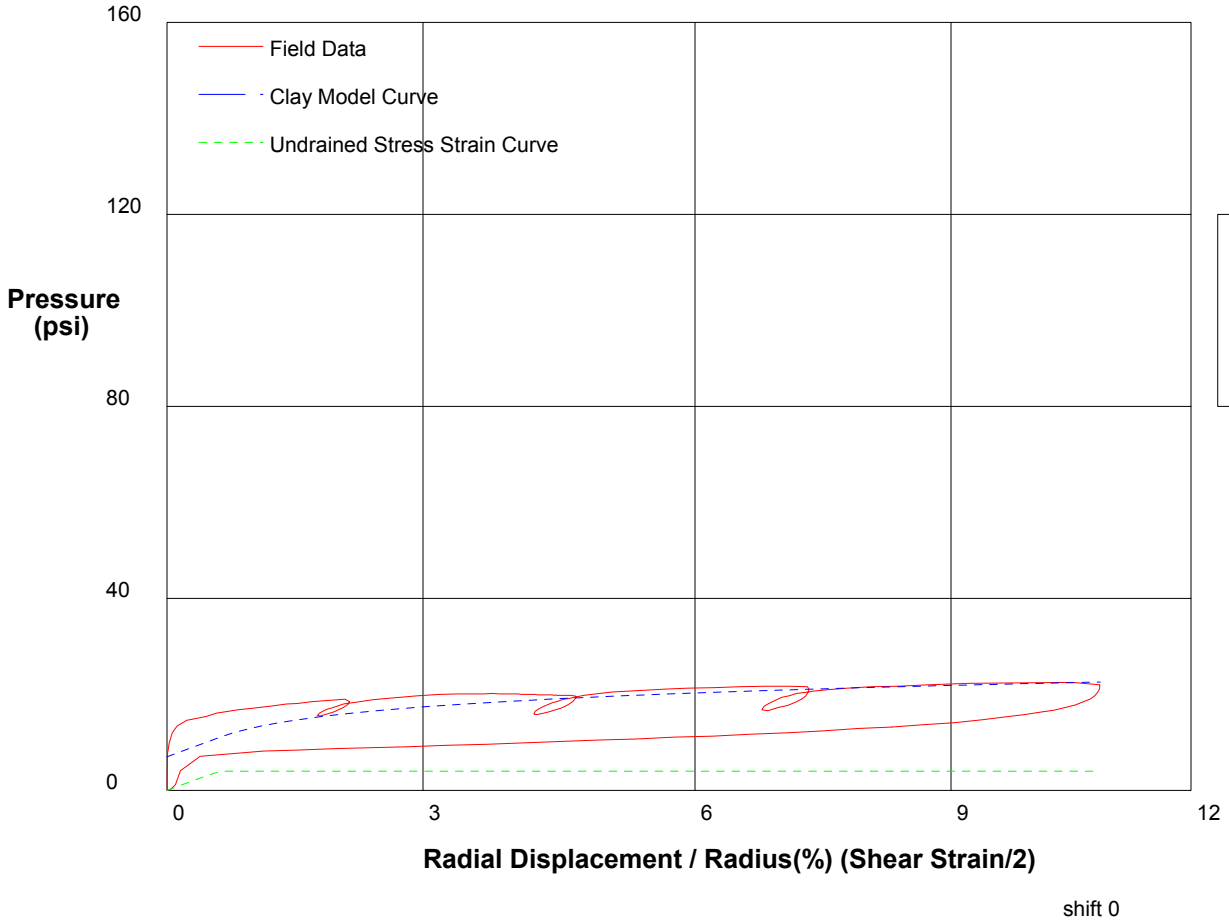
Water Pressure	2 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	3 psi
Shear Modulus	399 psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/13/2008**

Hole No. th29pm **Depth 18.2ft** **File C:\DATA\ISE-771\DOT61.P**

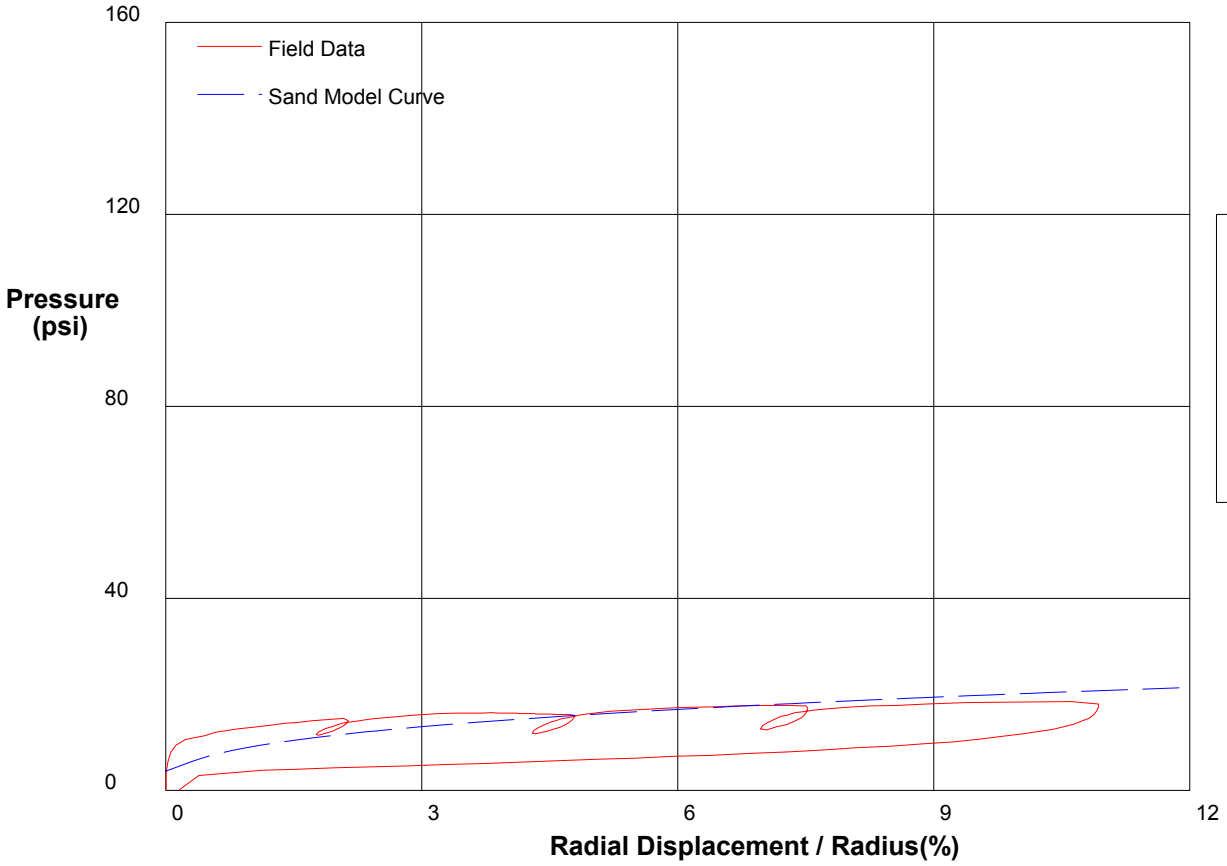


GIBSON'S CLAY MODEL

Shear Strength 4 psi
Insitu Stress 7 psi
Shear Modulus 330 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 18.2ft	File C:\DATA\ISE-771\DOT61.P



shift 0

THE In Situ Engineering SAND MODEL

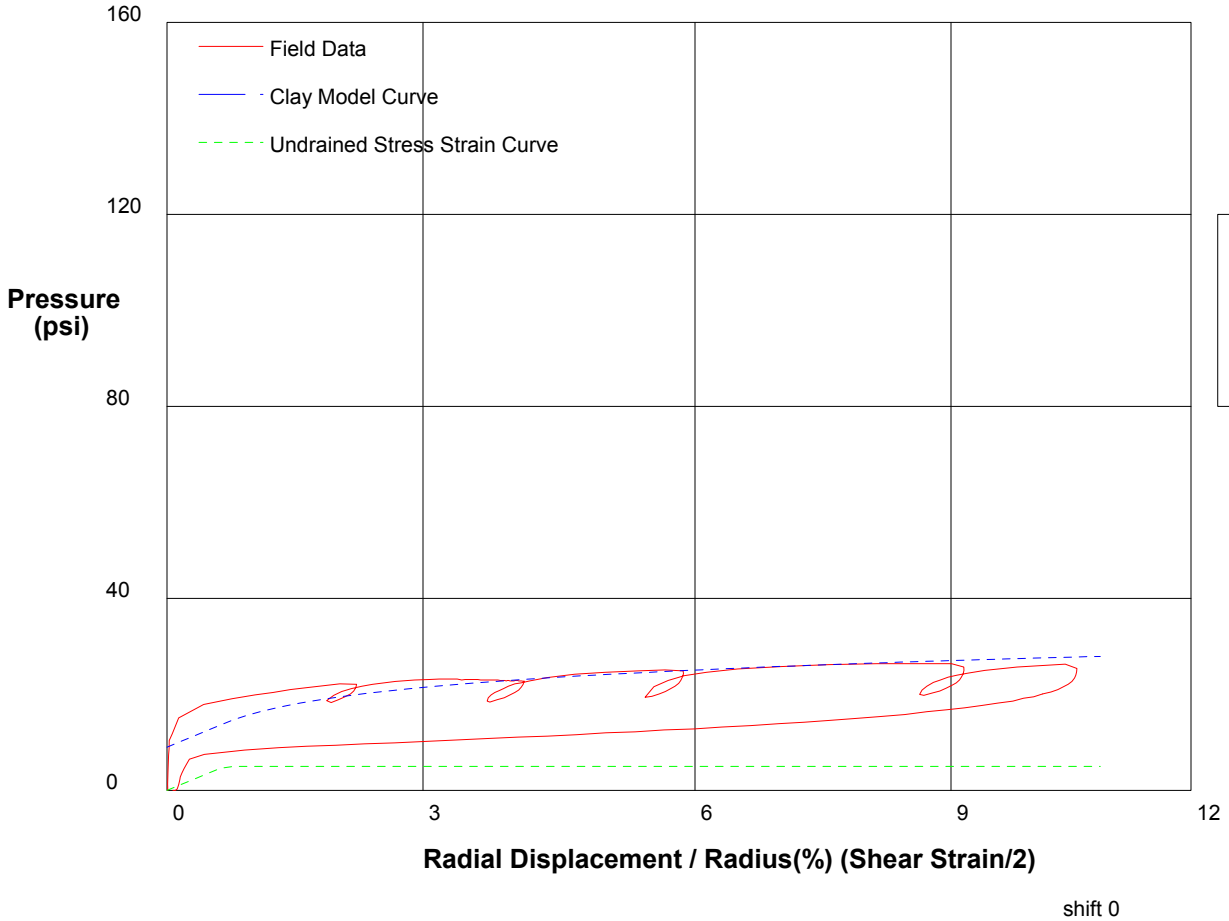
Water Pressure	4 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	4 psi
Shear Modulus	330 psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/13/2008**

Hole No. th29pm **Depth 21.2ft** **File C:\DATA\ISE-771\DOT62.P**

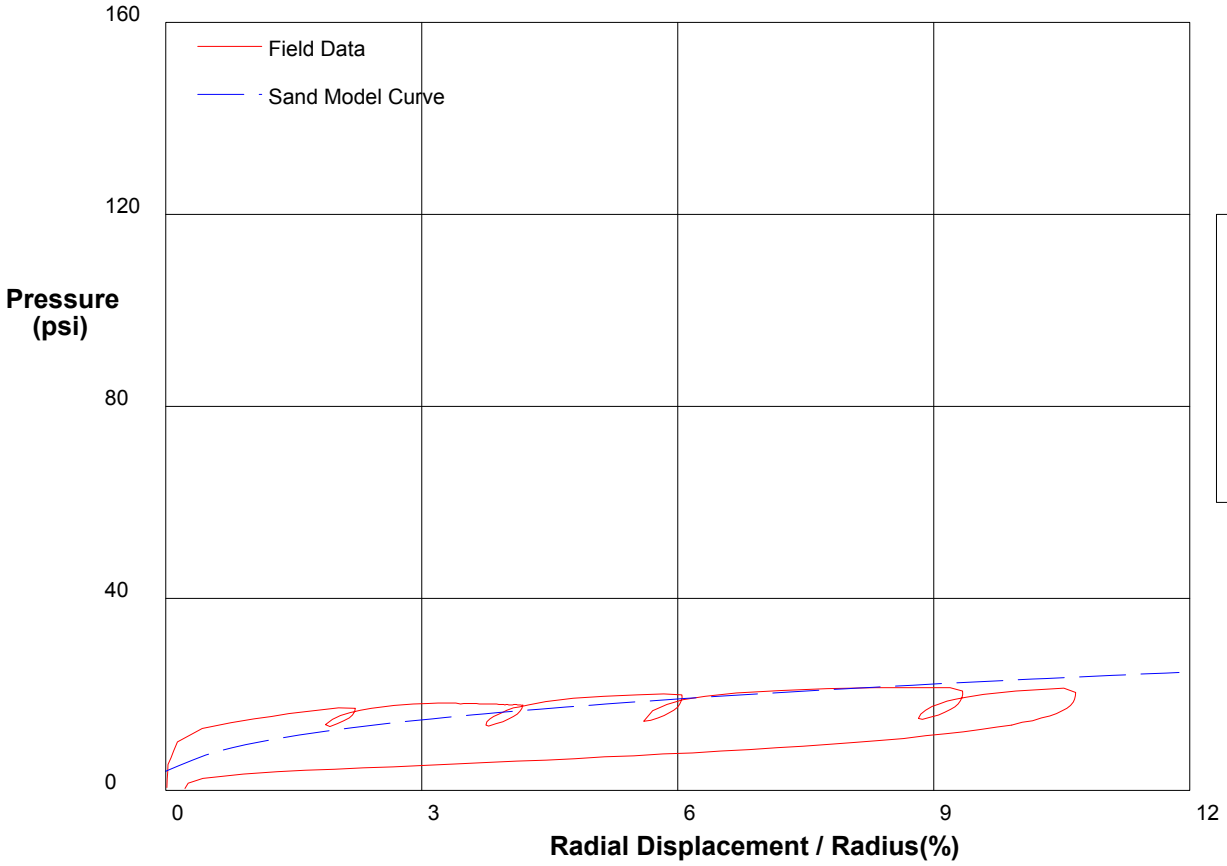


GIBSON'S CLAY MODEL

Shear Strength	**5**	**psi**
Insitu Stress	**9**	**psi**
Shear Modulus	**370**	**psi**

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 21.2ft	File C:\DATA\ISE-771\DOT62.P



shift 0

THE In Situ Engineering SAND MODEL

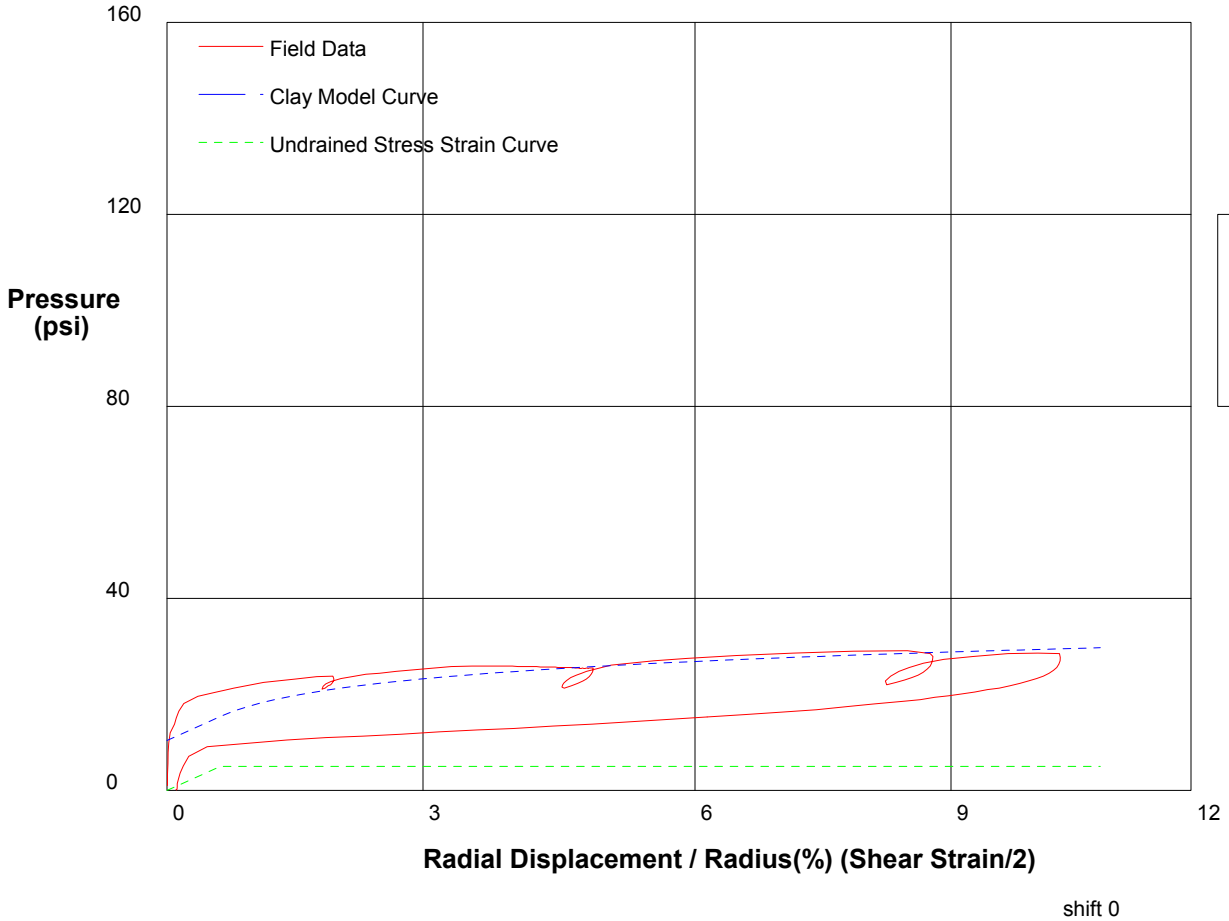
Water Pressure	5 psi
Friction Angle	34 deg
Critical Friction Angle	32 deg
Lateral Stress	4 psi
Shear Modulus	370 psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/13/2008**

Hole No. th29pm **Depth 24.2ft** **File C:\DATA\ISE-771\DOT63.P**

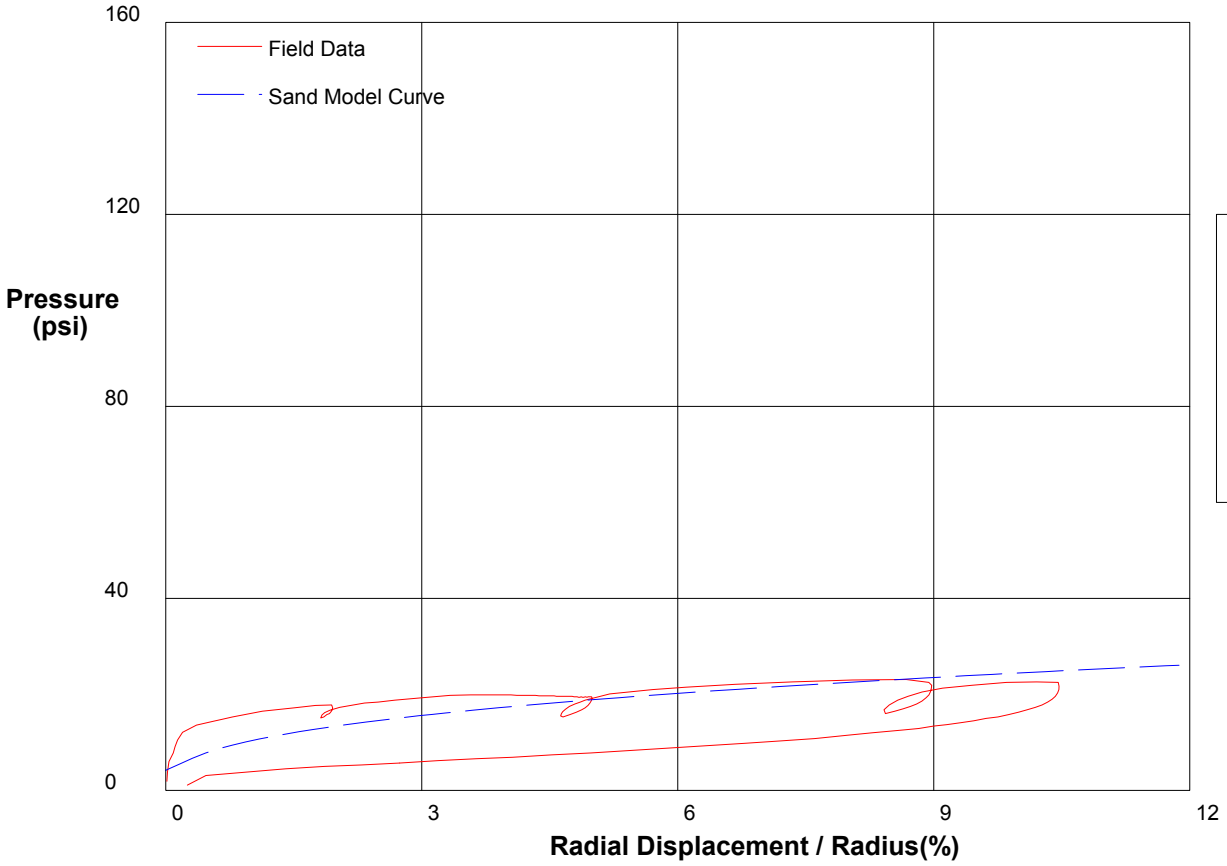


GIBSON'S CLAY MODEL

Shear Strength 5 psi
Insitu Stress 10.4 psi
Shear Modulus 400 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 24.2ft	File C:\DATA\ISE-771\DOT63.P



THE In Situ Engineering SAND MODEL

Water Pressure	6 psi
Friction Angle	34 deg
Critical Friction Angle	32 deg
Lateral Stress	4.2 psi
Shear Modulus	400 psi

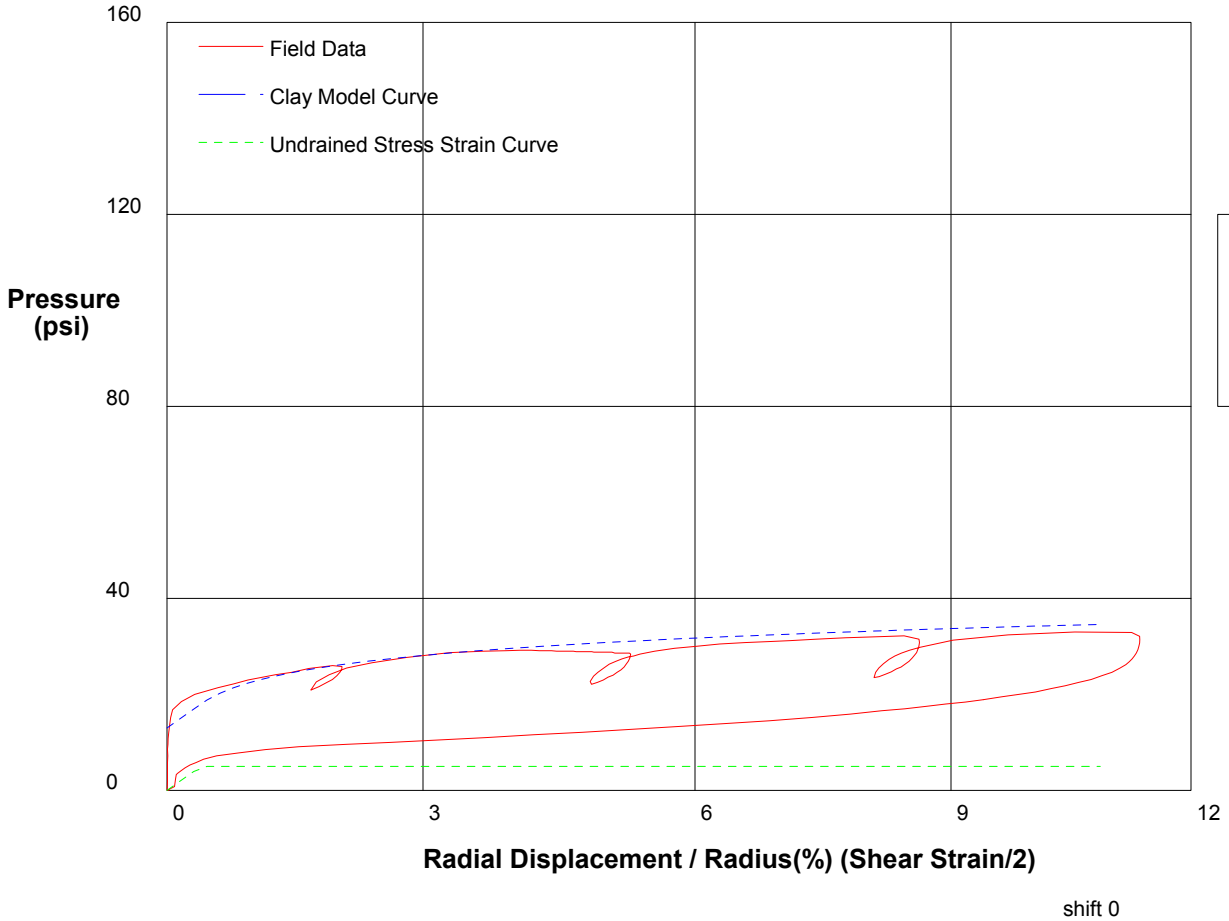
shift 0

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/13/2008**

Hole No. th29pm **Depth 28.2ft** **File C:\DATA\ISE-771\DOT64.P**



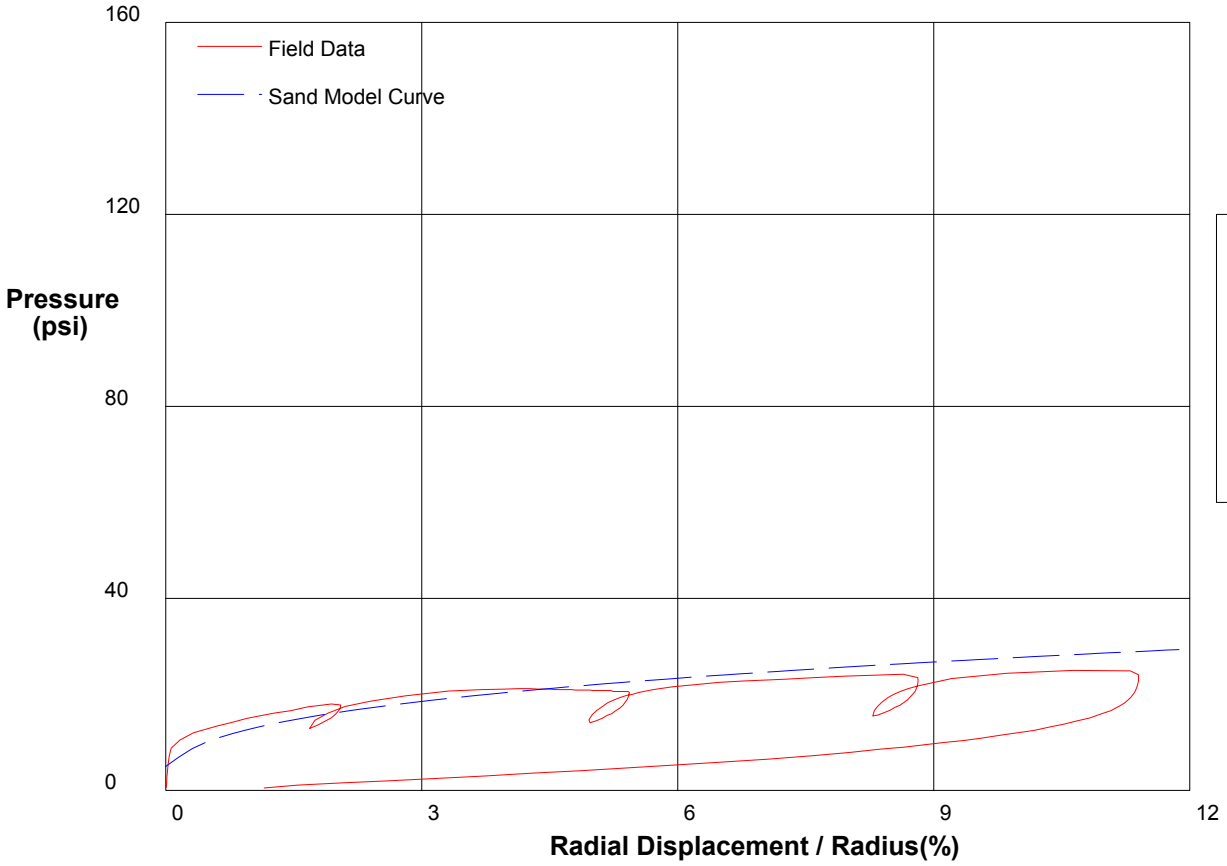
shift 0

GIBSON'S CLAY MODEL

Shear Strength 5 psi
Insitu Stress 13 psi
Shear Modulus 630 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 28.2ft	File C:\DATA\ISE-771\DOT64.P



shift 0

THE In Situ Engineering SAND MODEL

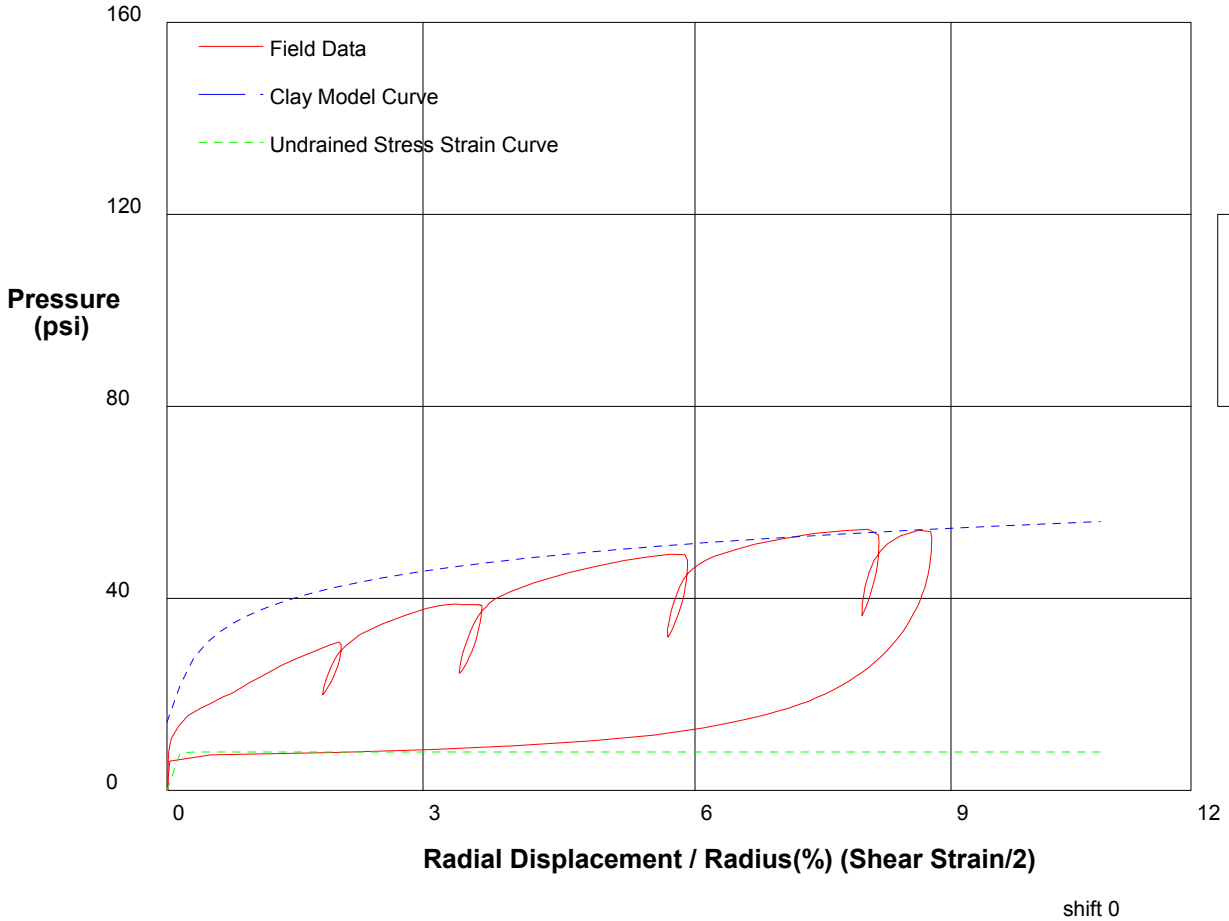
Water Pressure	8 psi
Friction Angle	30 deg
Critical Friction Angle	30 deg
Lateral Stress	5 psi
Shear Modulus	630 psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/13/2008**

Hole No. th29pm **Depth 31.2ft** **File C:\DATA\ISE-771\DOT65.P**

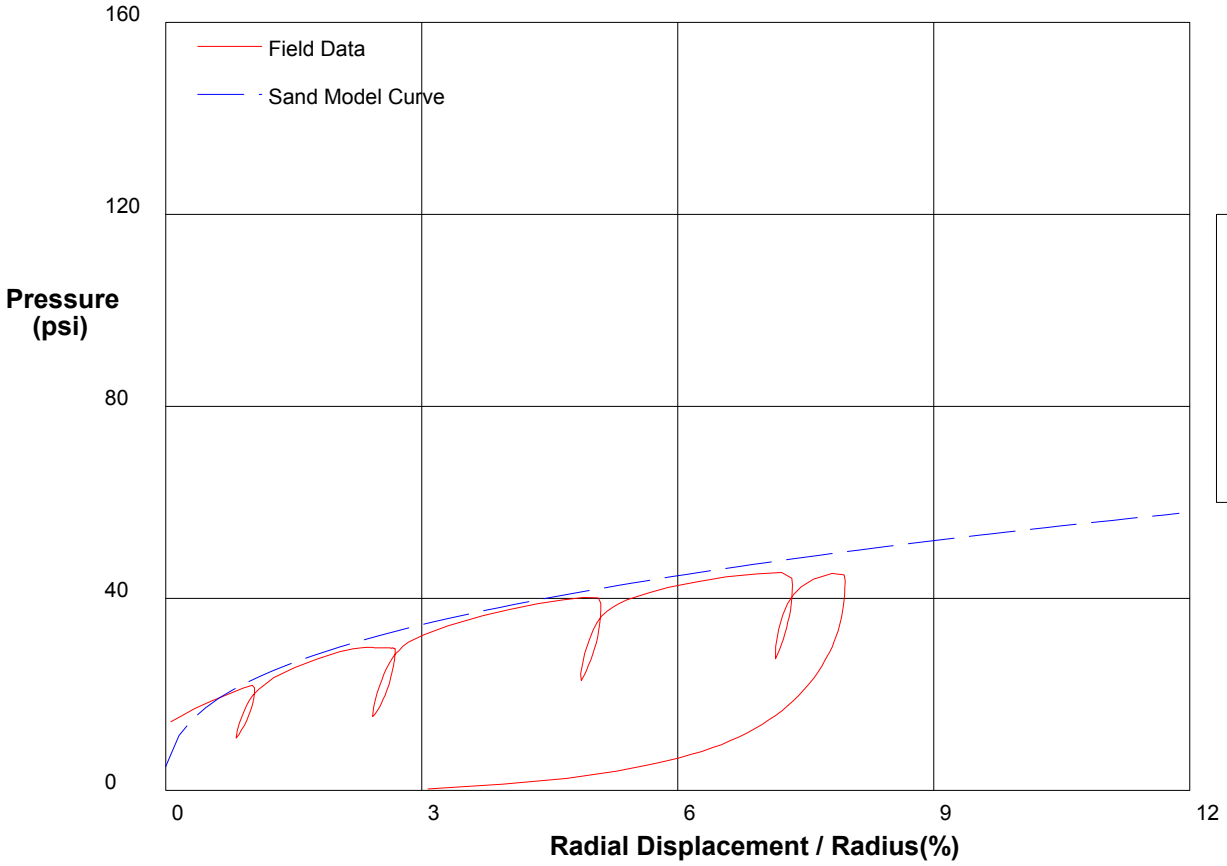


GIBSON'S CLAY MODEL

Shear Strength 8 psi
Insitu Stress 14.2 psi
Shear Modulus 2500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 31.2ft	File C:\DATA\ISE-771\DOT65.P



THE In Situ Engineering SAND MODEL

Water Pressure	9 psi
Friction Angle	34 deg
Critical Friction Angle	32 deg
Lateral Stress	5 psi
Shear Modulus	2500 psi

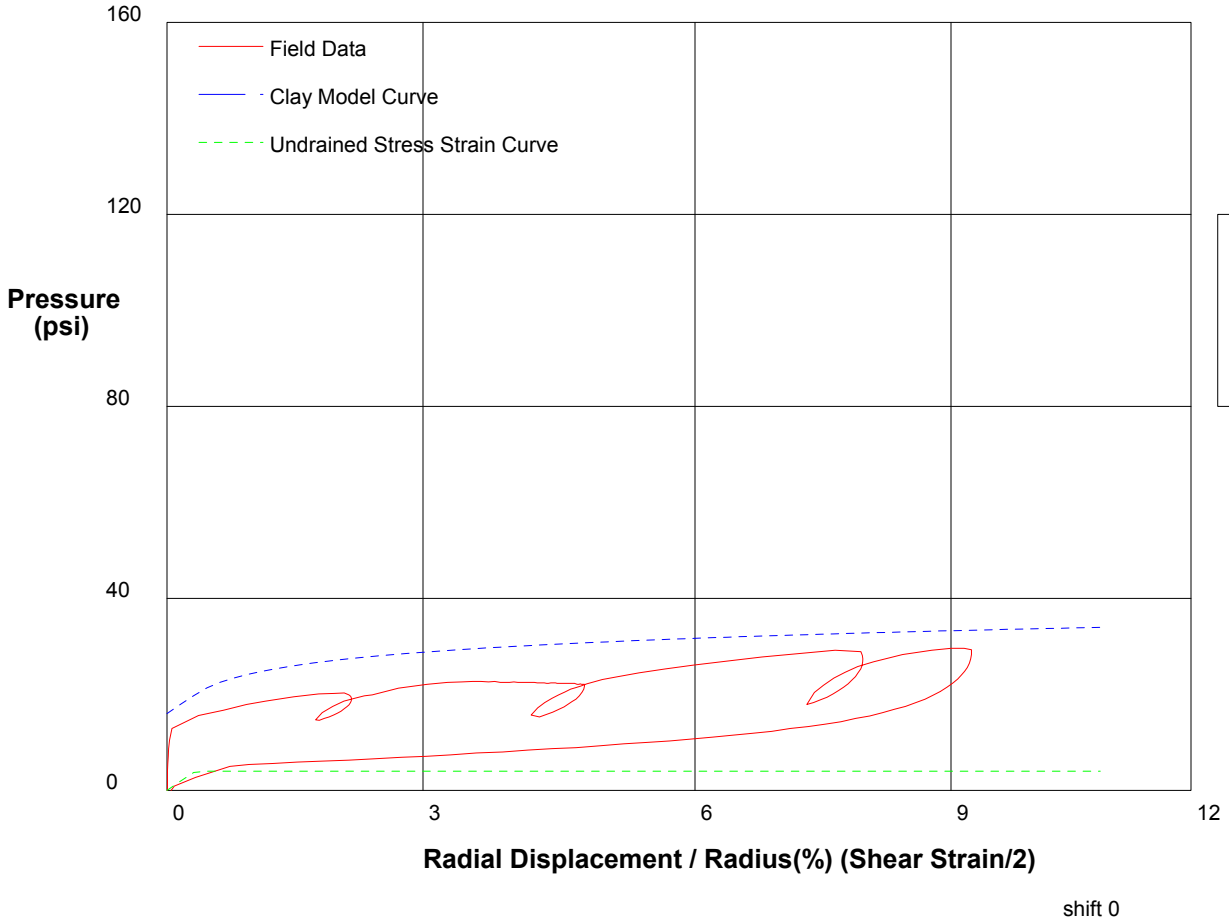
shift 1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/13/2008**

Hole No. th29pm **Depth 34.2ft** **File C:\DATA\ISE-771\DOT66.P**

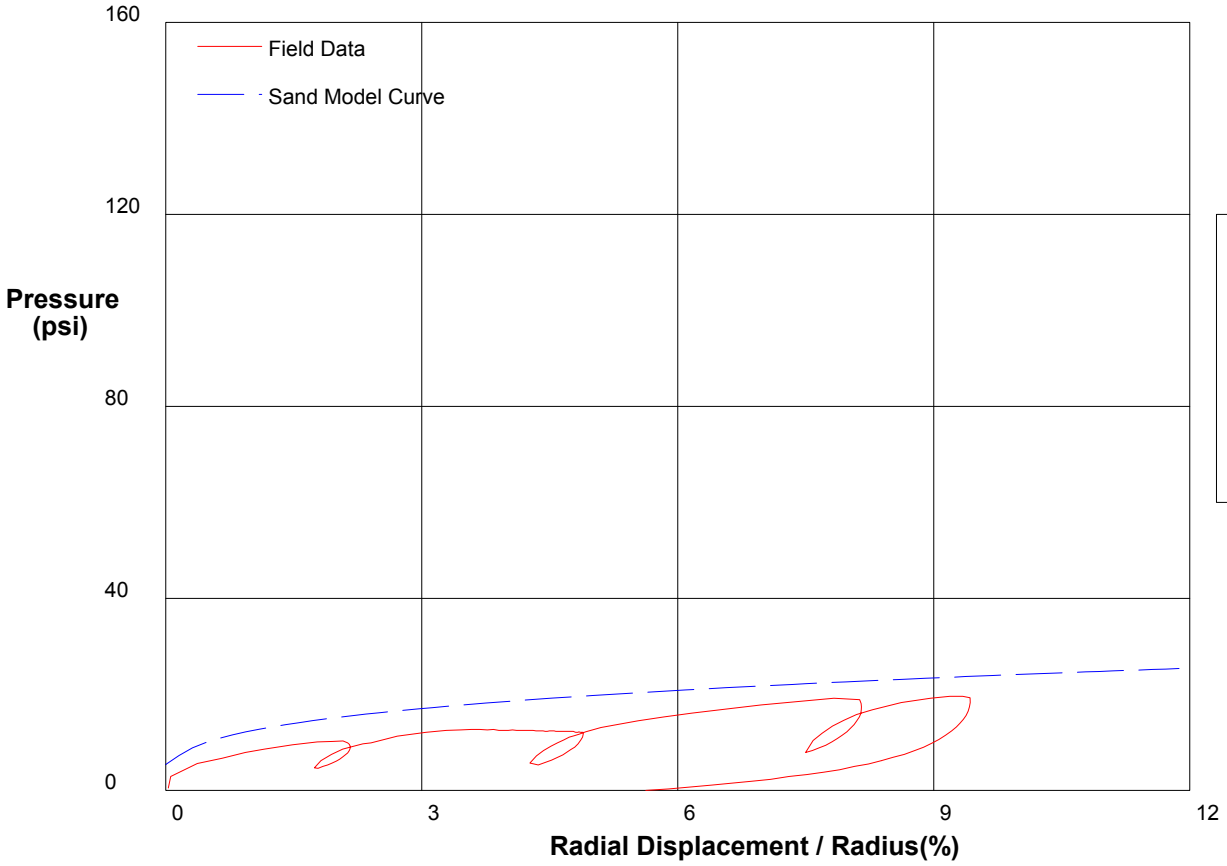


GIBSON'S CLAY MODEL

Shear Strength 4 psi
Insitu Stress 16 psi
Shear Modulus 600 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 34.2ft	File C:\DATA\ISE-771\DOT66.P



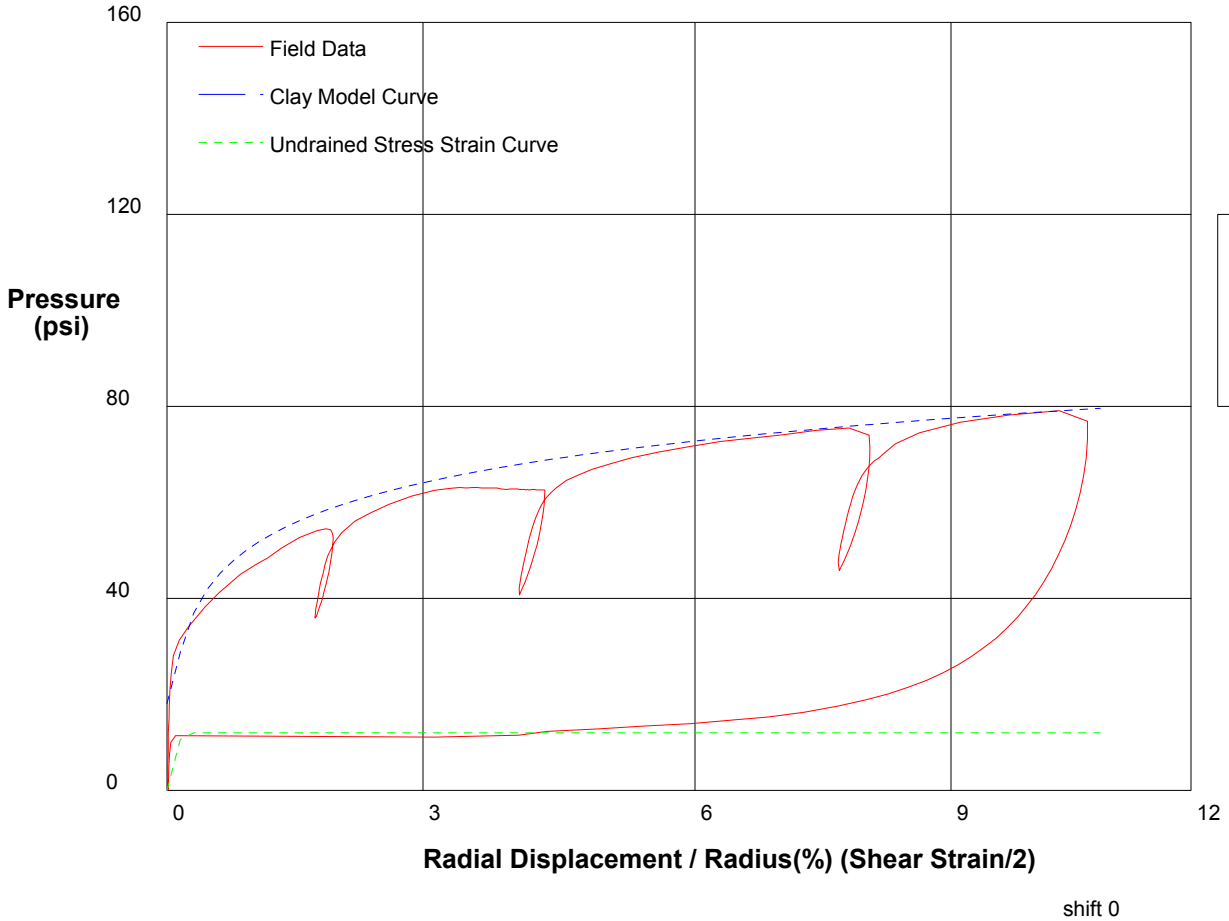
shift 0

THE In Situ Engineering SAND MODEL

Water Pressure	10 psi
Friction Angle	24 deg
Critical Friction Angle	24 deg
Lateral Stress	5.4 psi
Shear Modulus	600 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 38.2ft	File C:\DATA\ISE-771\DOT67.P

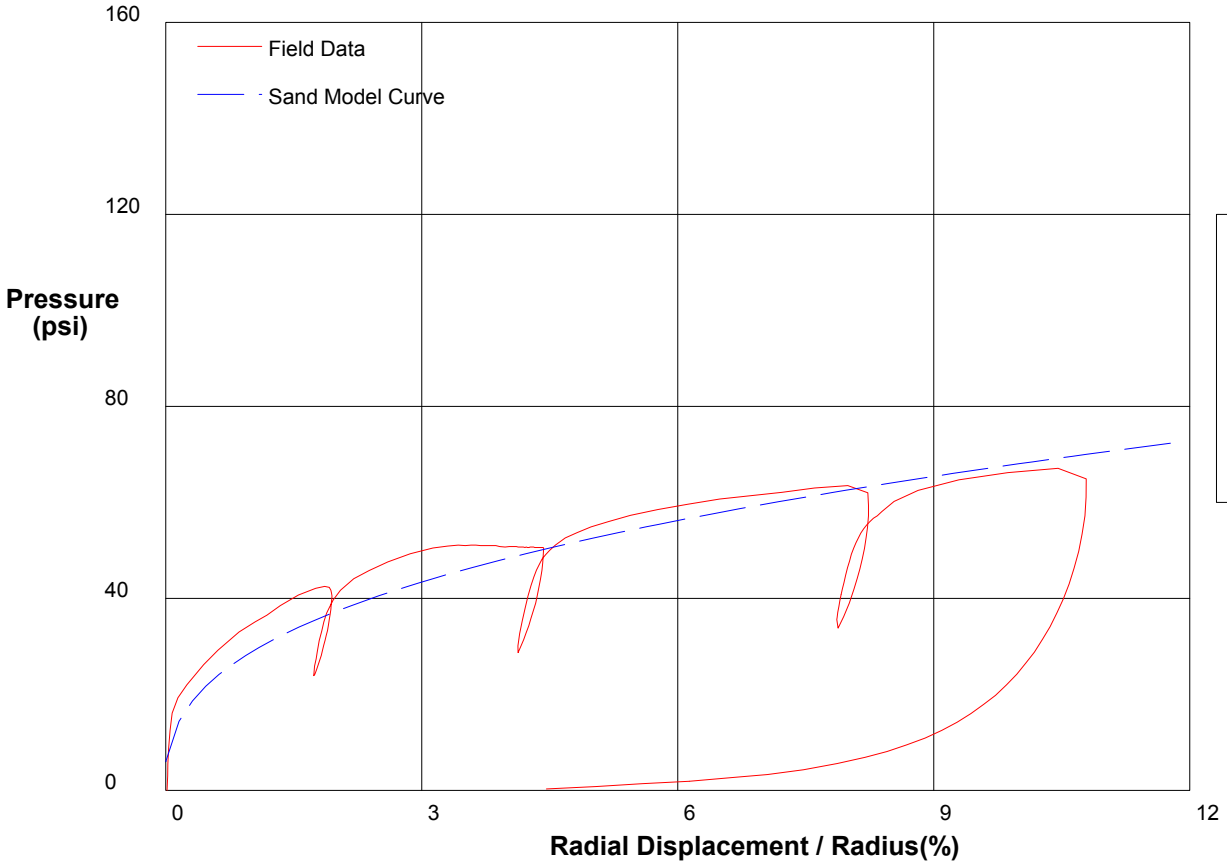


GIBSON'S CLAY MODEL

Shear Strength	12	psi
Insitu Stress	18.1	psi
Shear Modulus	3400	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 38.2ft	File C:\DATA\ISE-771\DOT67.P



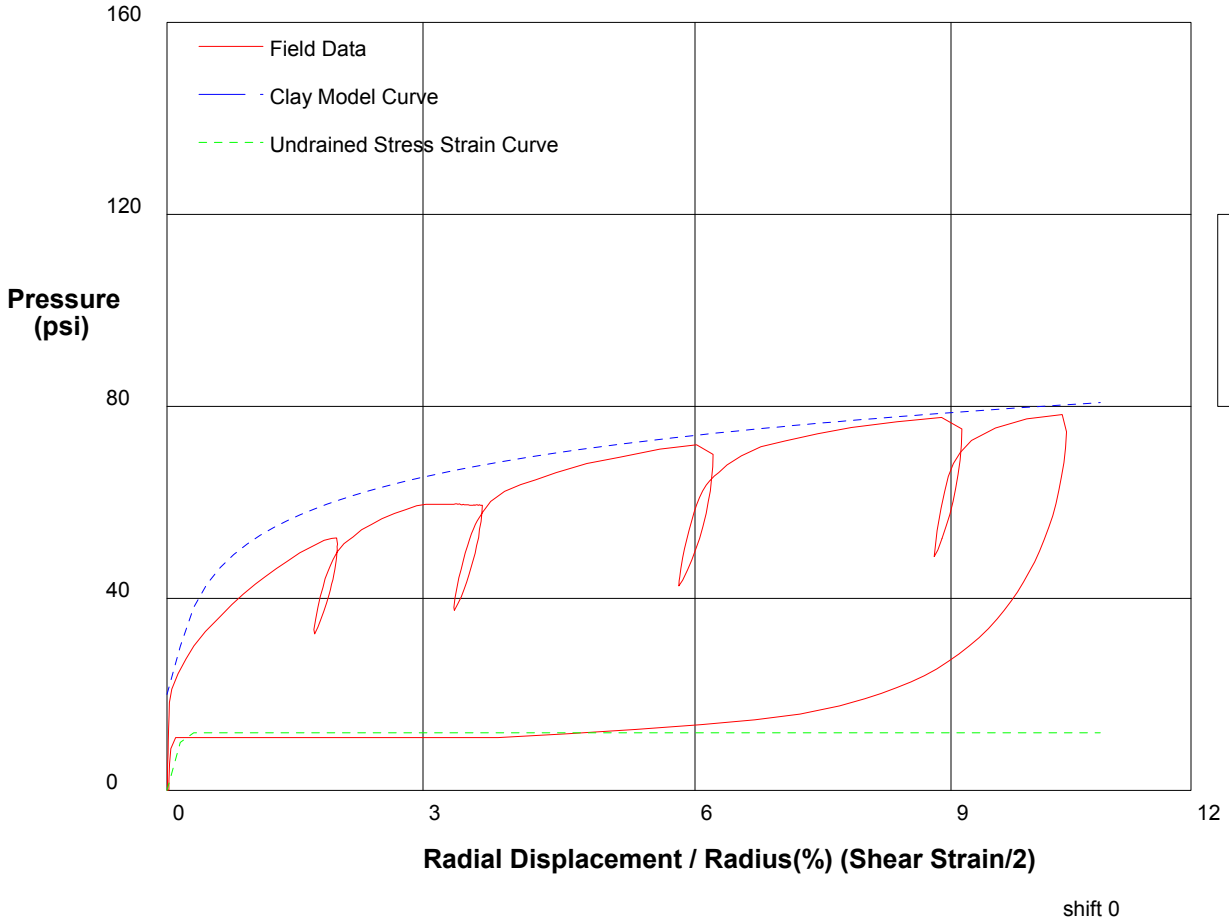
shift 0

THE In Situ Engineering SAND MODEL

Water Pressure	12 psi
Friction Angle	34 deg
Critical Friction Angle	32 deg
Lateral Stress	6 psi
Shear Modulus	3400 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 41.2ft	File C:\DATA\ISE-771\DOT68.P

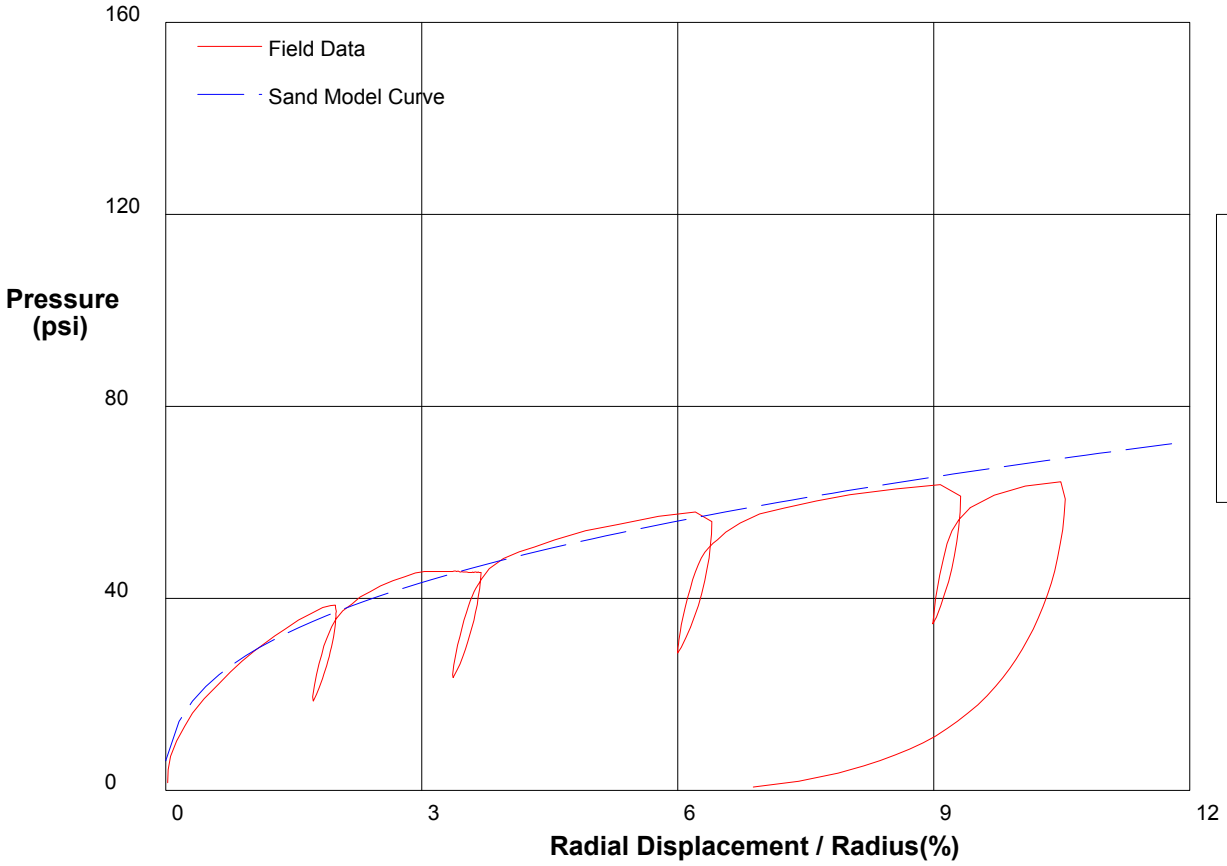


GIBSON'S CLAY MODEL

Shear Strength	12	psi
Insitu Stress	20	psi
Shear Modulus	3200	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 41.2ft	File C:\DATA\ISE-771\DOT68.P



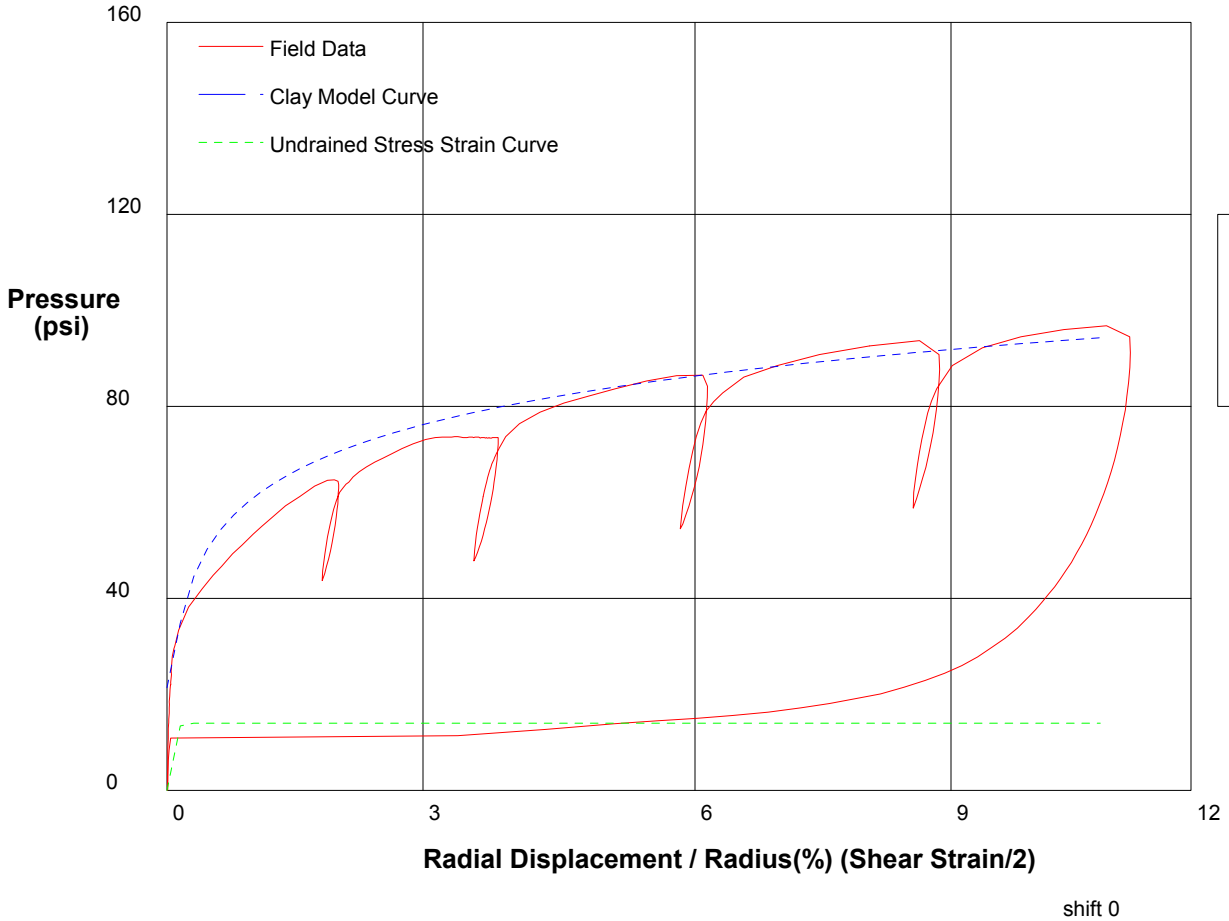
THE In Situ Engineering SAND MODEL

Water Pressure	14 psi
Friction Angle	34 deg
Critical Friction Angle	32 deg
Lateral Stress	6.2 psi
Shear Modulus	3200 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 44.2ft	File C:\DATA\ISE-771\DOT69.P

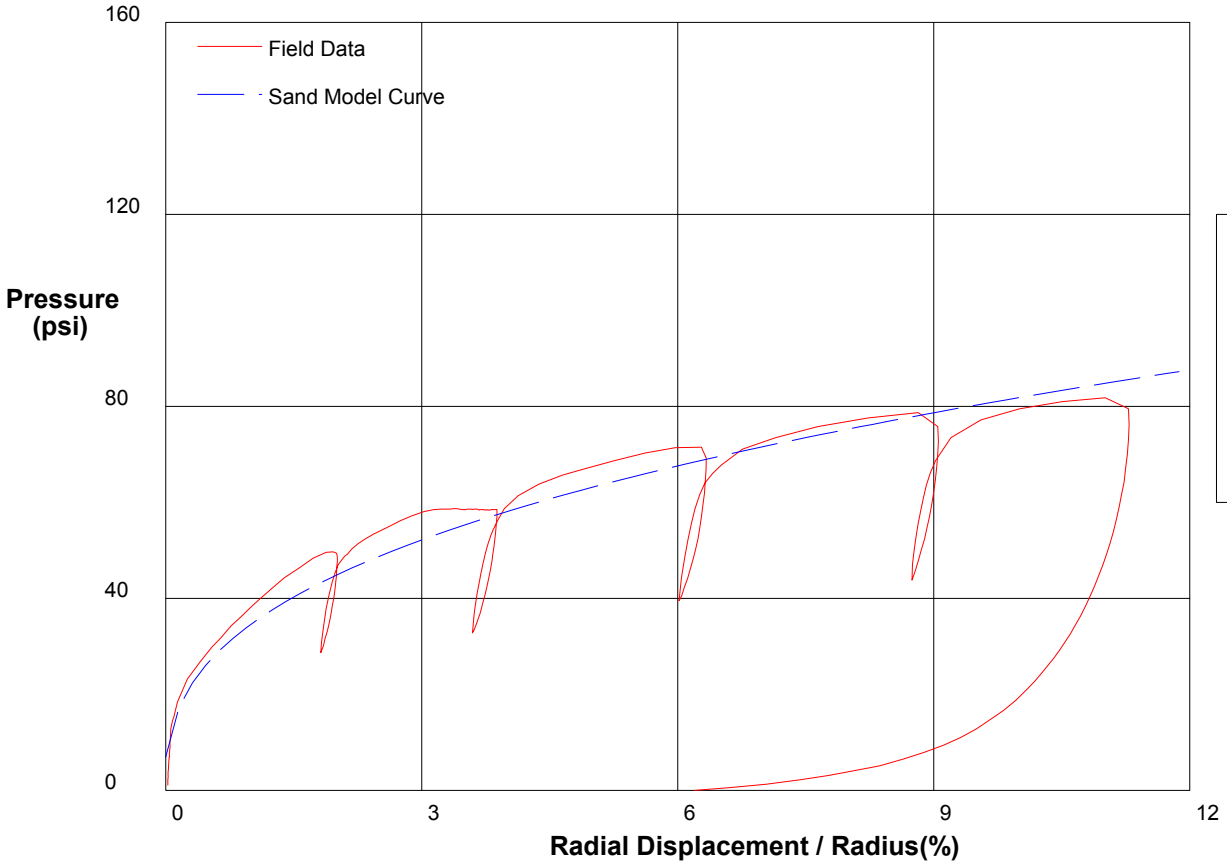


GIBSON'S CLAY MODEL

Shear Strength	14 psi
Insitu Stress	21.4 psi
Shear Modulus	4300 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 44.2ft	File C:\DATA\ISE-771\DOT69.P



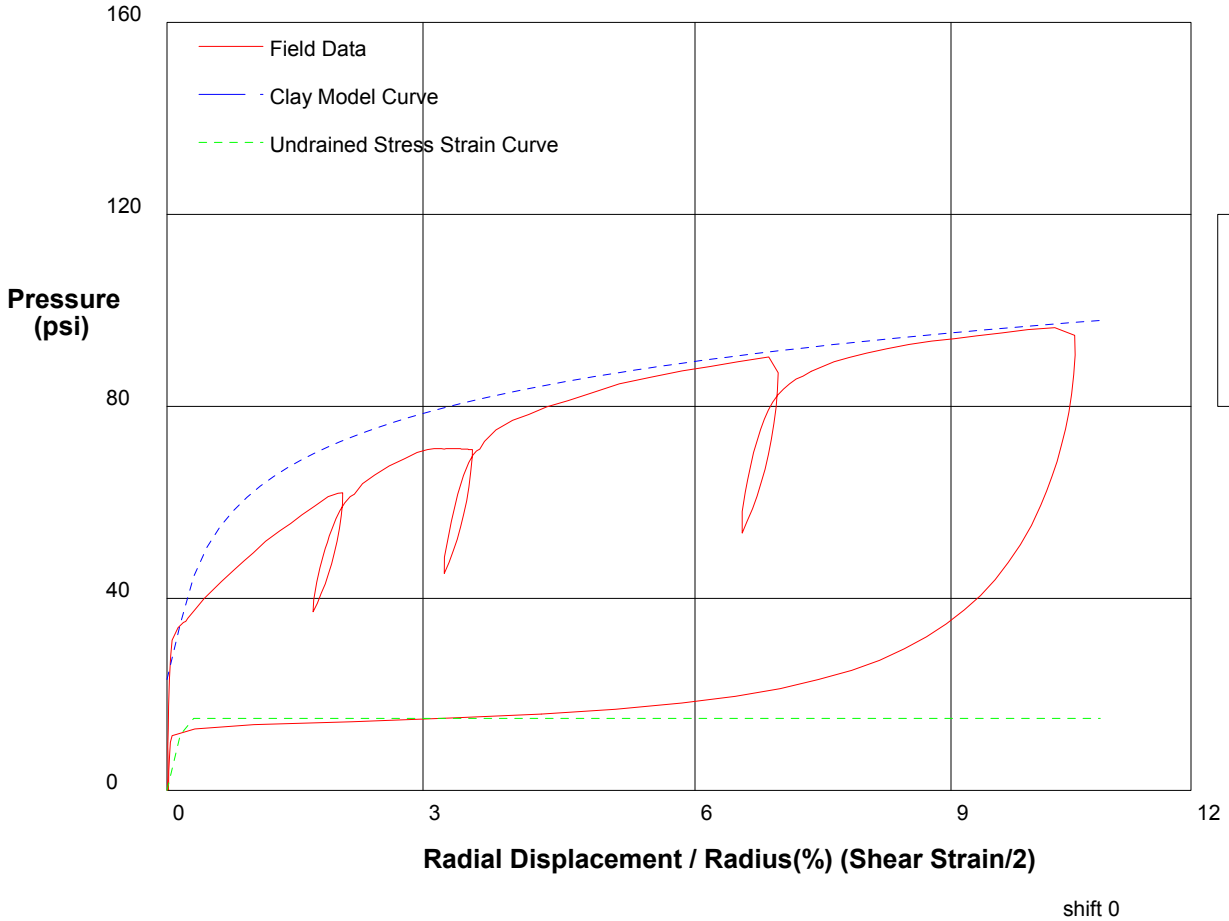
THE In Situ Engineering SAND MODEL

Water Pressure	15 psi
Friction Angle	34 deg
Critical Friction Angle	32 deg
Lateral Stress	7 psi
Shear Modulus	4300 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 47.2ft	File C:\DATA\ISE-771\DOT70.P

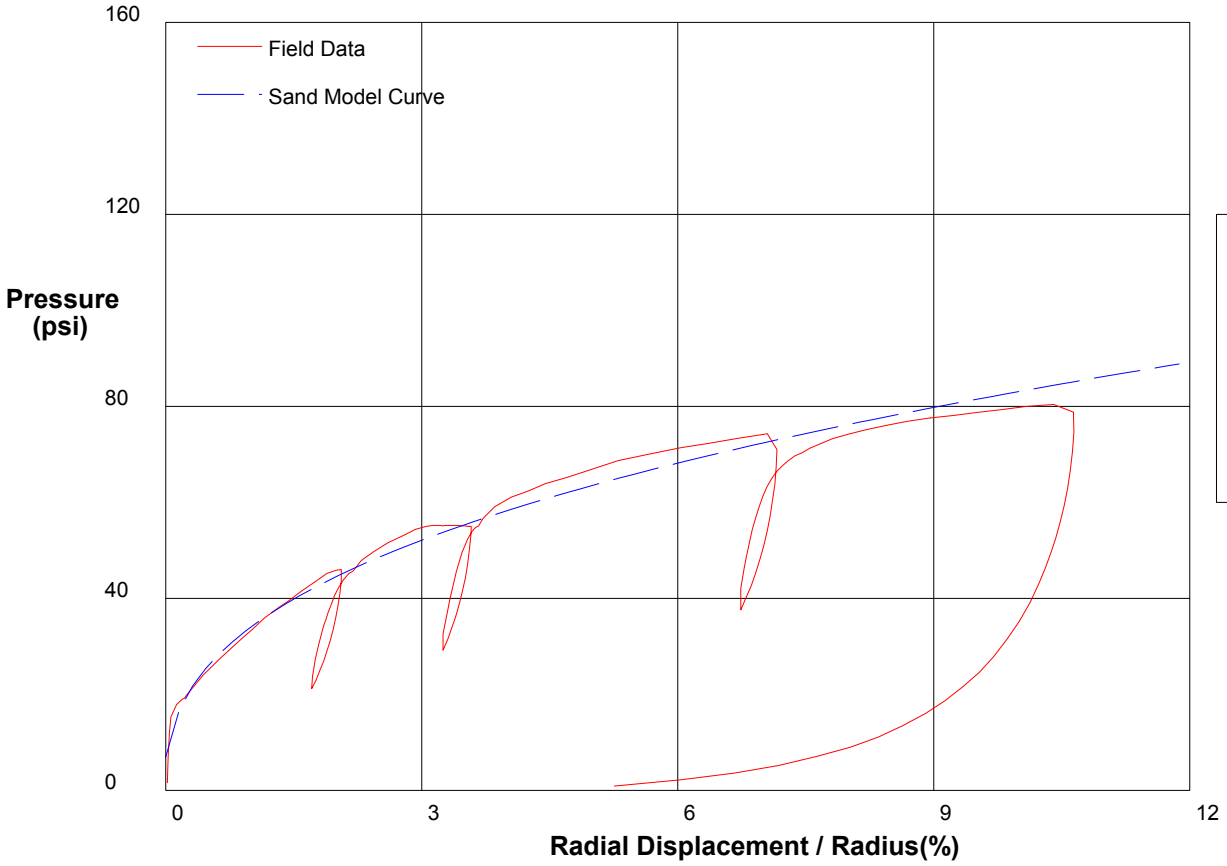


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	23.1 psi
Shear Modulus	3700 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 47.2ft	File C:\DATA\ISE-771\DOT70.P



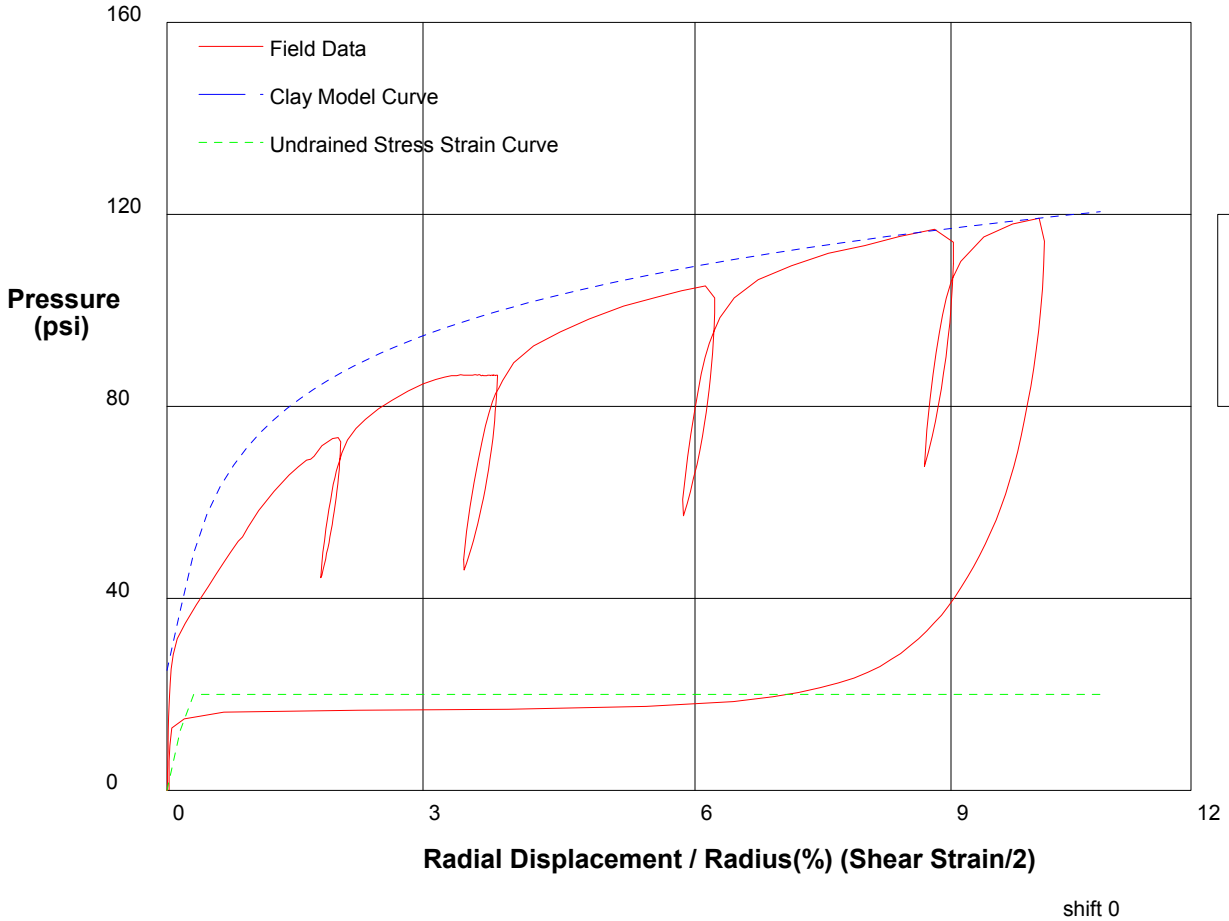
THE In Situ Engineering SAND MODEL

Water Pressure	16 psi
Friction Angle	35 deg
Critical Friction Angle	32 deg
Lateral Stress	7 psi
Shear Modulus	3700 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 50.2ft	File C:\DATA\ISE-771\DOT71.P

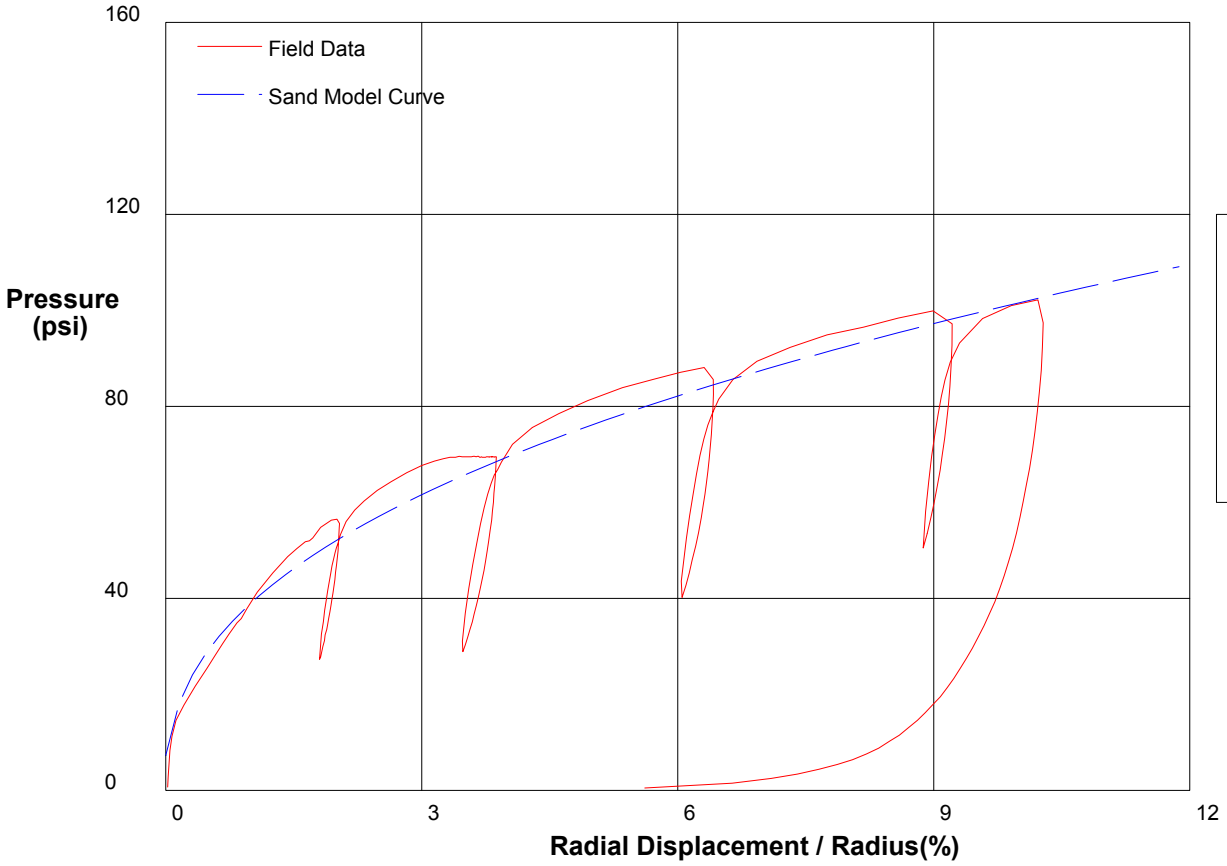


GIBSON'S CLAY MODEL

Shear Strength	20 psi
Insitu Stress	25 psi
Shear Modulus	4000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 50.2ft	File C:\DATA\ISE-771\DOT71.P



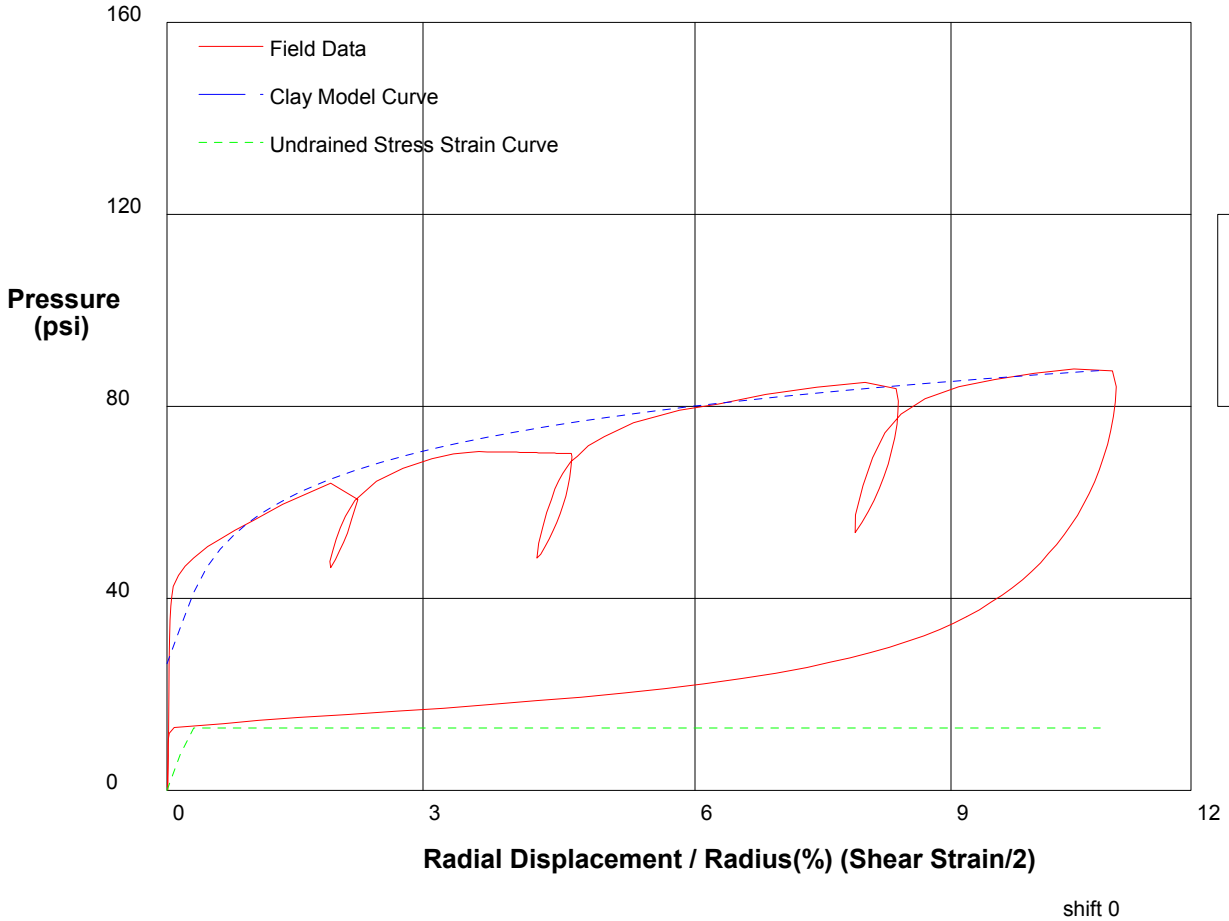
THE In Situ Engineering SAND MODEL

Water Pressure	17 psi
Friction Angle	37 deg
Critical Friction Angle	32 deg
Lateral Stress	7.3 psi
Shear Modulus	4000 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 53.2ft	File C:\DATA\ISE-771\DOT72.P

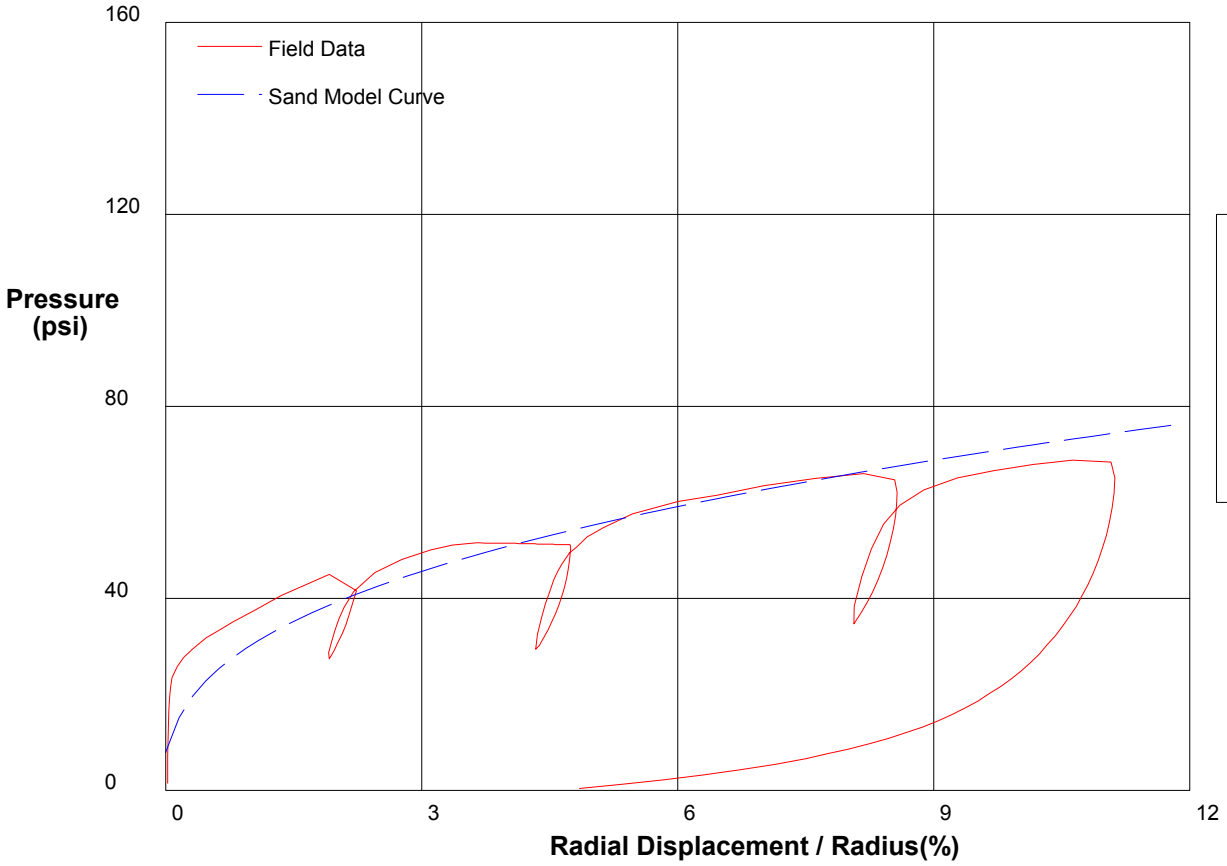


GIBSON'S CLAY MODEL

Shear Strength	13 psi
Insitu Stress	26.4 psi
Shear Modulus	2400 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 53.2ft	File C:\DATA\ISE-771\DOT72.P



THE In Situ Engineering SAND MODEL

Water Pressure	19 psi
Friction Angle	34 deg
Critical Friction Angle	32 deg
Lateral Stress	8 psi
Shear Modulus	2400 psi

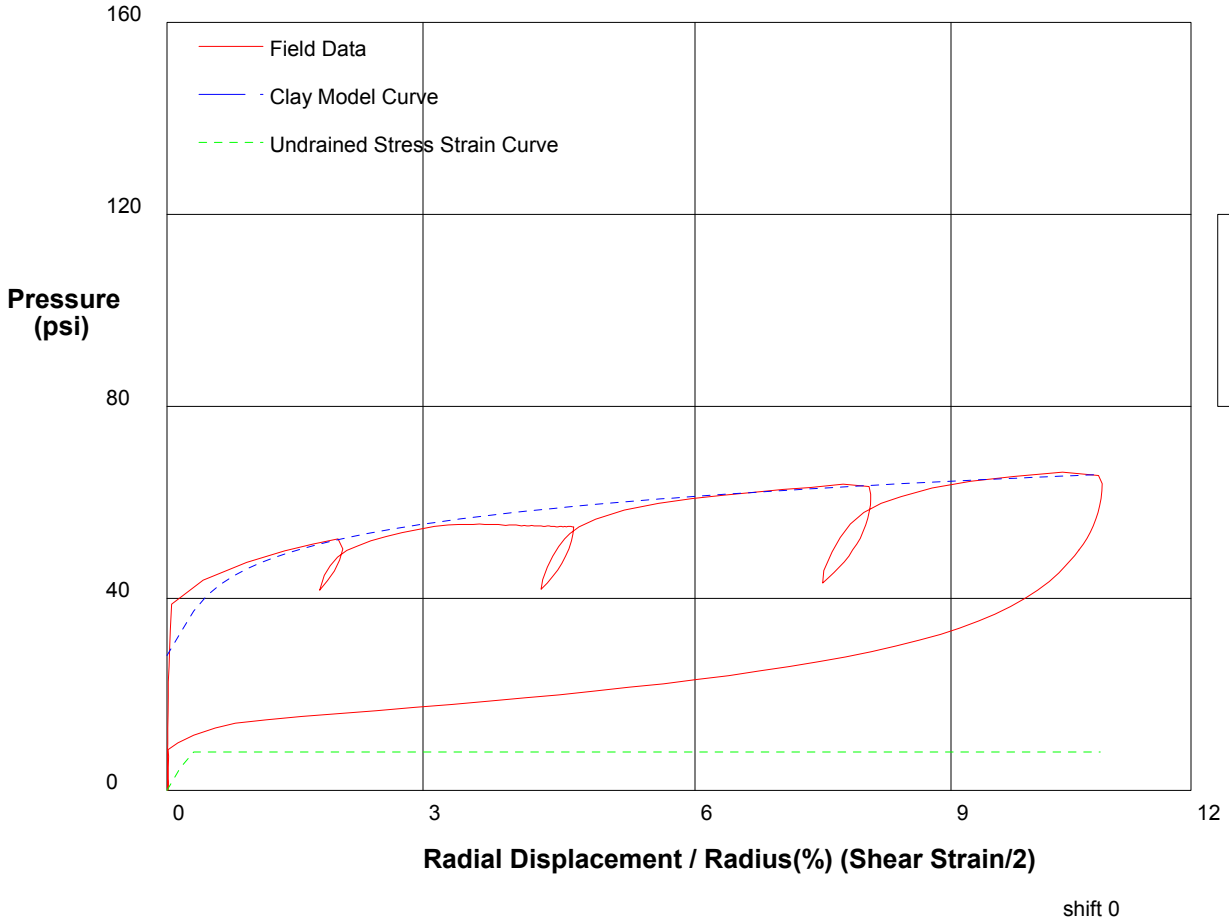
shift 0

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/13/2008**

Hole No. th29pm **Depth 56.2ft** **File C:\DATA\ISE-771\DOT73.P**



shift 0

GIBSON'S CLAY MODEL

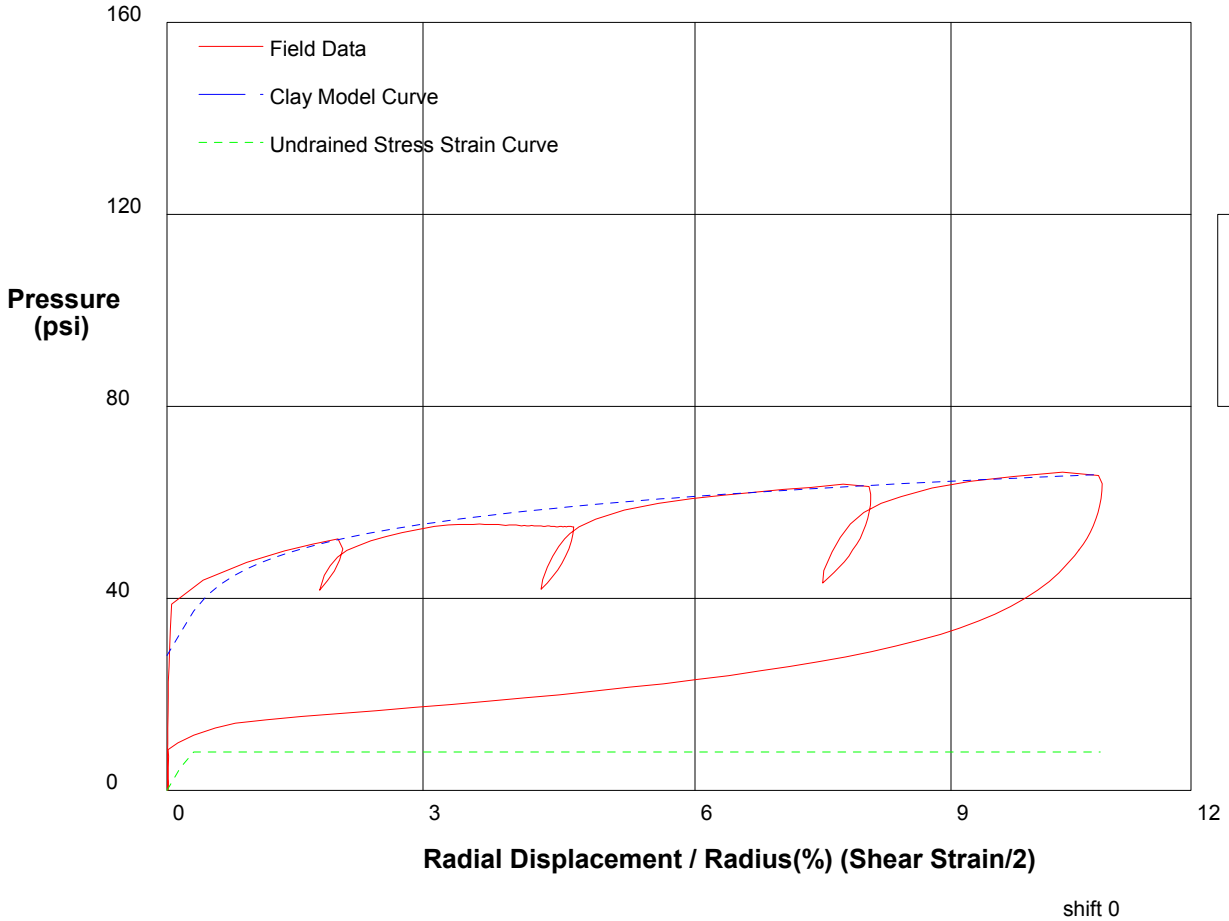
Shear Strength	**8**	**psi**
Insitu Stress	**28.1**	**psi**
Shear Modulus	**1500**	**psi**

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam WA. **7/13/2008**

Hole No. th29pm **Depth 56.2ft** **File C:\DATA\ISE-771\DOT73.P**



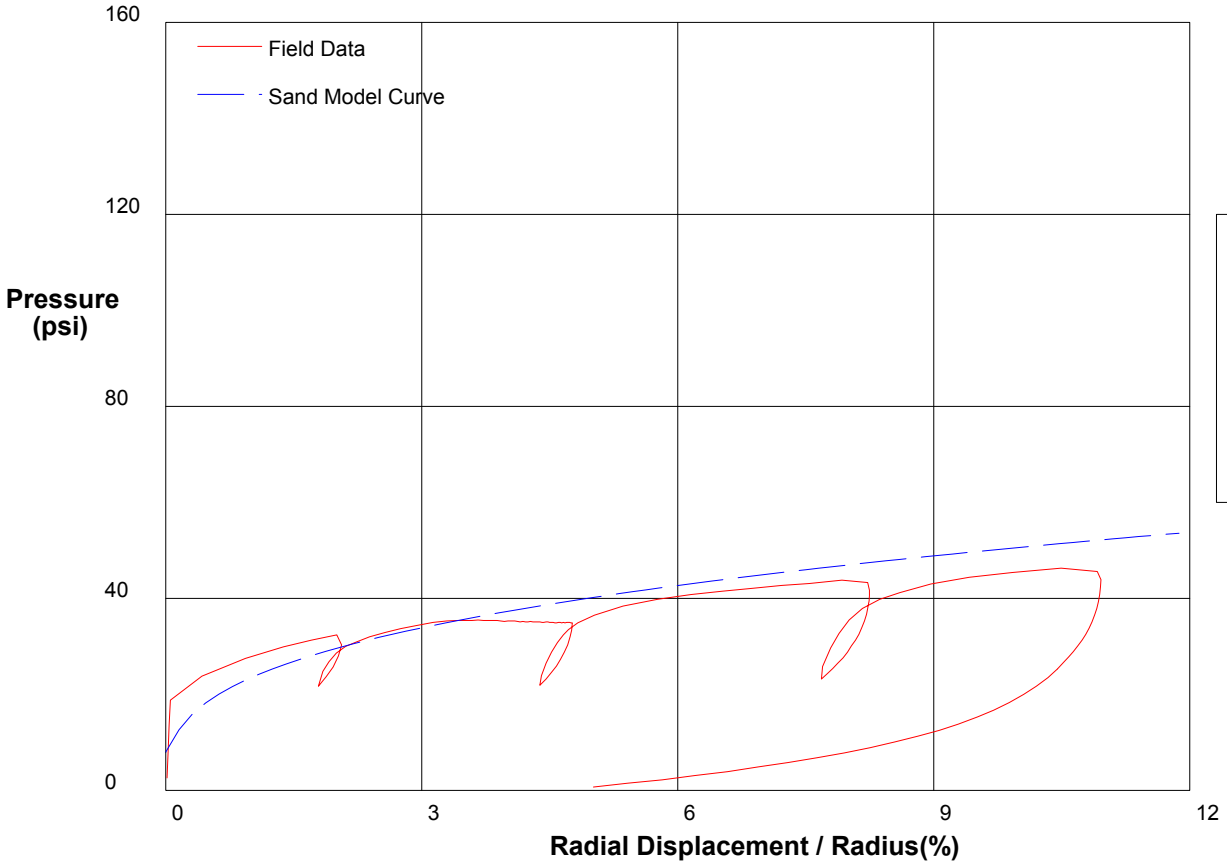
shift 0

GIBSON'S CLAY MODEL

Shear Strength	**8**	**psi**
Insitu Stress	**28.1**	**psi**
Shear Modulus	**1500**	**psi**

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 56.2ft	File C:\DATA\ISE-771\DOT73.P



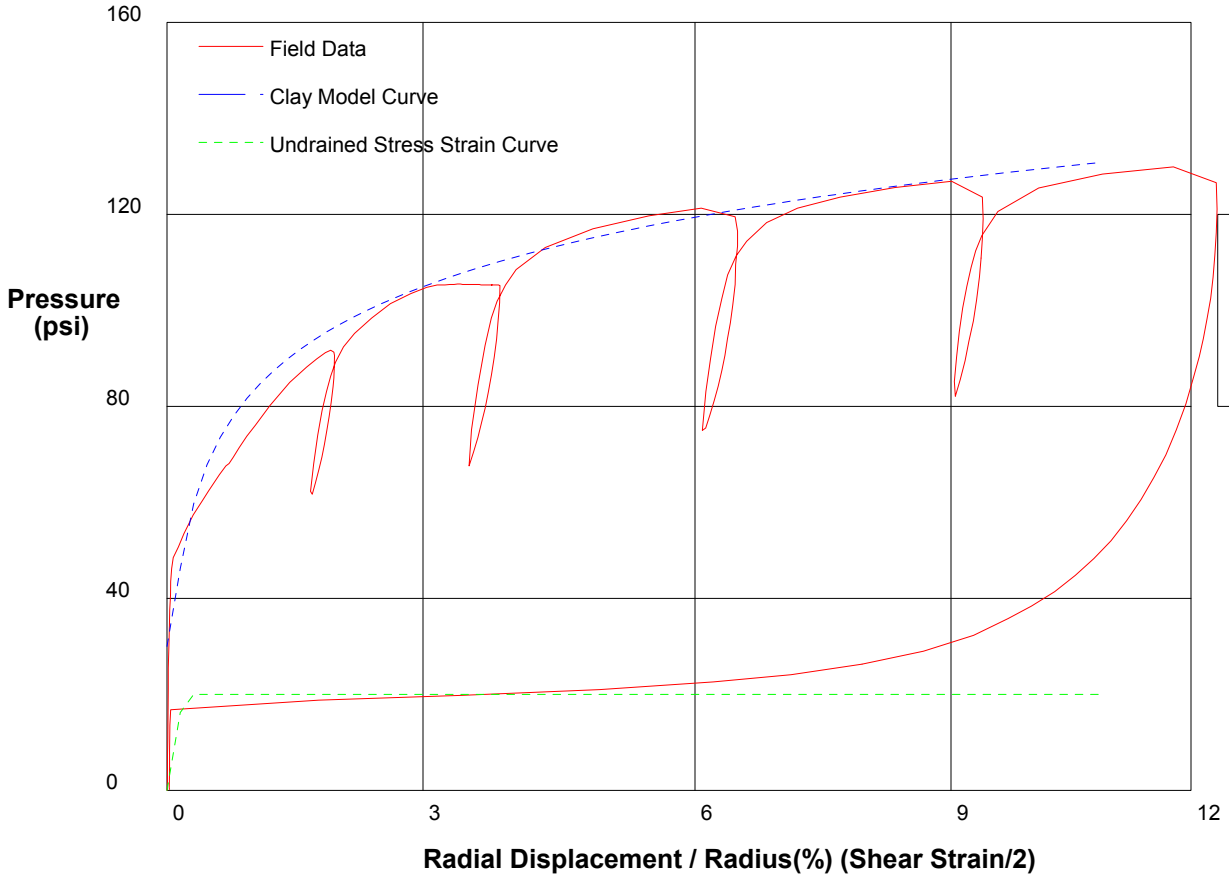
THE In Situ Engineering SAND MODEL

Water Pressure	20 psi
Friction Angle	30 deg
Critical Friction Angle	30 deg
Lateral Stress	8 psi
Shear Modulus	1500 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 59.2ft	File C:\DATA\ISE-771\DOT74.P



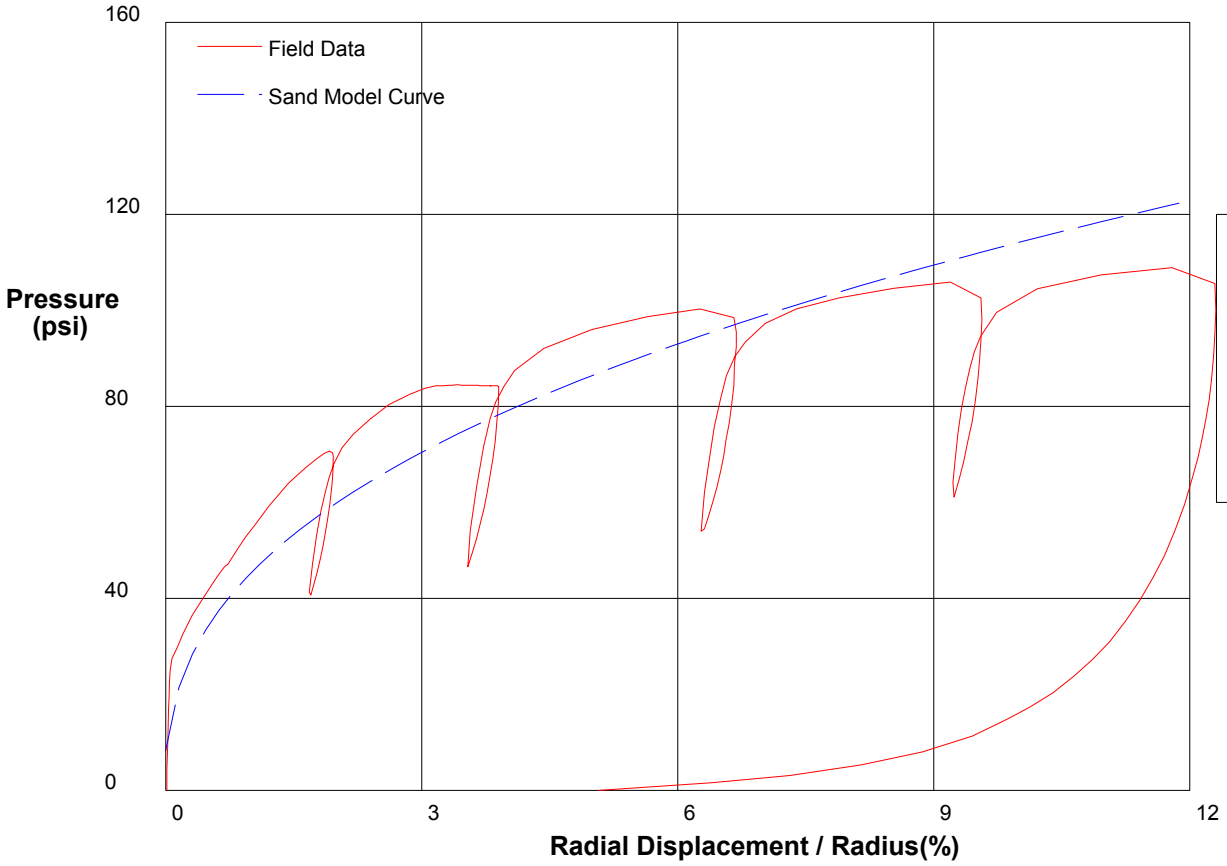
GIBSON'S CLAY MODEL

Shear Strength	20	psi
Insitu Stress	30	psi
Shear Modulus	5200	psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 59.2ft	File C:\DATA\ISE-771\DOT74.P



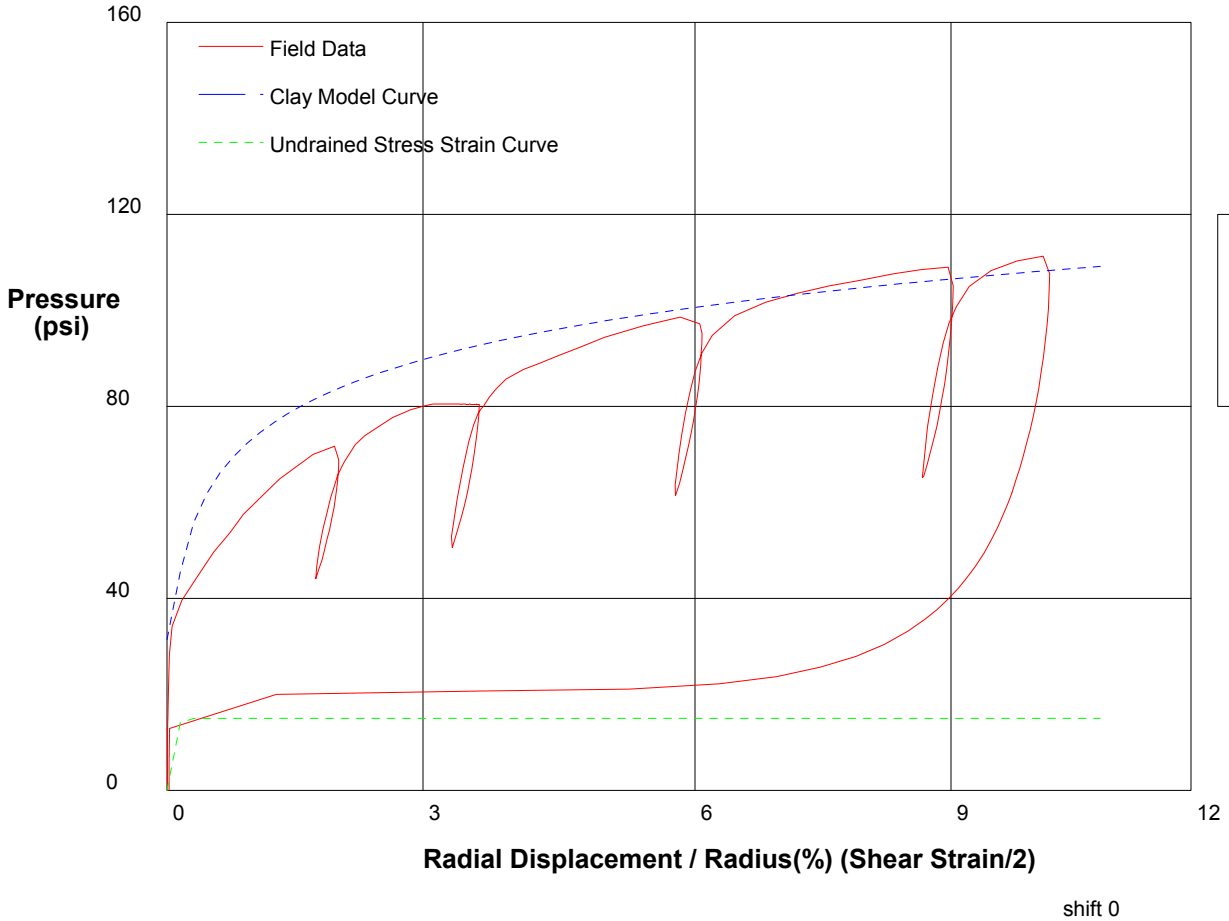
THE In Situ Engineering SAND MODEL

Water Pressure	21 psi
Friction Angle	36 deg
Critical Friction Angle	32 deg
Lateral Stress	8.4 psi
Shear Modulus	5200 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 62.2ft	File C:\DATA\ISE-771\DOT75.P

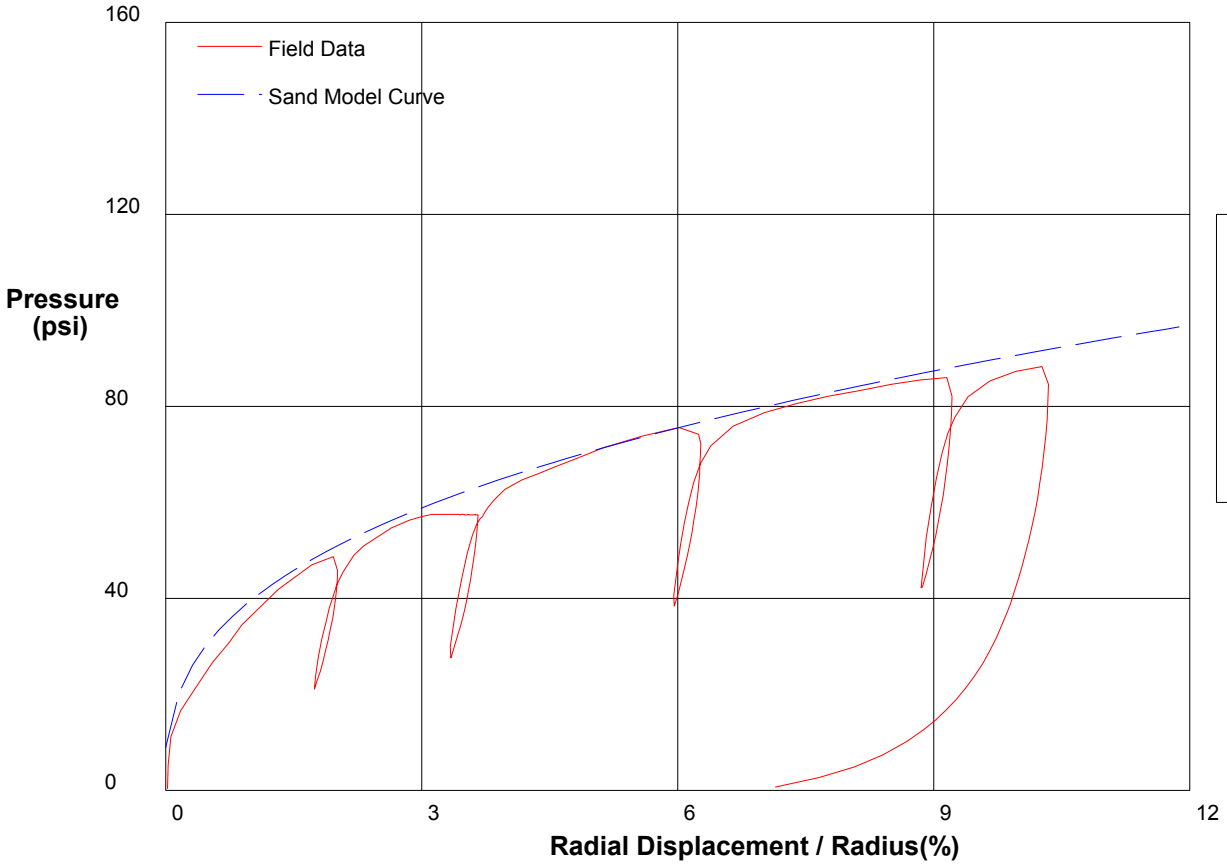


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	31.4 psi
Shear Modulus	4500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/13/2008
Hole No. th29pm	Depth 62.2ft	File C:\DATA\ISE-771\DOT75.P



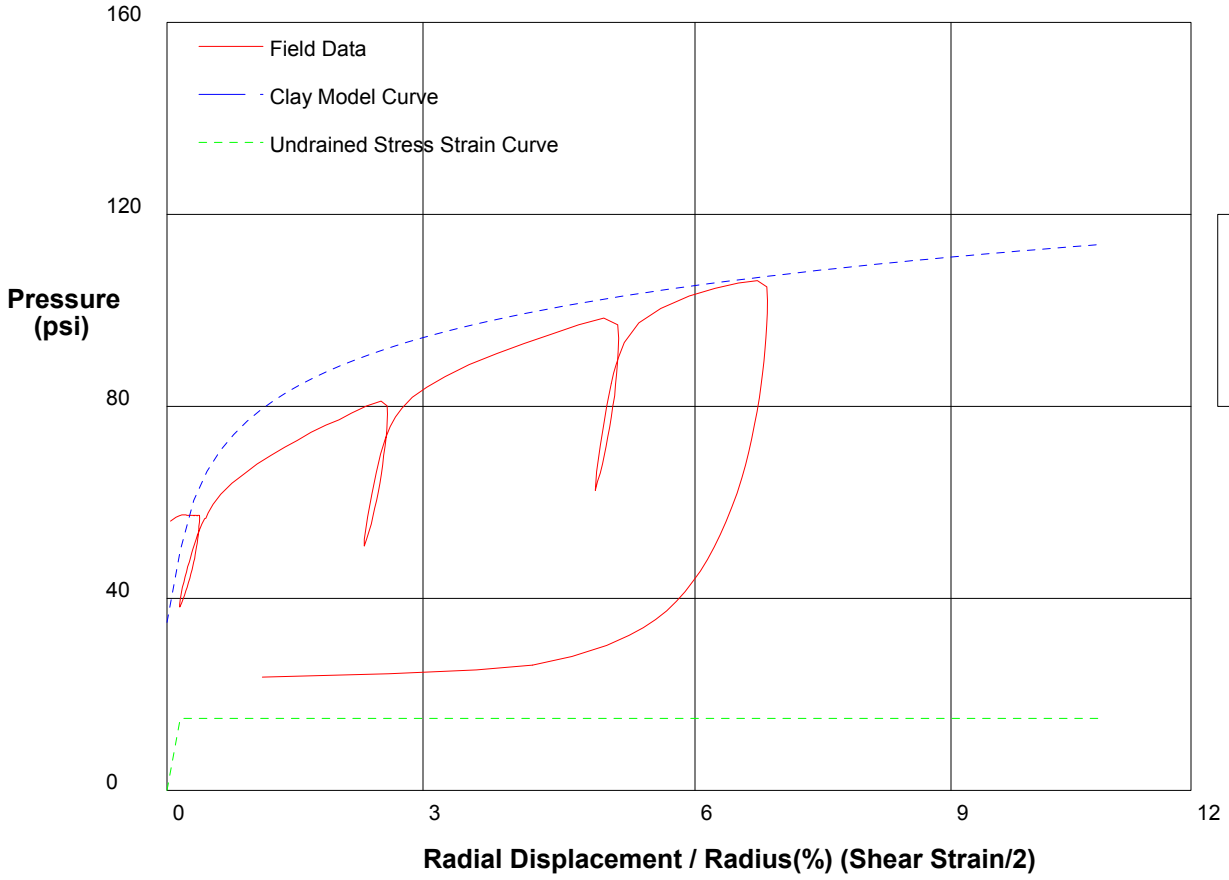
THE In Situ Engineering SAND MODEL

Water Pressure	23 psi
Friction Angle	33 deg
Critical Friction Angle	32 deg
Lateral Stress	9 psi
Shear Modulus	4500 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/14/2008
Hole No. th29pm	Depth 68.2ft	File C:\DATA\ISE-771\DOT76.P



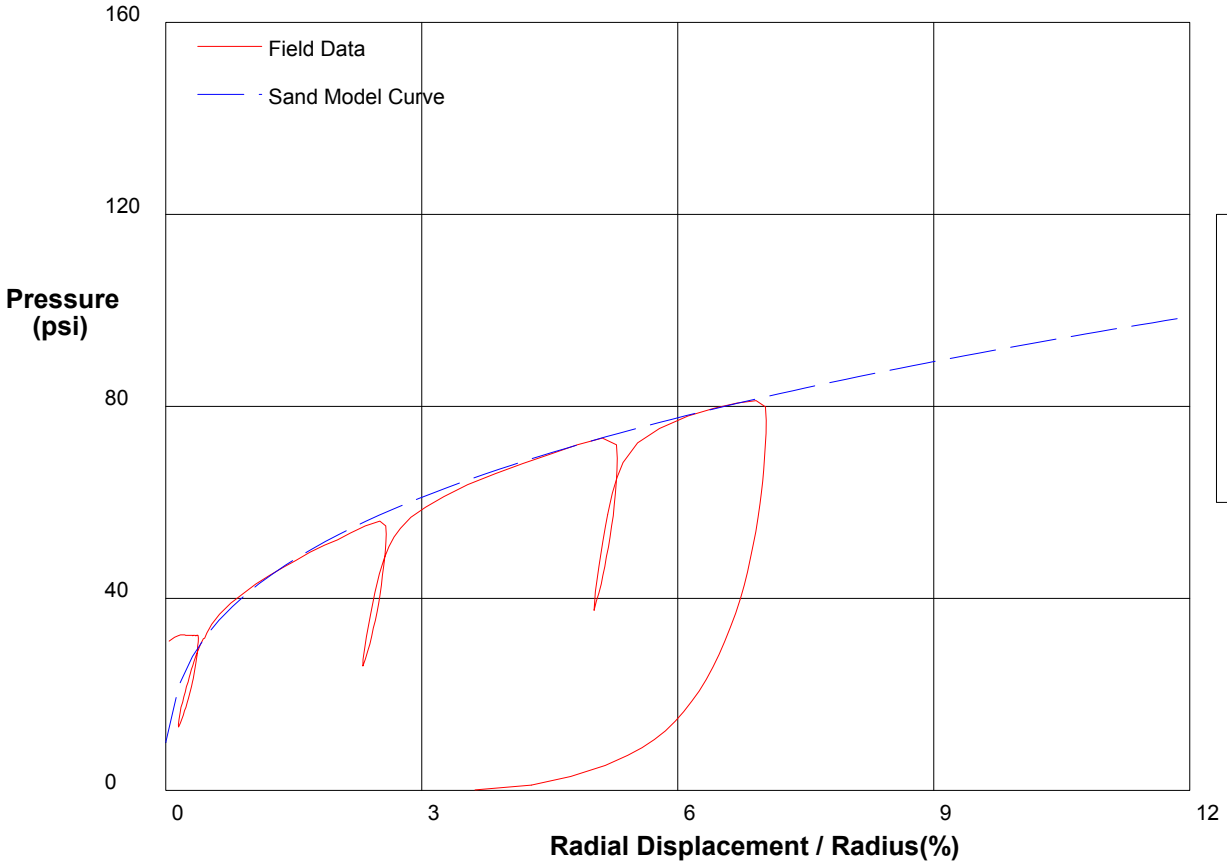
GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	35 psi
Shear Modulus	4800 psi

shift 3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/14/2008
Hole No. th29pm	Depth 68.2ft	File C:\DATA\ISE-771\DOT76.P



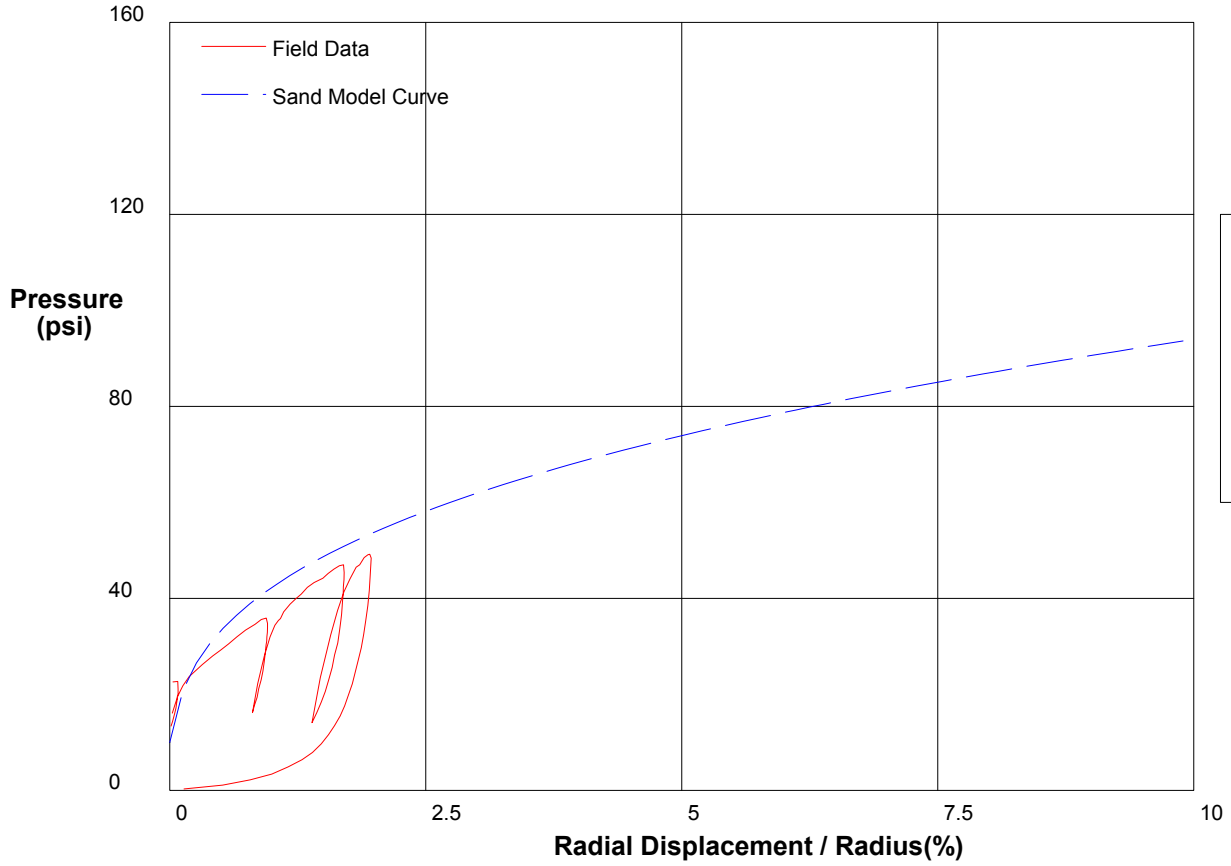
THE In Situ Engineering SAND MODEL

Water Pressure	25 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	10 psi
Shear Modulus	4800 psi

shift 3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/14/2008
Hole No. th29pm	Depth 74.2ft	File C:\DATA\ISE-771\DOT78.P



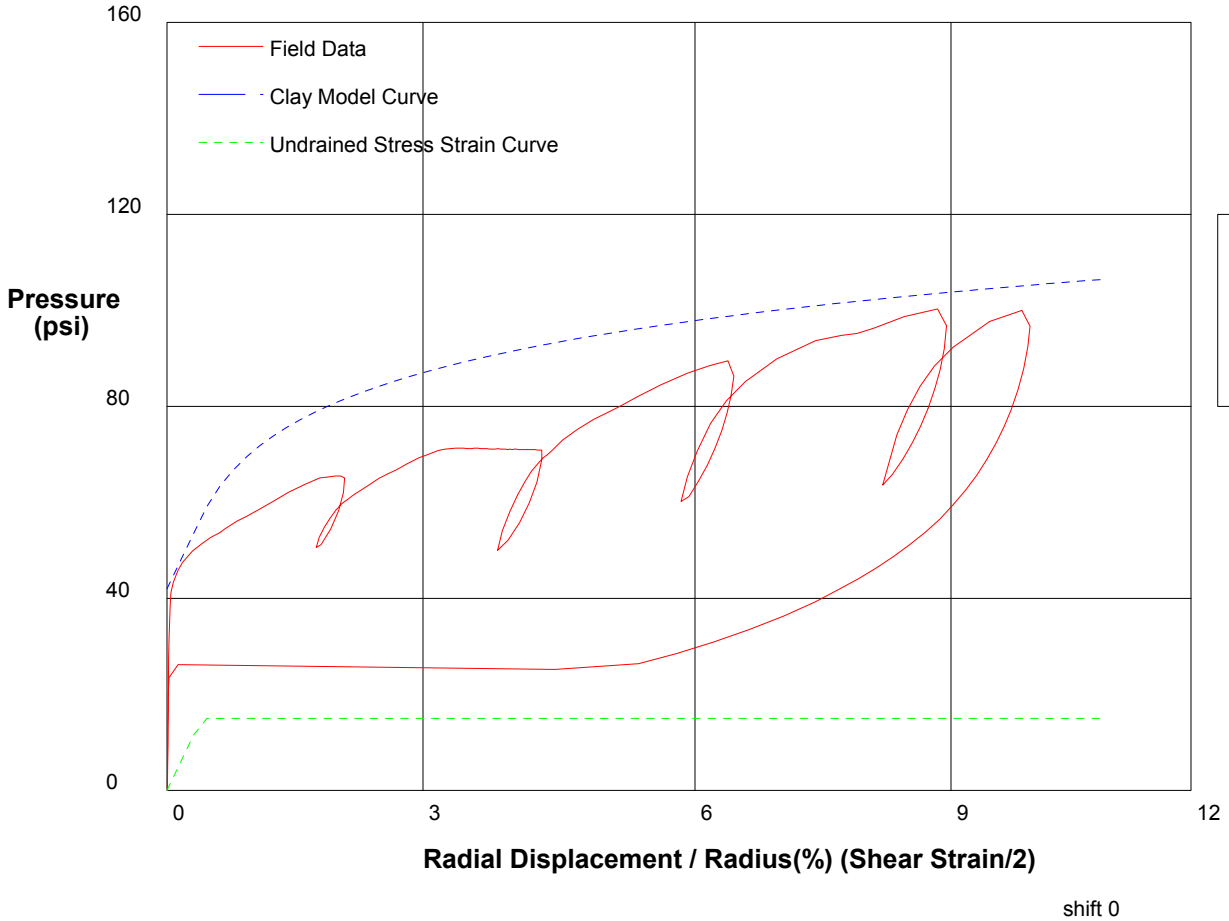
THE In Situ Engineering SAND MODEL

Water Pressure	28 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	10 psi
Shear Modulus	5000 psi

shift 4.5

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/14/2008
Hole No. th29pm	Depth 81.2ft	File C:\DATA\ISE-771\DOT80.P

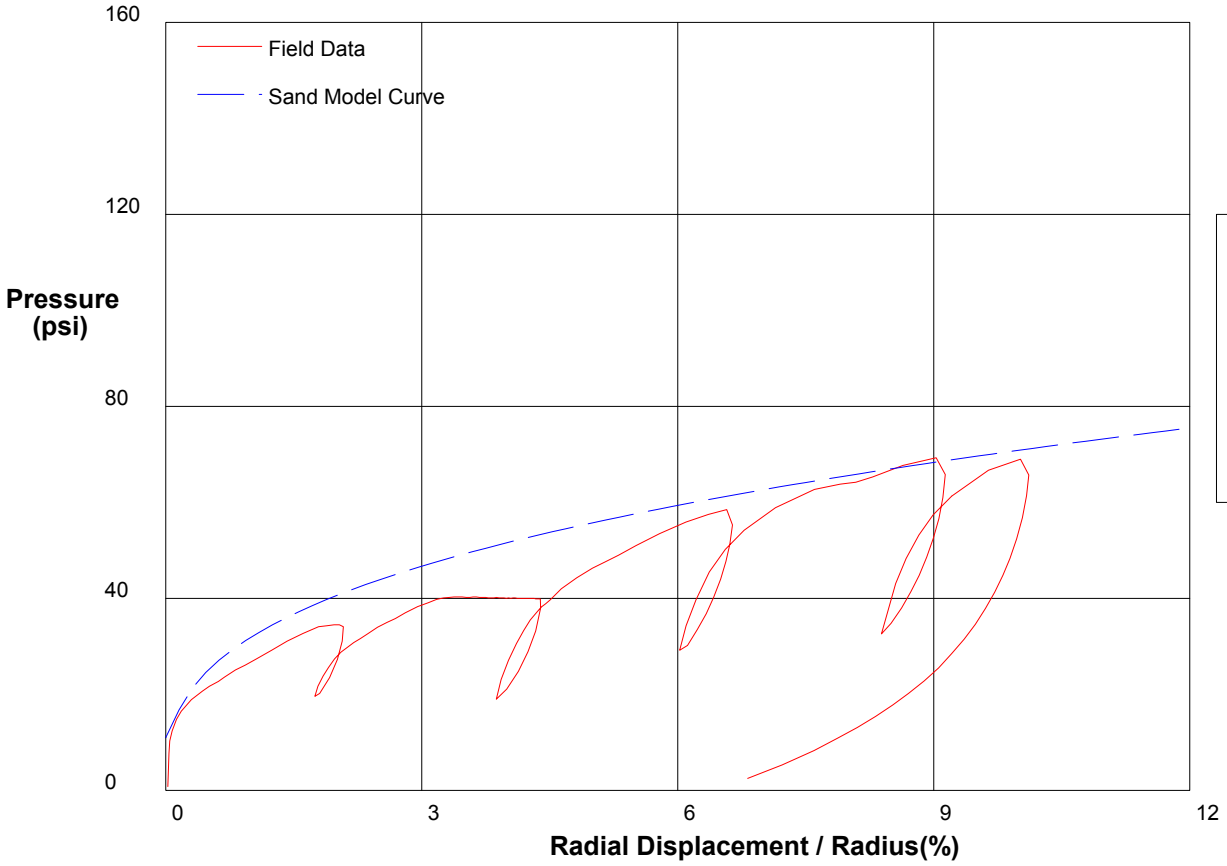


GIBSON'S CLAY MODEL

Shear Strength	15	psi
Insitu Stress	42	psi
Shear Modulus	1850	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/14/2008
Hole No. th29pm	Depth 81.2ft	File C:\DATA\ISE-771\DOT80.P



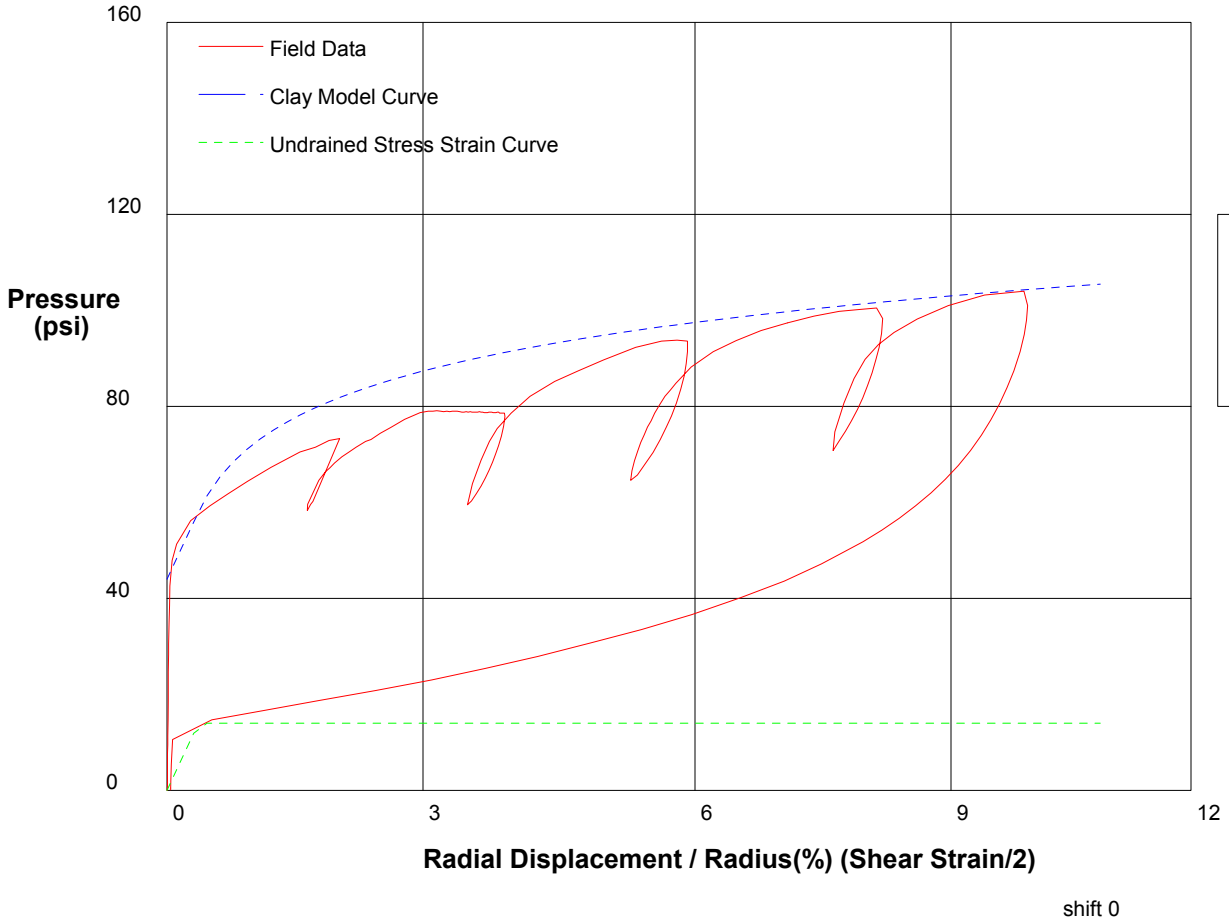
THE In Situ Engineering SAND MODEL

Water Pressure	31 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	11 psi
Shear Modulus	1850 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/14/2008
Hole No. th29pm	Depth 84.2ft	File C:\DATA\ISE-771\DOT81.P

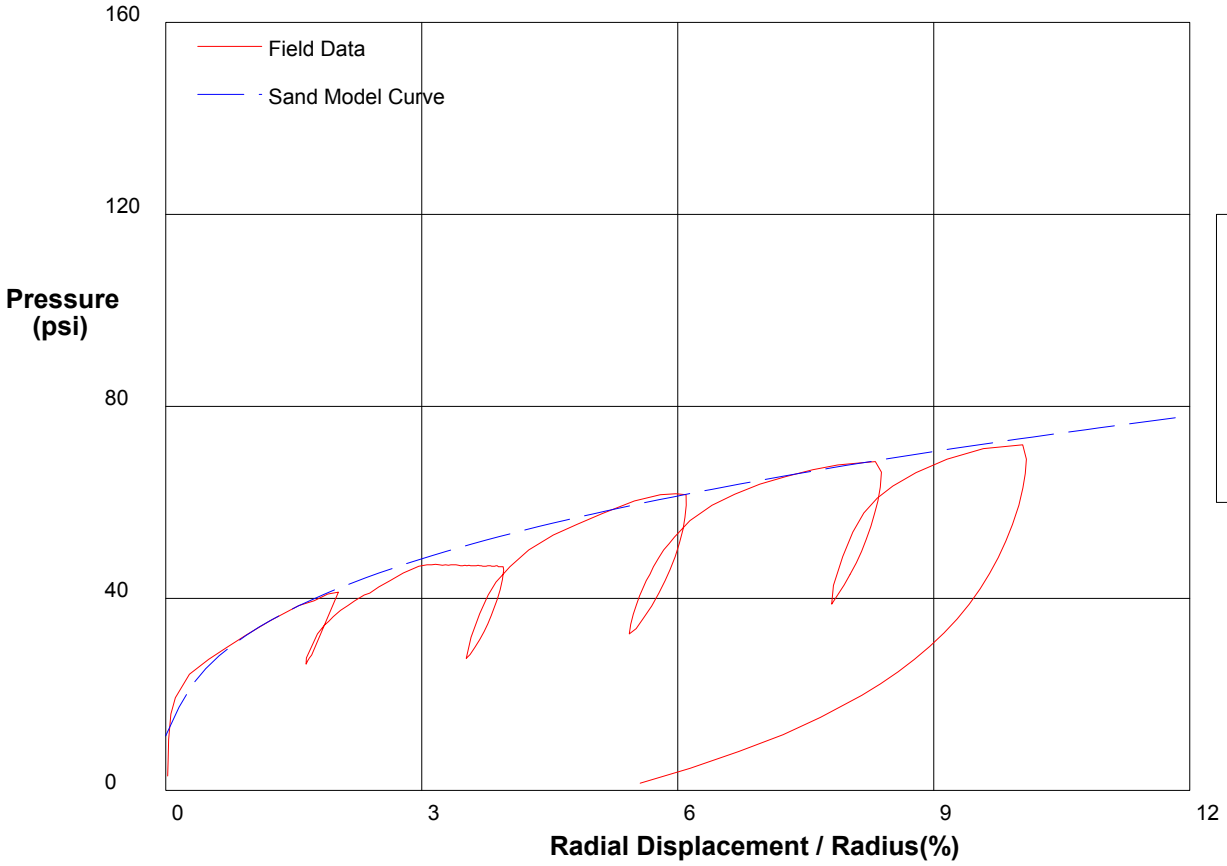


GIBSON'S CLAY MODEL

Shear Strength	14	psi
Insitu Stress	44	psi
Shear Modulus	1900	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/14/2008
Hole No. th29pm	Depth 84.2ft	File C:\DATA\ISE-771\DOT81.P



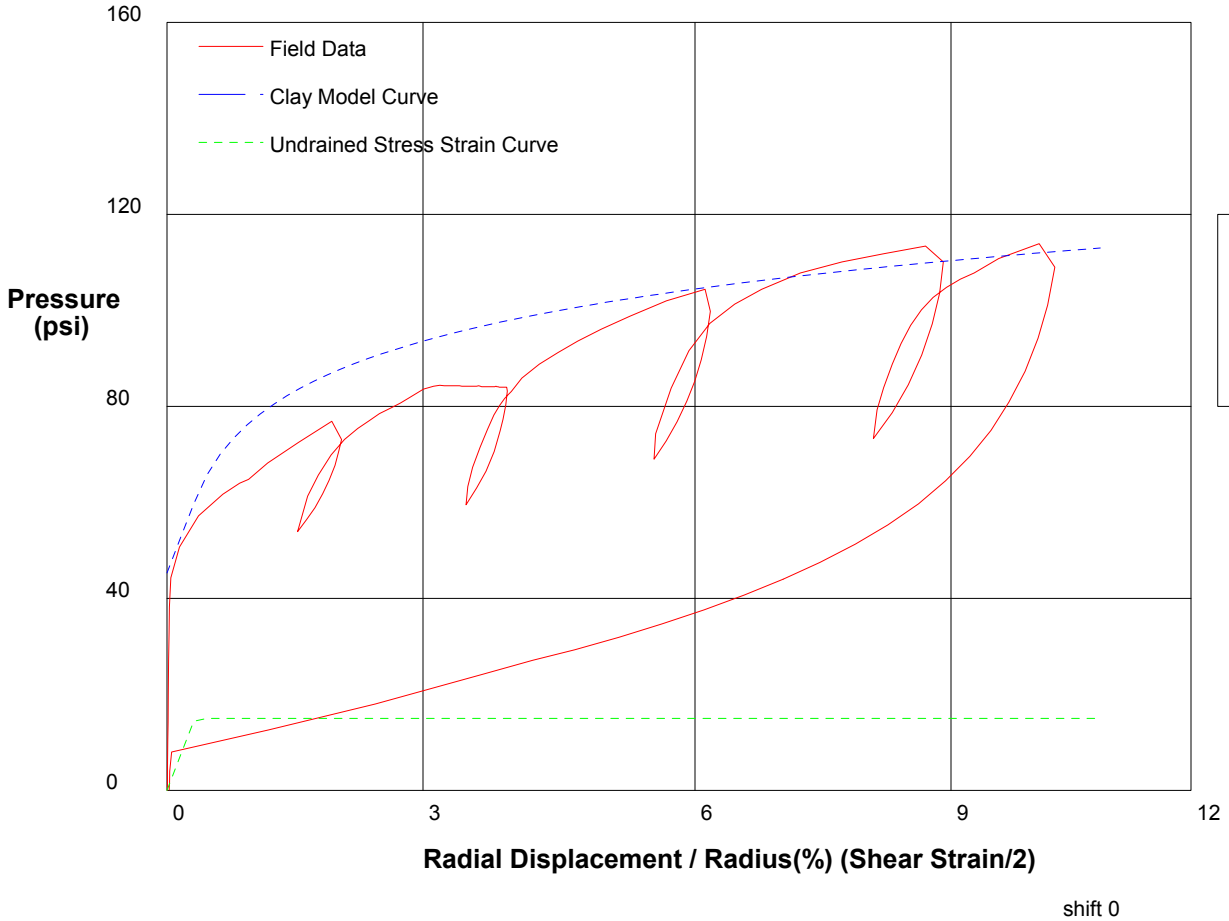
THE In Situ Engineering SAND MODEL

Water Pressure	32 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	11.4 psi
Shear Modulus	1900 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/14/2008
Hole No. th29pm	Depth 87.2ft	File C:\DATA\ISE-771\DOT82.P

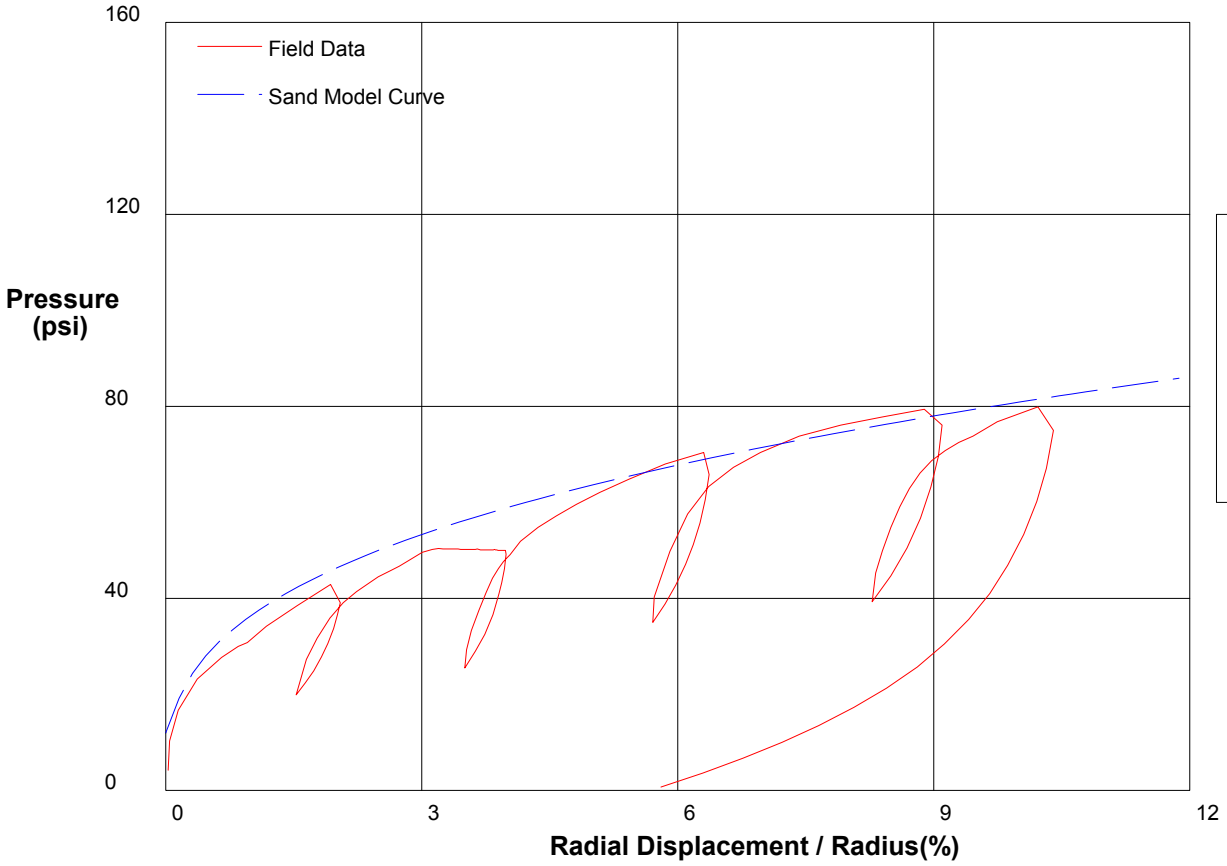


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	45.3 psi
Shear Modulus	2300 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/14/2008
Hole No. th29pm	Depth 87.2ft	File C:\DATA\ISE-771\DOT82.P



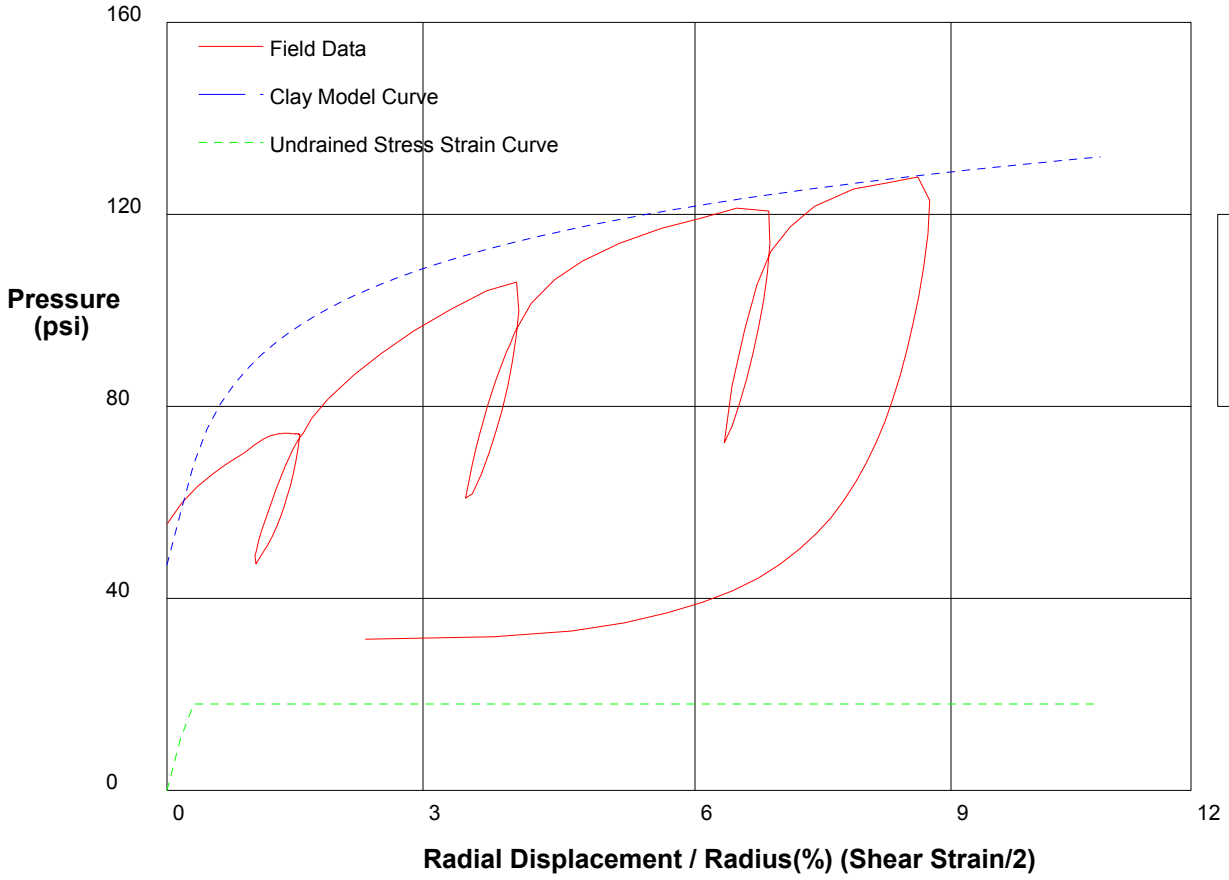
THE In Situ Engineering SAND MODEL

Water Pressure	34 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	12 psi
Shear Modulus	2300 psi

shift 0

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/14/2008
Hole No. th29pm	Depth 90.2ft	File C:\DATA\ISE-771\DOT83.P



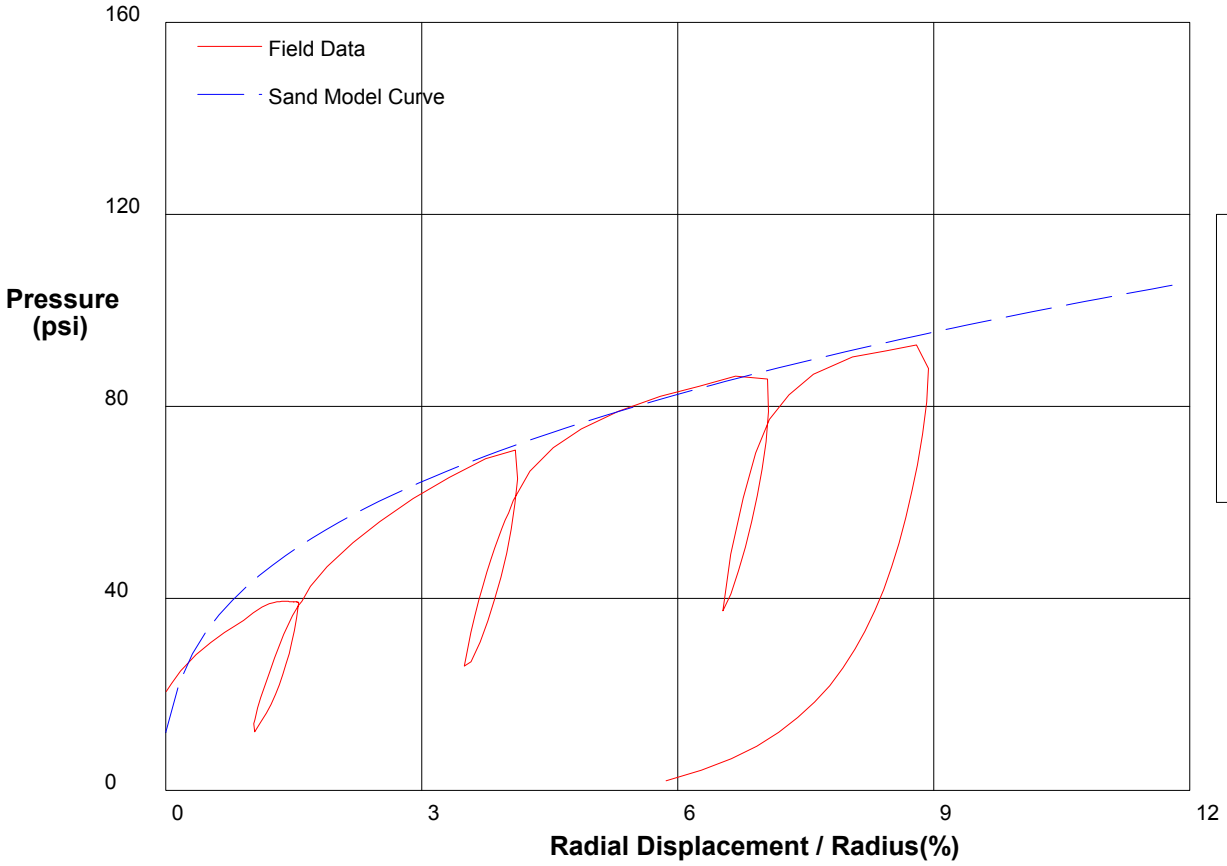
shift 2

GIBSON'S CLAY MODEL

Shear Strength	18 psi
Insitu Stress	47 psi
Shear Modulus	3400 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation	
Grays Harbor, Hoquiam WA.		7/14/2008
Hole No. th29pm	Depth 90.2ft	File C:\DATA\ISE-771\DOT83.P



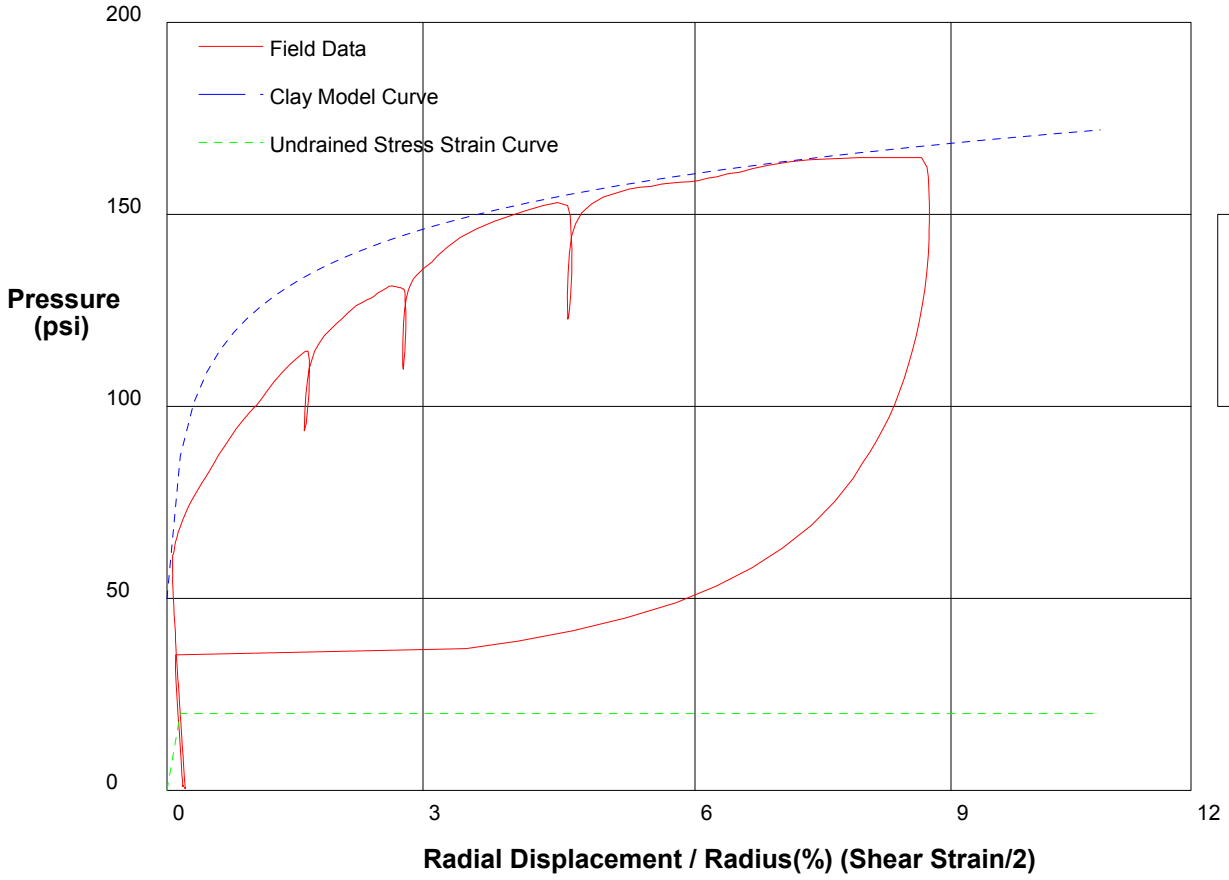
THE In Situ Engineering SAND MODEL

Water Pressure	35 psi
Friction Angle	33 deg
Critical Friction Angle	32 deg
Lateral Stress	12.1 psi
Shear Modulus	3400 psi

shift 2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/4/2008
Hole No. TH-29B-PMT-08 Depth 92.0ft	File C:\DATA\ISE-771\ST2\DOT-84.P



GIBSON'S CLAY MODEL

Shear Strength	20	psi
Insitu Stress	50	psi
Shear Modulus	15000	psi

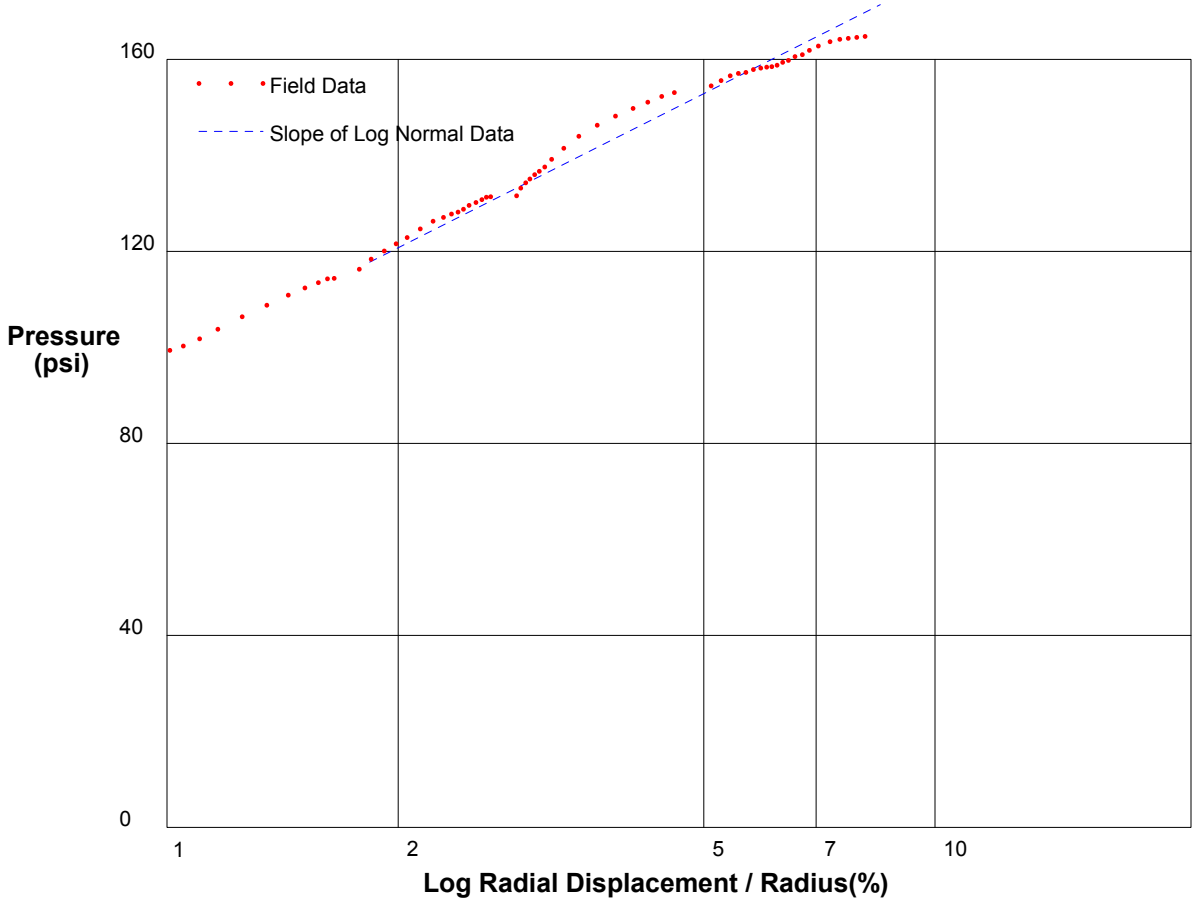
shift-1.3

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA. **9/4/2008**

Hole No. TH-29B-PMT-08 Depth 92.0ft **File C:\DATA\ISE-771\ST2\DOT-84.P**



Shear Strength 35 psi
Limit Pressure 226 psi

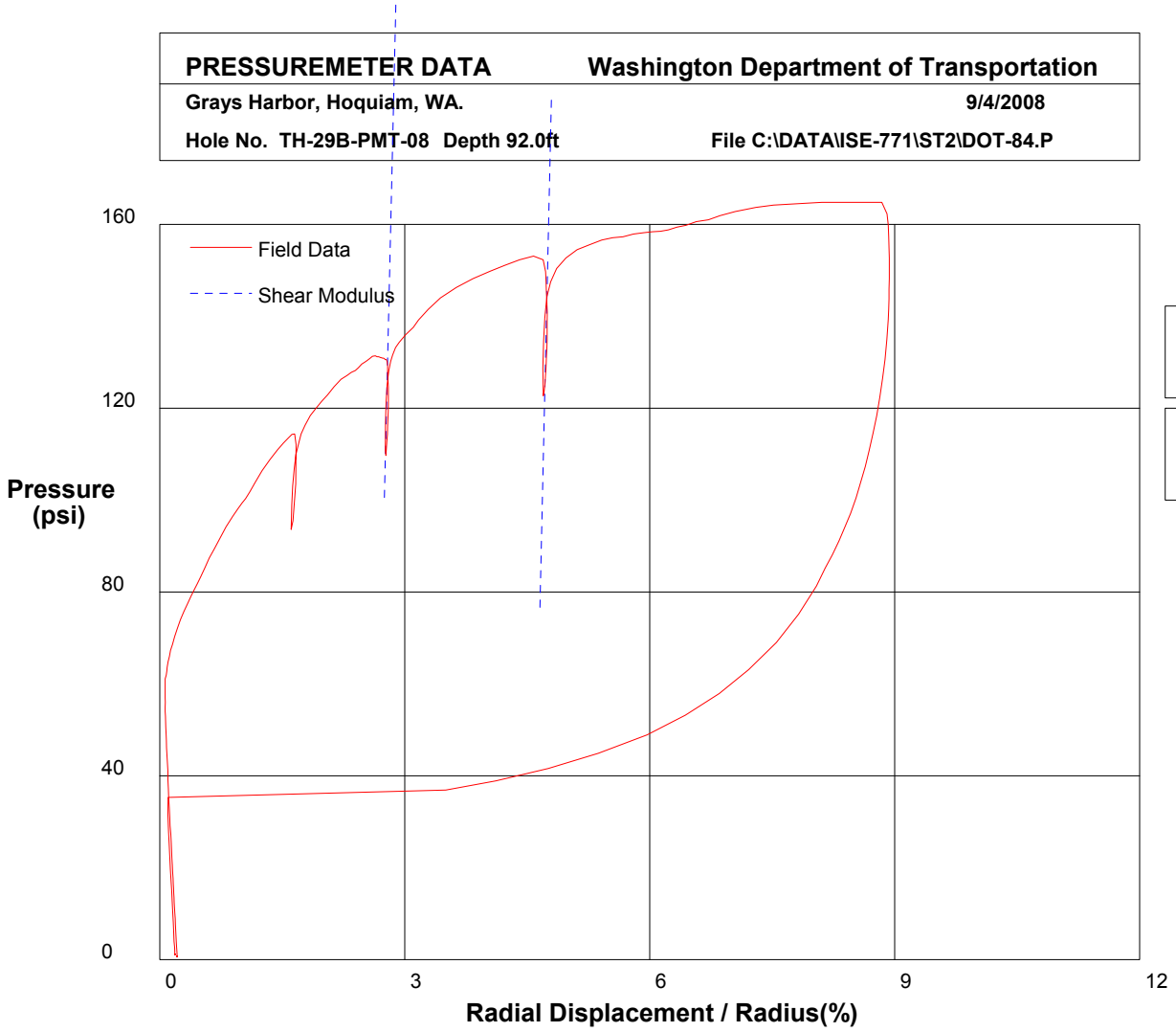
shift-1.3

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA. **9/4/2008**

Hole No. TH-29B-PMT-08 Depth 92.0ft **File C:\DATA\ISE-771\ST2\DOT-84.P**



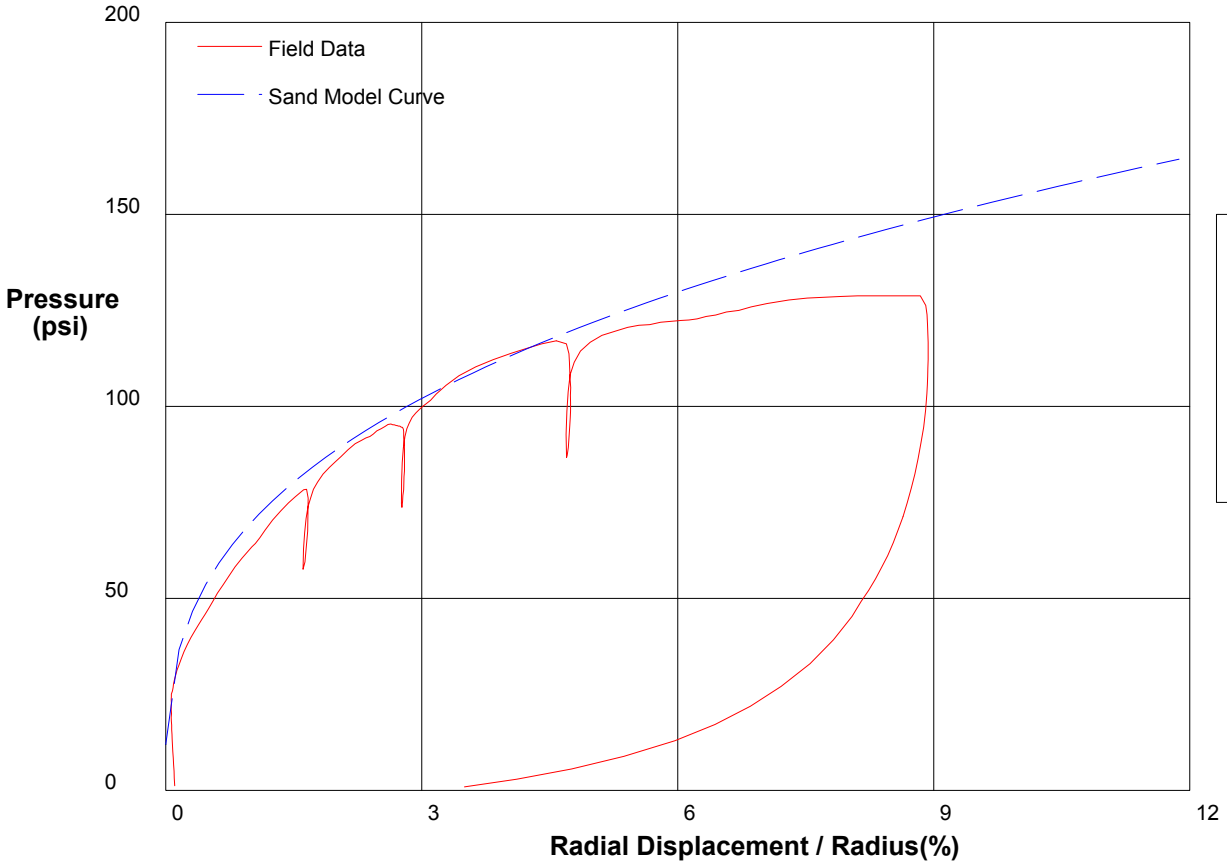
Shear Modulus 38222 psi

Shear Modulus 39407 psi

shift-1.3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/4/2008
Hole No. TH-29B-PMT-08 Depth 92.0ft	File C:\DATA\ISE-771\ST2\DOT-84.P



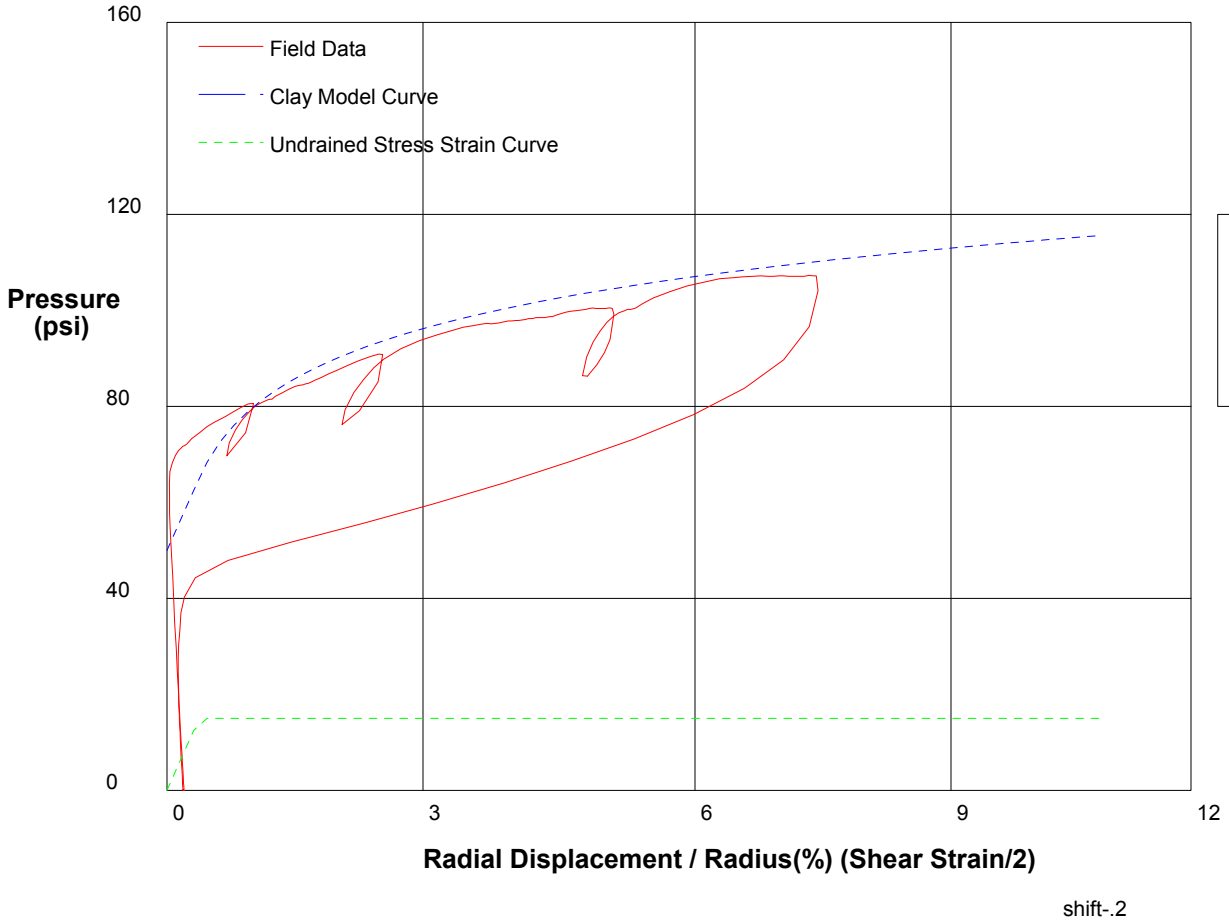
THE In Situ Engineering SAND MODEL

Water Pressure	36 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	12 psi
Shear Modulus	15000 psi

shift-1.3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 98ft	File C:\DATA\ISE-771\ST2\DOT-85.P

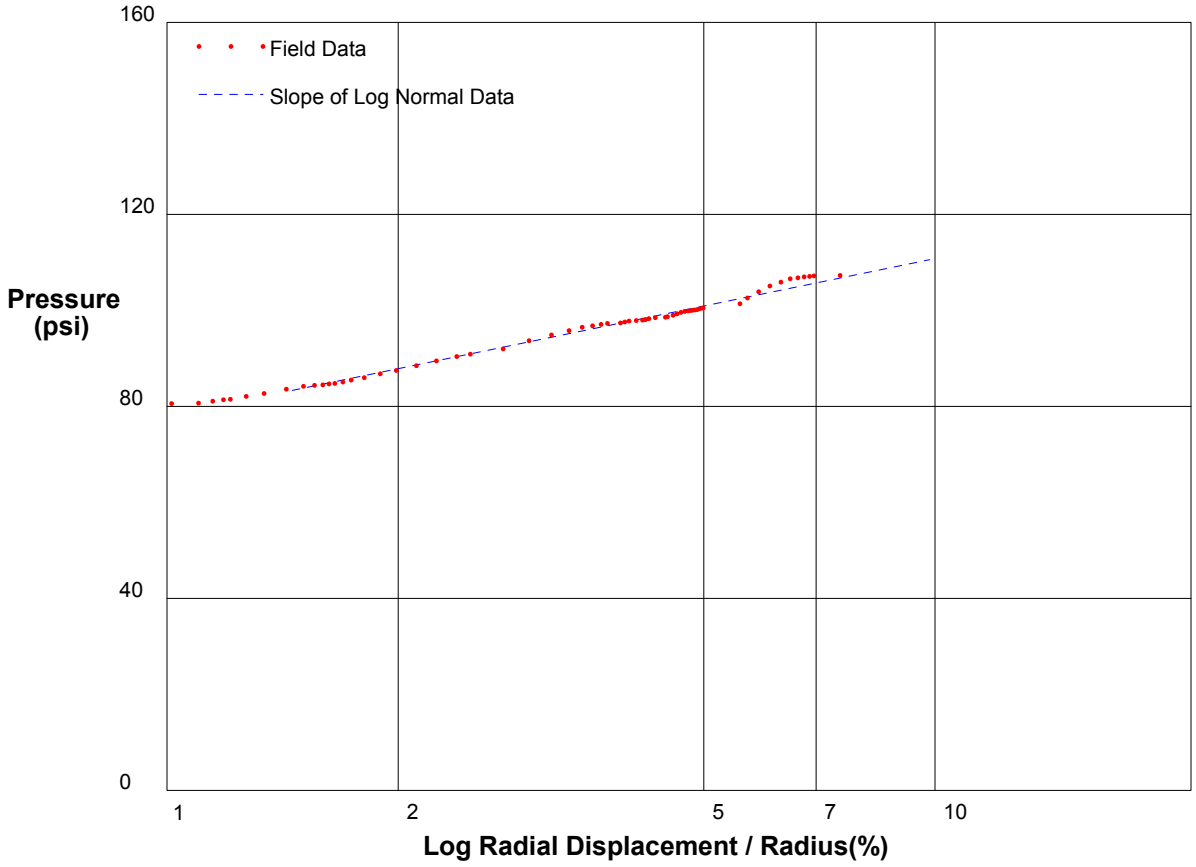


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	50 psi
Shear Modulus	2000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 98ft	File C:\DATA\ISE-771\ST2\DOT-85.P

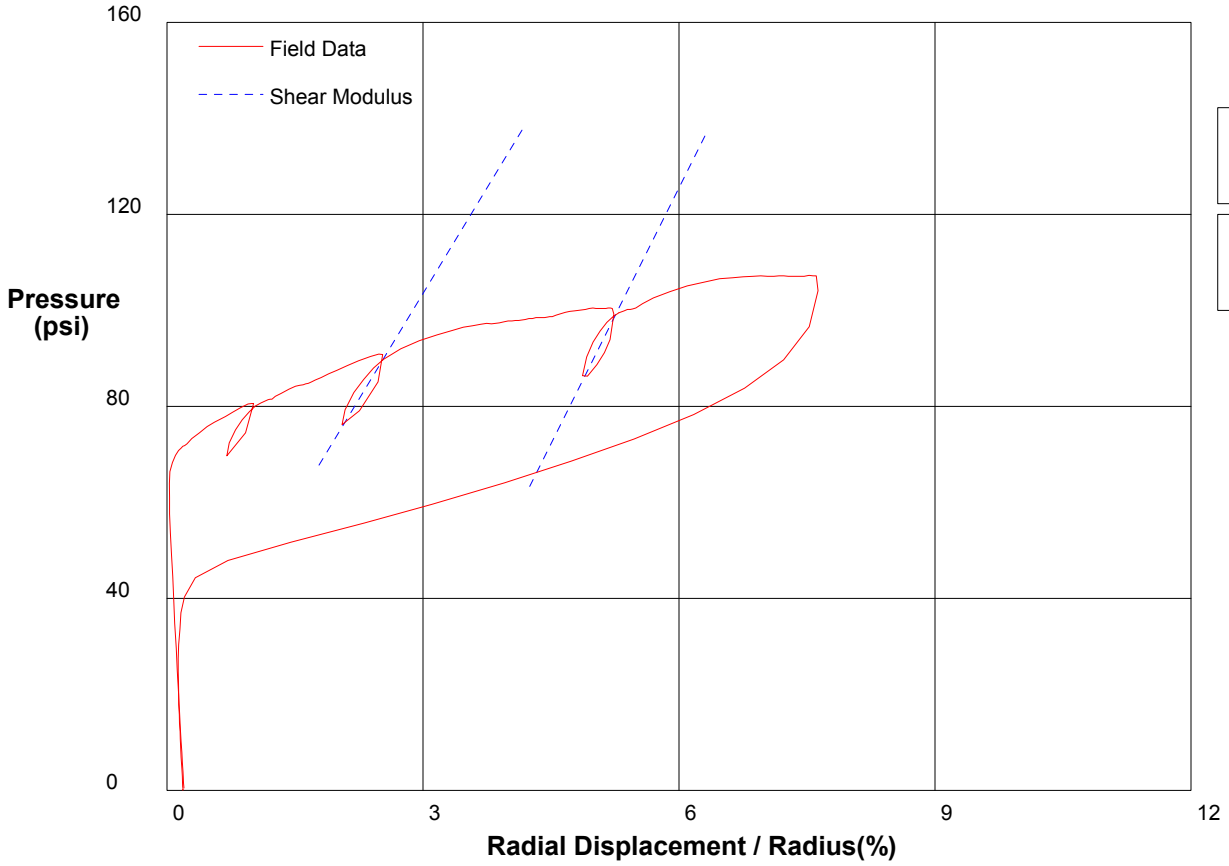


Shear Strength 14.2 psi
Limit Pressure 130 psi

shift-.2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 98ft	File C:\DATA\ISE-771\ST2\DOT-85.P



Shear Modulus 1777 psi

Shear Modulus 1466 psi

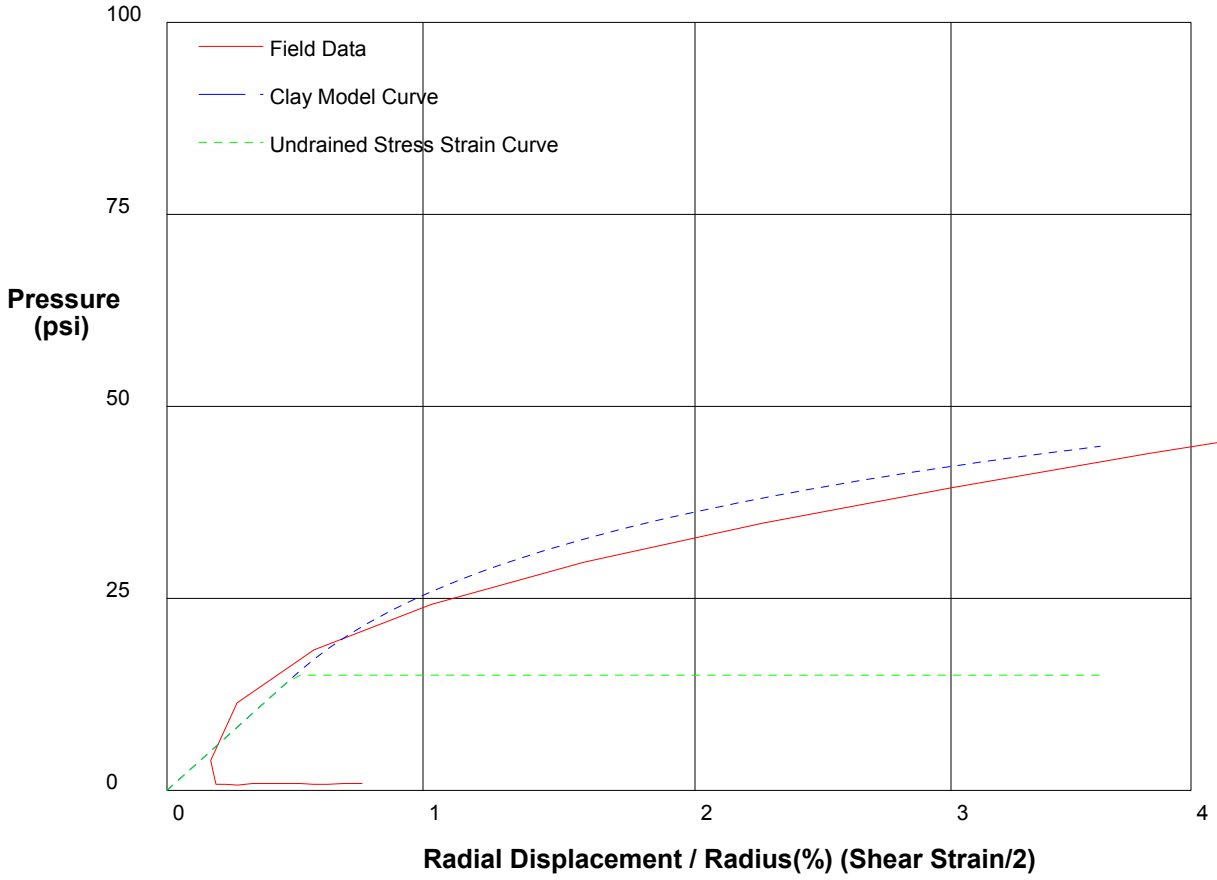
shift-.2

In Situ Engineering

PRESSUREMETER DATA

9/5/2008

Hole No. TH-29B-PMT-08 Depth 98ft File C:\DATA\ISE-771\ST2\DOT-85U.P



GIBSON'S CLAY MODEL

Shear Strength 15 psi
Insitu Stress 0 psi
Shear Modulus 1500 psi

shift 4.4

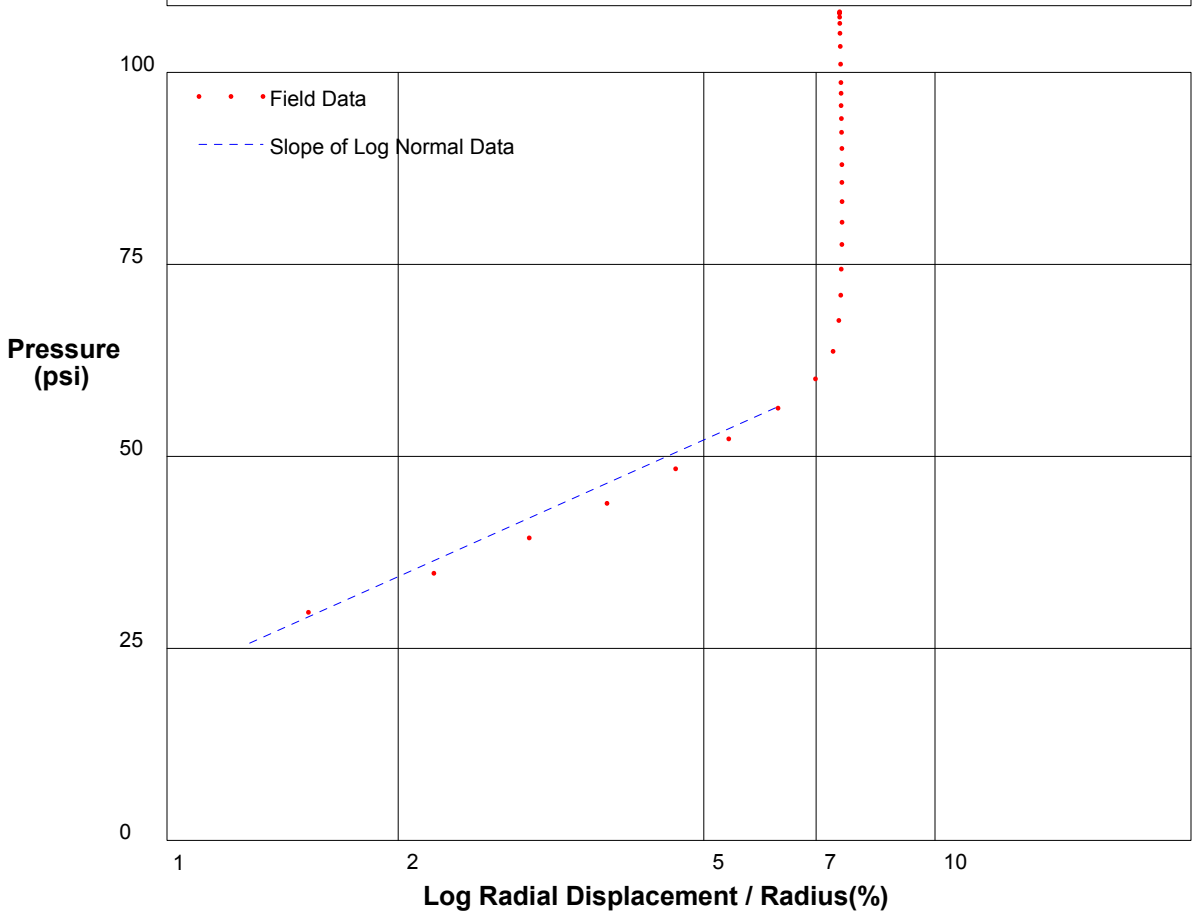
In Situ Engineering

PRESSUREMETER DATA

9/5/2008

Hole No. TH-29B-PMT-08 Depth 98ft

File C:\DATA\ISE-771\ST2\DOT-85U.P

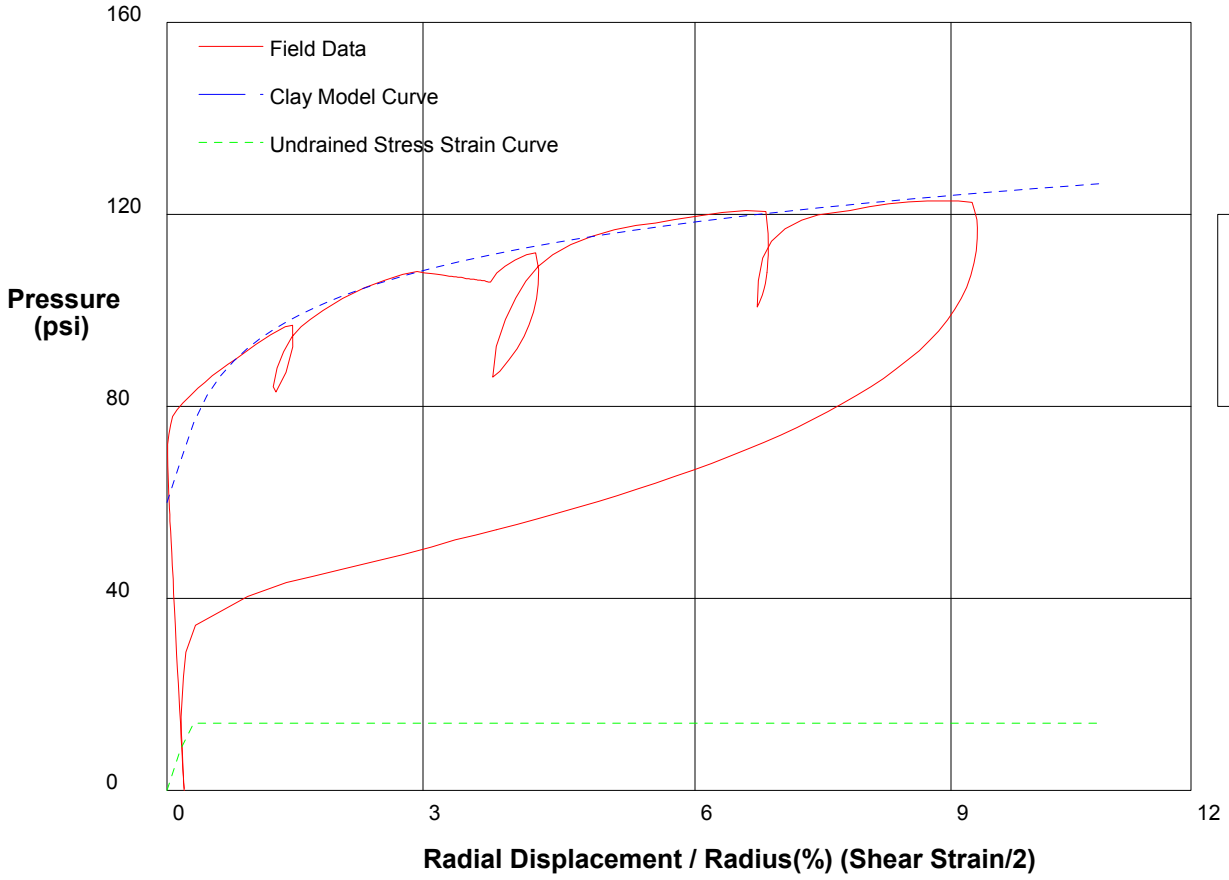


Shear Strength 19.4 psi
Limit Pressure 93 psi

shift 4.5

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 100ft	File C:\DATA\ISE-771\ST2\DOT-86.P



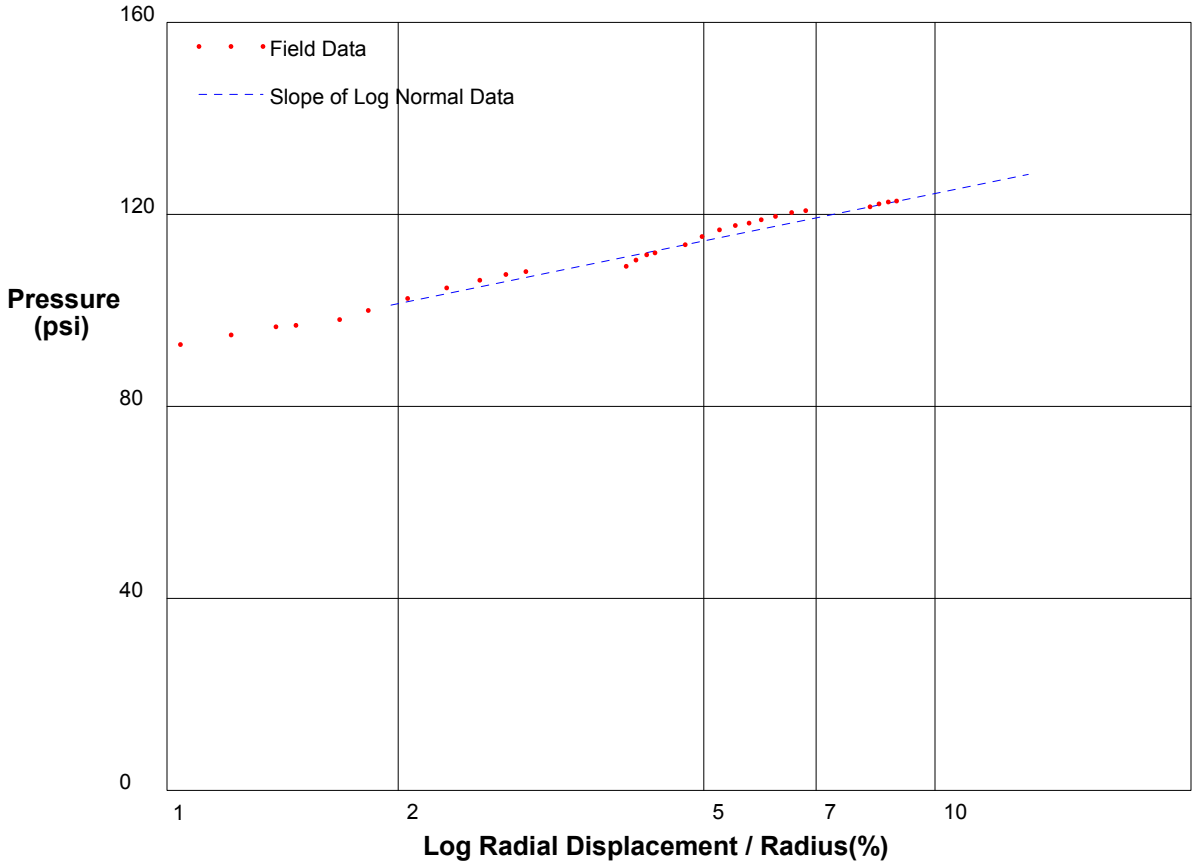
GIBSON'S CLAY MODEL

Shear Strength	14 psi
Insitu Stress	60 psi
Shear Modulus	2700 psi

shift-.2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 100ft	File C:\DATA\ISE-771\ST2\DOT-86.P

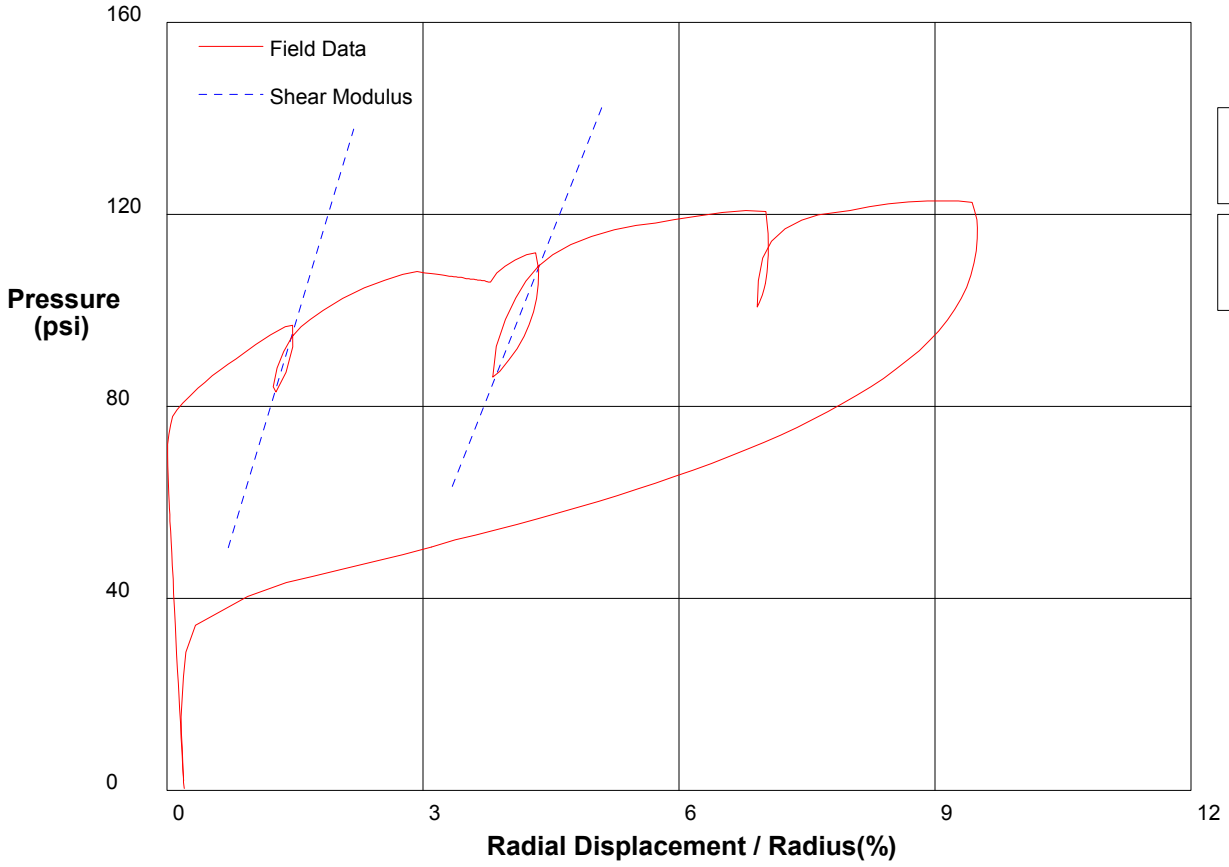


Shear Strength 14.2 psi
Limit Pressure 144 psi

shift-.2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 100ft	File C:\DATA\ISE-771\ST2\DOT-86.P



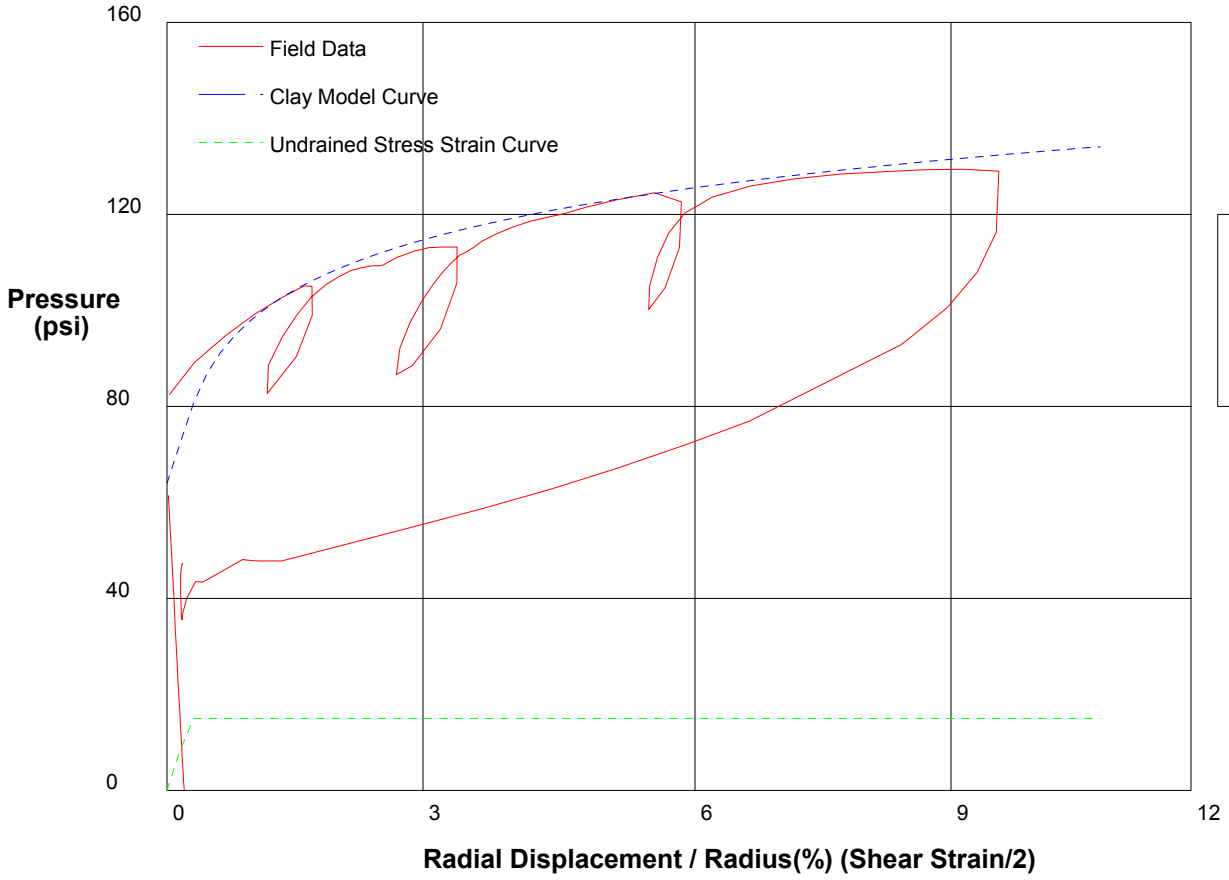
Shear Modulus 2253 psi

Shear Modulus 2969 psi

shift-.2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 102ft	File C:\DATA\ISE-771\ST2\DOT-87.P



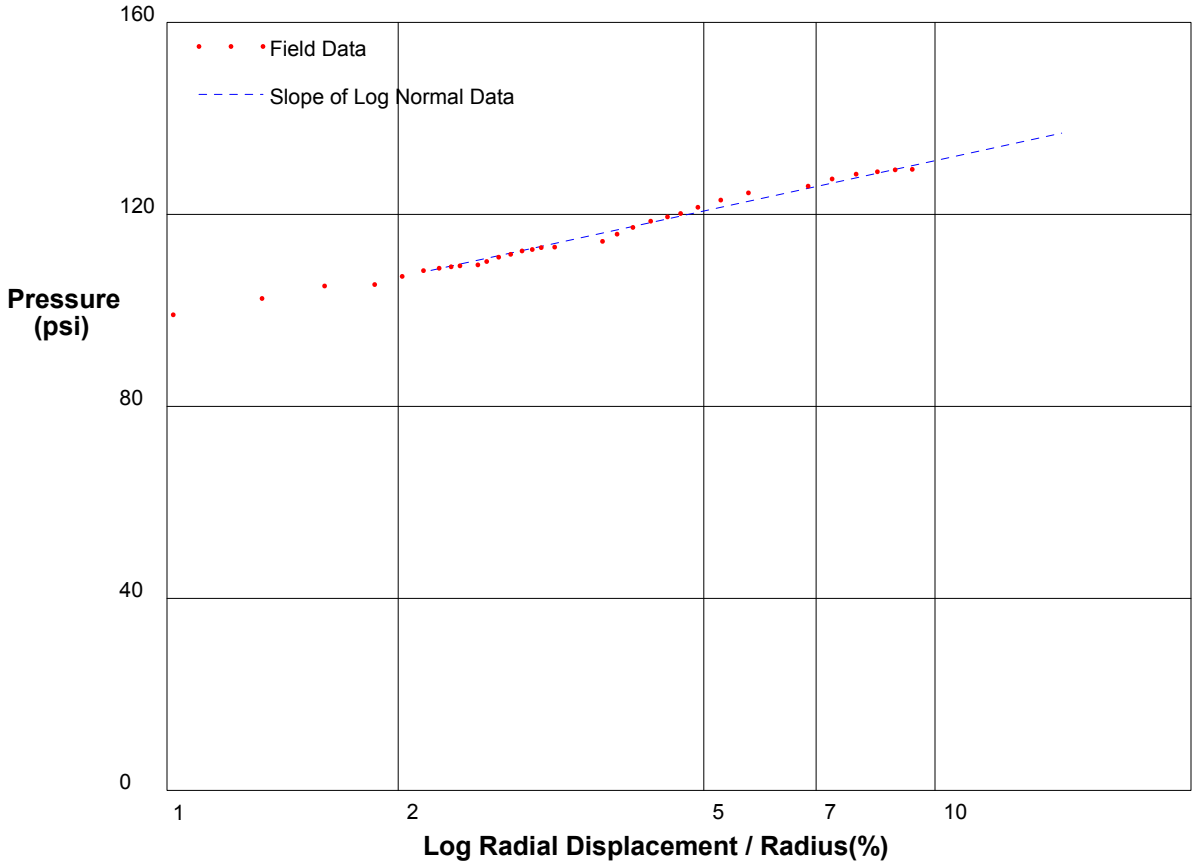
shift-.2

GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	64 psi
Shear Modulus	2700 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 102ft	File C:\DATA\ISE-771\ST2\DOT-87.P

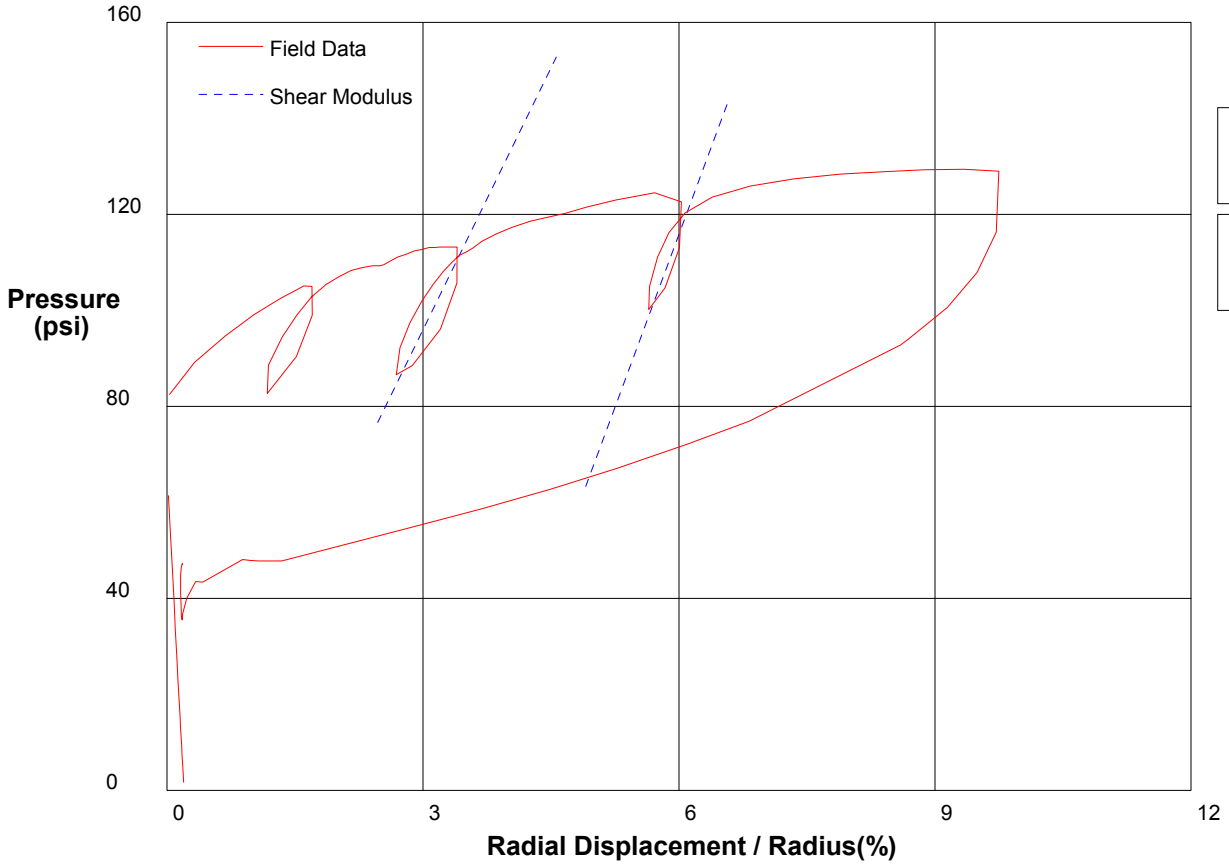


Shear Strength 15.1 psi
Limit Pressure 152 psi

shift-.2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 102ft	File C:\DATA\ISE-771\ST2\DOT-87.P



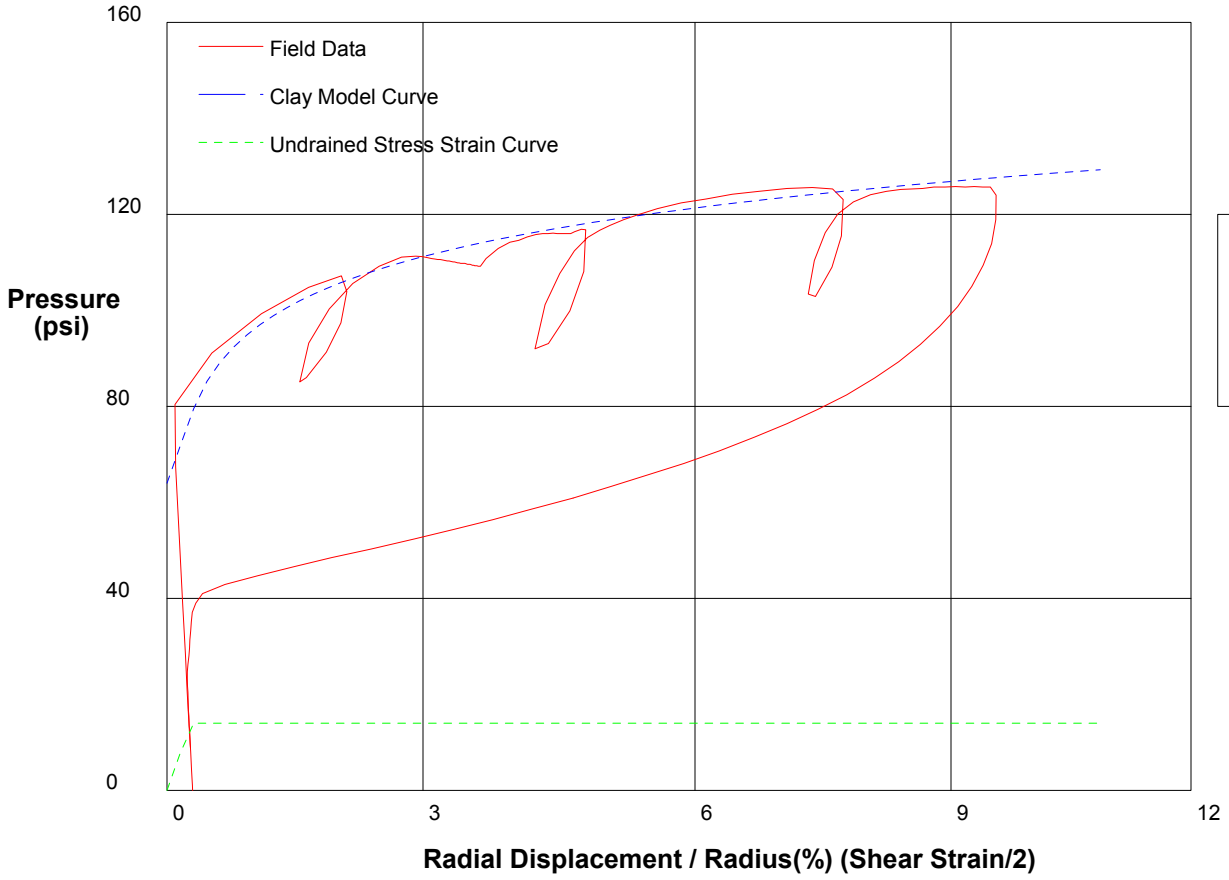
Shear Modulus 2400 psi

Shear Modulus 1817 psi

shift-.2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 104ft	File C:\DATA\ISE-771\ST2\DOT-88.P



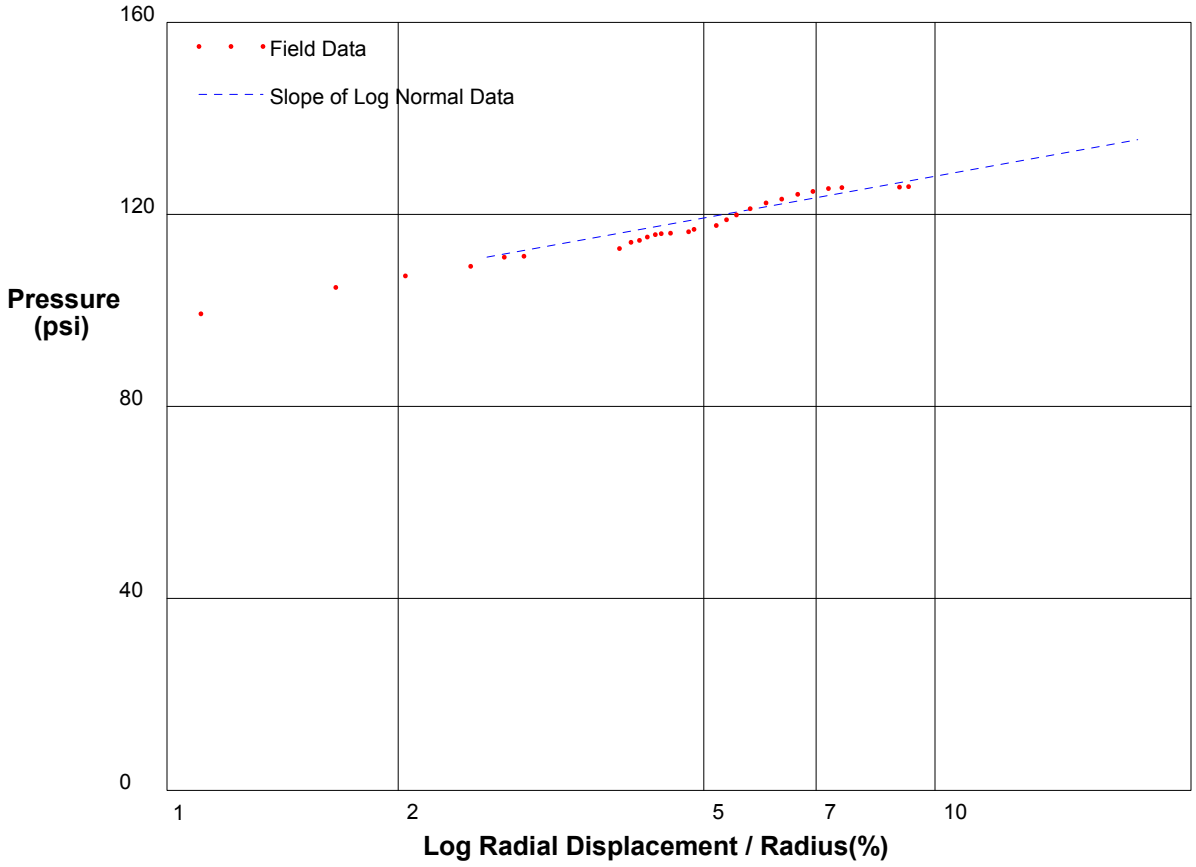
shift-.3

GIBSON'S CLAY MODEL

Shear Strength	14 psi
Insitu Stress	64 psi
Shear Modulus	2500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 104ft	File C:\DATA\ISE-771\ST2\DOT-88.P

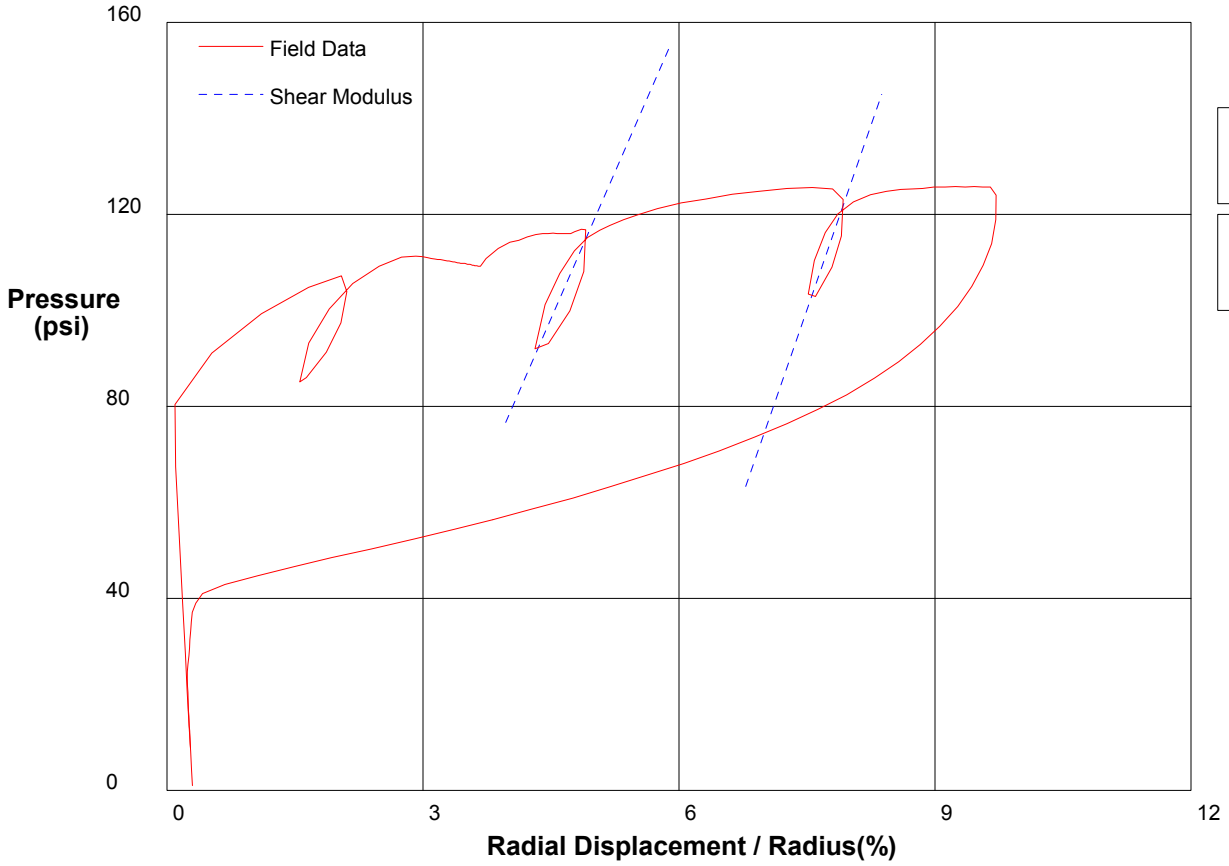


Shear Strength 12.5 psi
Limit Pressure 145 psi

shift-.3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 104ft	File C:\DATA\ISE-771\ST2\DOT-88.P



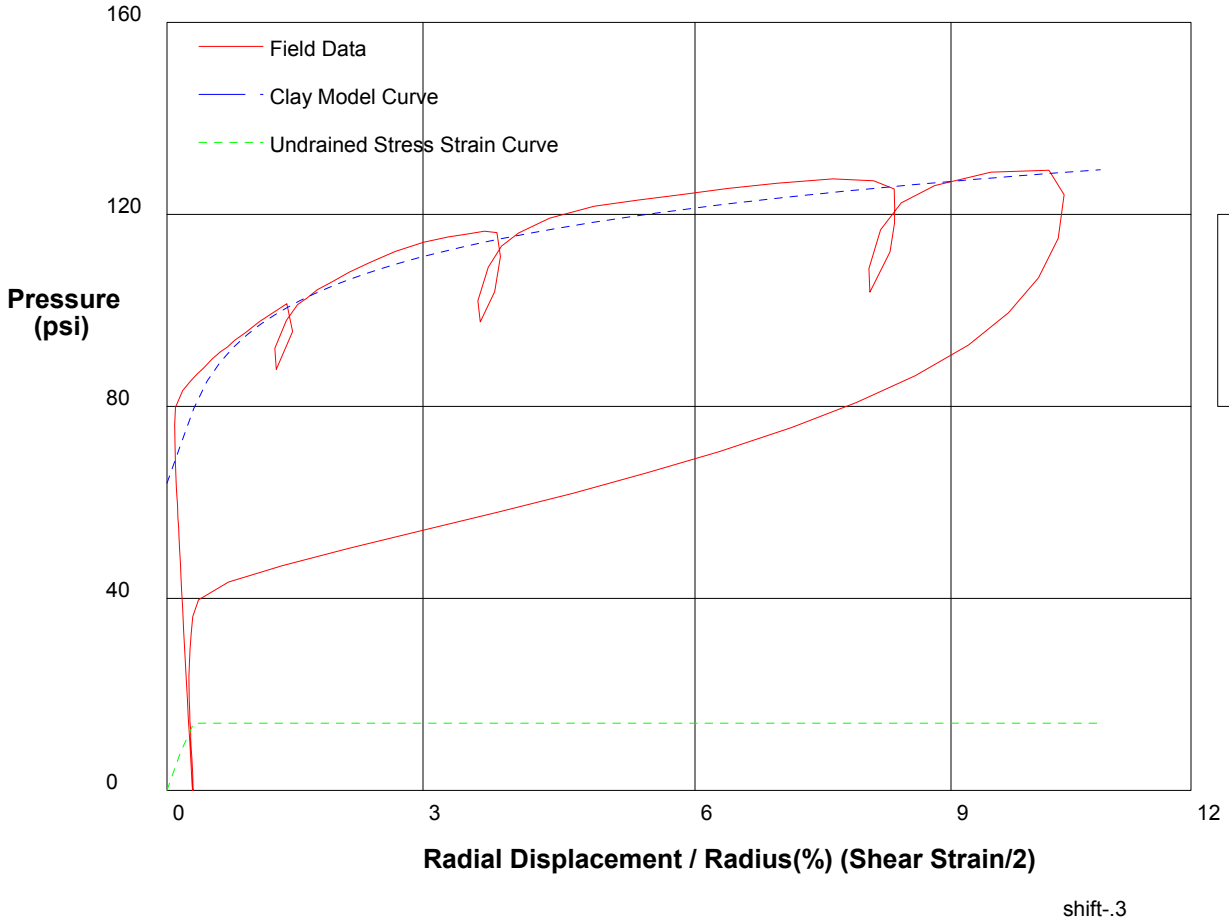
Shear Modulus 2562 psi

Shear Modulus 2035 psi

shift-.3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 106ft	File C:\DATA\ISE-771\ST2\DOT-89.P

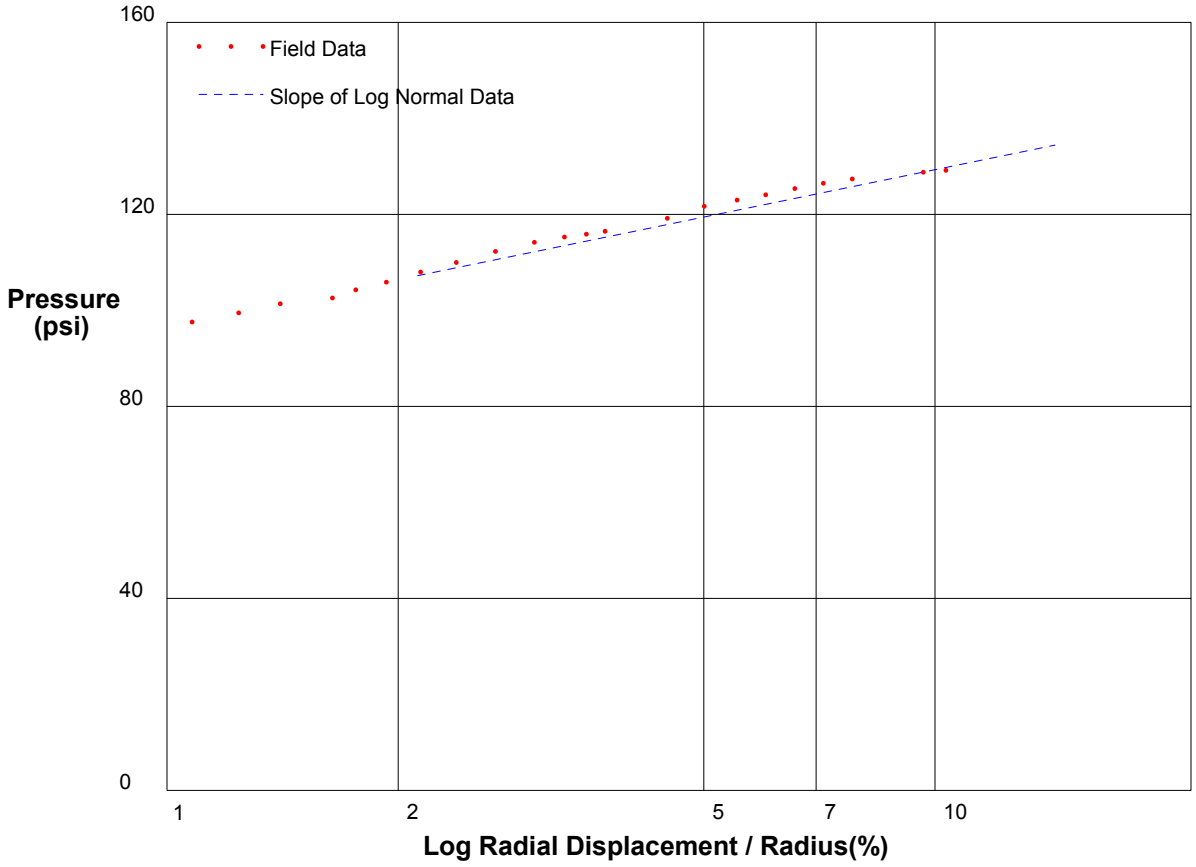


GIBSON'S CLAY MODEL

Shear Strength	14	psi
Insitu Stress	64	psi
Shear Modulus	2500	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 106ft	File C:\DATA\ISE-771\ST2\DOT-89.P

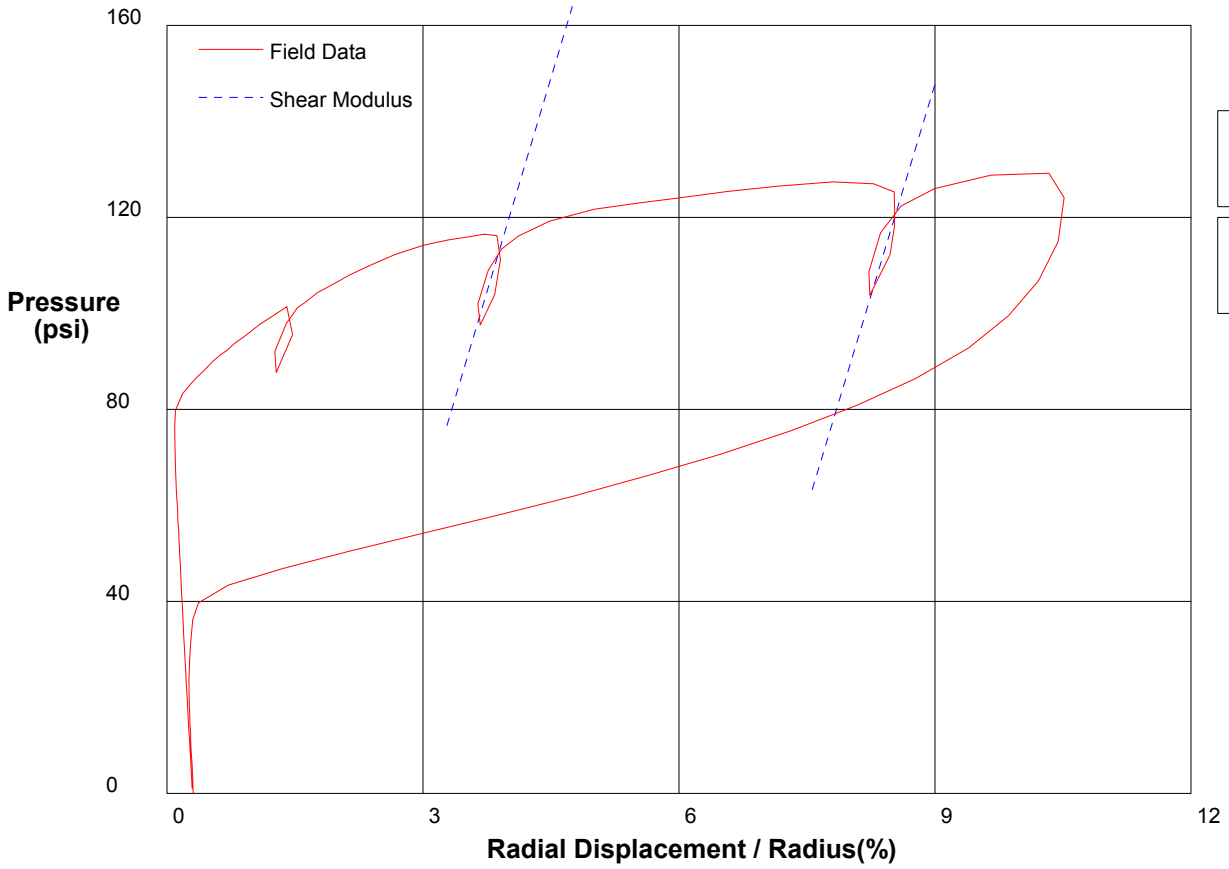


Shear Strength 14.2 psi
Limit Pressure 149 psi

shift-.3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 106ft	File C:\DATA\ISE-771\ST2\DOT-89.P



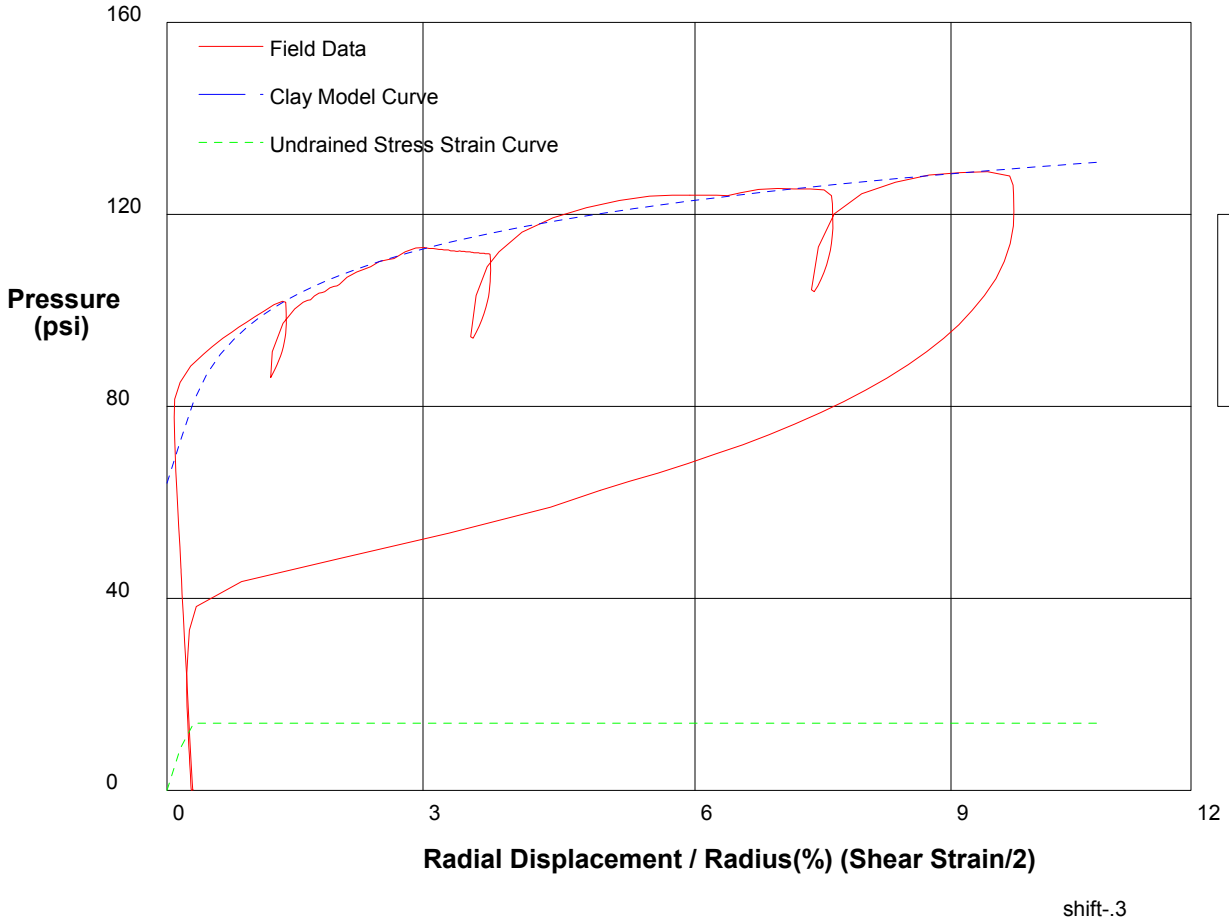
Shear Modulus 2937 psi

Shear Modulus 2969 psi

shift-.3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 108ft	File C:\DATA\ISE-771\ST2\DOT-90.P

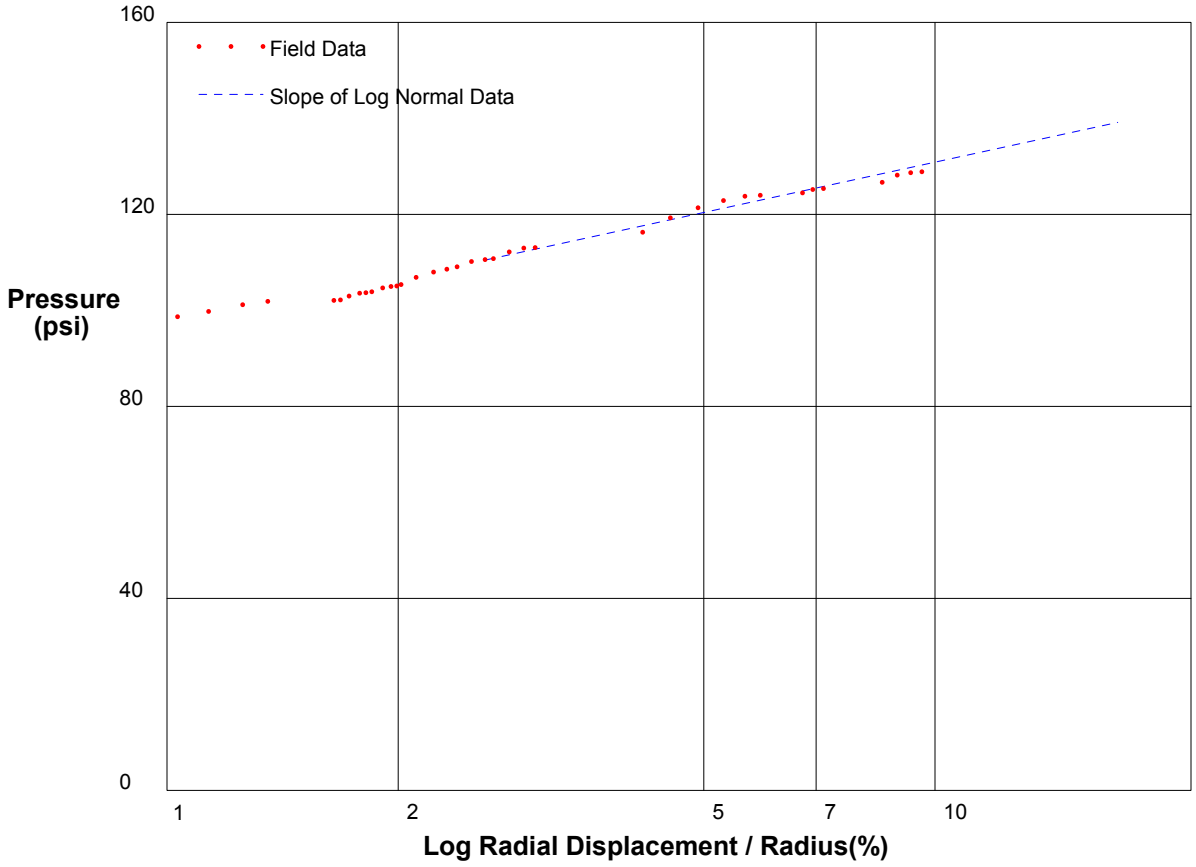


GIBSON'S CLAY MODEL

Shear Strength	14 psi
Insitu Stress	64 psi
Shear Modulus	2800 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 108ft	File C:\DATA\ISE-771\ST2\DOT-90.P

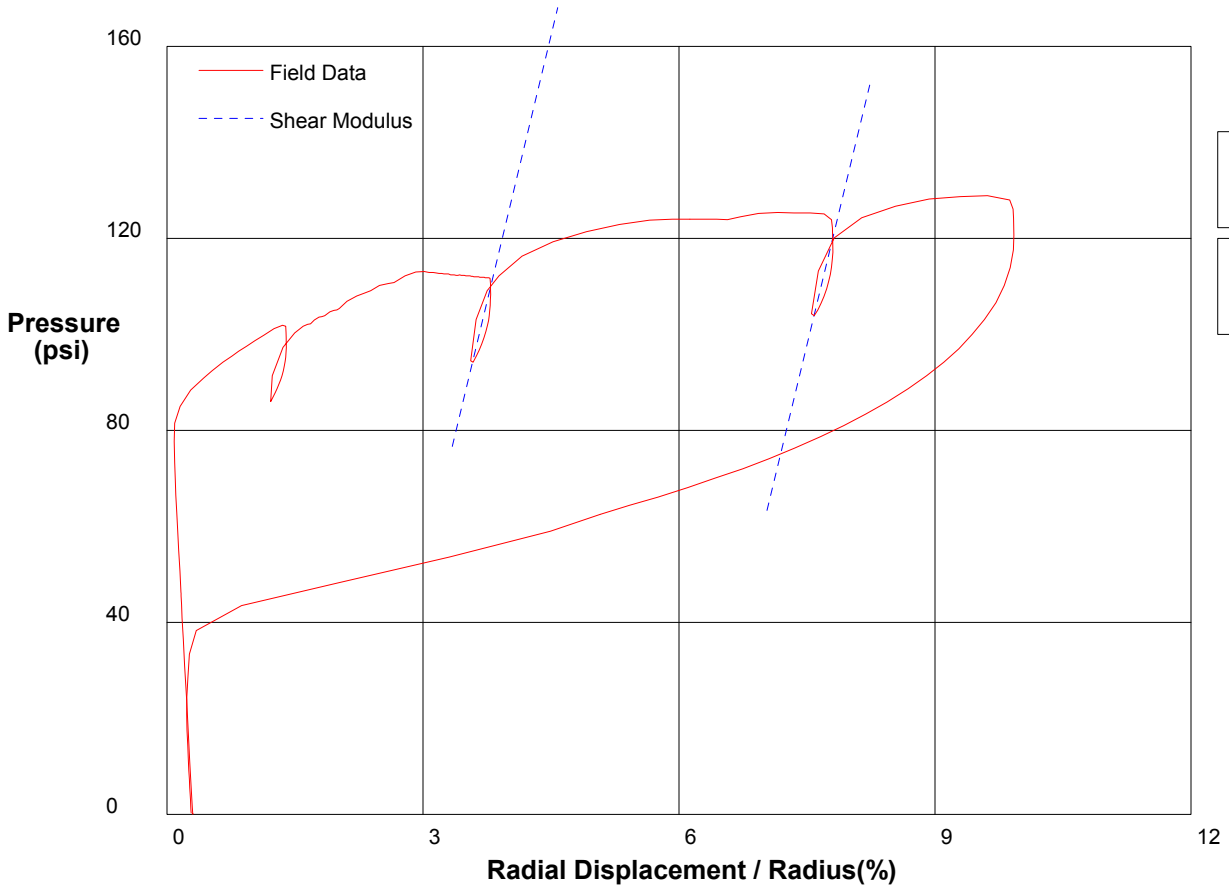


Shear Strength 15.1 psi
Limit Pressure 152 psi

shift-.3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA.	9/5/2008
Hole No. TH-29B-PMT-08 Depth 108ft	File C:\DATA\ISE-771\ST2\DOT-90.P



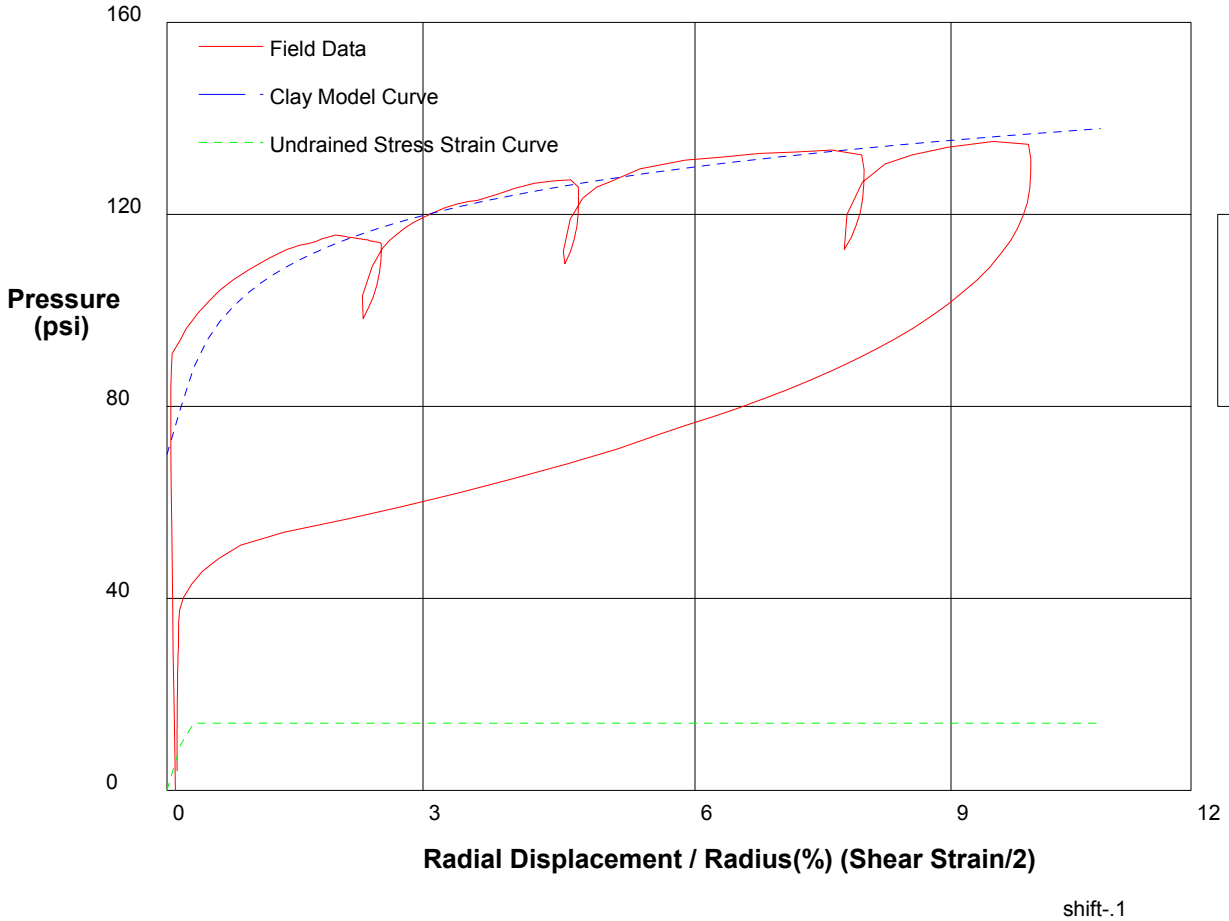
Shear Modulus 3682 psi

Shear Modulus 3701 psi

shift-.3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 113ft	File C:\DATA\ISE-787\DOT91.P

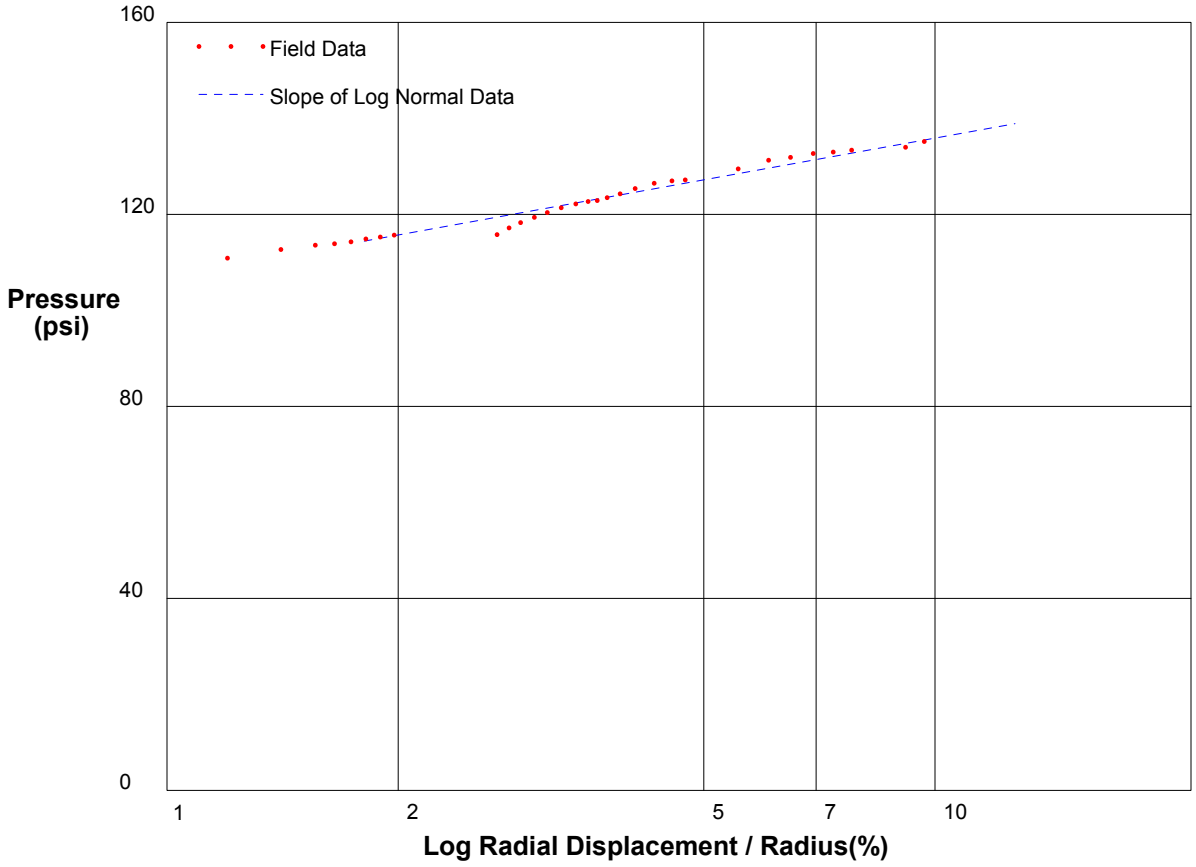


GIBSON'S CLAY MODEL

Shear Strength	14 psi
Insitu Stress	70 psi
Shear Modulus	3000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 113ft	File C:\DATA\ISE-787\DOT91.P

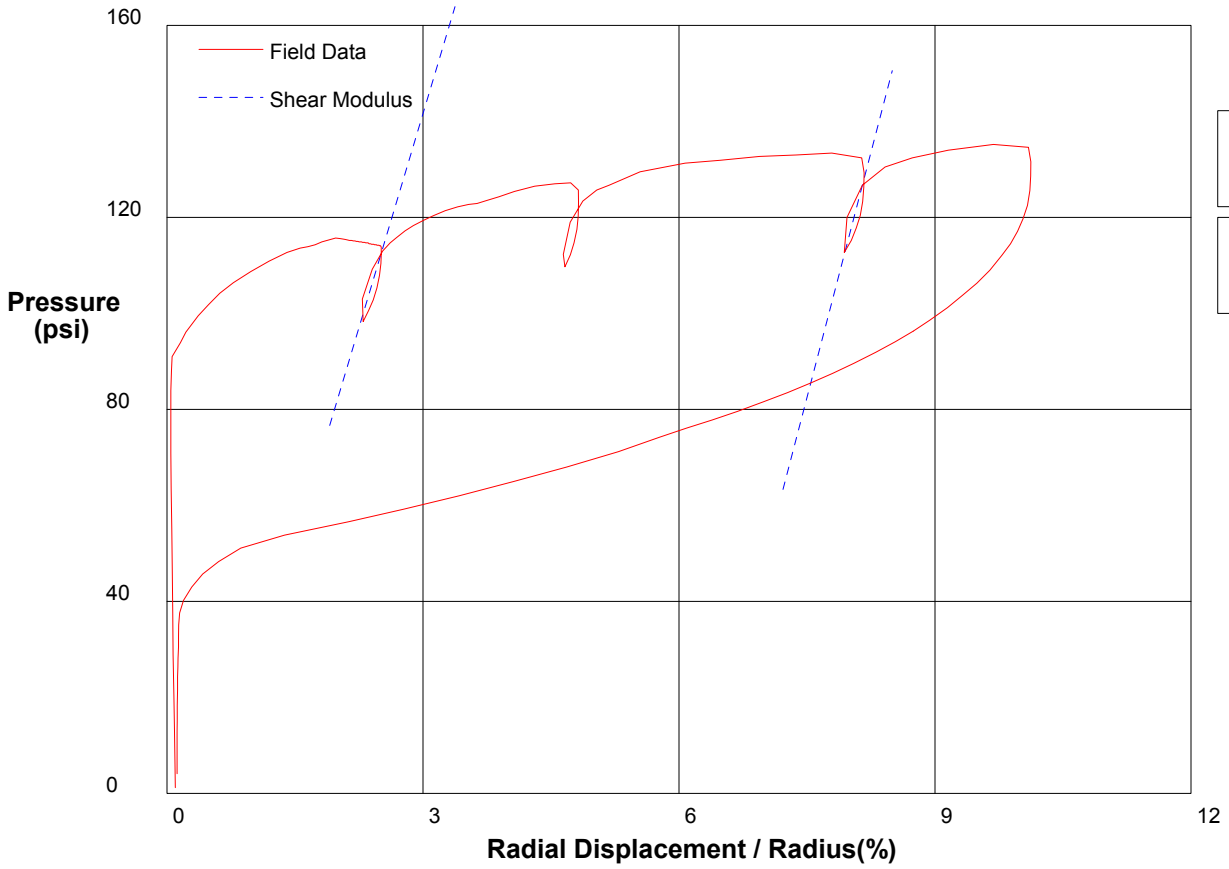


Shear Strength 12.5 psi
Limit Pressure 153 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 113ft	File C:\DATA\ISE-787\DOT91.P



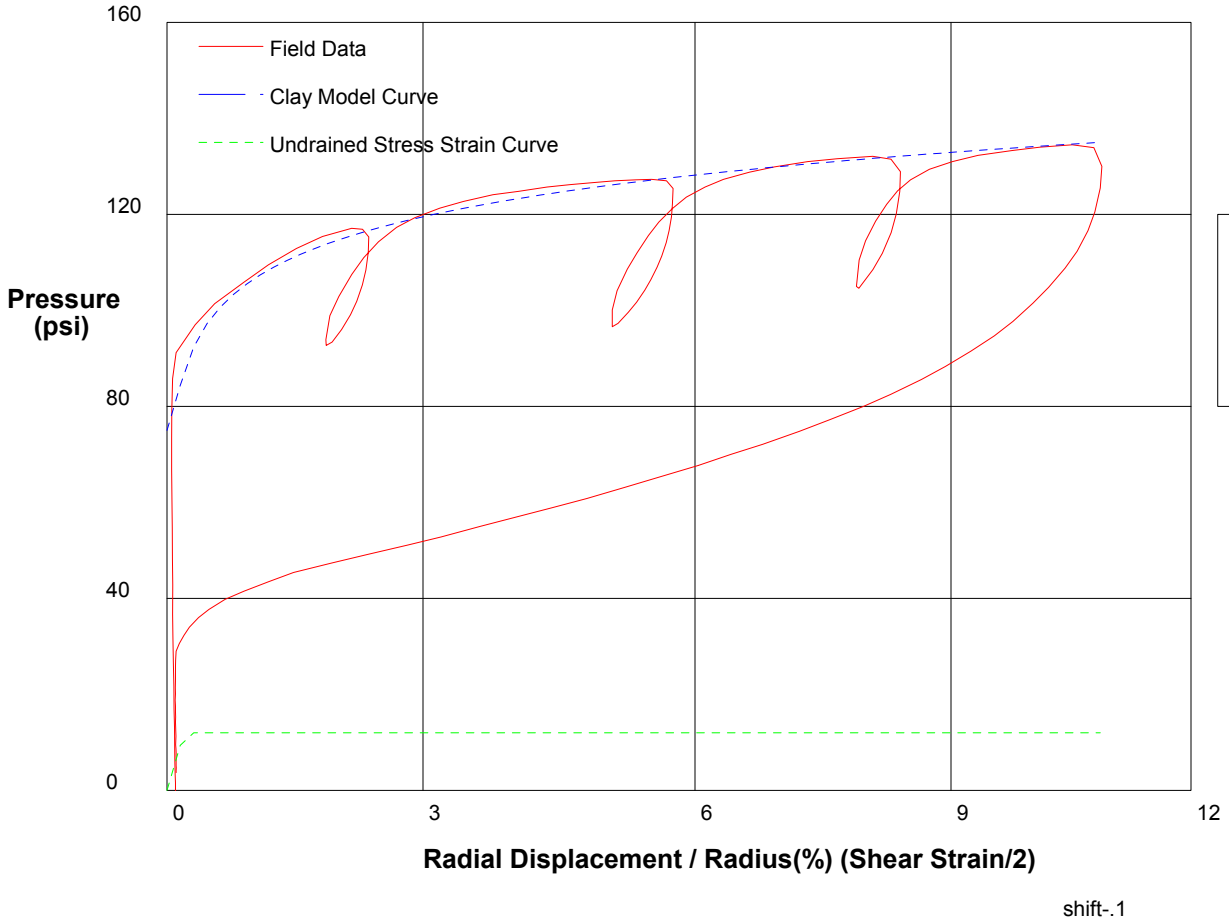
Shear Modulus 3403 psi

Shear Modulus 2969 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 115ft	File C:\DATA\ISE-787\DOT92.P

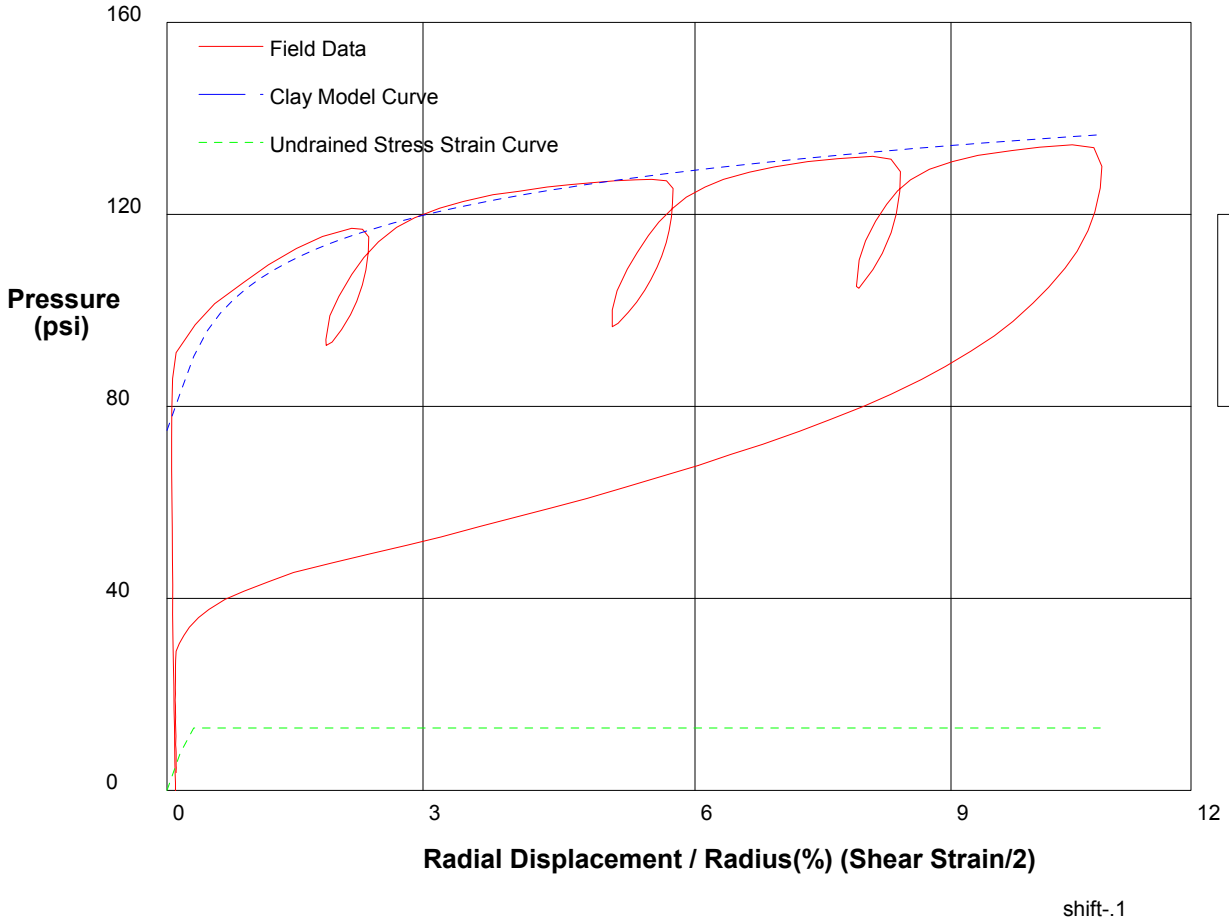


GIBSON'S CLAY MODEL

Shear Strength	12 psi
Insitu Stress	75 psi
Shear Modulus	3000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 115ft	File C:\DATA\ISE-787\DOT92.P

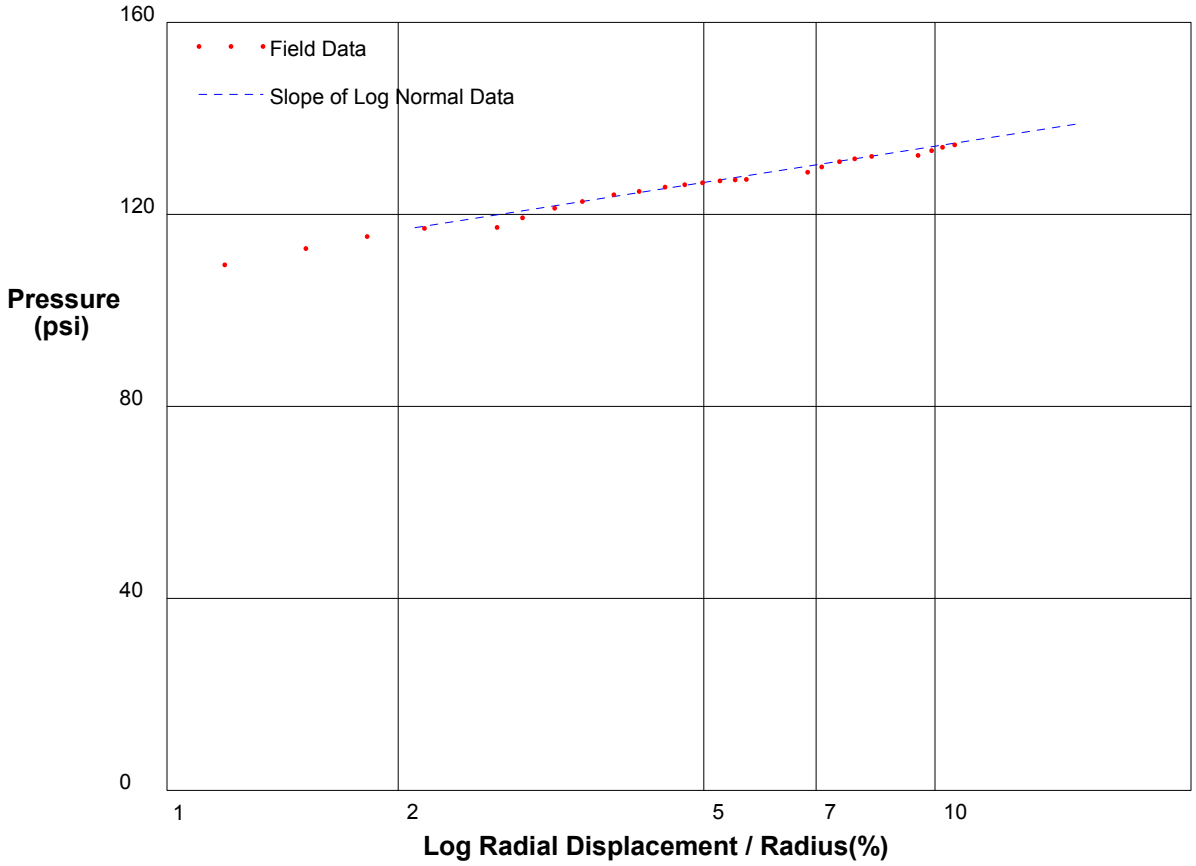


GIBSON'S CLAY MODEL

Shear Strength	13 psi
Insitu Stress	75 psi
Shear Modulus	2500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 115ft	File C:\DATA\ISE-787\DOT92.P

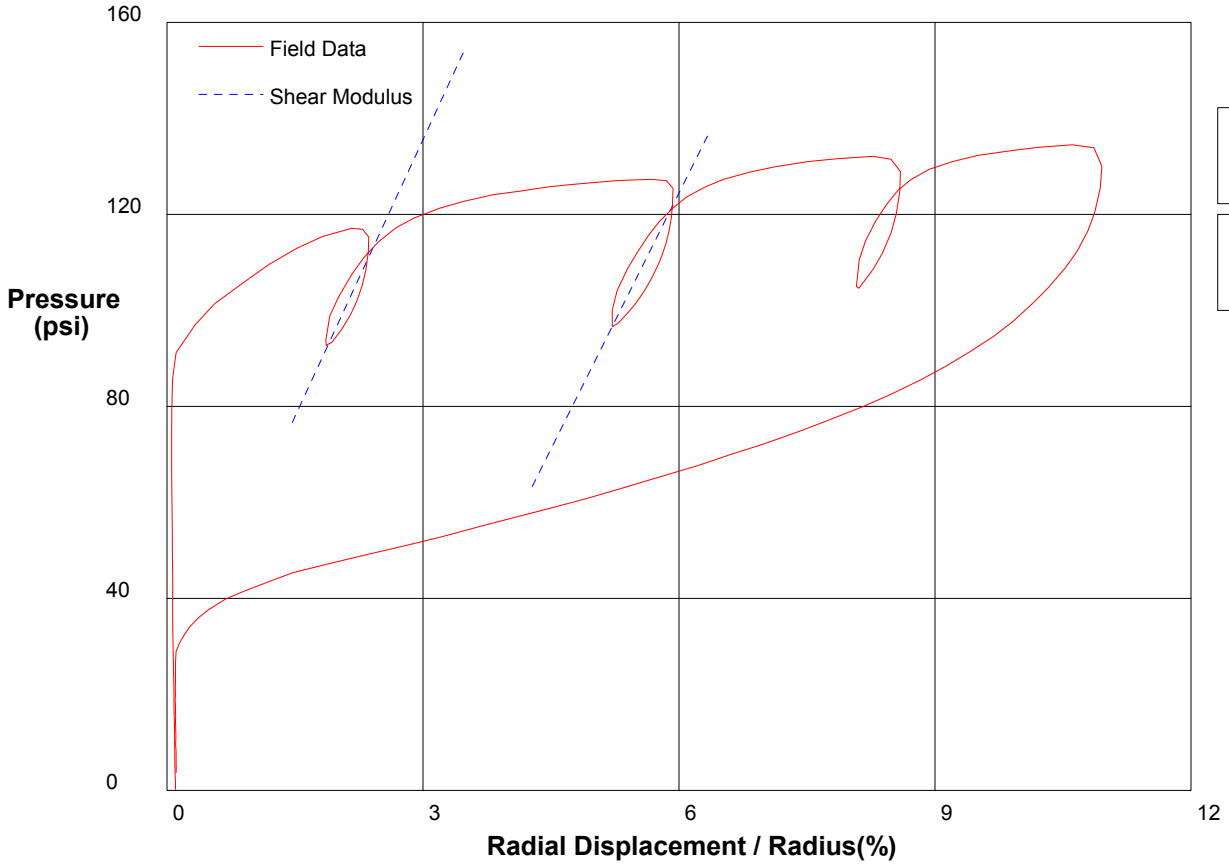


Shear Strength 10.8 psi
Limit Pressure 149 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 115ft	File C:\DATA\ISE-787\DOT92.P



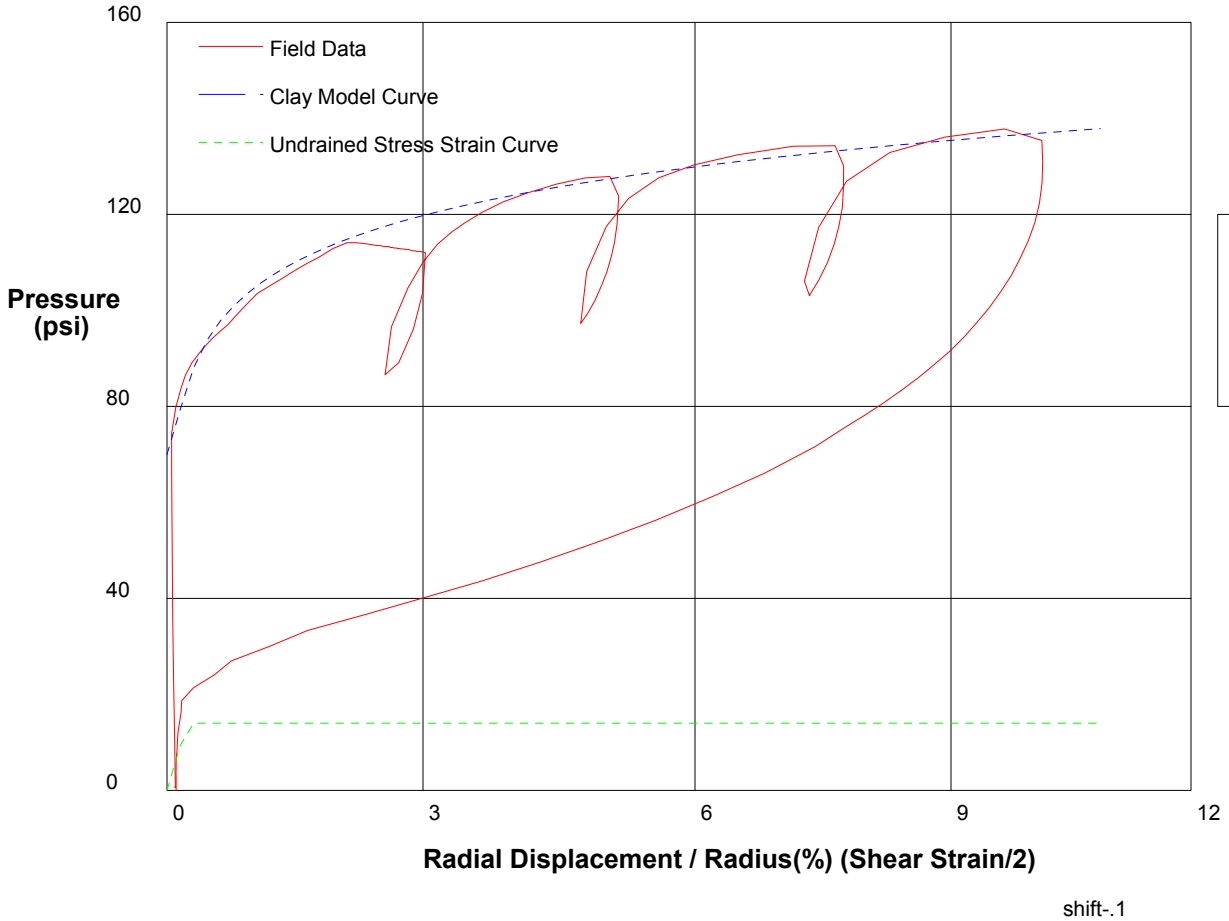
Shear Modulus 1777 psi

Shear Modulus 1922 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 117ft	File C:\DATA\ISE-787\DOT93.P

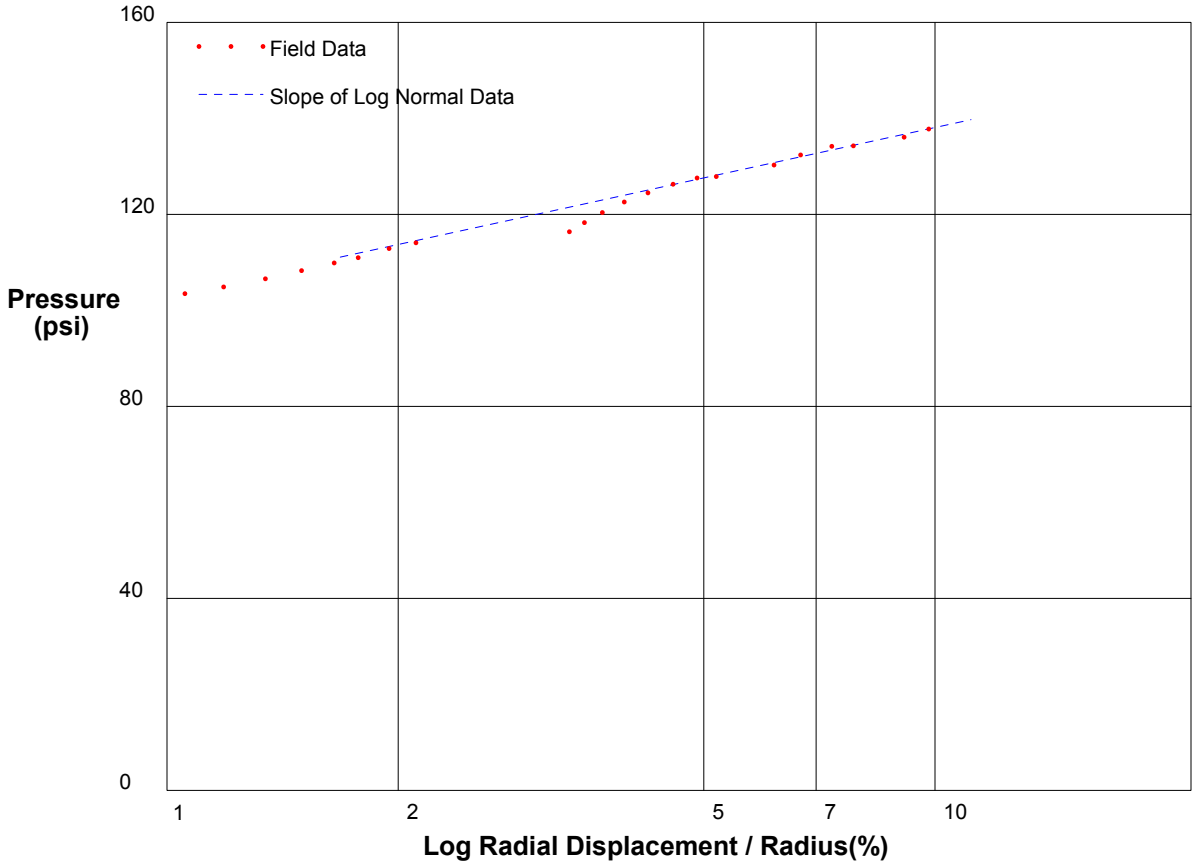


GIBSON'S CLAY MODEL

Shear Strength	14 psi
Insitu Stress	70 psi
Shear Modulus	3000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 117ft	File C:\DATA\ISE-787\DOT93.P

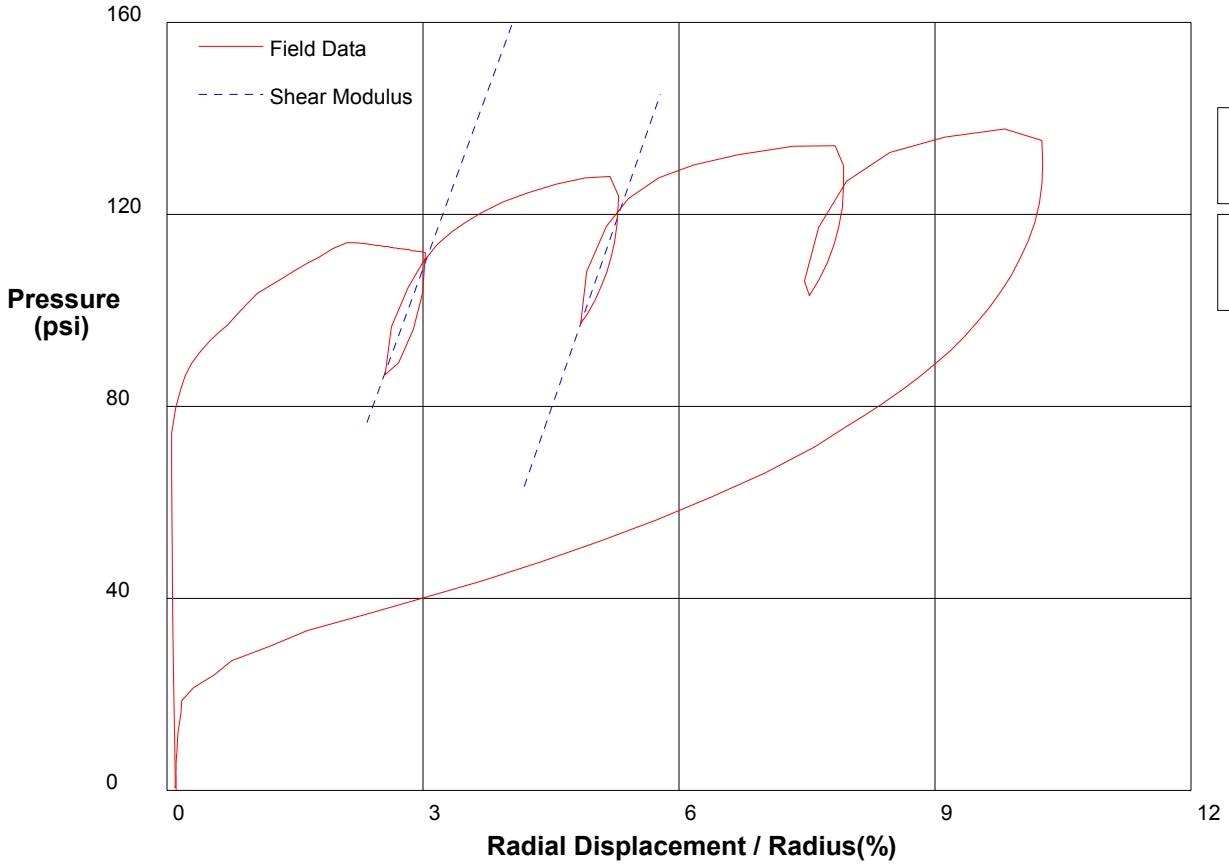


Shear Strength 15.1 psi
Limit Pressure 159 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 117ft	File C:\DATA\ISE-787\DOT93.P



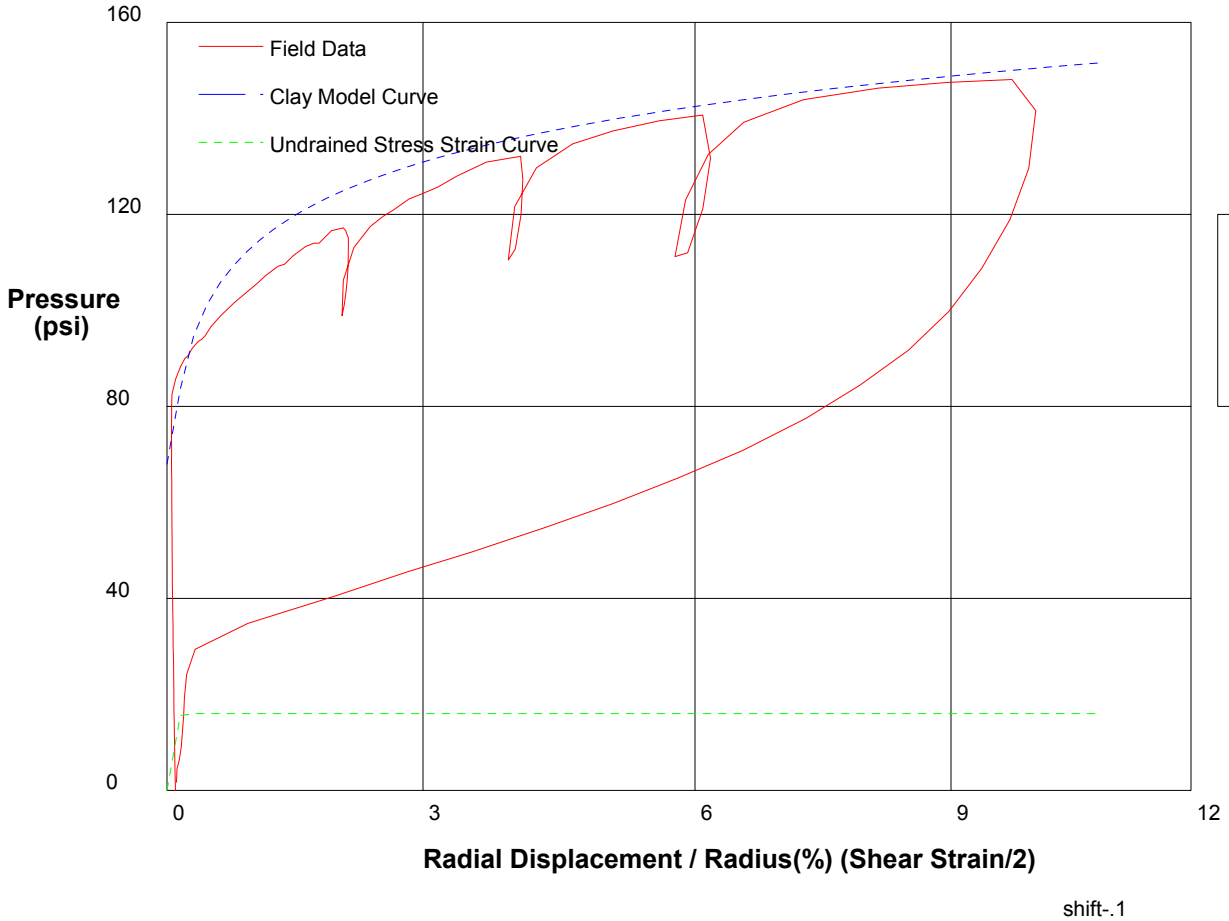
Shear Modulus 2562 psi

Shear Modulus 2438 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 119ft	File C:\DATA\ISE-787\DOT94.P

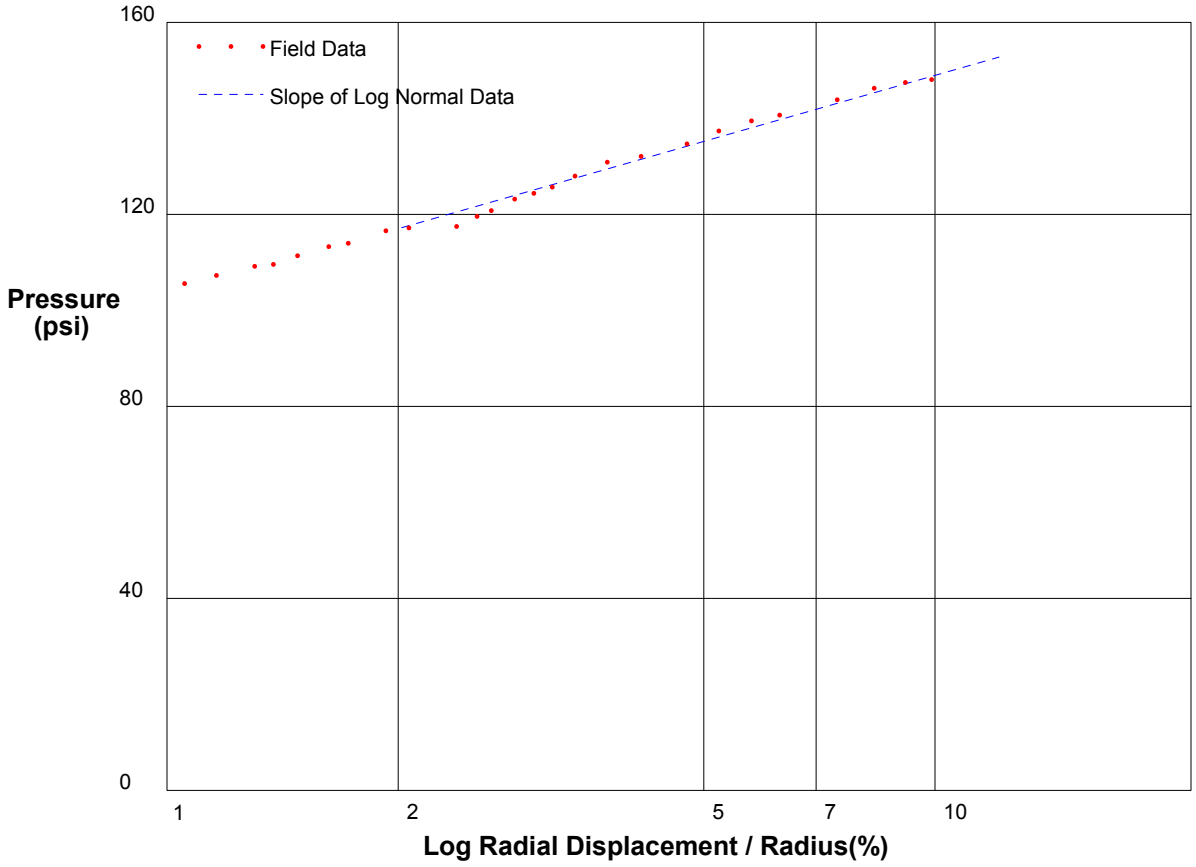


GIBSON'S CLAY MODEL

Shear Strength	16 psi
Insitu Stress	68 psi
Shear Modulus	5000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 119ft	File C:\DATA\ISE-787\DOT94.P



Shear Strength 19.8 psi
Limit Pressure 176 psi

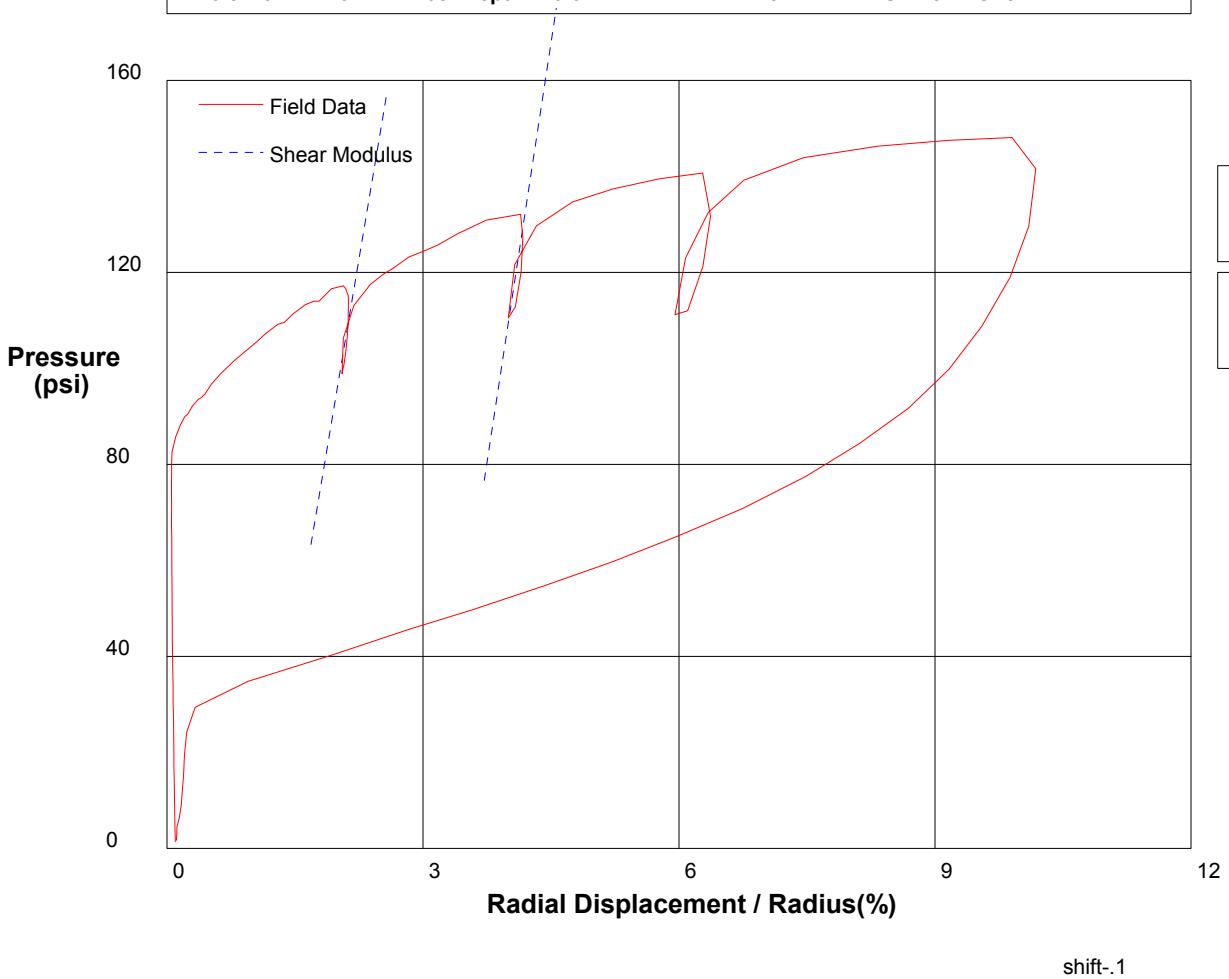
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/5/2008**

Hole No. TH-29B-PMT-08 Depth 119ft **File C:\DATA\ISE-787\DOT94.P**

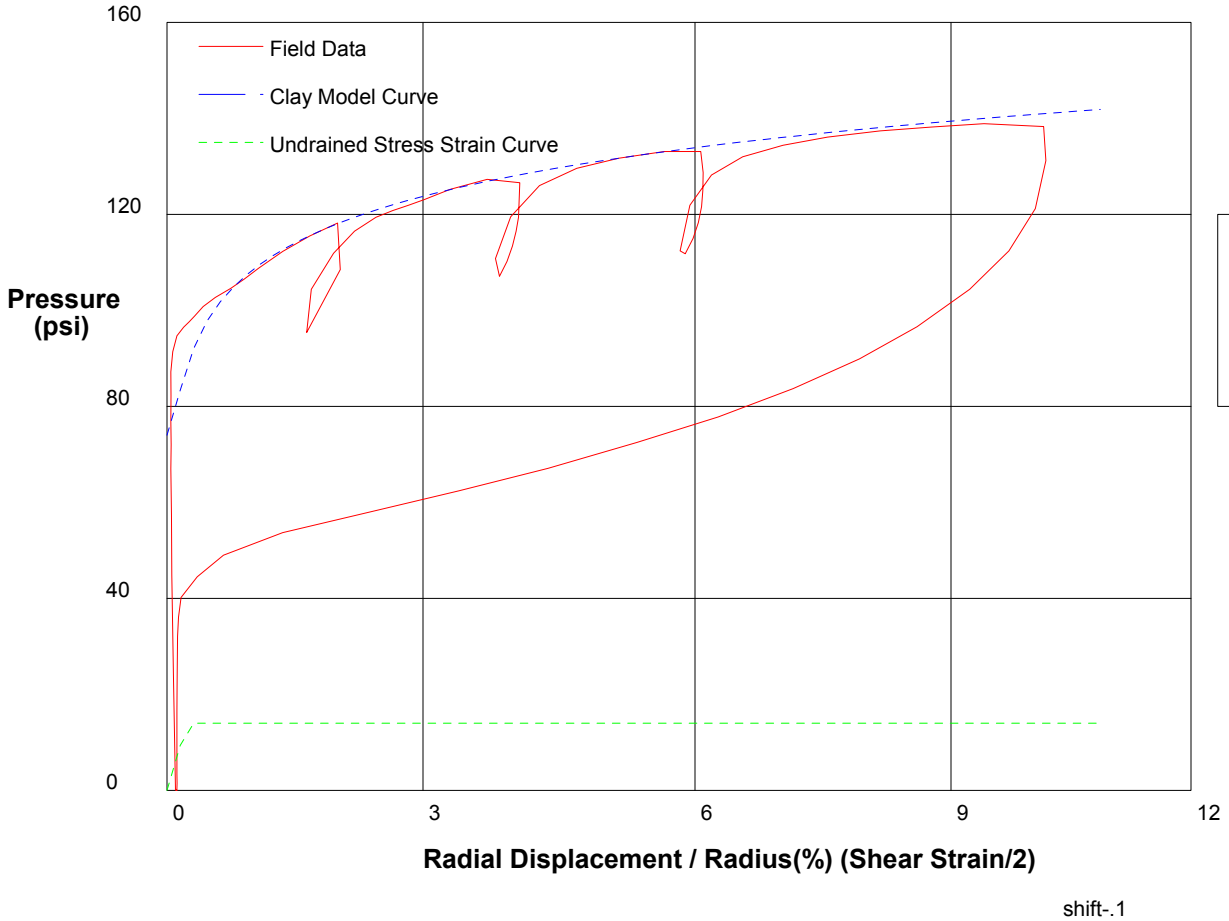


Shear Modulus 5286 psi

Shear Modulus 5827 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 121ft	File C:\DATA\ISE-787\DOT95.P

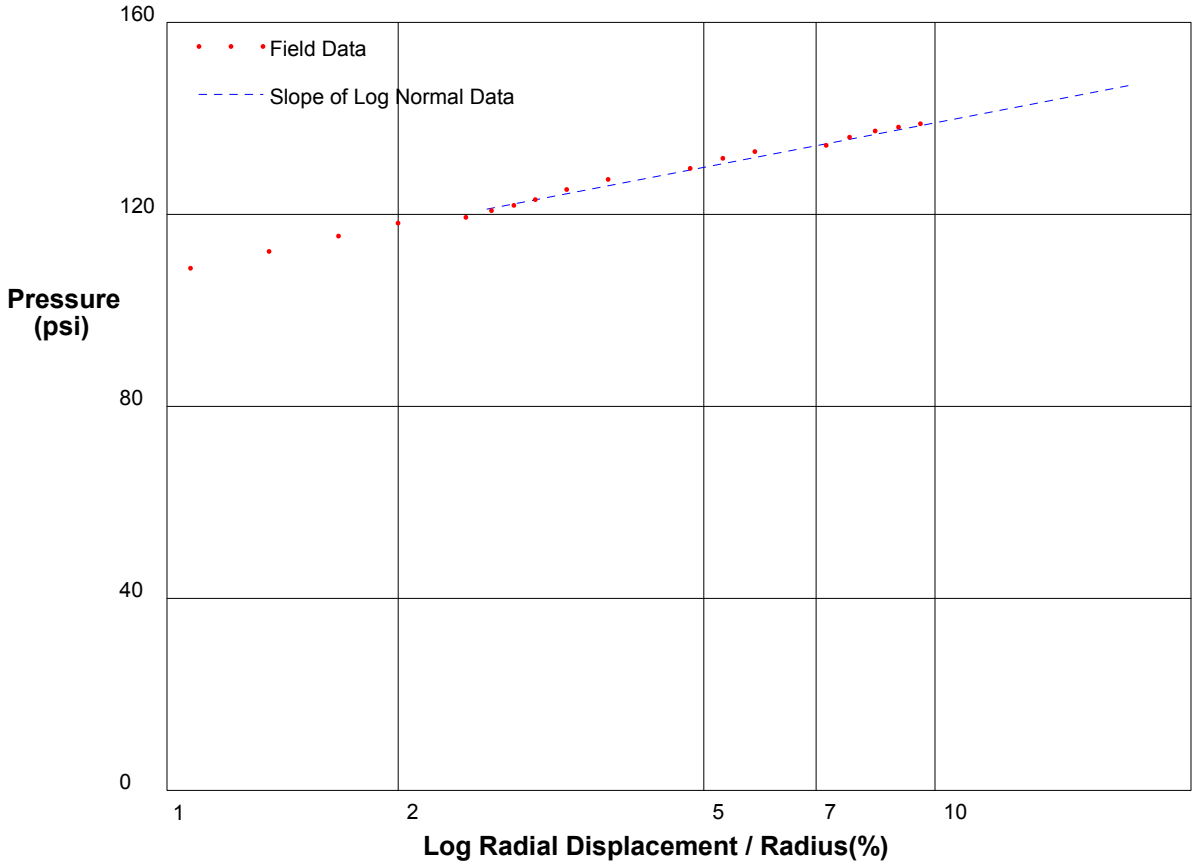


GIBSON'S CLAY MODEL

Shear Strength	14 psi
Insitu Stress	74 psi
Shear Modulus	3000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 121ft	File C:\DATA\ISE-787\DOT95.P

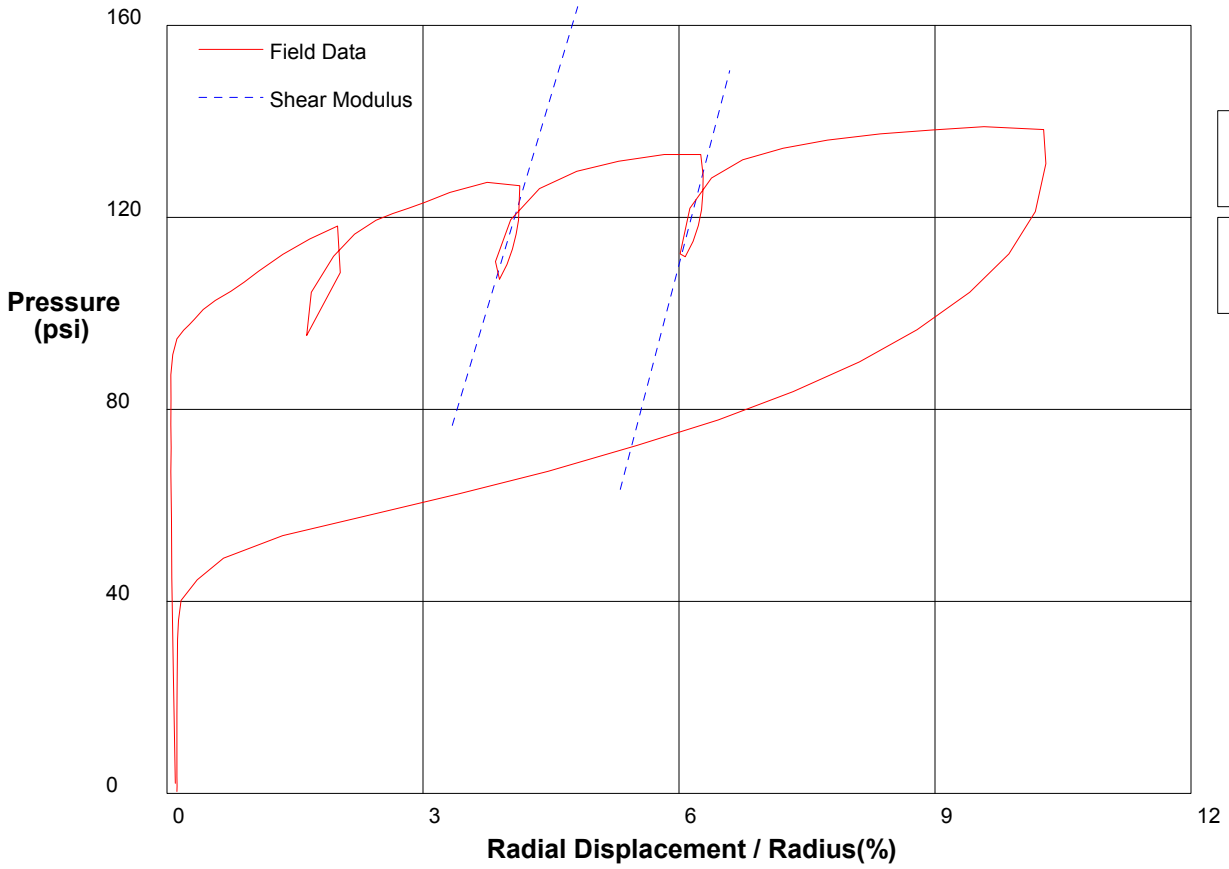


Shear Strength 13.3 psi
Limit Pressure 157 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 121ft	File C:\DATA\ISE-787\DOT95.P



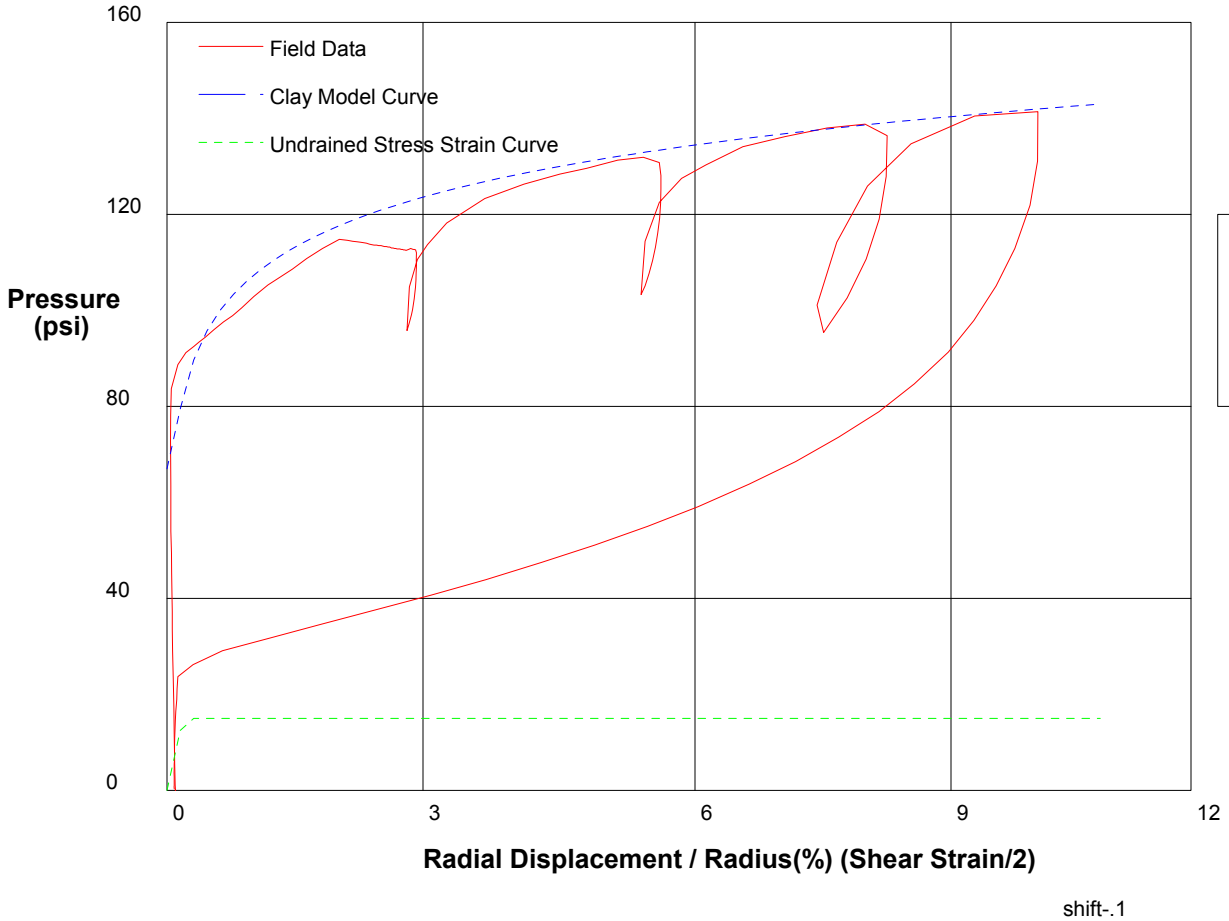
Shear Modulus 3403 psi

Shear Modulus 2969 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 123ft	File C:\DATA\ISE-787\DOT96.P

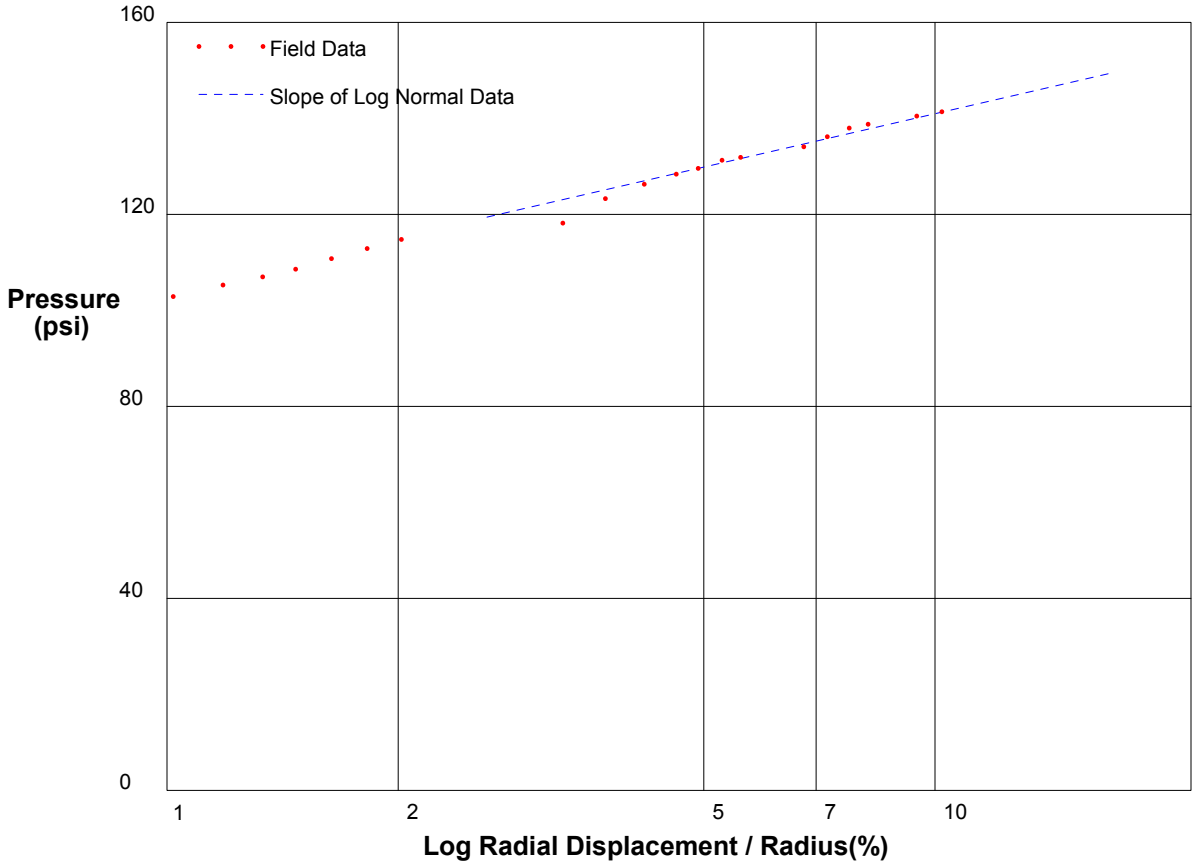


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	67 psi
Shear Modulus	4000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 123ft	File C:\DATA\ISE-787\DOT96.P



Shear Strength 16 psi
Limit Pressure 163 psi

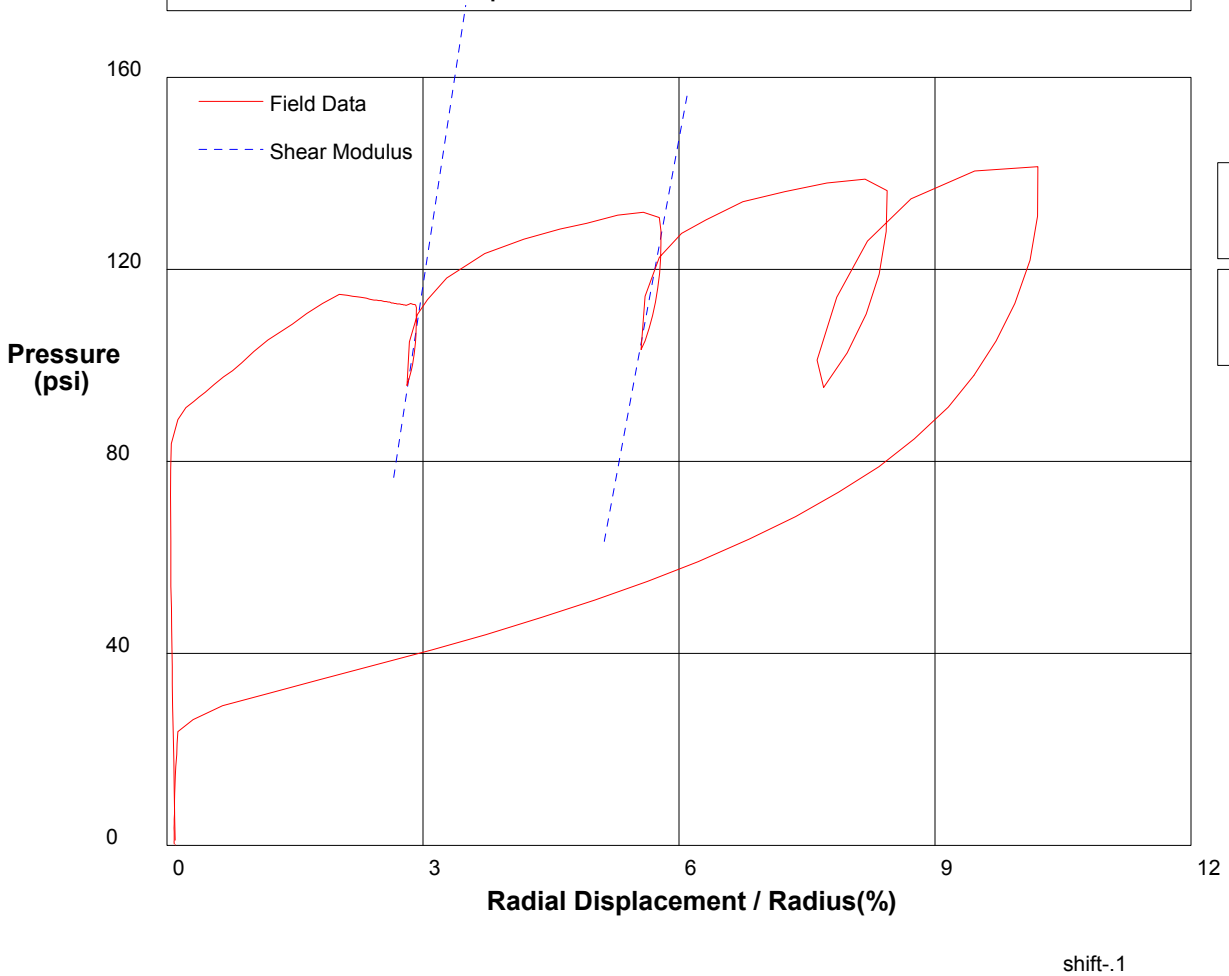
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/5/2008**

Hole No. TH-29B-PMT-08 Depth 123ft **File C:\DATA\ISE-787\DOT96.P**

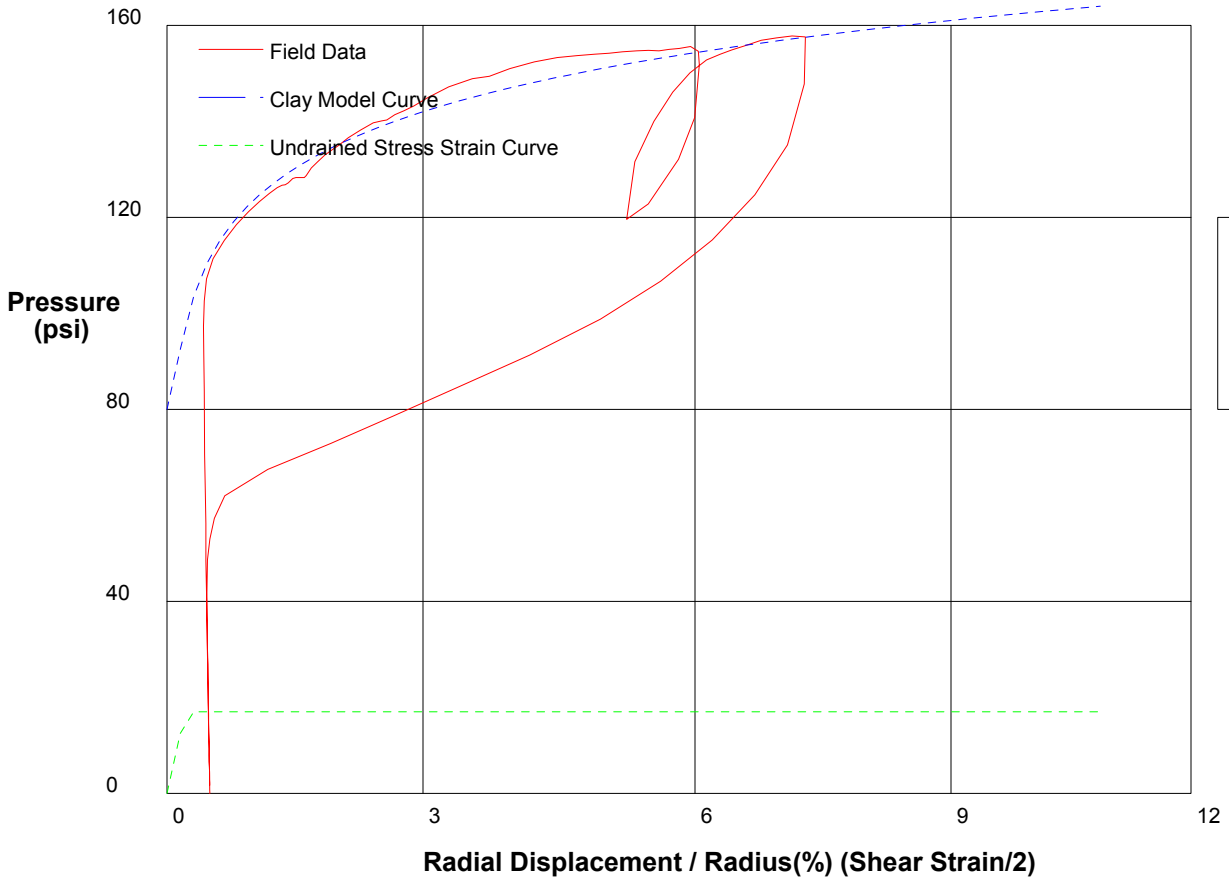


Shear Modulus 4788 psi

Shear Modulus 5827 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 127ft	File C:\DATA\ISE-787\DOT97.P



shift-.5

GIBSON'S CLAY MODEL

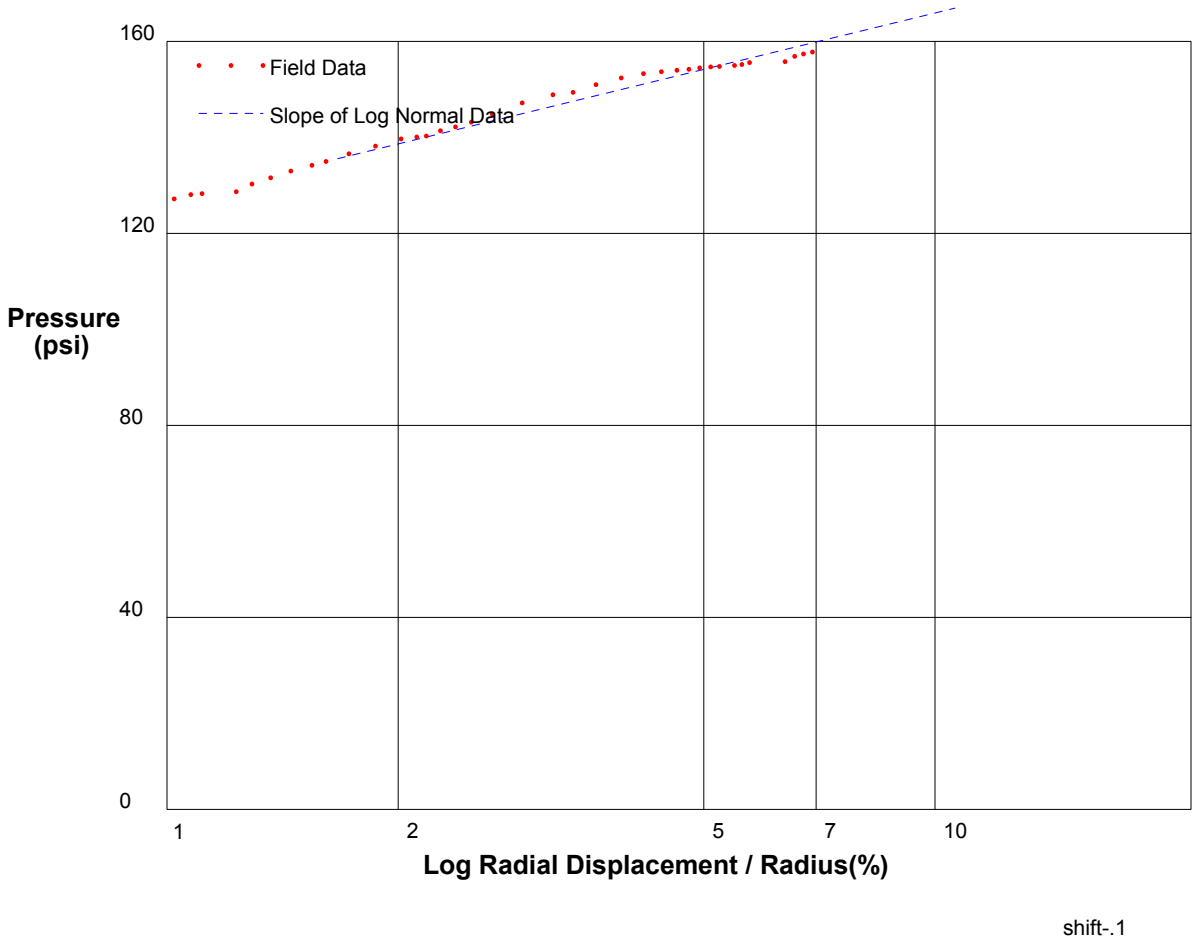
Shear Strength	17 psi
Insitu Stress	80 psi
Shear Modulus	4000 psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/5/2008**

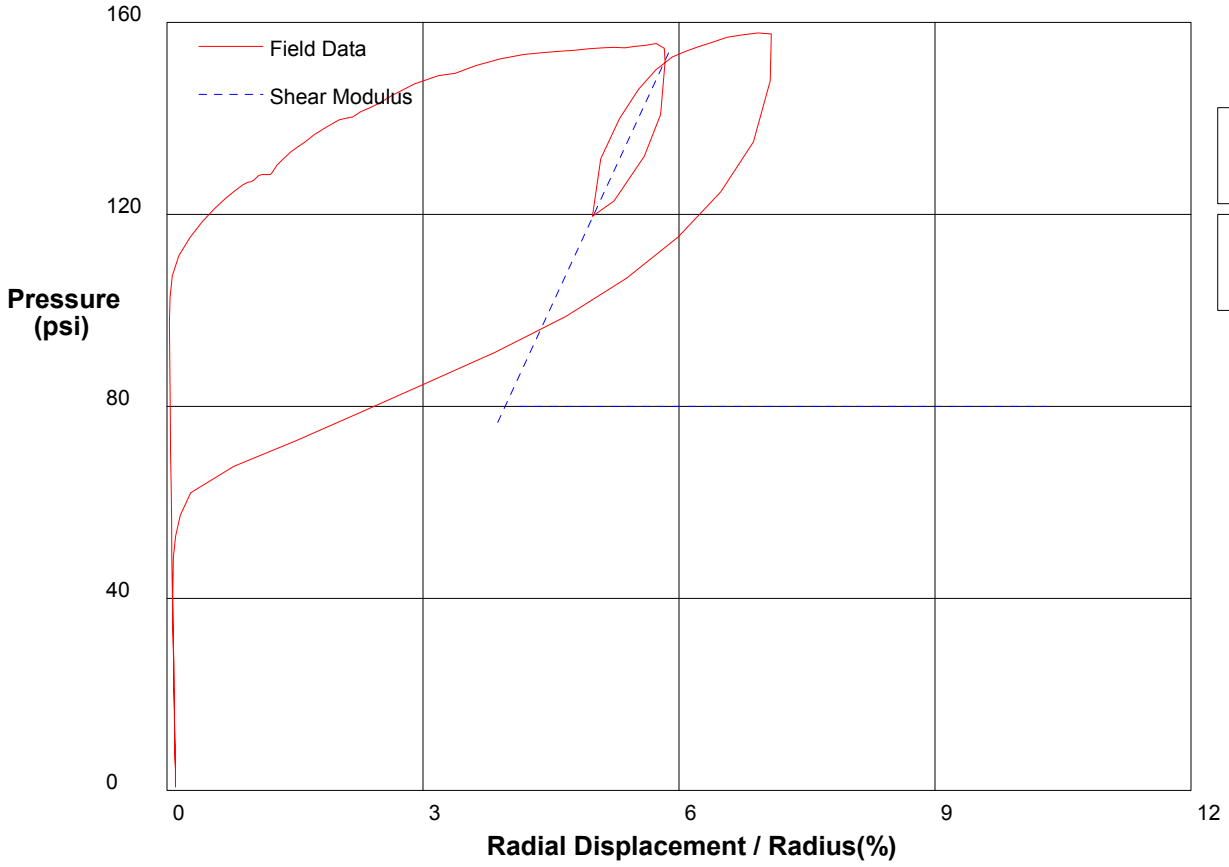
Hole No. TH-29B-PMT-08 Depth 127ft **File C:\DATA\ISE-787\DOT97.P**



Shear Strength 16.9 psi
Limit Pressure 189 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 127ft	File C:\DATA\ISE-787\DOT97.P



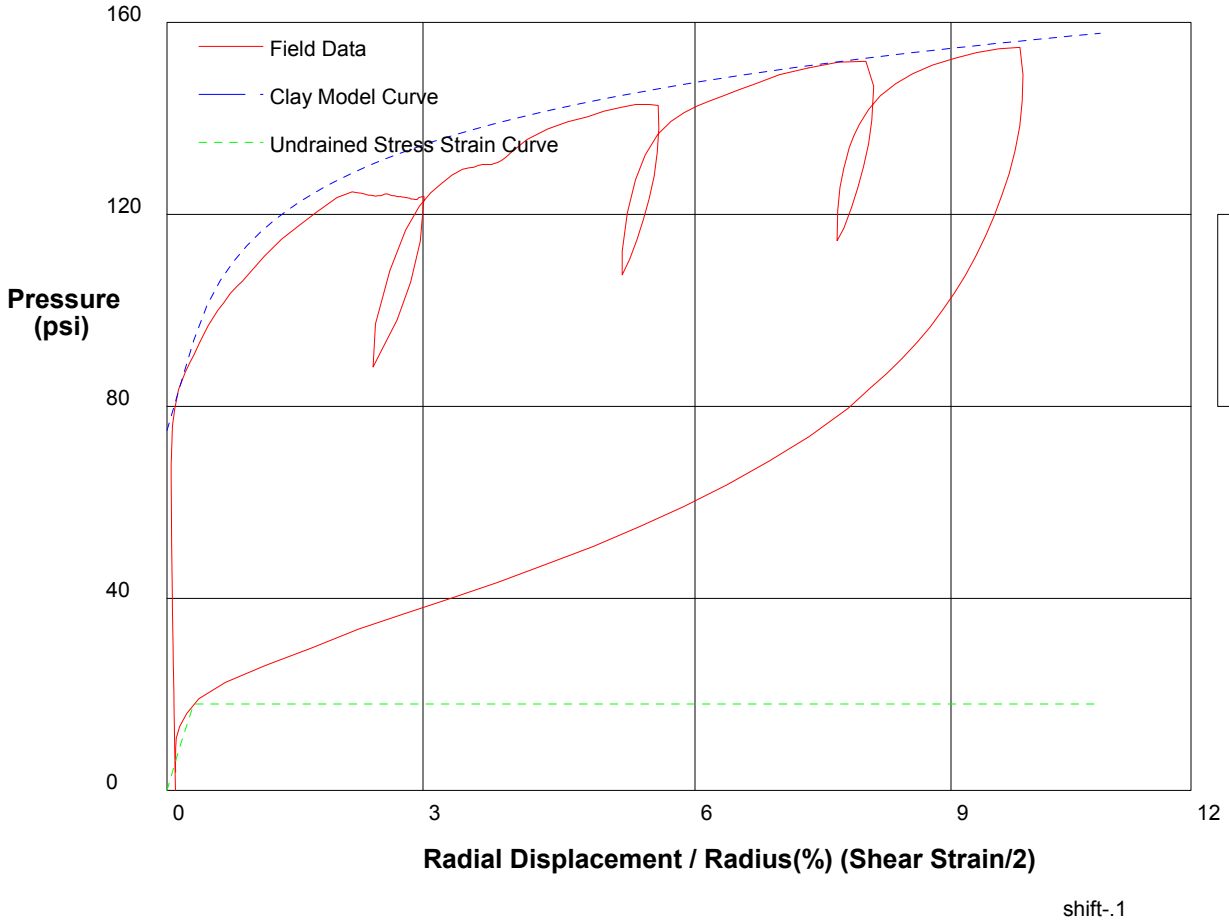
Shear Modulus 0 psi

Shear Modulus 1922 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 129ft	File C:\DATA\ISE-787\DOT98.P

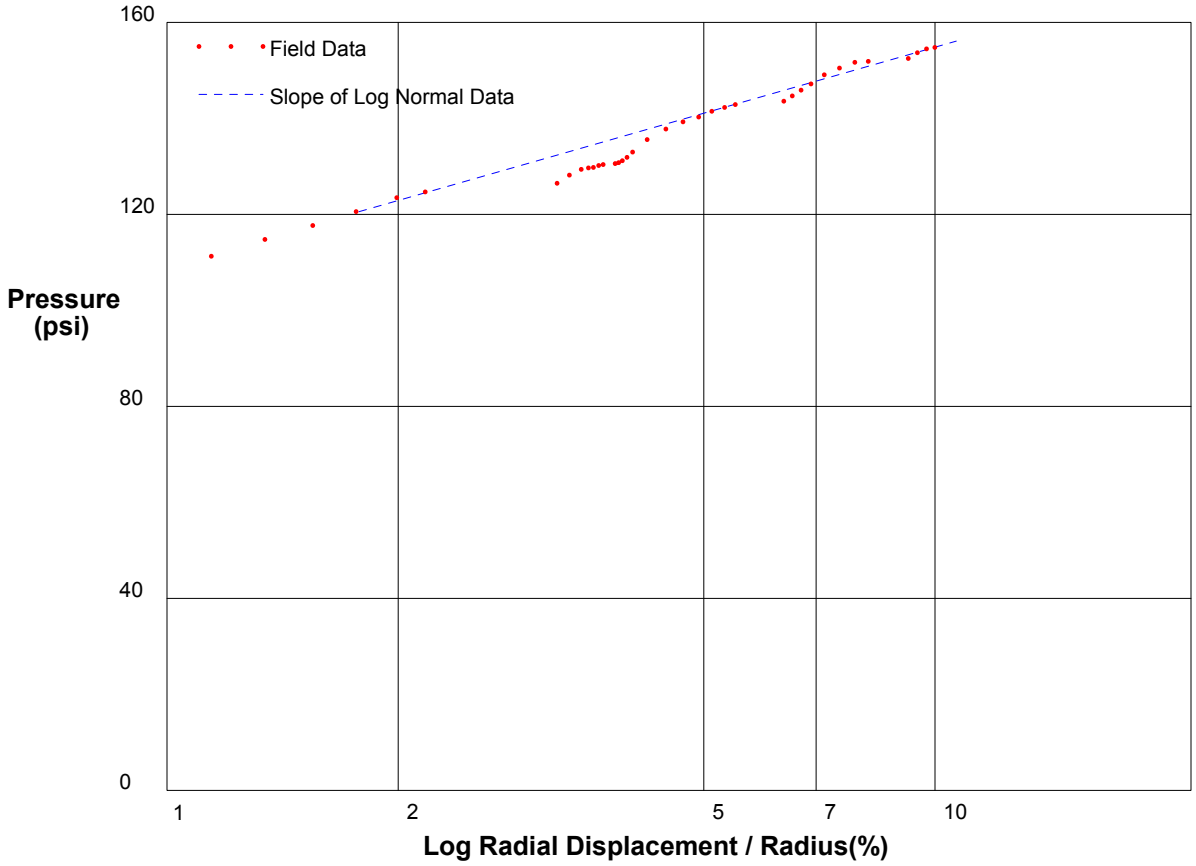


GIBSON'S CLAY MODEL

Shear Strength	18 psi
Insitu Stress	75 psi
Shear Modulus	3000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 129ft	File C:\DATA\ISE-787\DOT98.P

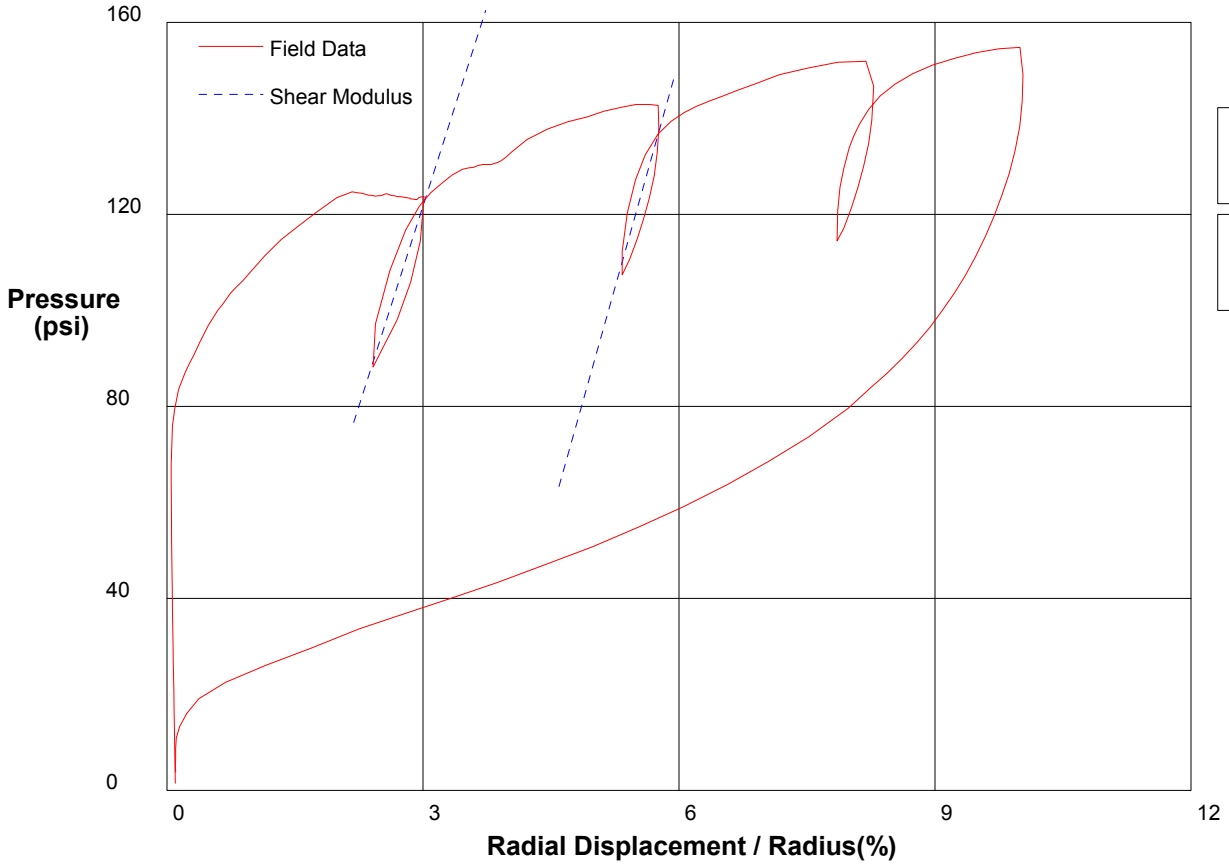


Shear Strength 19.8 psi
Limit Pressure 182 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 129ft	File C:\DATA\ISE-787\DOT98.P



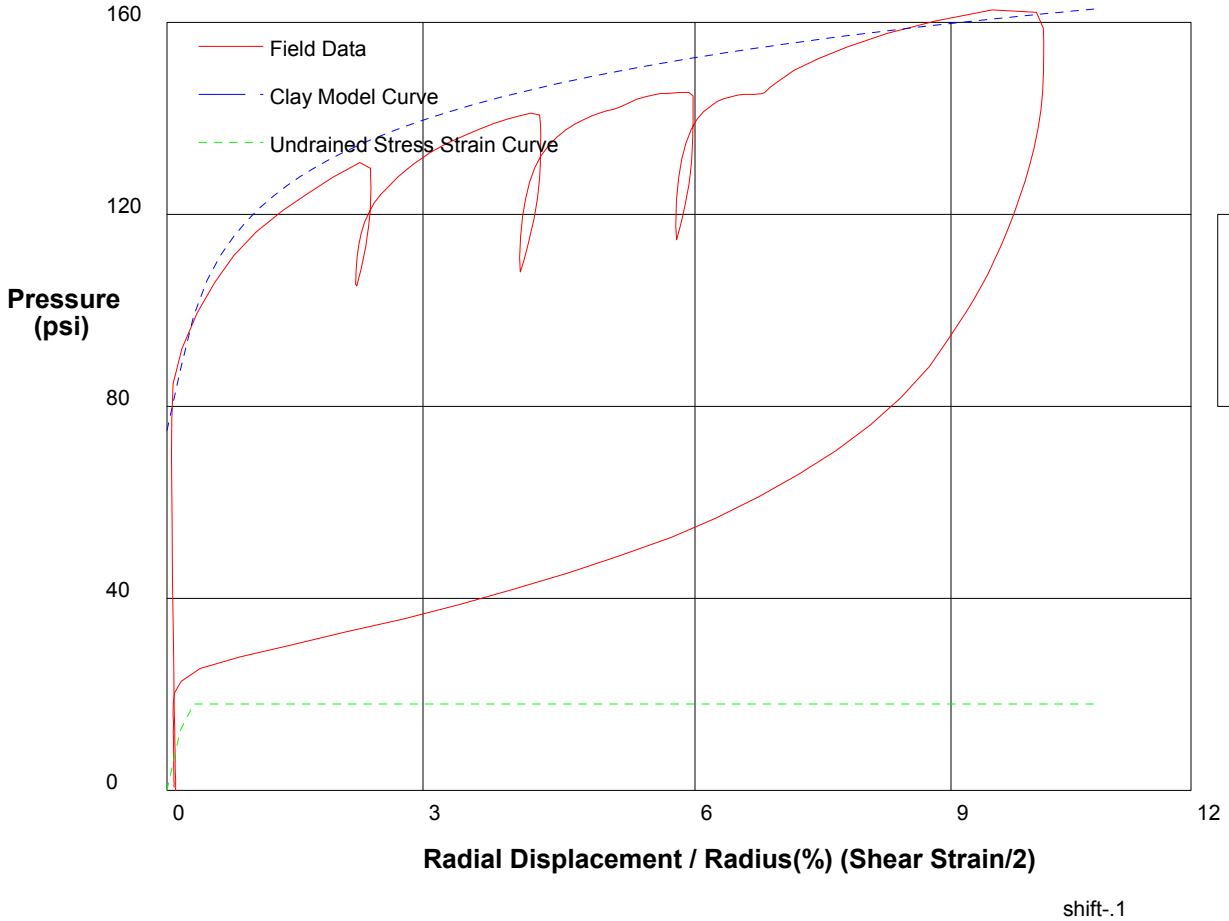
Shear Modulus 3157 psi

Shear Modulus 2774 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 131ft	File C:\DATA\ISE-787\DOT99.P

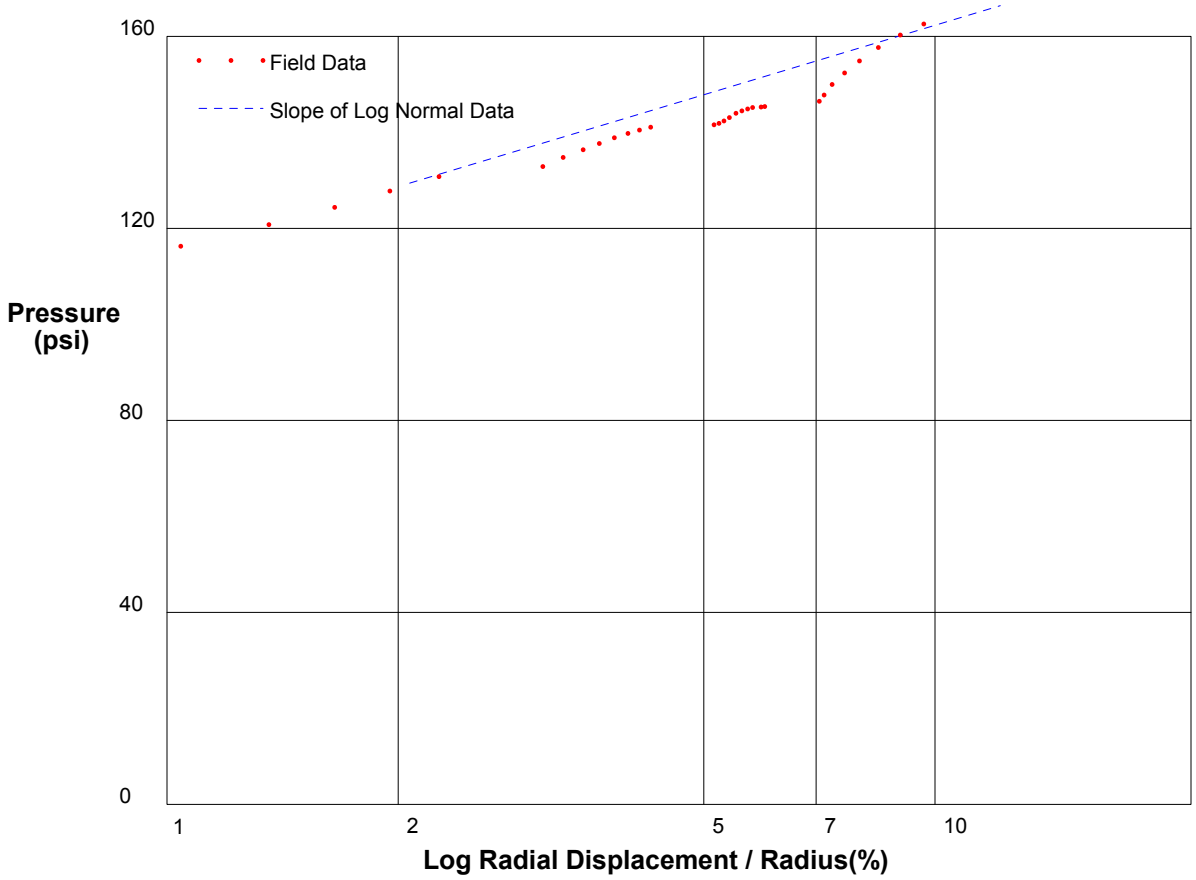


GIBSON'S CLAY MODEL

Shear Strength	18 psi
Insitu Stress	75 psi
Shear Modulus	4000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/5/2008
Hole No. TH-29B-PMT-08 Depth 131ft	File C:\DATA\ISE-787\DOT99.P



Shear Strength 20.8 psi
Limit Pressure 191 psi

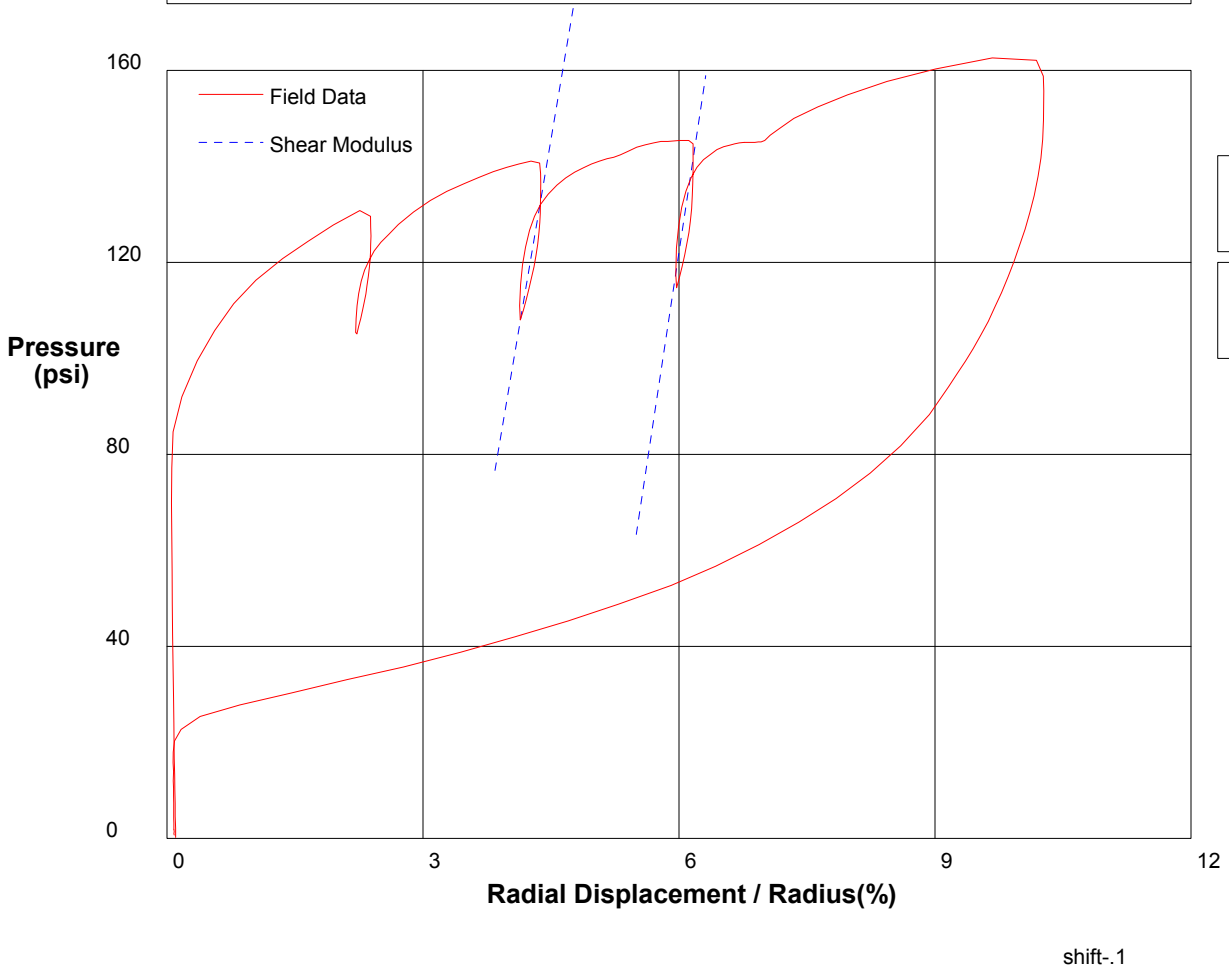
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/5/2008**

Hole No. TH-29B-PMT-08 Depth 131ft **File C:\DATA\ISE-787\DOT99.P**

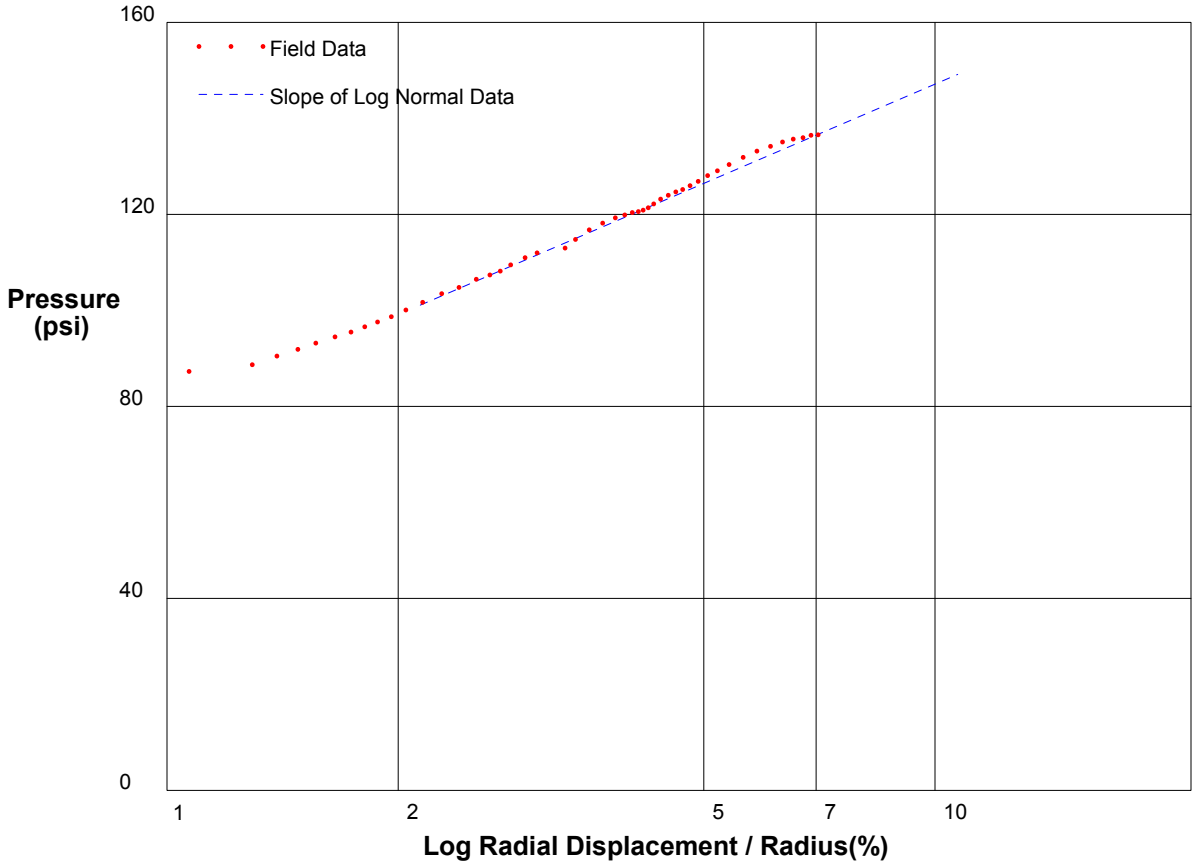


Shear Modulus 5880 psi

Shear Modulus 5258 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 92ft	File C:\DATA\ISE-787\DOT100.P

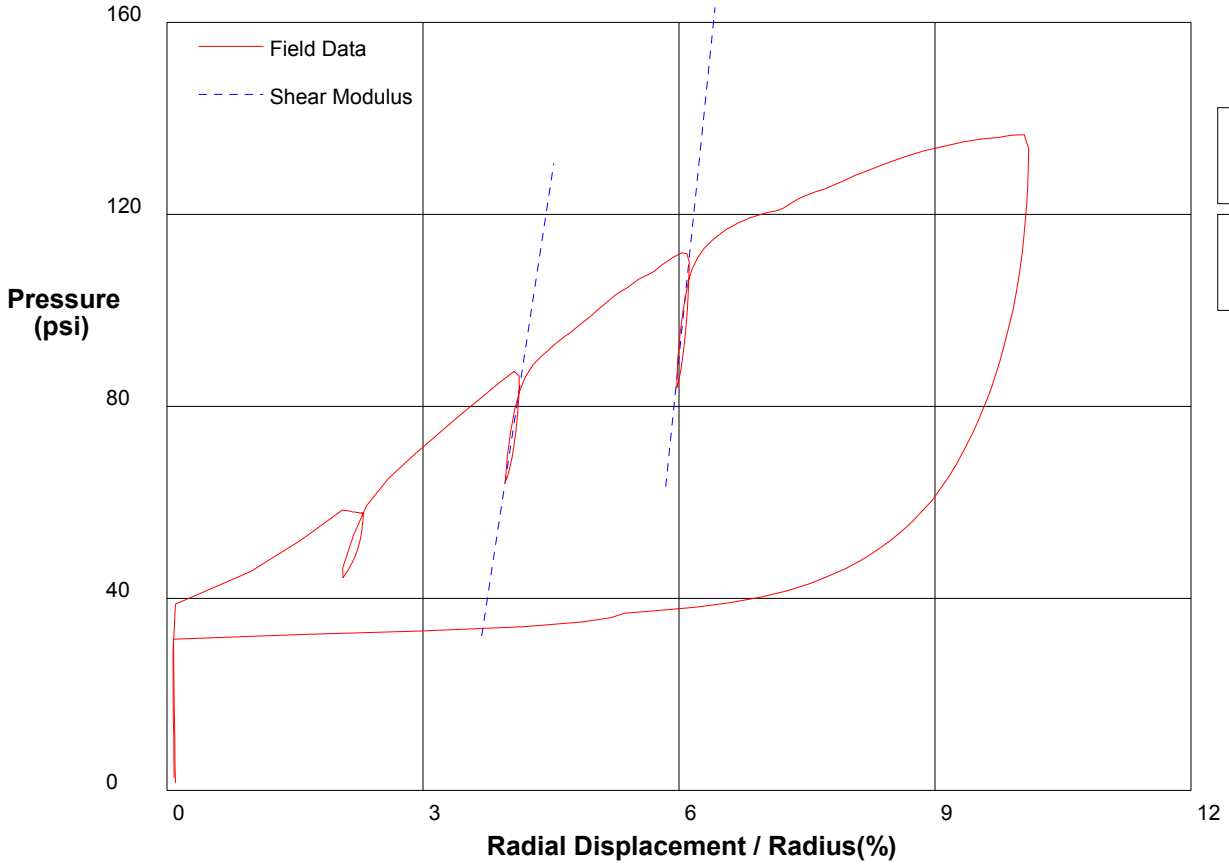


Shear Strength 29.8 psi
Limit Pressure 189 psi

shift 2.9

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 92ft	File C:\DATA\ISE-787\DOT100.P



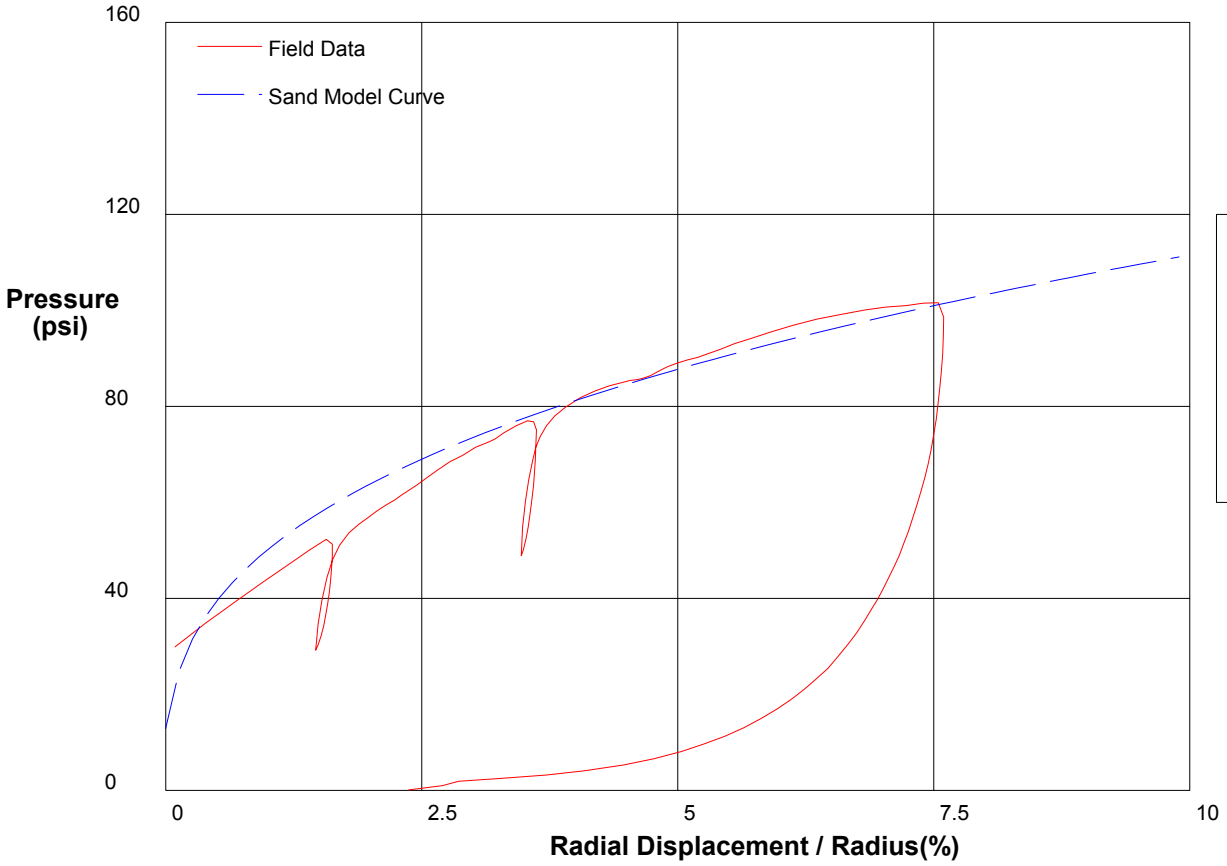
Shear Modulus 8624 psi

Shear Modulus 5827 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 92ft	File C:\DATA\ISE-787\DOT100.P



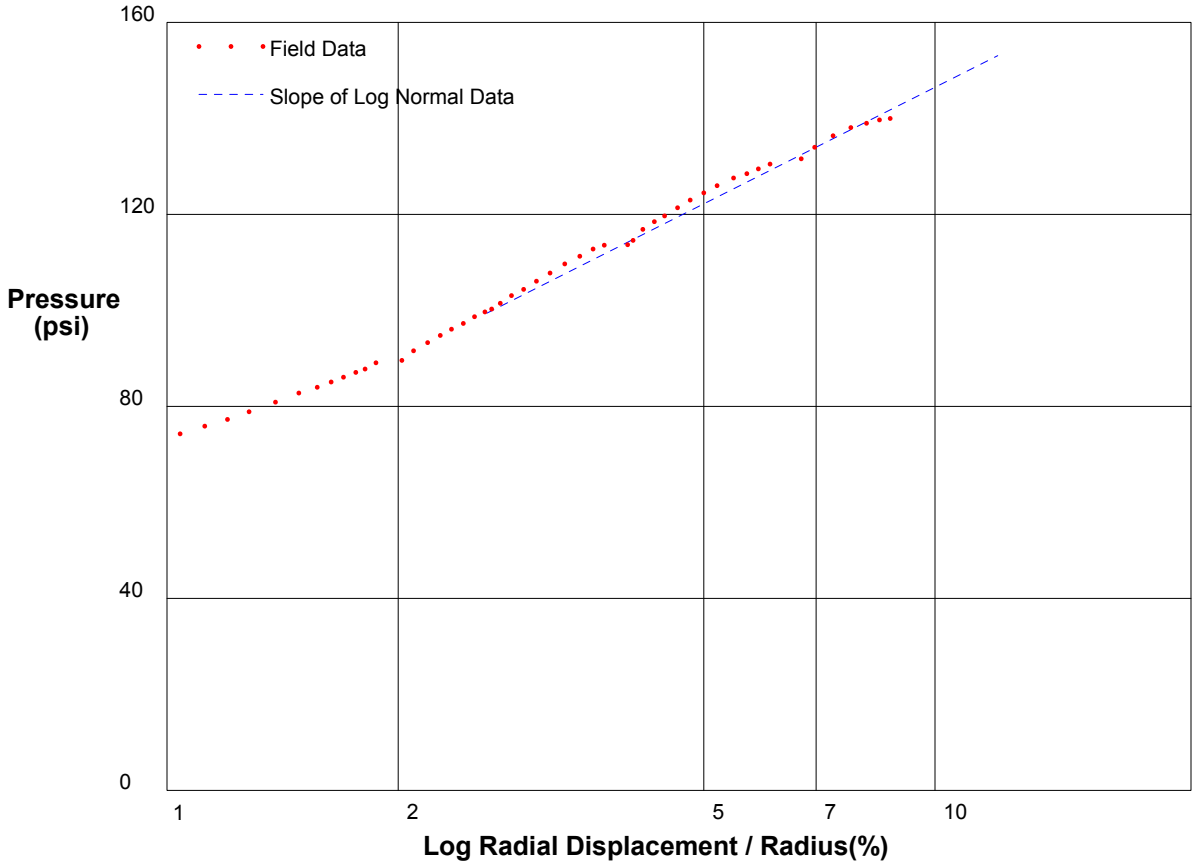
THE In Situ Engineering SAND MODEL

Water Pressure	35 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	13 psi
Shear Modulus	5000 psi

shift 2.4

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 94ft	File C:\DATA\ISE-787\DOT101.P

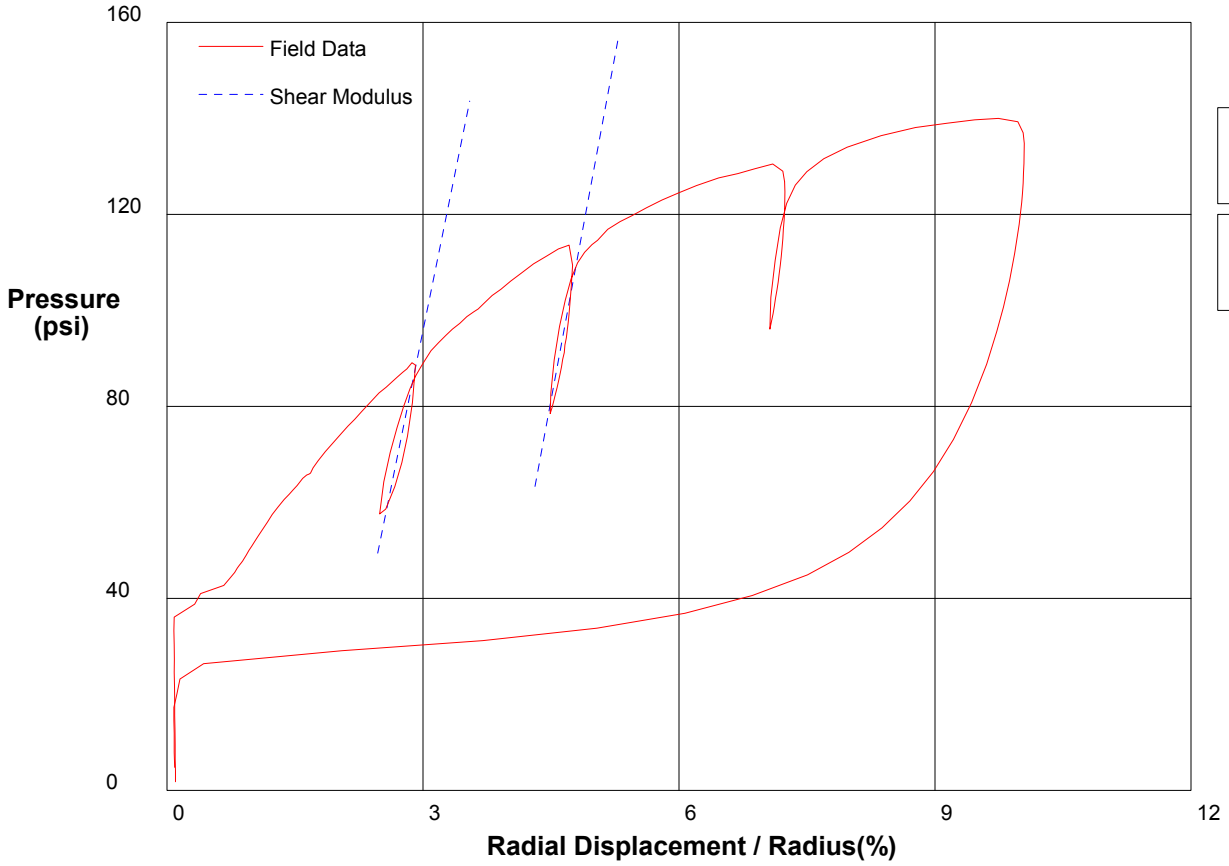


Shear Strength 35 psi
Limit Pressure 195 psi

shift .9

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 94ft	File C:\DATA\ISE-787\DOT101.P



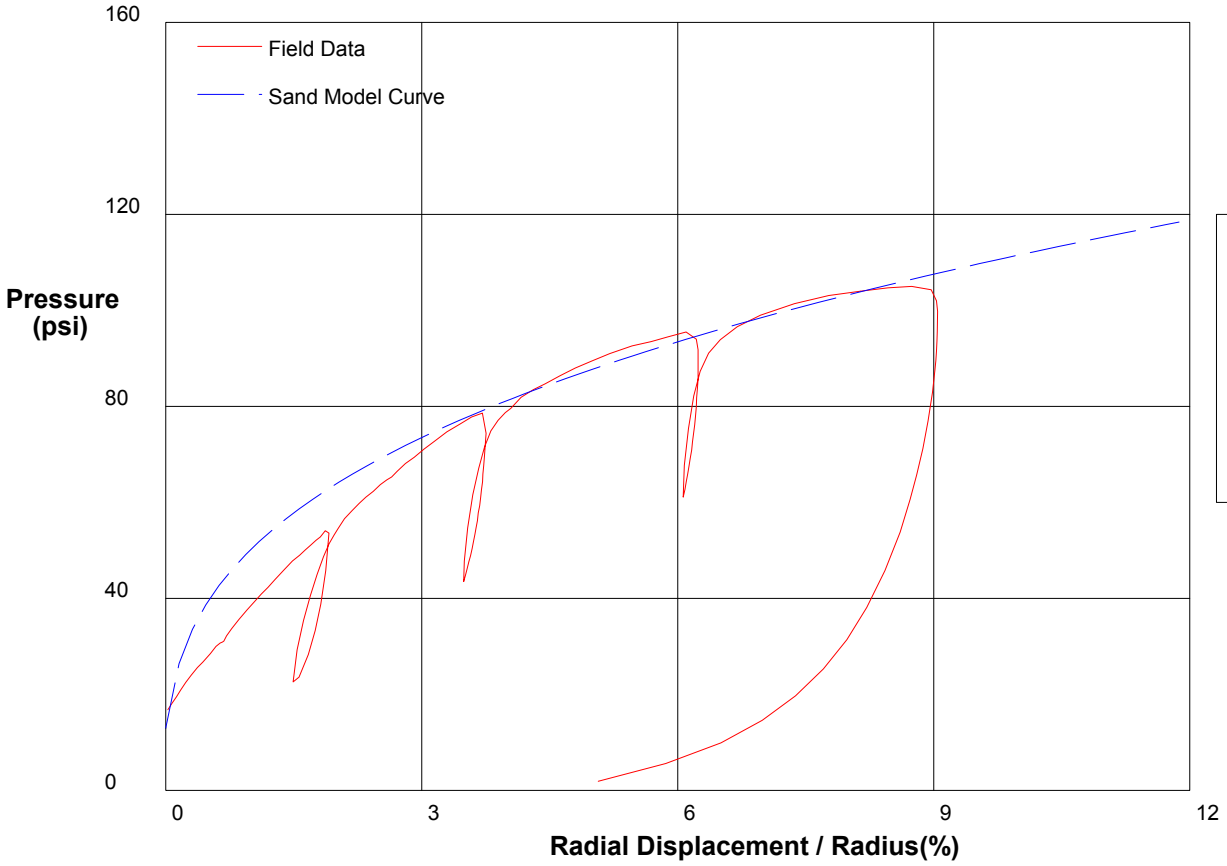
Shear Modulus 4788 psi

Shear Modulus 4367 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 94ft	File C:\DATA\ISE-787\DOT101.P



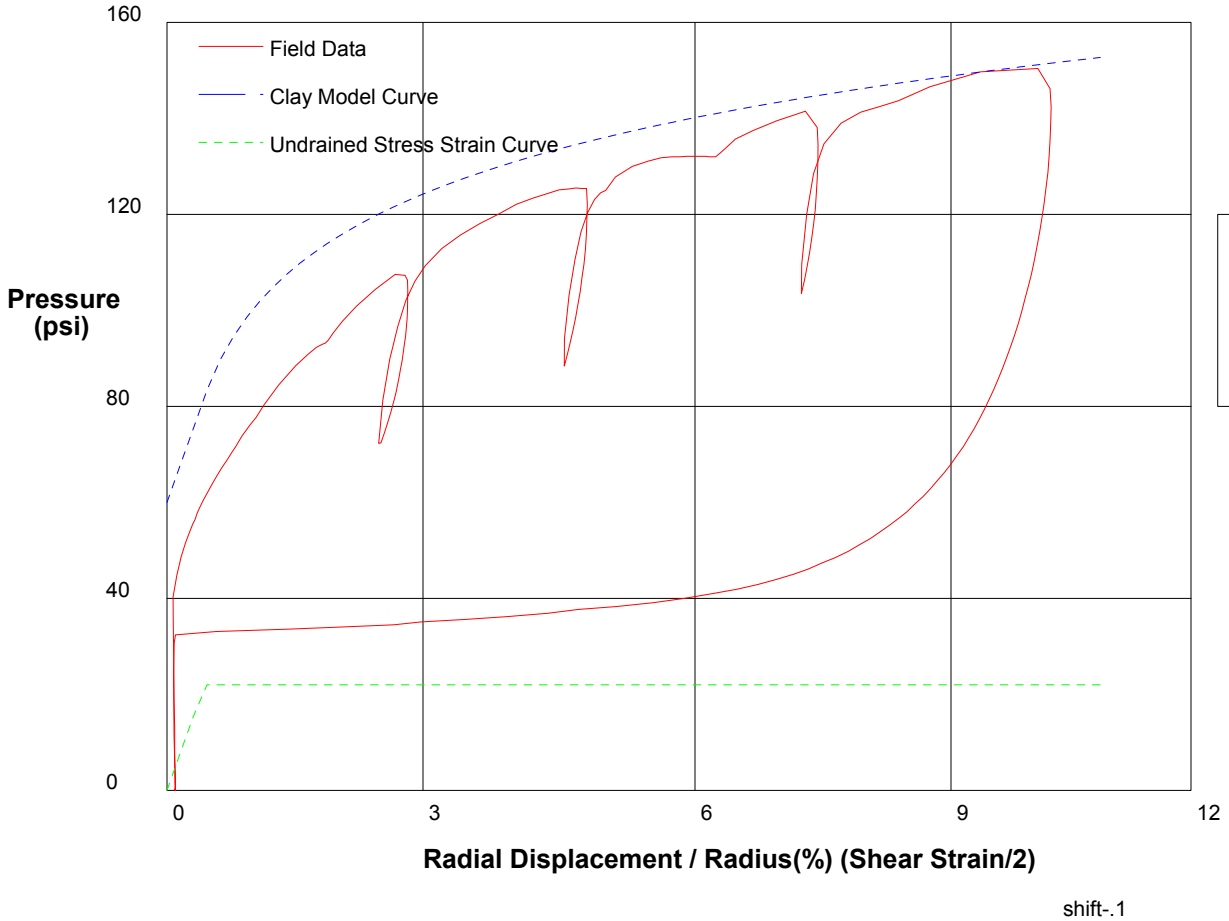
THE In Situ Engineering SAND MODEL

Water Pressure	35 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	13 psi
Shear Modulus	5000 psi

shift .9

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 96ft	File C:\DATA\ISE-787\DOT102.P

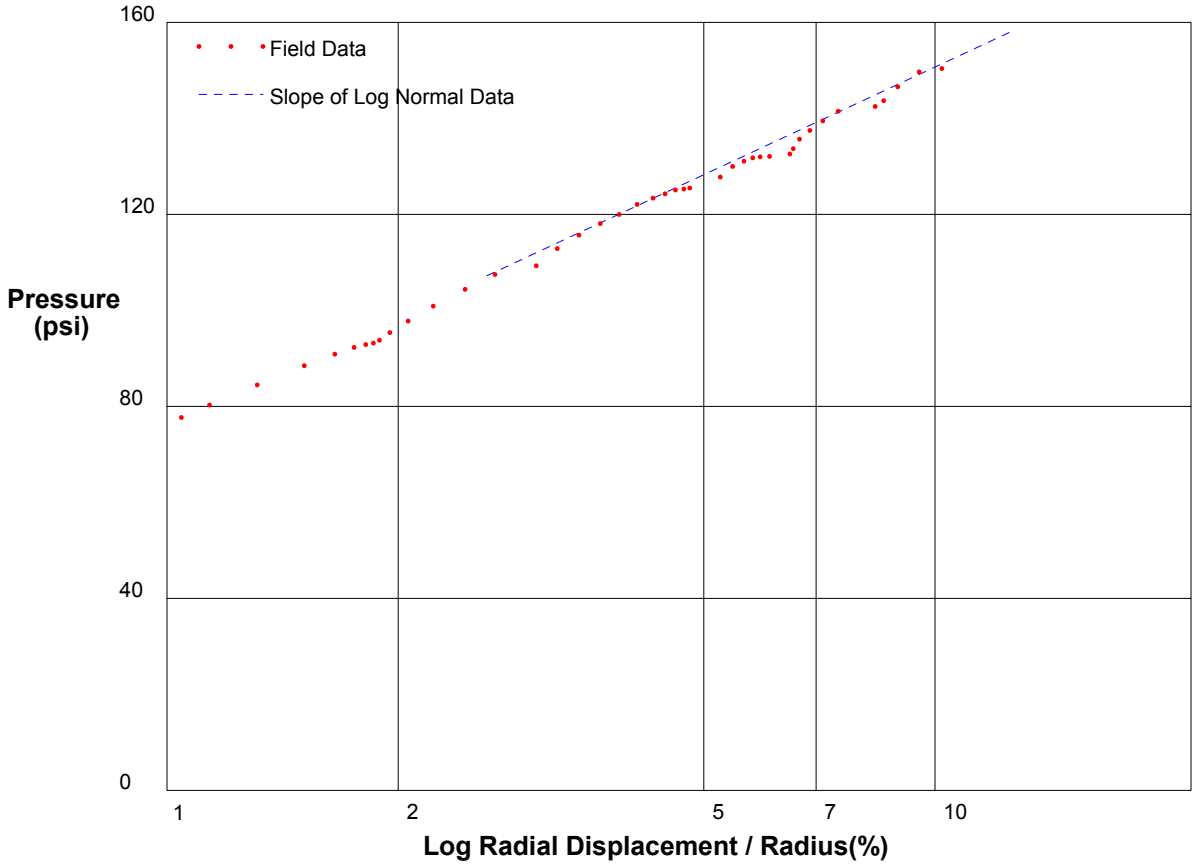


GIBSON'S CLAY MODEL

Shear Strength	22 psi
Insitu Stress	60 psi
Shear Modulus	2500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 96ft	File C:\DATA\ISE-787\DOT102.P



Shear Strength 32.3 psi
Limit Pressure 196 psi

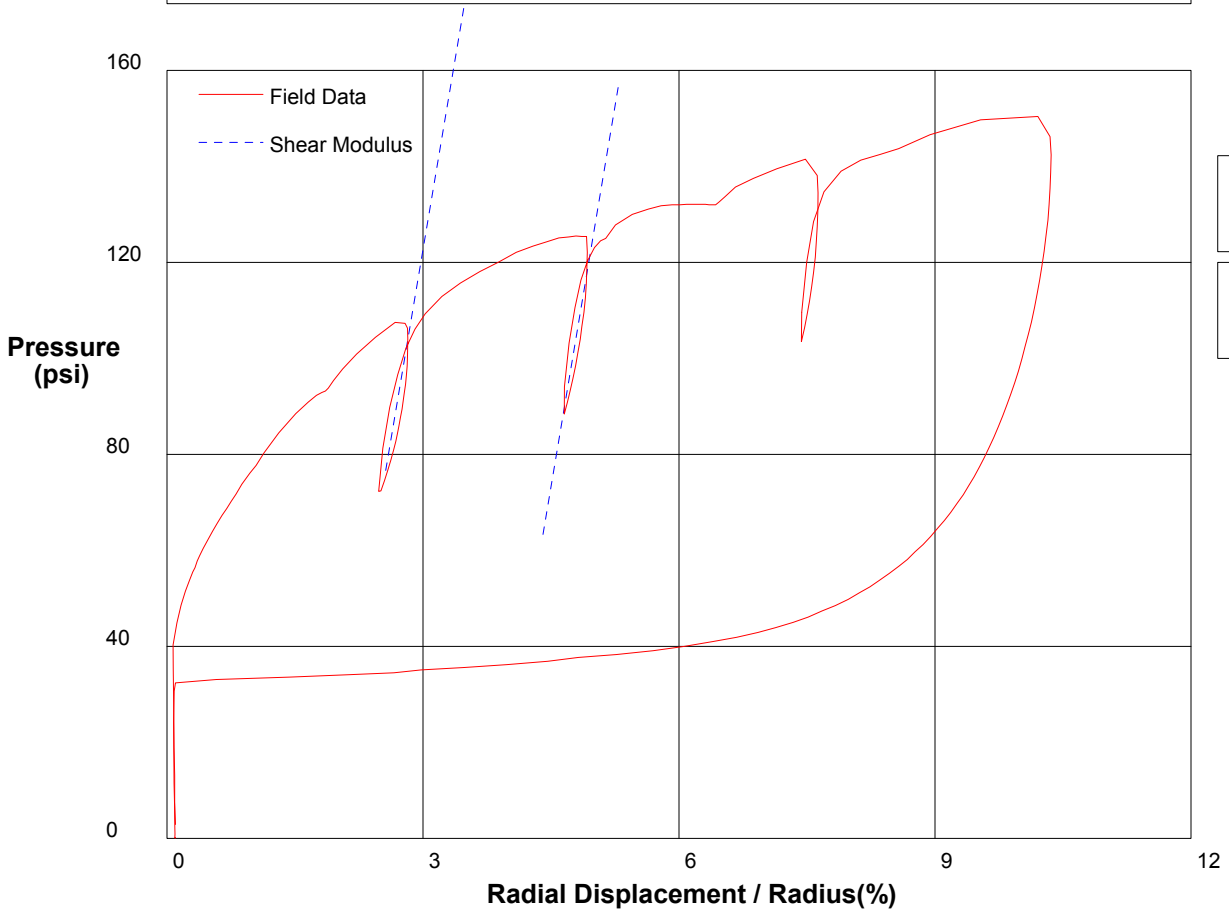
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/6/2008**

Hole No. TH-30B-PMT-08 Depth 96ft **File C:\DATA\ISE-787\DOT102.P**



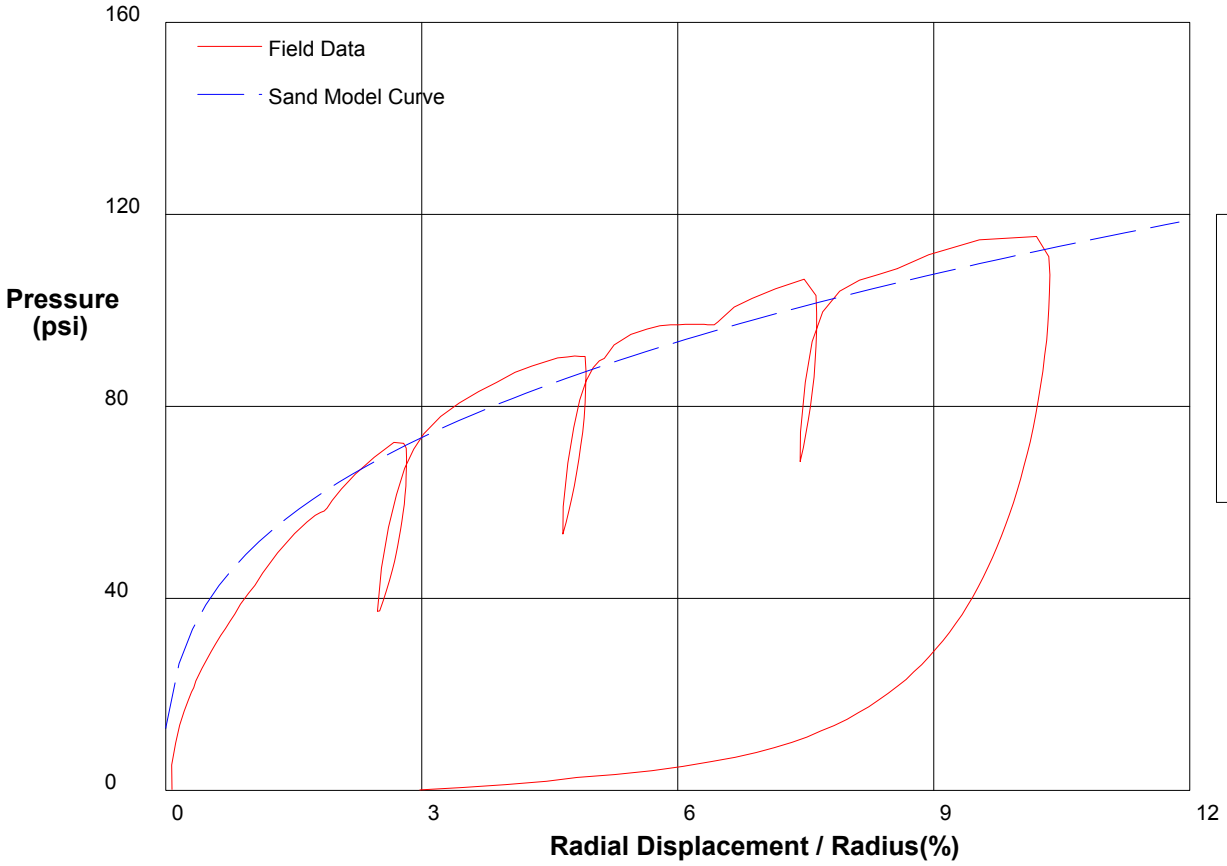
Shear Modulus 5286 psi

Shear Modulus 5258 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 96ft	File C:\DATA\ISE-787\DOT102.P



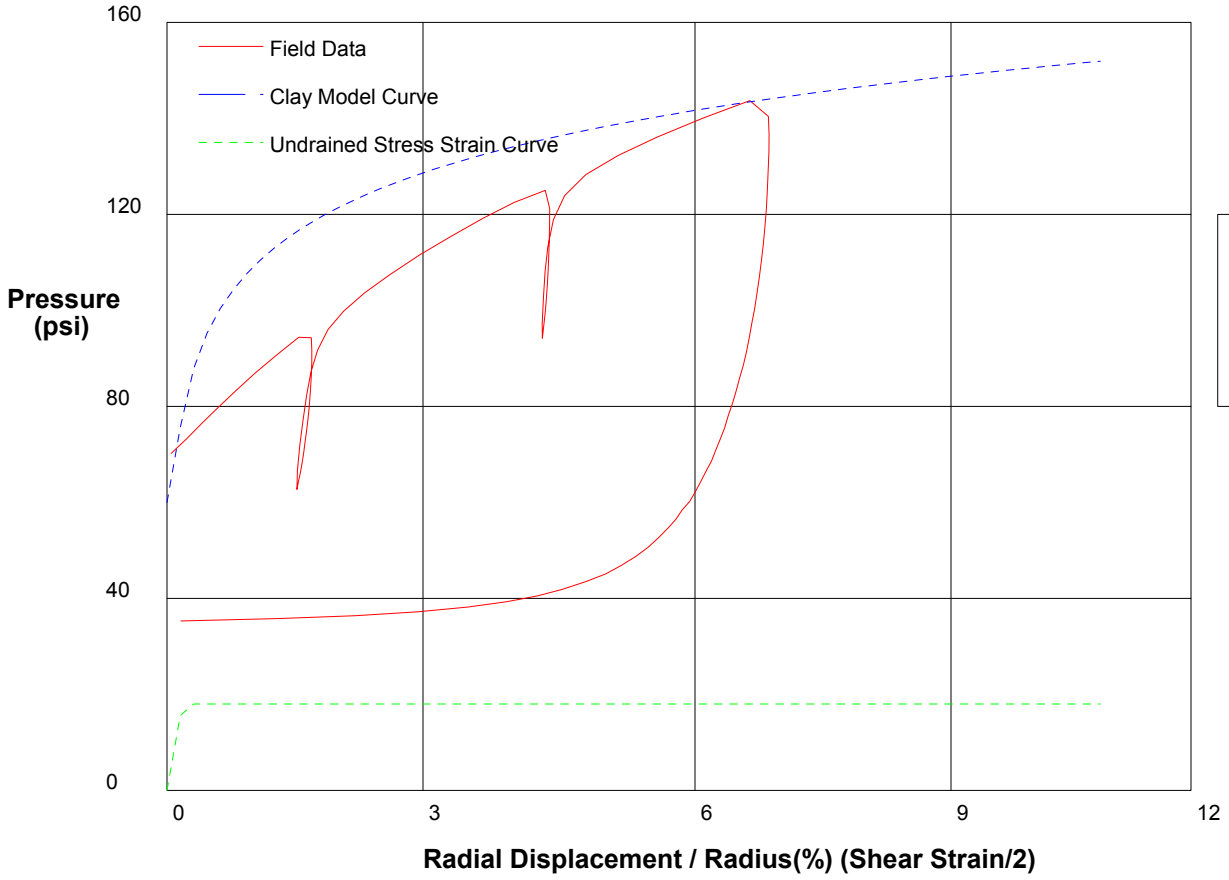
THE In Situ Engineering SAND MODEL

Water Pressure	35 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	13 psi
Shear Modulus	5000 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 98ft	File C:\DATA\ISE-787\DOT103.P



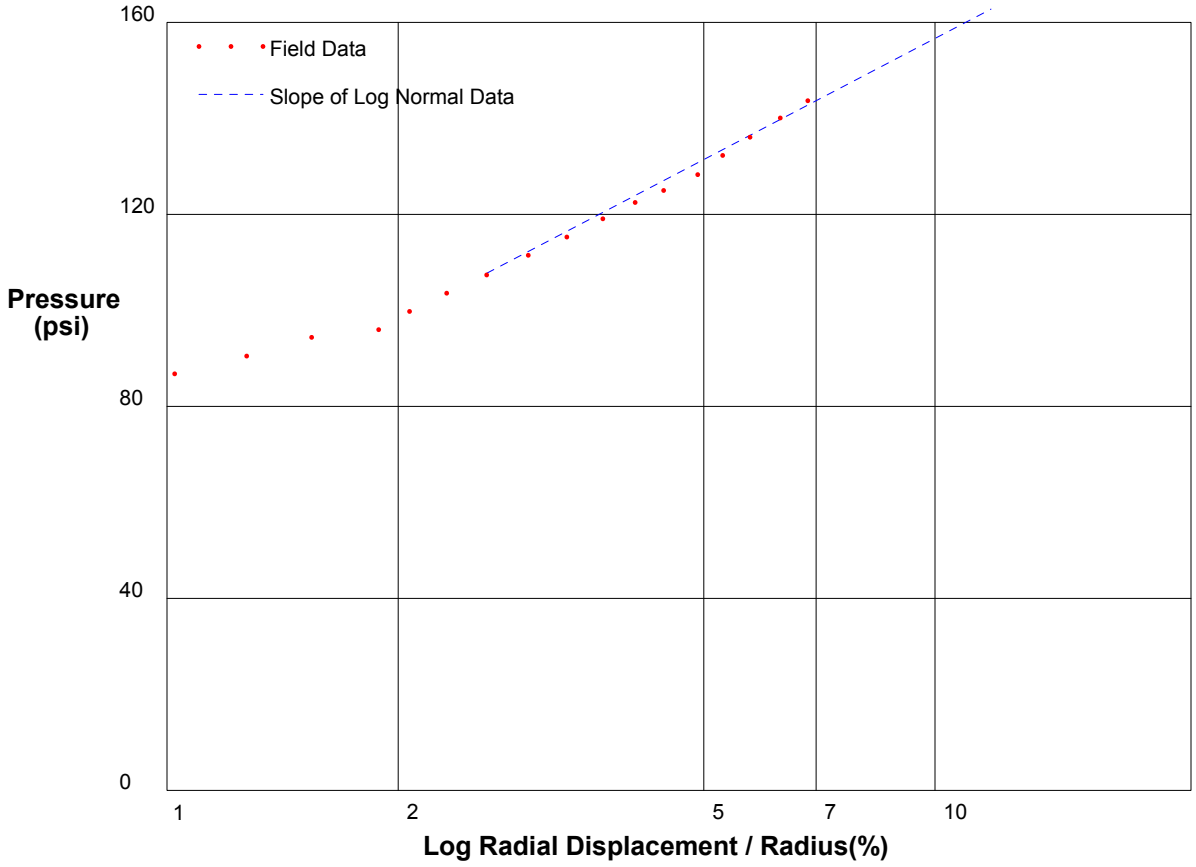
GIBSON'S CLAY MODEL

Shear Strength	18 psi
Insitu Stress	60 psi
Shear Modulus	5000 psi

shift 3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 98ft	File C:\DATA\ISE-787\DOT103.P

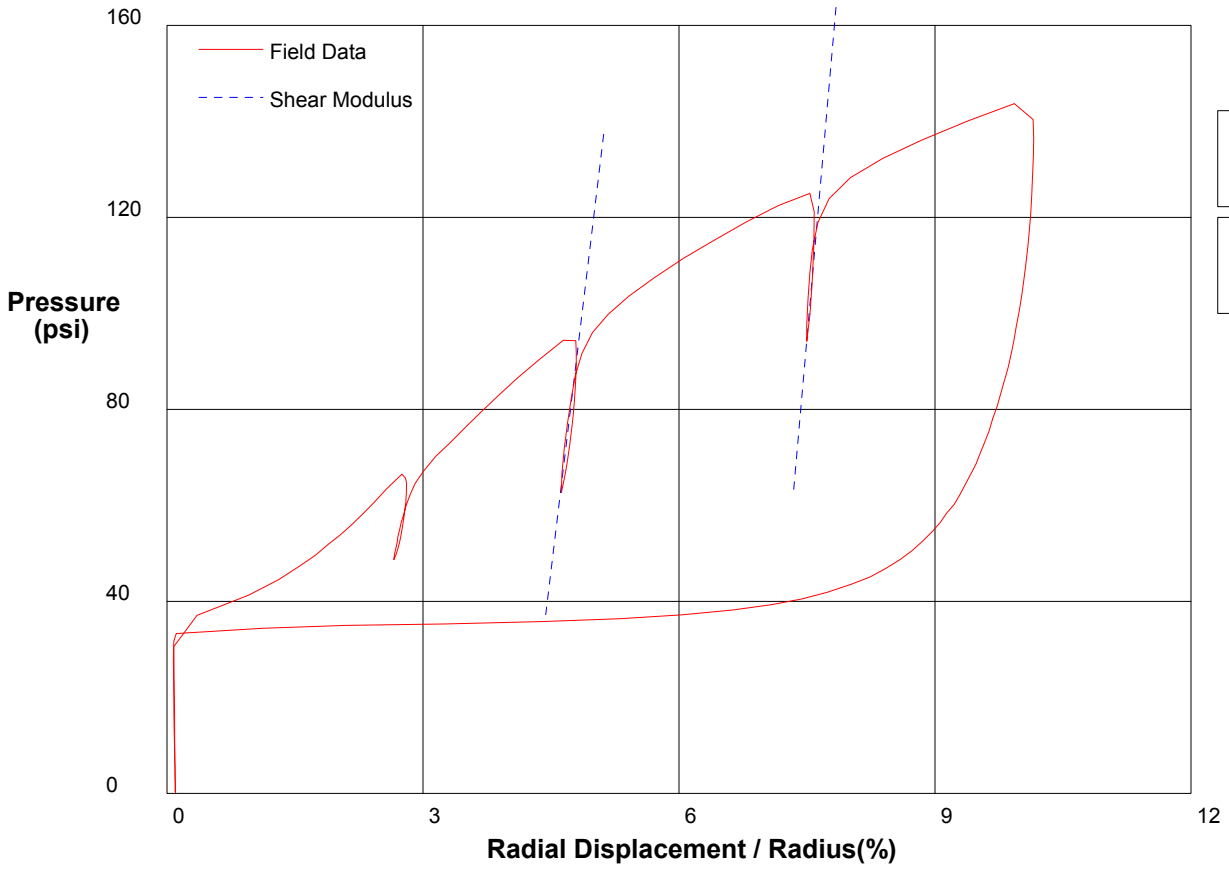


Shear Strength 36.3 psi
Limit Pressure 208 psi

shift 3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 98ft	File C:\DATA\ISE-787\DOT103.P



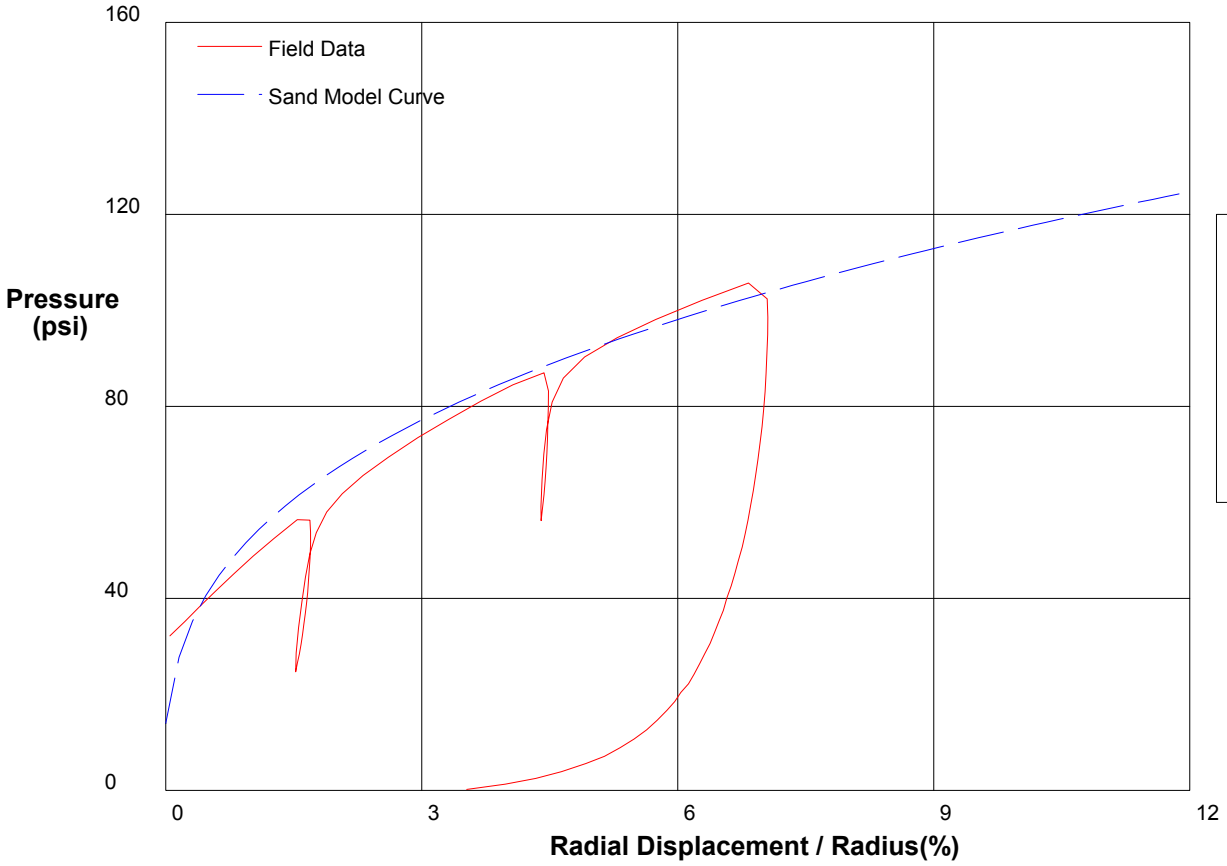
Shear Modulus 10111 psi

Shear Modulus 7353 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 98ft	File C:\DATA\ISE-787\DOT103.P



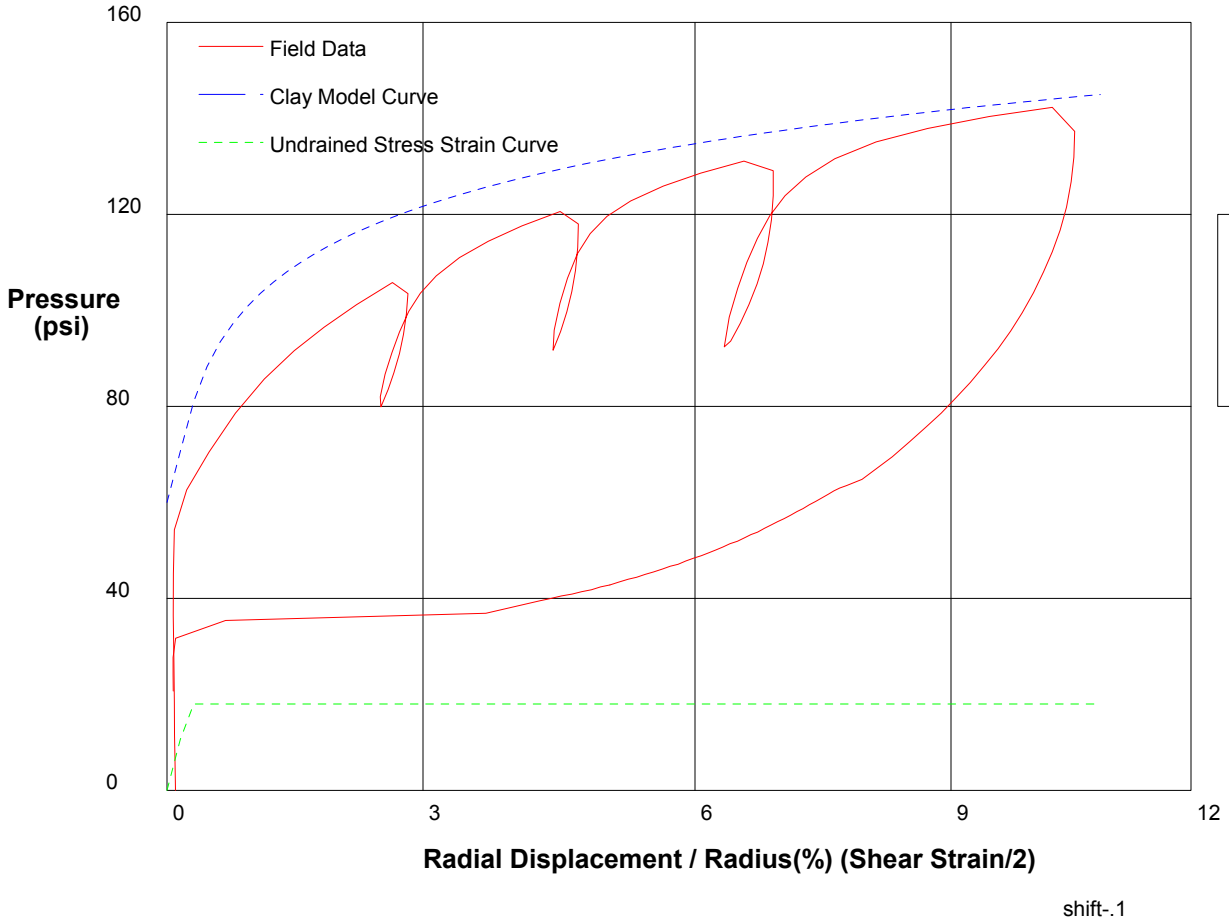
THE In Situ Engineering SAND MODEL

Water Pressure	38 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	14 psi
Shear Modulus	5000 psi

shift 3

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 100ft	File C:\DATA\ISE-787\DOT104.P

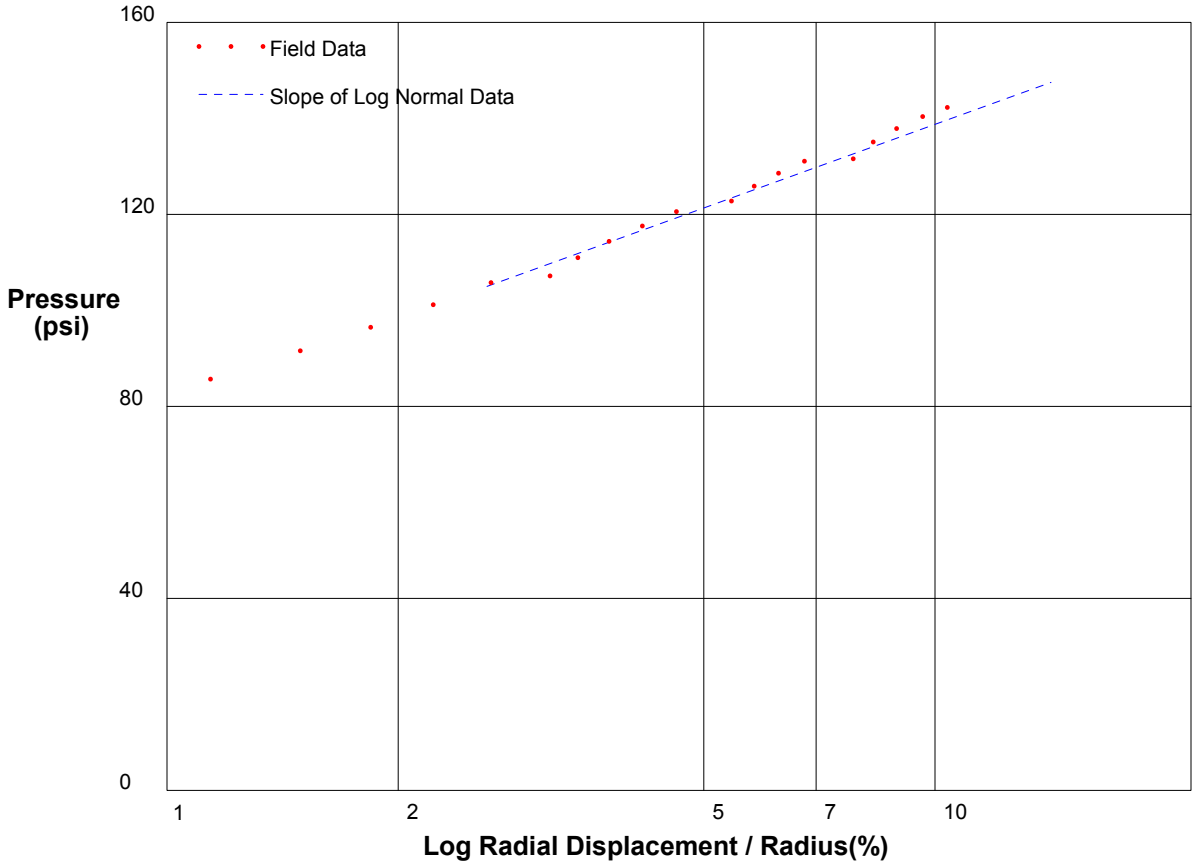


GIBSON'S CLAY MODEL

Shear Strength	18 psi
Insitu Stress	60 psi
Shear Modulus	3400 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 100ft	File C:\DATA\ISE-787\DOT104.P

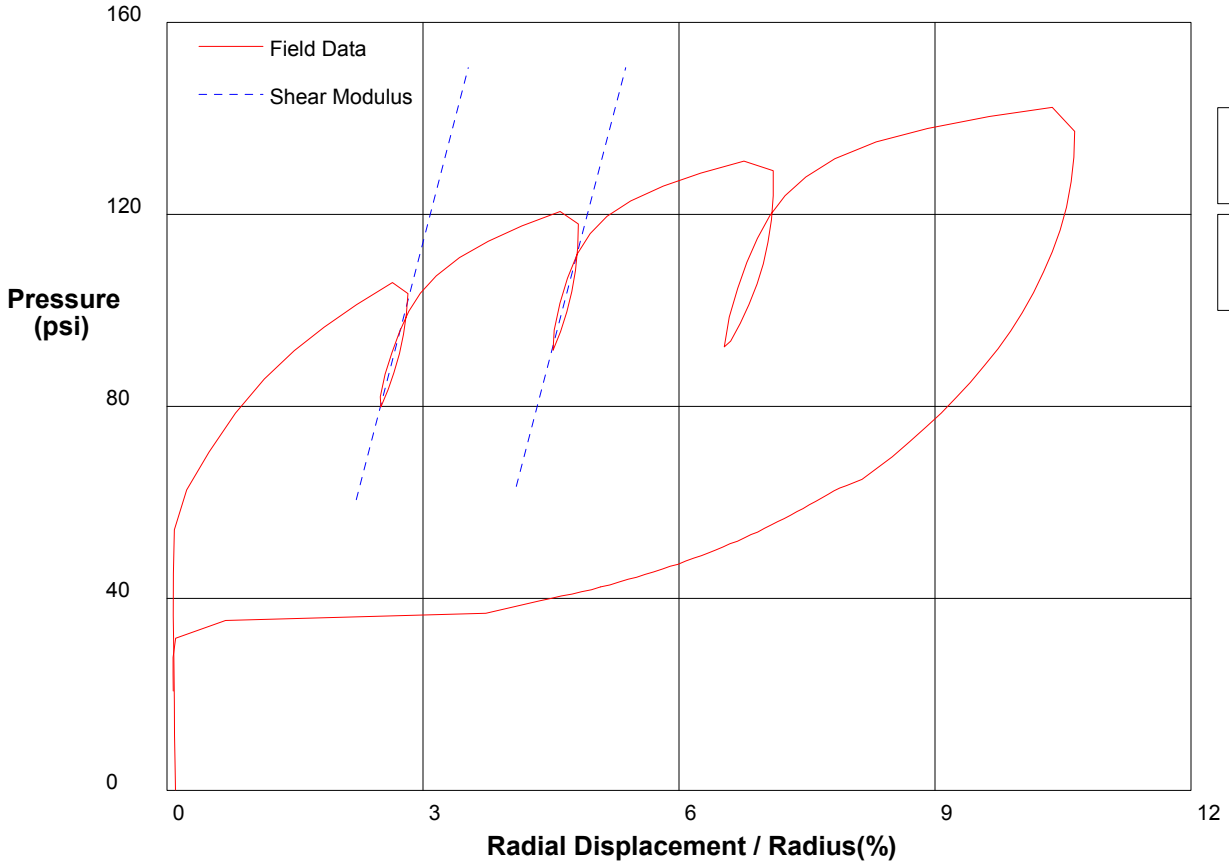


Shear Strength 25.1 psi
Limit Pressure 174 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 100ft	File C:\DATA\ISE-787\DOT104.P



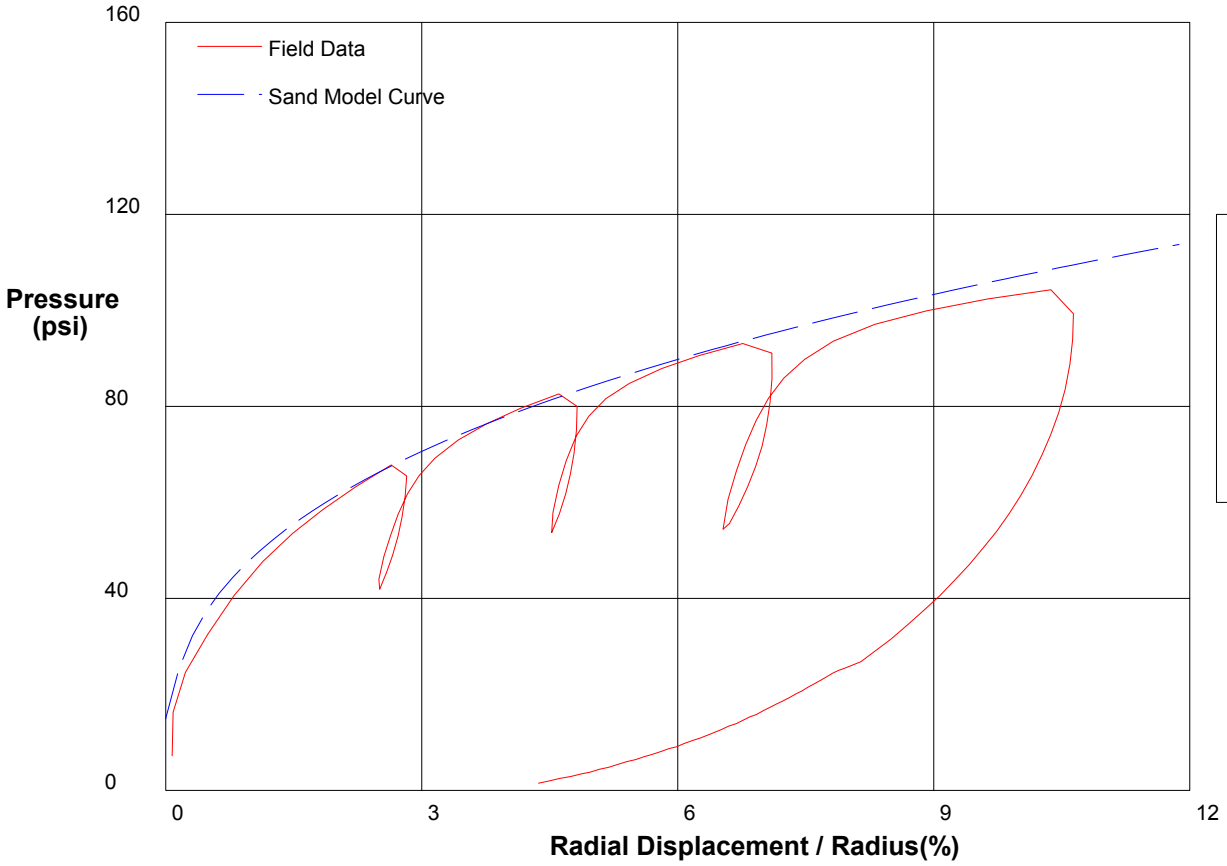
Shear Modulus 3403 psi

Shear Modulus 3428 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 100ft	File C:\DATA\ISE-787\DOT104.P



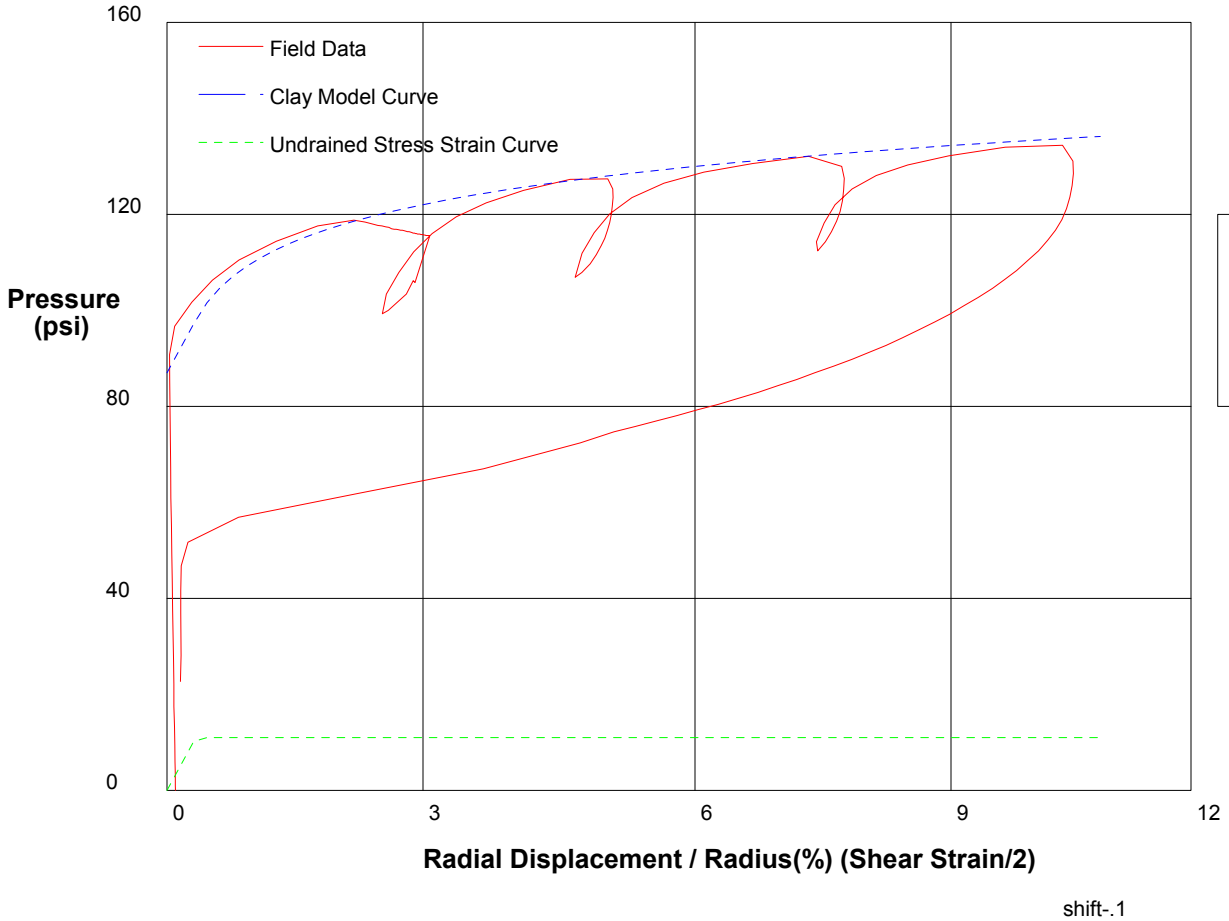
THE In Situ Engineering SAND MODEL

Water Pressure	38 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	15 psi
Shear Modulus	3400 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 102ft	File C:\DATA\ISE-787\DOT105.P

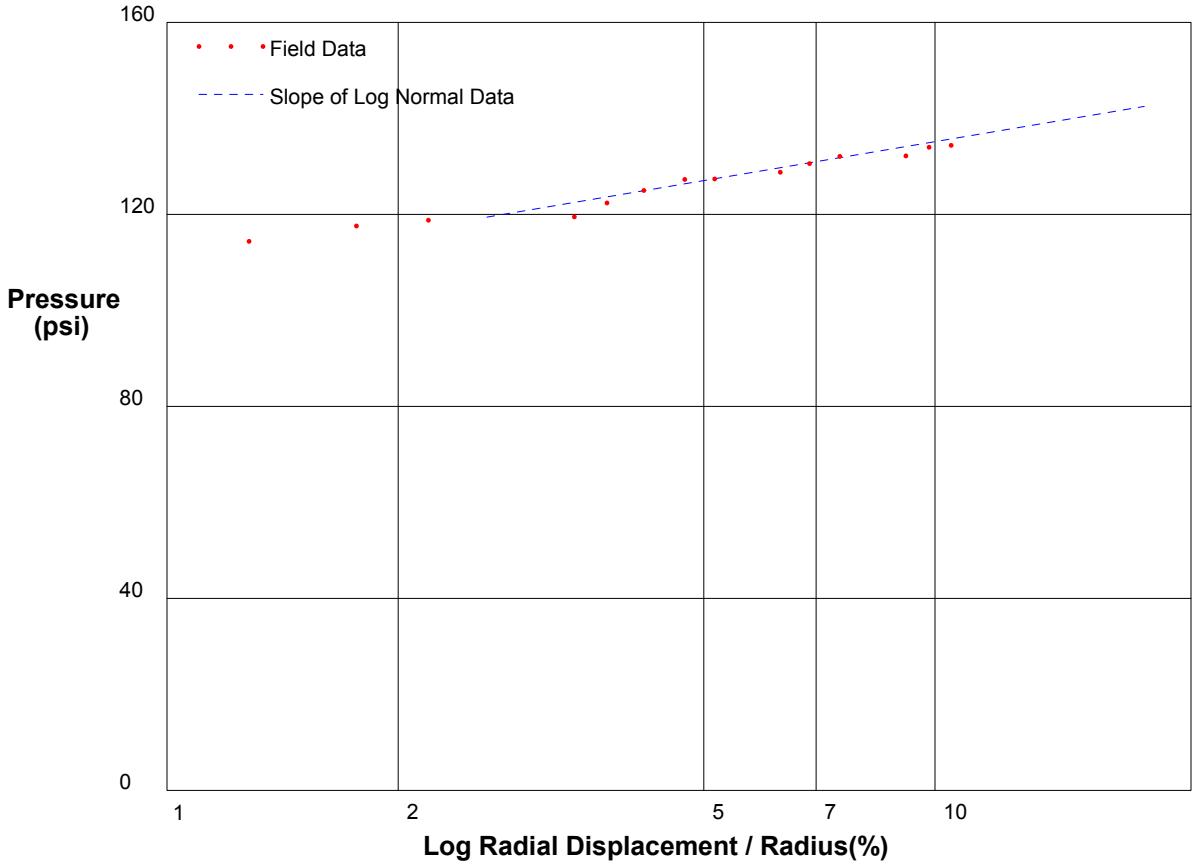


GIBSON'S CLAY MODEL

Shear Strength	11 psi
Insitu Stress	87 psi
Shear Modulus	1629 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 102ft	File C:\DATA\ISE-787\DOT105.P

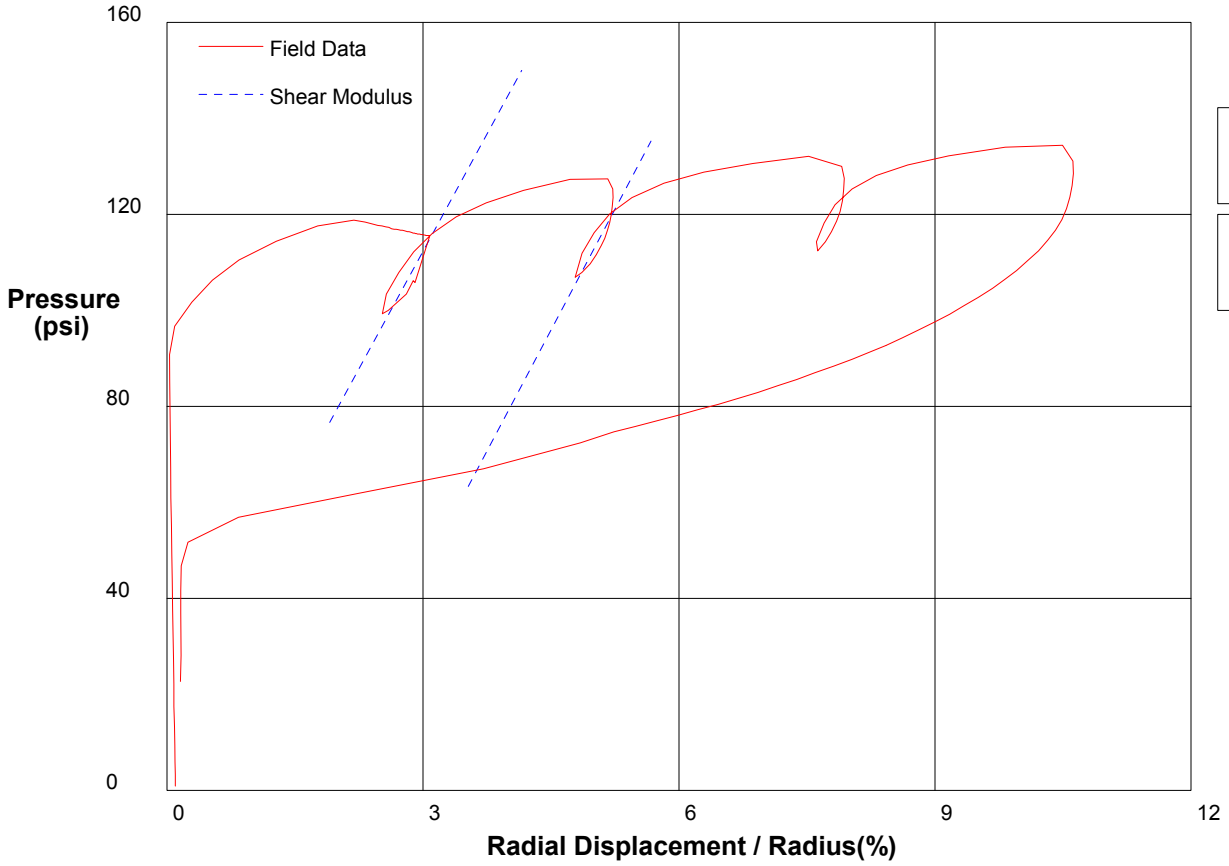


Shear Strength 11.6 psi
Limit Pressure 151 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 102ft	File C:\DATA\ISE-787\DOT105.P



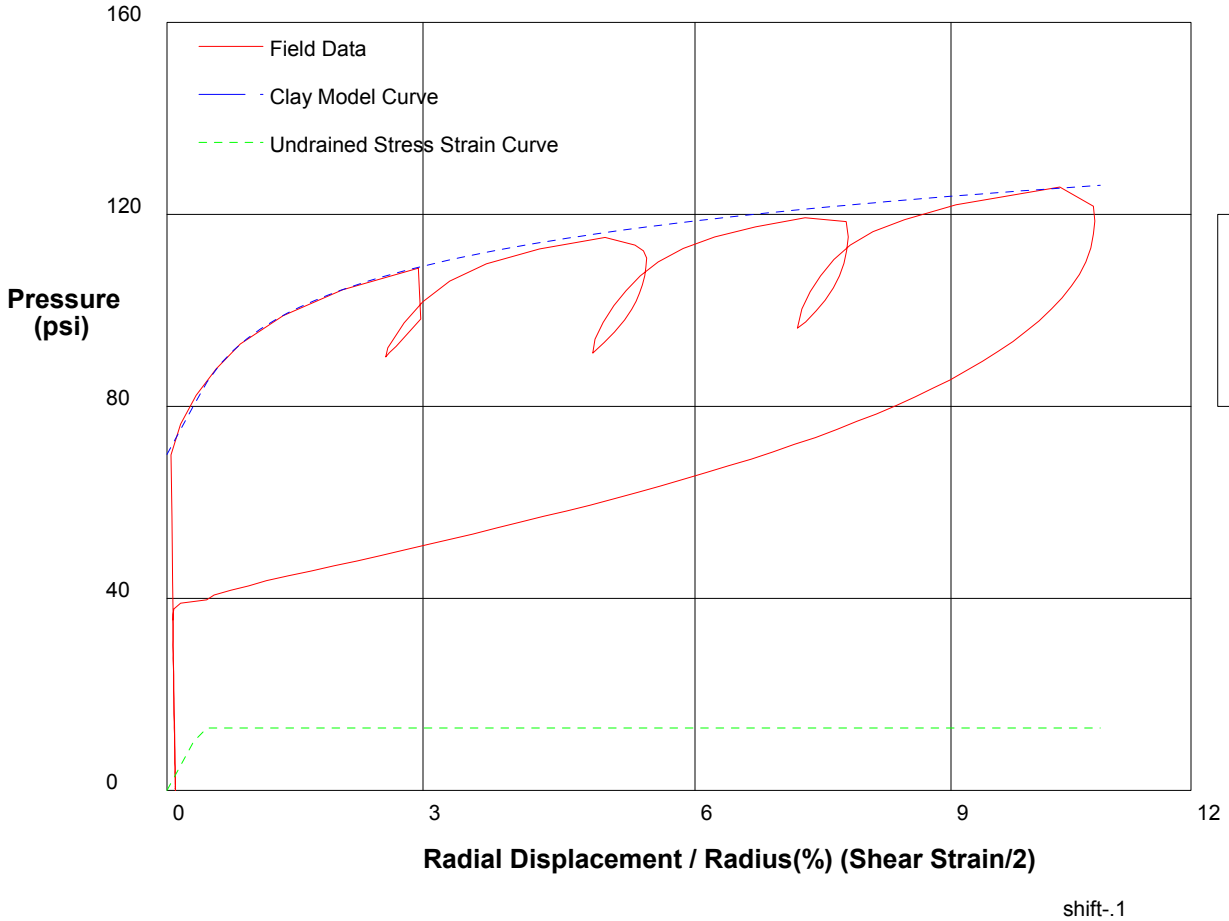
Shear Modulus 1680 psi

Shear Modulus 1629 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 104ft	File C:\DATA\ISE-787\DOT106.P

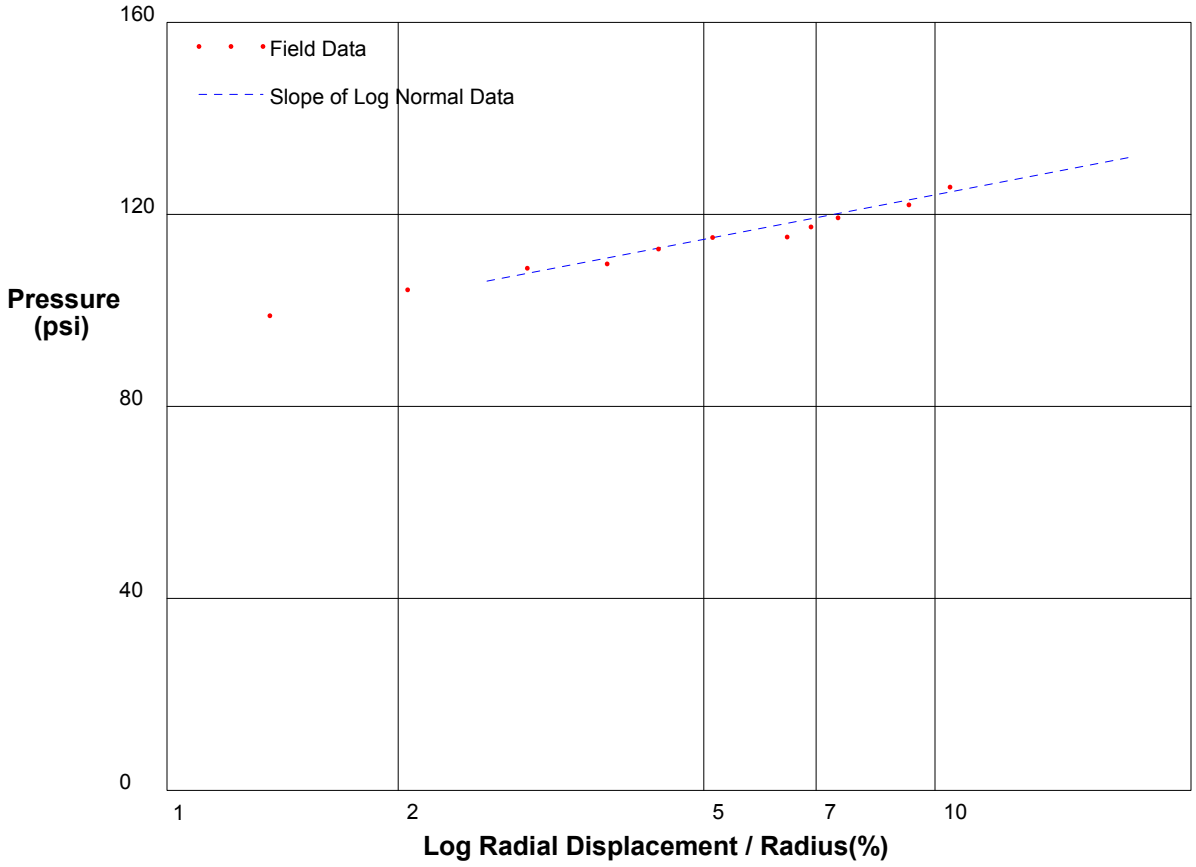


GIBSON'S CLAY MODEL

Shear Strength	13 psi
Insitu Stress	70 psi
Shear Modulus	1629 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 104ft	File C:\DATA\ISE-787\DOT106.P

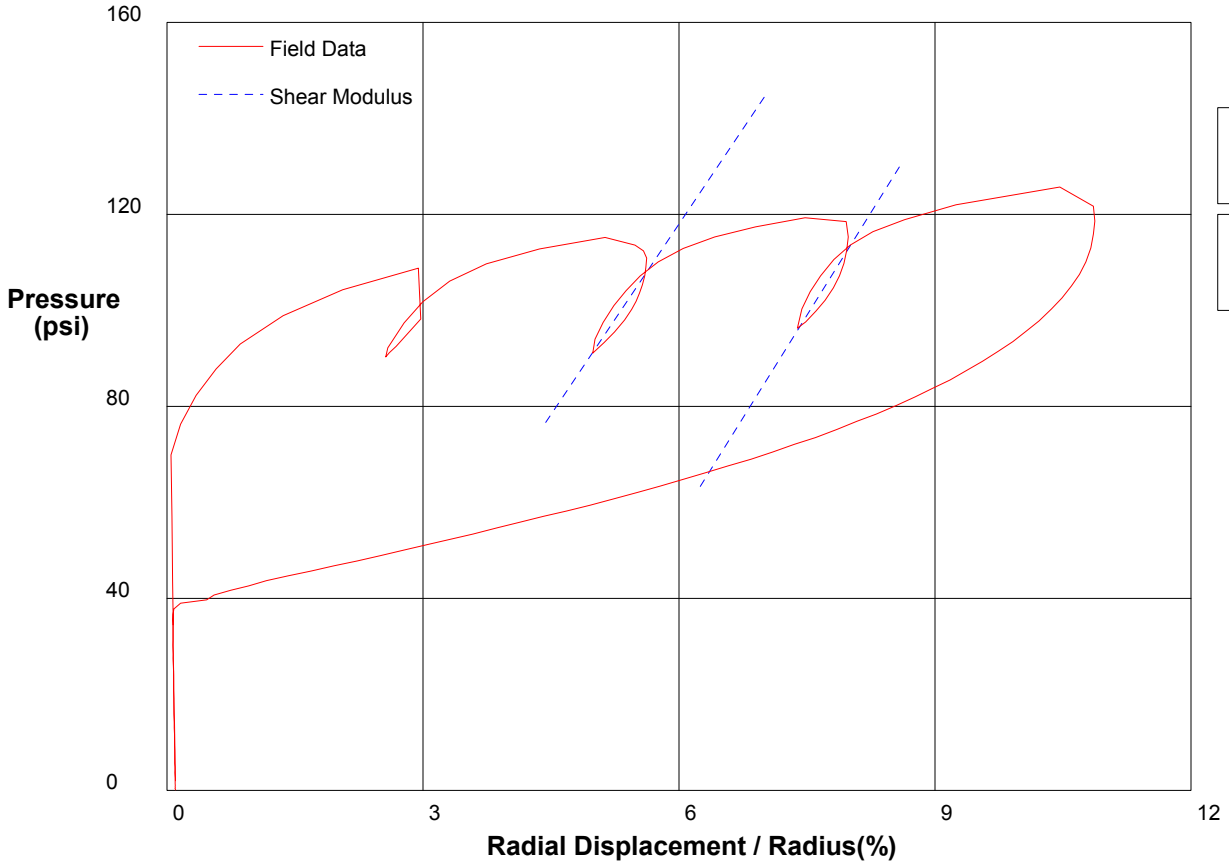


Shear Strength 13.3 psi
Limit Pressure 142 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 104ft	File C:\DATA\ISE-787\DOT106.P



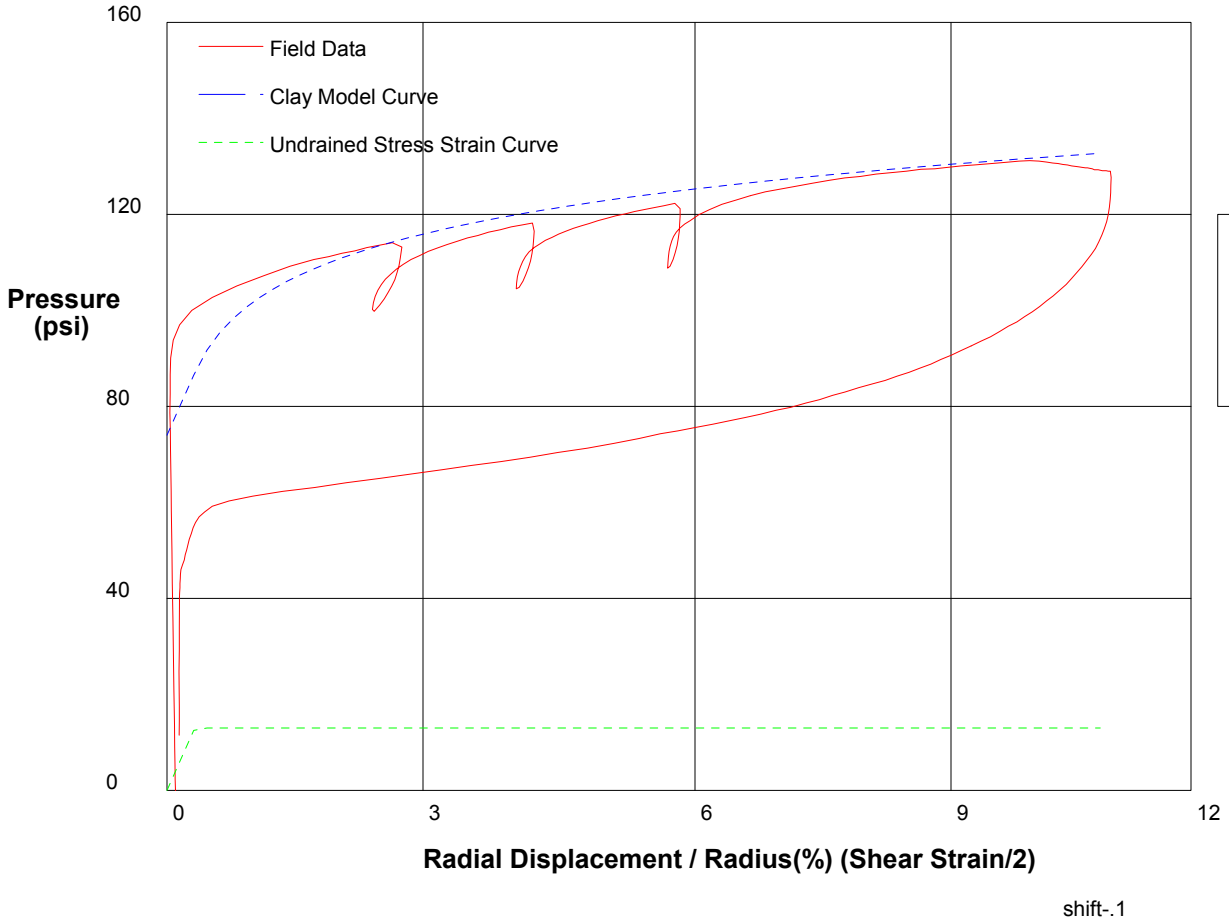
Shear Modulus 1426 psi

Shear Modulus 1322 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 107ft	File C:\DATA\ISE-787\DOT107.P

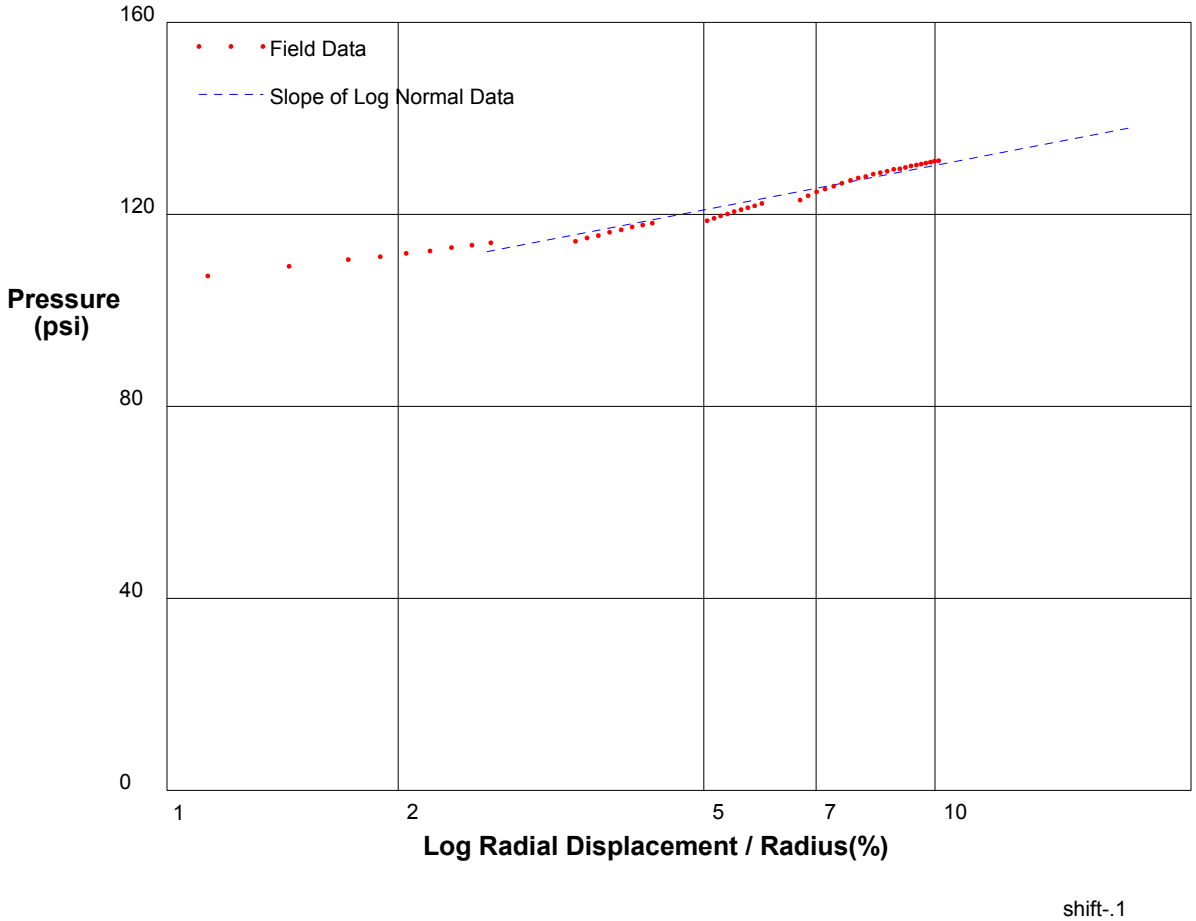


GIBSON'S CLAY MODEL

Shear Strength	13 psi
Insitu Stress	74 psi
Shear Modulus	2000 psi

In Situ Engineering

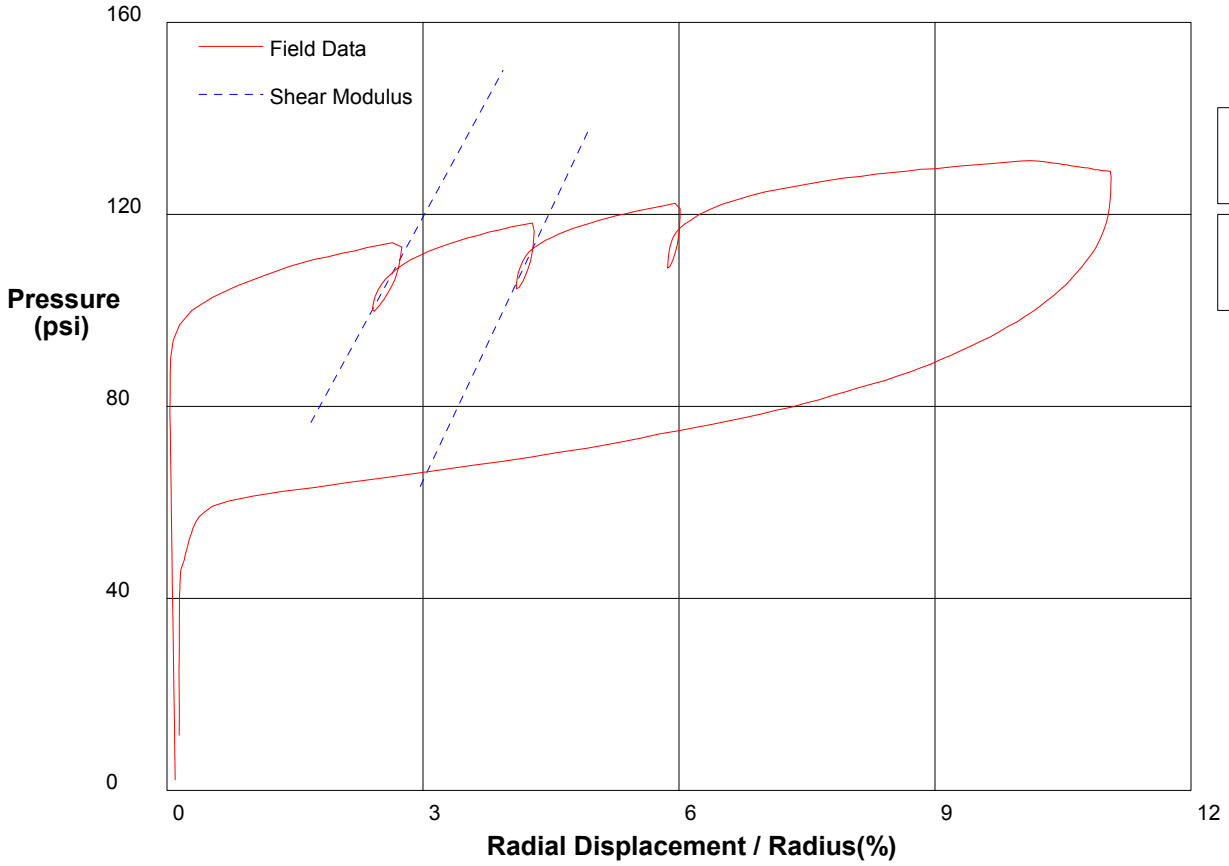
PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 107ft	File C:\DATA\ISE-787\DOT107.P



Shear Strength 13.3 psi
Limit Pressure 149 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 107ft	File C:\DATA\ISE-787\DOT107.P



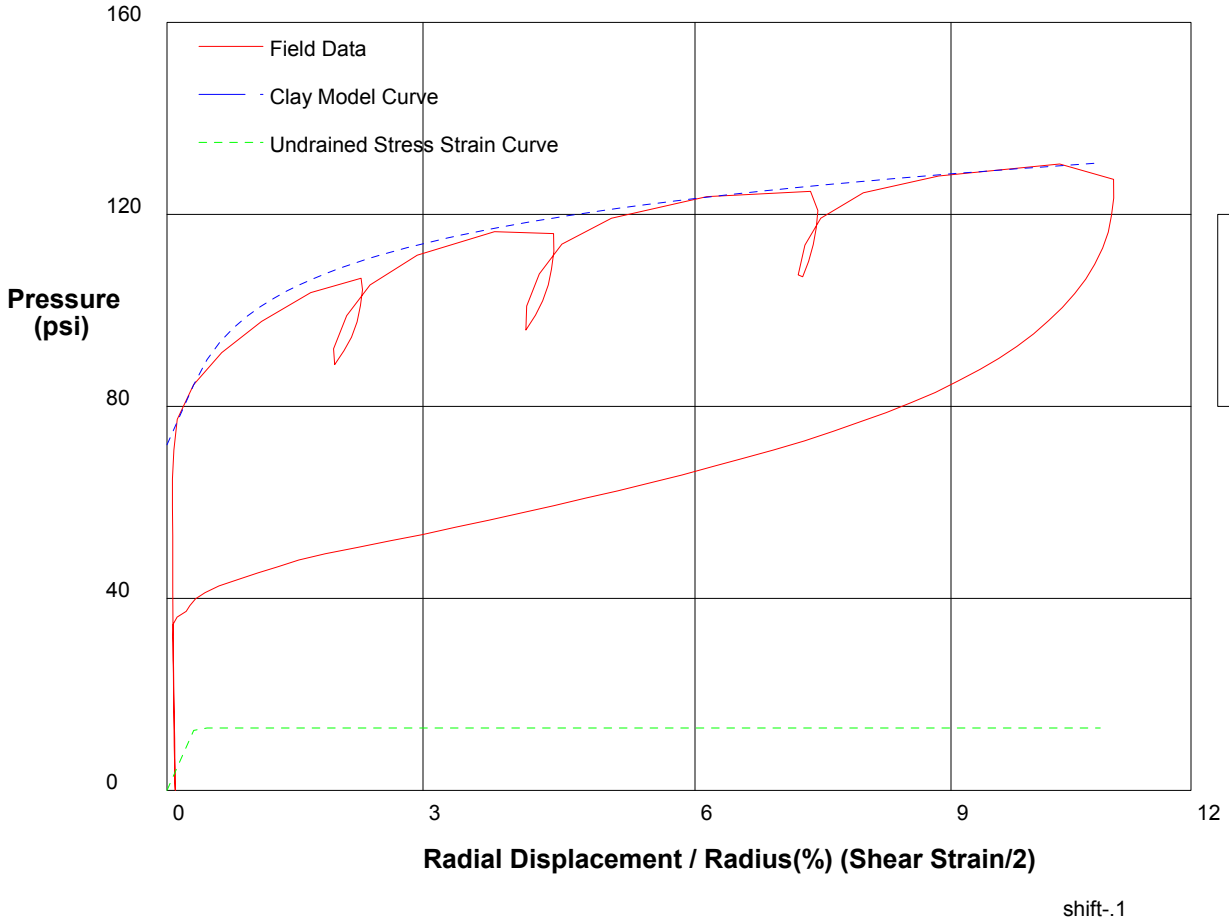
Shear Modulus 1882 psi

Shear Modulus 1629 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 110ft	File C:\DATA\ISE-787\DOT108.P

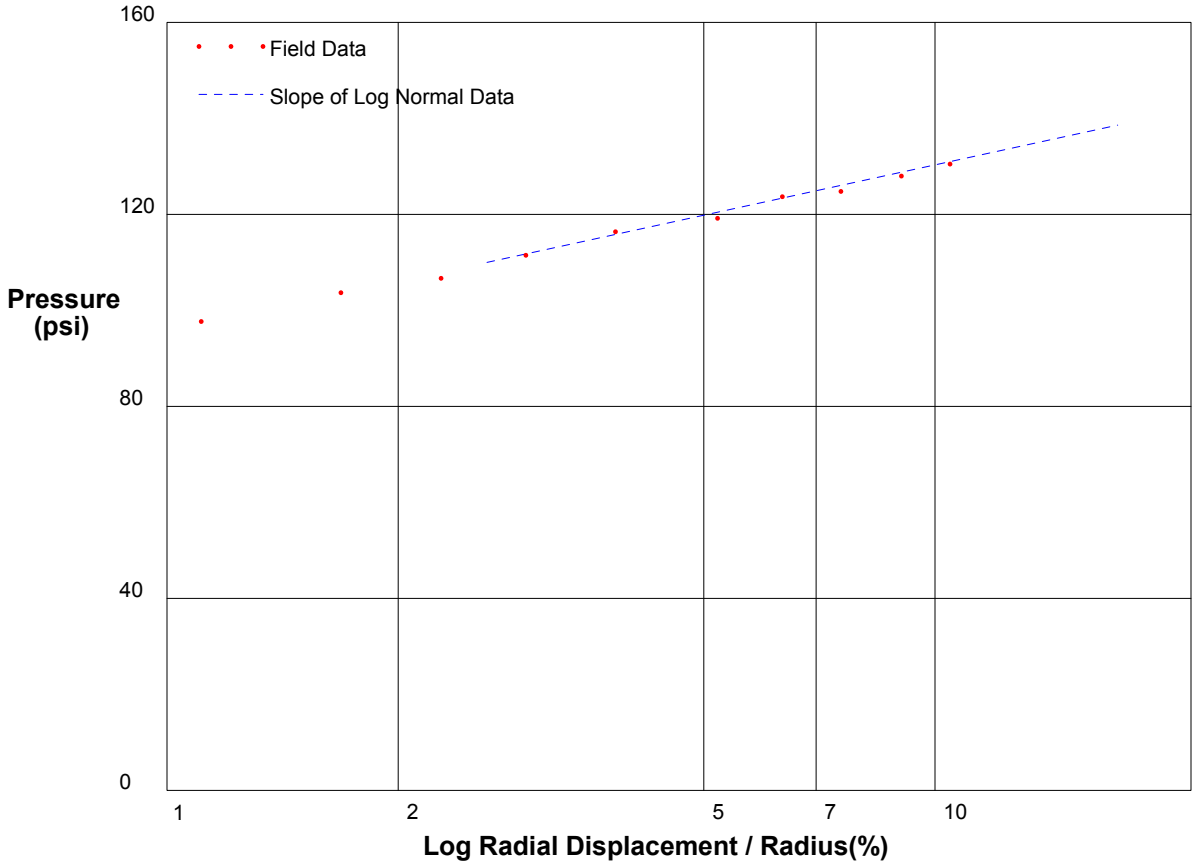


GIBSON'S CLAY MODEL

Shear Strength	13 psi
Insitu Stress	72 psi
Shear Modulus	2000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 110ft	File C:\DATA\ISE-787\DOT108.P

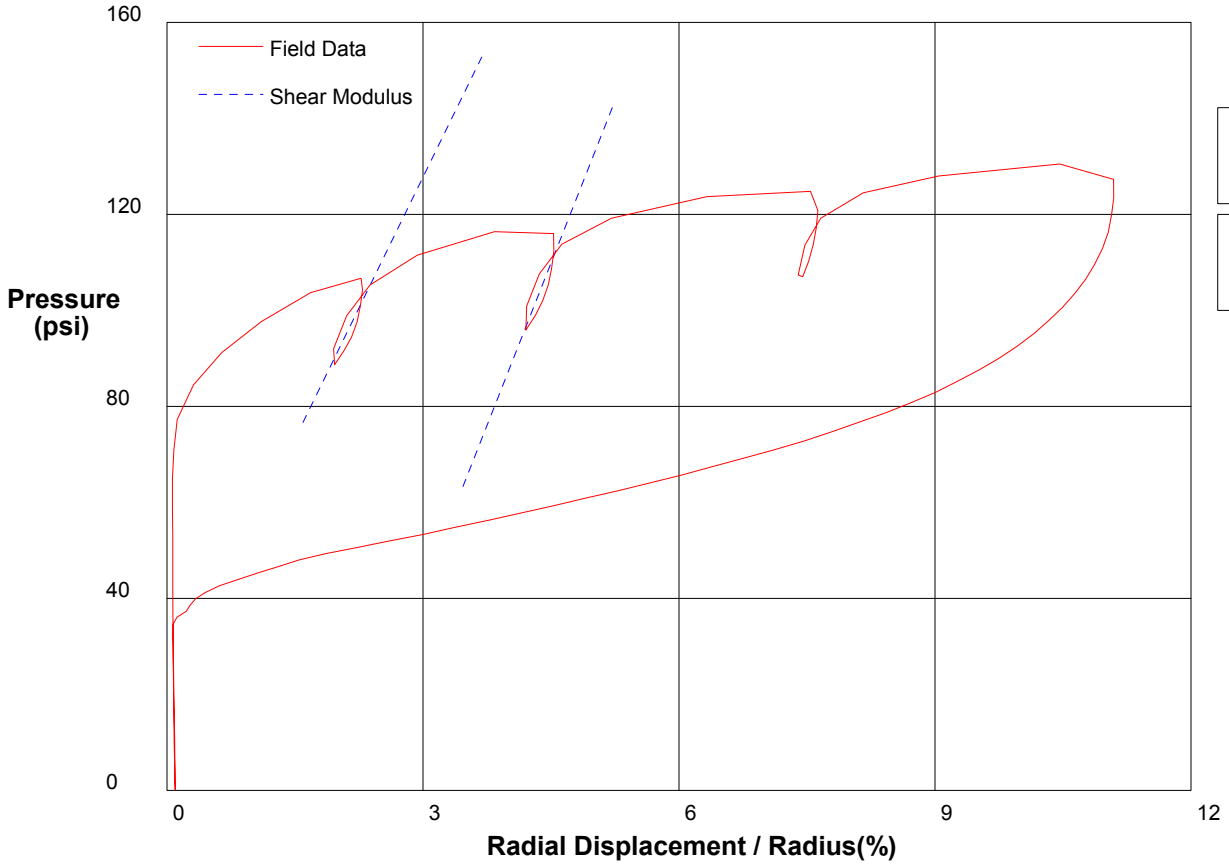


Shear Strength 15.1 psi
Limit Pressure 151 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 110ft	File C:\DATA\ISE-787\DOT108.P



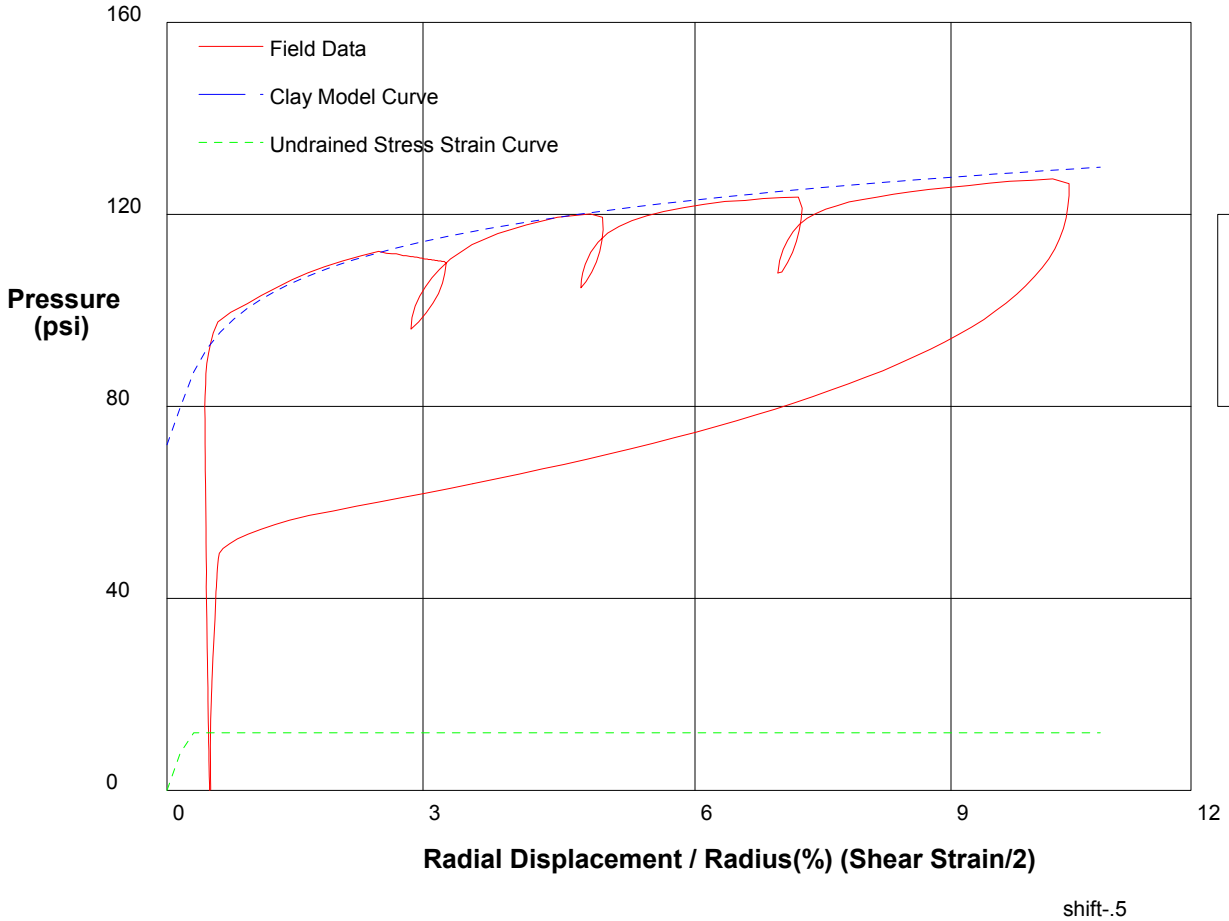
Shear Modulus 2253 psi

Shear Modulus 1817 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 112ft	File C:\DATA\ISE-787\DOT109.P

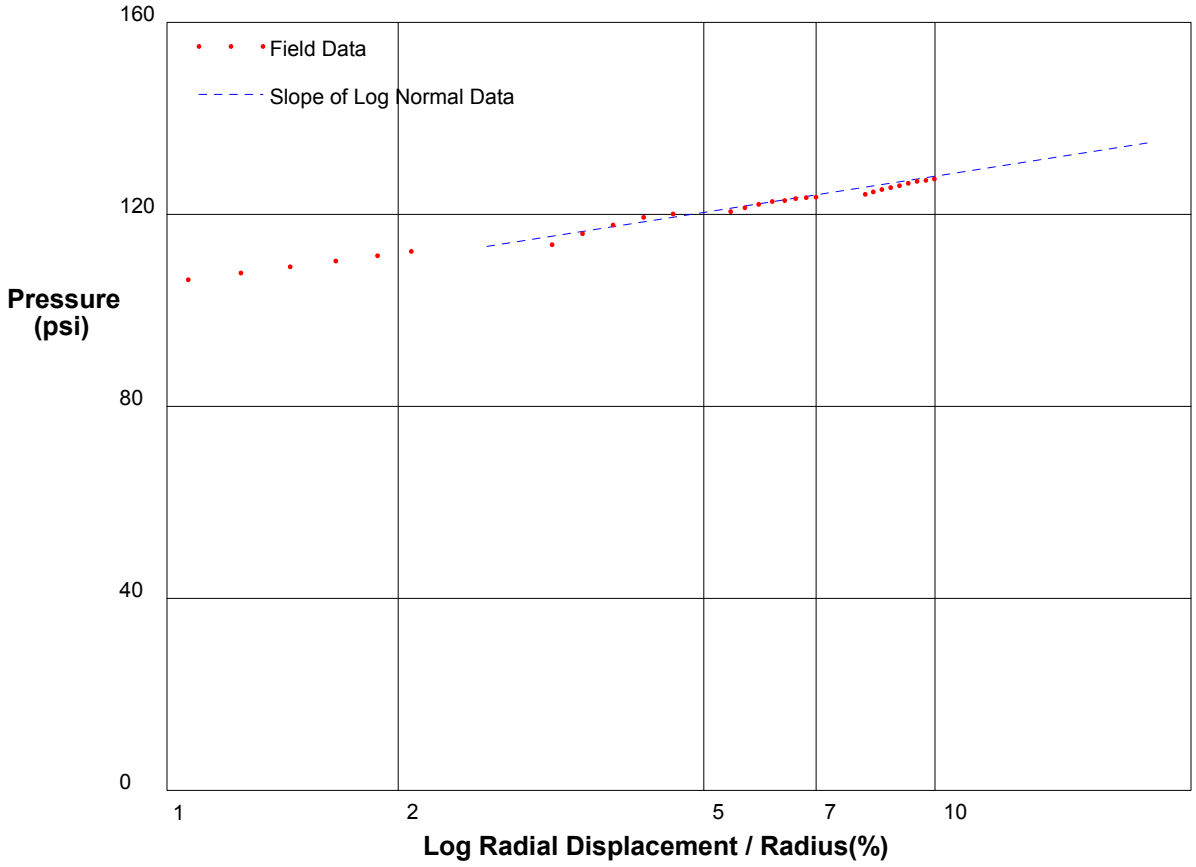


GIBSON'S CLAY MODEL

Shear Strength	12	psi
Insitu Stress	72	psi
Shear Modulus	2500	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 112ft	File C:\DATA\ISE-787\DOT109.P

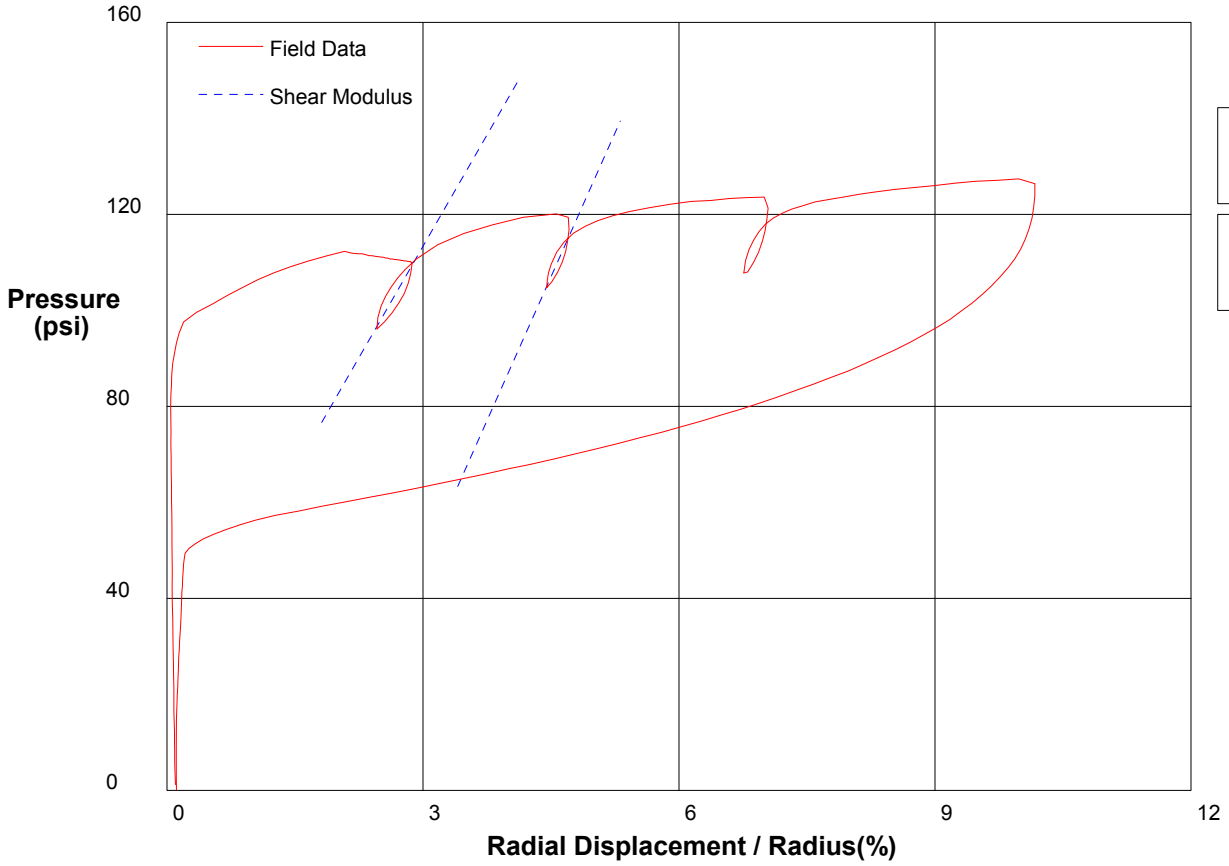


Shear Strength 10.8 psi
Limit Pressure 143 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 112ft	File C:\DATA\ISE-787\DOT109.P



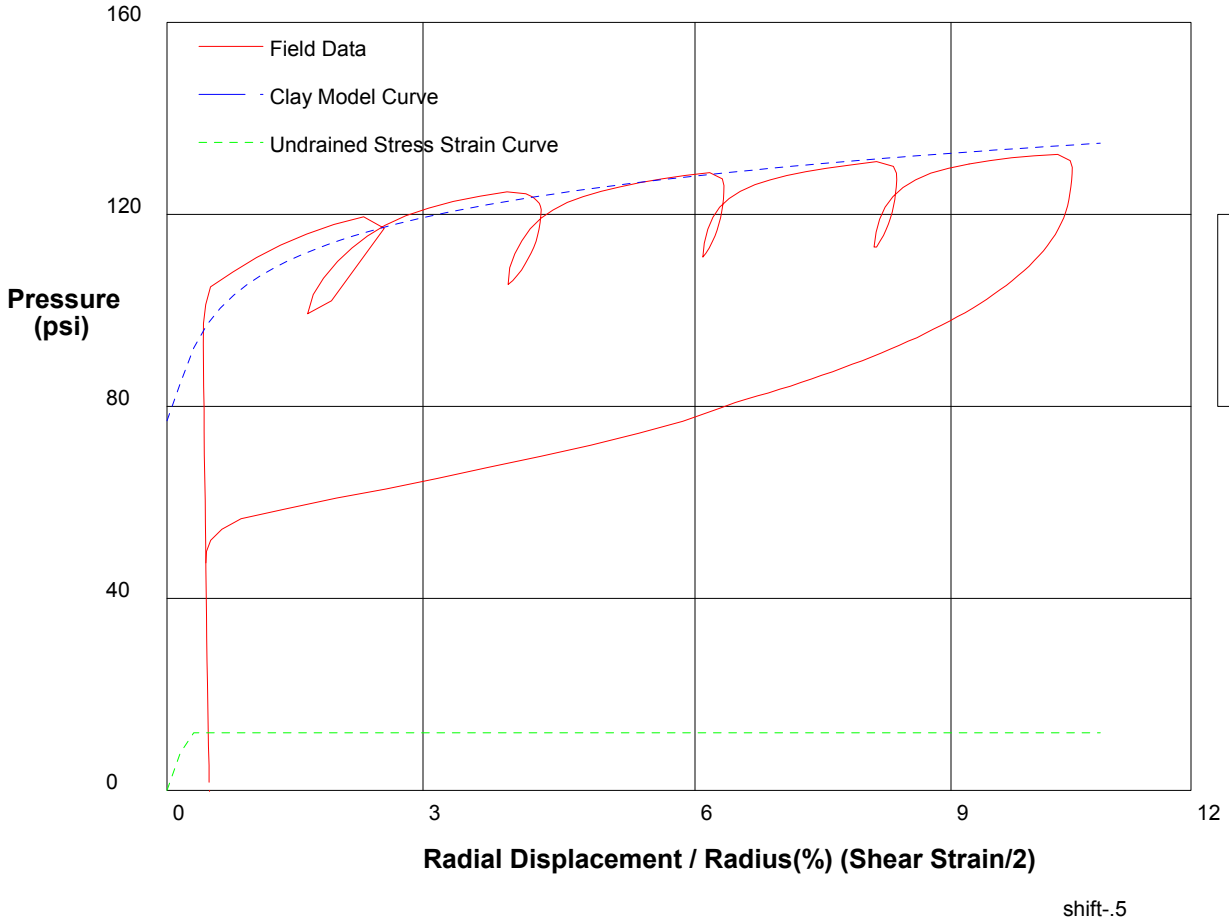
Shear Modulus 1996 psi

Shear Modulus 1545 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 114ft	File C:\DATA\ISE-787\DOT110.P

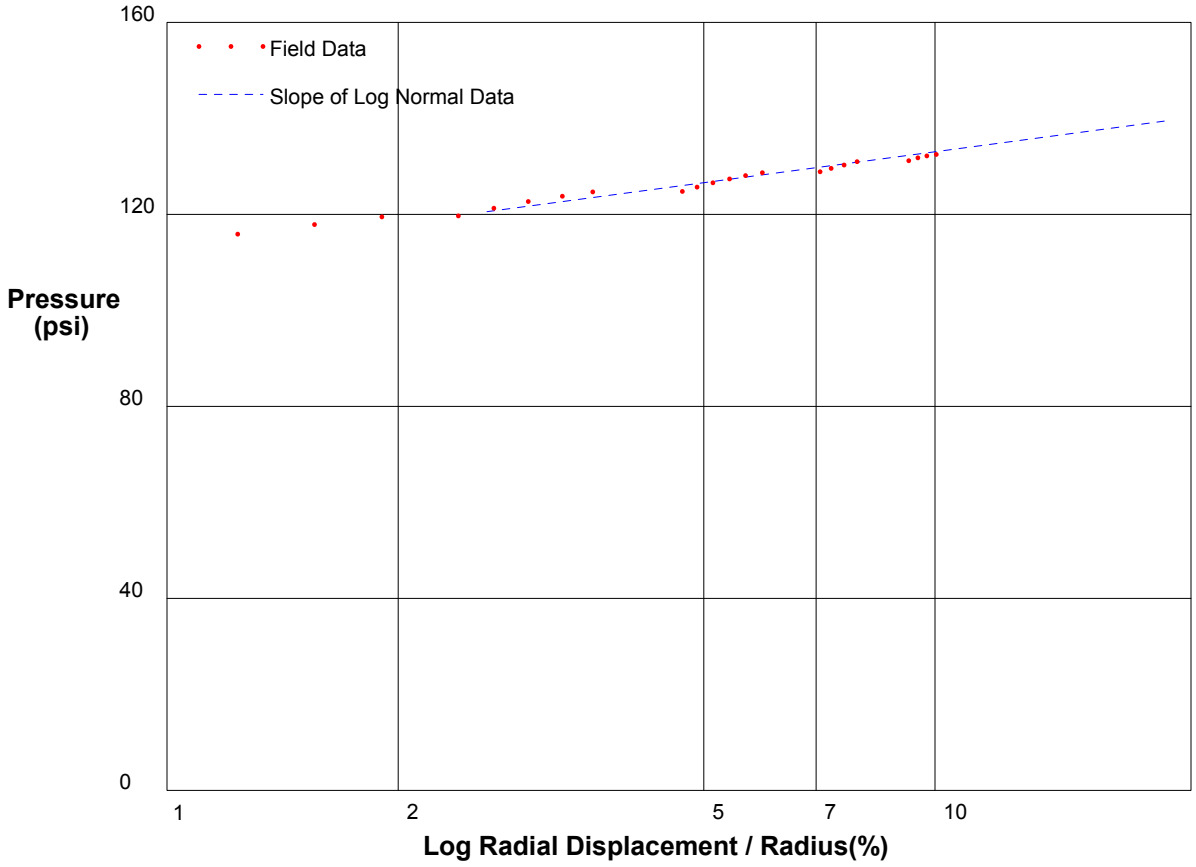


GIBSON'S CLAY MODEL

Shear Strength	12	psi
Insitu Stress	77	psi
Shear Modulus	2500	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 114ft	File C:\DATA\ISE-787\DOT110.P

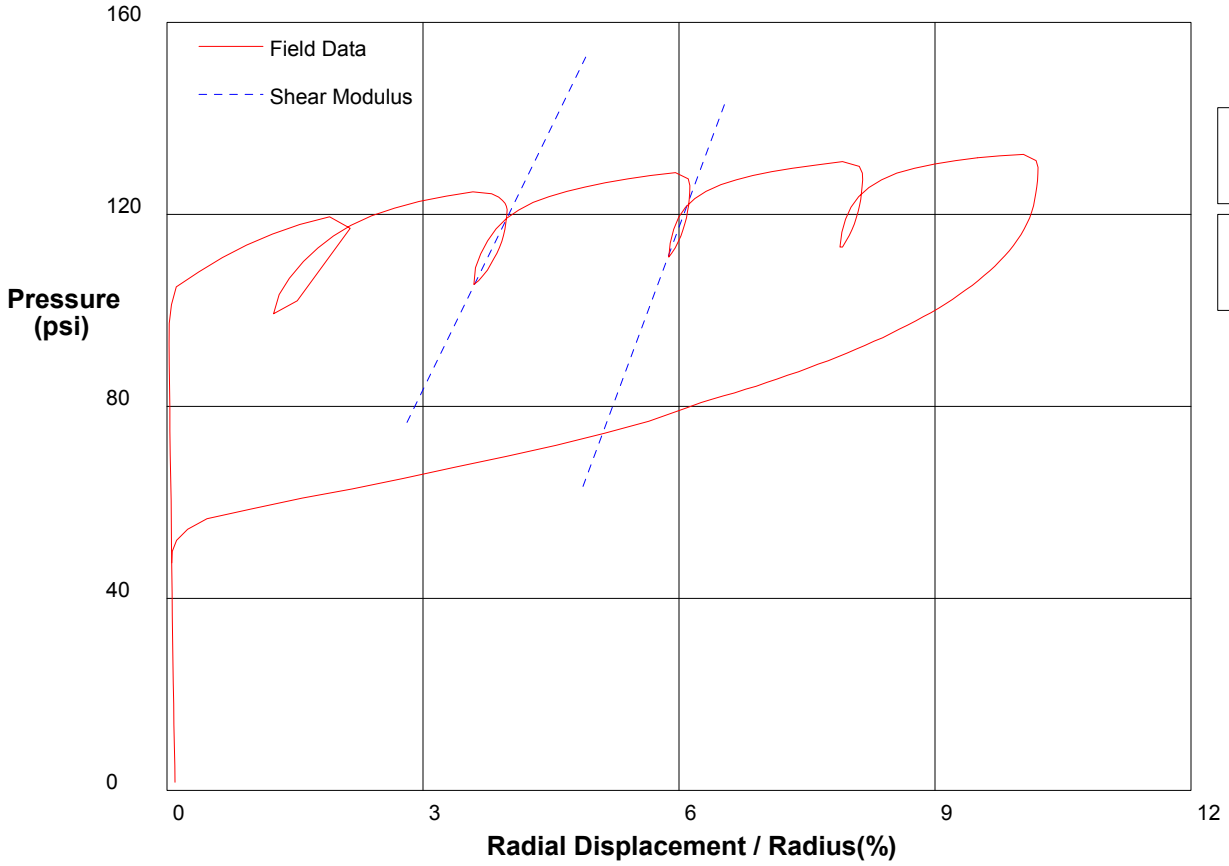


Shear Strength 9.3 psi
Limit Pressure 146 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 114ft	File C:\DATA\ISE-787\DOT110.P



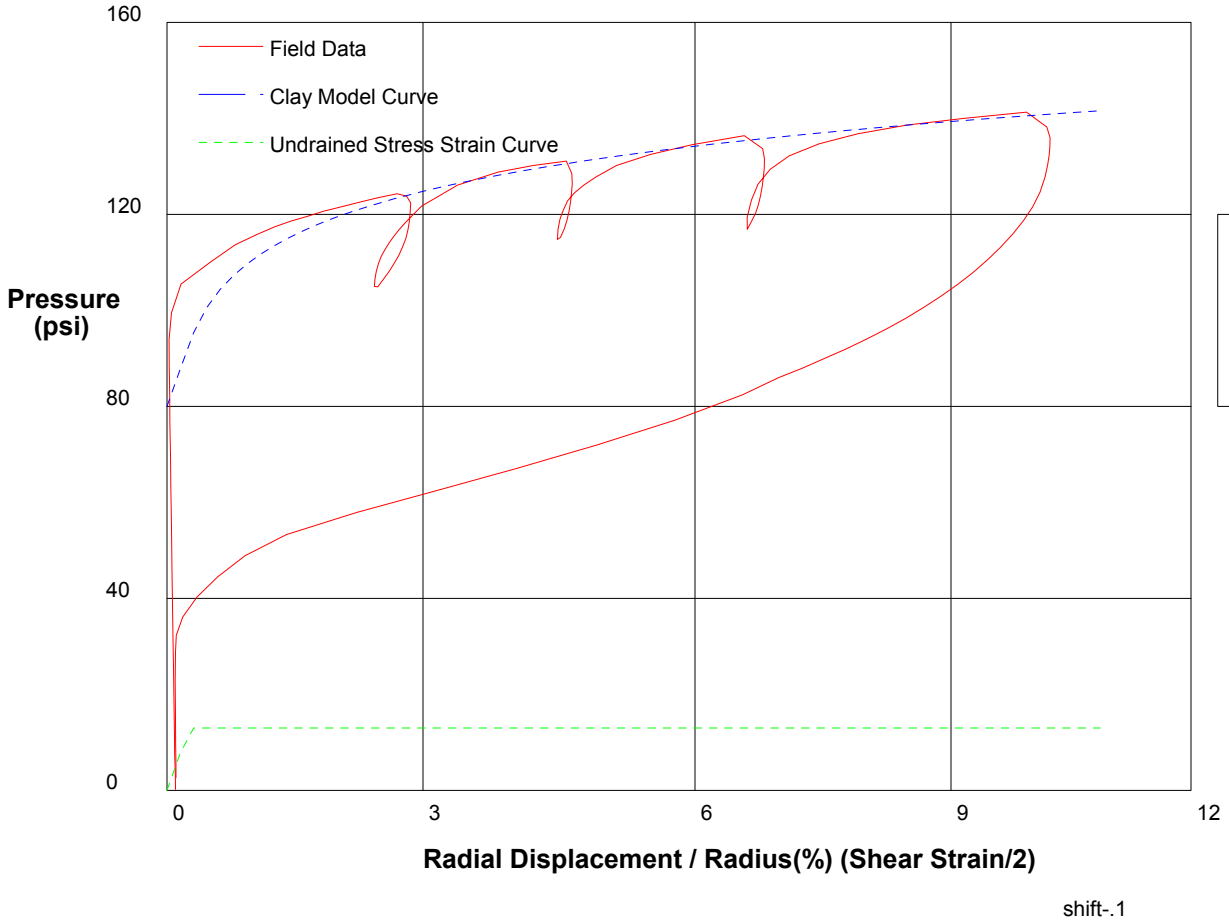
Shear Modulus 2400 psi

Shear Modulus 1817 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 116ft	File C:\DATA\ISE-787\DOT111.P

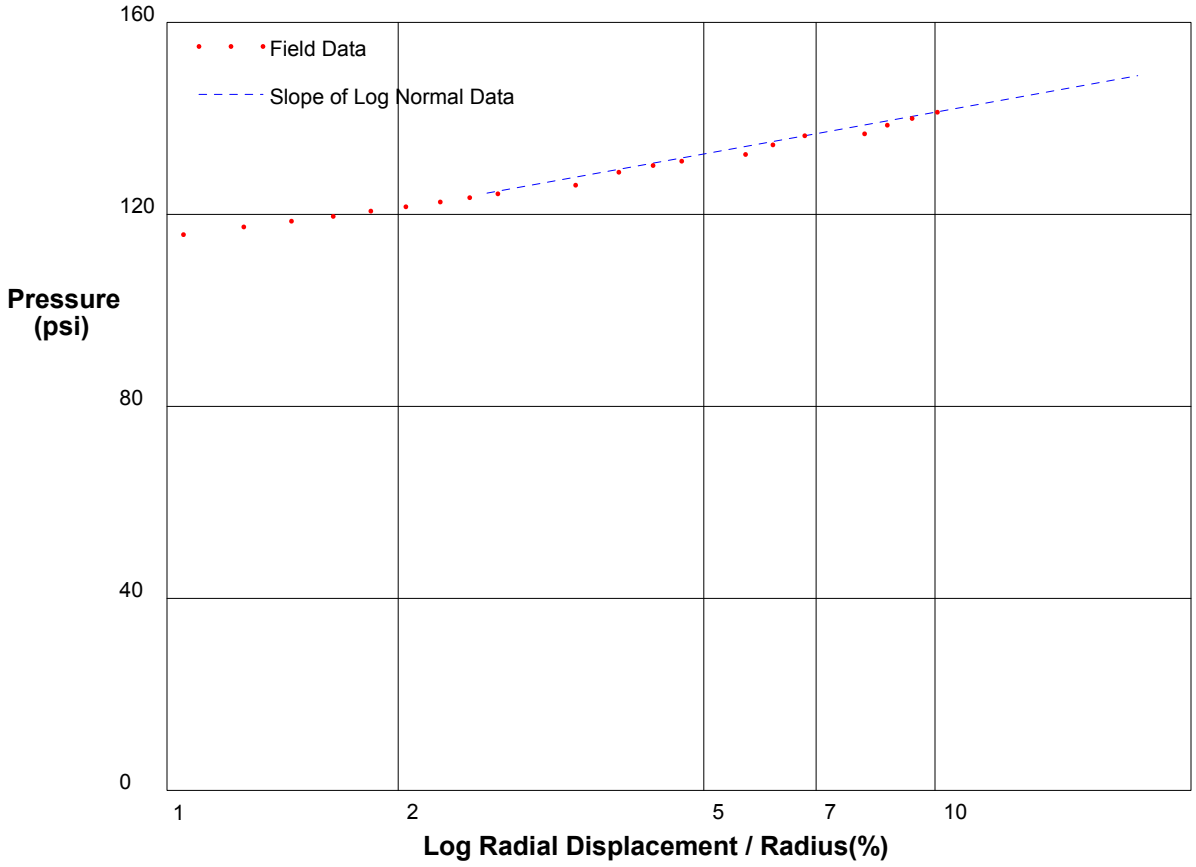


GIBSON'S CLAY MODEL

Shear Strength	13 psi
Insitu Stress	80 psi
Shear Modulus	2500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 116ft	File C:\DATA\ISE-787\DOT111.P



Shear Strength 12.5 psi
Limit Pressure 158 psi

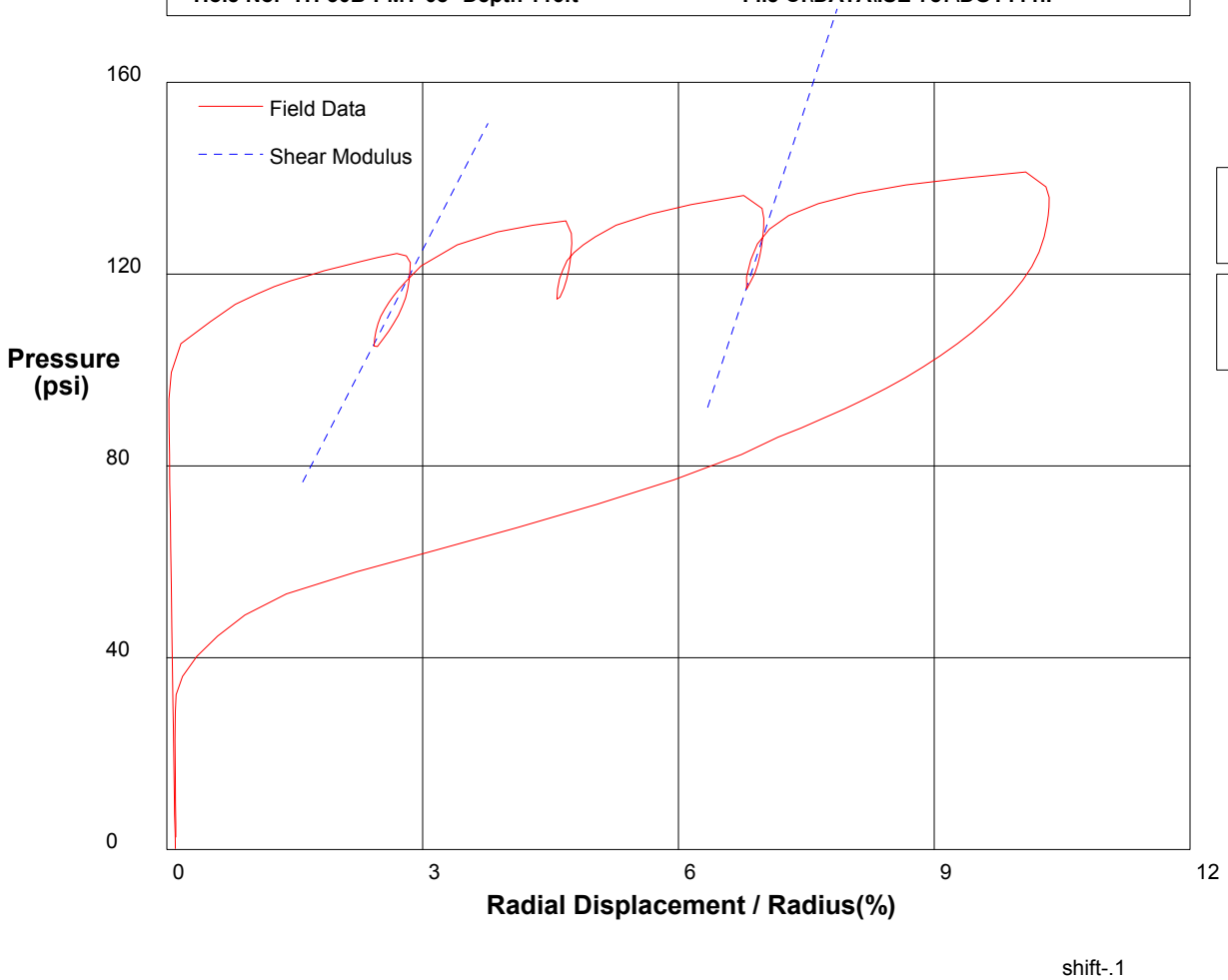
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/6/2008**

Hole No. TH-30B-PMT-08 Depth 116ft **File C:\DATA\ISE-787\DOT111.P**

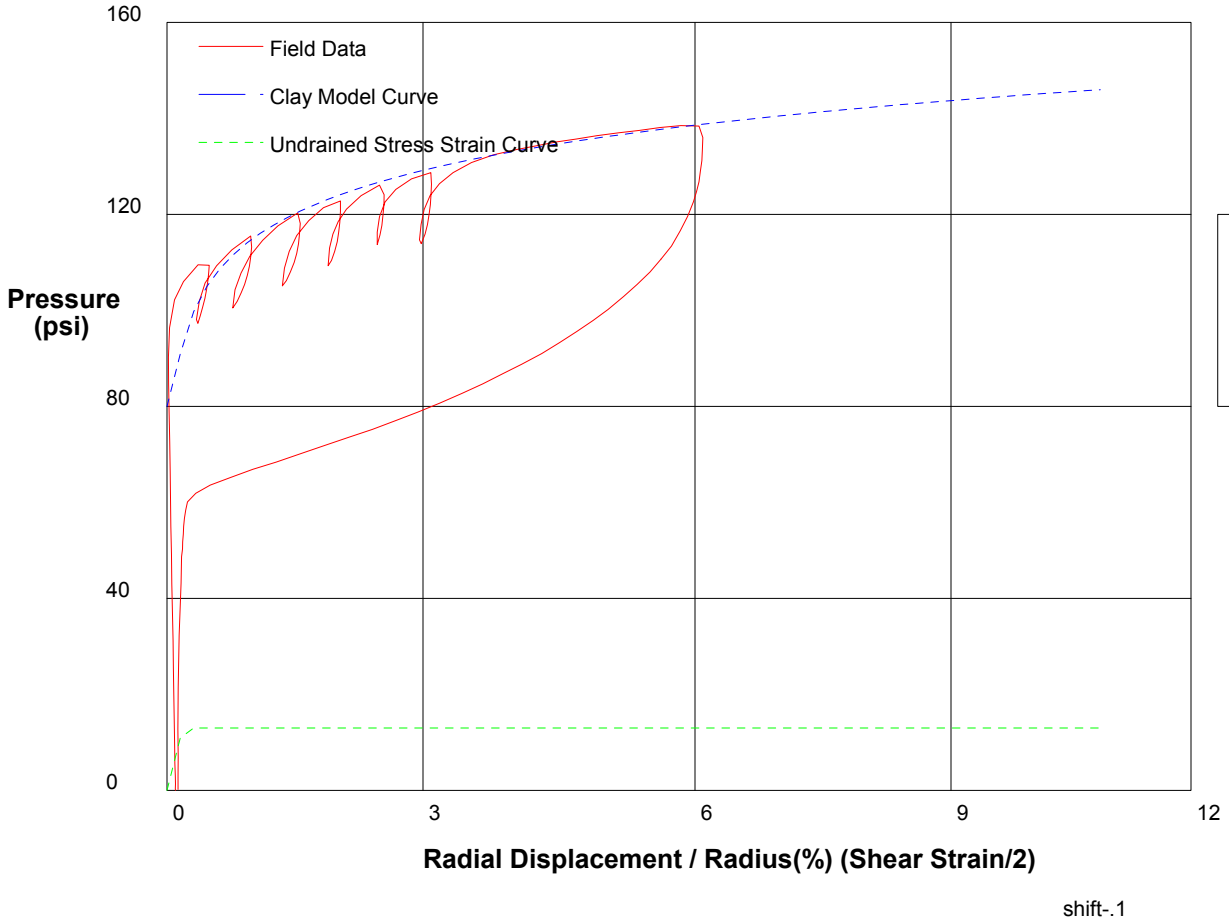


Shear Modulus 2739 psi

Shear Modulus 1720 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 118ft	File C:\DATA\ISE-787\DOT112.P

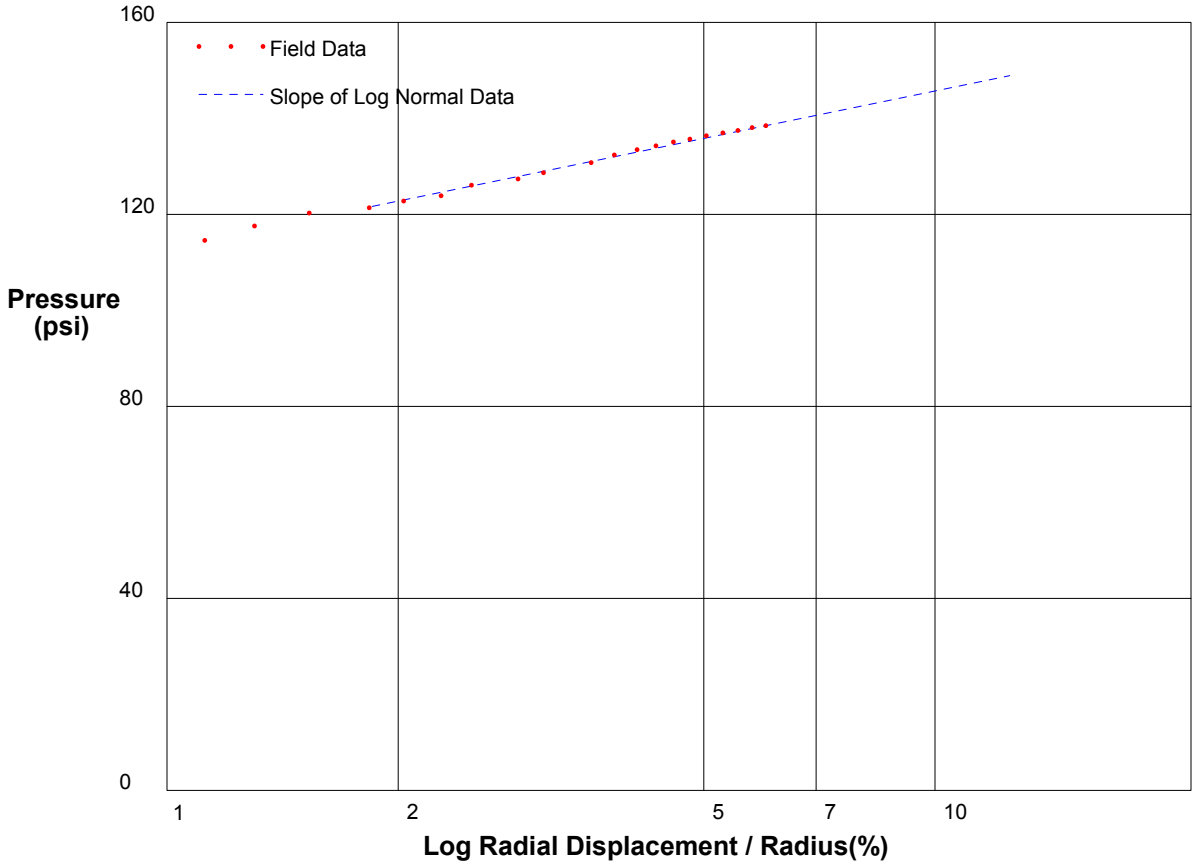


GIBSON'S CLAY MODEL

Shear Strength	13	psi
Insitu Stress	80	psi
Shear Modulus	3500	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 118ft	File C:\DATA\ISE-787\DOT112.P

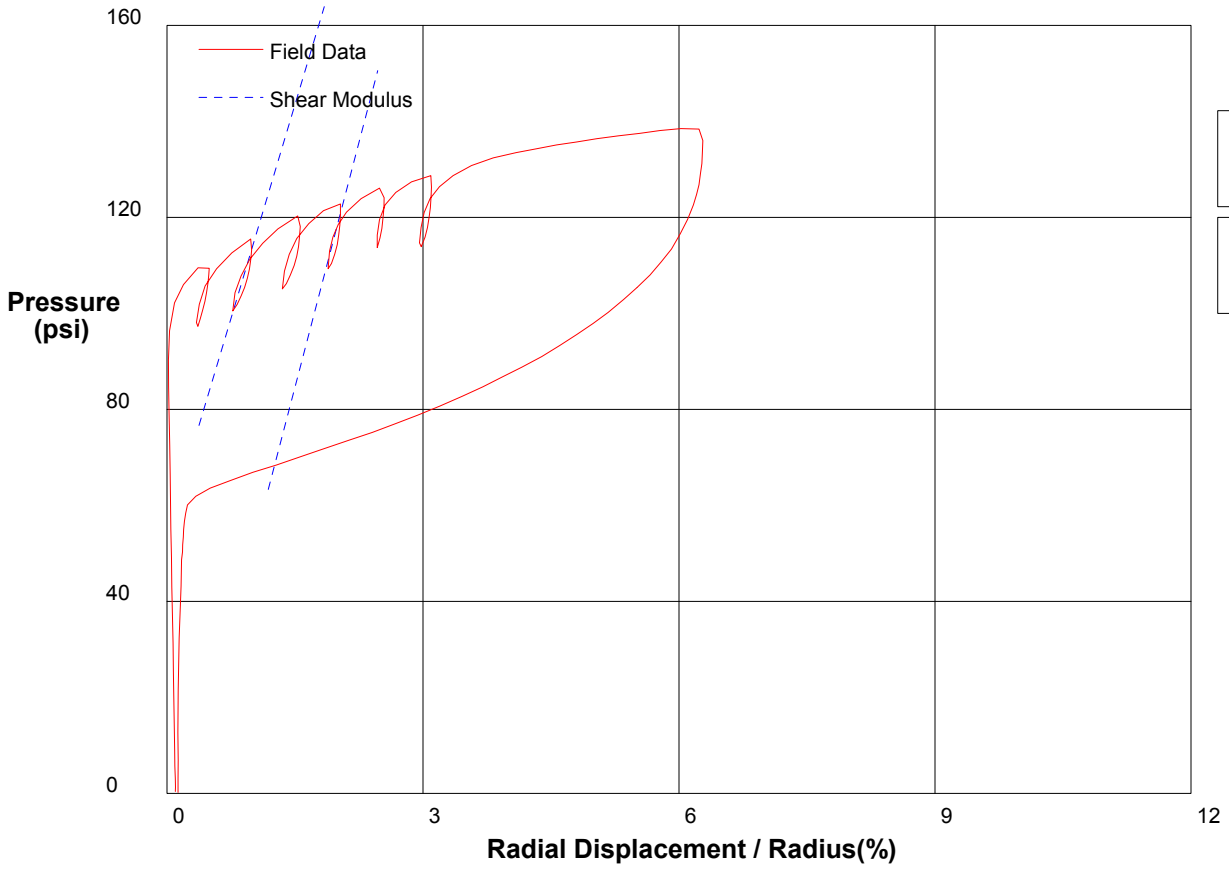


Shear Strength 14.2 psi
Limit Pressure 165 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 118ft	File C:\DATA\ISE-787\DOT112.P



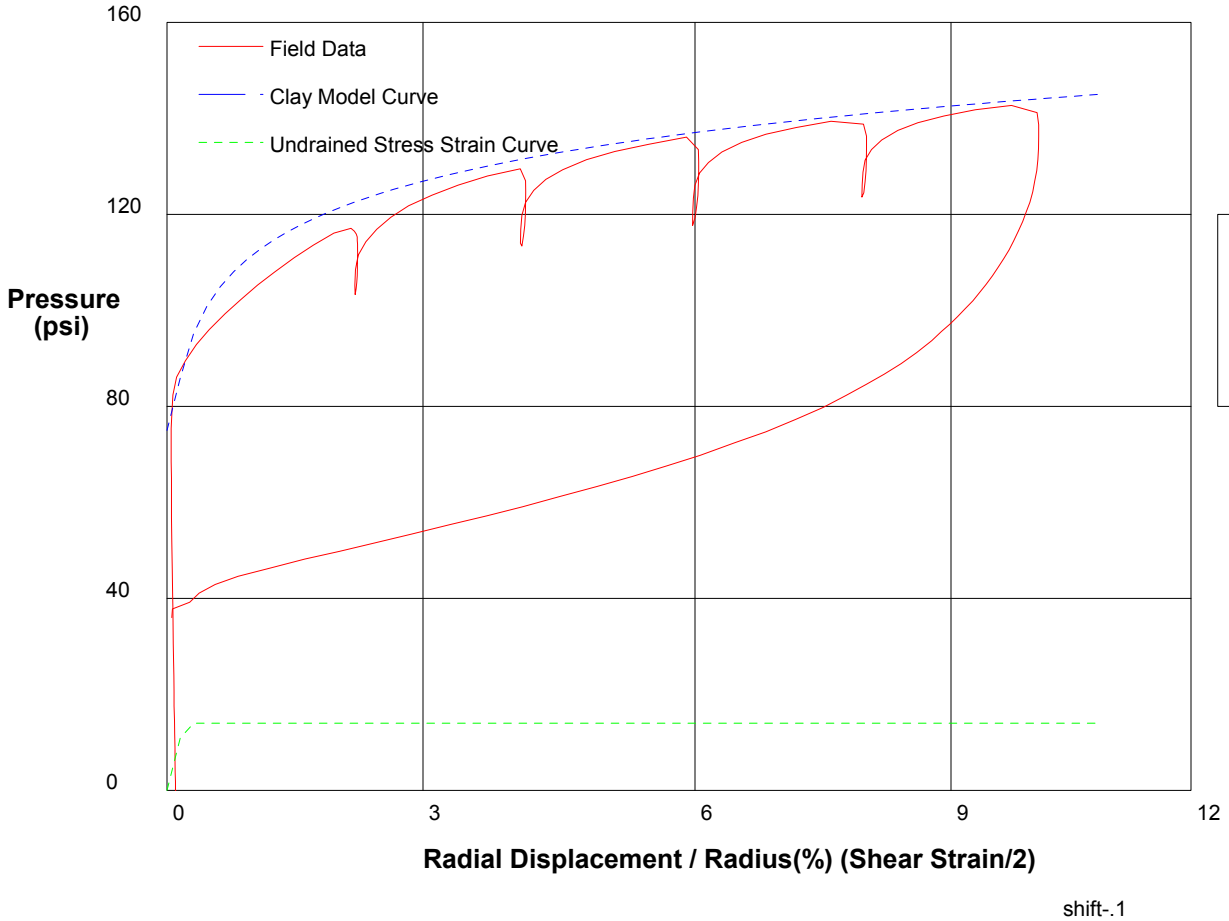
Shear Modulus 3403 psi

Shear Modulus 2969 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 122ft	File C:\DATA\ISE-787\DOT113.P

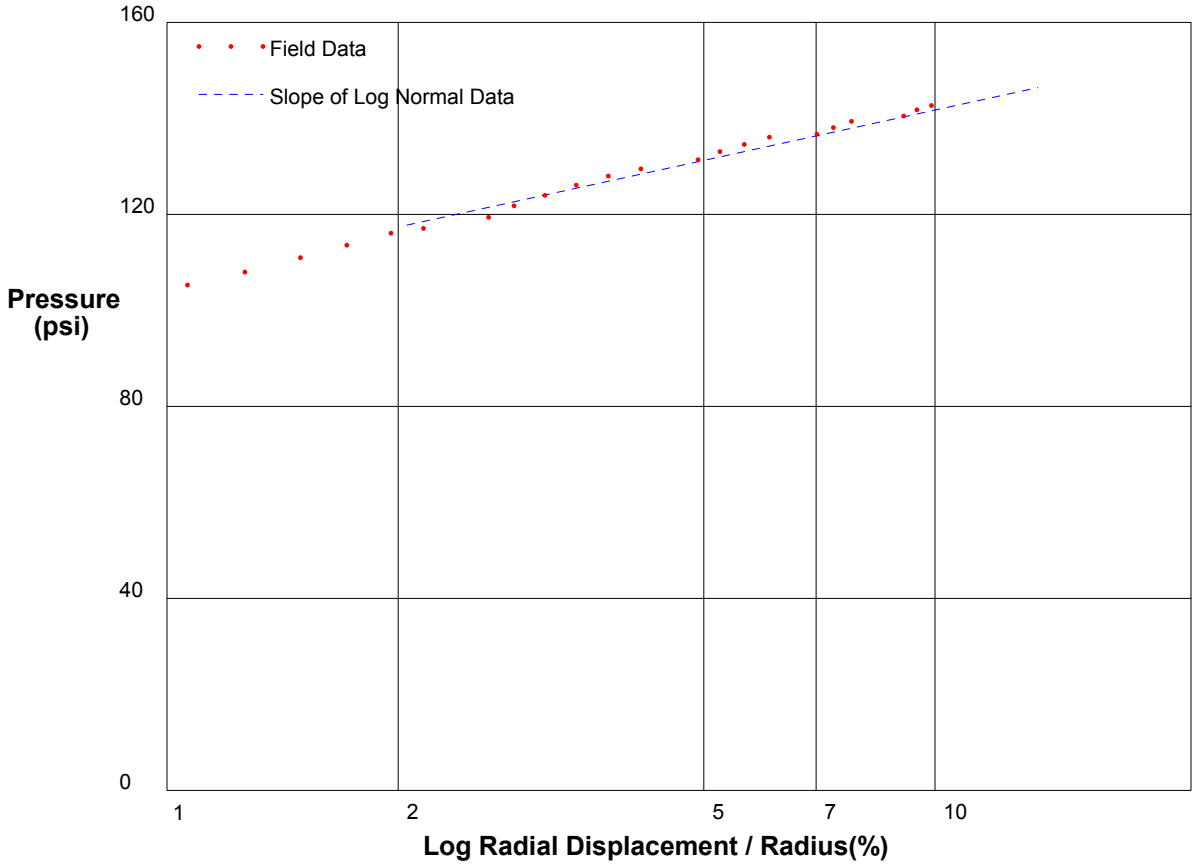


GIBSON'S CLAY MODEL

Shear Strength	14 psi
Insitu Stress	75 psi
Shear Modulus	3500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 122ft	File C:\DATA\ISE-787\DOT113.P

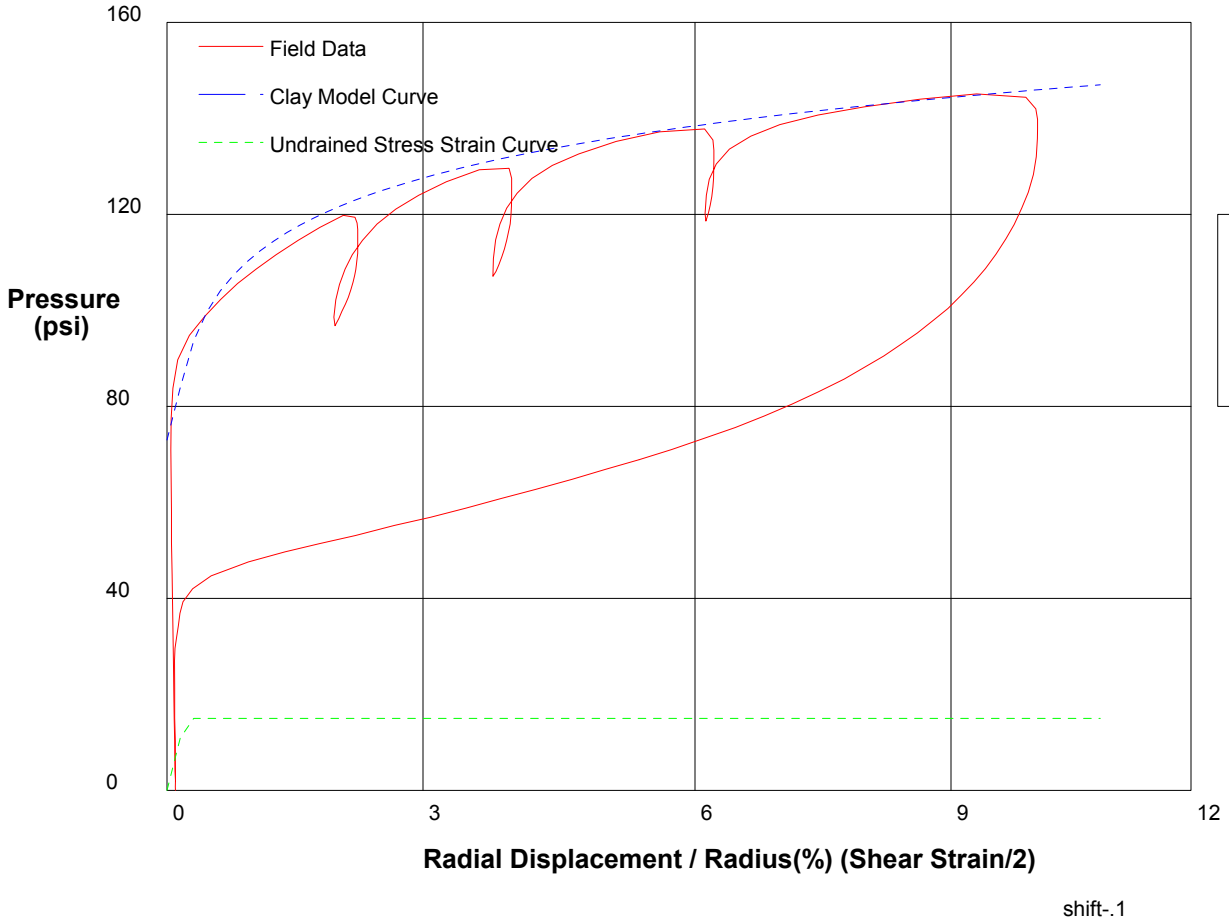


Shear Strength 15.1 psi
Limit Pressure 163 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 124ft	File C:\DATA\ISE-787\DOT114.P

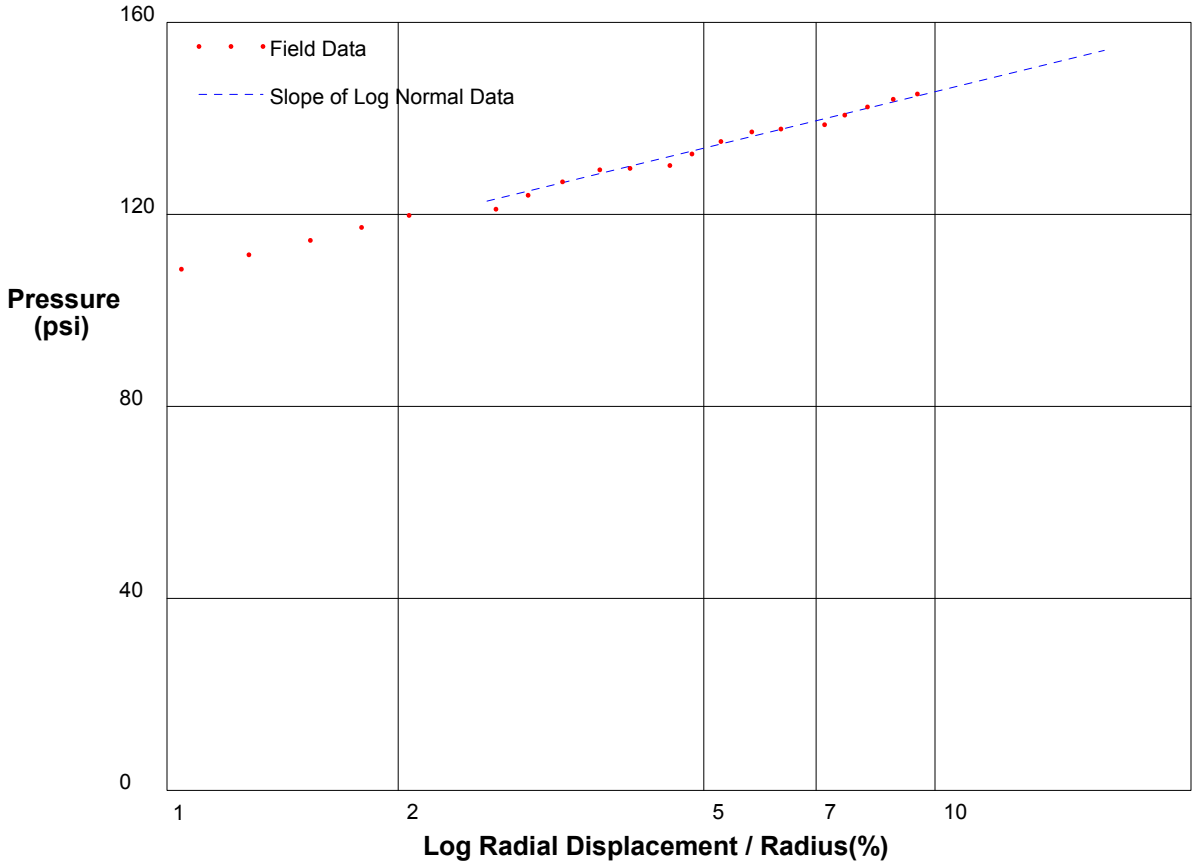


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	73 psi
Shear Modulus	3500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 124ft	File C:\DATA\ISE-787\DOT114.P

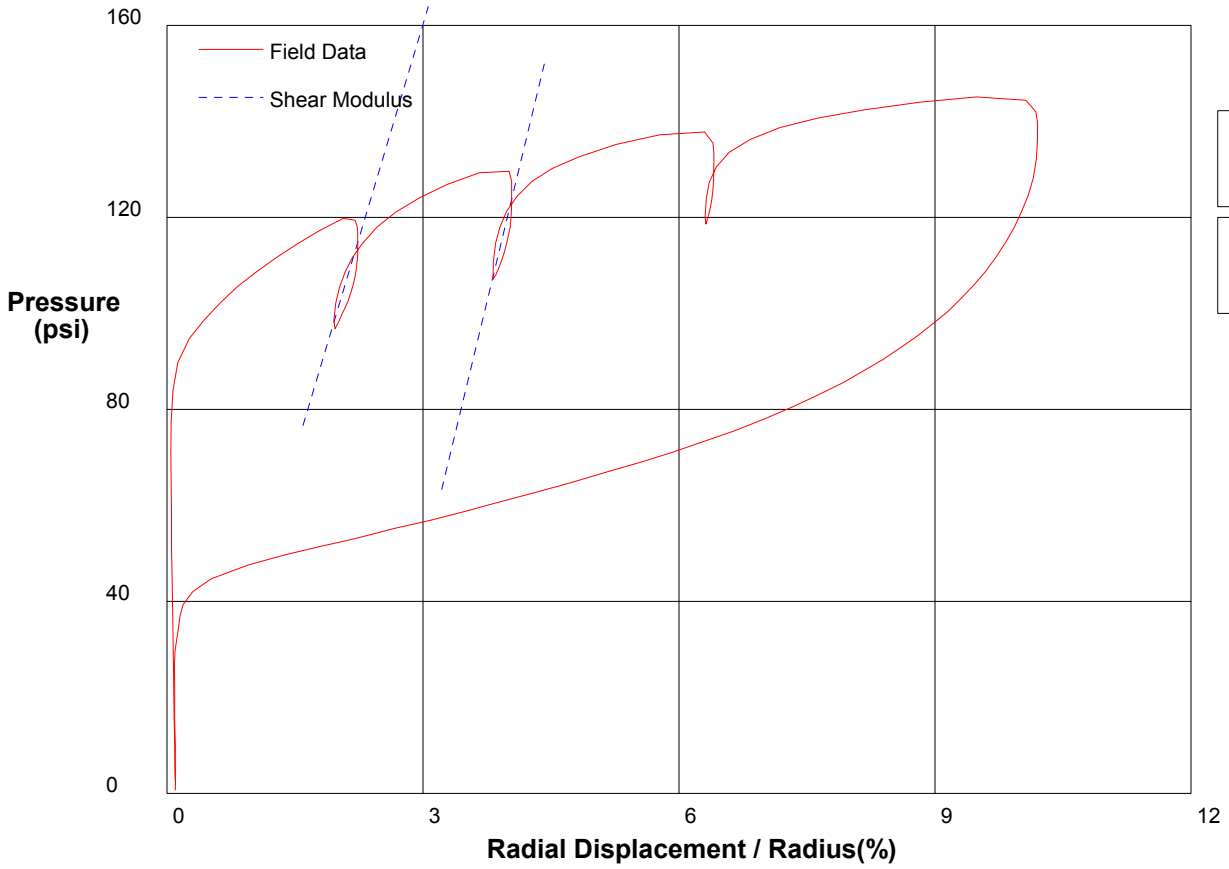


Shear Strength 16.9 psi
Limit Pressure 169 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 124ft	File C:\DATA\ISE-787\DOT114.P



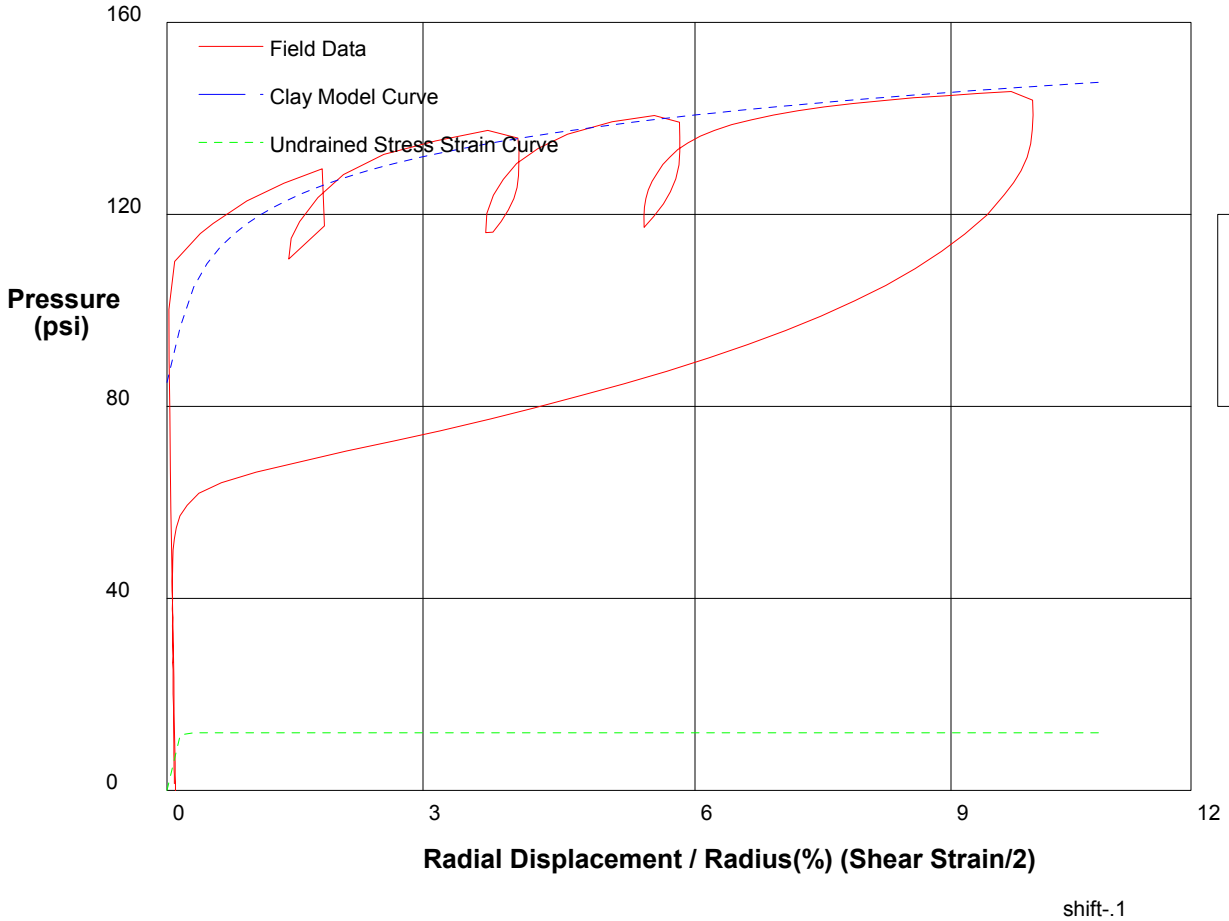
Shear Modulus 3682 psi

Shear Modulus 2969 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 126ft	File C:\DATA\ISE-787\DOT115.P

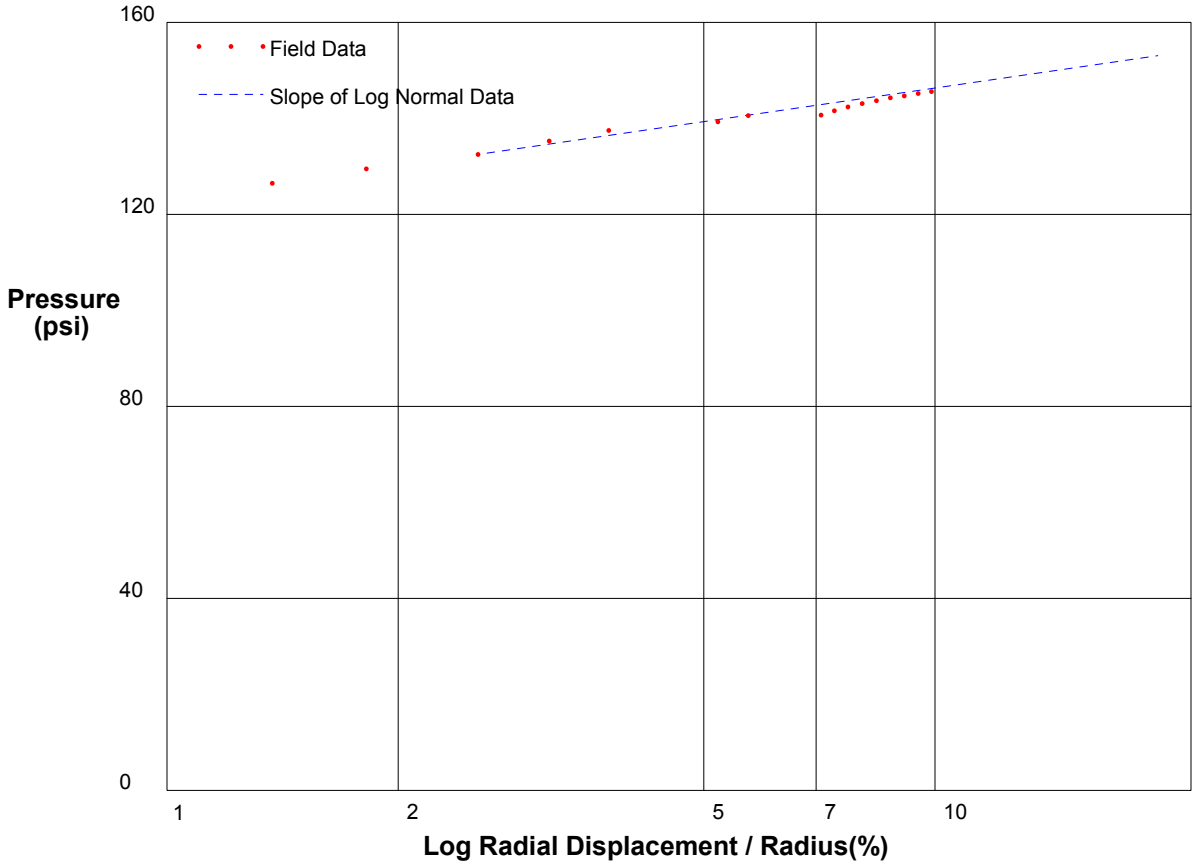


GIBSON'S CLAY MODEL

Shear Strength	12 psi
Insitu Stress	85 psi
Shear Modulus	3700 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 126ft	File C:\DATA\ISE-787\DOT115.P

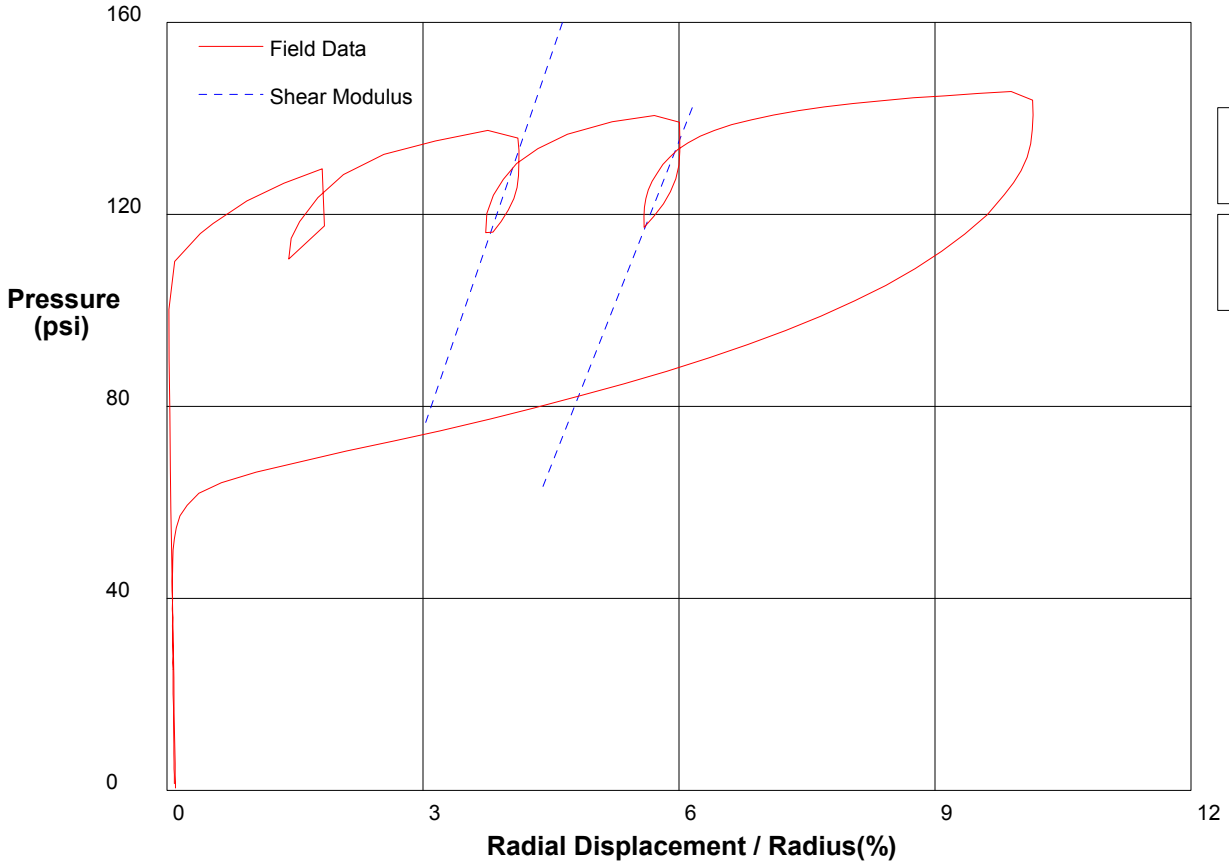


Shear Strength 10 psi
Limit Pressure 160 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 126ft	File C:\DATA\ISE-787\DOT115.P



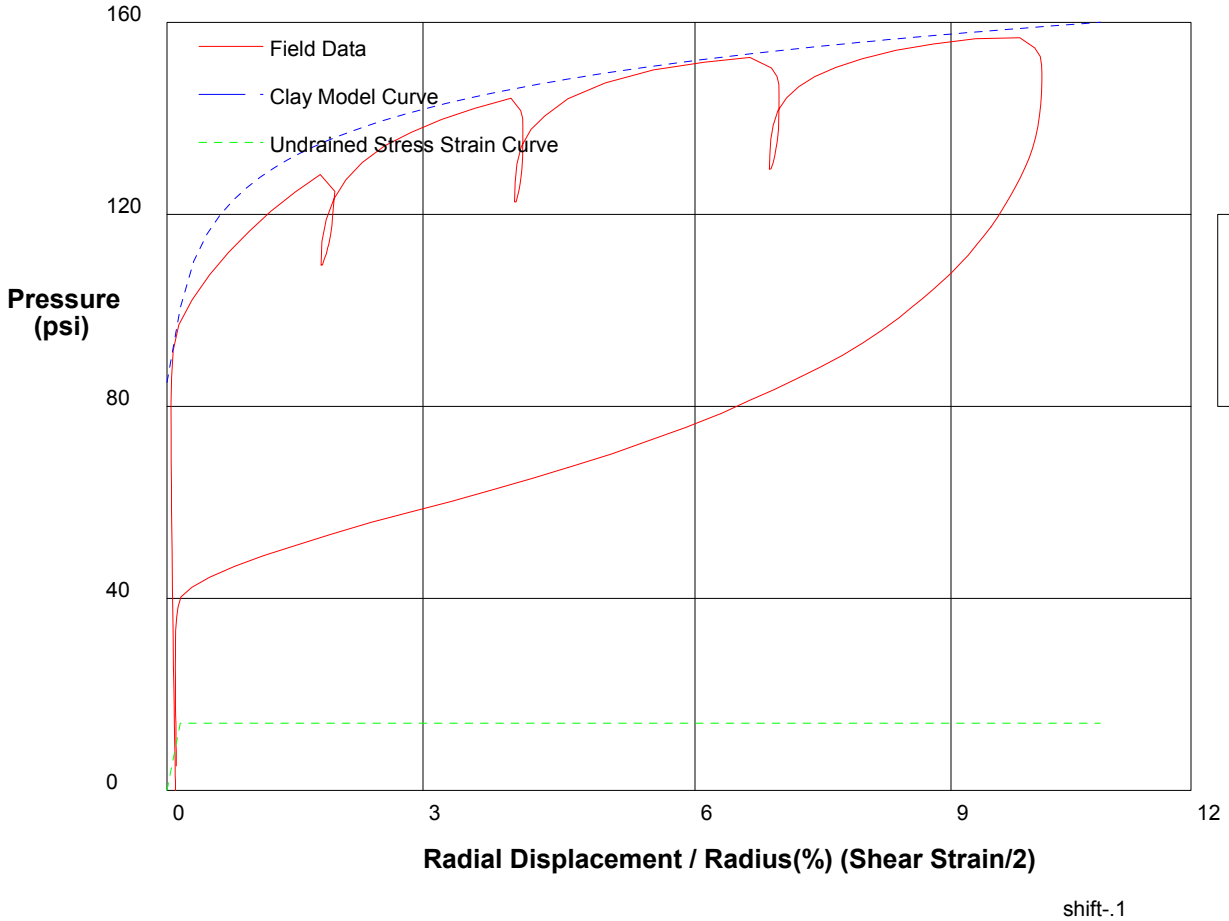
Shear Modulus 2253 psi

Shear Modulus 2598 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 128ft	File C:\DATA\ISE-787\DOT116.P

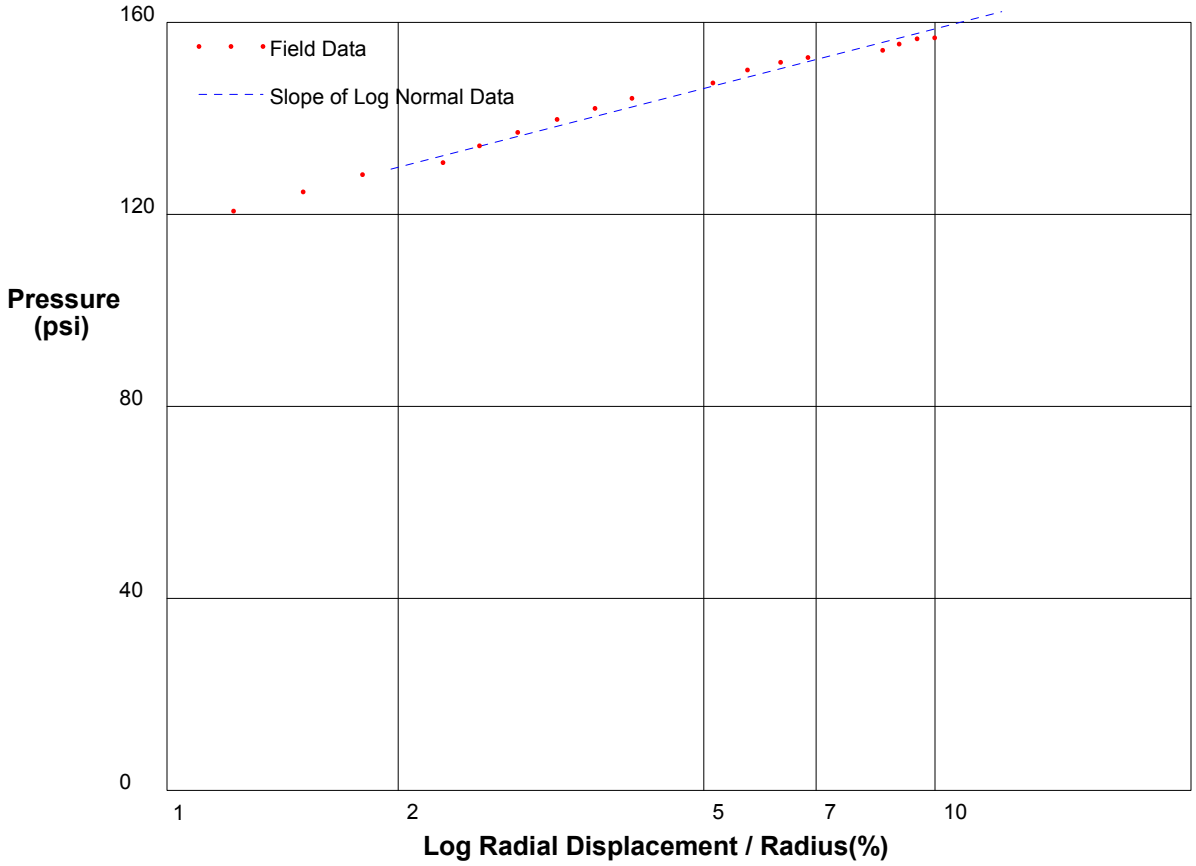


GIBSON'S CLAY MODEL

Shear Strength	14 psi
Insitu Stress	85 psi
Shear Modulus	5000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/6/2008
Hole No. TH-30B-PMT-08 Depth 128ft	File C:\DATA\ISE-787\DOT116.P



Shear Strength 17.9 psi
Limit Pressure 183 psi

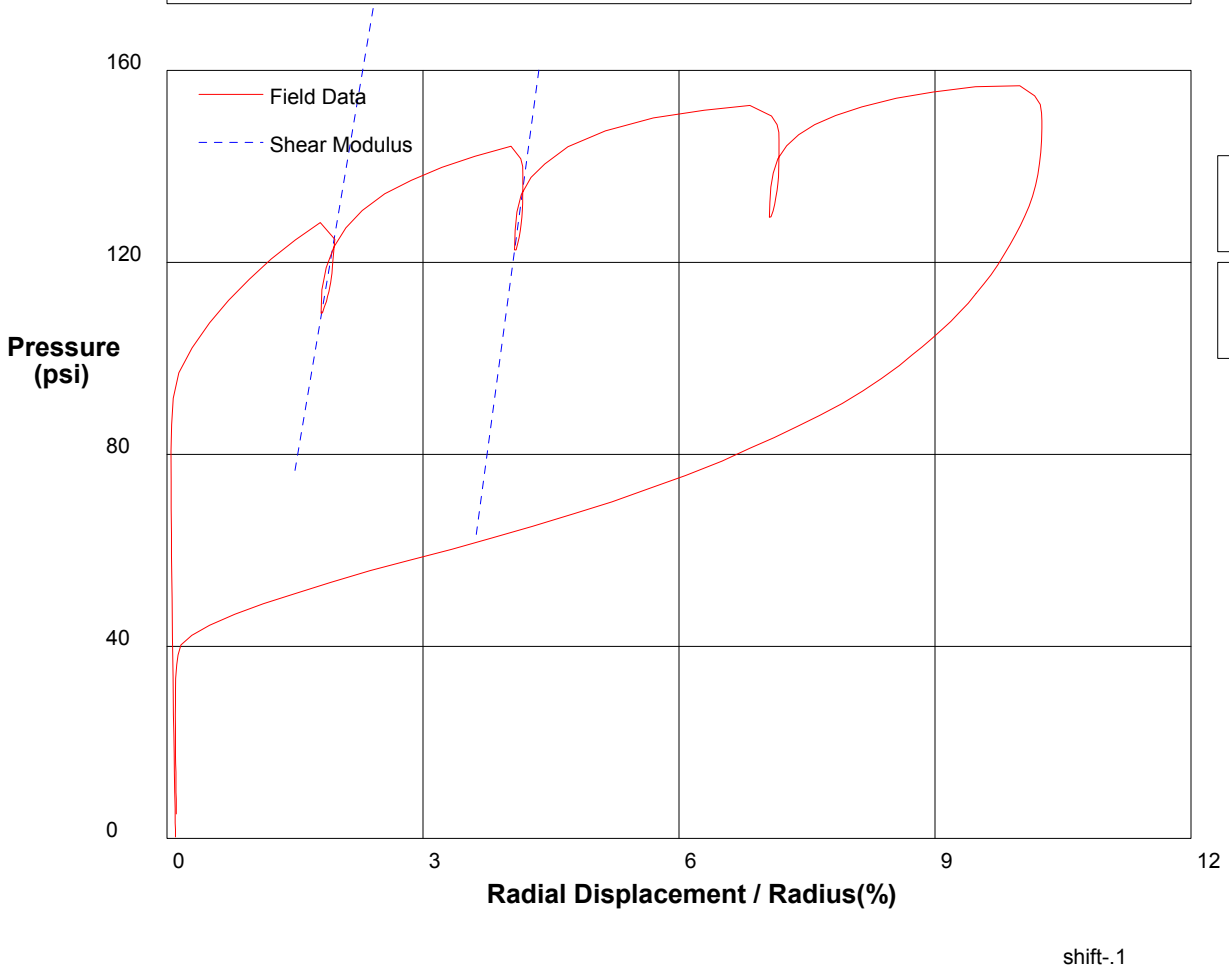
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/6/2008**

Hole No. TH-30B-PMT-08 Depth 128ft **File C:\DATA\ISE-787\DOT116.P**



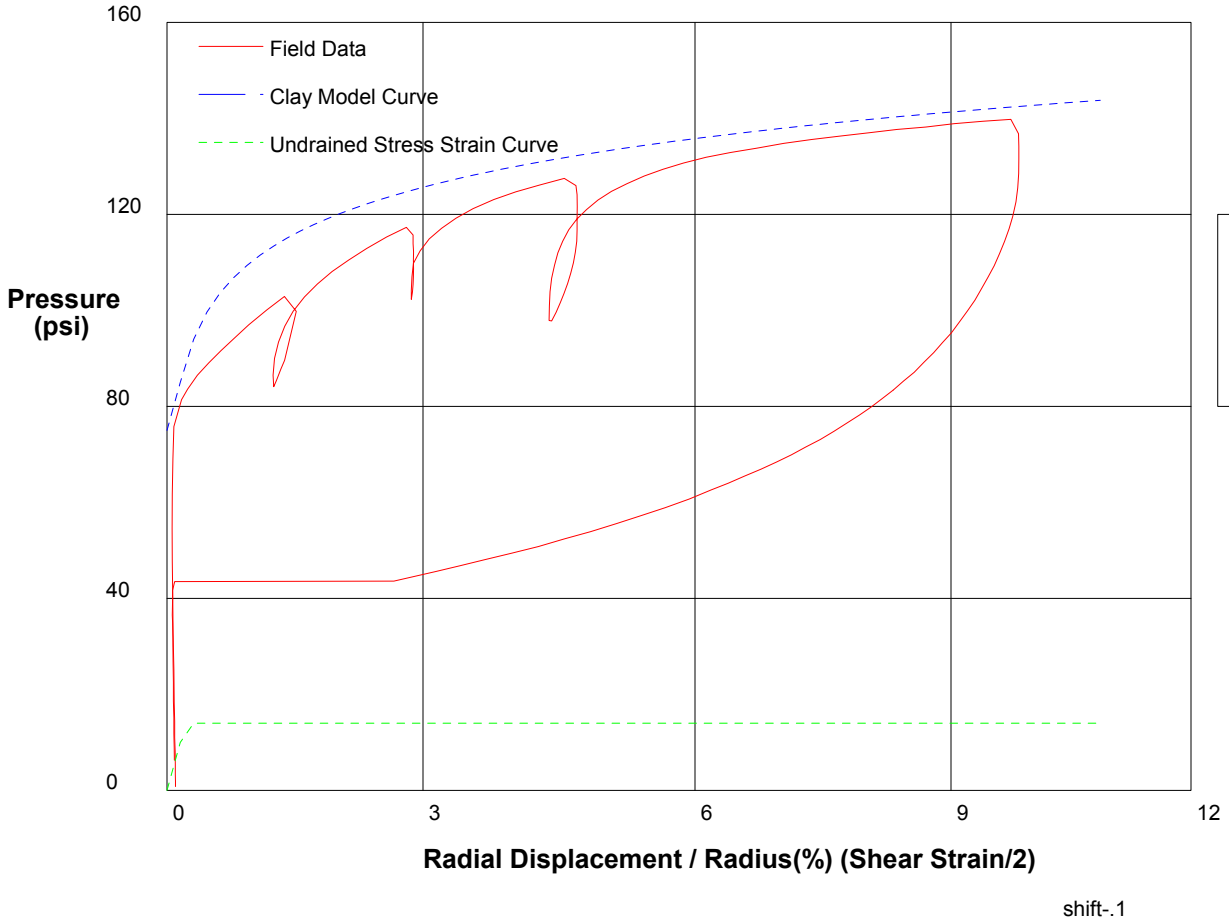
Shear Modulus 6600 psi

Shear Modulus 5258 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-30B-PMT-08 Depth 132ft	File C:\DATA\ISE-787\DOT117.P

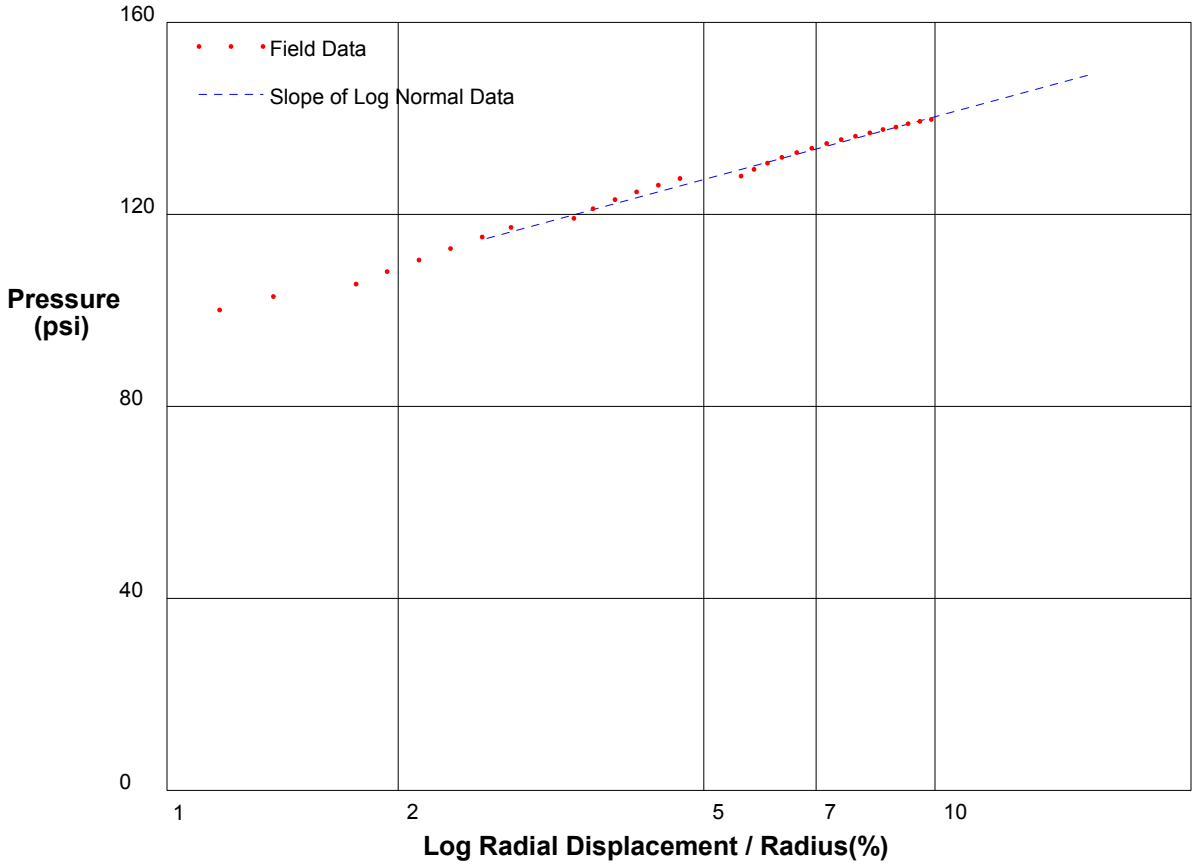


GIBSON'S CLAY MODEL

Shear Strength	14 psi
Insitu Stress	75 psi
Shear Modulus	3200 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-30B-PMT-08 Depth 132ft	File C:\DATA\ISE-787\DOT117.P

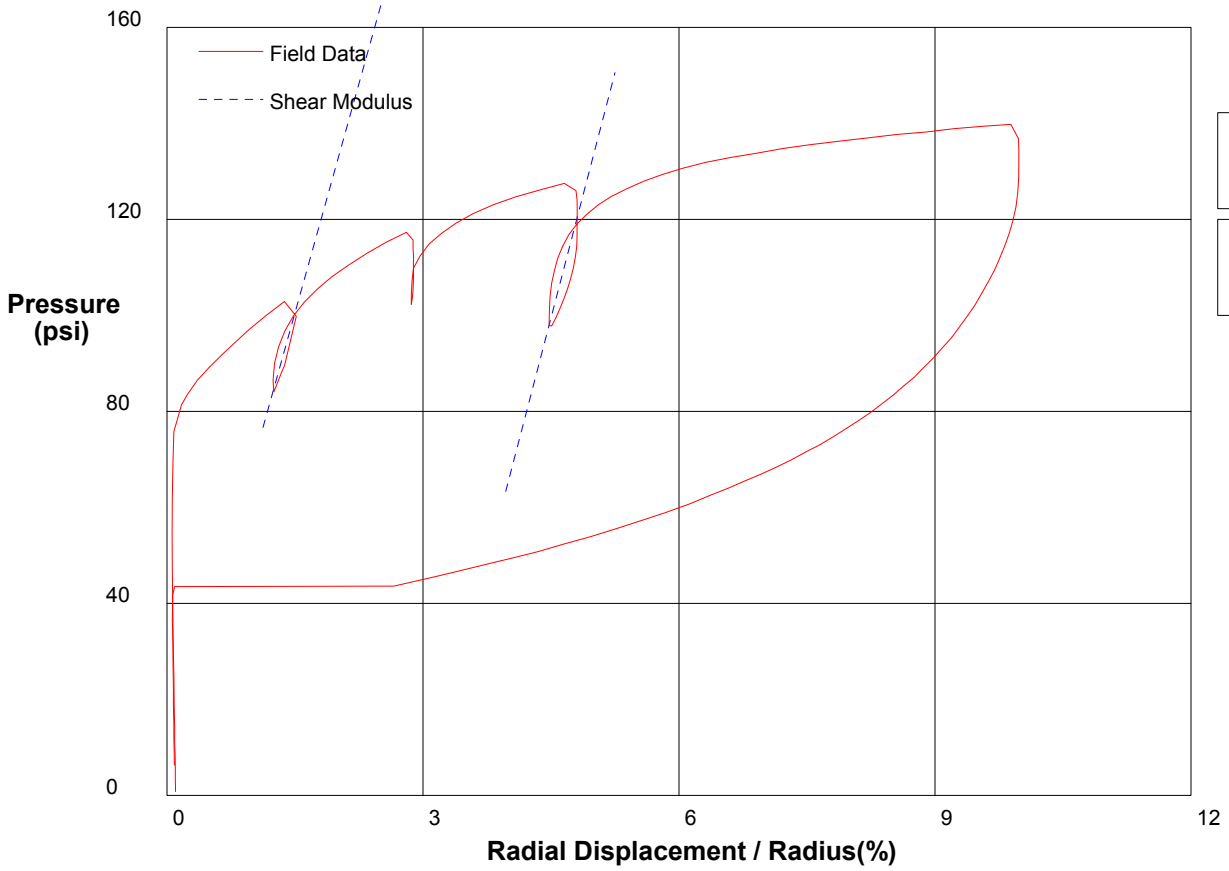


Shear Strength 18.8 psi
Limit Pressure 166 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-30B-PMT-08 Depth 132ft	File C:\DATA\ISE-787\DOT117.P



Shear Modulus 3403 psi

Shear Modulus 3186 psi

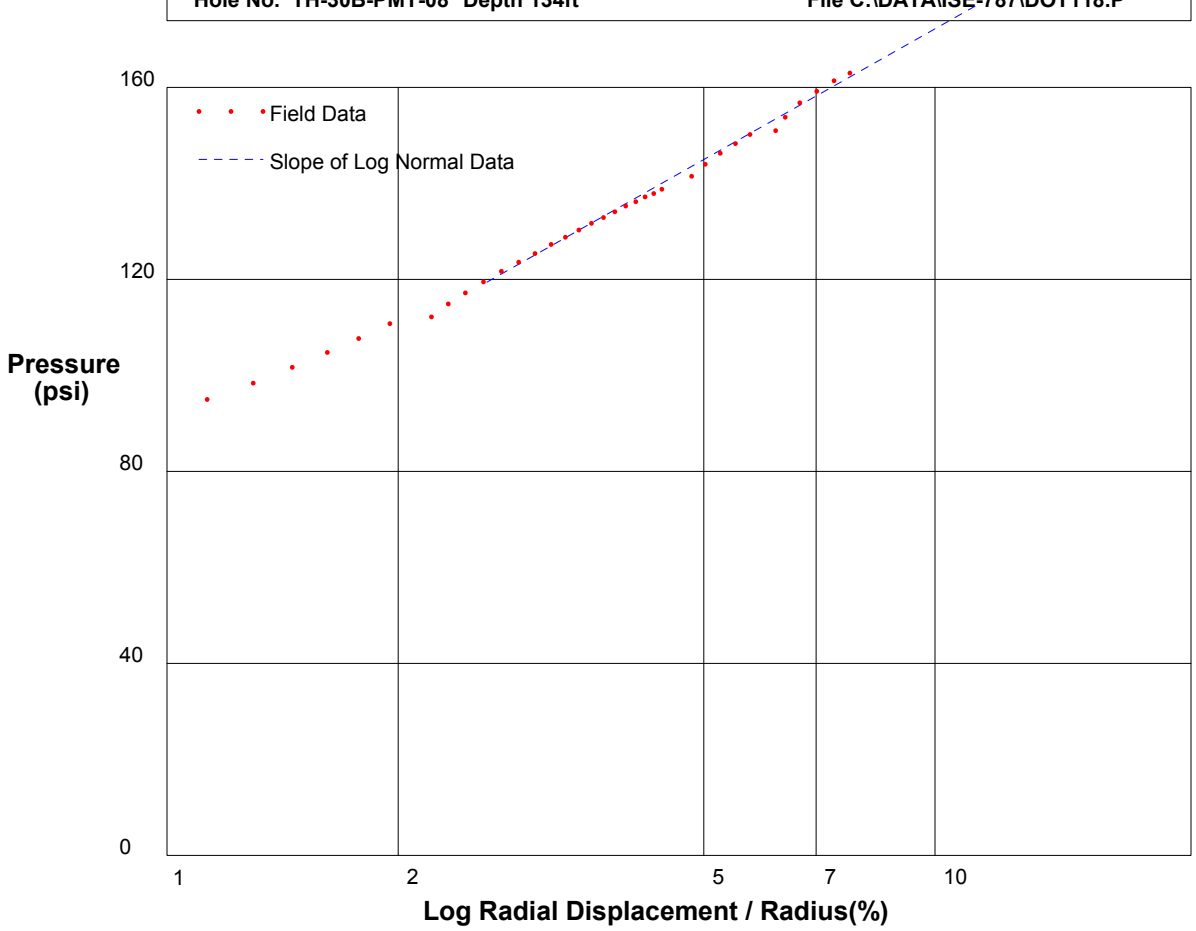
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/7/2008**

Hole No. TH-30B-PMT-08 Depth 134ft **File C:\DATA\ISE-787\DOT118.P**

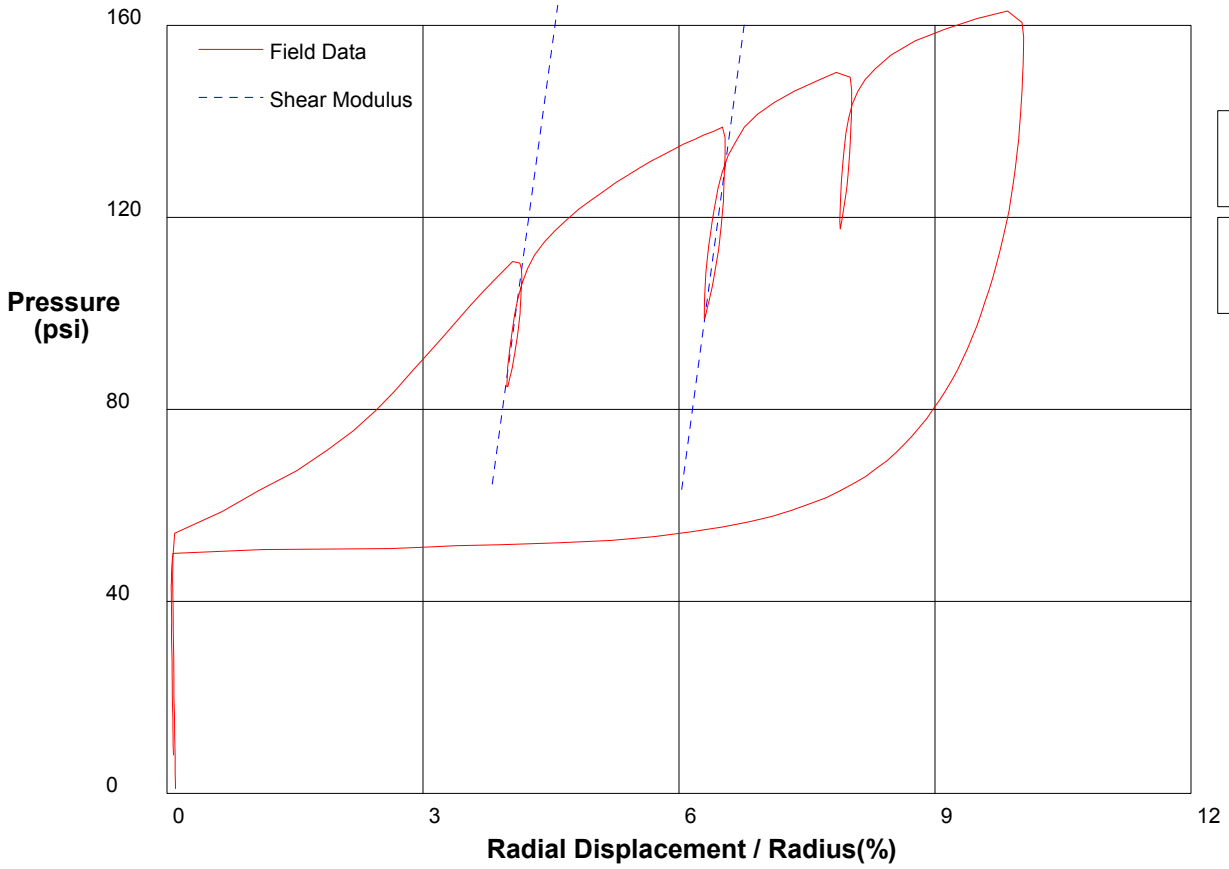


Shear Strength 39.2 psi
Limit Pressure 227 psi

shift 2

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-30B-PMT-08 Depth 134ft	File C:\DATA\ISE-787\DOT118.P



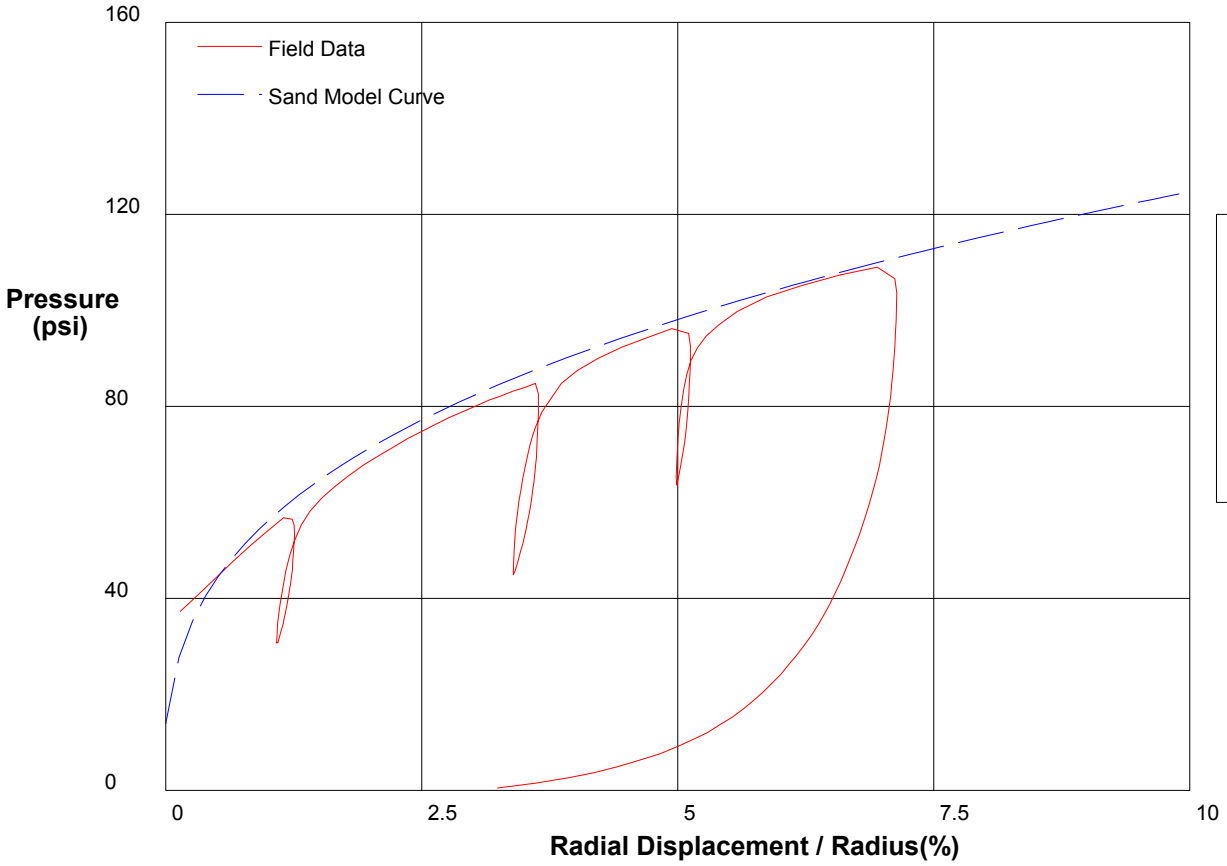
Shear Modulus 6600 psi

Shear Modulus 6512 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-30B-PMT-08 Depth 134ft	File C:\DATA\ISE-787\DOT118.P



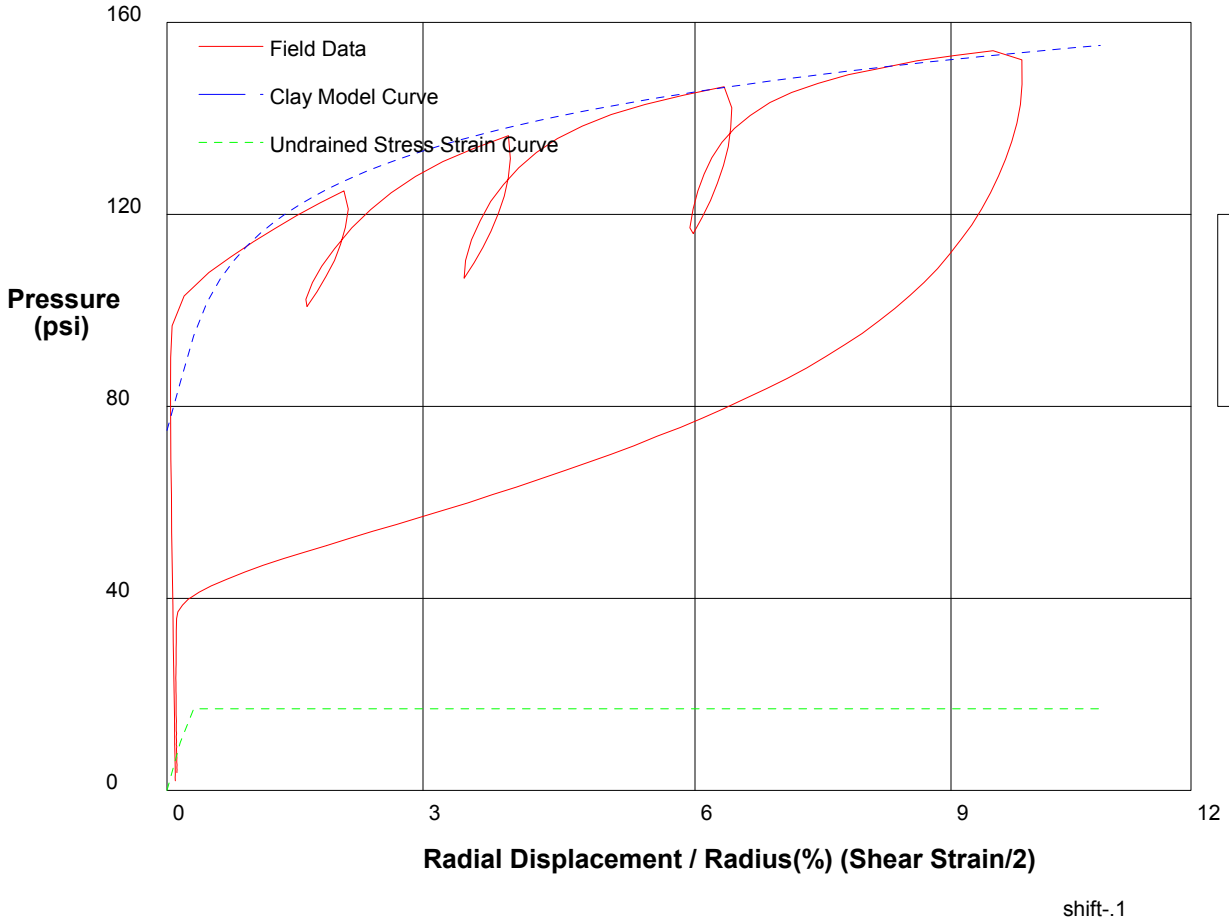
THE In Situ Engineering SAND MODEL

Water Pressure	54 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	14 psi
Shear Modulus	6000 psi

shift 2.8

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-30B-PMT-08 Depth 136ft	File C:\DATA\ISE-787\DOT119.P

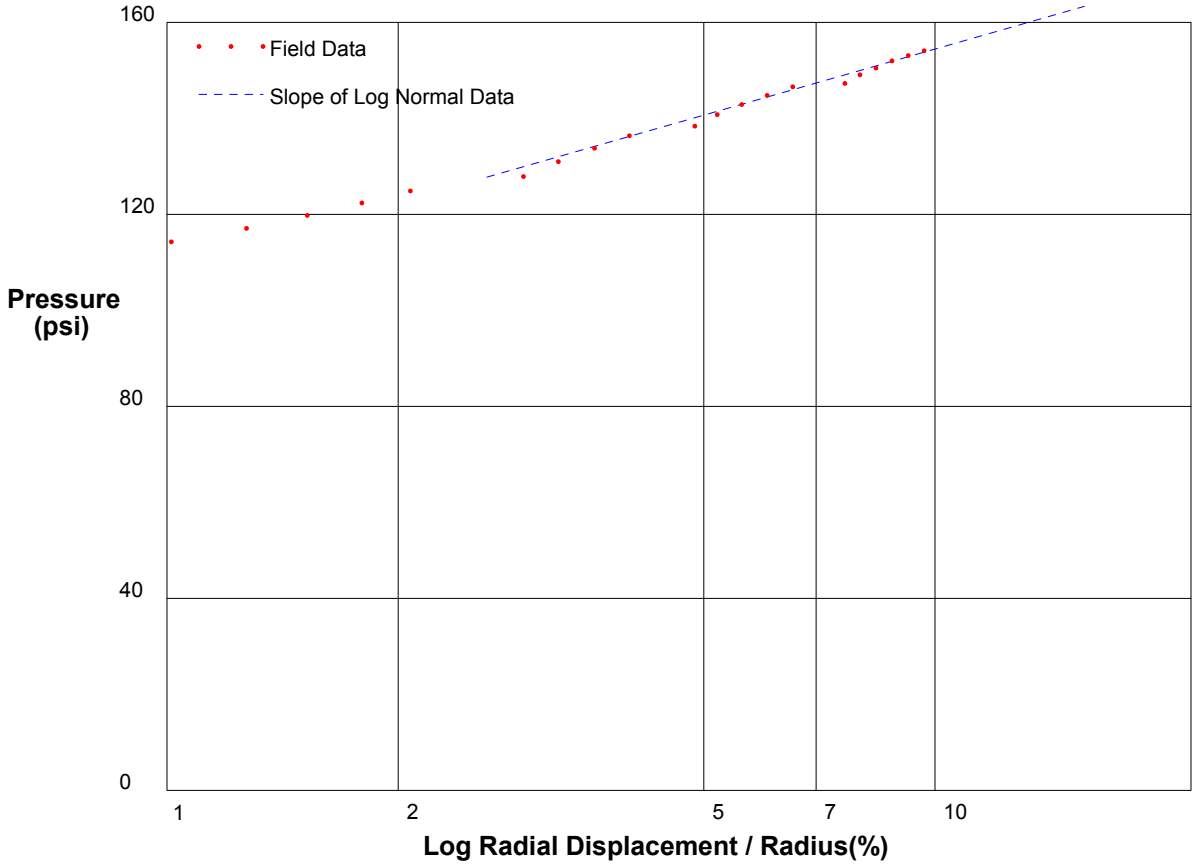


GIBSON'S CLAY MODEL

Shear Strength	17 psi
Insitu Stress	75 psi
Shear Modulus	3200 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-30B-PMT-08 Depth 136ft	File C:\DATA\ISE-787\DOT119.P

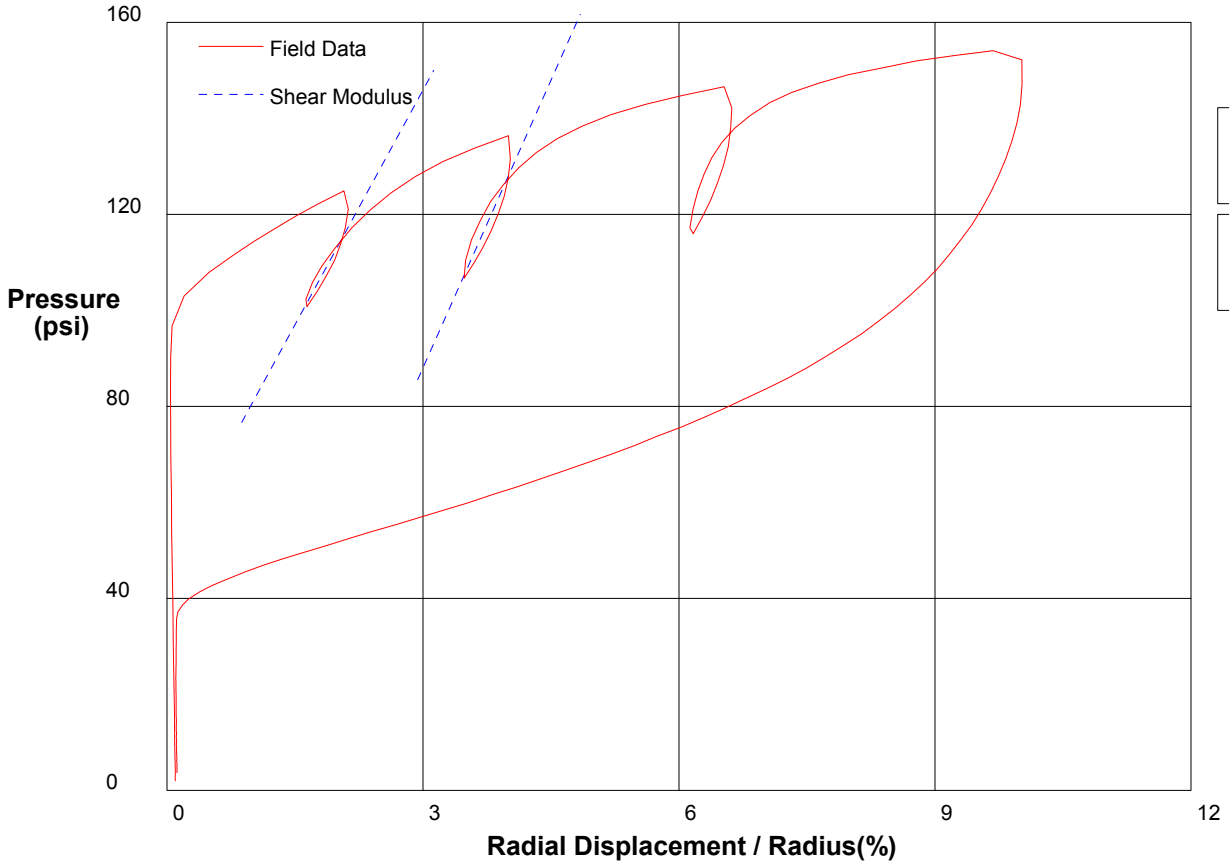


Shear Strength 19.8 psi
Limit Pressure 182 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-30B-PMT-08 Depth 136ft	File C:\DATA\ISE-787\DOT119.P



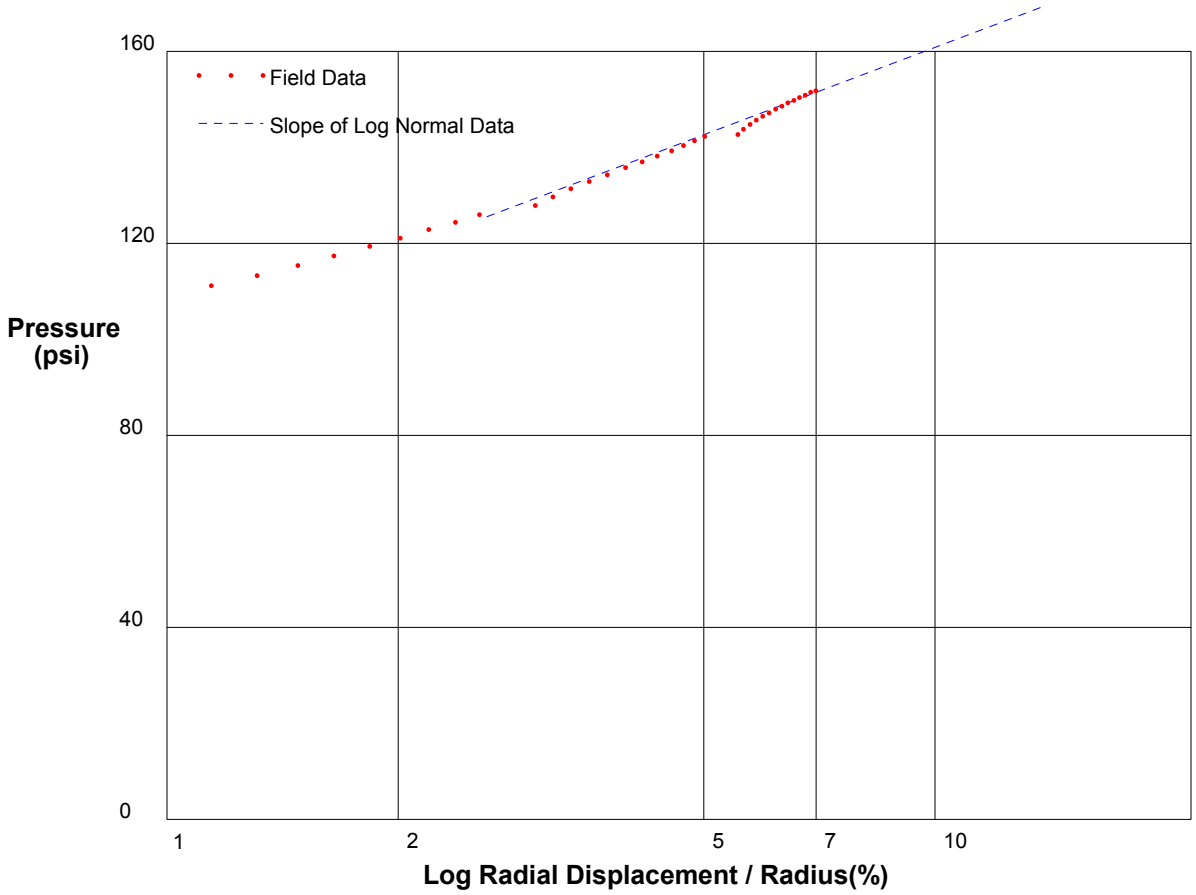
Shear Modulus 1996 psi

Shear Modulus 1629 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-30B-PMT-08 Depth 138ft	File C:\DATA\ISE-787\DOT120.P



Shear Strength 26.2 psi
Limit Pressure 197 psi

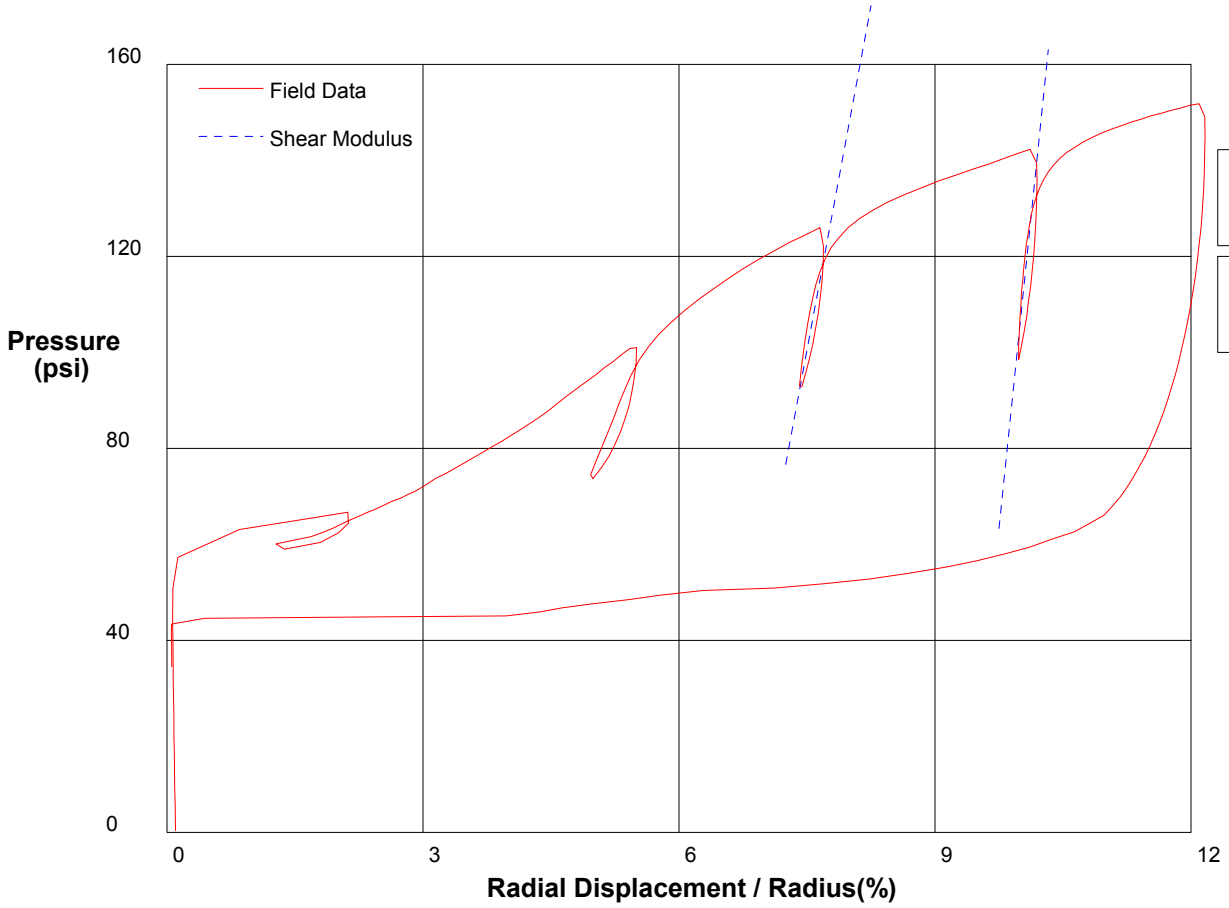
shift 5

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/7/2008**

Hole No. TH-30B-PMT-08 Depth 138ft **File C:\DATA\ISE-787\DOT120.P**



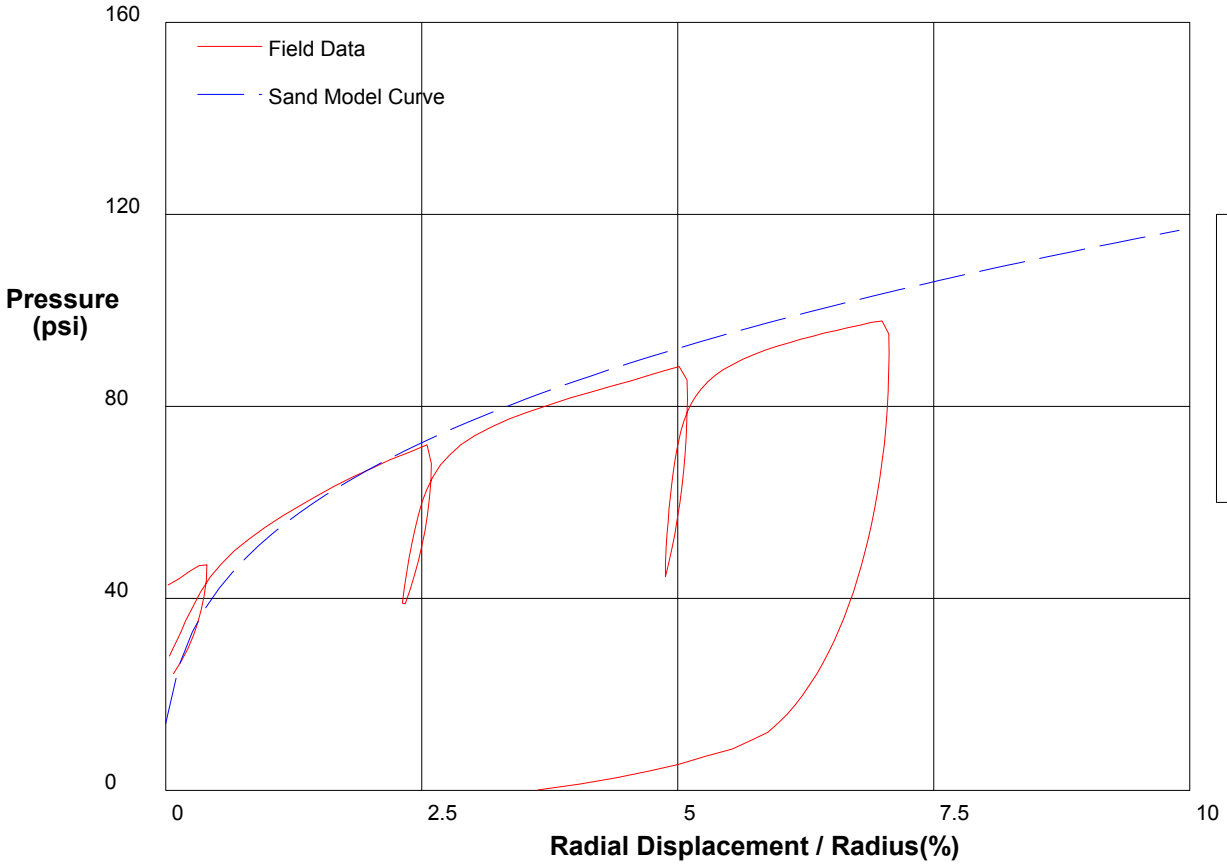
Shear Modulus 8624 psi

Shear Modulus 4777 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-30B-PMT-08 Depth 138ft	File C:\DATA\ISE-787\DOT120.P



THE In Situ Engineering SAND MODEL

Water Pressure	54 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	14 psi
Shear Modulus	5000 psi

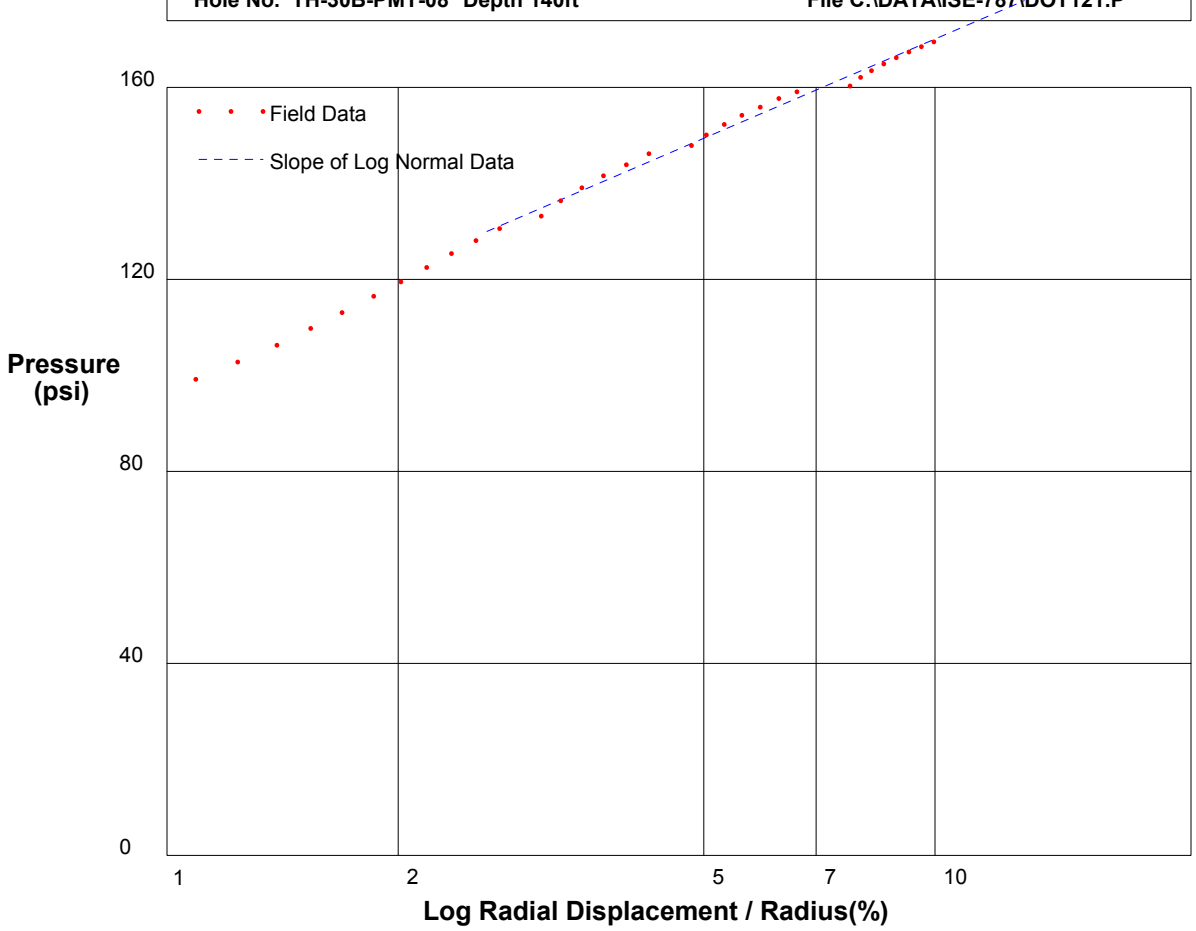
shift 5

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/7/2008**

Hole No. TH-30B-PMT-08 Depth 140ft **File C:\DATA\ISE-787\DOT121.P**



Shear Strength 29.8 psi
Limit Pressure 212 psi

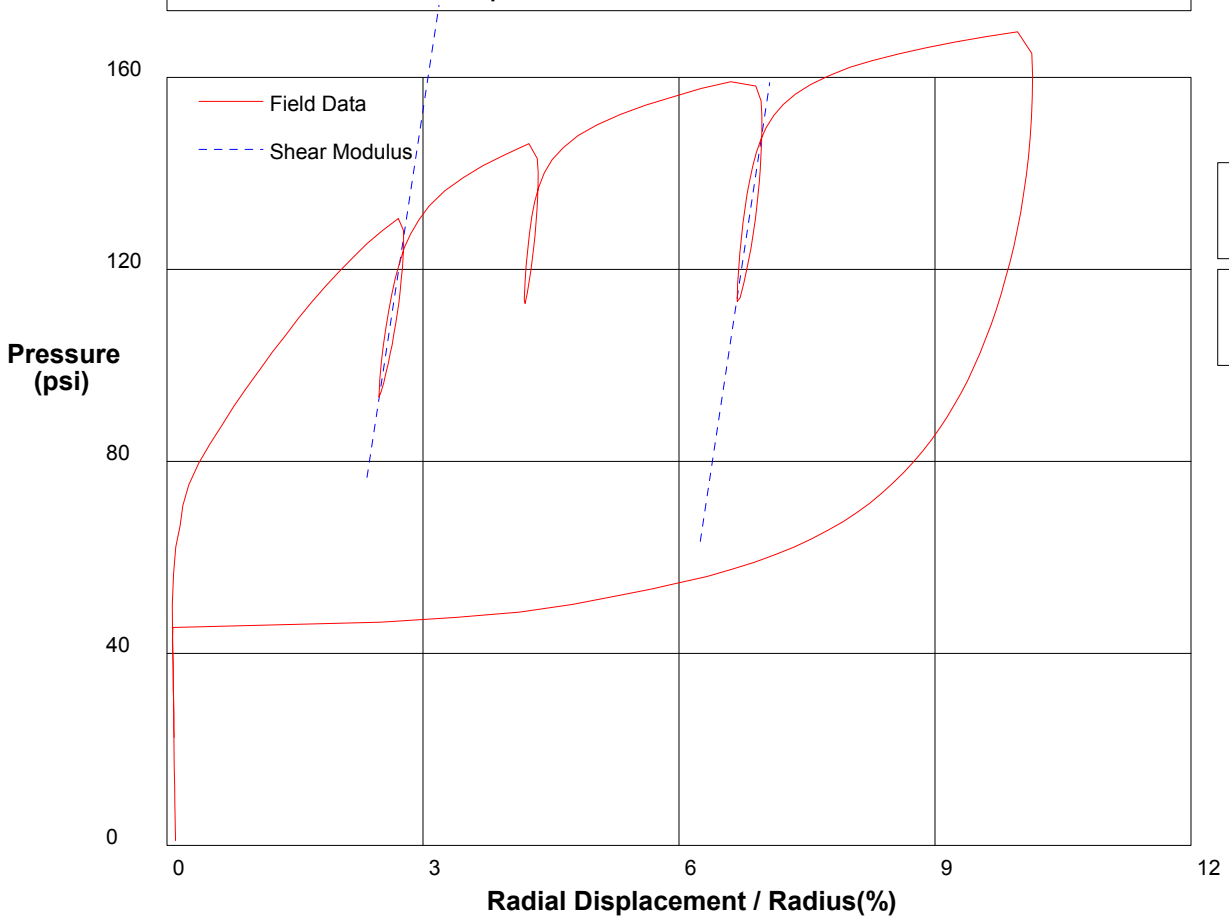
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/7/2008**

Hole No. TH-30B-PMT-08 Depth 140ft **File C:\DATA\ISE-787\DOT121.P**



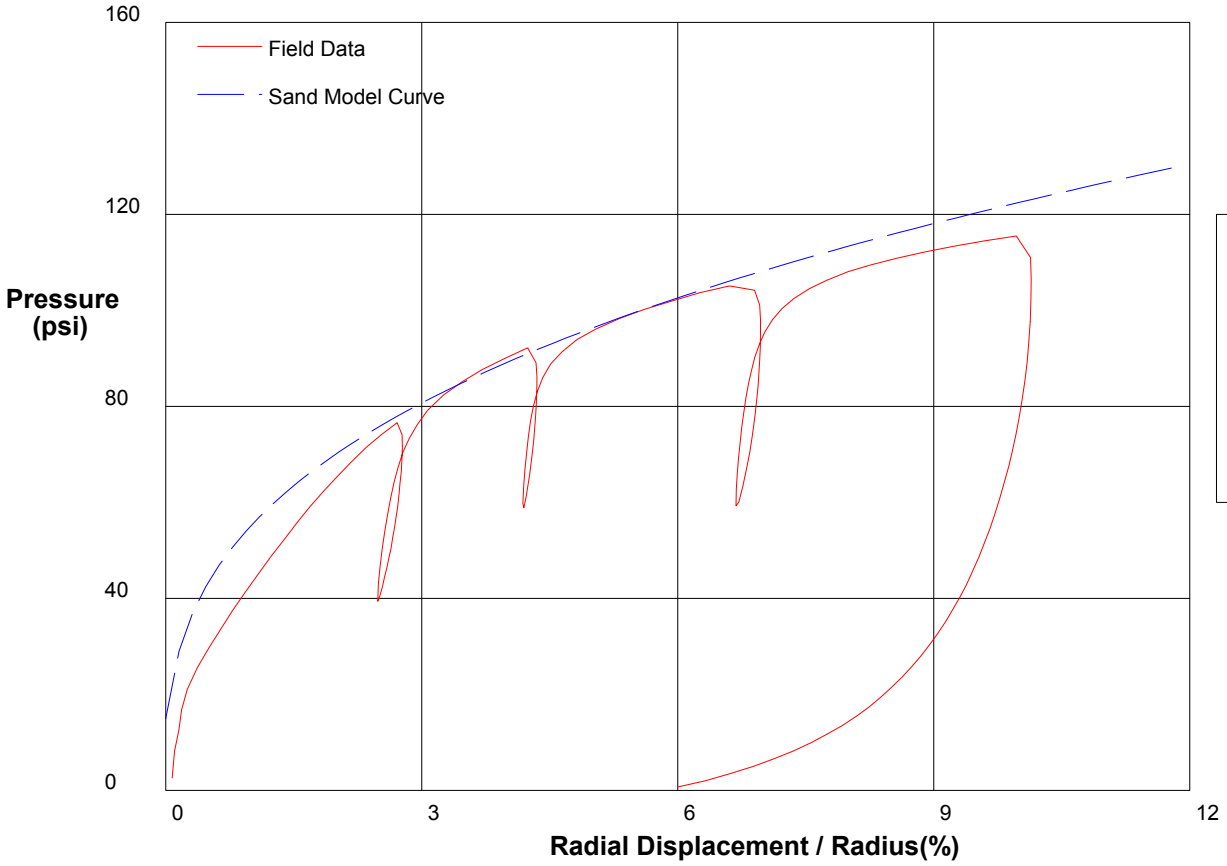
Shear Modulus 5880 psi

Shear Modulus 5827 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-30B-PMT-08 Depth 140ft	File C:\DATA\ISE-787\DOT121.P



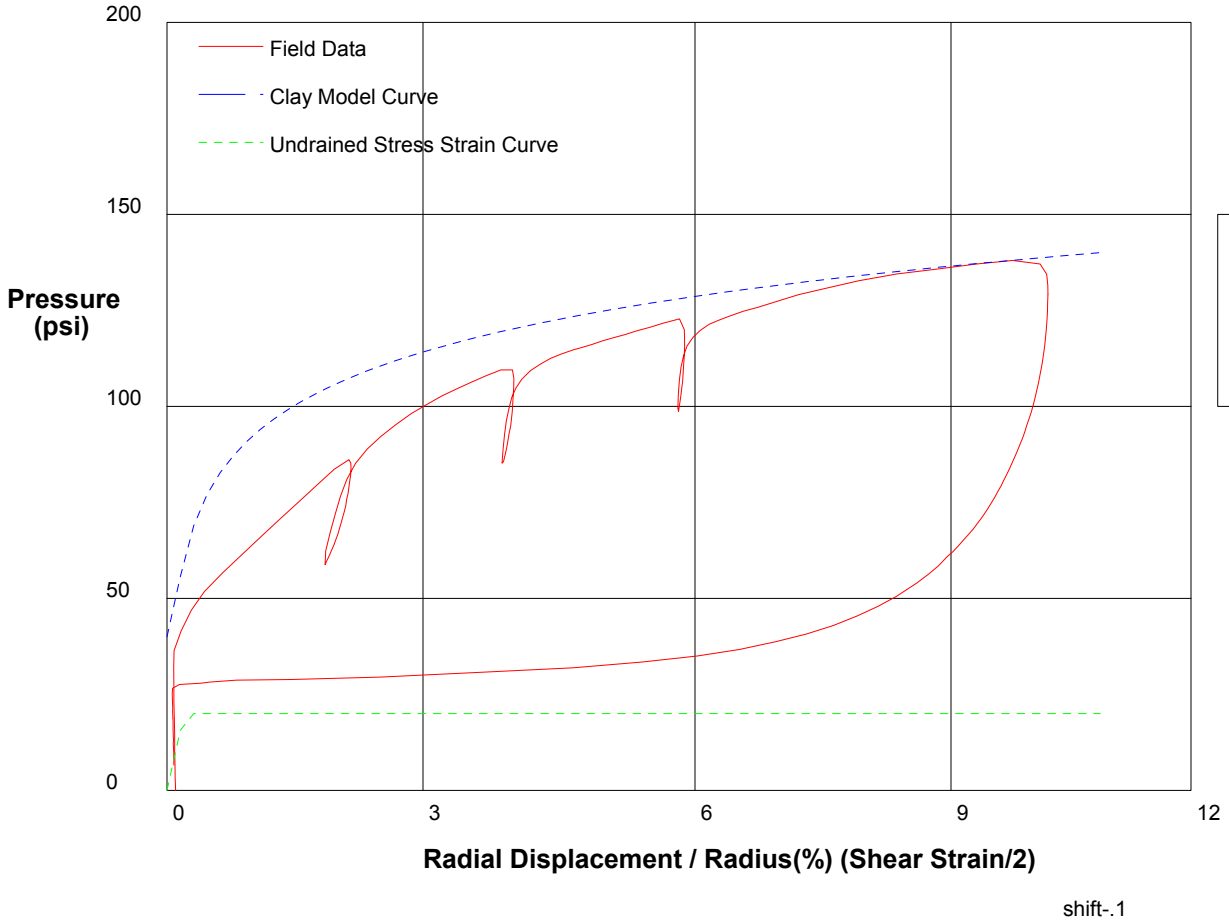
THE In Situ Engineering SAND MODEL

Water Pressure	54 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	15 psi
Shear Modulus	5000 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 92ft	File C:\DATA\ISE-787\DOT122.P

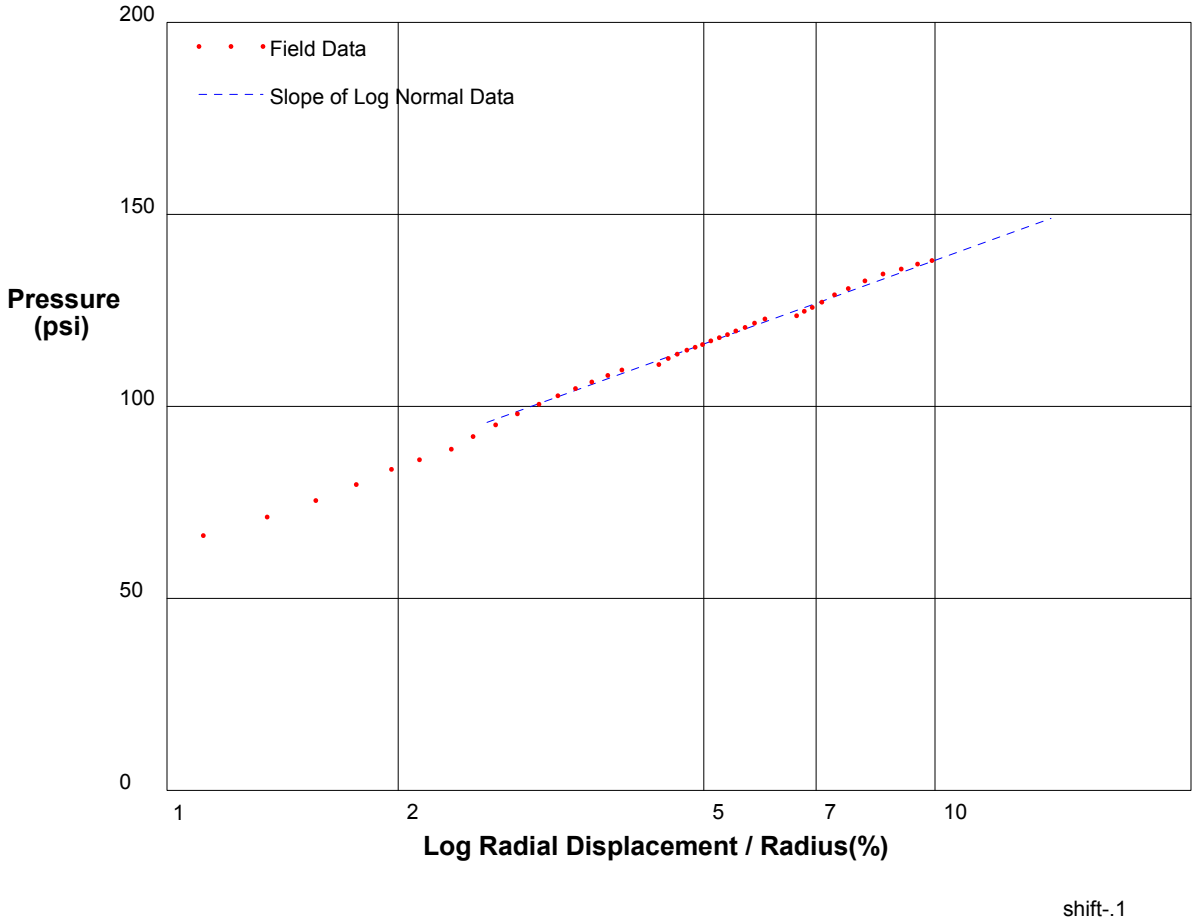


GIBSON'S CLAY MODEL

Shear Strength	20	psi
Insitu Stress	40	psi
Shear Modulus	5000	psi

In Situ Engineering

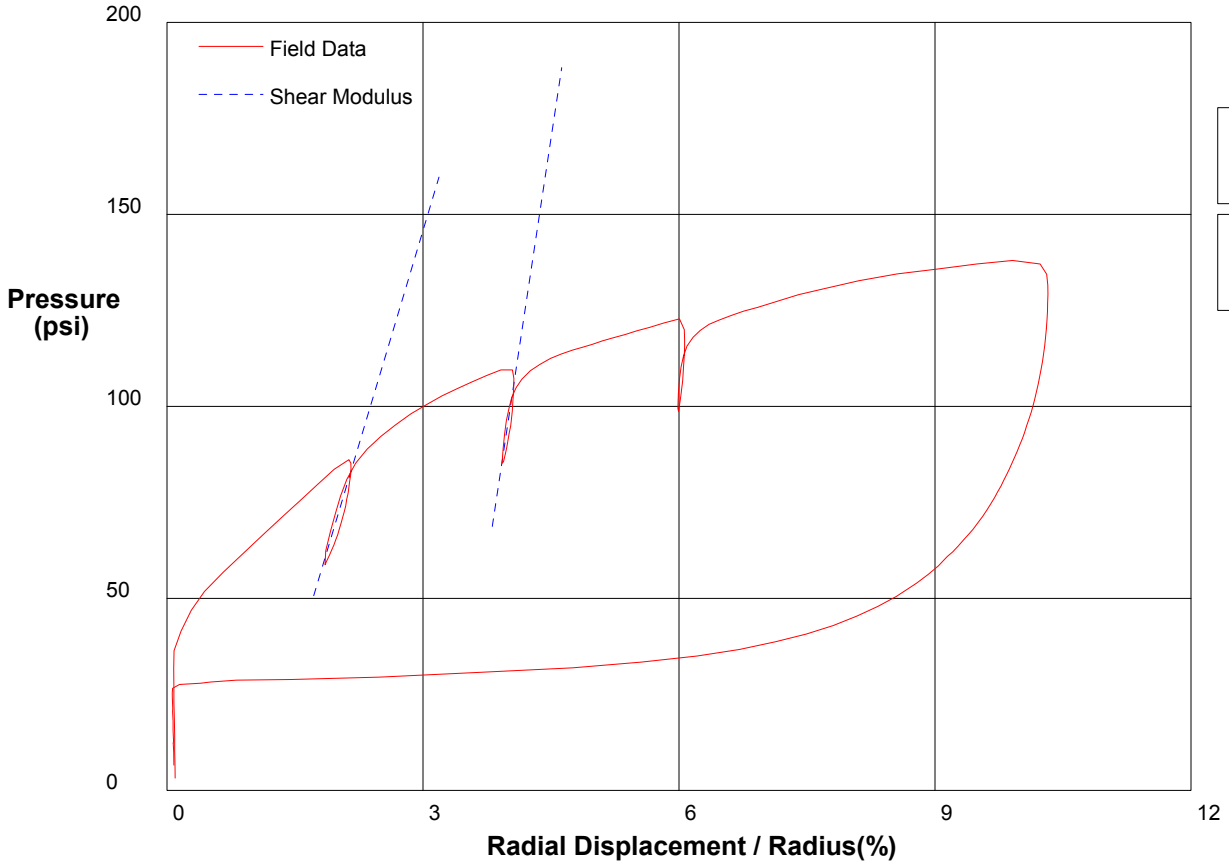
PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 92ft	File C:\DATA\ISE-787\DOT122.P



Shear Strength 31.4 psi
Limit Pressure 182 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 92ft	File C:\DATA\ISE-787\DOT122.P



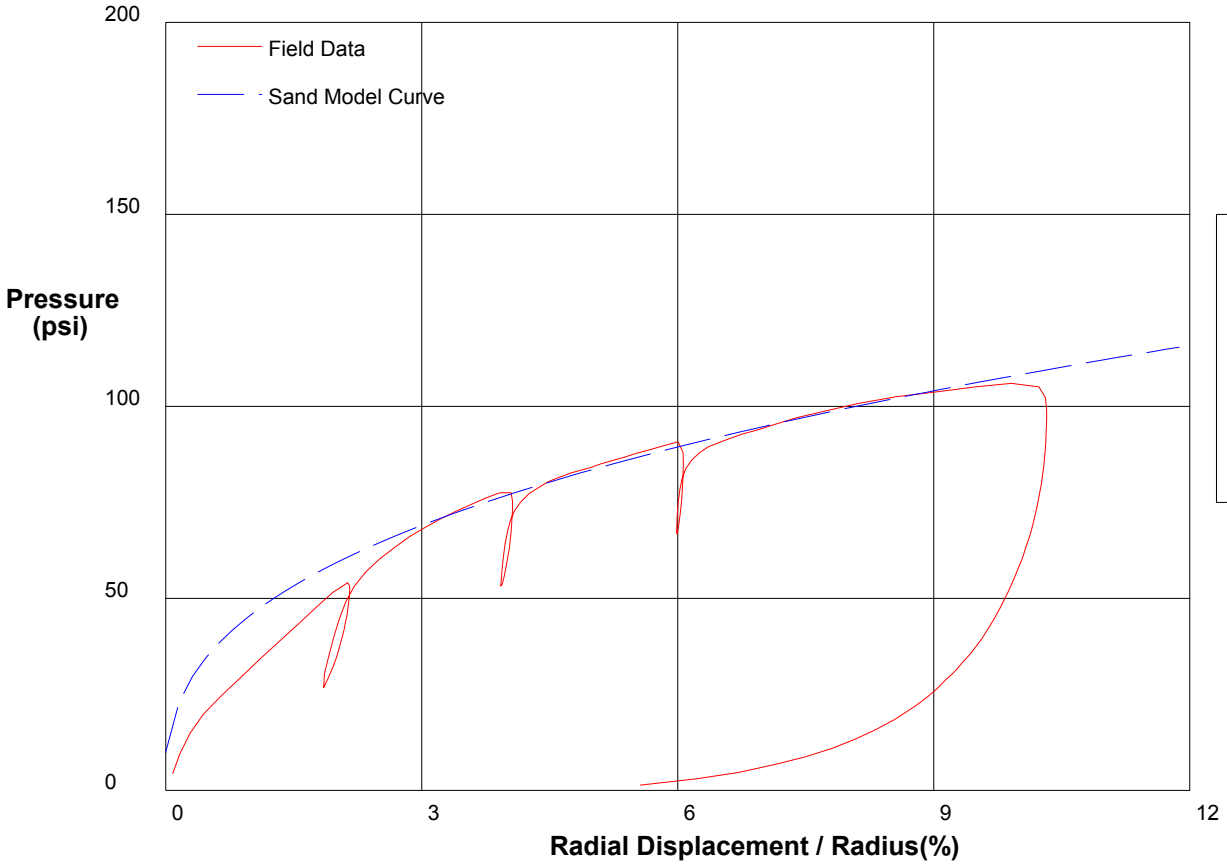
Shear Modulus 7350 psi

Shear Modulus 3711 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 92ft	File C:\DATA\ISE-787\DOT122.P



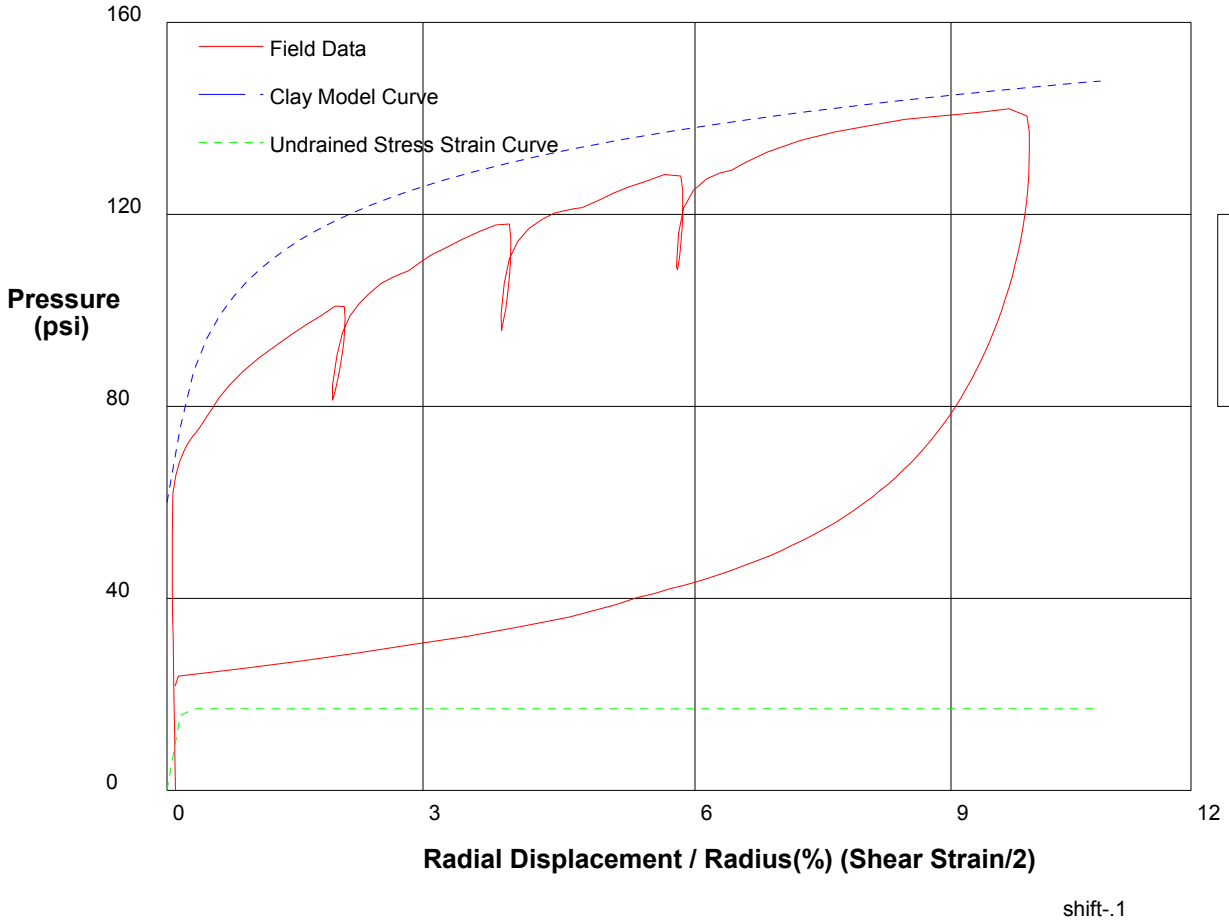
THE In Situ Engineering SAND MODEL

Water Pressure	32 psi
Friction Angle	34 deg
Critical Friction Angle	32 deg
Lateral Stress	10 psi
Shear Modulus	5000 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 94ft	File C:\DATA\ISE-787\DOT123.P

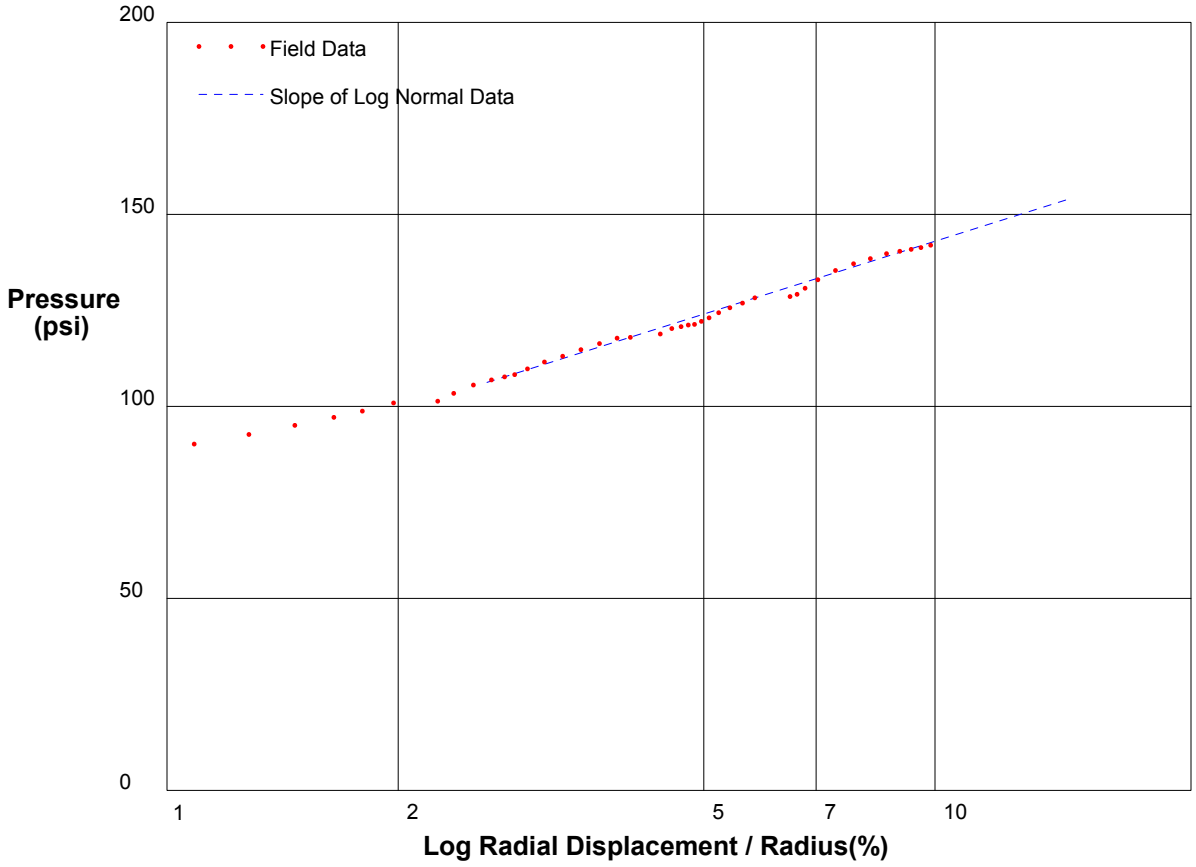


GIBSON'S CLAY MODEL

Shear Strength	17 psi
Insitu Stress	60 psi
Shear Modulus	5000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 94ft	File C:\DATA\ISE-787\DOT123.P

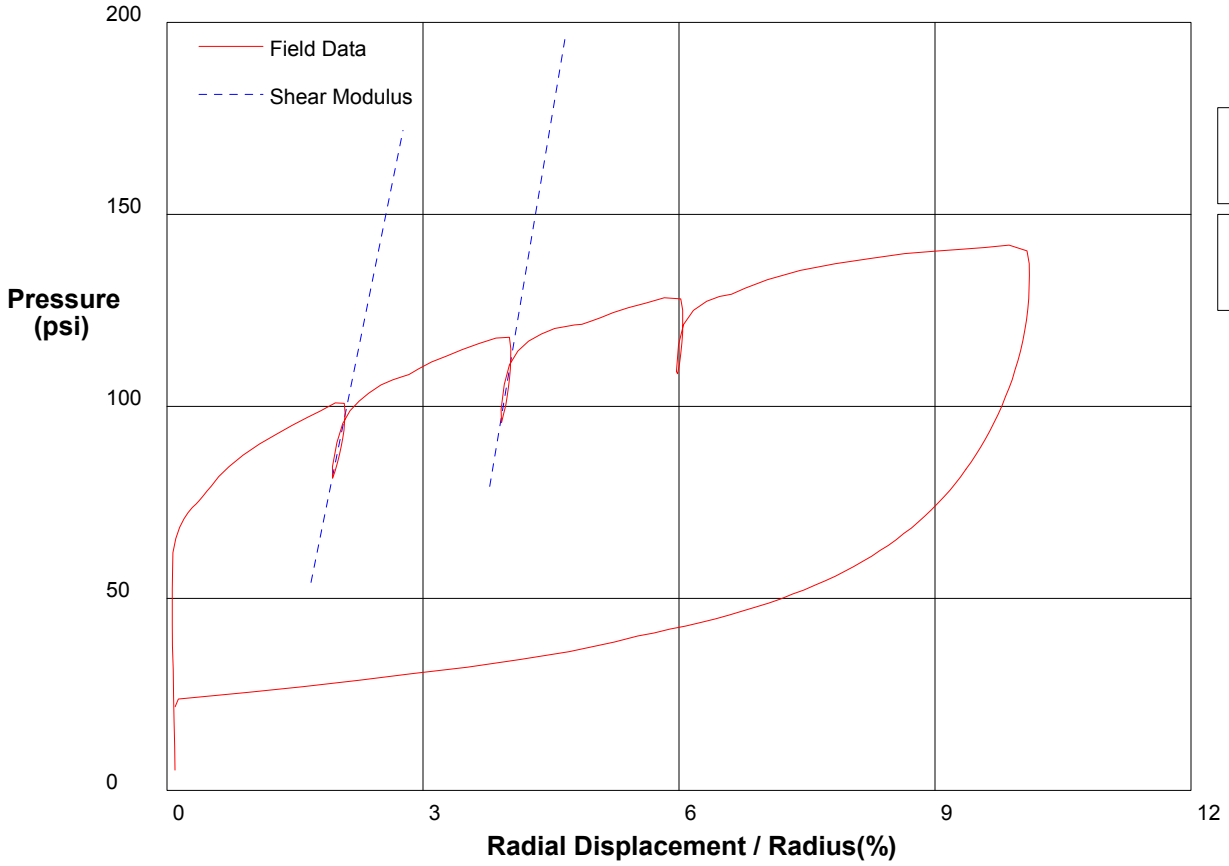


Shear Strength 27.3 psi
Limit Pressure 181 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 94ft	File C:\DATA\ISE-787\DOT123.P



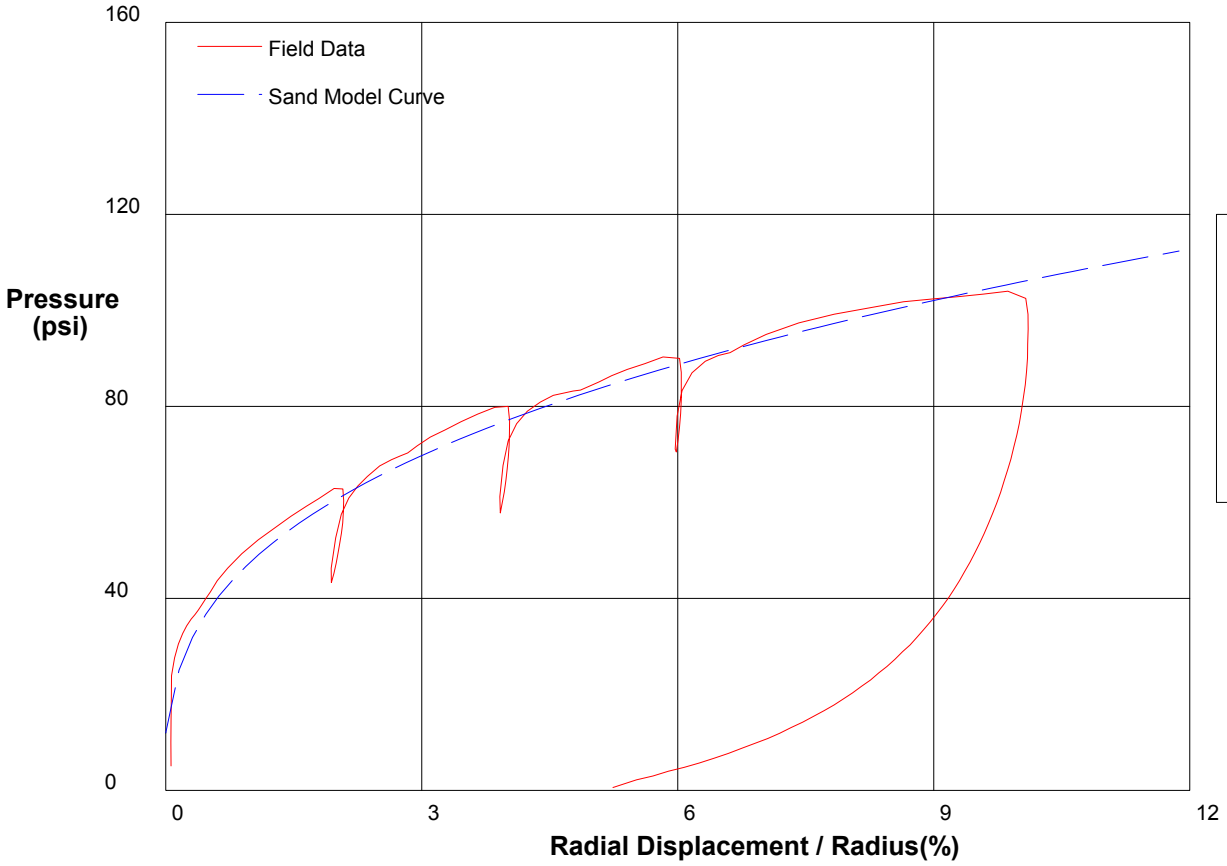
Shear Modulus 6608 psi

Shear Modulus 5458 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 94ft	File C:\DATA\ISE-787\DOT123.P



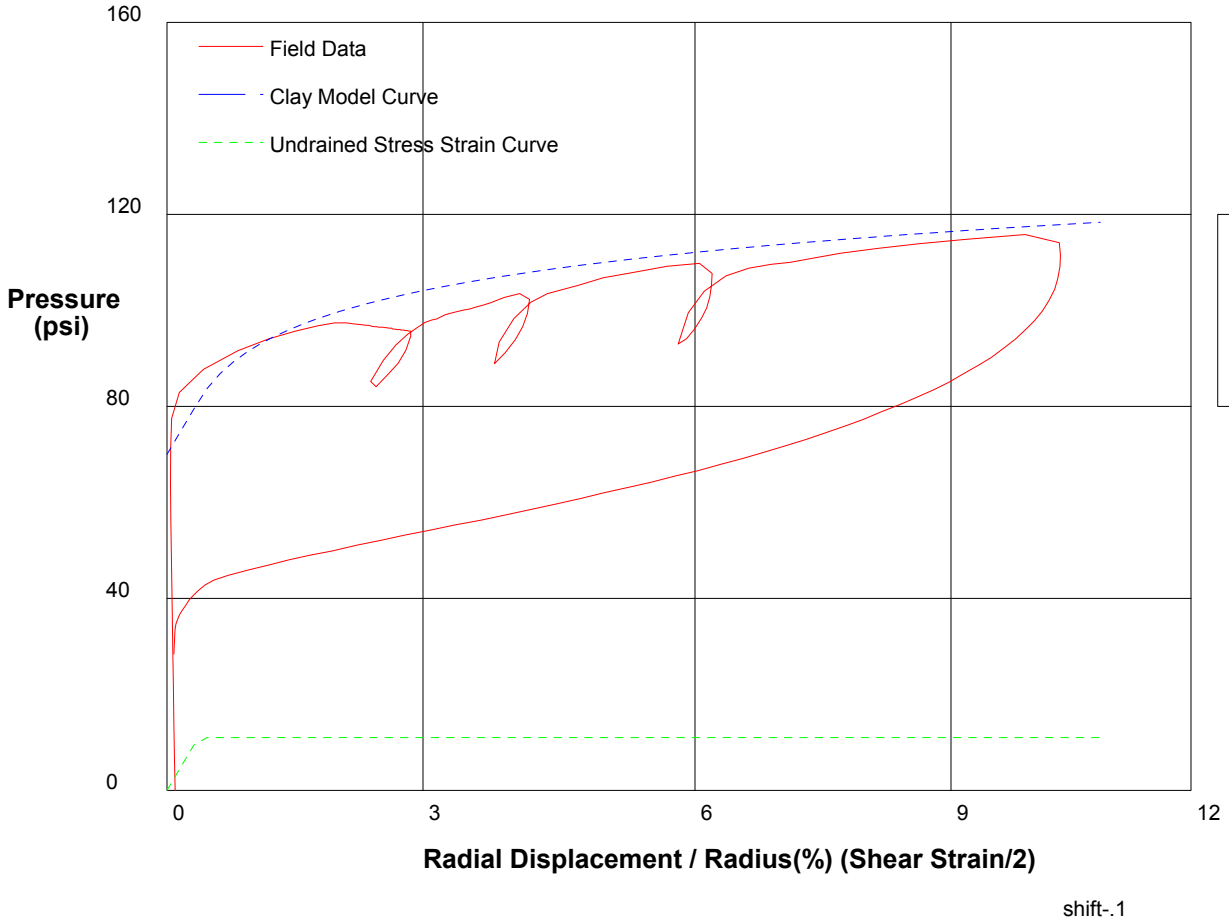
THE In Situ Engineering SAND MODEL

Water Pressure	38 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	12 psi
Shear Modulus	5000 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 96ft	File C:\DATA\ISE-787\DOT124.P

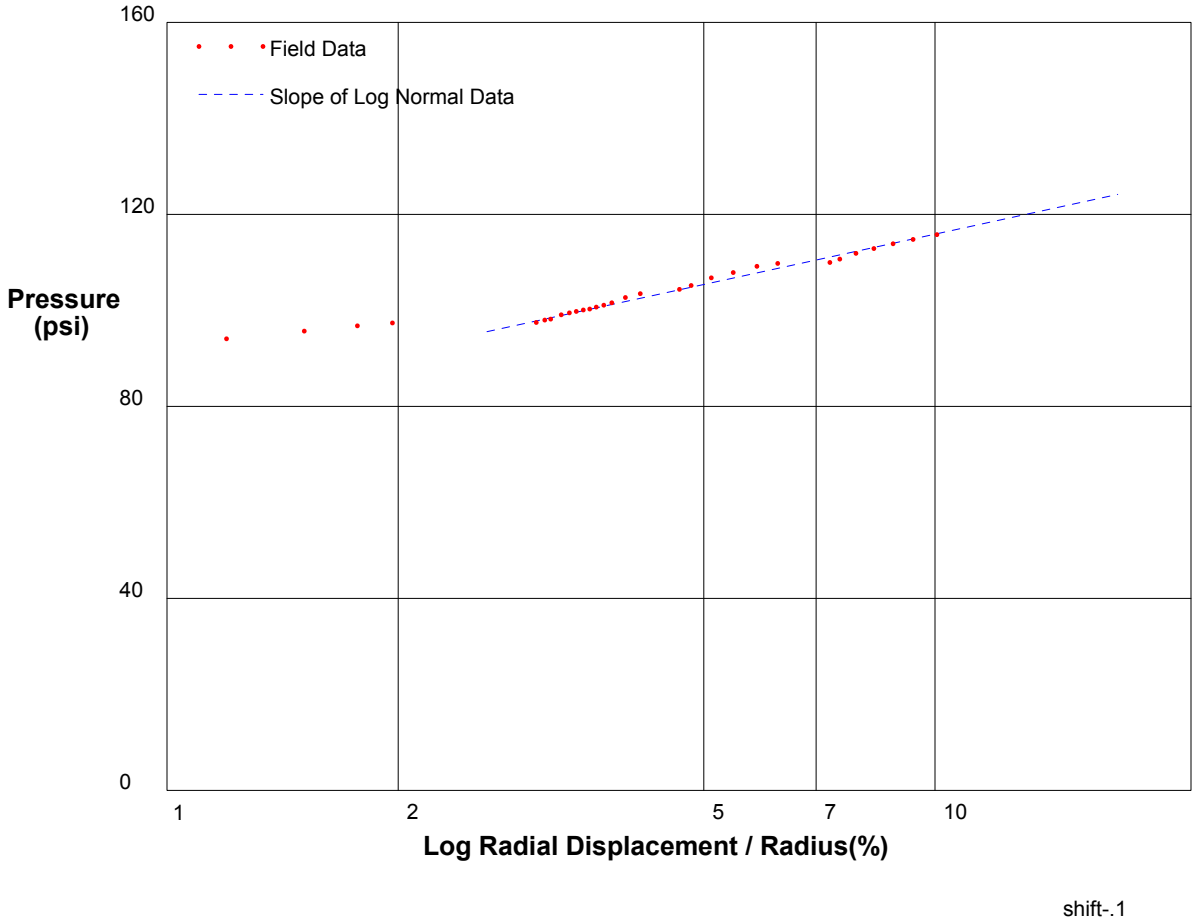


GIBSON'S CLAY MODEL

Shear Strength	11 psi
Insitu Stress	70 psi
Shear Modulus	1500 psi

In Situ Engineering

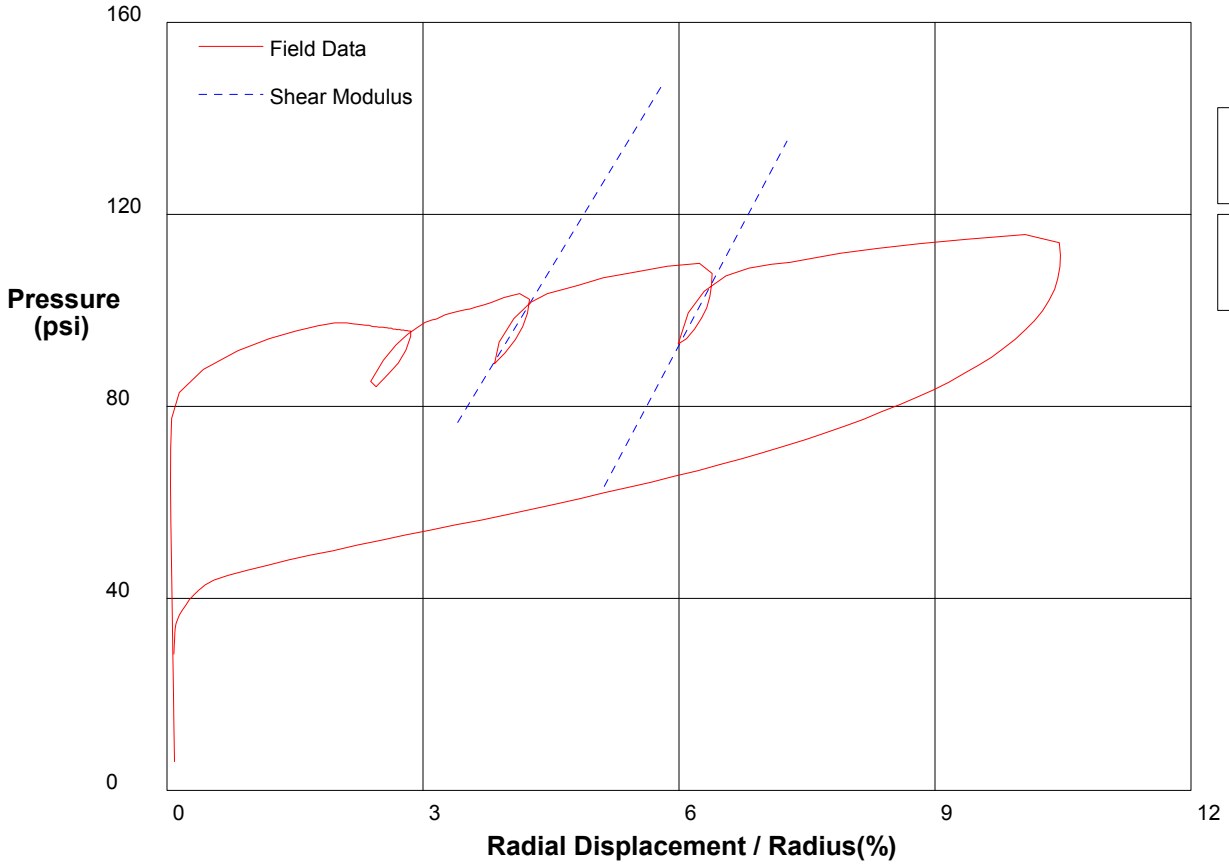
PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 96ft	File C:\DATA\ISE-787\DOT124.P



Shear Strength 15.1 psi
Limit Pressure 137 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 96ft	File C:\DATA\ISE-787\DOT124.P



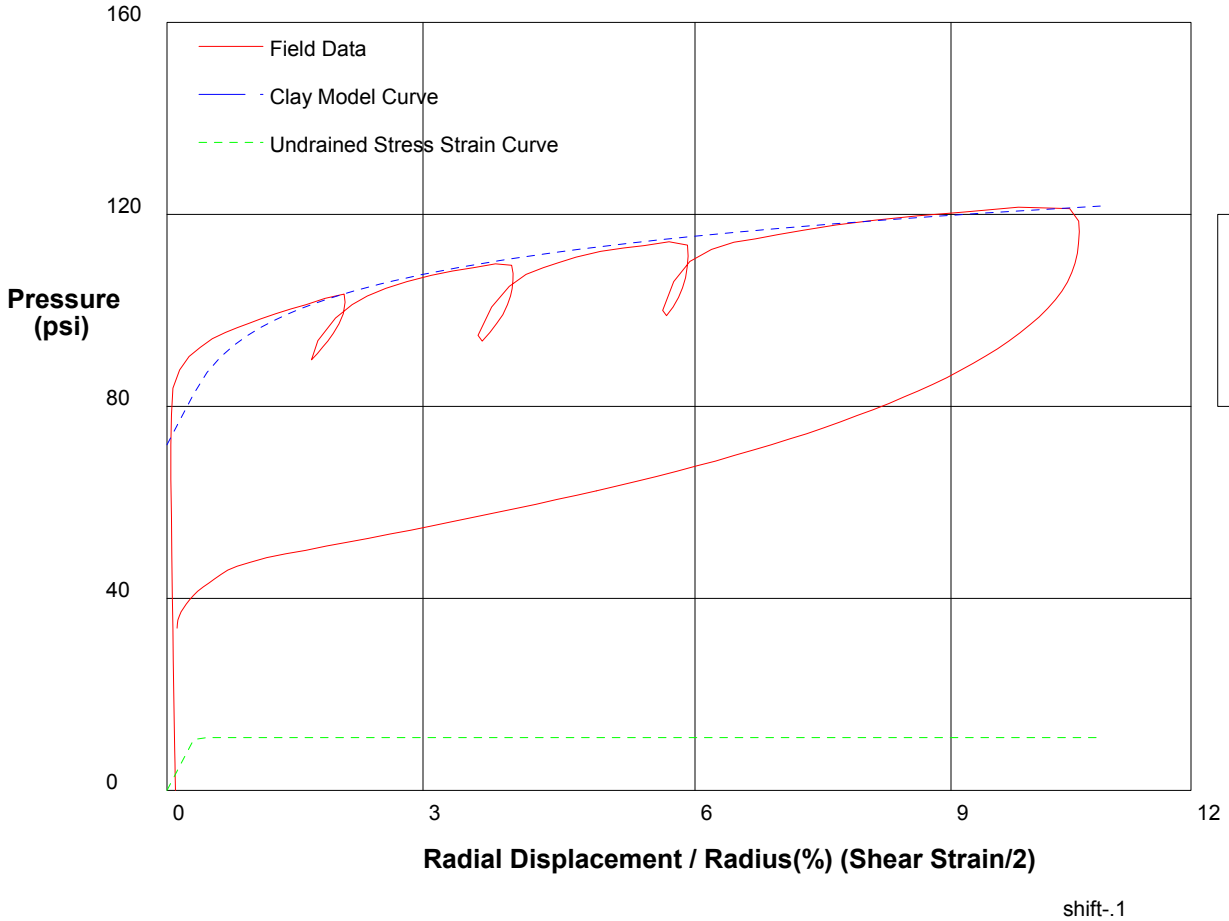
Shear Modulus 1680 psi

Shear Modulus 1466 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 98ft	File C:\DATA\ISE-787\DOT125.P

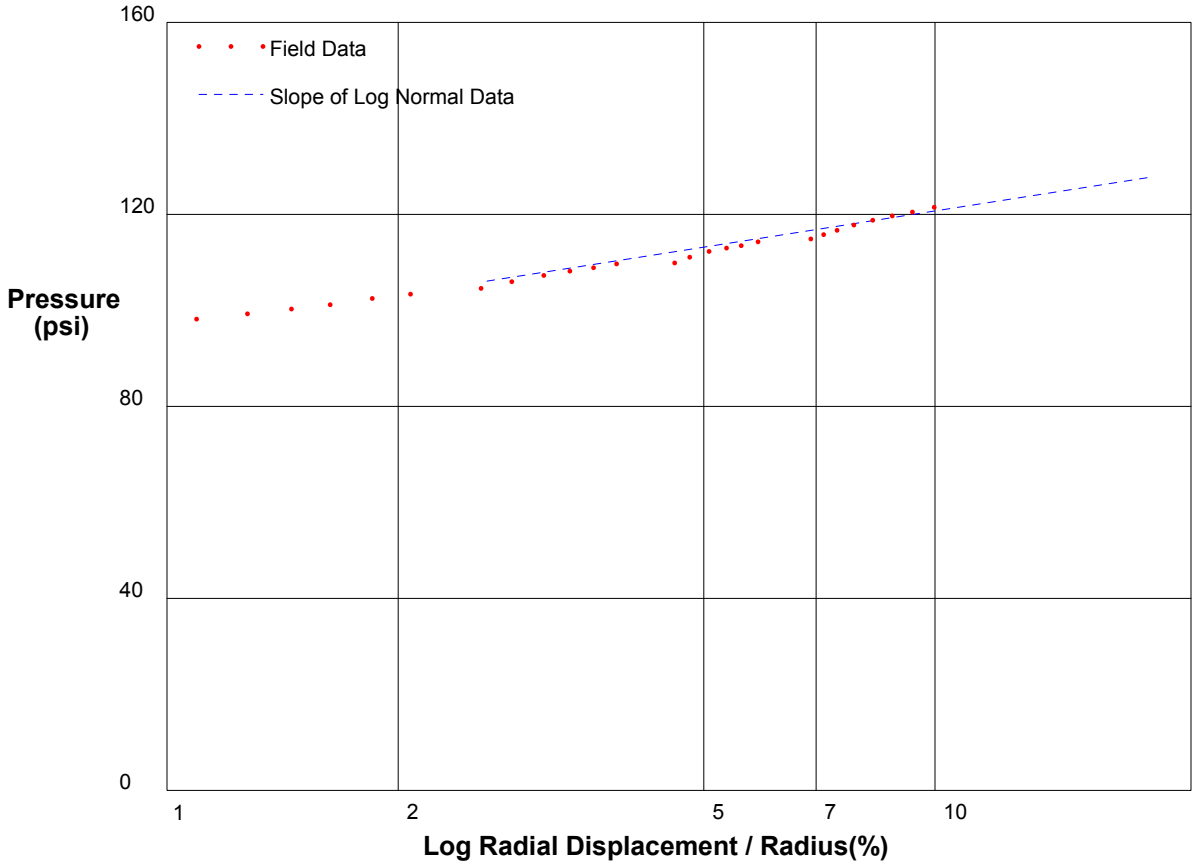


GIBSON'S CLAY MODEL

Shear Strength	11 psi
Insitu Stress	72 psi
Shear Modulus	1700 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 98ft	File C:\DATA\ISE-787\DOT125.P

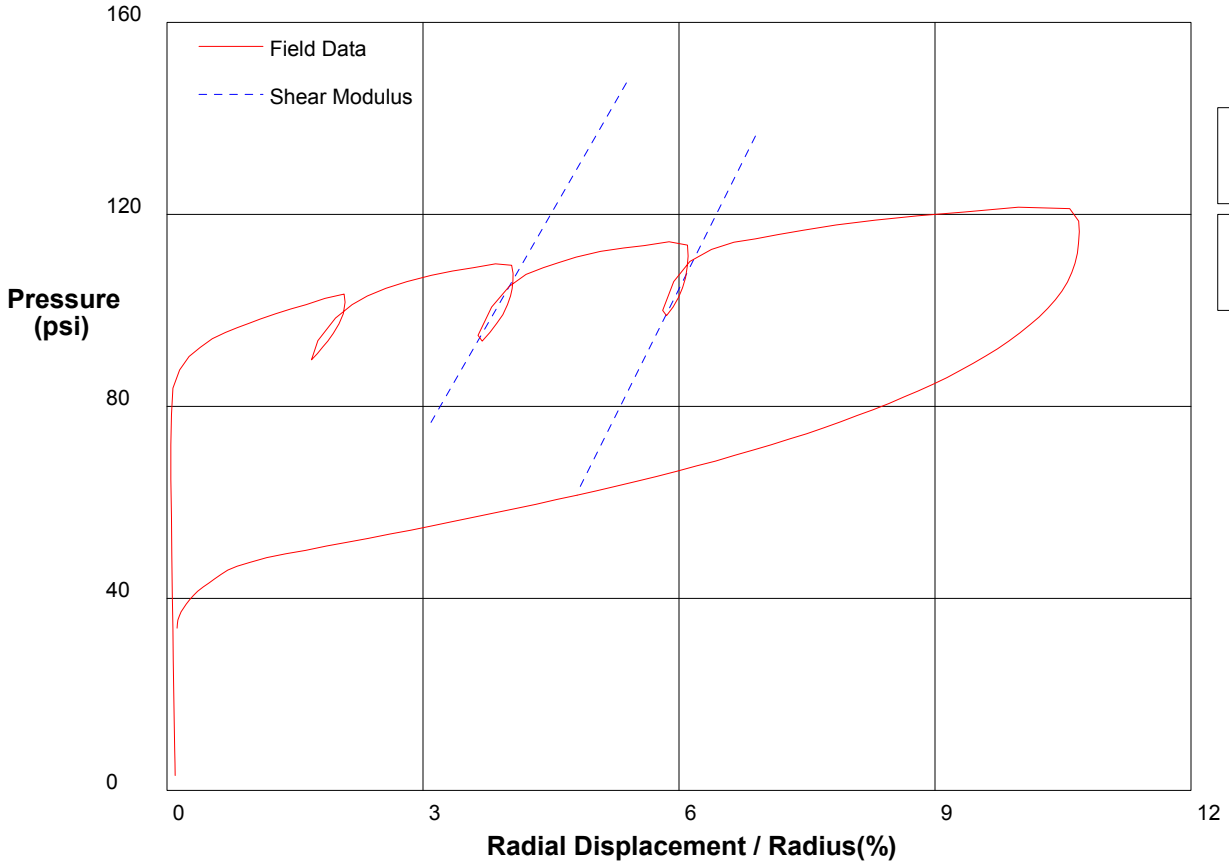


Shear Strength 10.8 psi
Limit Pressure 136 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 98ft	File C:\DATA\ISE-787\DOT125.P



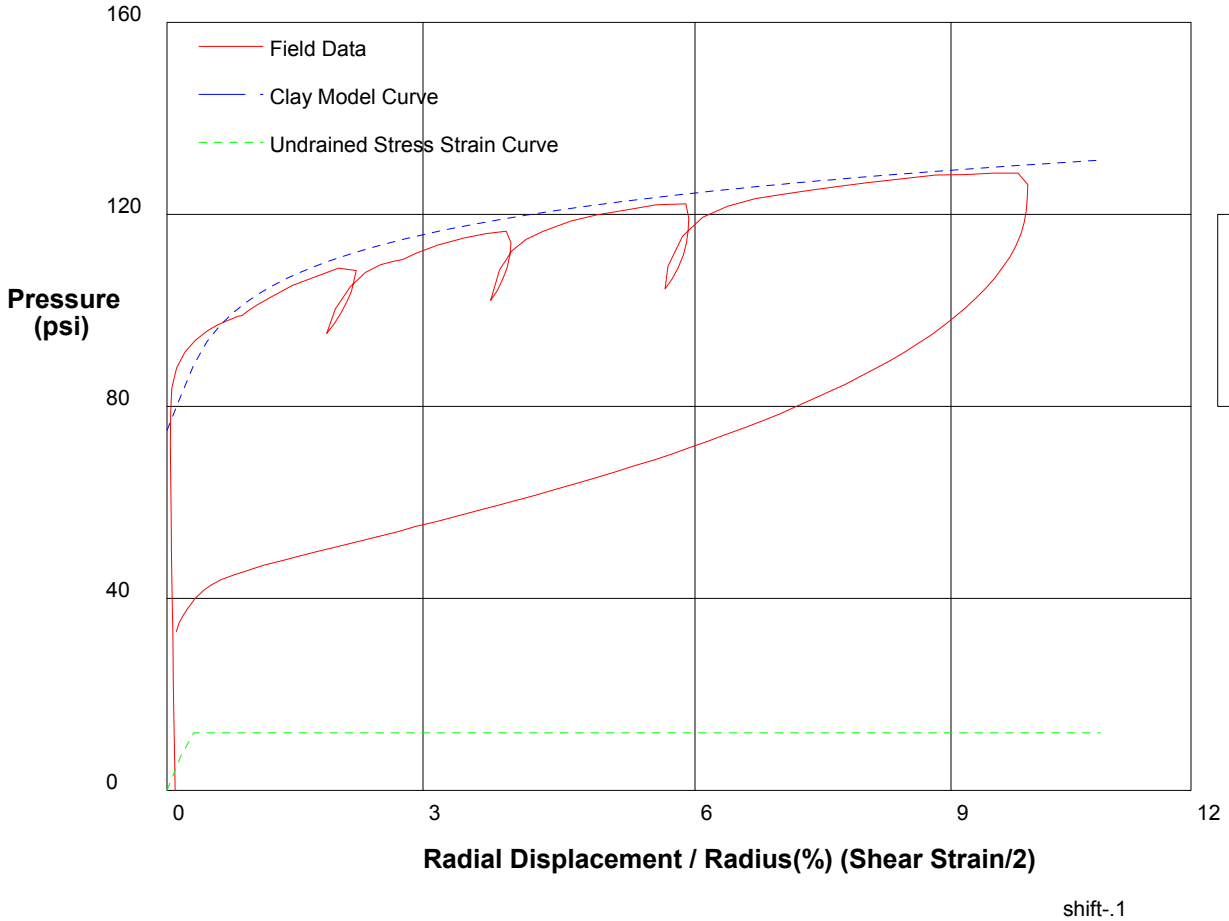
Shear Modulus 1777 psi

Shear Modulus 1545 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 100ft	File C:\DATA\ISE-787\DOT126.P

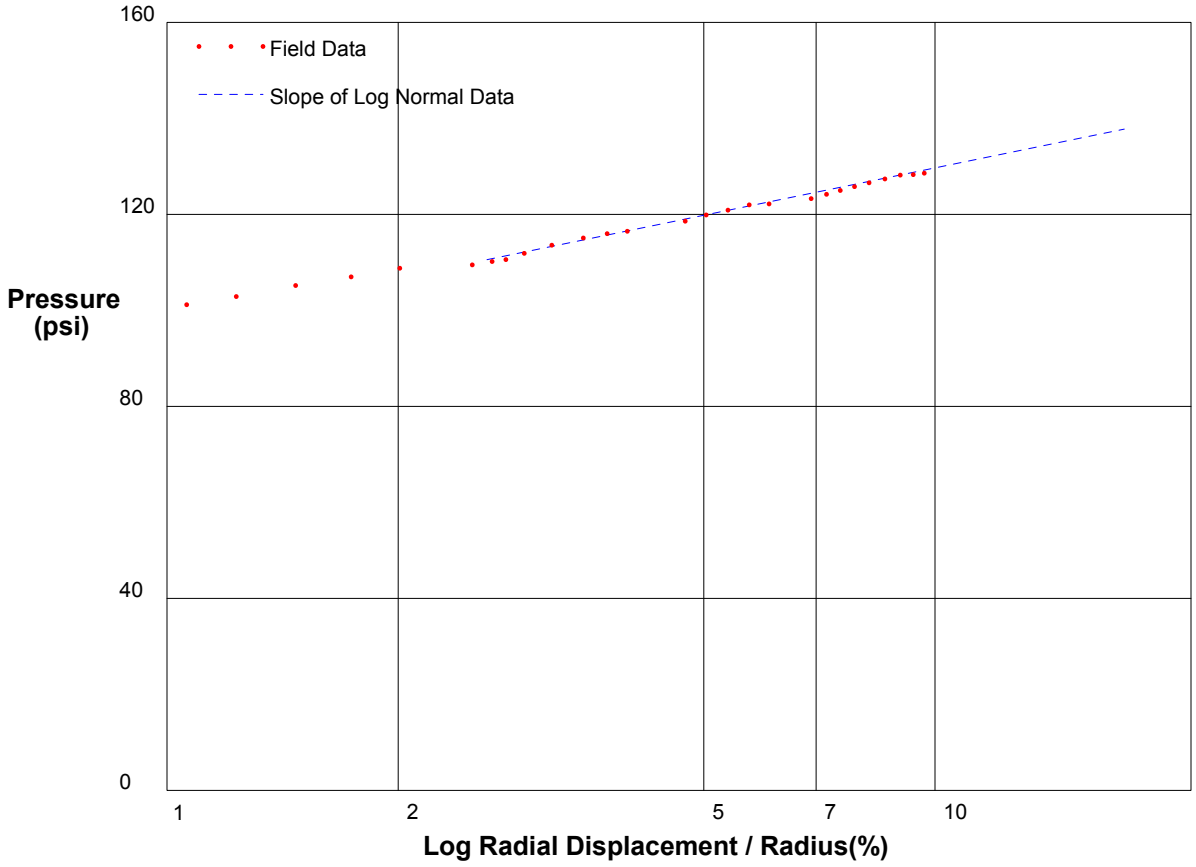


GIBSON'S CLAY MODEL

Shear Strength	12 psi
Insitu Stress	75 psi
Shear Modulus	2200 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 100ft	File C:\DATA\ISE-787\DOT126.P

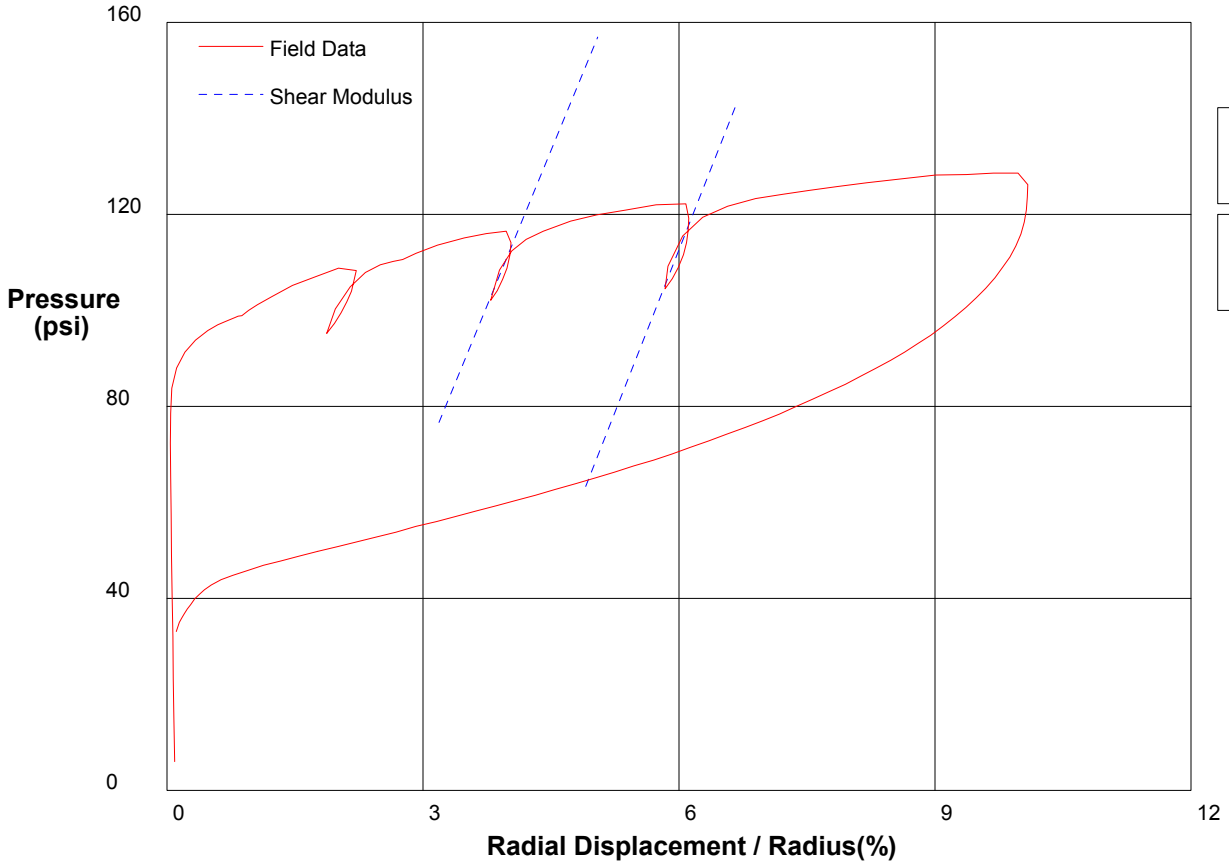


Shear Strength 14.2 psi
Limit Pressure 149 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 100ft	File C:\DATA\ISE-787\DOT126.P



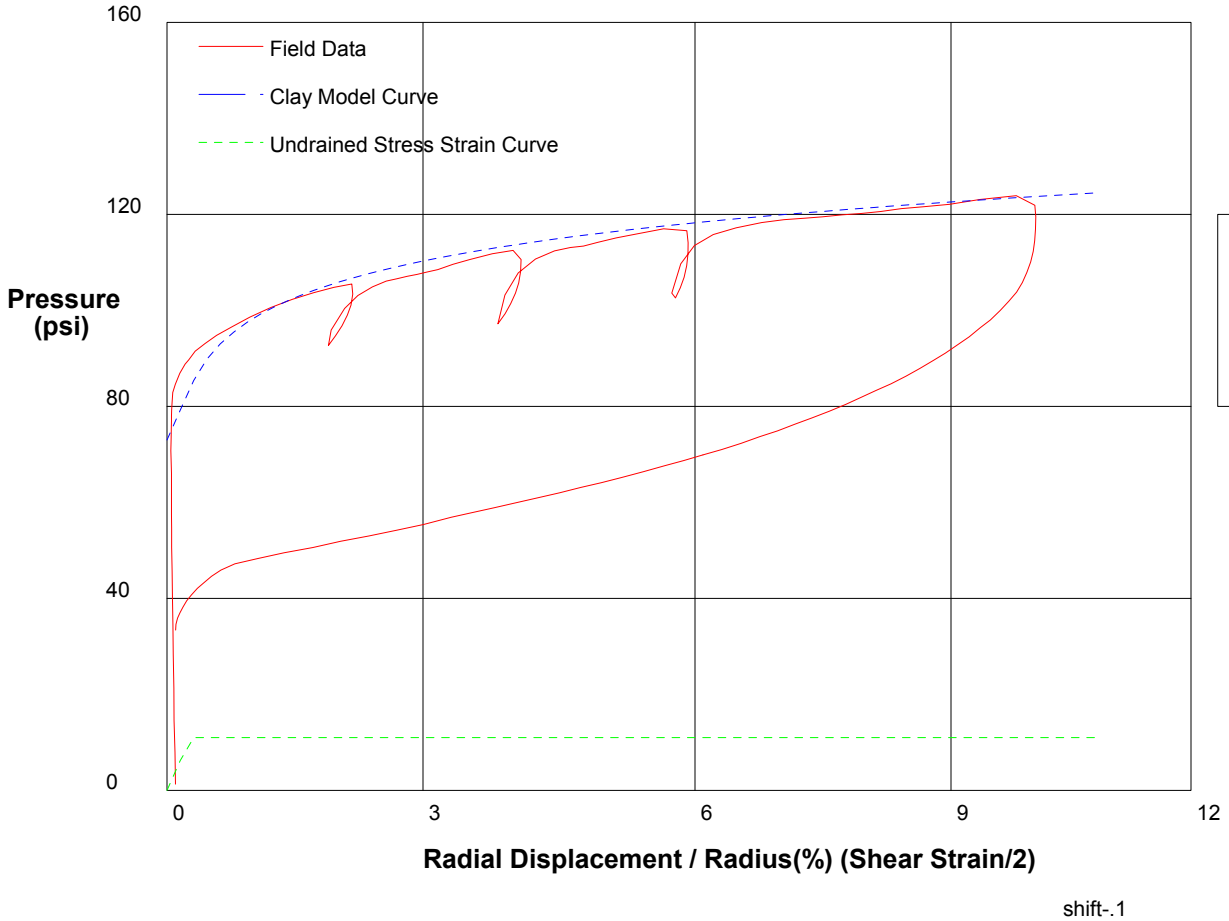
Shear Modulus 2253 psi

Shear Modulus 2158 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 102ft	File C:\DATA\ISE-787\DOT127.P

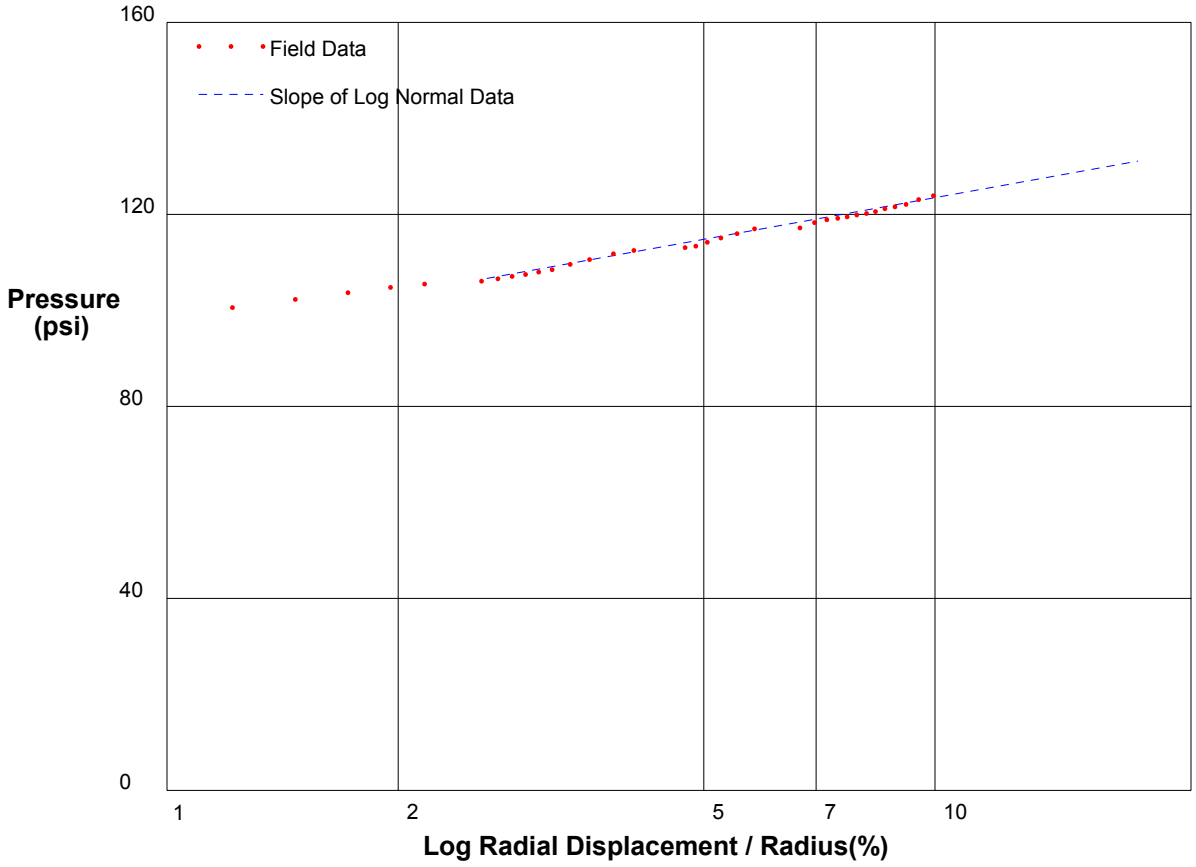


GIBSON'S CLAY MODEL

Shear Strength	11	psi
Insitu Stress	73	psi
Shear Modulus	2000	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 102ft	File C:\DATA\ISE-787\DOT127.P

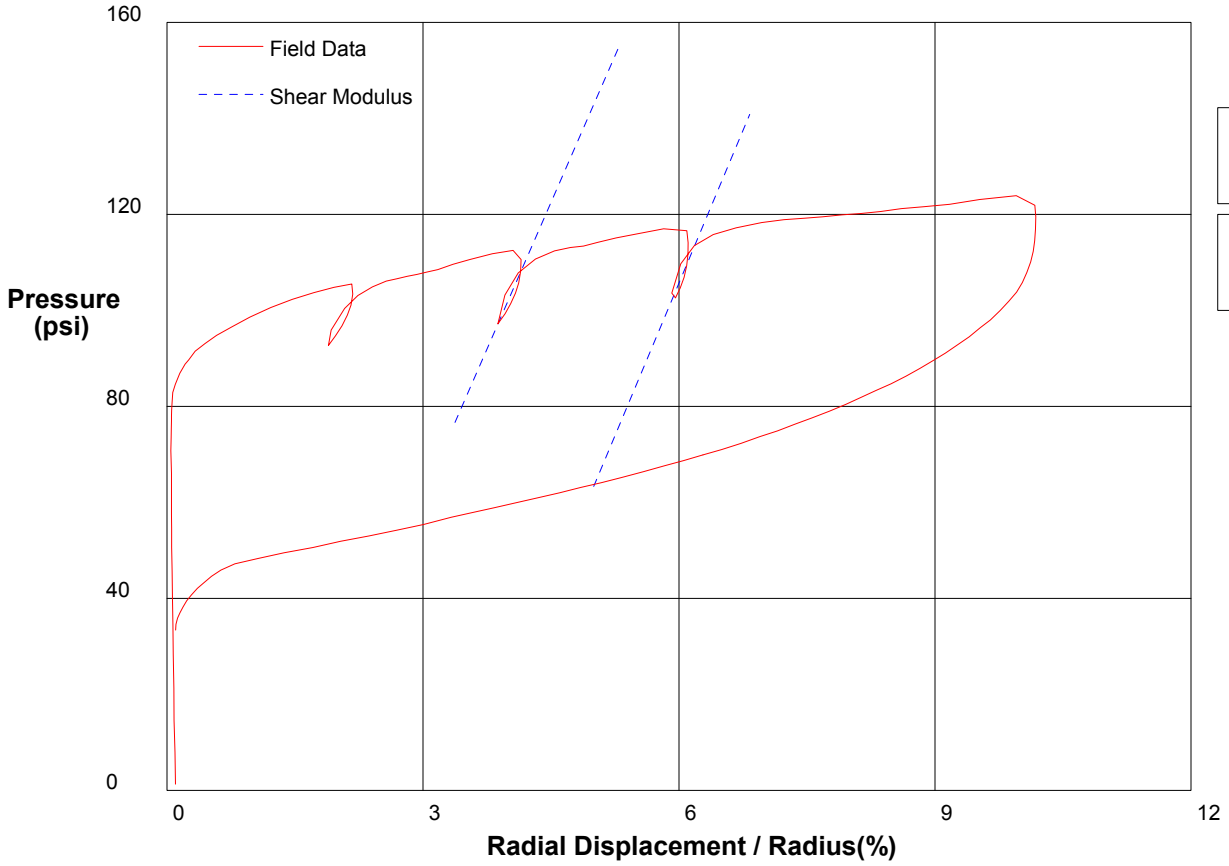


Shear Strength 12.5 psi
Limit Pressure 141 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 102ft	File C:\DATA\ISE-787\DOT127.P



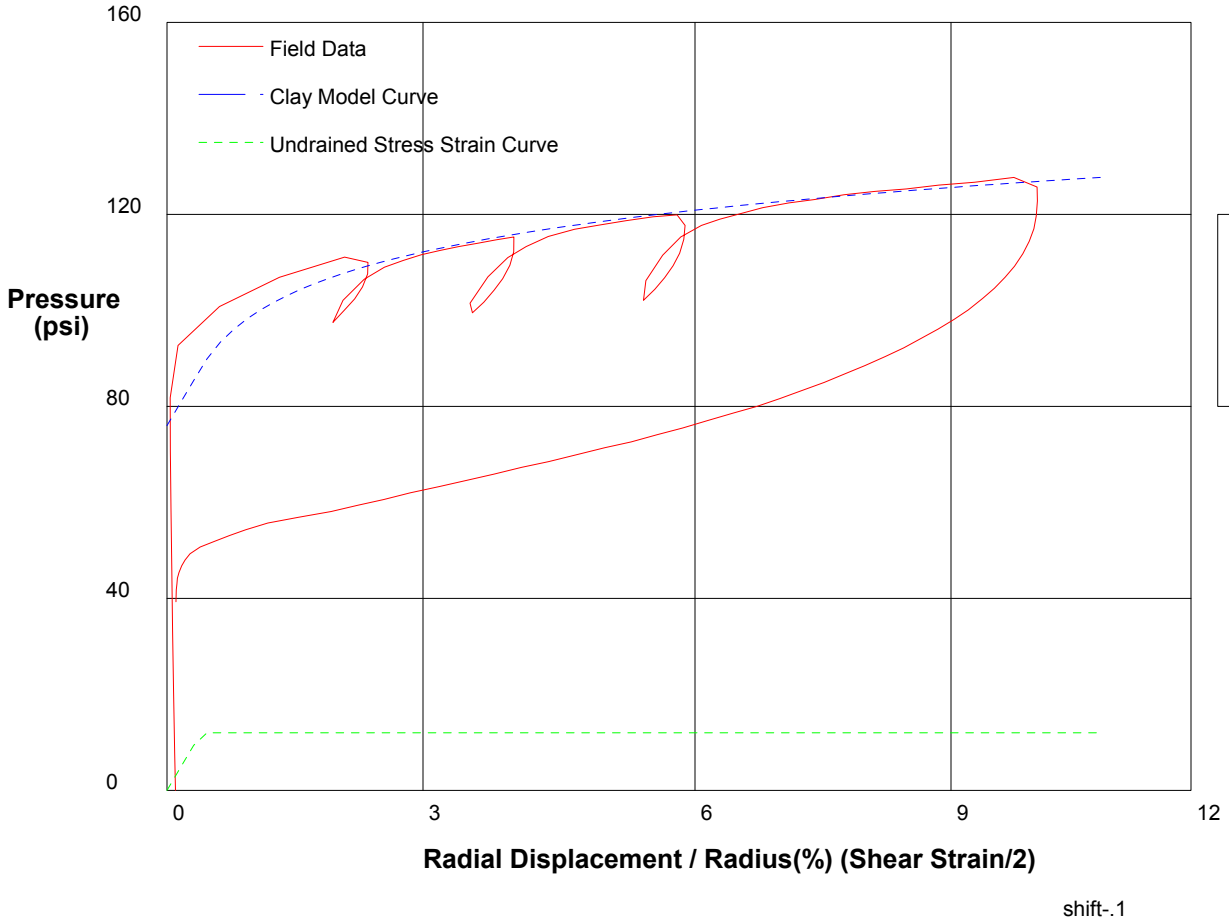
Shear Modulus 2119 psi

Shear Modulus 2035 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 104ft	File C:\DATA\ISE-787\DOT128.P

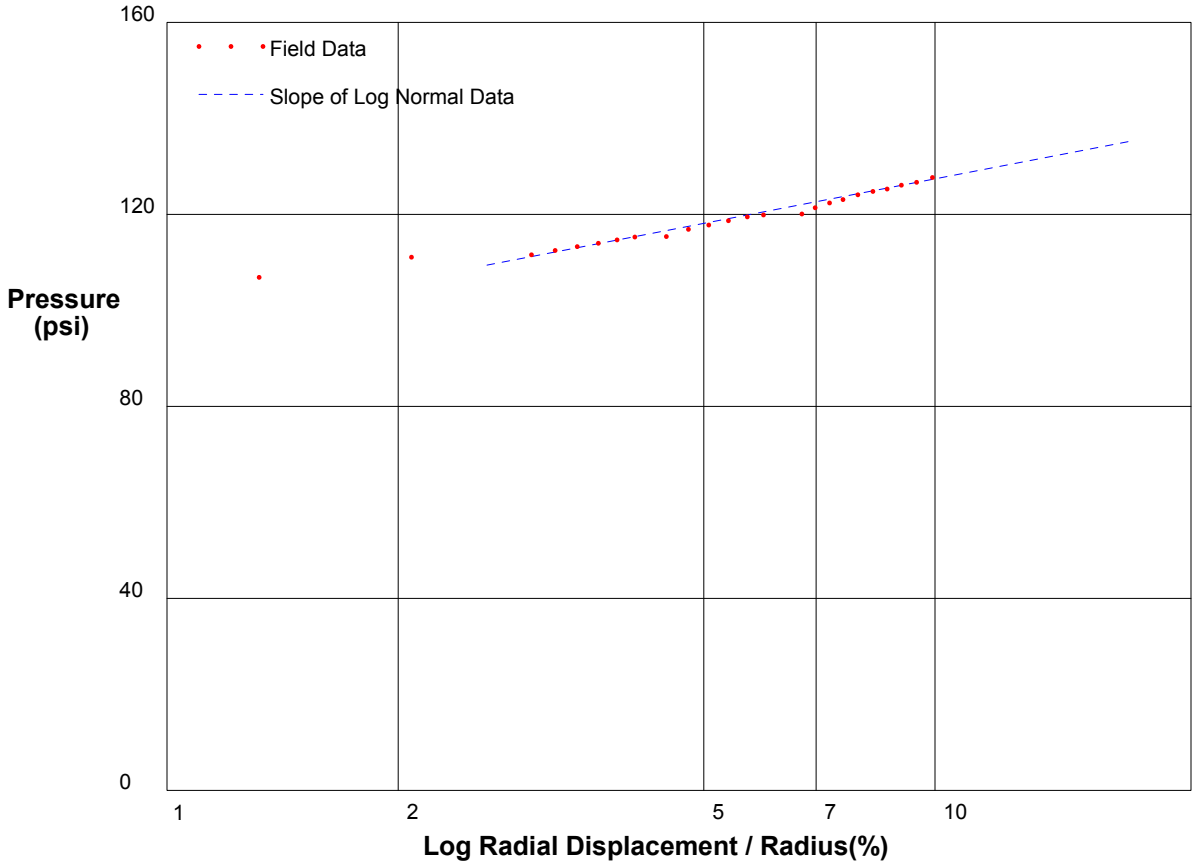


GIBSON'S CLAY MODEL

Shear Strength	12 psi
Insitu Stress	76 psi
Shear Modulus	1500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 104ft	File C:\DATA\ISE-787\DOT128.P

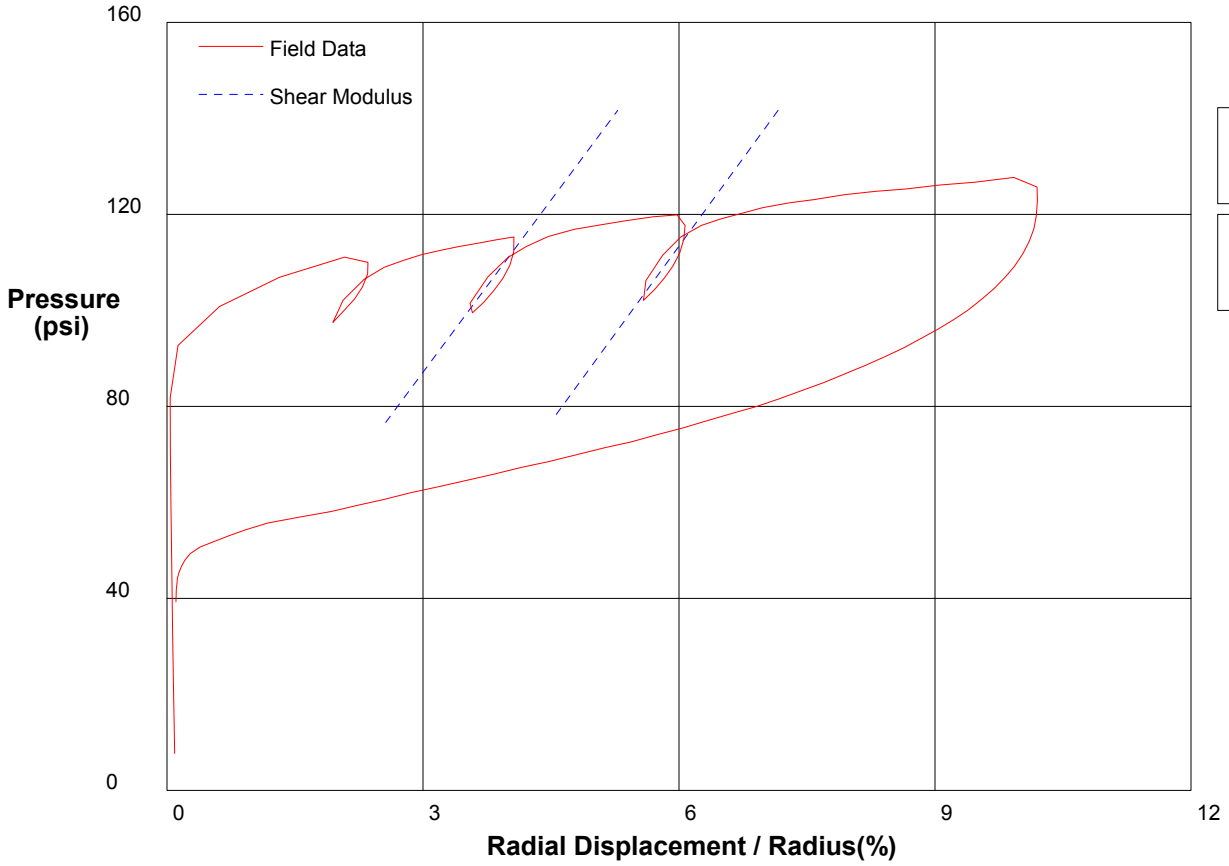


Shear Strength 13.3 psi
Limit Pressure 146 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/7/2008
Hole No. TH-31B-PMT-08 Depth 104ft	File C:\DATA\ISE-787\DOT128.P



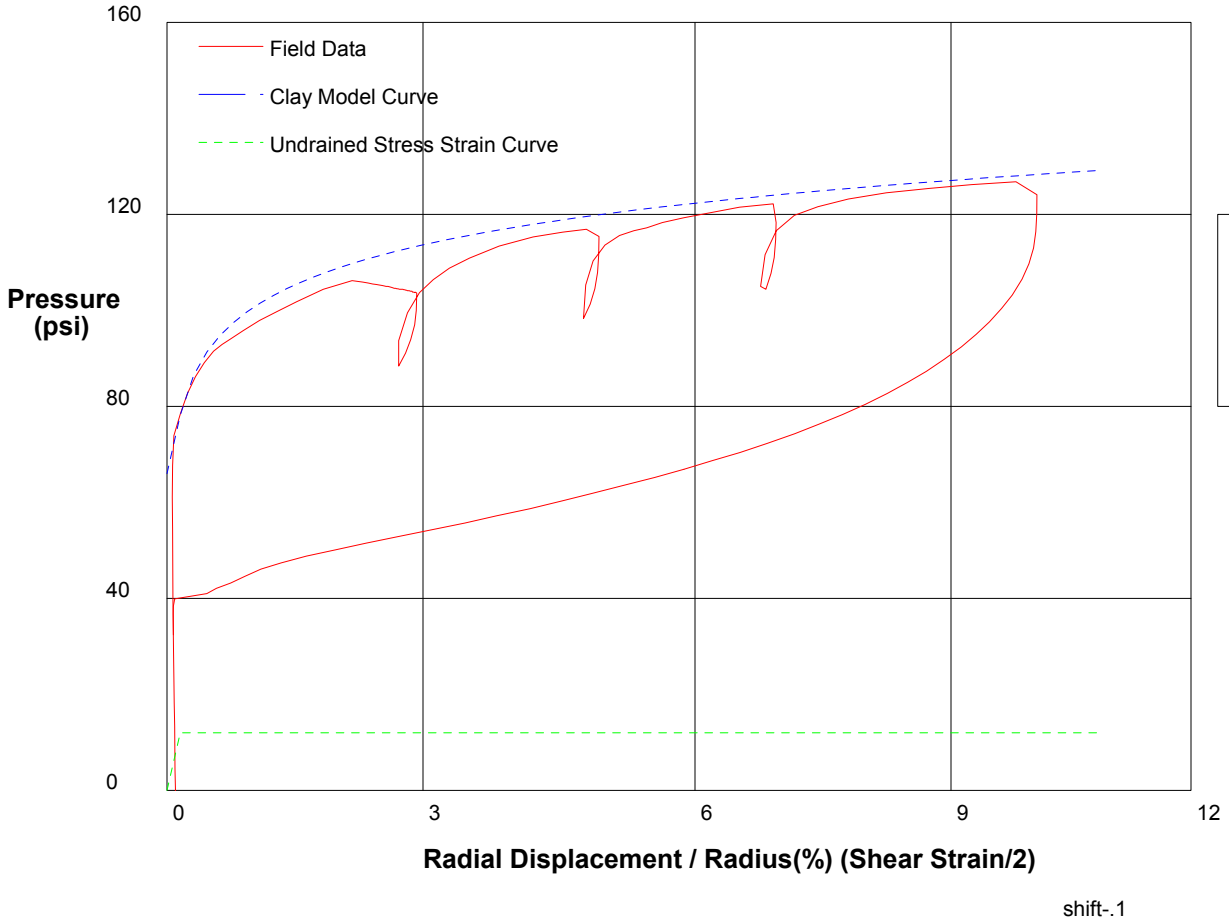
Shear Modulus 1218 psi

Shear Modulus 1195 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 107ft	File C:\DATA\ISE-787\DOT129.P

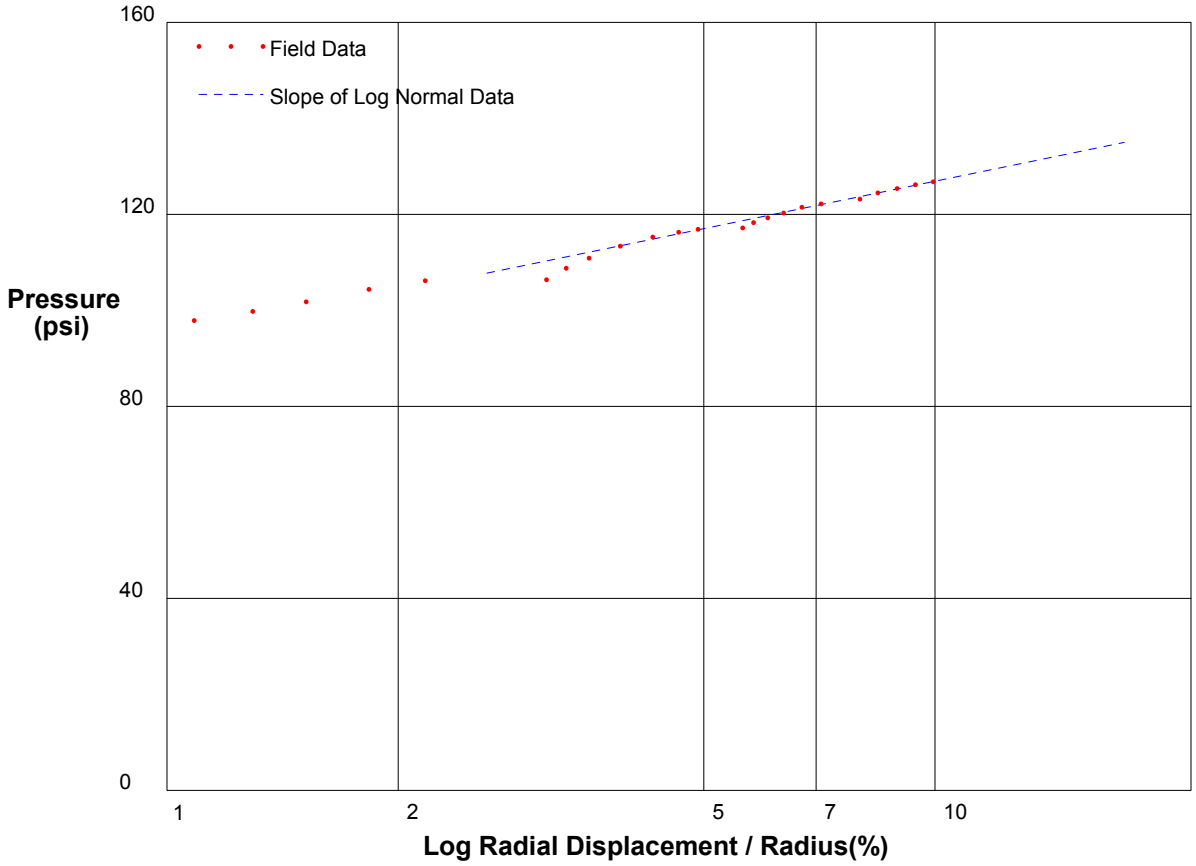


GIBSON'S CLAY MODEL

Shear Strength	12 psi
Insitu Stress	66 psi
Shear Modulus	3900 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 107ft	File C:\DATA\ISE-787\DOT129.P

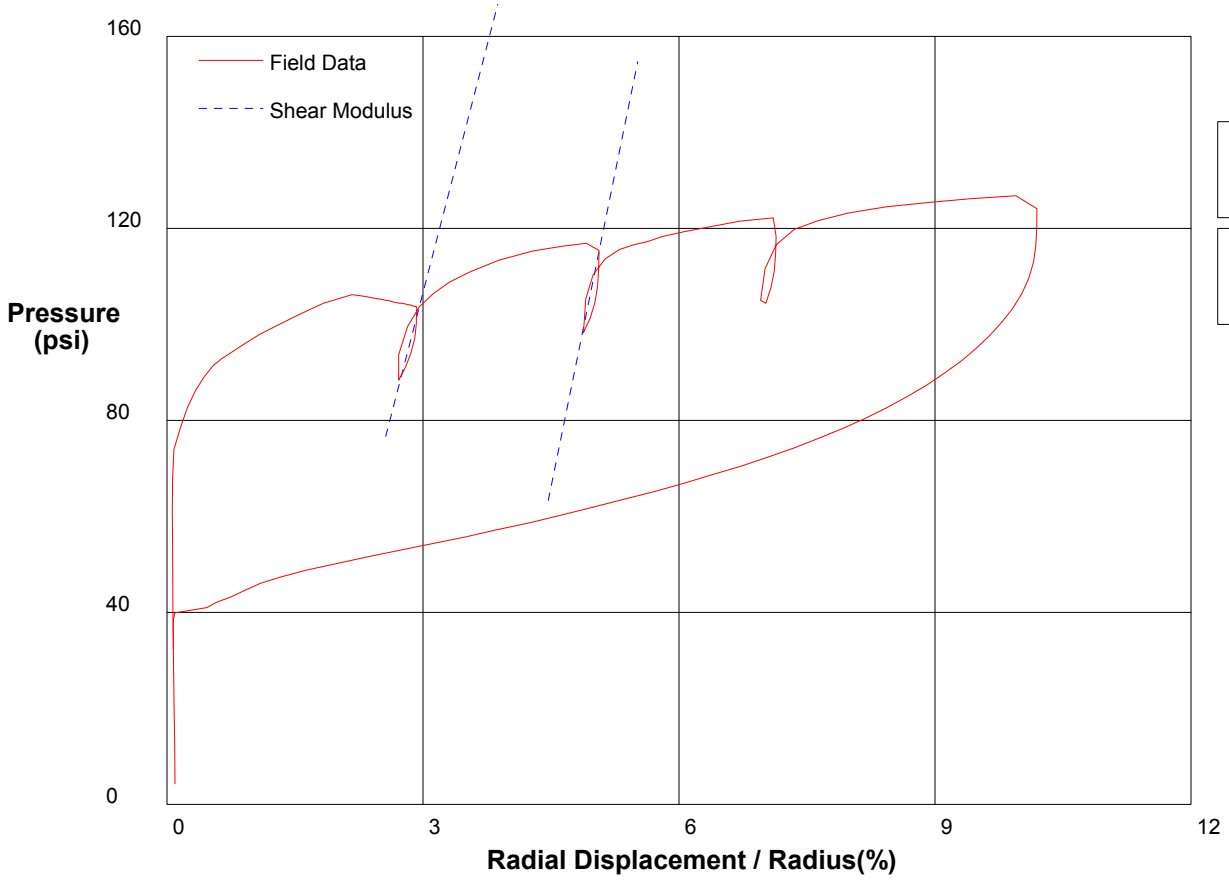


Shear Strength 14.2 psi
Limit Pressure 147 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 107ft	File C:\DATA\ISE-787\DOT129.P



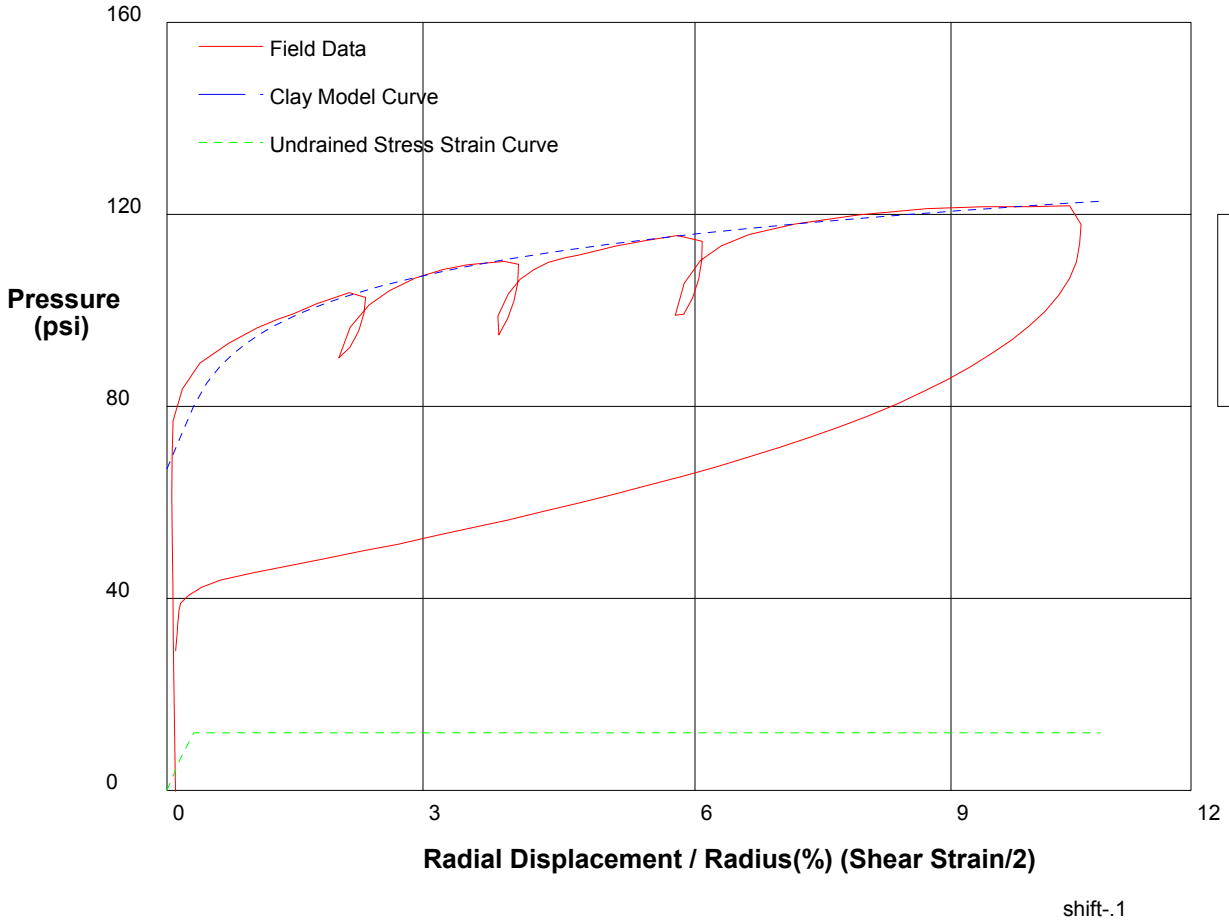
Shear Modulus 4364 psi

Shear Modulus 3428 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 109ft	File C:\DATA\ISE-787\DOT130.P

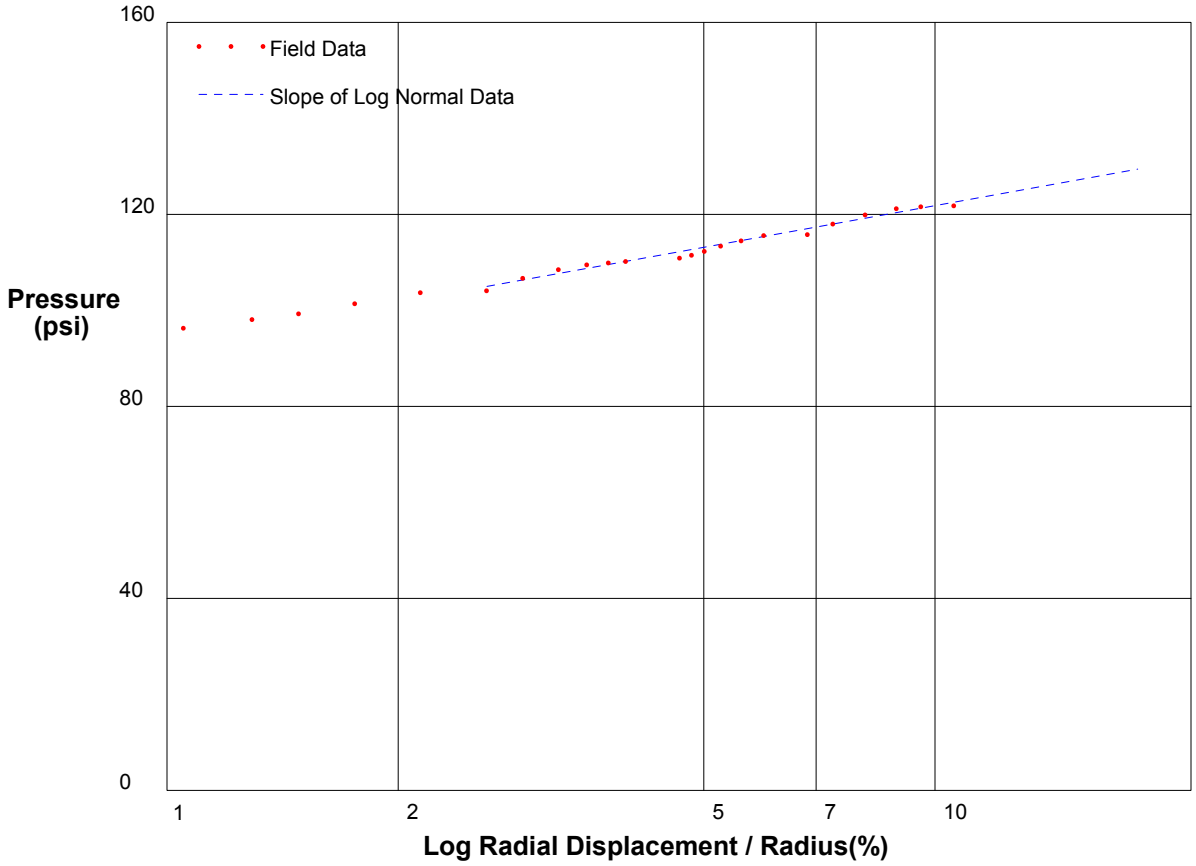


GIBSON'S CLAY MODEL

Shear Strength	12	psi
Insitu Stress	67	psi
Shear Modulus	2100	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 109ft	File C:\DATA\ISE-787\DOT130.P

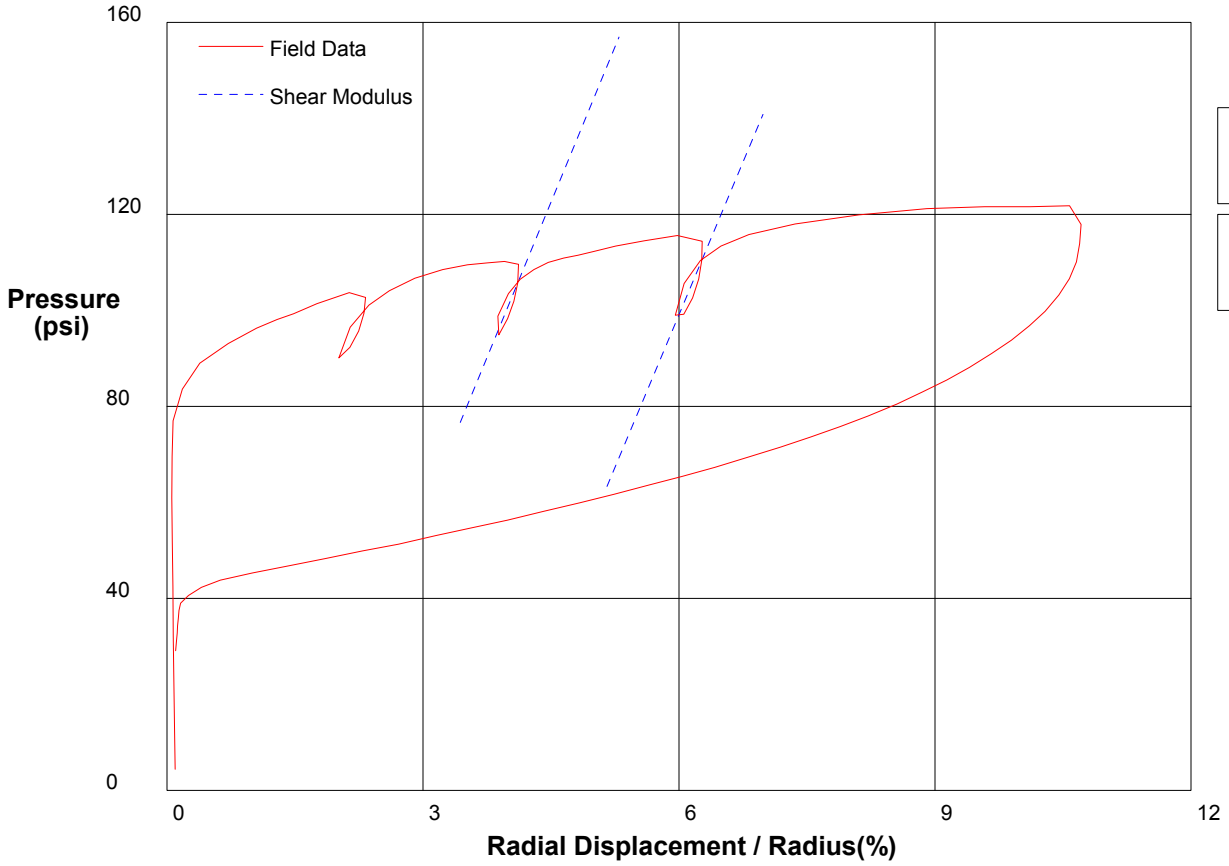


Shear Strength 12.5 psi
Limit Pressure 139 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 109ft	File C:\DATA\ISE-787\DOT130.P



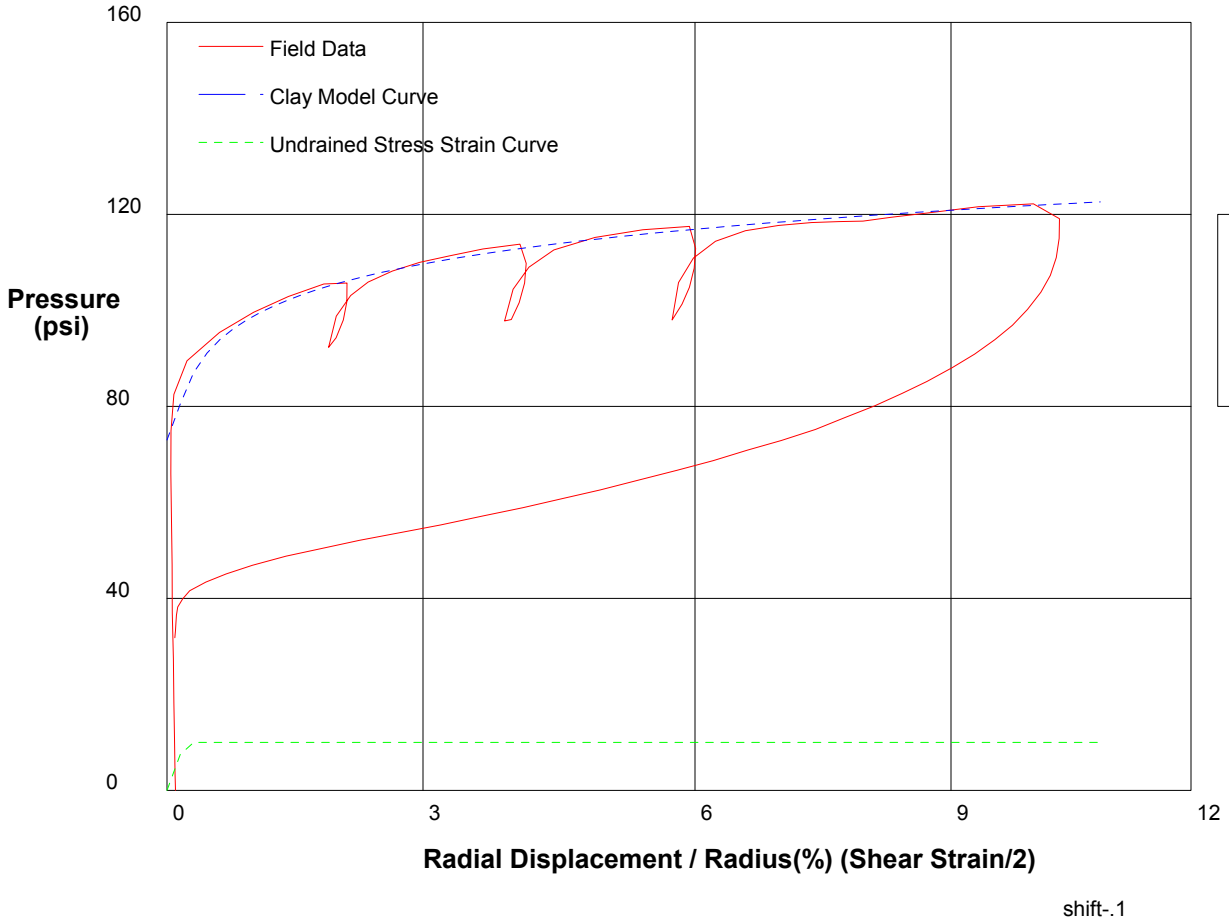
Shear Modulus 2119 psi

Shear Modulus 2158 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 111ft	File C:\DATA\ISE-787\DOT131.P

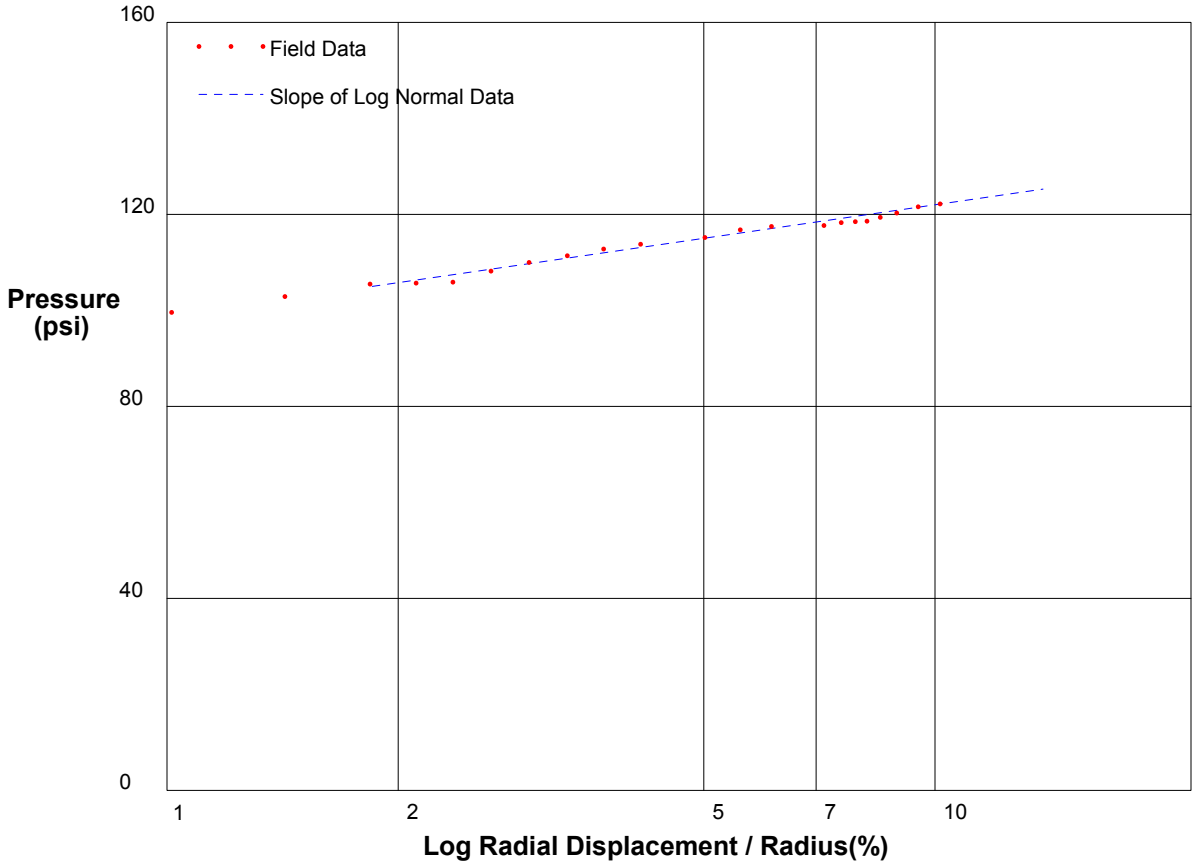


GIBSON'S CLAY MODEL

Shear Strength	10	psi
Insitu Stress	73	psi
Shear Modulus	2400	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 111ft	File C:\DATA\ISE-787\DOT131.P

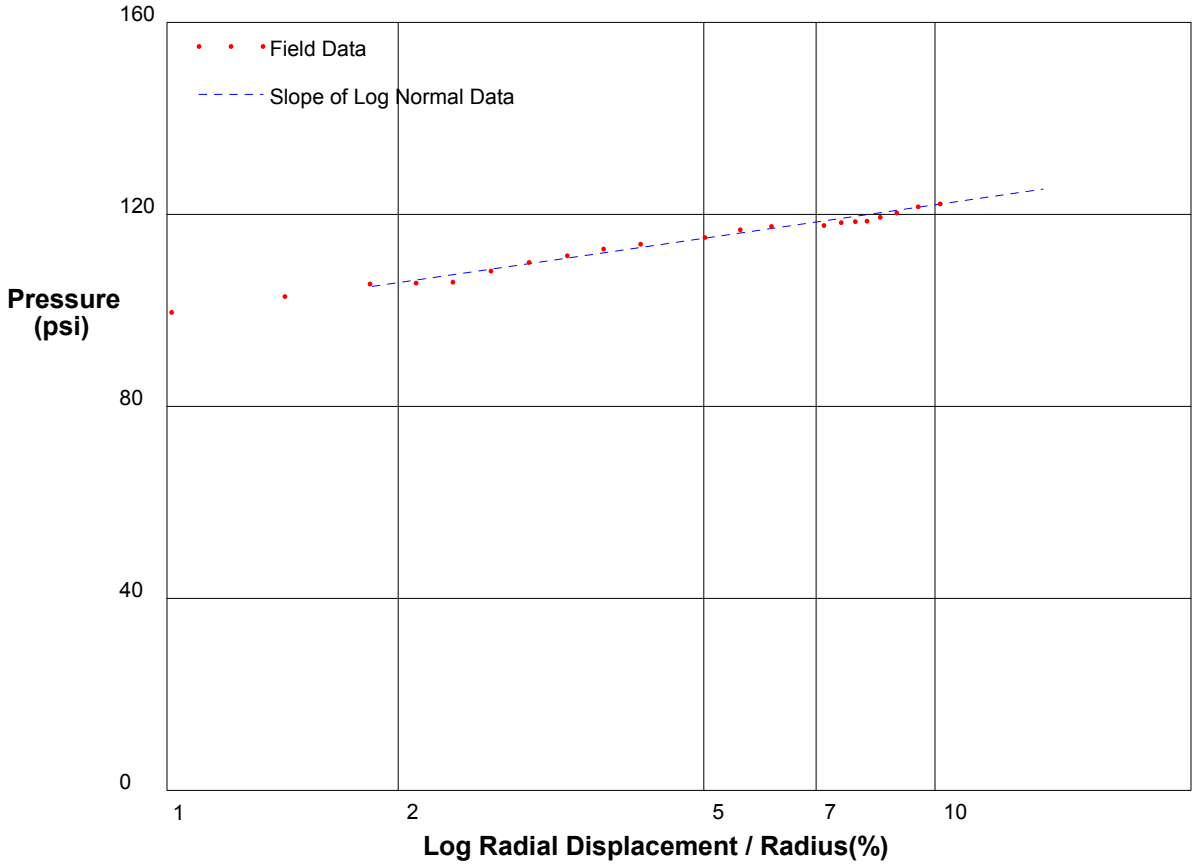


Shear Strength 10 psi
Limit Pressure 136 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 111ft	File C:\DATA\ISE-787\DOT131.P

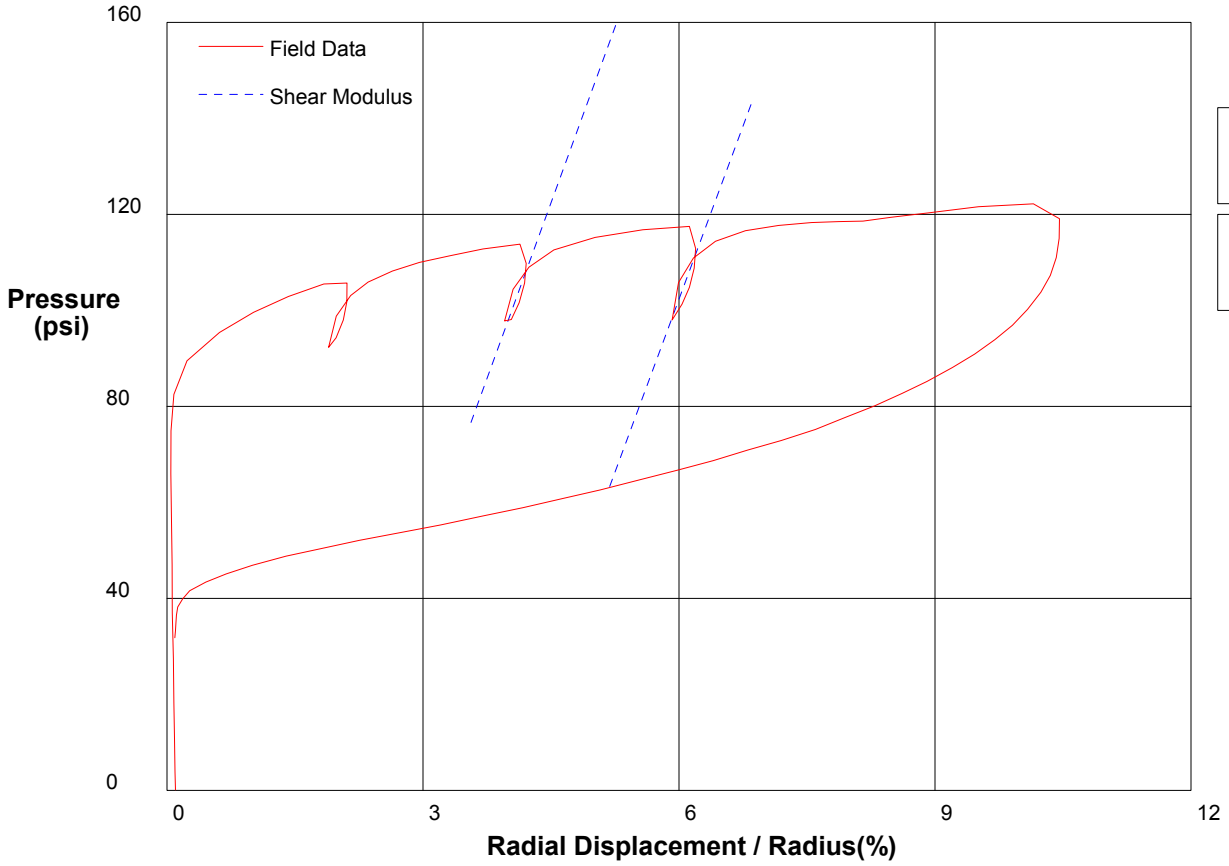


Shear Strength 10 psi
Limit Pressure 136 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 111ft	File C:\DATA\ISE-787\DOT131.P



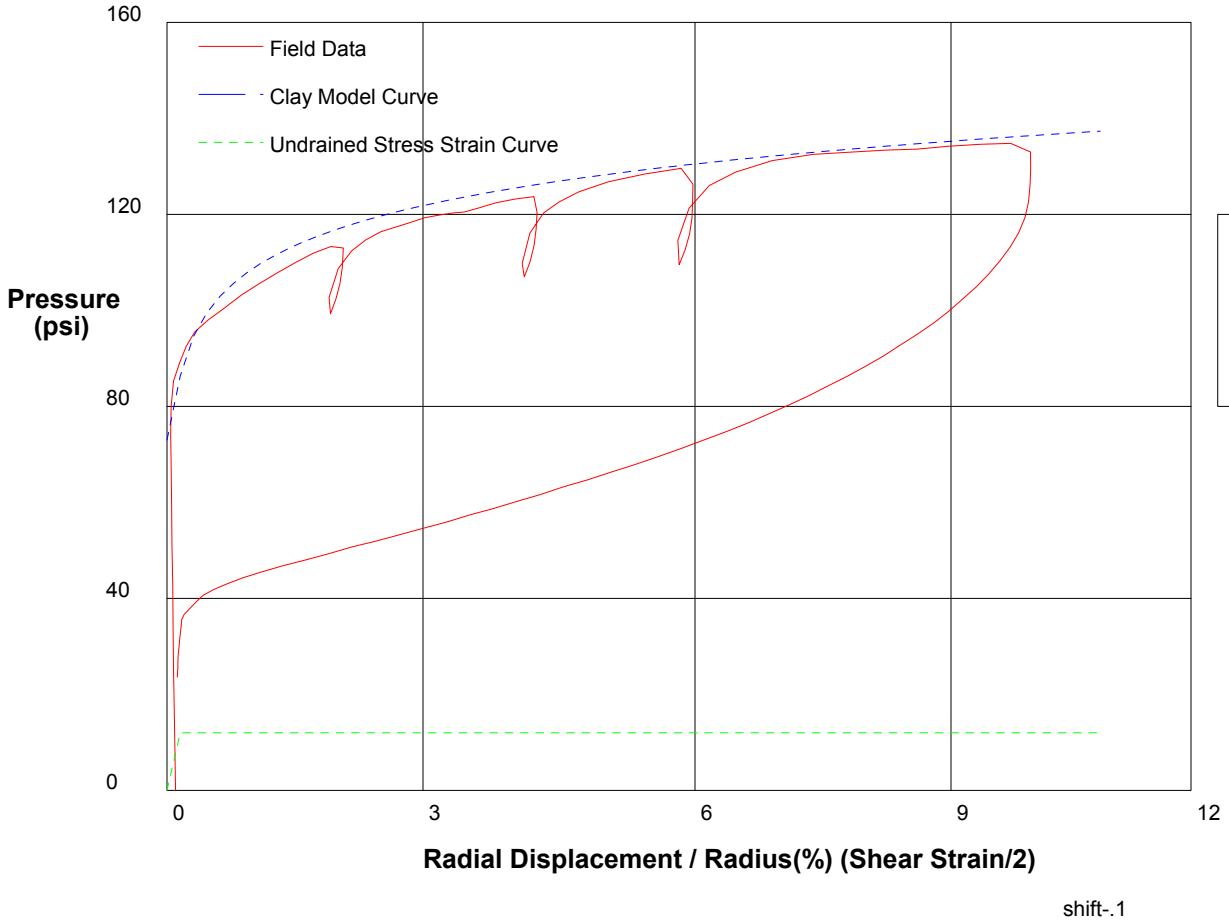
Shear Modulus 2400 psi

Shear Modulus 2438 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 113ft	File C:\DATA\ISE-787\DOT132.P

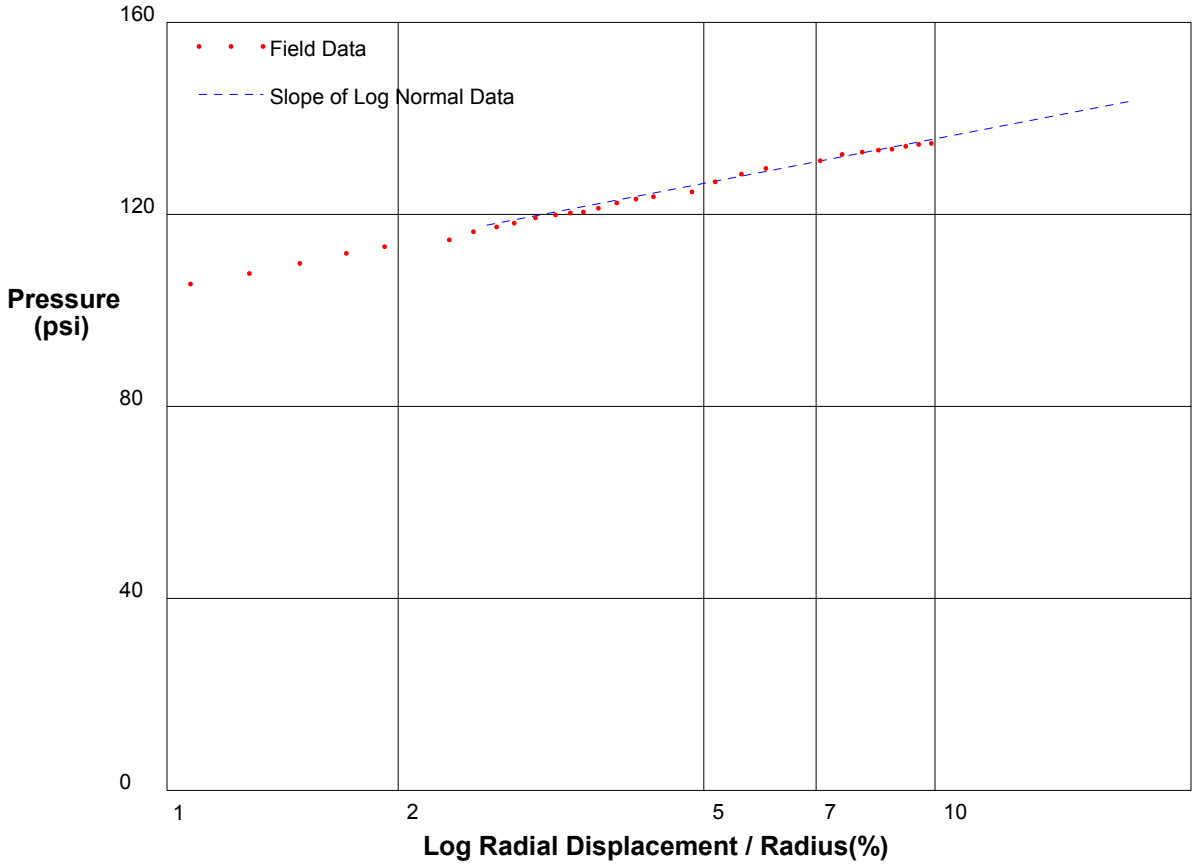


GIBSON'S CLAY MODEL

Shear Strength	12 psi
Insitu Stress	73 psi
Shear Modulus	4300 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 113ft	File C:\DATA\ISE-787\DOT132.P



Shear Strength 13.3 psi
Limit Pressure 154 psi

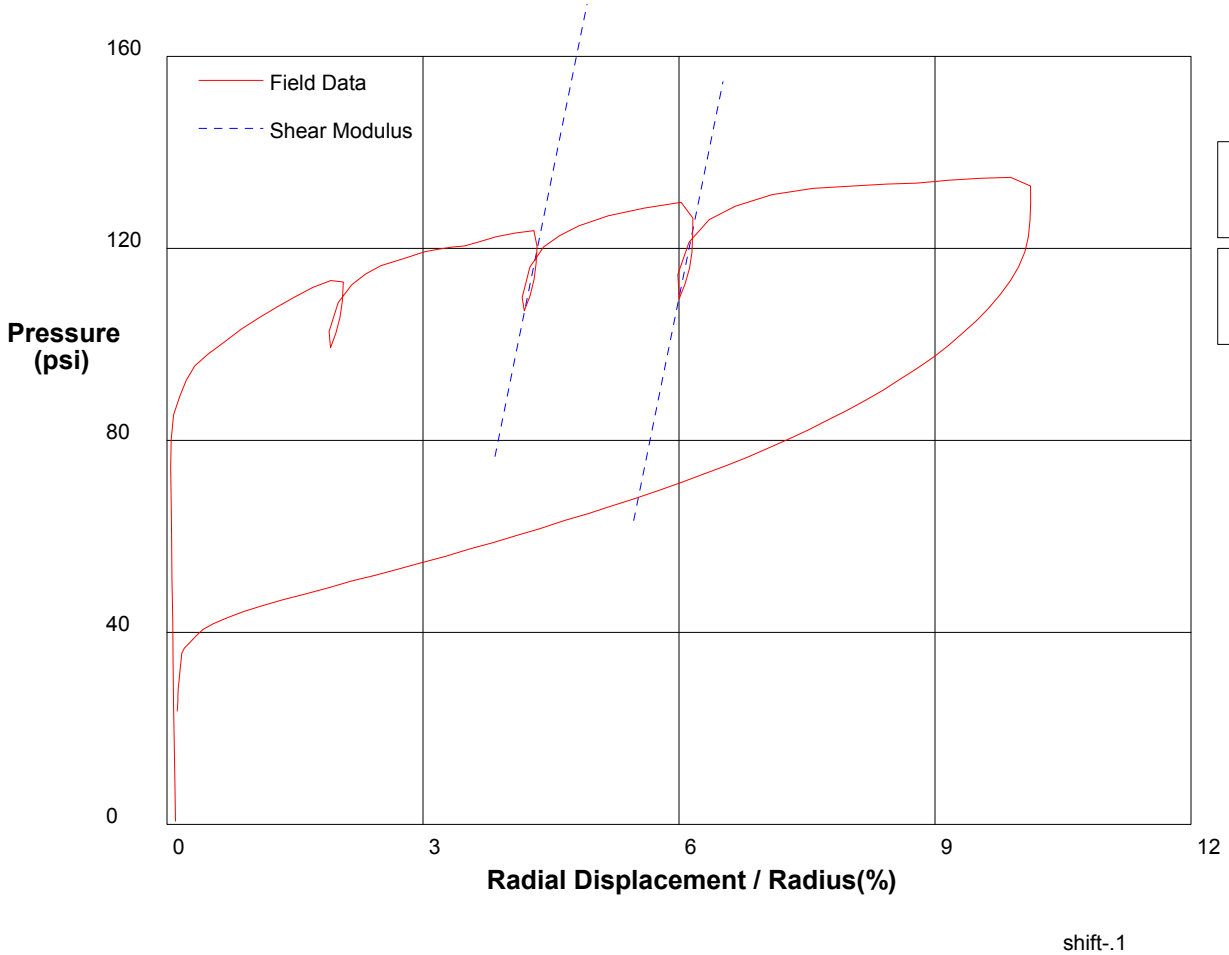
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/8/2008**

Hole No. TH-31B-PMT-08 Depth 113ft **File C:\DATA\ISE-787\DOT132.P**

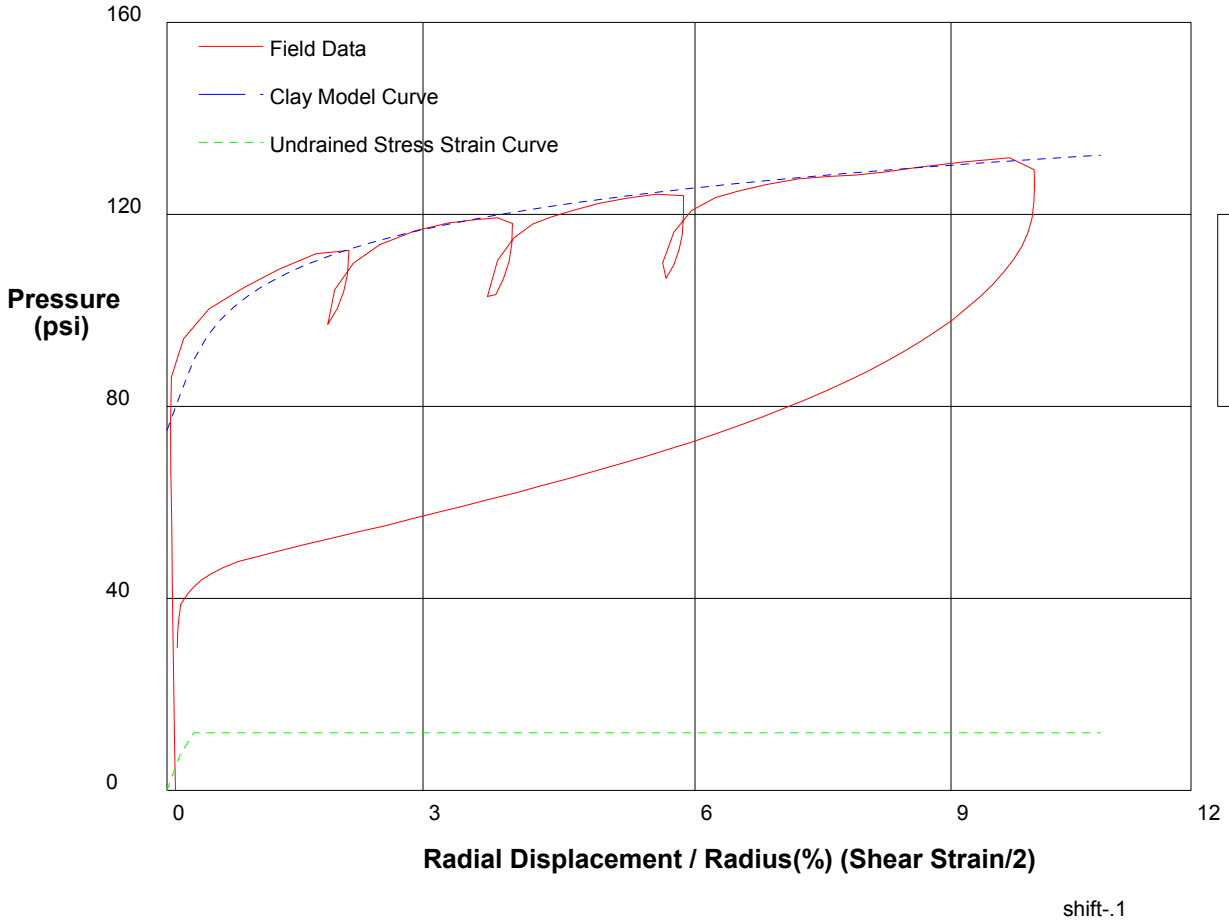


Shear Modulus 4364 psi

Shear Modulus 4367 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT_08 Depth 115ft	File C:\DATA\ISE-787\DOT133.P

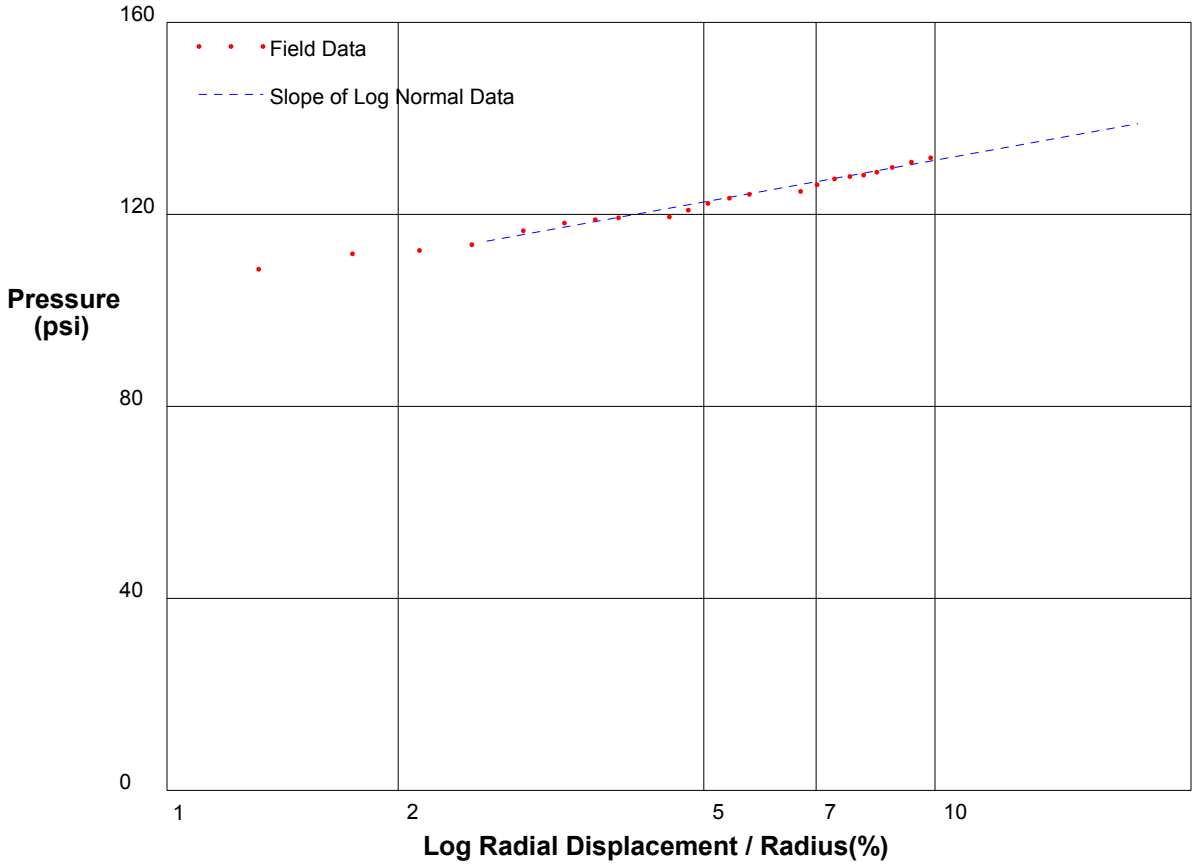


GIBSON'S CLAY MODEL

Shear Strength	12 psi
Insitu Stress	75 psi
Shear Modulus	2400 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT_08 Depth 115ft	File C:\DATA\ISE-787\DOT133.P

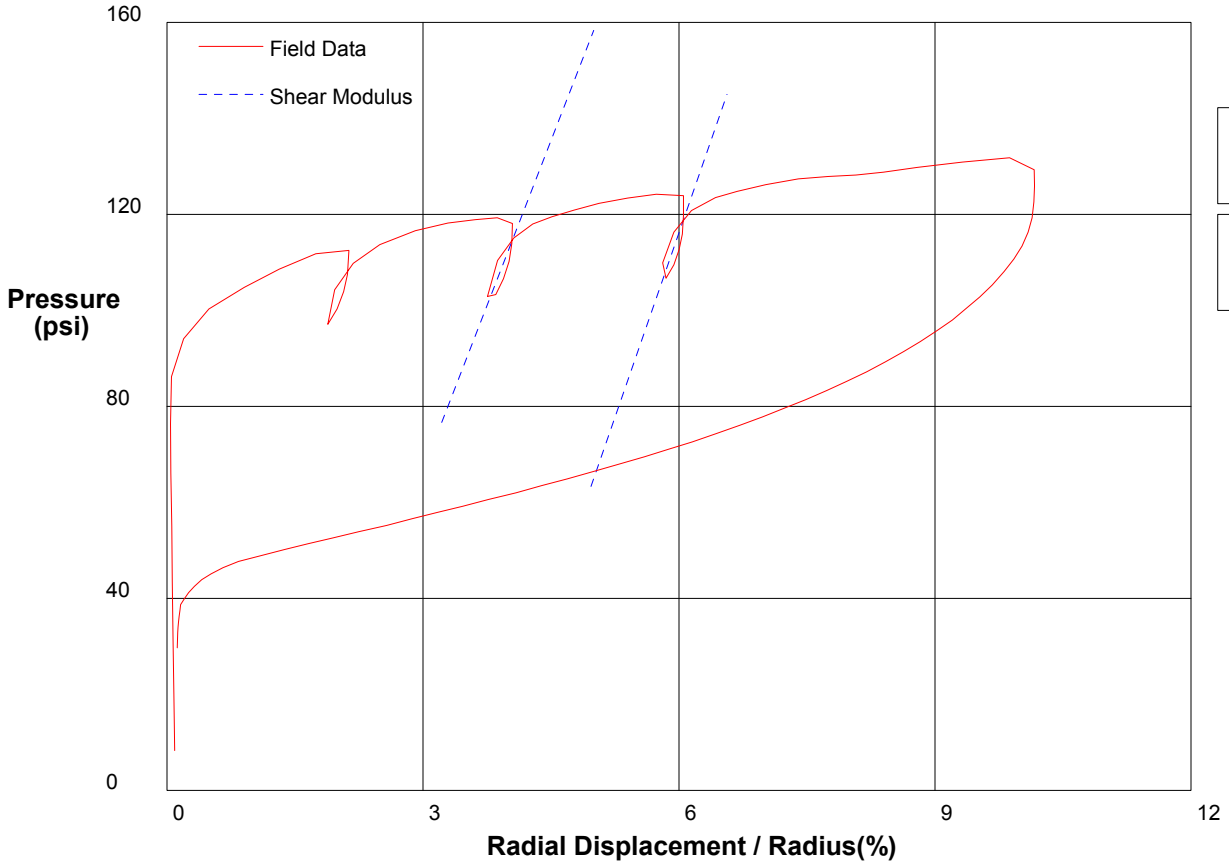


Shear Strength 12.5 psi
Limit Pressure 148 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT_08 Depth 115ft	File C:\DATA\ISE-787\DOT133.P



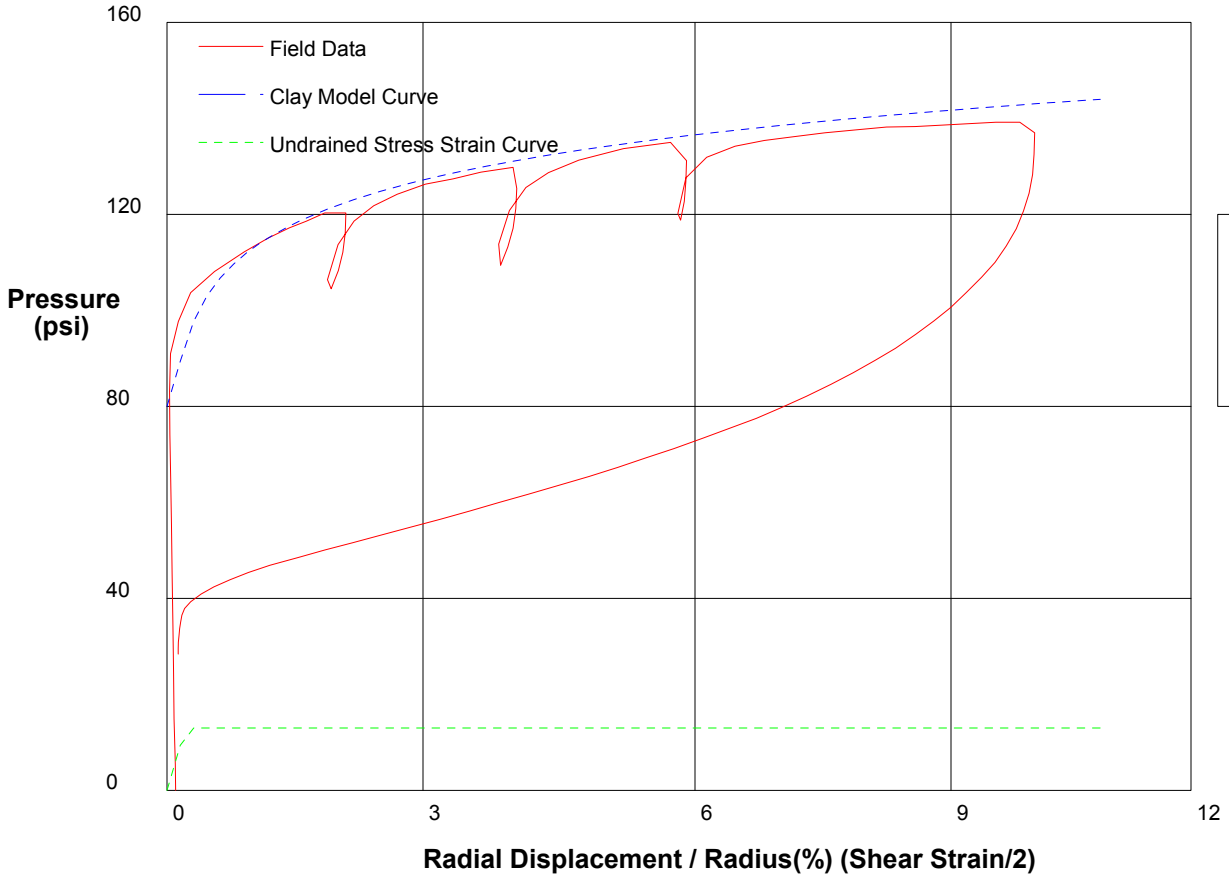
Shear Modulus 2562 psi

Shear Modulus 2292 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 117ft	File C:\DATA\ISE-787\DOT134.P



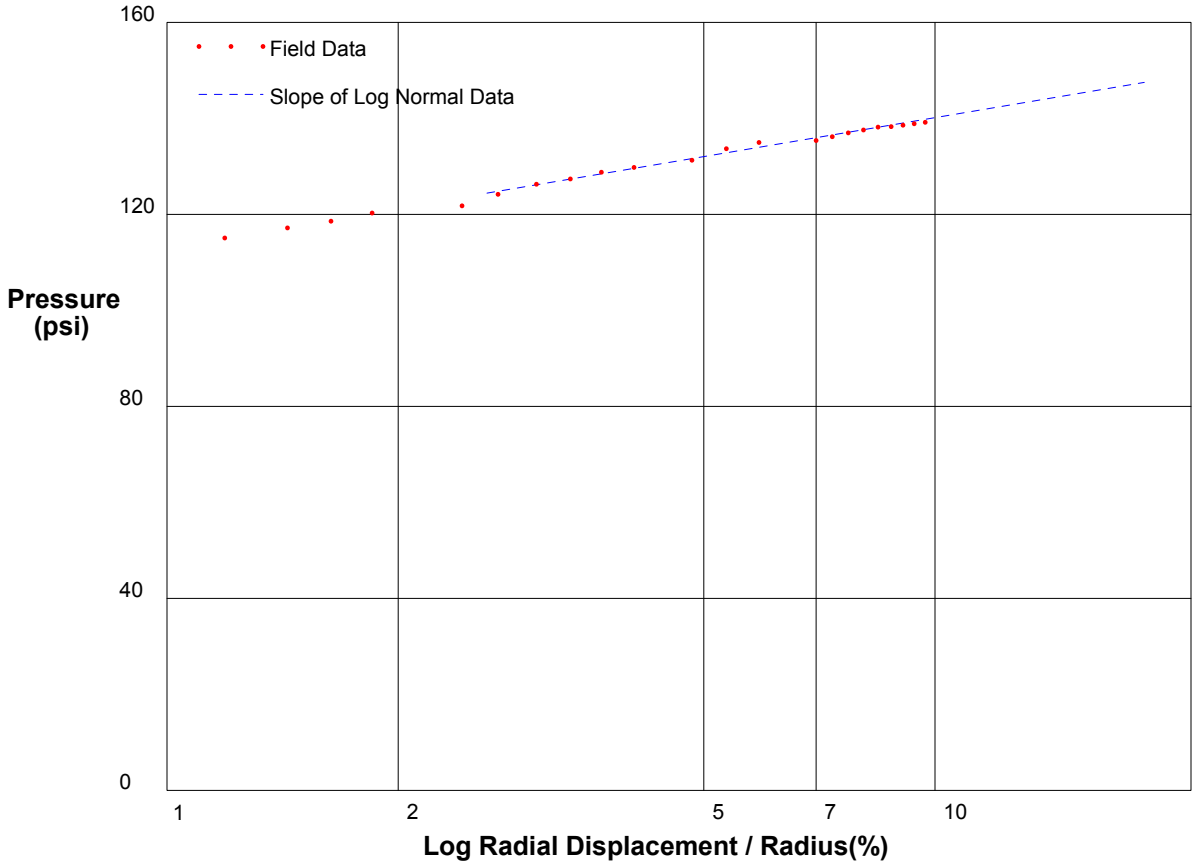
shift-.1

GIBSON'S CLAY MODEL

Shear Strength	13 psi
Insitu Stress	80 psi
Shear Modulus	3000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 117ft	File C:\DATA\ISE-787\DOT134.P

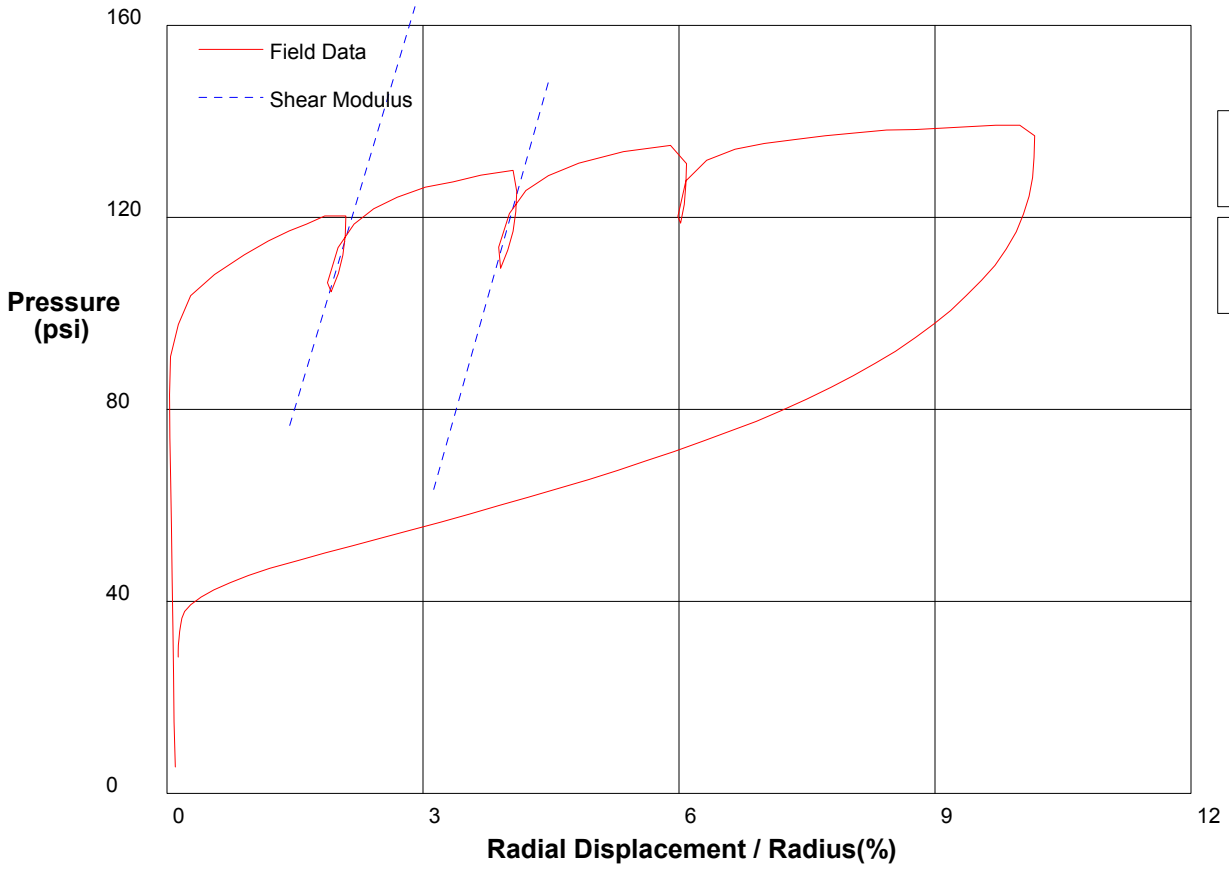


Shear Strength 11.6 psi
Limit Pressure 156 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 117ft	File C:\DATA\ISE-787\DOT134.P



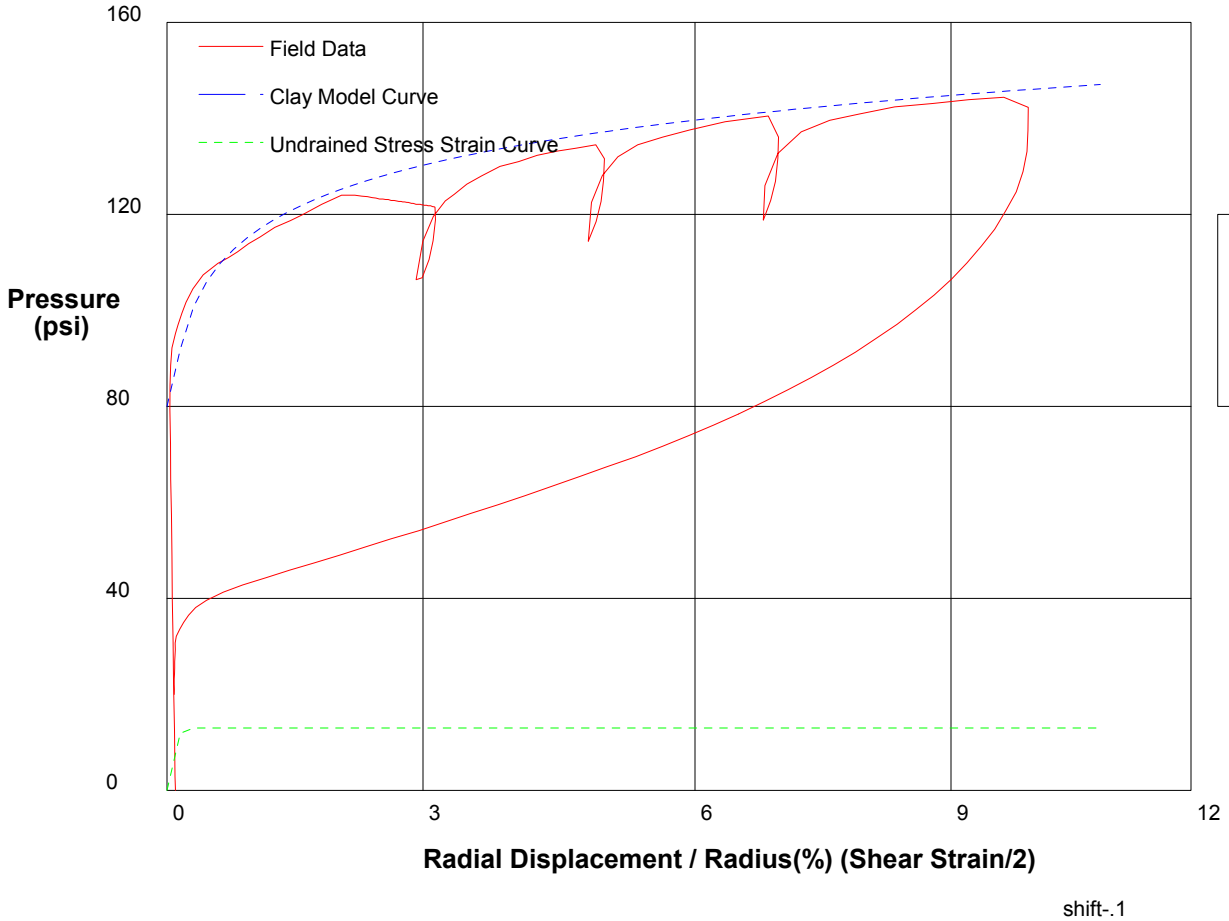
Shear Modulus 3157 psi

Shear Modulus 2969 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 119ft	File C:\DATA\ISE-787\DOT135.P

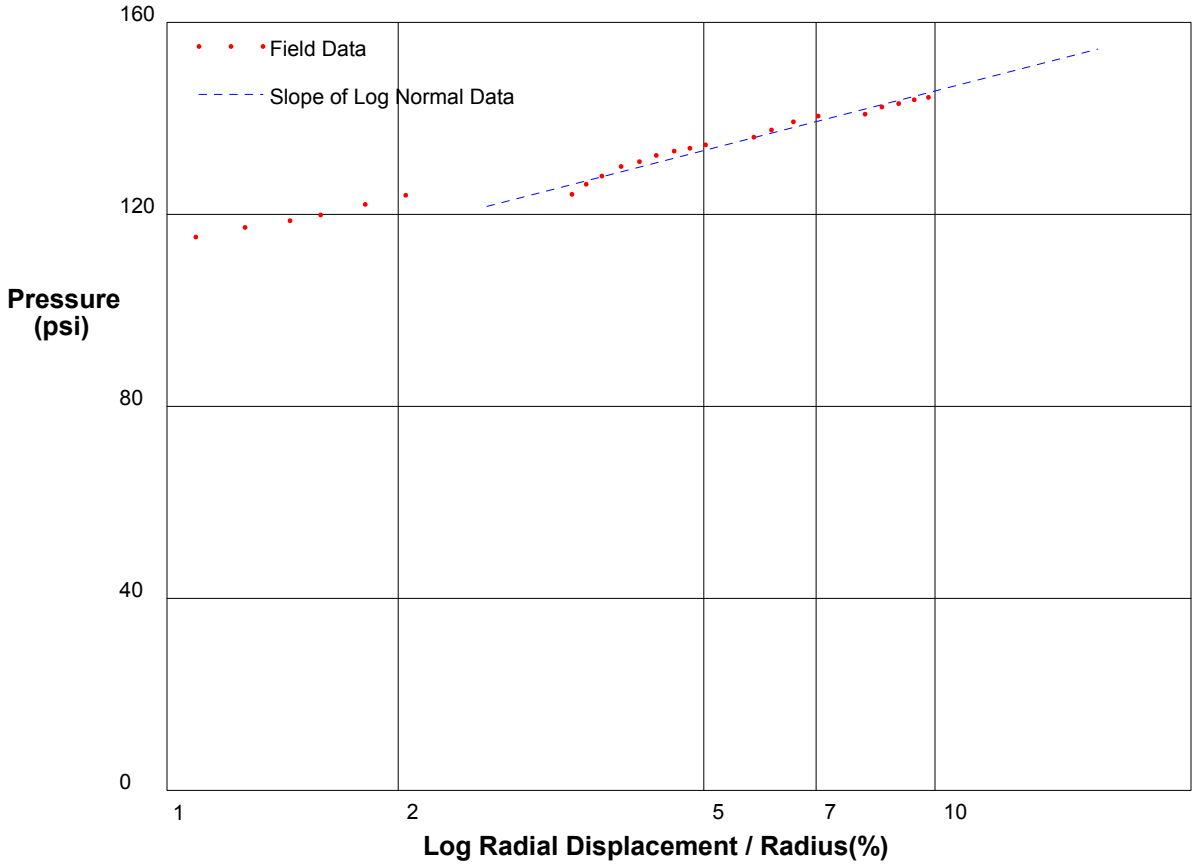


GIBSON'S CLAY MODEL

Shear Strength	13	psi
Insitu Stress	80	psi
Shear Modulus	3800	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 119ft	File C:\DATA\ISE-787\DOT135.P



Shear Strength 17.9 psi
Limit Pressure 170 psi

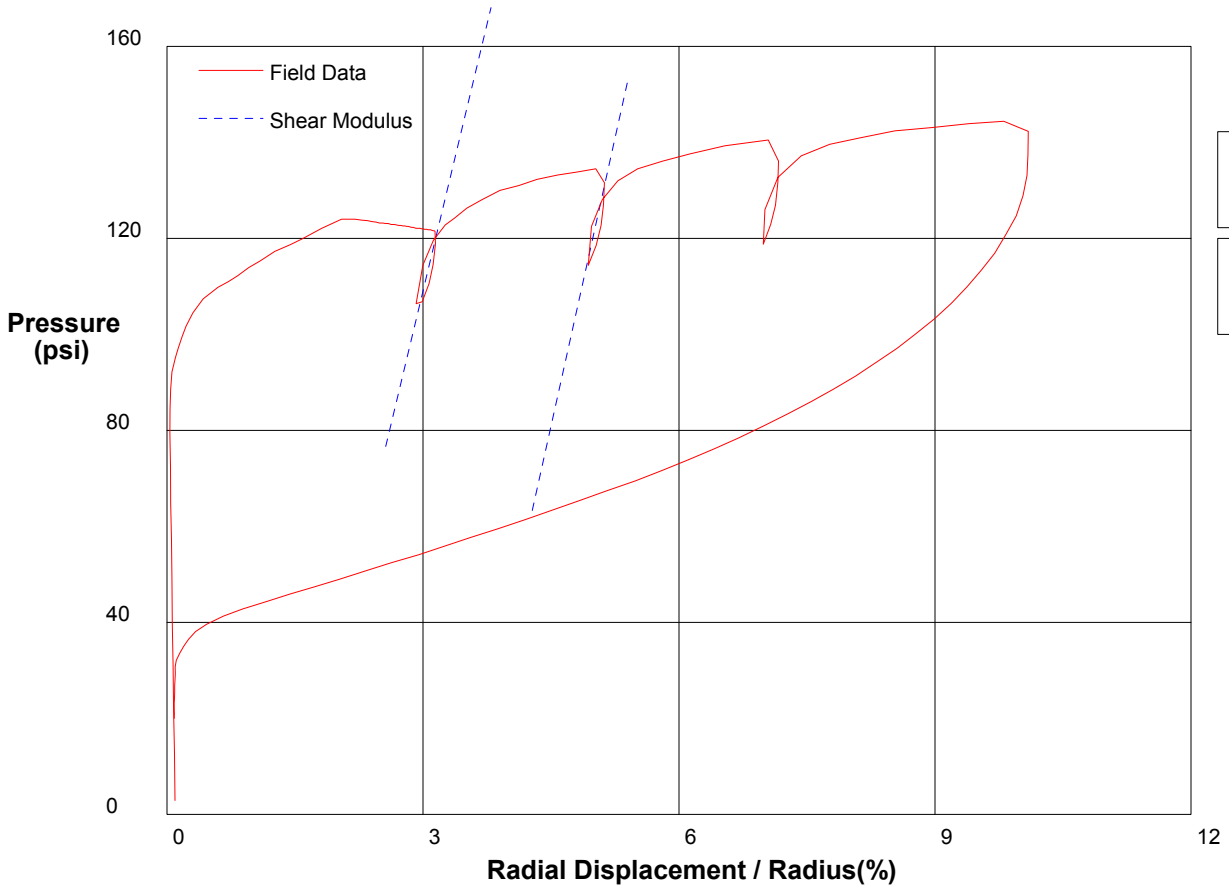
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/8/2008**

Hole No. TH-31B-PMT-08 Depth 119ft **File C:\DATA\ISE-787\DOT135.P**



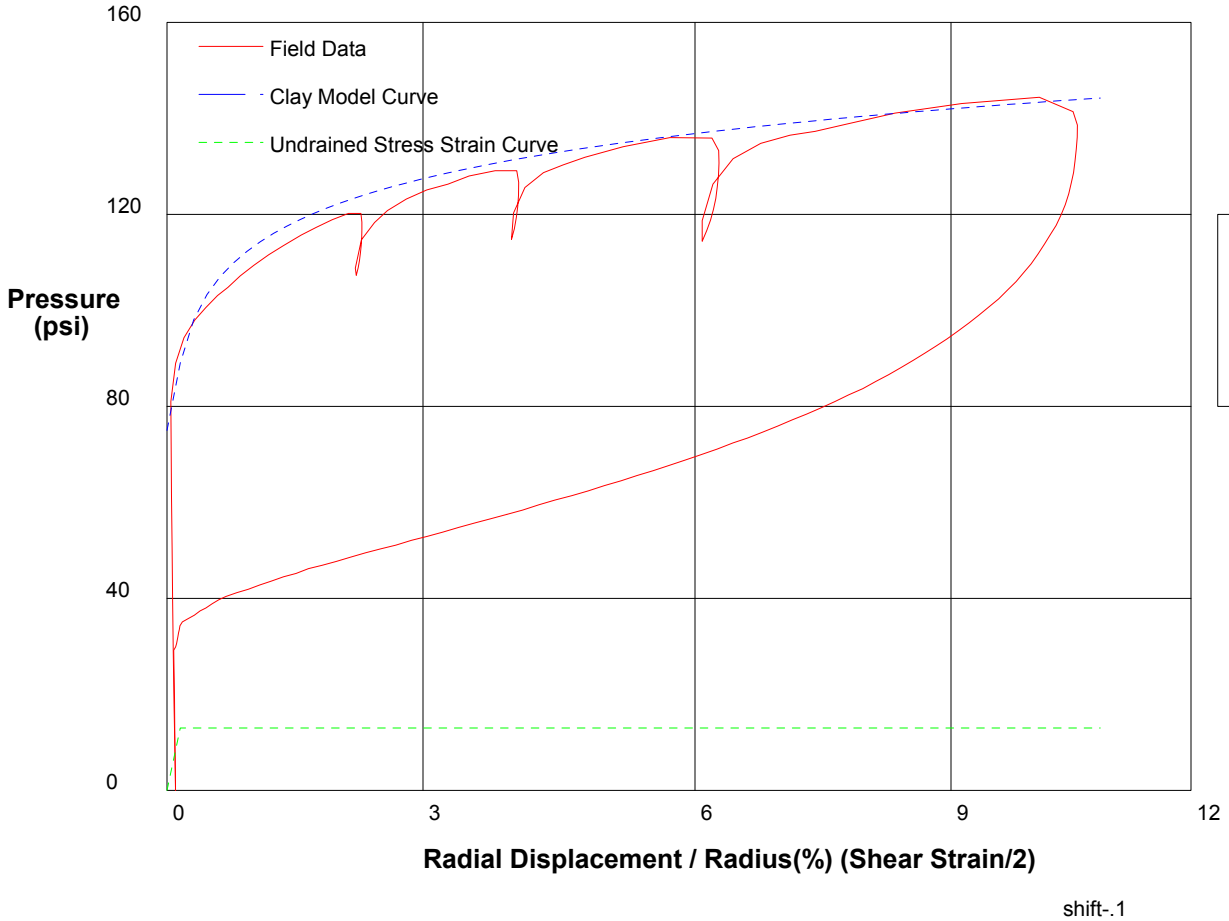
Shear Modulus 4000 psi

Shear Modulus 3701 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 122ft	File C:\DATA\ISE-787\DOT-136.P

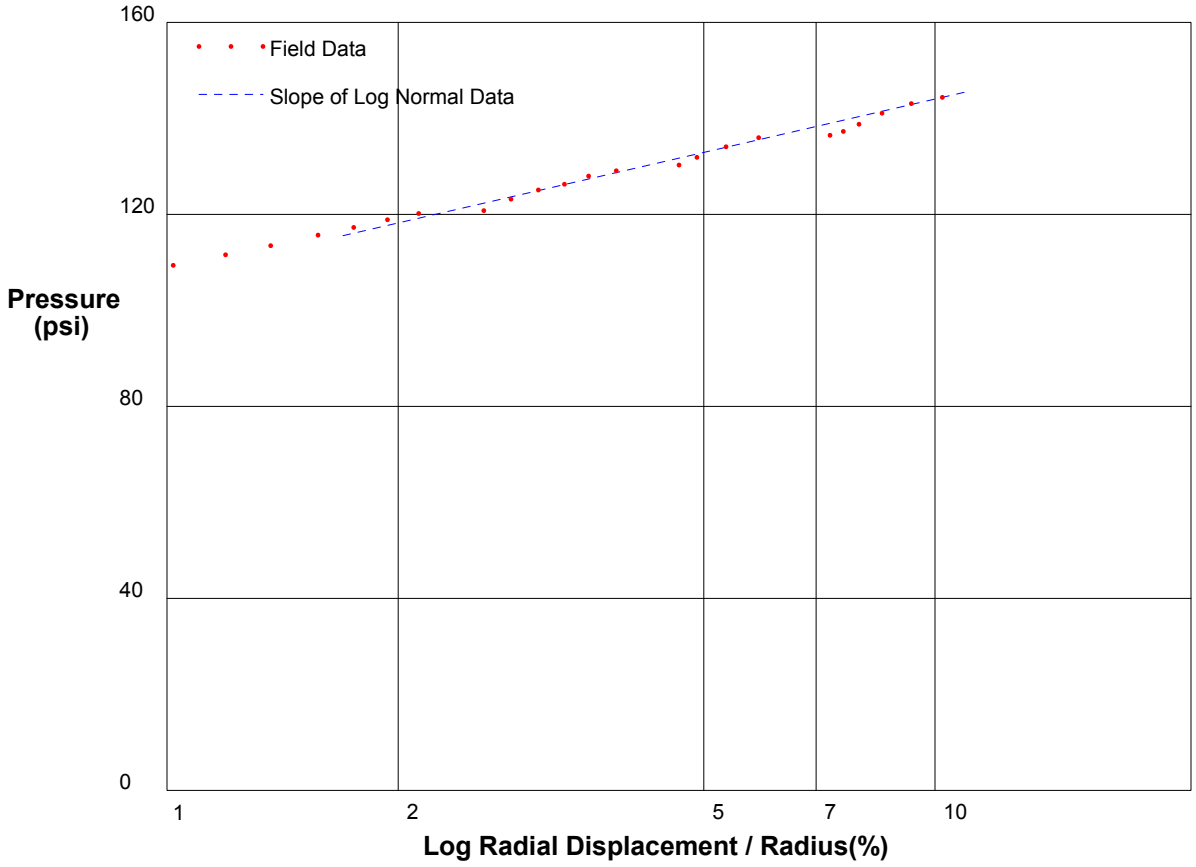


GIBSON'S CLAY MODEL

Shear Strength	13 psi
Insitu Stress	75 psi
Shear Modulus	4500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 122ft	File C:\DATA\ISE-787\DOT-136.P



Shear Strength 16 psi
Limit Pressure 166 psi

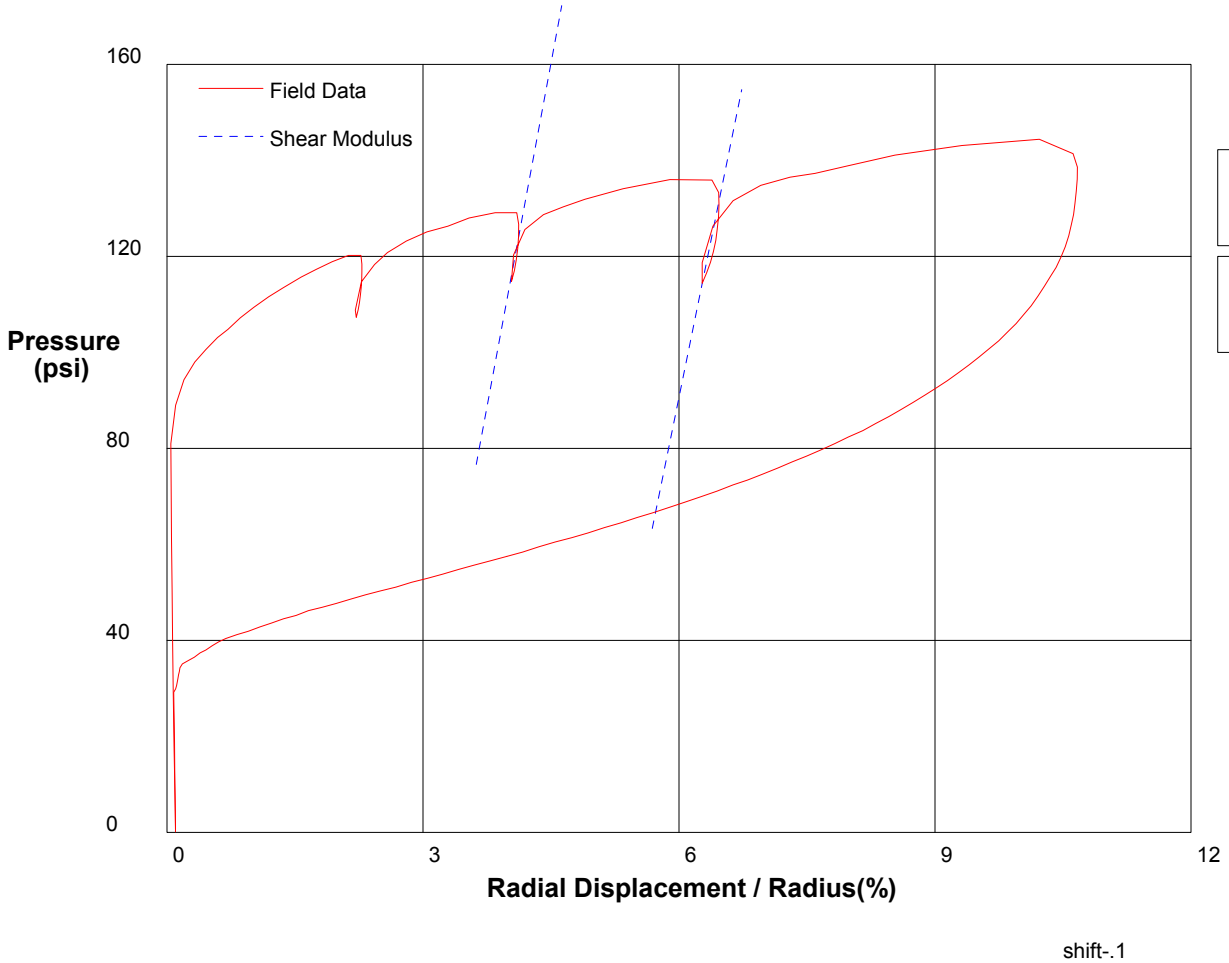
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/8/2008**

Hole No. TH-31B-PMT-08 Depth 122ft **File C:\DATA\ISE-787\DOT-136.P**



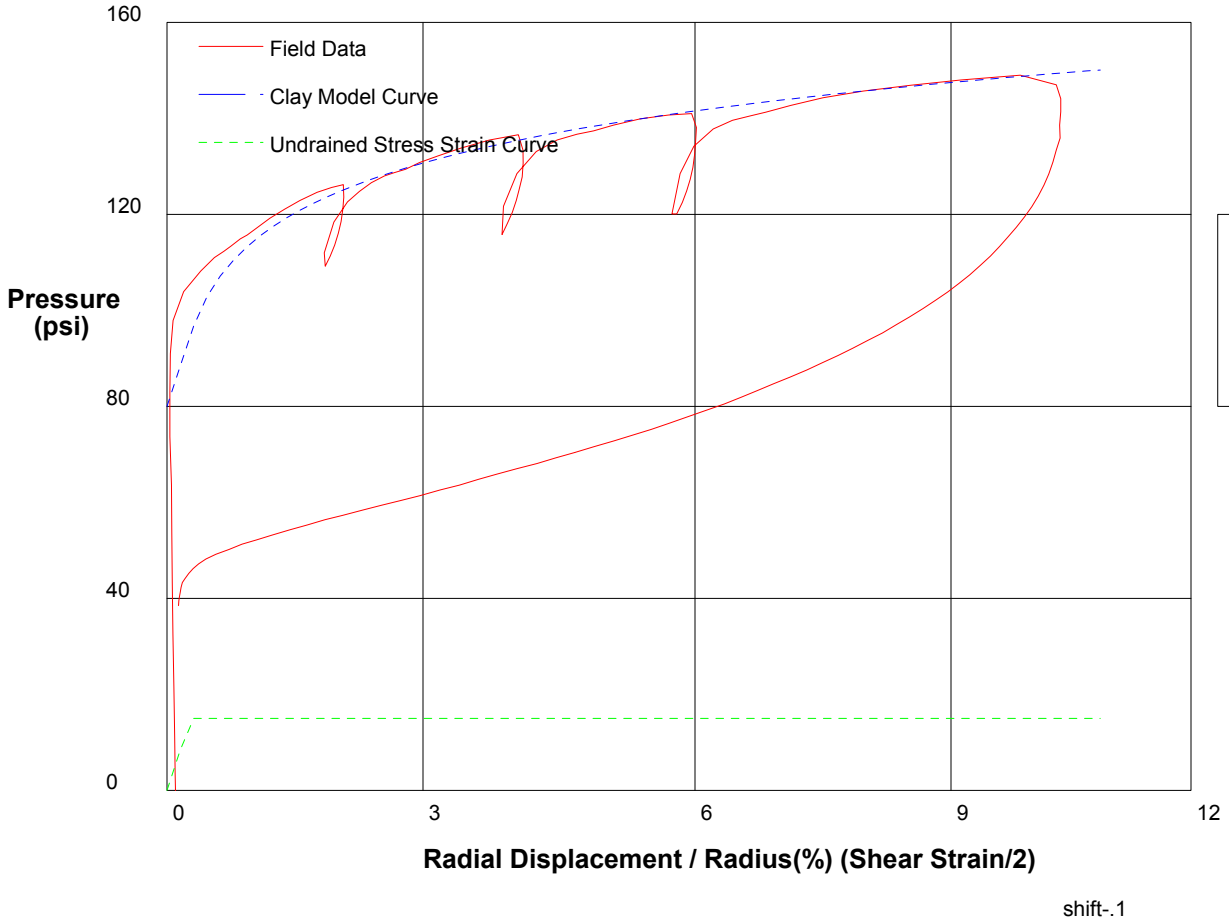
Shear Modulus 4364 psi

Shear Modulus 4777 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 124ft	File C:\DATA\ISE-787\DOT137.P

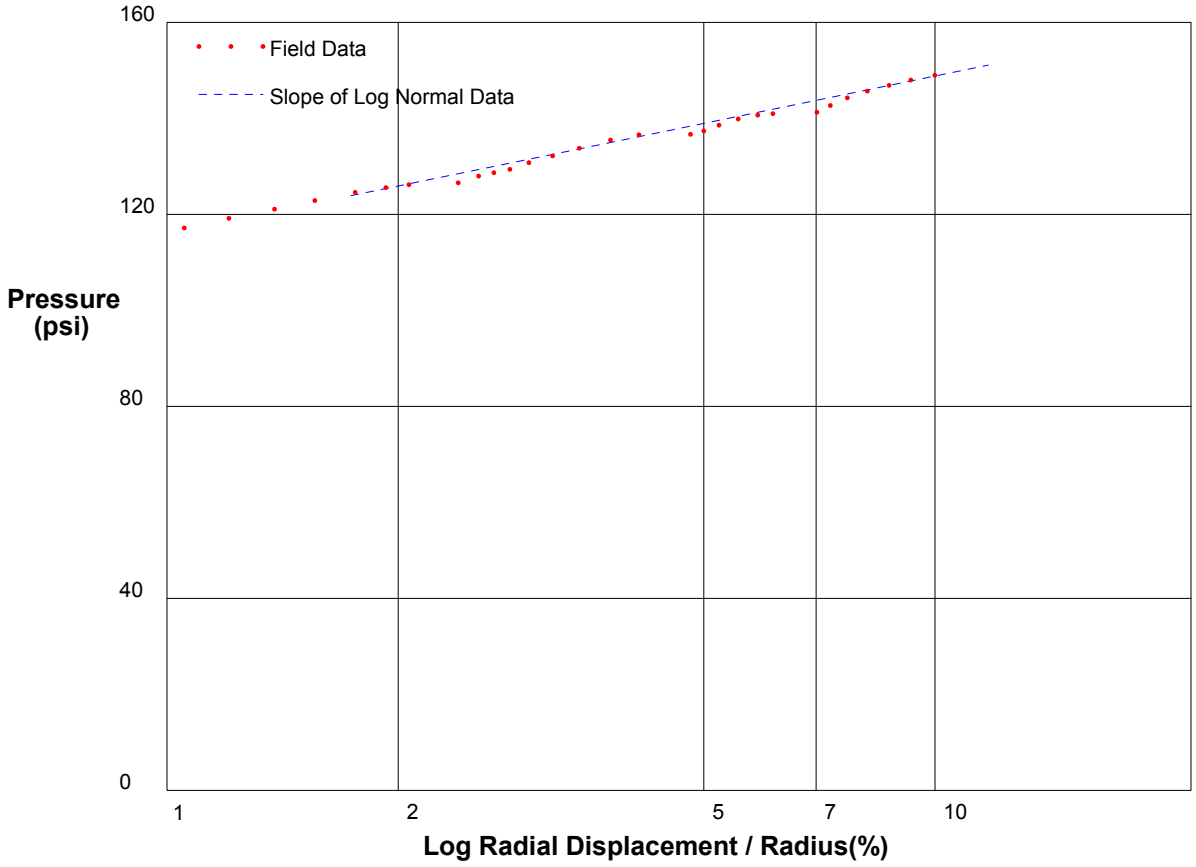


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	80 psi
Shear Modulus	2700 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 124ft	File C:\DATA\ISE-787\DOT137.P

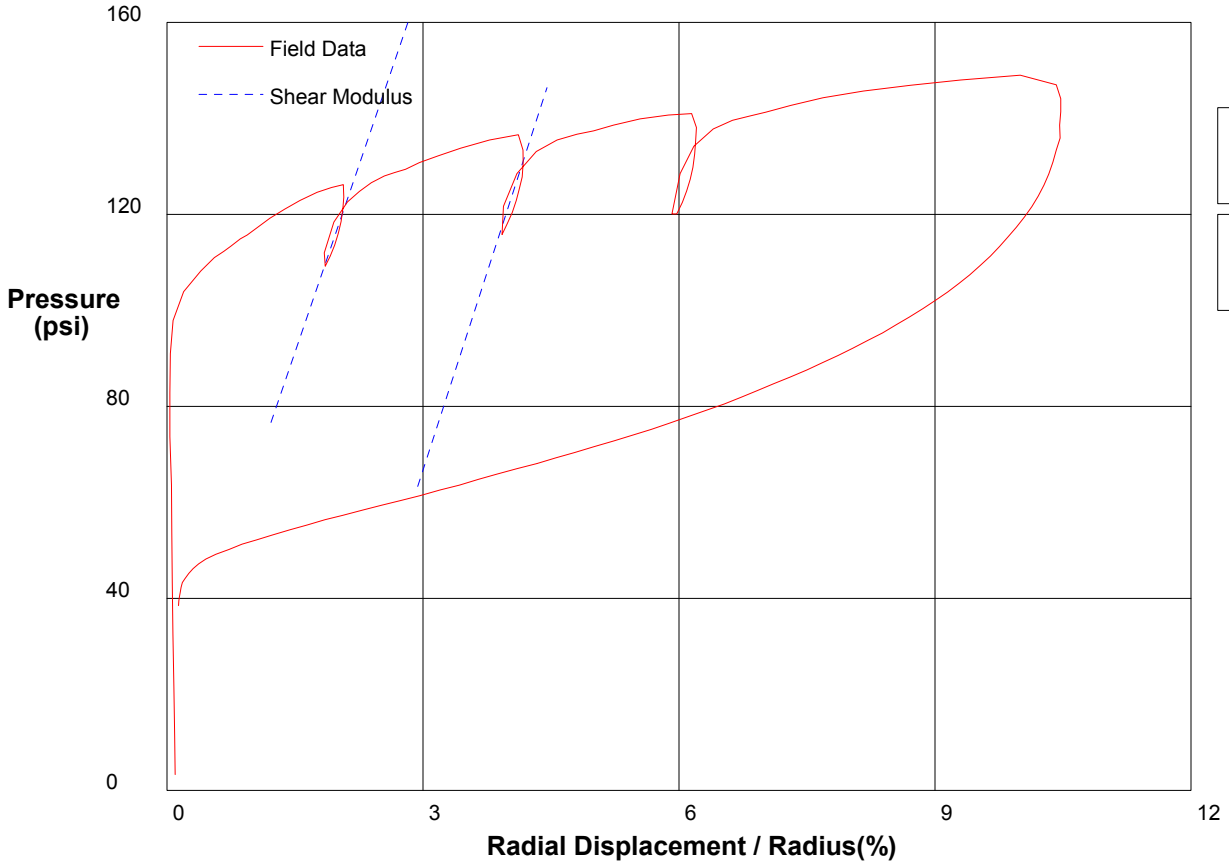


Shear Strength 14.2 psi
Limit Pressure 168 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 124ft	File C:\DATA\ISE-787\DOT137.P



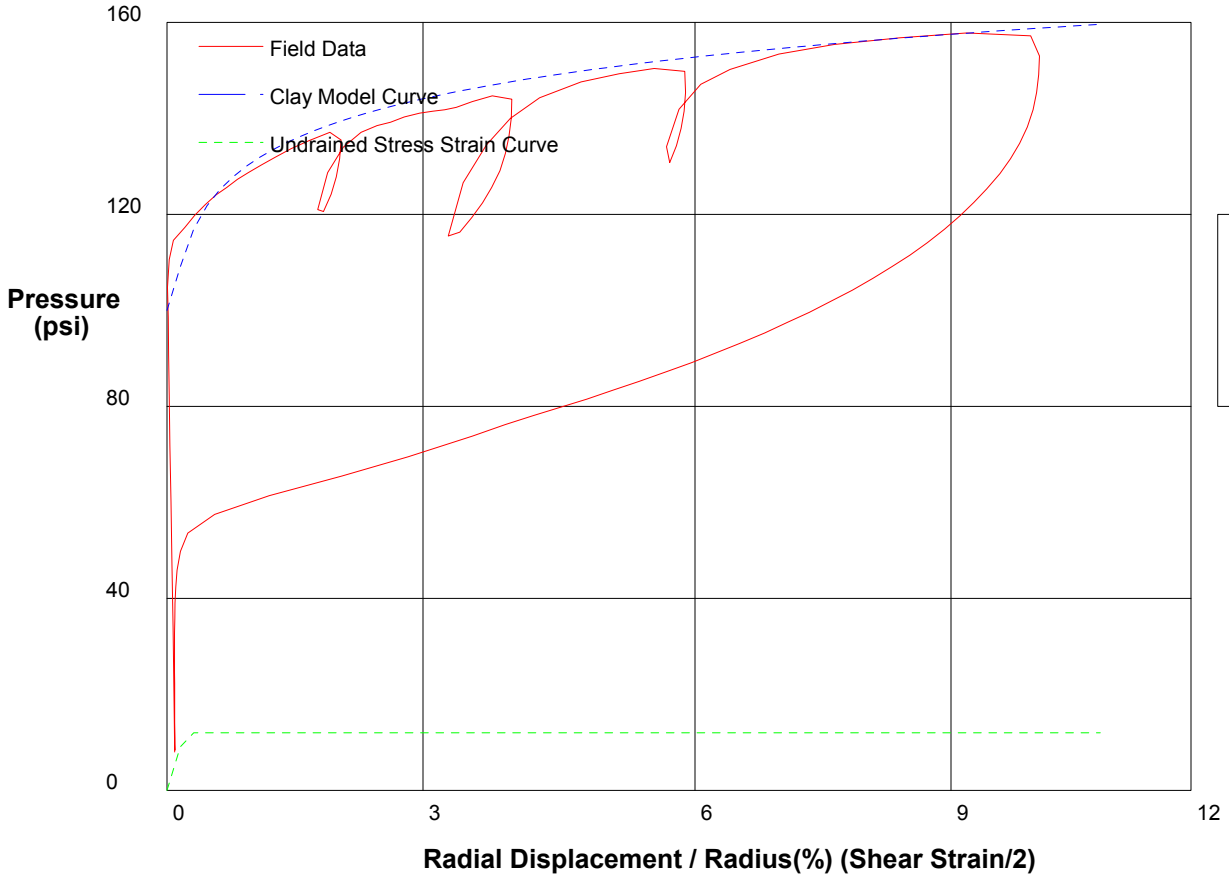
Shear Modulus 2739 psi

Shear Modulus 2598 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 126ft	File C:\DATA\ISE-787\DOT138.P



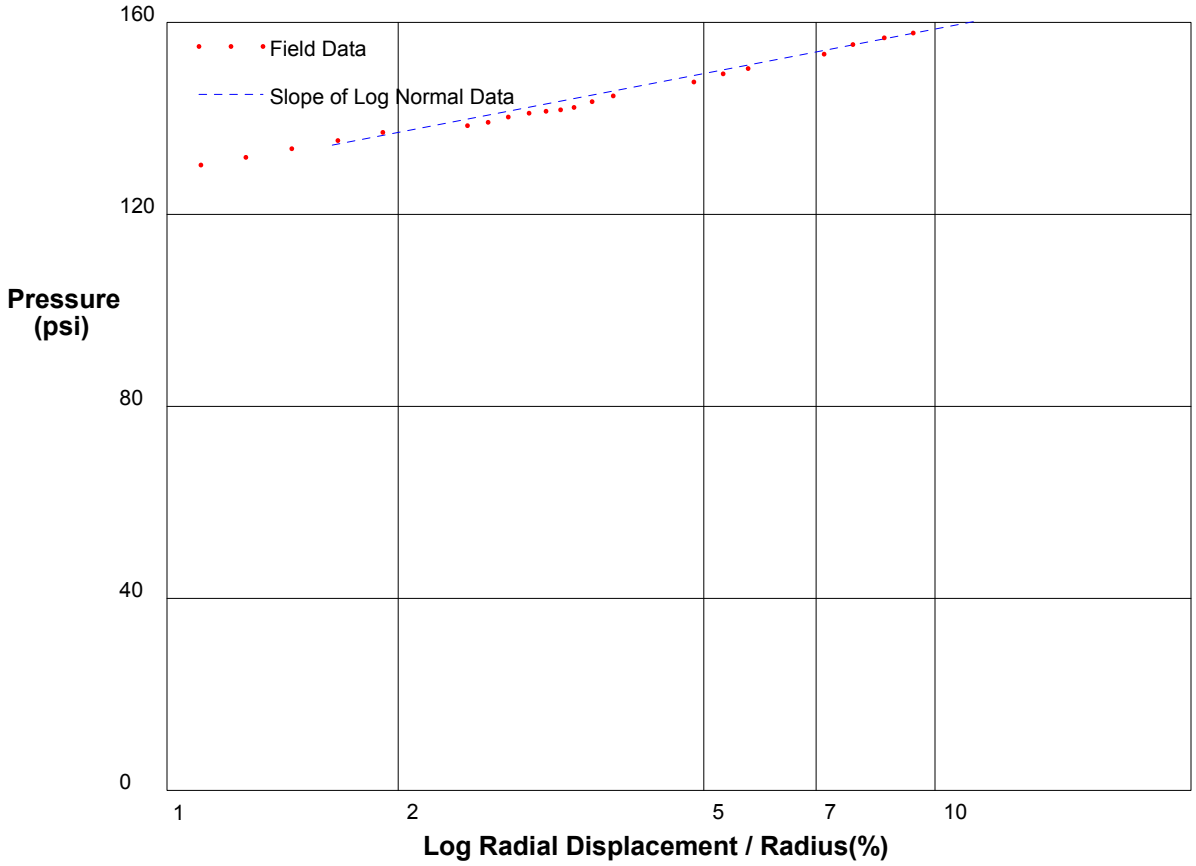
shift-.1

GIBSON'S CLAY MODEL

Shear Strength	12 psi
Insitu Stress	100 psi
Shear Modulus	2900 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 126ft	File C:\DATA\ISE-787\DOT138.P



Shear Strength 13.3 psi
Limit Pressure 177 psi

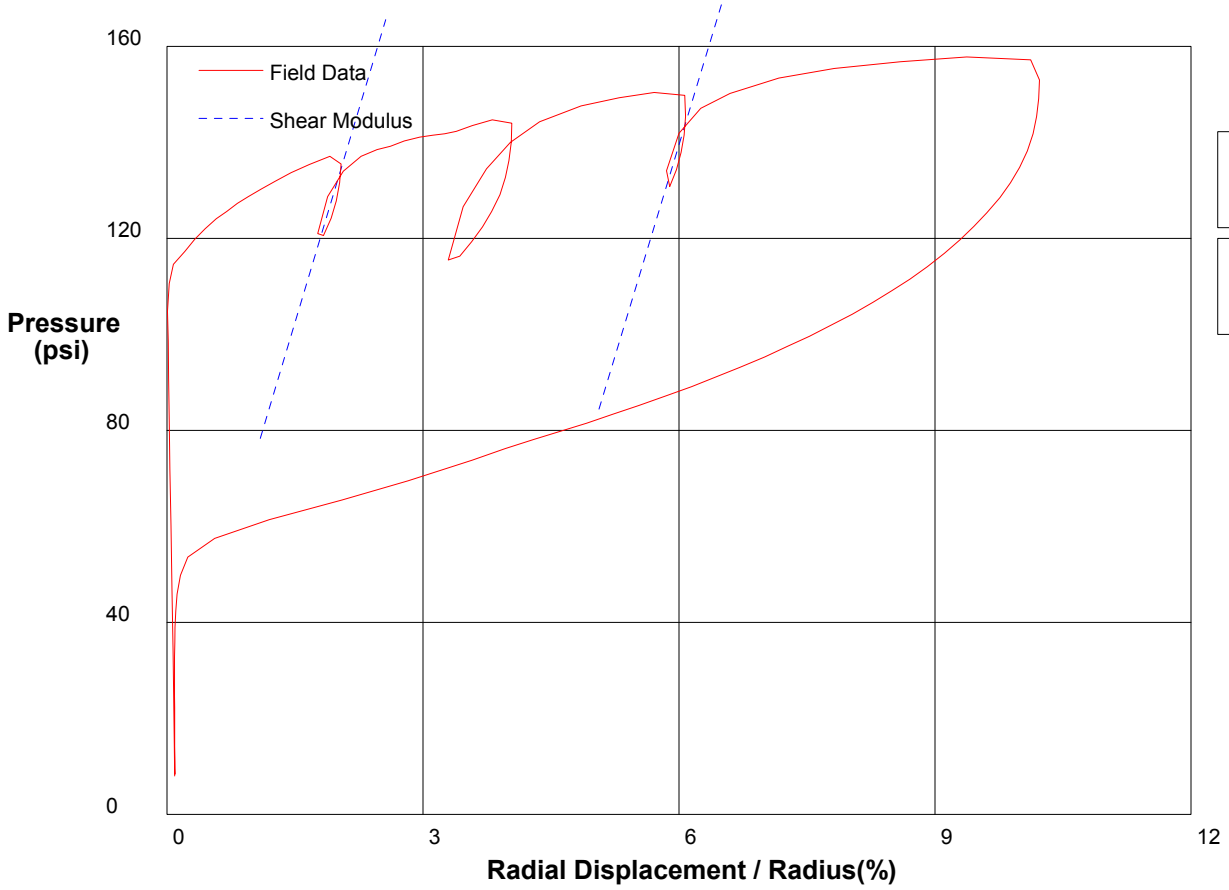
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/8/2008**

Hole No. TH-31B-PMT-08 Depth 126ft **File C:\DATA\ISE-787\DOT138.P**



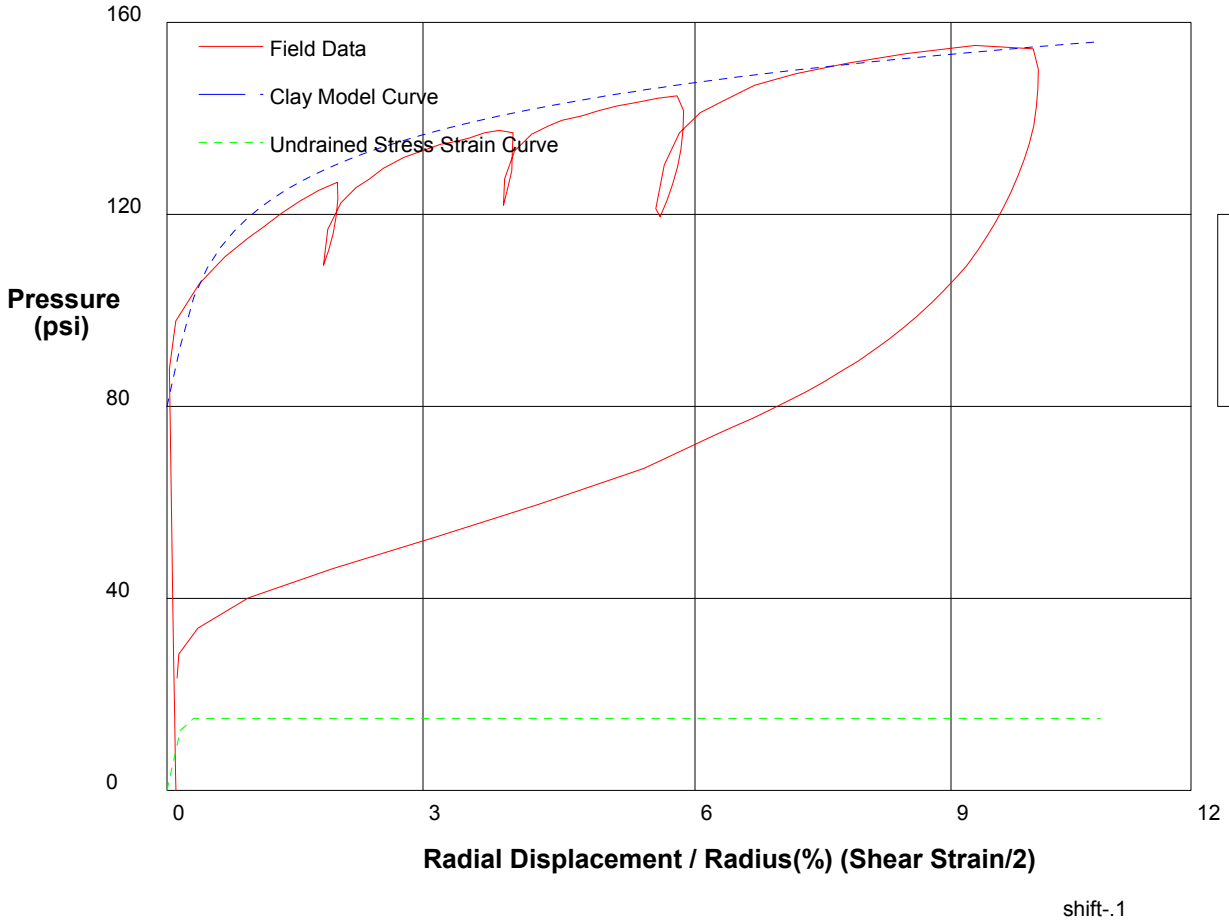
Shear Modulus 2937 psi

Shear Modulus 2969 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 128ft	File C:\DATA\ISE-787\DOT-139.P

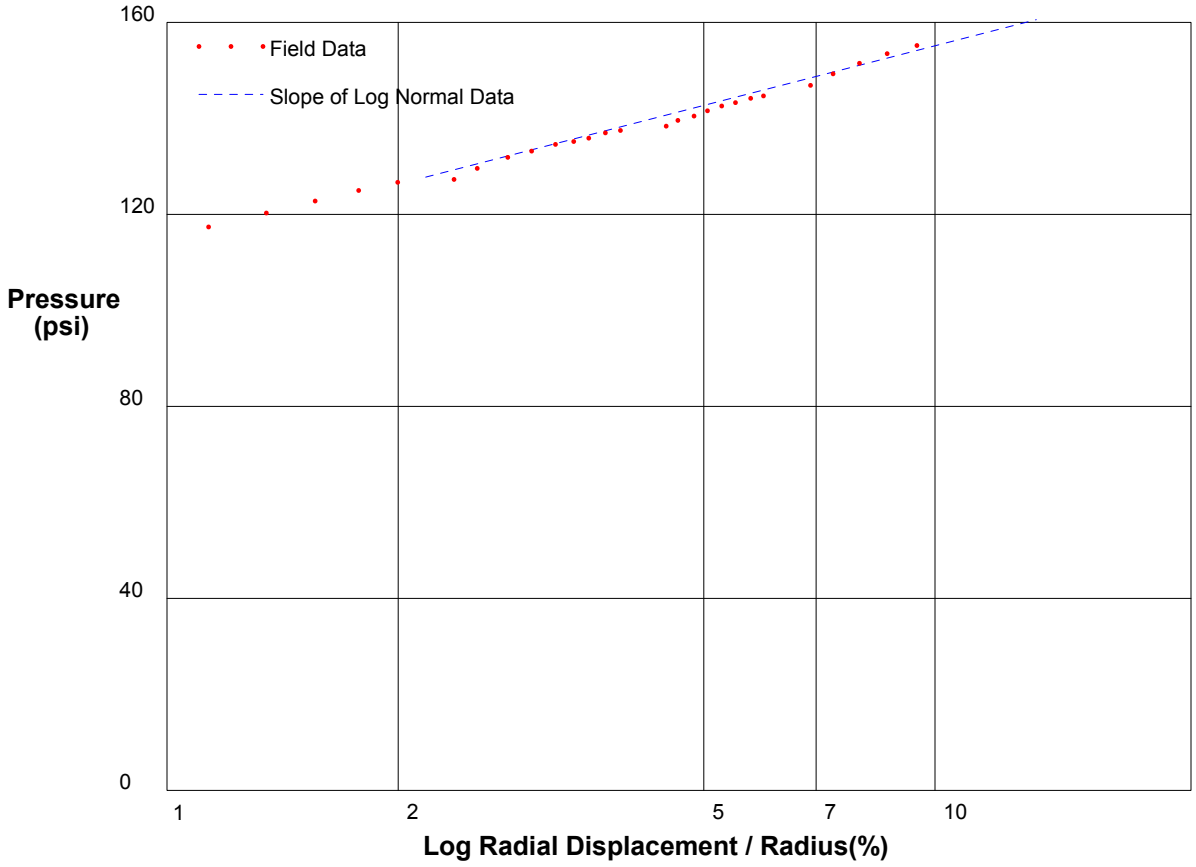


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	80 psi
Shear Modulus	4000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 128ft	File C:\DATA\ISE-787\DOT-139.P

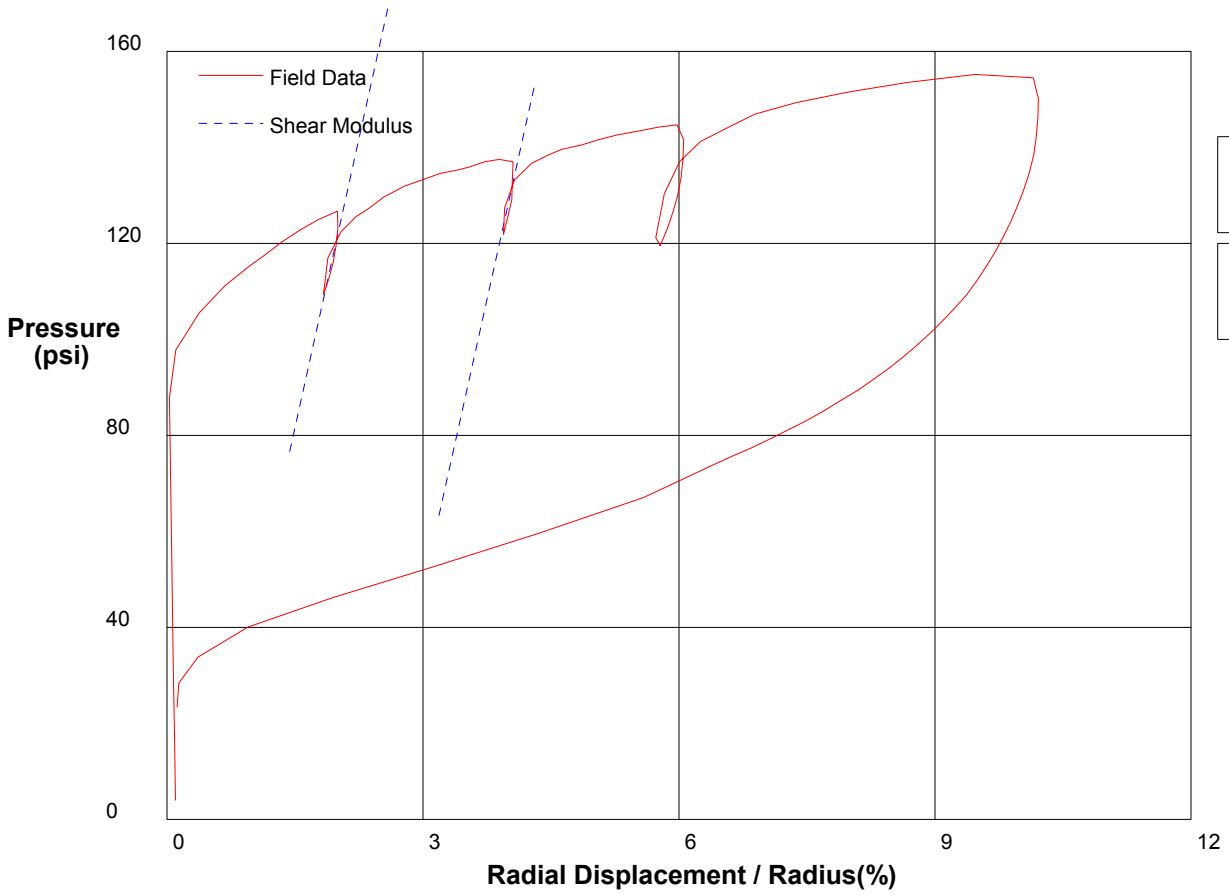


Shear Strength 17.9 psi
Limit Pressure 180 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 128ft	File C:\DATA\ISE-787\DOT-139.P



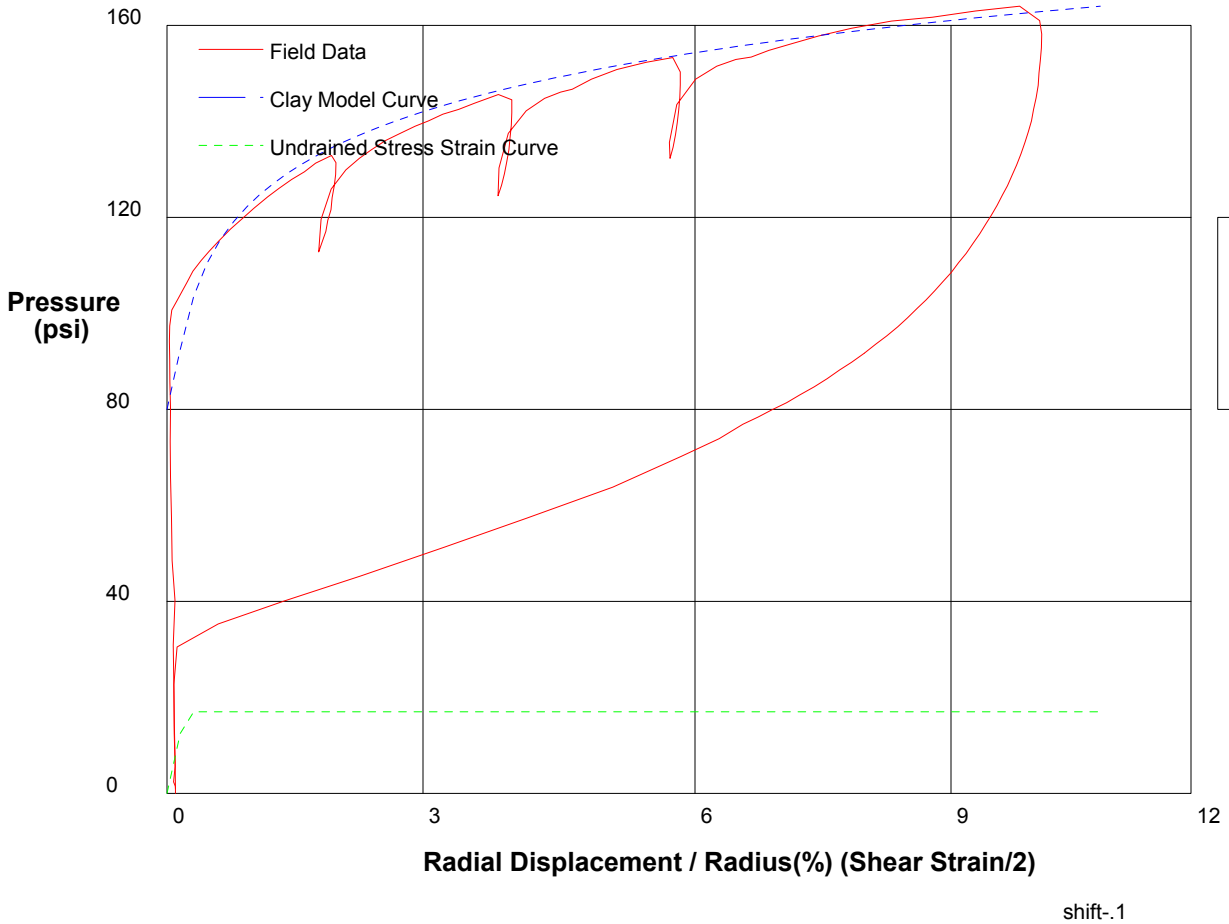
Shear Modulus 4000 psi

Shear Modulus 4012 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 130ft	File C:\DATA\ISE-787\DOT140.P

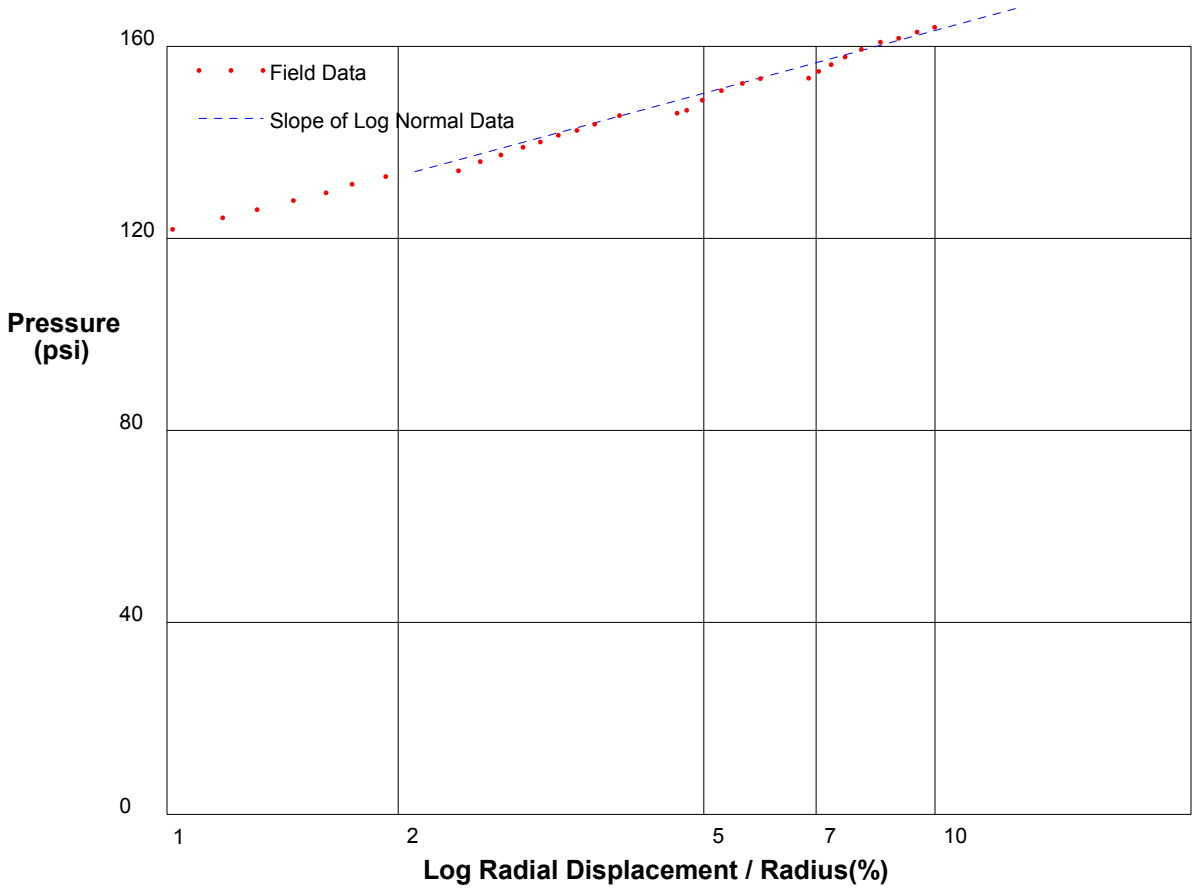


GIBSON'S CLAY MODEL

Shear Strength	17 psi
Insitu Stress	80 psi
Shear Modulus	4000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 130ft	File C:\DATA\ISE-787\DOT140.P



Shear Strength 18.8 psi
Limit Pressure 189 psi

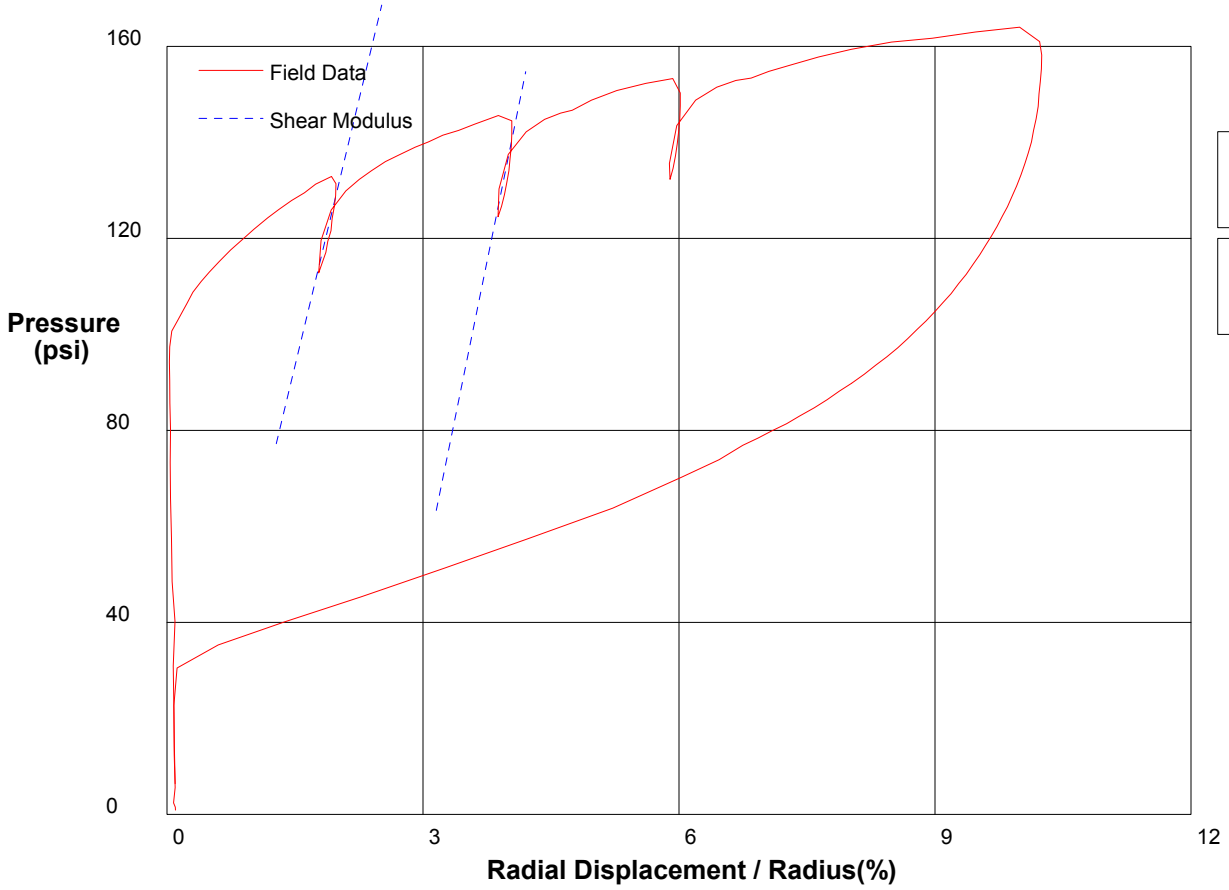
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/8/2008**

Hole No. TH-31B-PMT-08 Depth 130ft **File C:\DATA\ISE-787\DOT140.P**



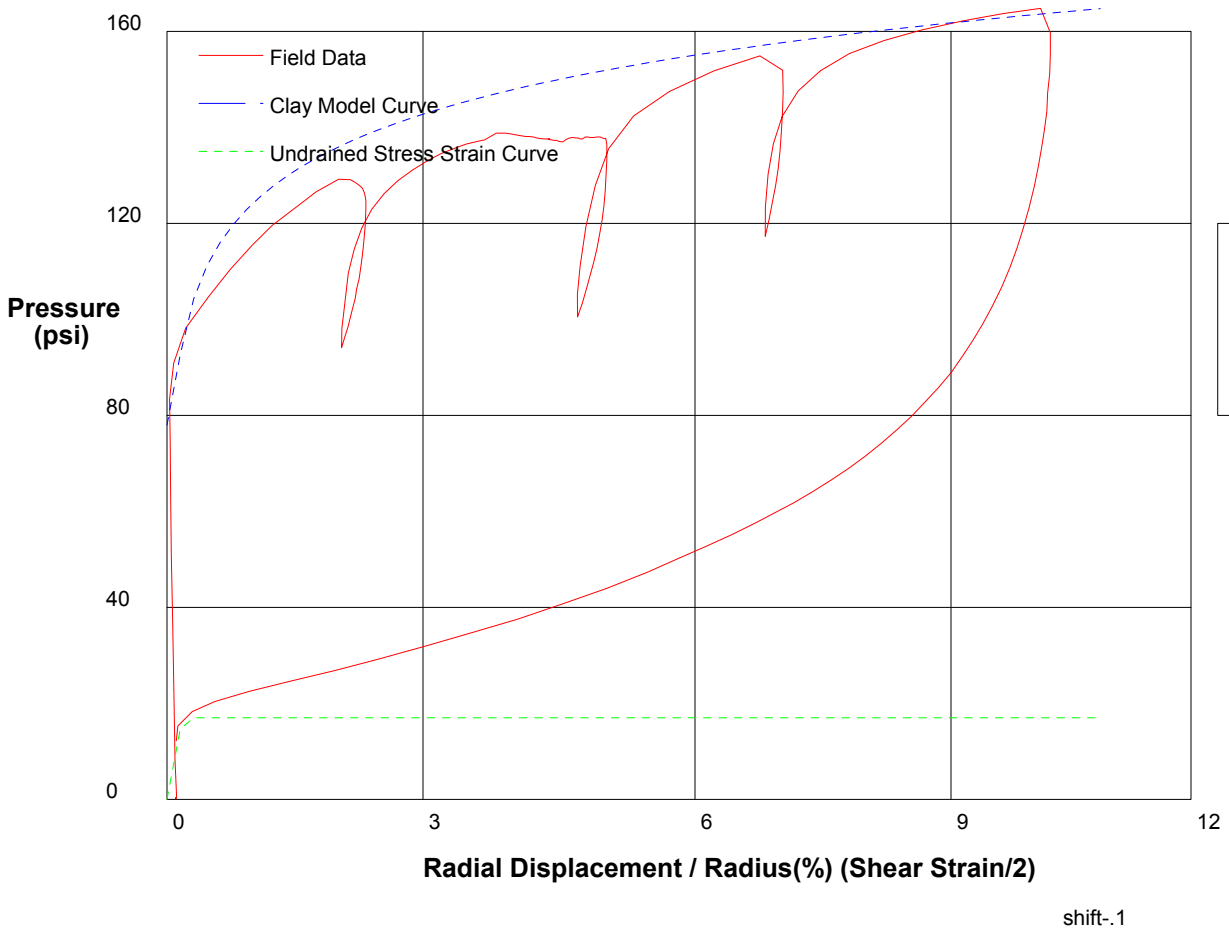
Shear Modulus 4364 psi

Shear Modulus 3701 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 132ft	File C:\DATA\ISE-787\DOT141.P

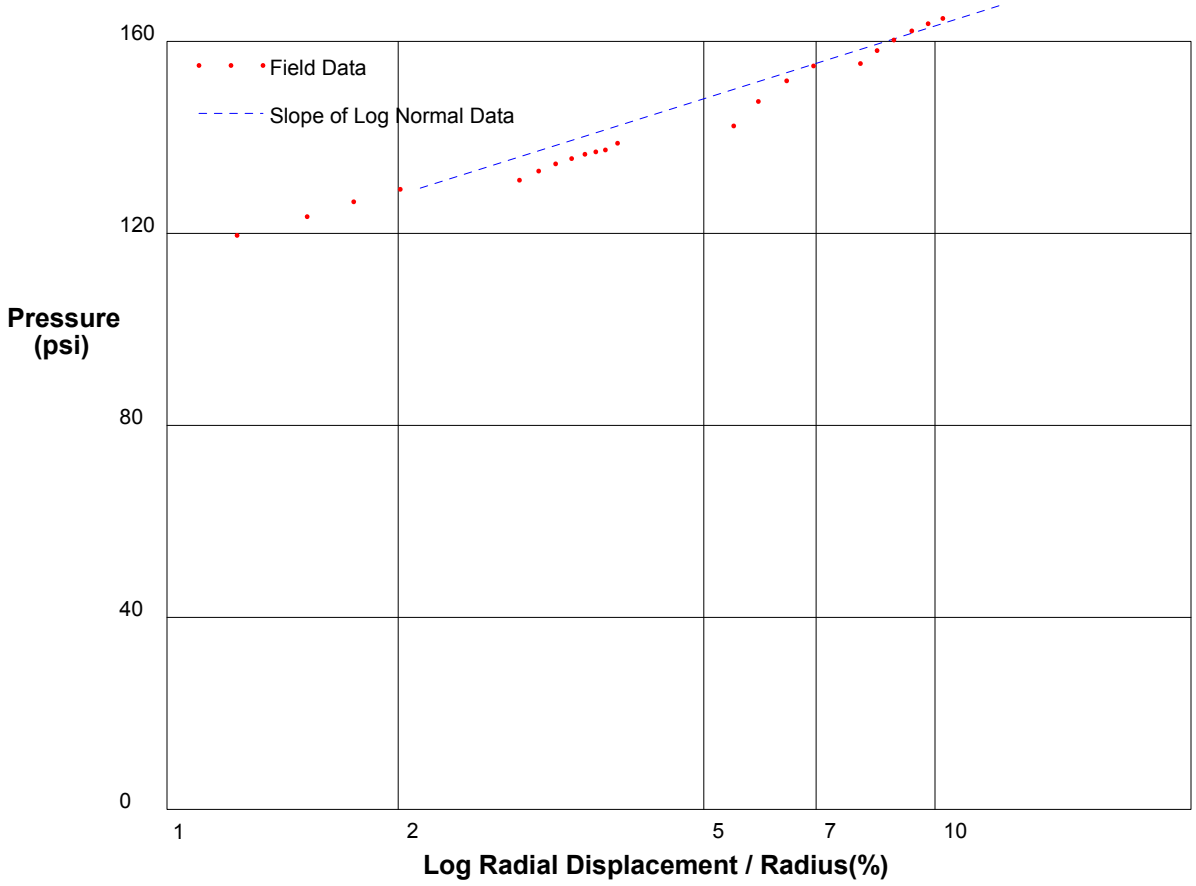


GIBSON'S CLAY MODEL

Shear Strength	17 psi
Insitu Stress	78 psi
Shear Modulus	4700 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 132ft	File C:\DATA\ISE-787\DOT141.P



Shear Strength 21.8 psi
Limit Pressure 194 psi

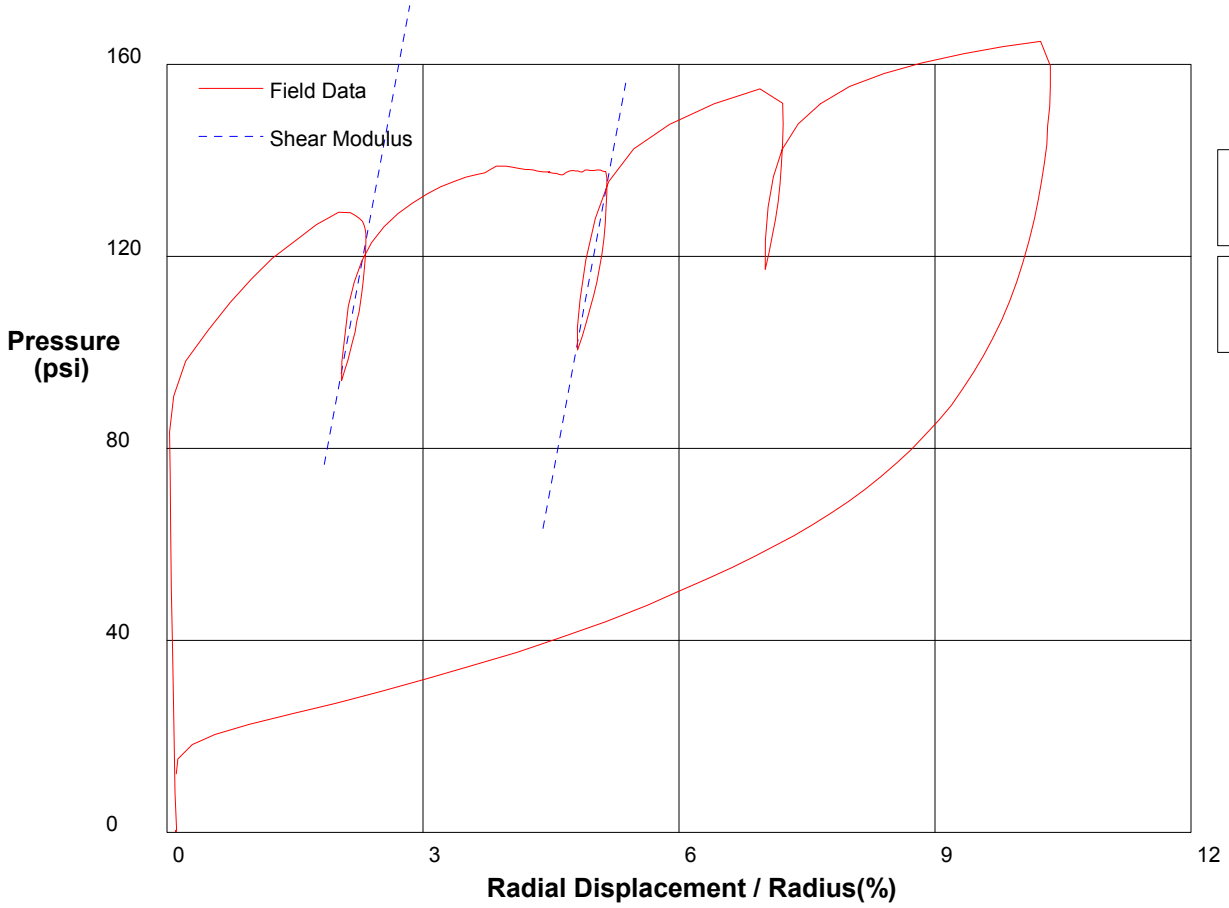
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/8/2008**

Hole No. TH-31B-PMT-08 Depth 132ft **File C:\DATA\ISE-787\DOT141.P**



Shear Modulus 4788 psi

Shear Modulus 4777 psi

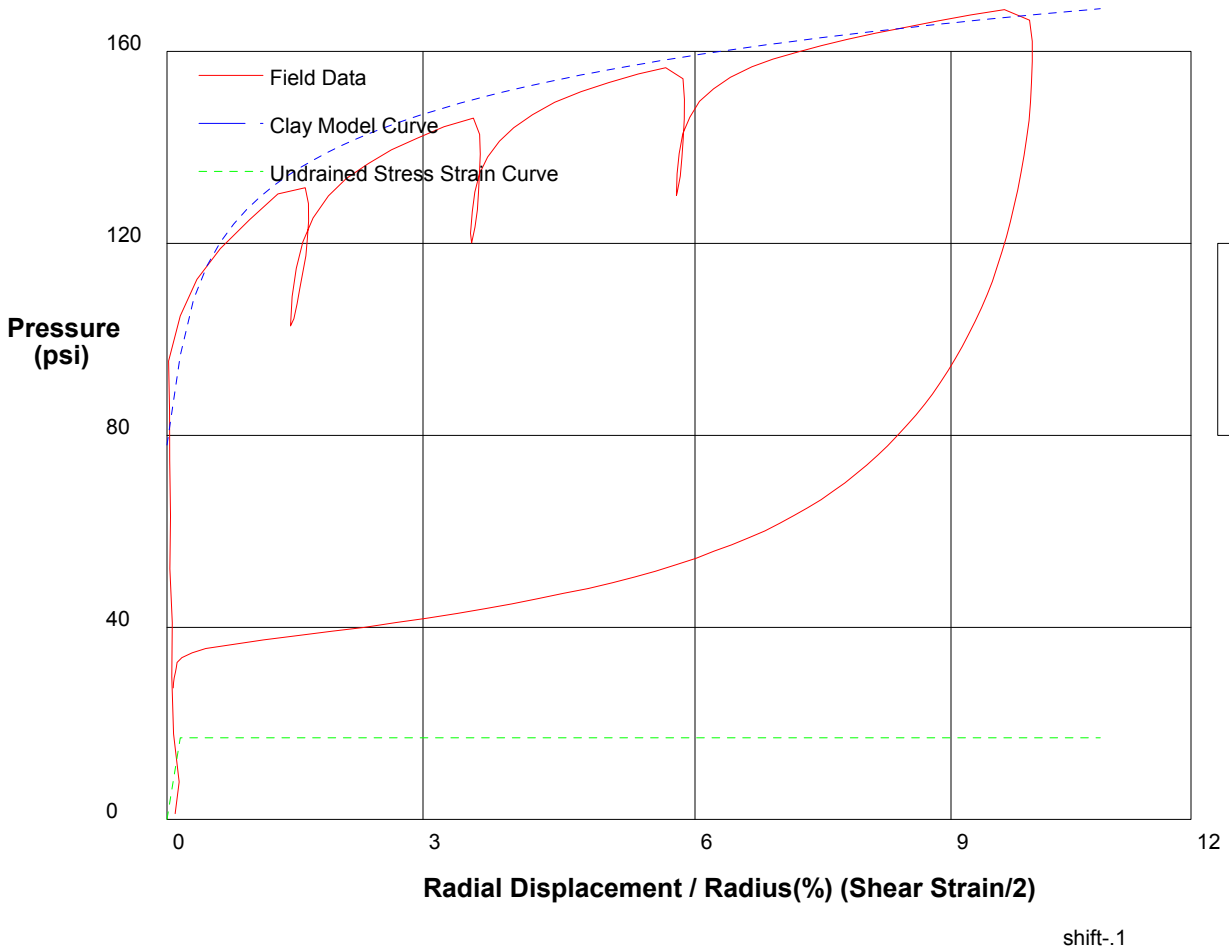
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/8/2008**

Hole No. TH-31B-PMT-08 Depth 134ft **File C:\DATA\ISE-787\DOT142.P**



GIBSON'S CLAY MODEL

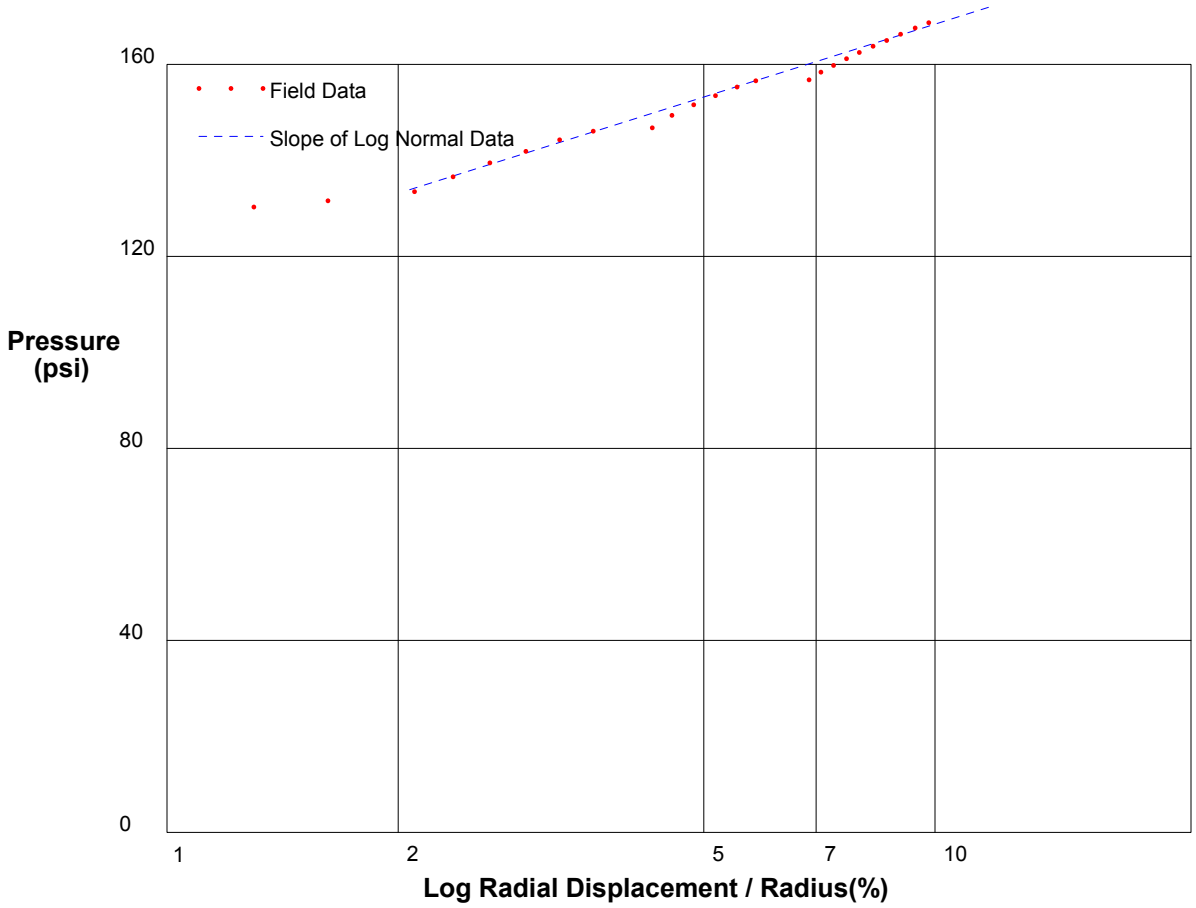
Shear Strength	**17**	**psi**
Insitu Stress	**78**	**psi**
Shear Modulus	**6000**	**psi**

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/8/2008**

Hole No. TH-31B-PMT-08 Depth 134ft **File C:\DATA\ISE-787\DOT142.P**



Shear Strength 21.8 psi
Limit Pressure 199 psi

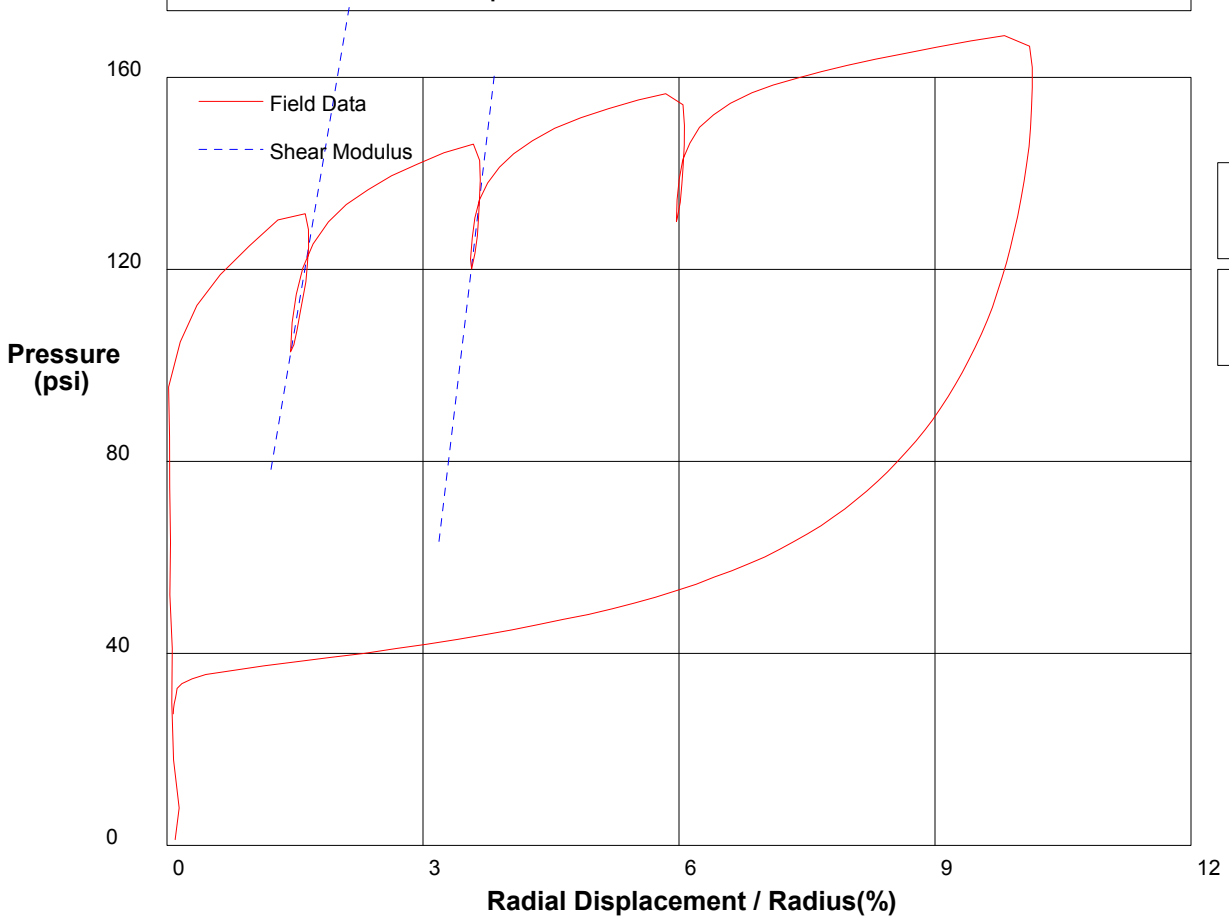
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/8/2008**

Hole No. TH-31B-PMT-08 Depth 134ft **File C:\DATA\ISE-787\DOT142.P**



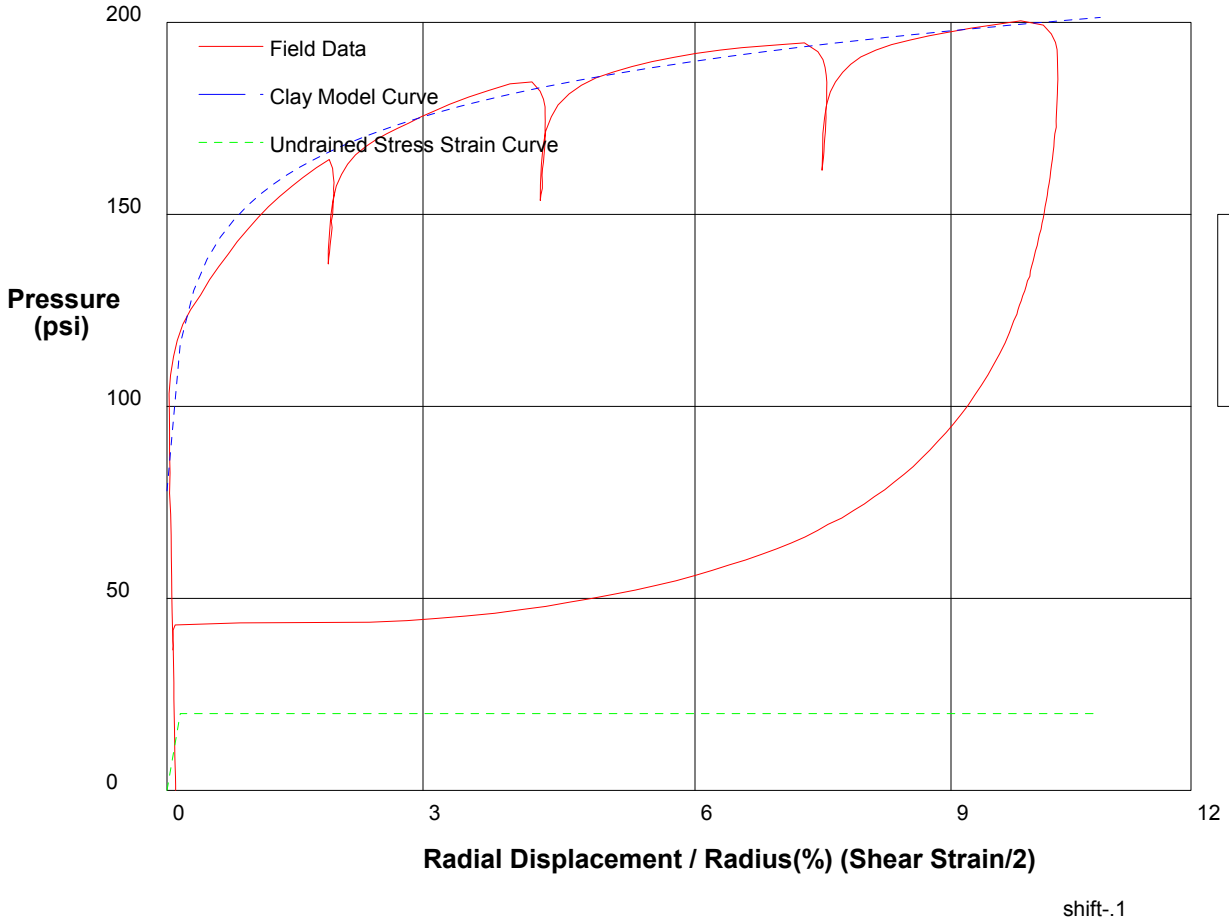
Shear Modulus 7492 psi

Shear Modulus 5258 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 136ft	File C:\DATA\ISE-787\DOT143.P

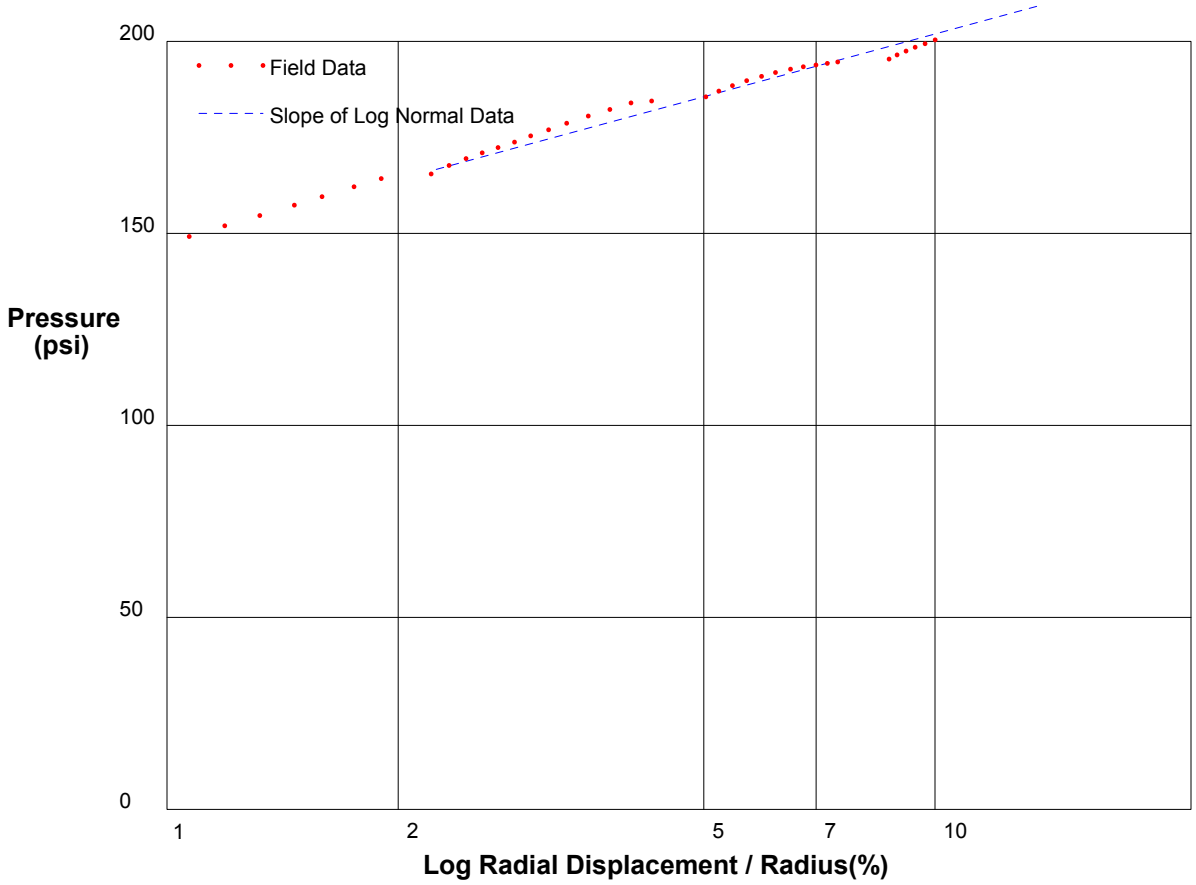


GIBSON'S CLAY MODEL

Shear Strength	20 psi
Insitu Stress	78 psi
Shear Modulus	16000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-31B-PMT-08 Depth 136ft	File C:\DATA\ISE-787\DOT143.P



Shear Strength 23.5 psi
Limit Pressure 235 psi

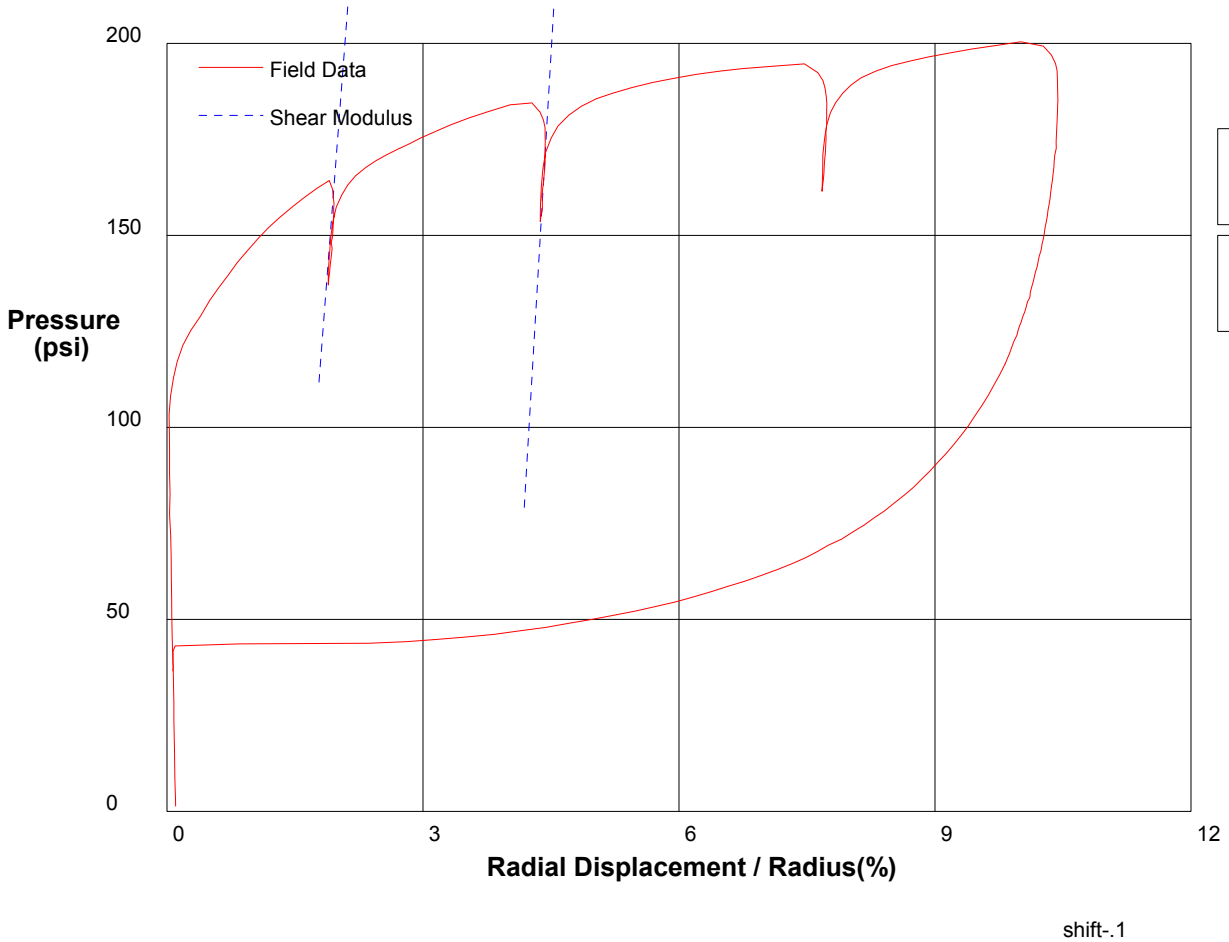
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/8/2008**

Hole No. TH-31B-PMT-08 Depth 136ft **File C:\DATA\ISE-787\DOT143.P**



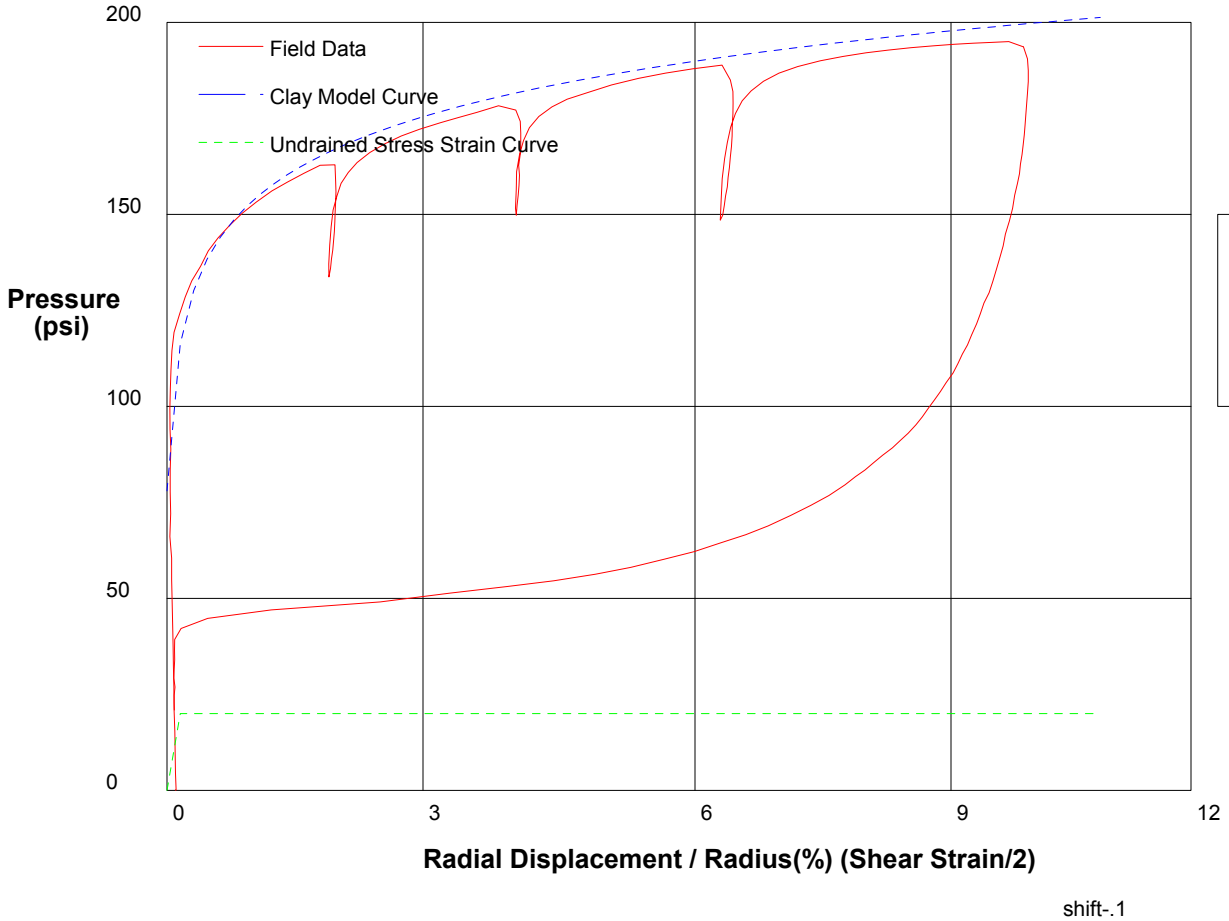
Shear Modulus 18888 psi

Shear Modulus 14521 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-21B-PMT-08 Depth 138ft	File C:\DATA\ISE-787\DOT144.P

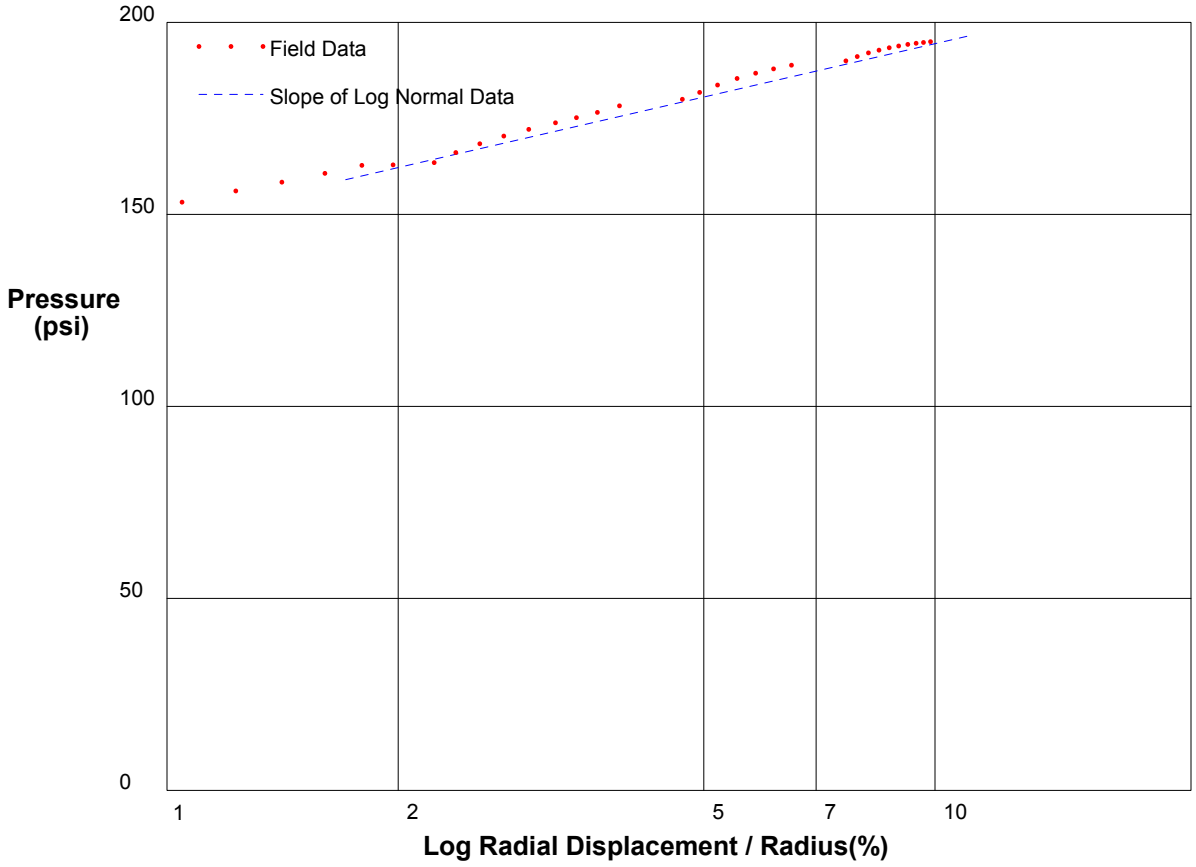


GIBSON'S CLAY MODEL

Shear Strength	20 psi
Insitu Stress	78 psi
Shear Modulus	16000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/8/2008
Hole No. TH-21B-PMT-08 Depth 138ft	File C:\DATA\ISE-787\DOT144.P



Shear Strength 20 psi
Limit Pressure 222 psi

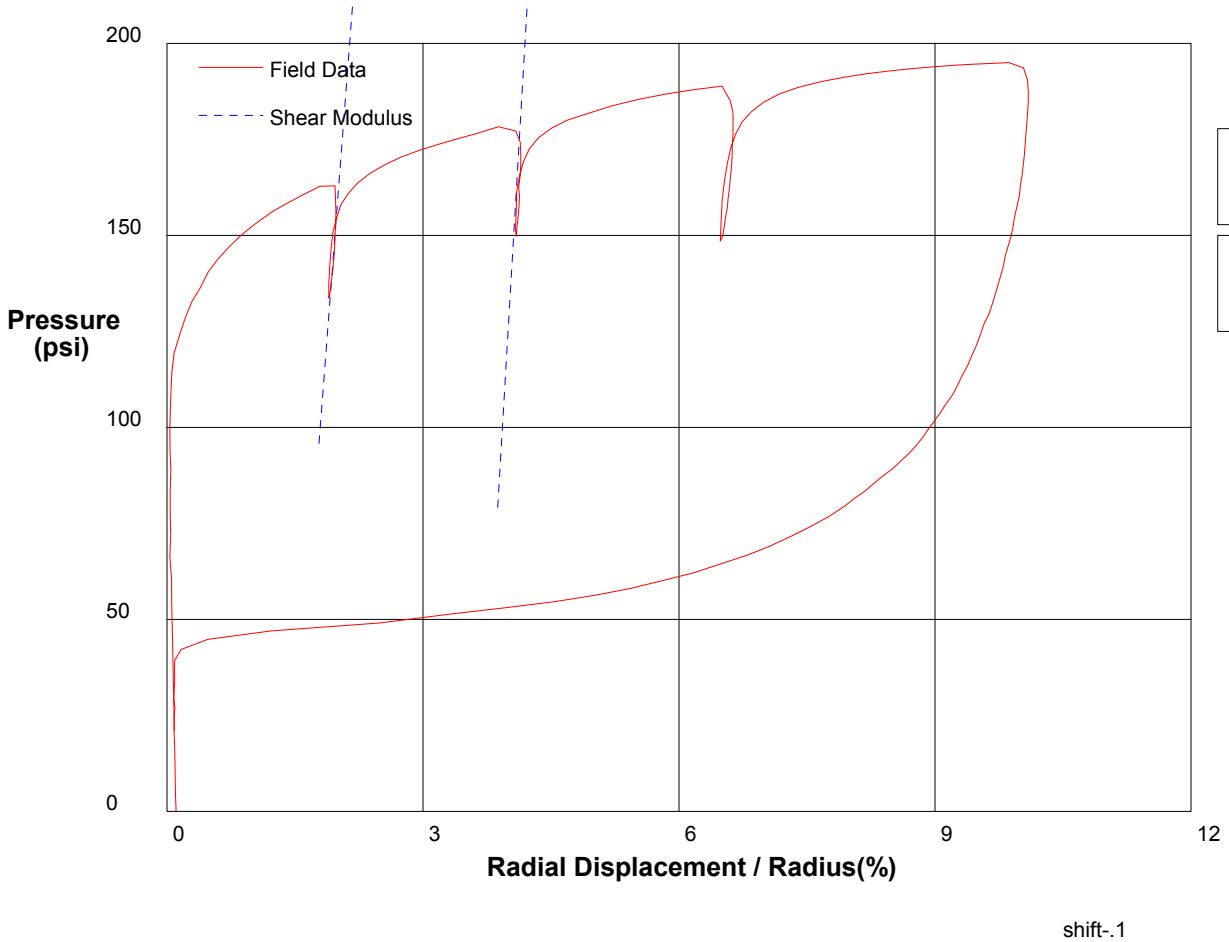
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/8/2008**

Hole No. TH-21B-PMT-08 Depth 138ft **File C:\DATA\ISE-787\DOT144.P**



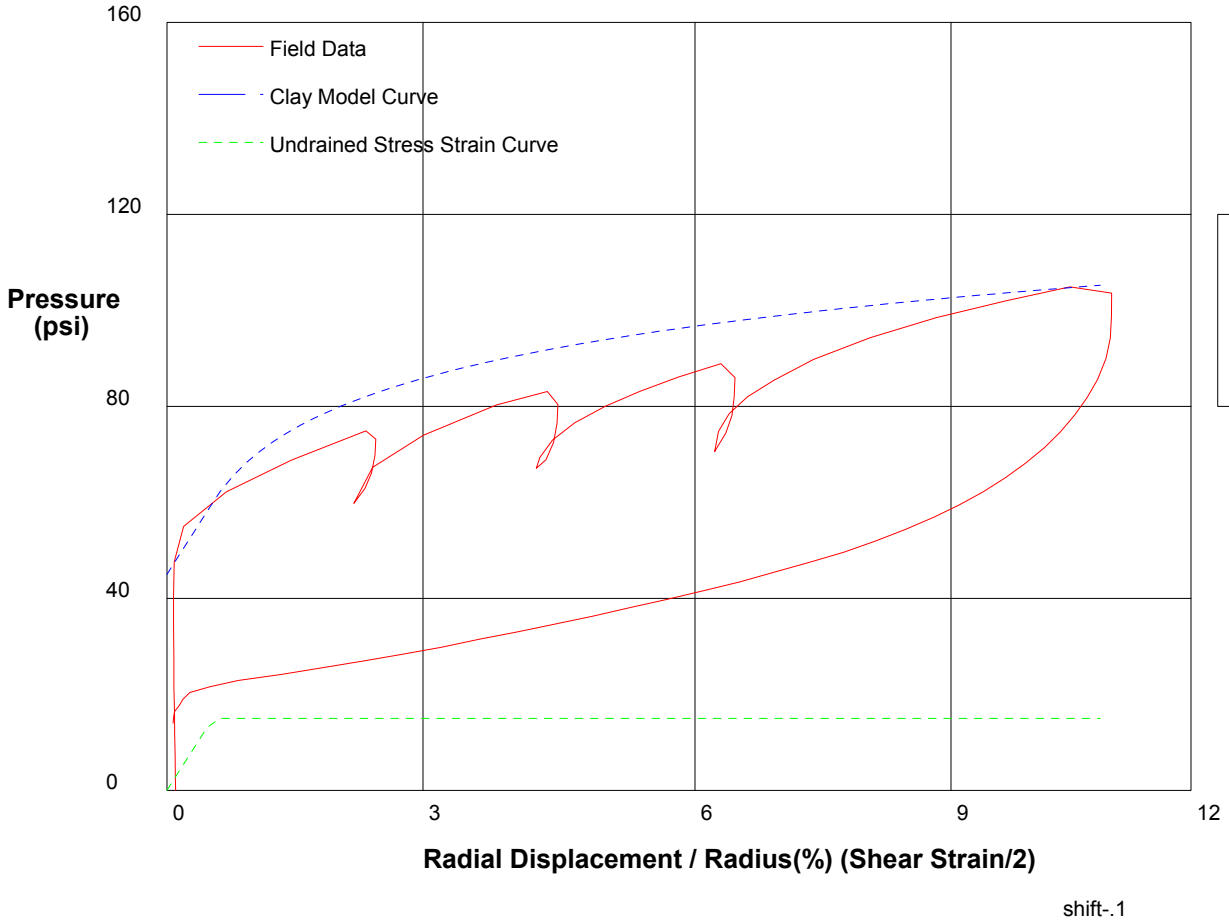
Shear Modulus 18888 psi

Shear Modulus 14521 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 82ft	File C:\DATA\ISE-787\DOT145.P

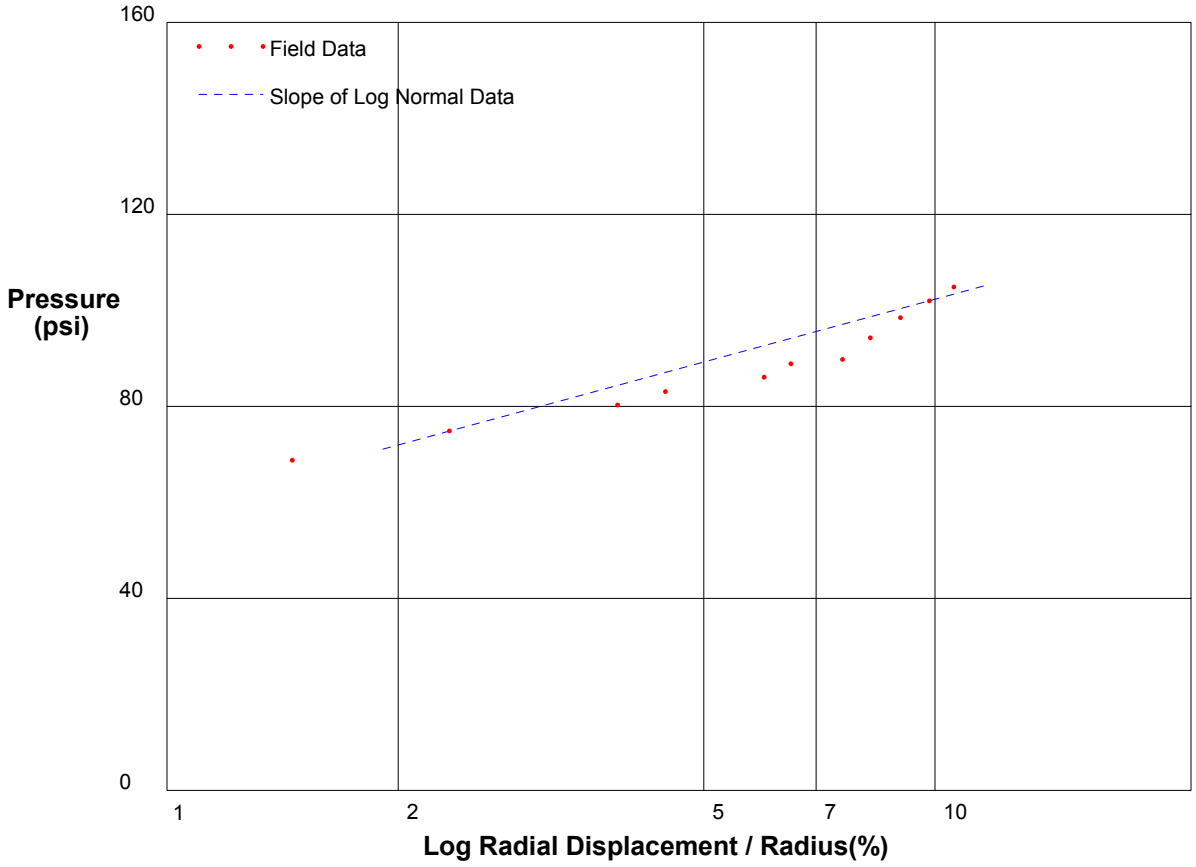


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	45 psi
Shear Modulus	1400 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 82ft	File C:\DATA\ISE-787\DOT145.P

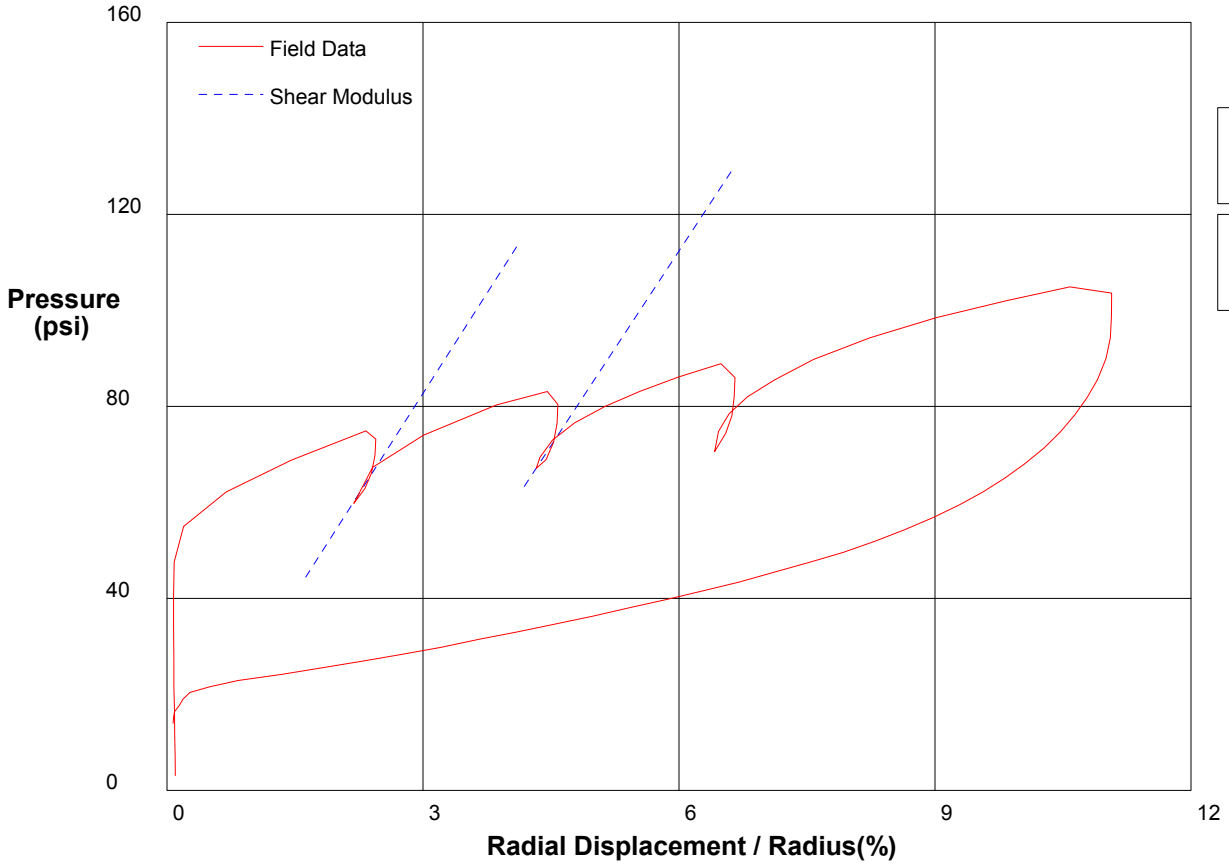


Shear Strength 18.8 psi
Limit Pressure 128 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 82ft	File C:\DATA\ISE-787\DOT145.P



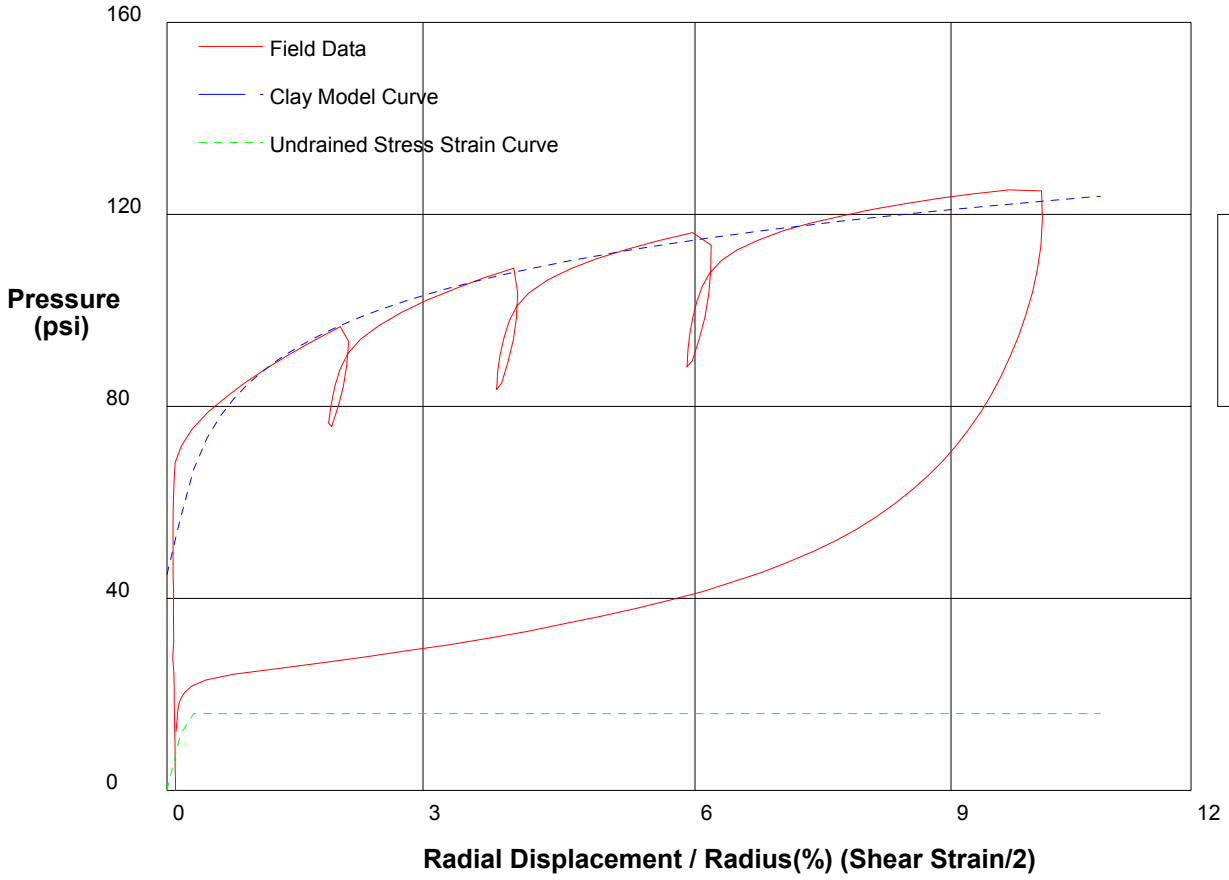
Shear Modulus 1353 psi

Shear Modulus 1392 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 84ft	File C:\DATA\ISE-787\DOT146.P



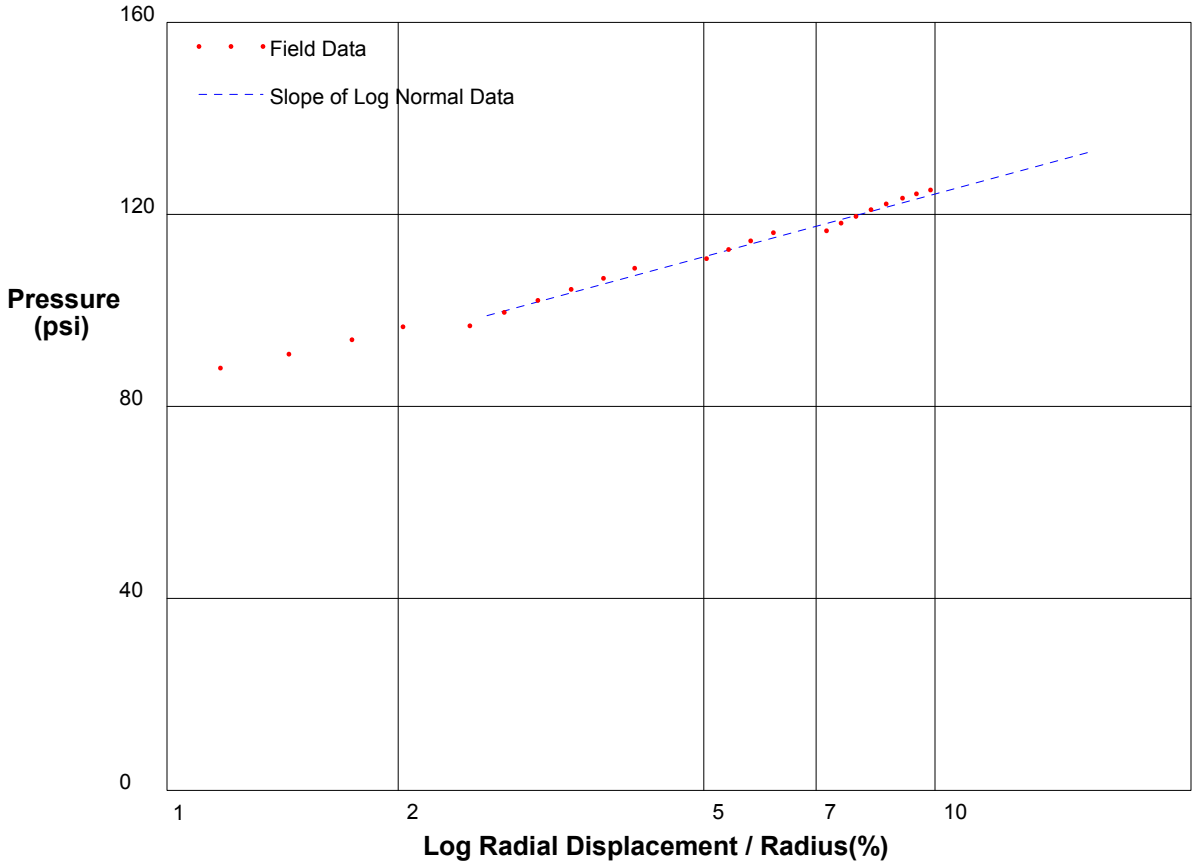
GIBSON'S CLAY MODEL

Shear Strength	16 psi
Insitu Stress	45 psi
Shear Modulus	3700 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 84ft	File C:\DATA\ISE-787\DOT146.P

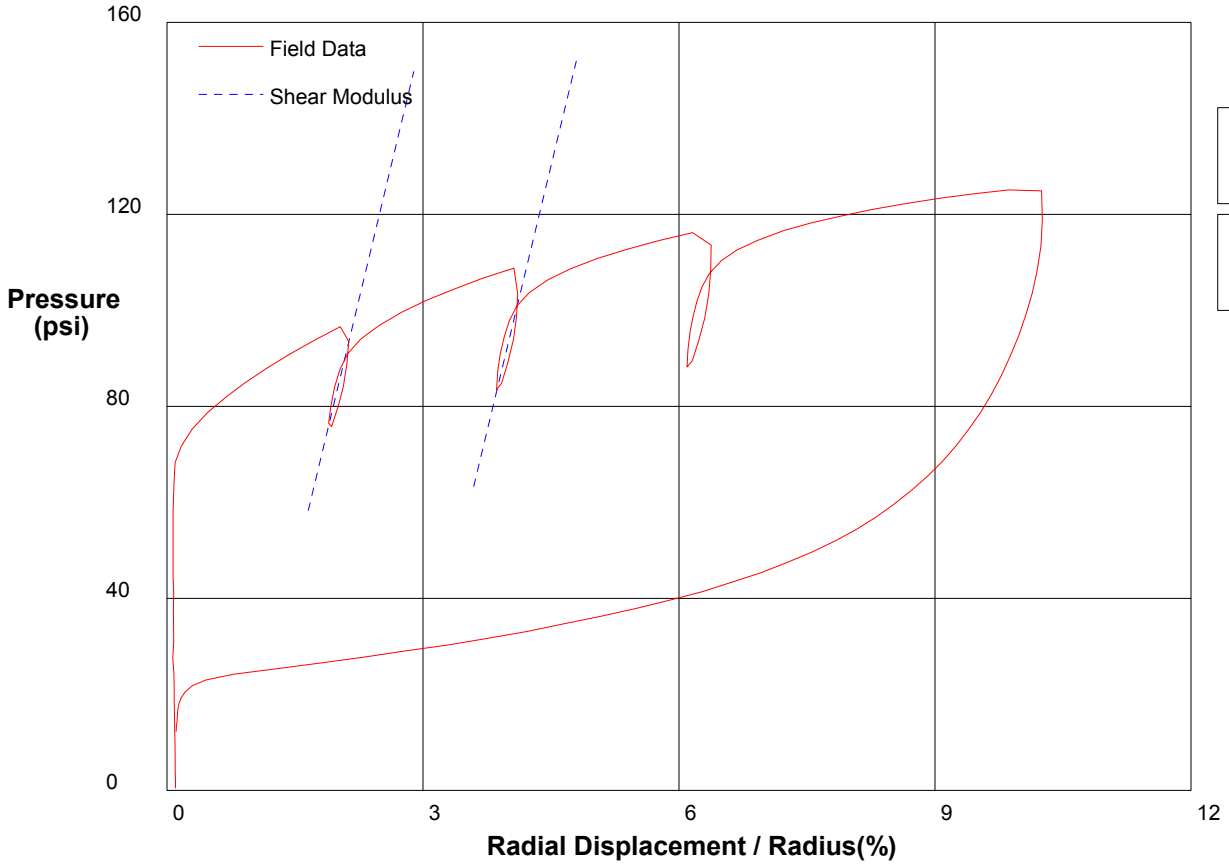


Shear Strength 18.8 psi
Limit Pressure 150 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 84ft	File C:\DATA\ISE-787\DOT146.P



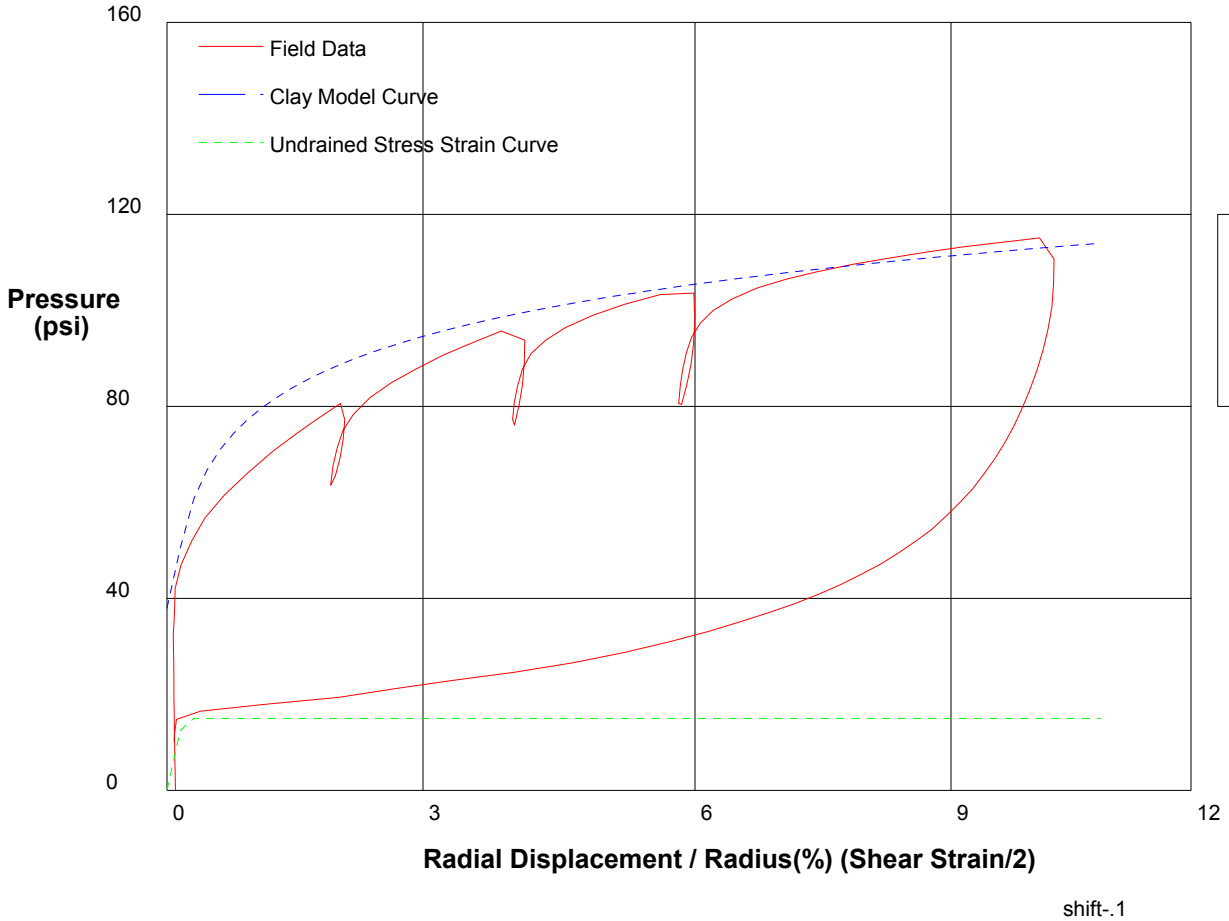
Shear Modulus 3682 psi

Shear Modulus 3701 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 86ft	File C:\DATA\ISE-787\DOT147.P

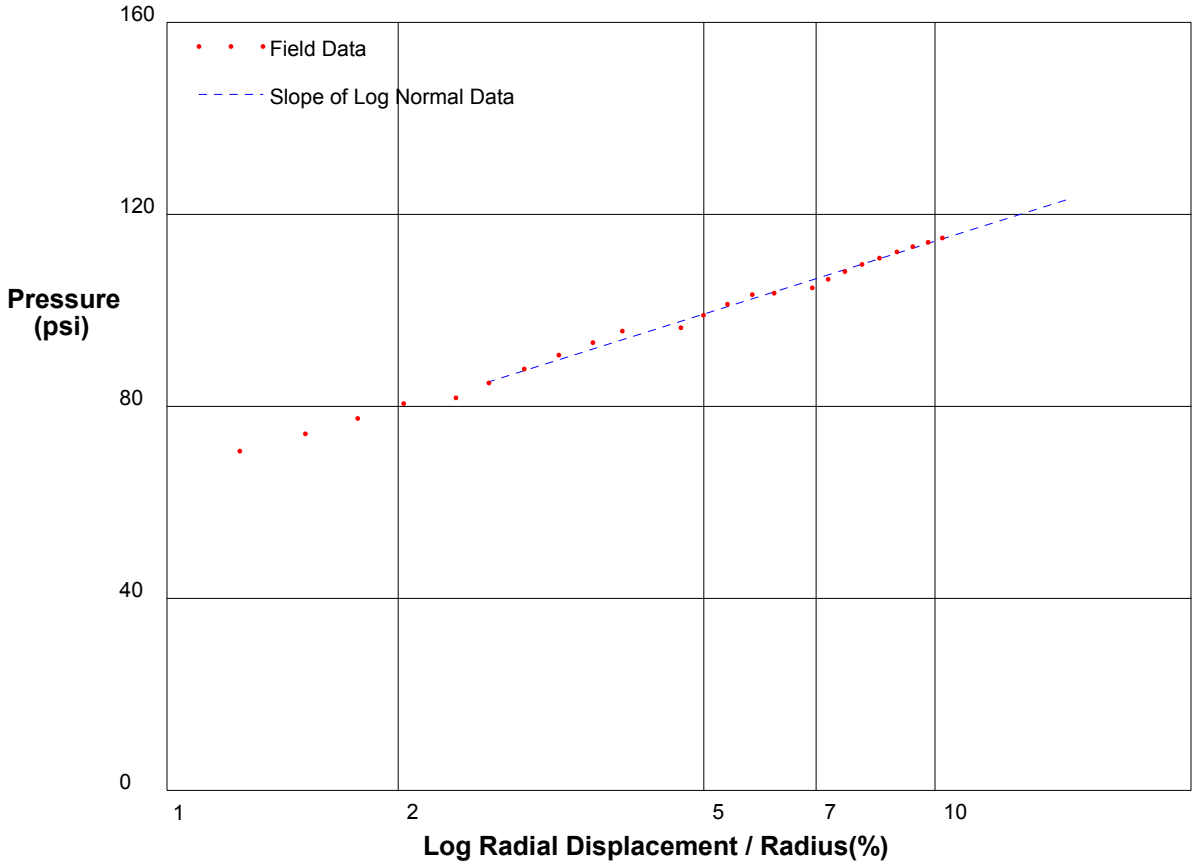


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	38 psi
Shear Modulus	4000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 86ft	File C:\DATA\ISE-787\DOT147.P

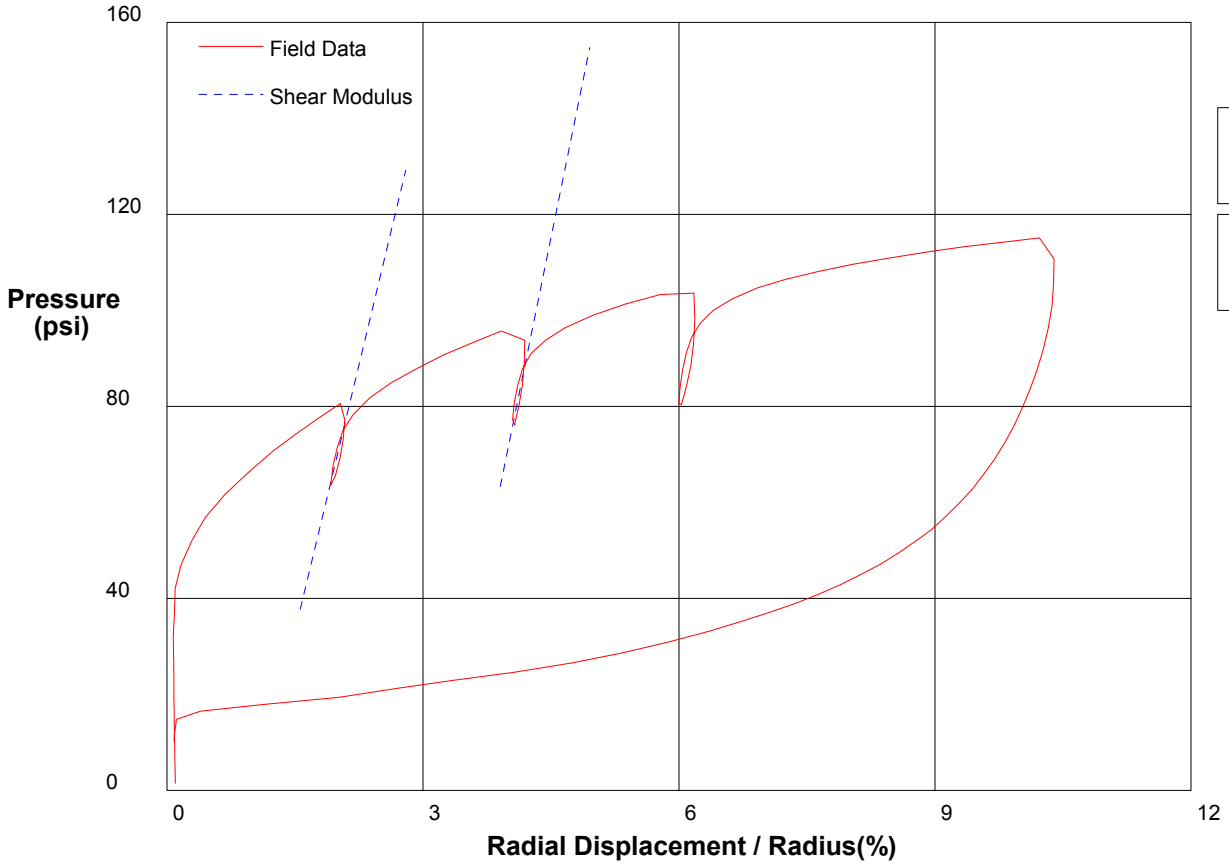


Shear Strength 21.8 psi
Limit Pressure 145 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 86ft	File C:\DATA\ISE-787\DOT147.P



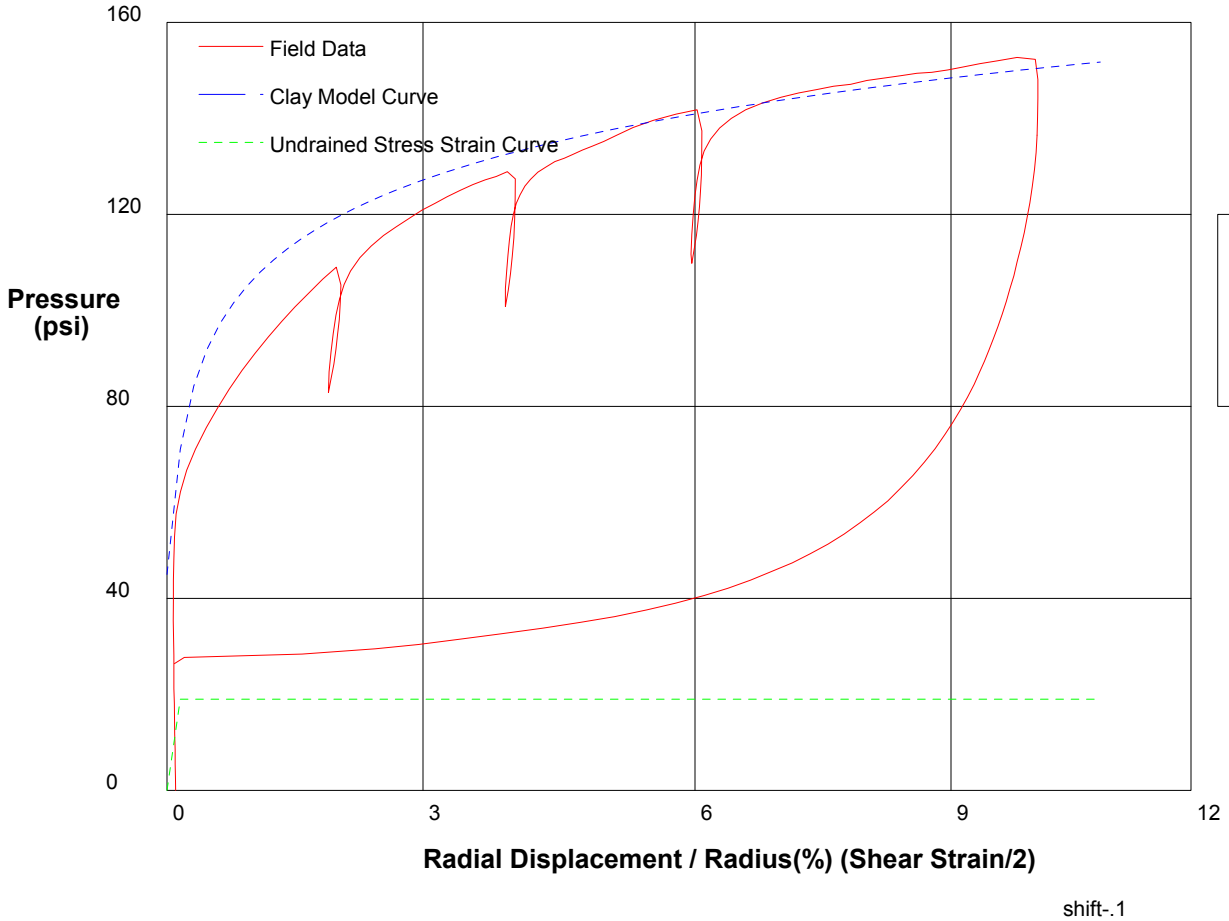
Shear Modulus 4364 psi

Shear Modulus 3701 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 88ft	File C:\DATA\ISE-787\DOT148.P

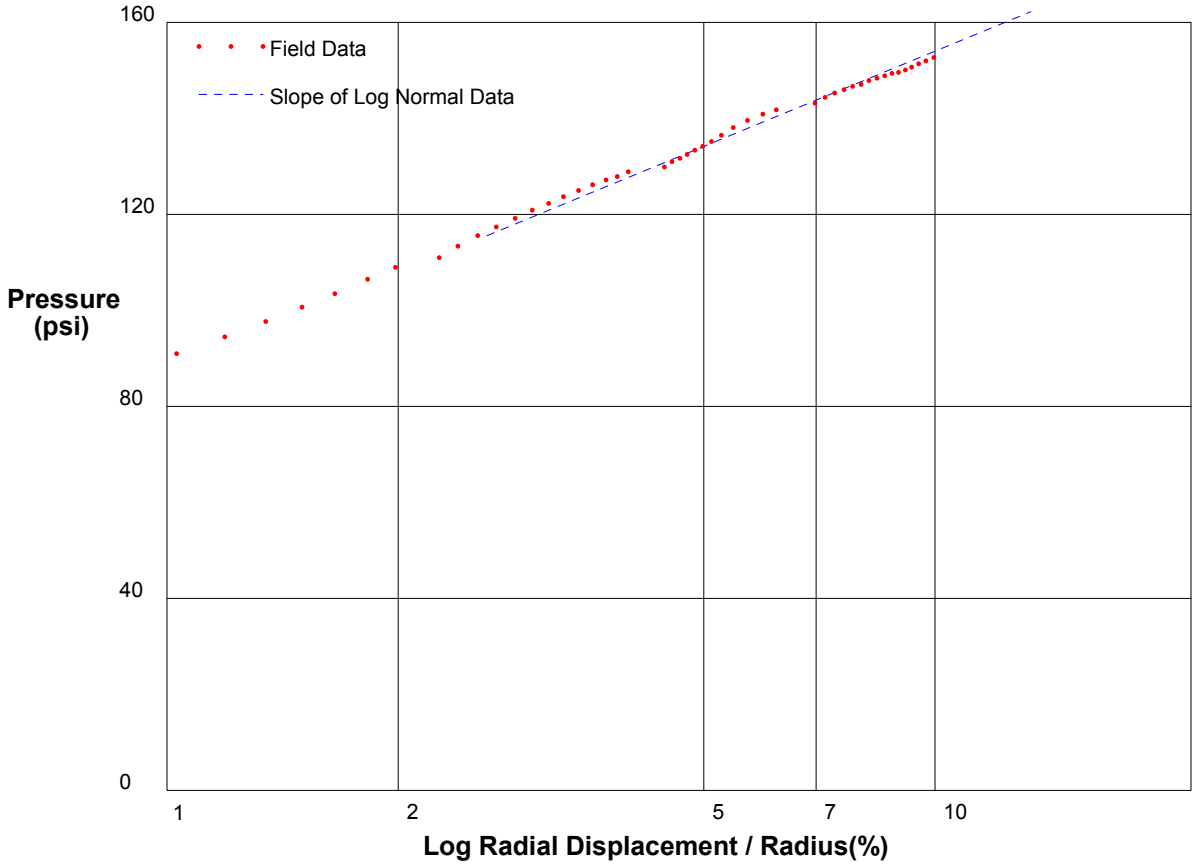


GIBSON'S CLAY MODEL

Shear Strength	19 psi
Insitu Stress	45 psi
Shear Modulus	8800 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 88ft	File C:\DATA\ISE-787\DOT148.P



Shear Strength 28.6 psi
Limit Pressure 194 psi

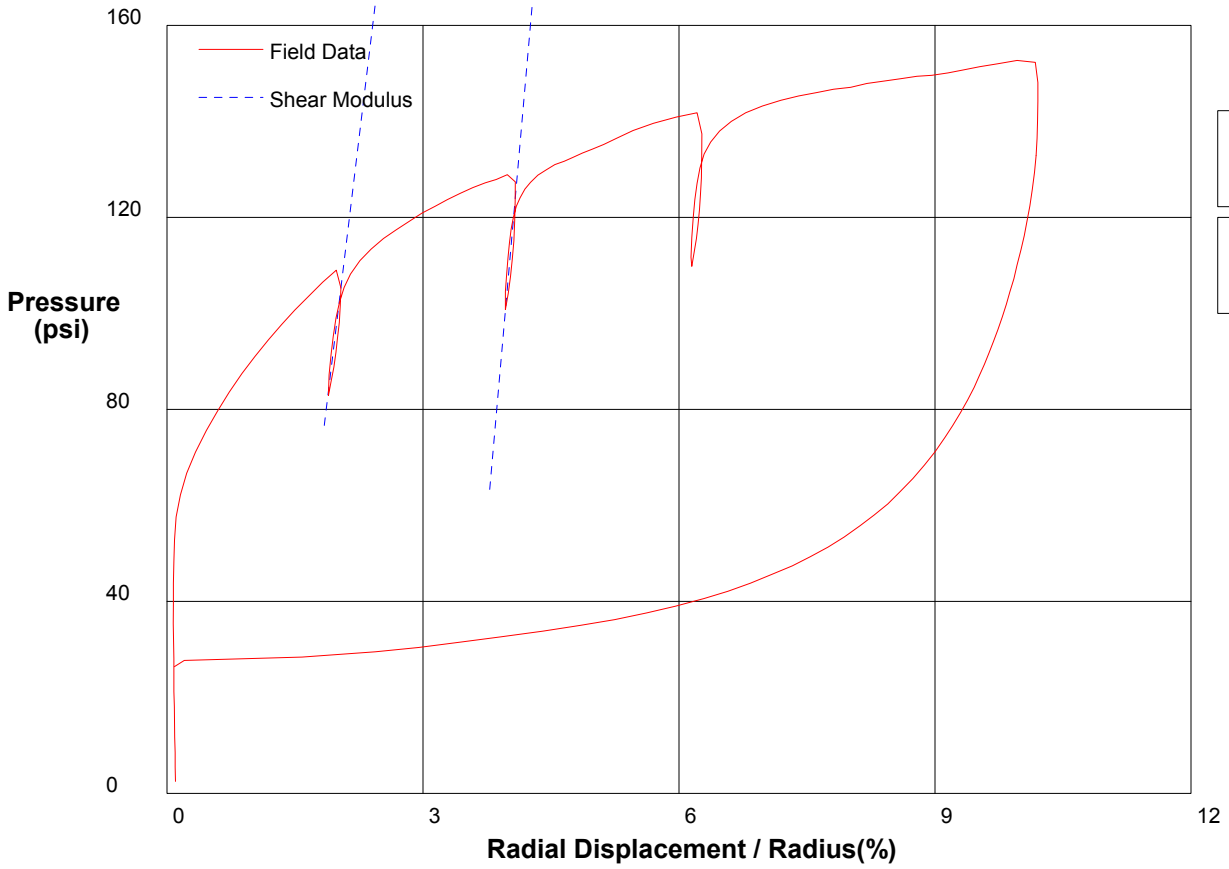
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/9/2008**

Hole No. TH-28B-PMT-08 Depth 88ft **File C:\DATA\ISE-787\DOT148.P**



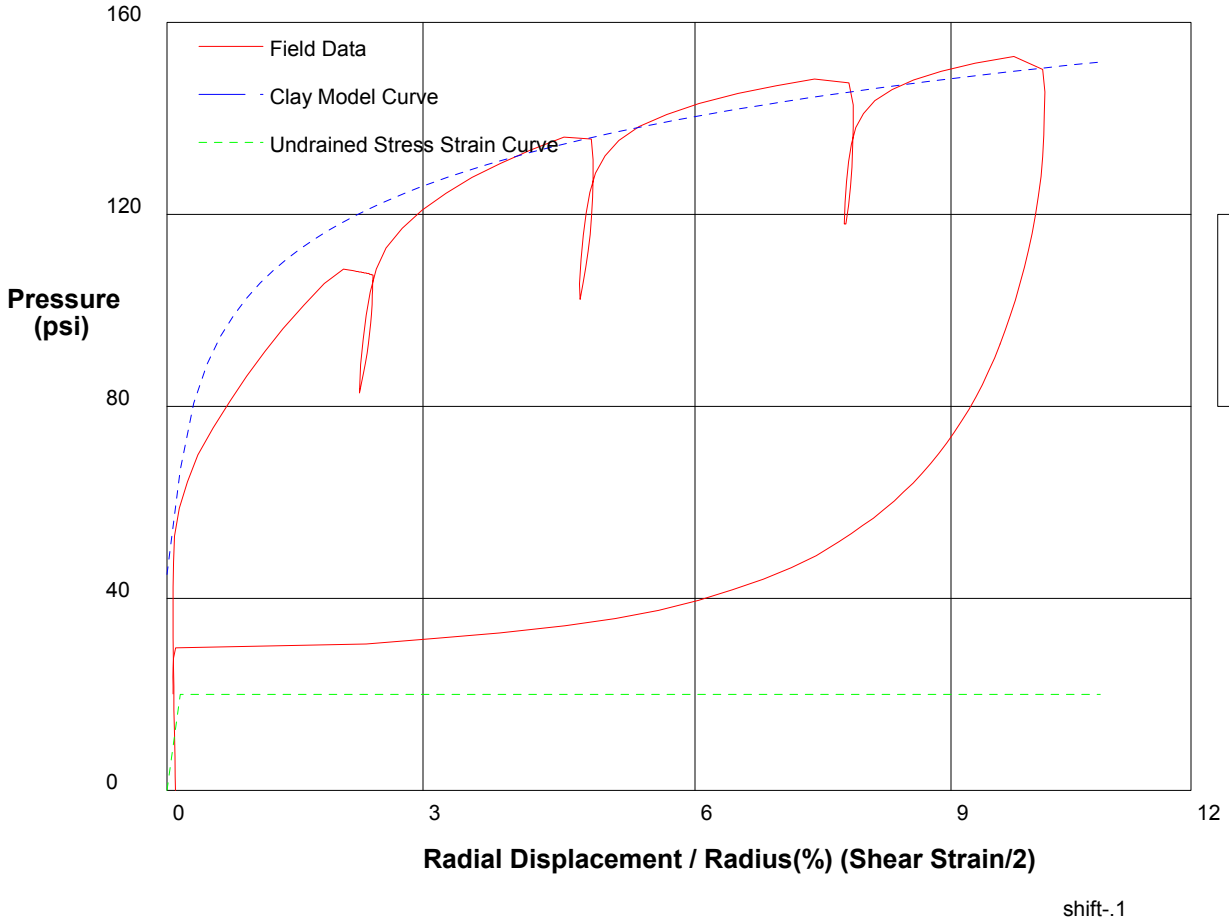
Shear Modulus 10111 psi

Shear Modulus 7353 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 90ft	File C:\DATA\ISE-787\DOT149.P

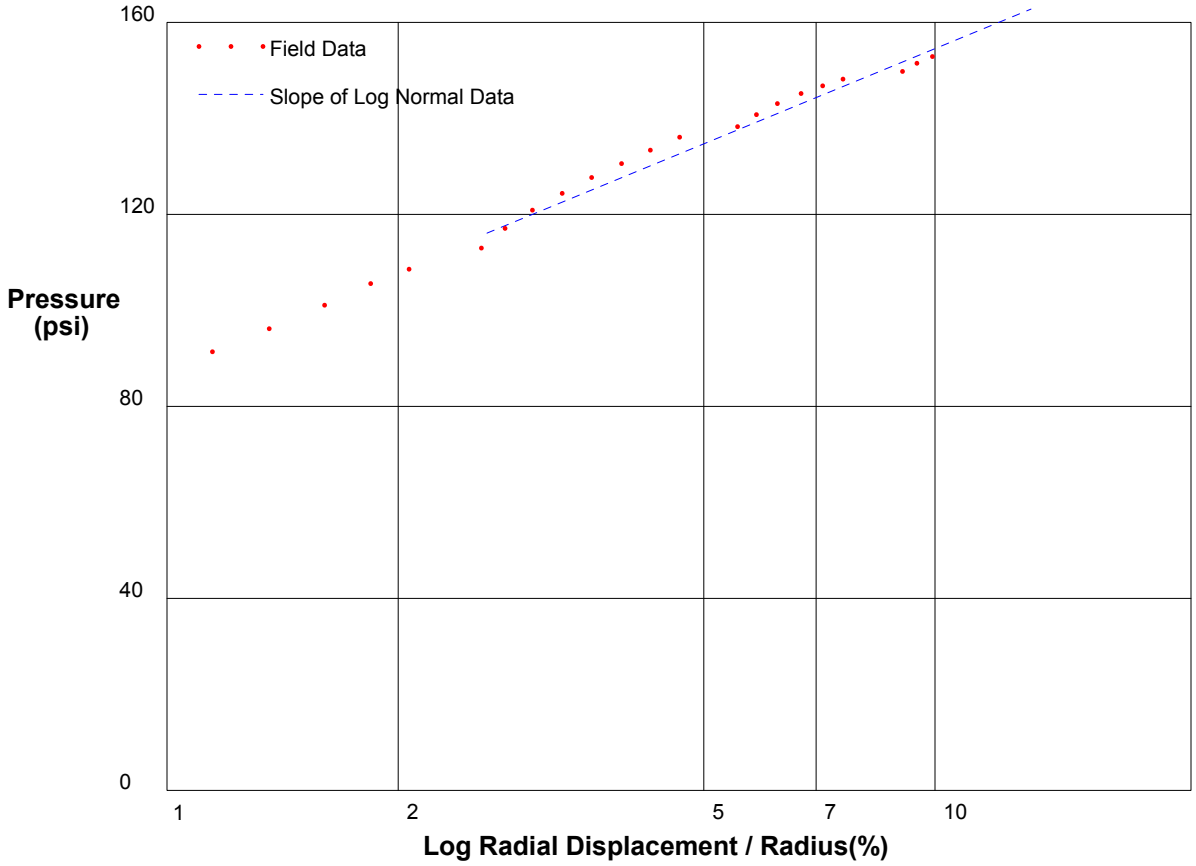


GIBSON'S CLAY MODEL

Shear Strength	20	psi
Insitu Stress	45	psi
Shear Modulus	7000	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 90ft	File C:\DATA\ISE-787\DOT149.P



Shear Strength 28.6 psi
Limit Pressure 194 psi

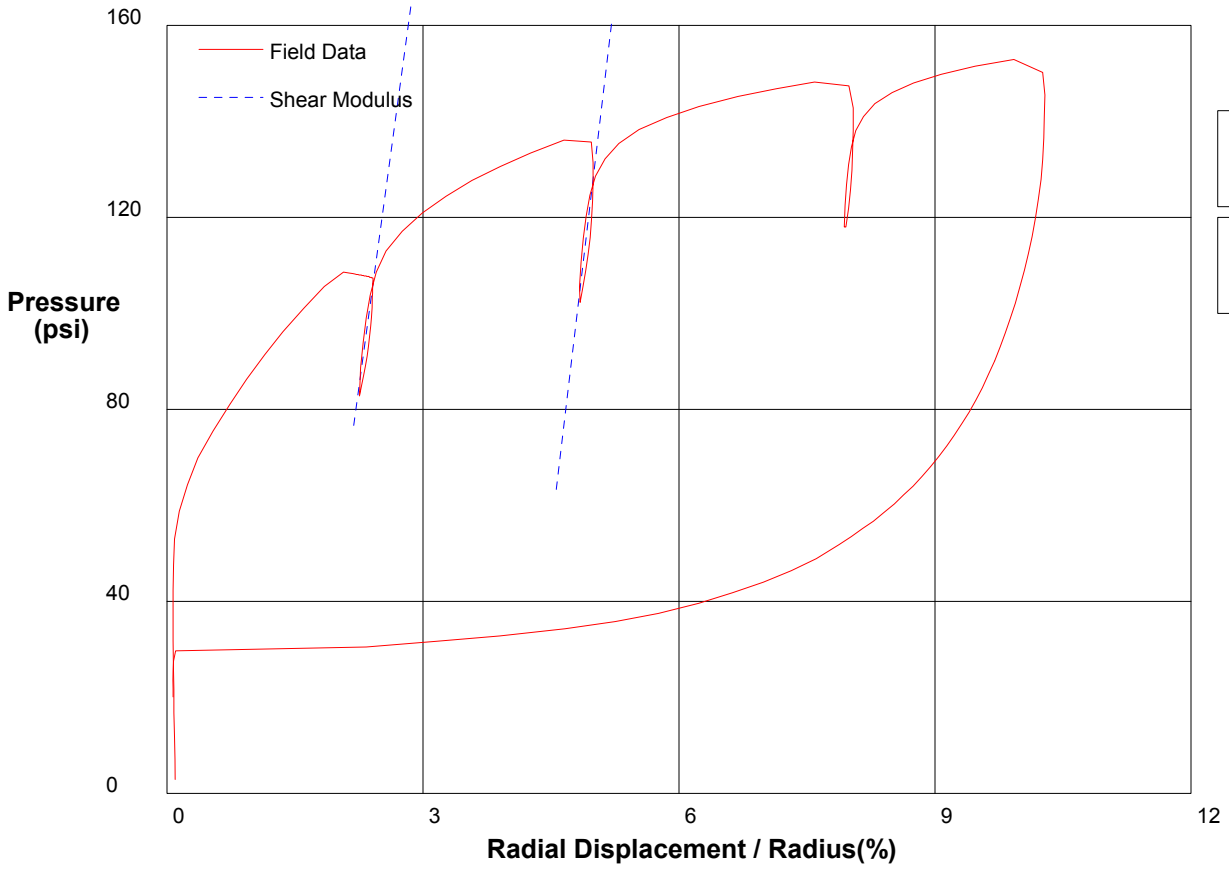
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/9/2008**

Hole No. TH-28B-PMT-08 Depth 90ft **File C:\DATA\ISE-787\DOT149.P**



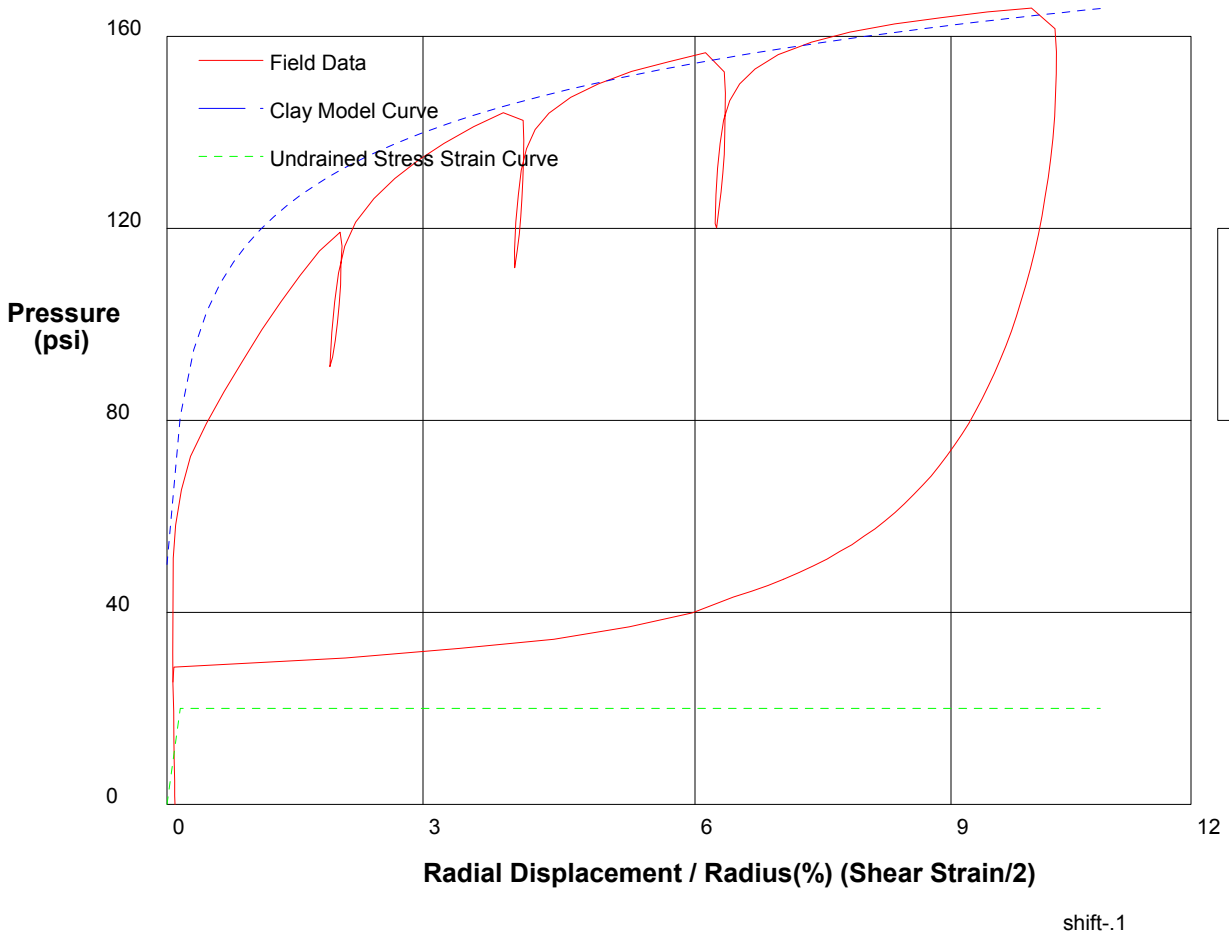
Shear Modulus 7492 psi

Shear Modulus 6512 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 92ft	File C:\DATA\ISE-787\DOT150.P



GIBSON'S CLAY MODEL

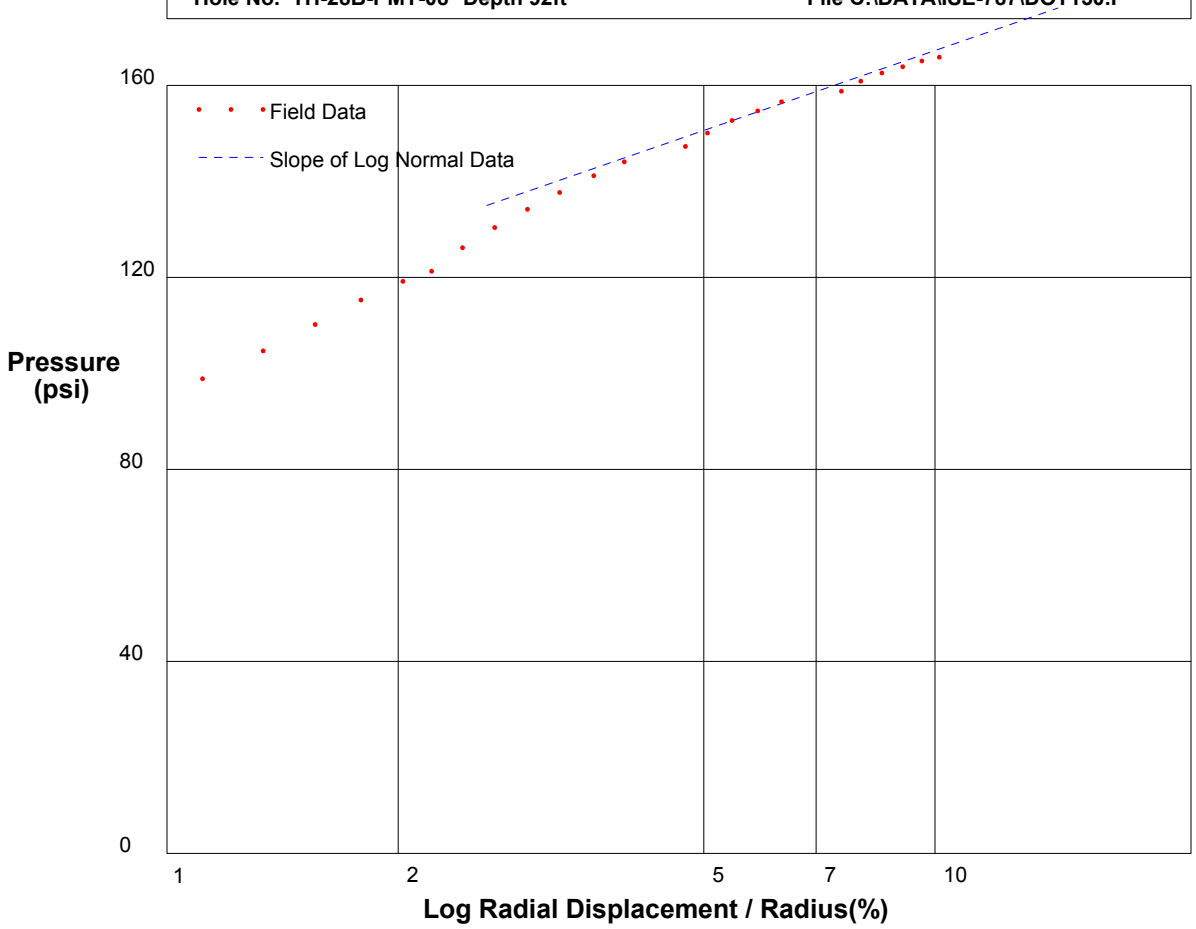
Shear Strength	20	psi
Insitu Stress	50	psi
Shear Modulus	11000	psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/9/2008**

Hole No. TH-28B-PMT-08 Depth 92ft **File C:\DATA\ISE-787\DOT150.P**



Shear Strength 24 psi
Limit Pressure 201 psi

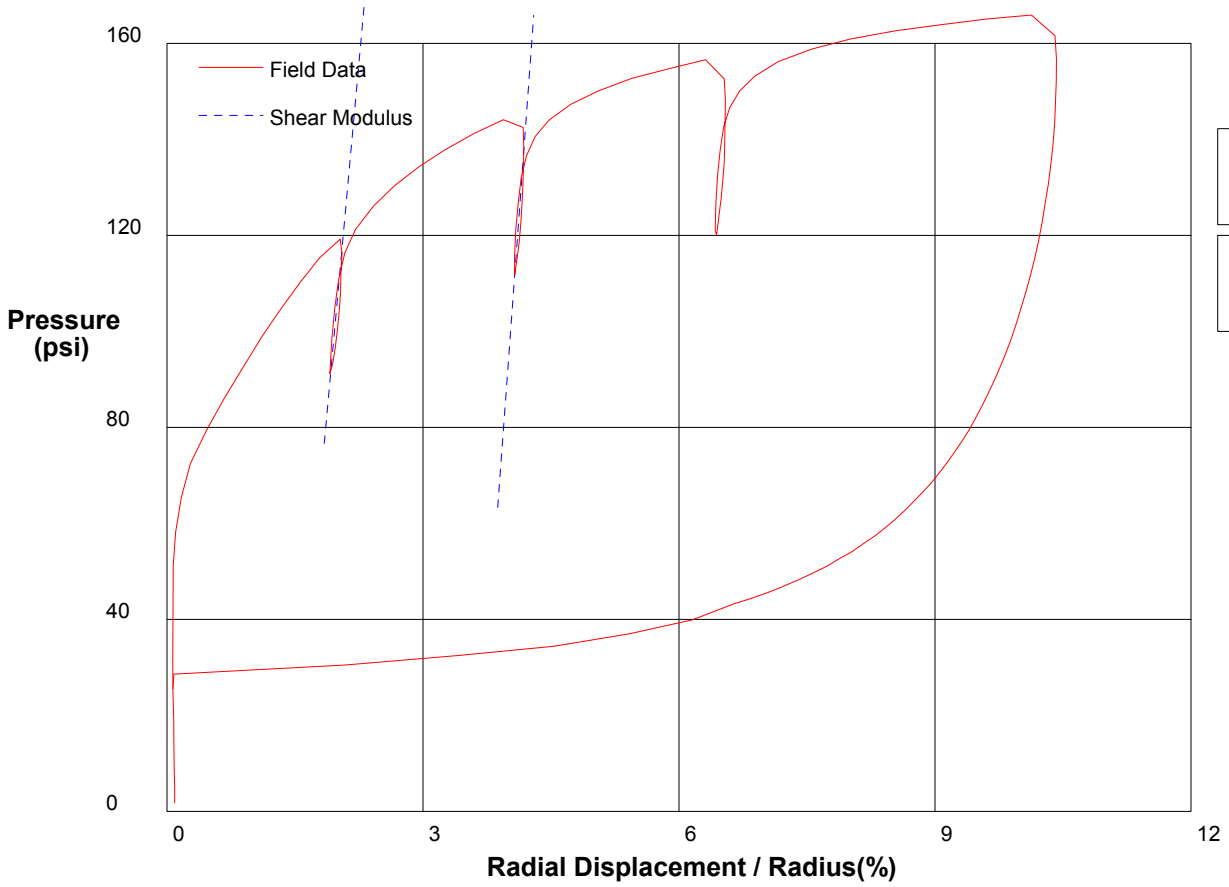
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/9/2008**

Hole No. TH-28B-PMT-08 Depth 92ft **File C:\DATA\ISE-787\DOT150.P**



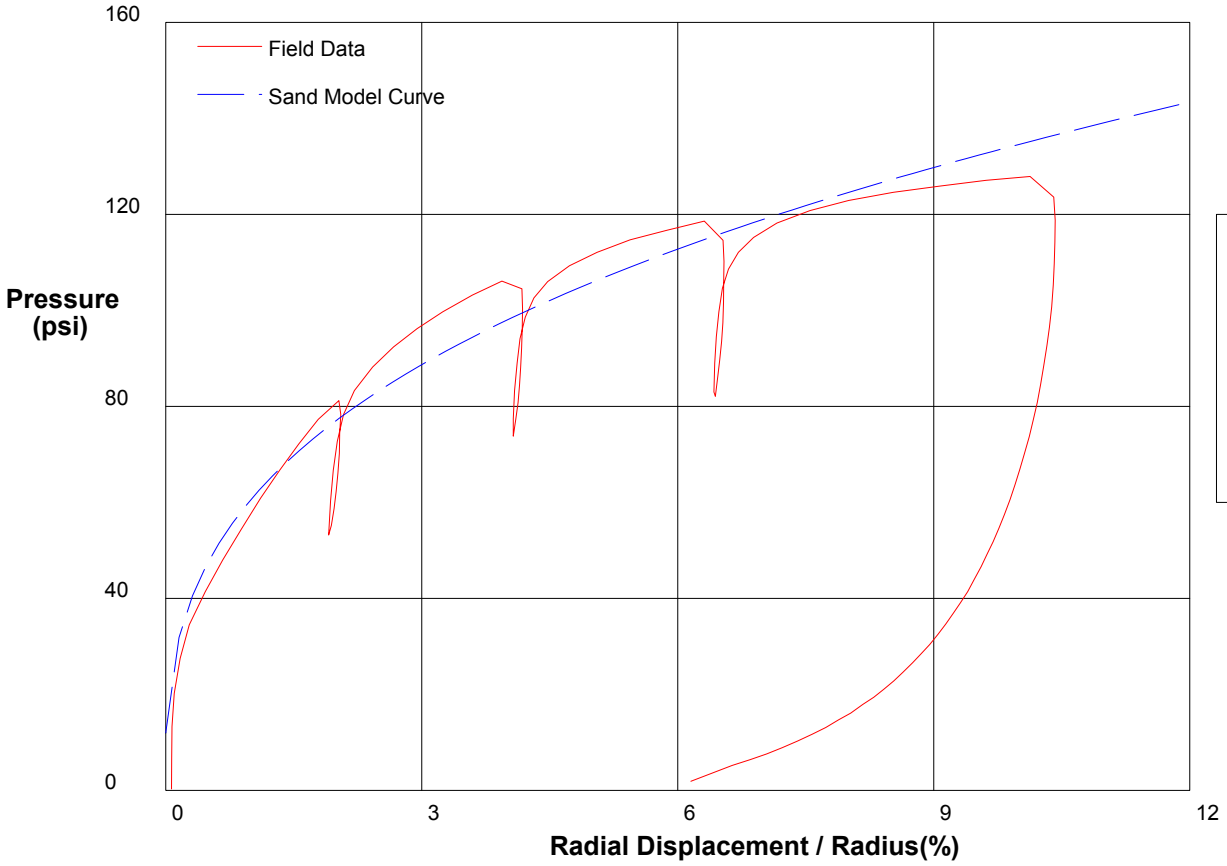
Shear Modulus 12148 psi

Shear Modulus 9777 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 92ft	File C:\DATA\ISE-787\DOT150.P



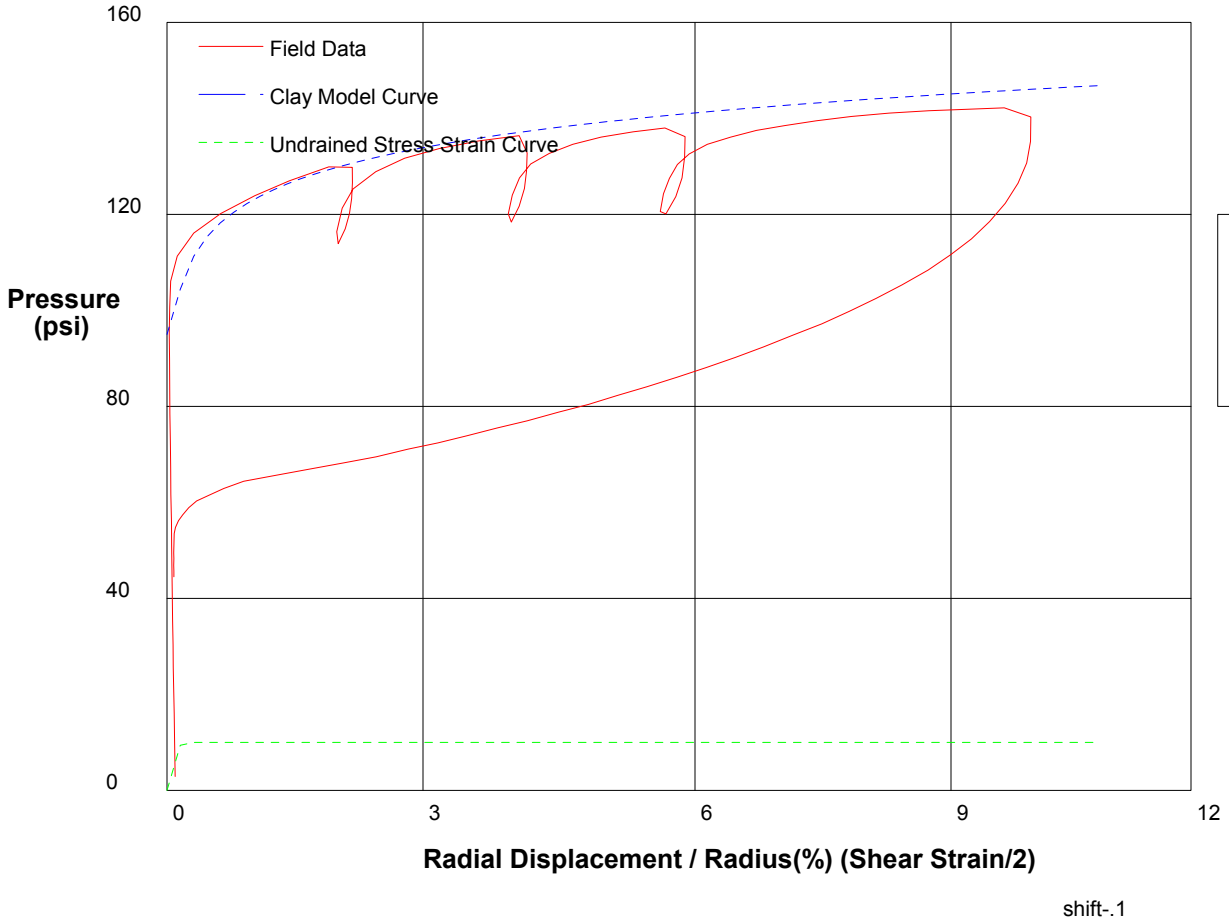
THE In Situ Engineering SAND MODEL

Water Pressure	38 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	12 psi
Shear Modulus	10000 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 94ft	File C:\DATA\ISE-787\DOT151.P

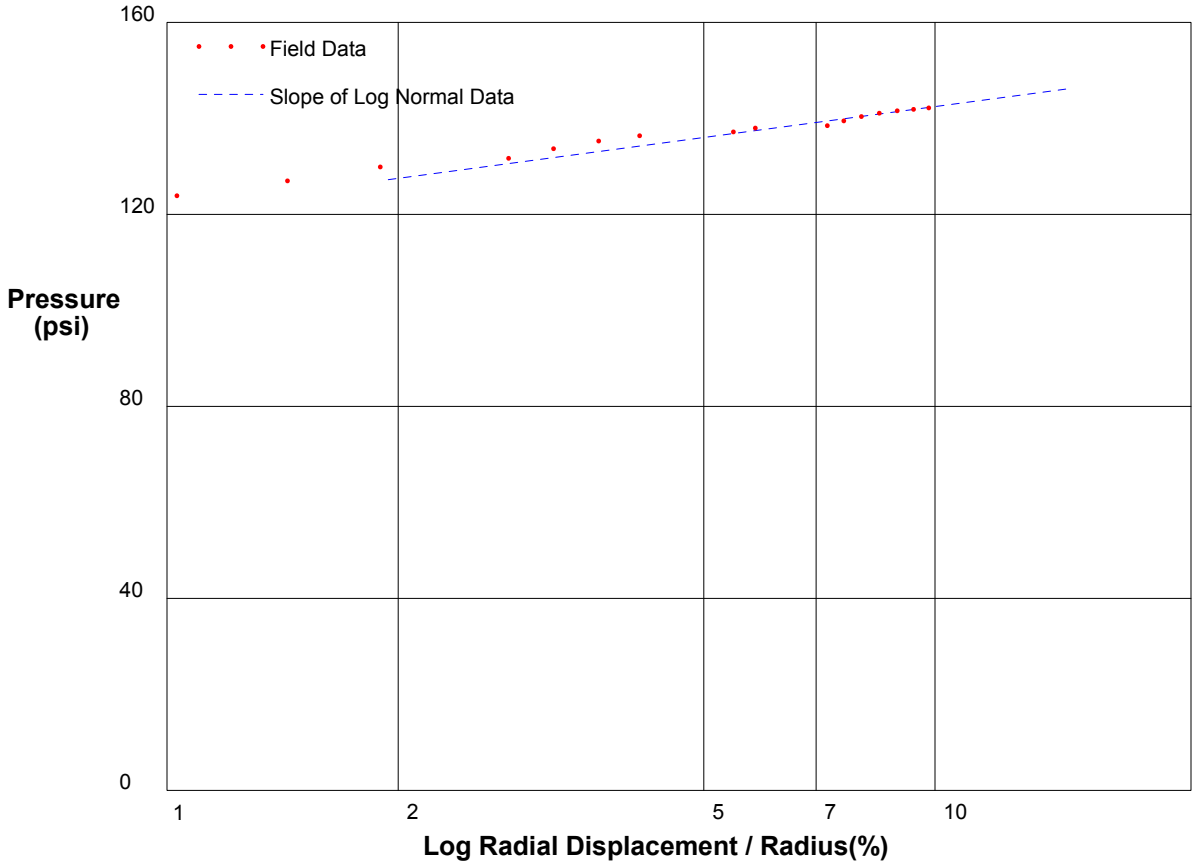


GIBSON'S CLAY MODEL

Shear Strength	10	psi
Insitu Stress	95	psi
Shear Modulus	3000	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 94ft	File C:\DATA\ISE-787\DOT151.P

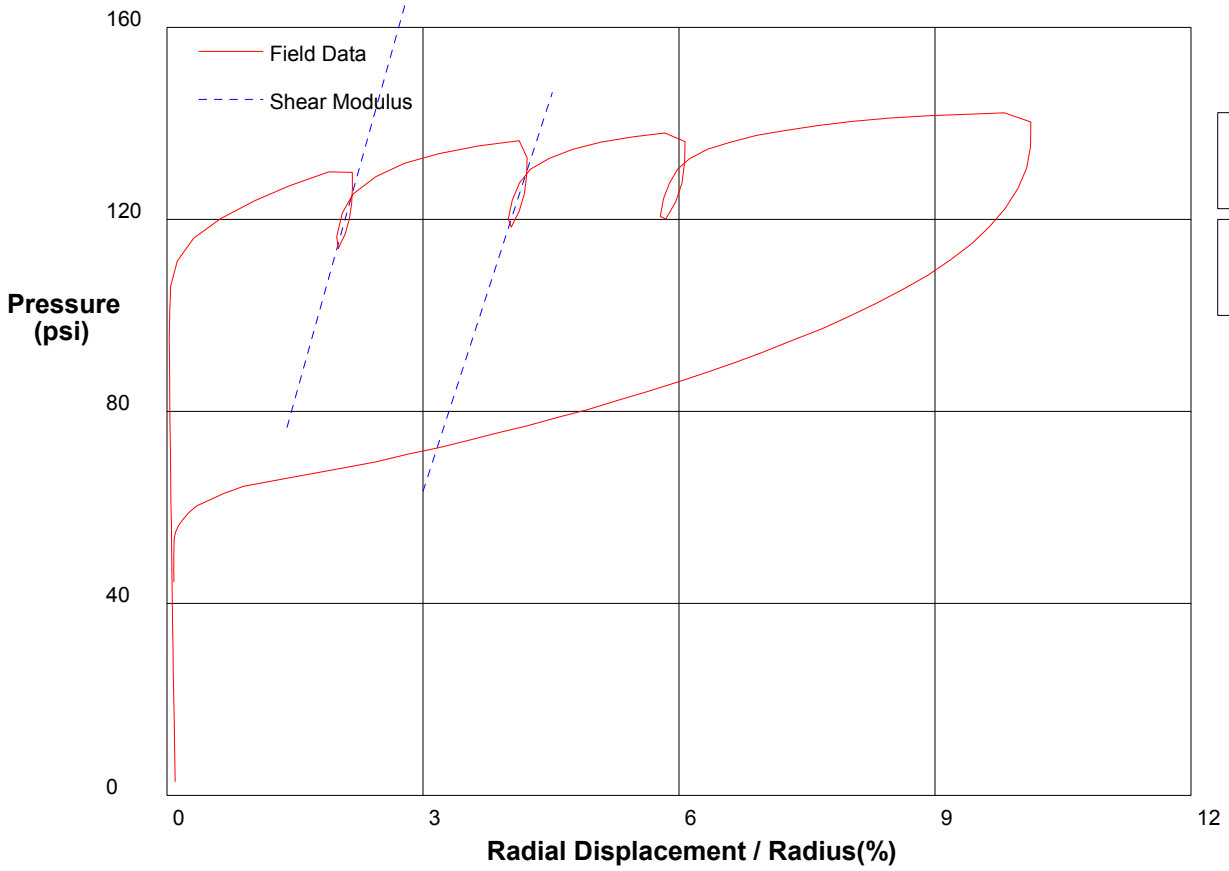


Shear Strength 9.3 psi
Limit Pressure 155 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 94ft	File C:\DATA\ISE-787\DOT151.P



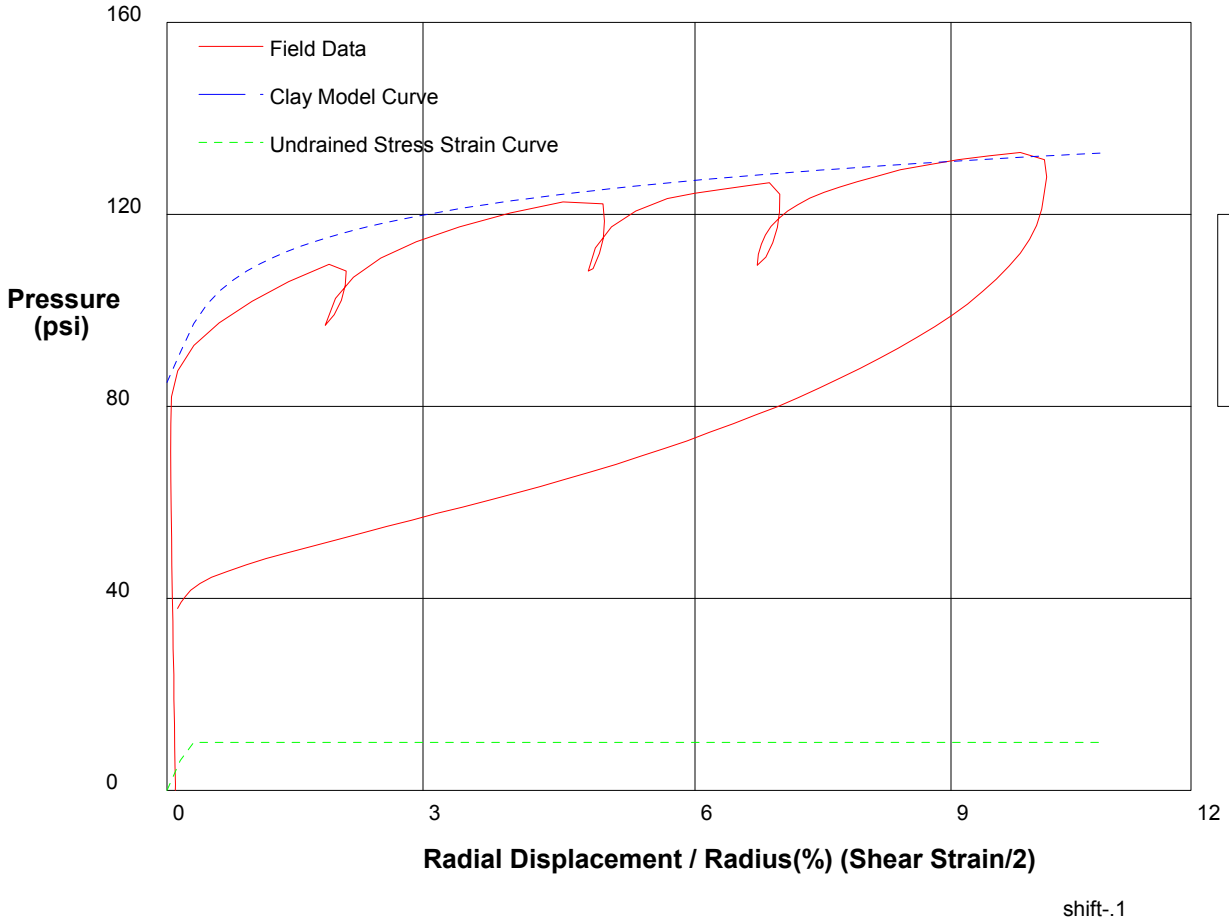
Shear Modulus 2739 psi

Shear Modulus 3186 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 97ft	File C:\DATA\ISE-787\DOT152.P

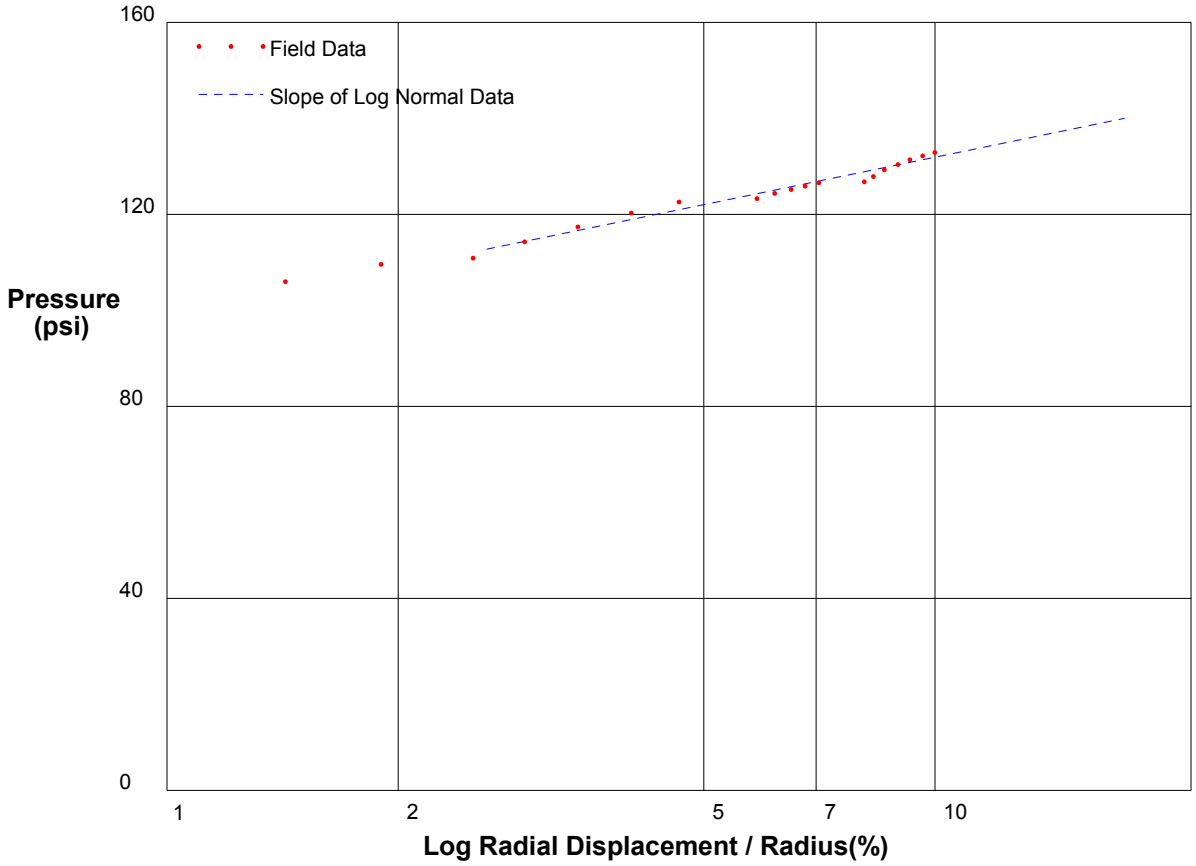


GIBSON'S CLAY MODEL

Shear Strength	10 psi
Insitu Stress	85 psi
Shear Modulus	2000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 97ft	File C:\DATA\ISE-787\DOT152.P

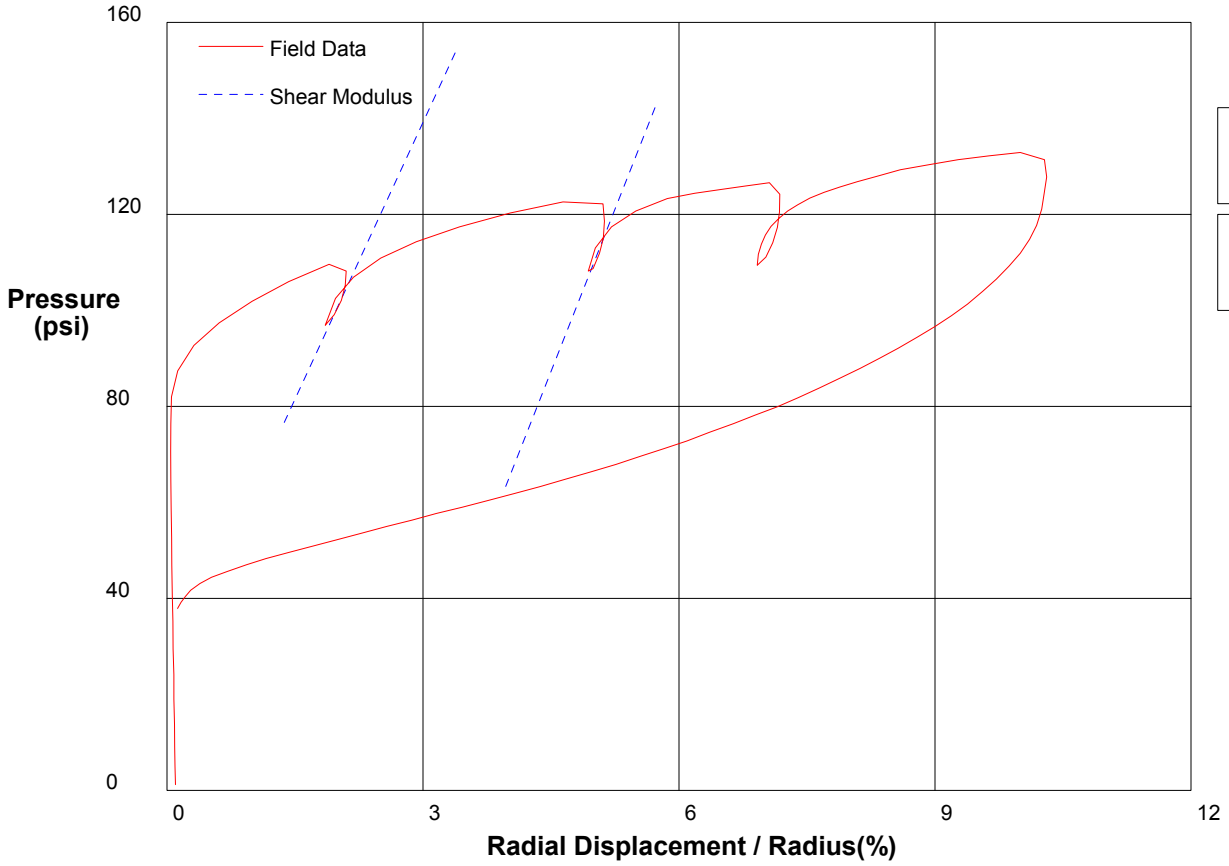


Shear Strength 14.2 psi
Limit Pressure 152 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 97ft	File C:\DATA\ISE-787\DOT152.P



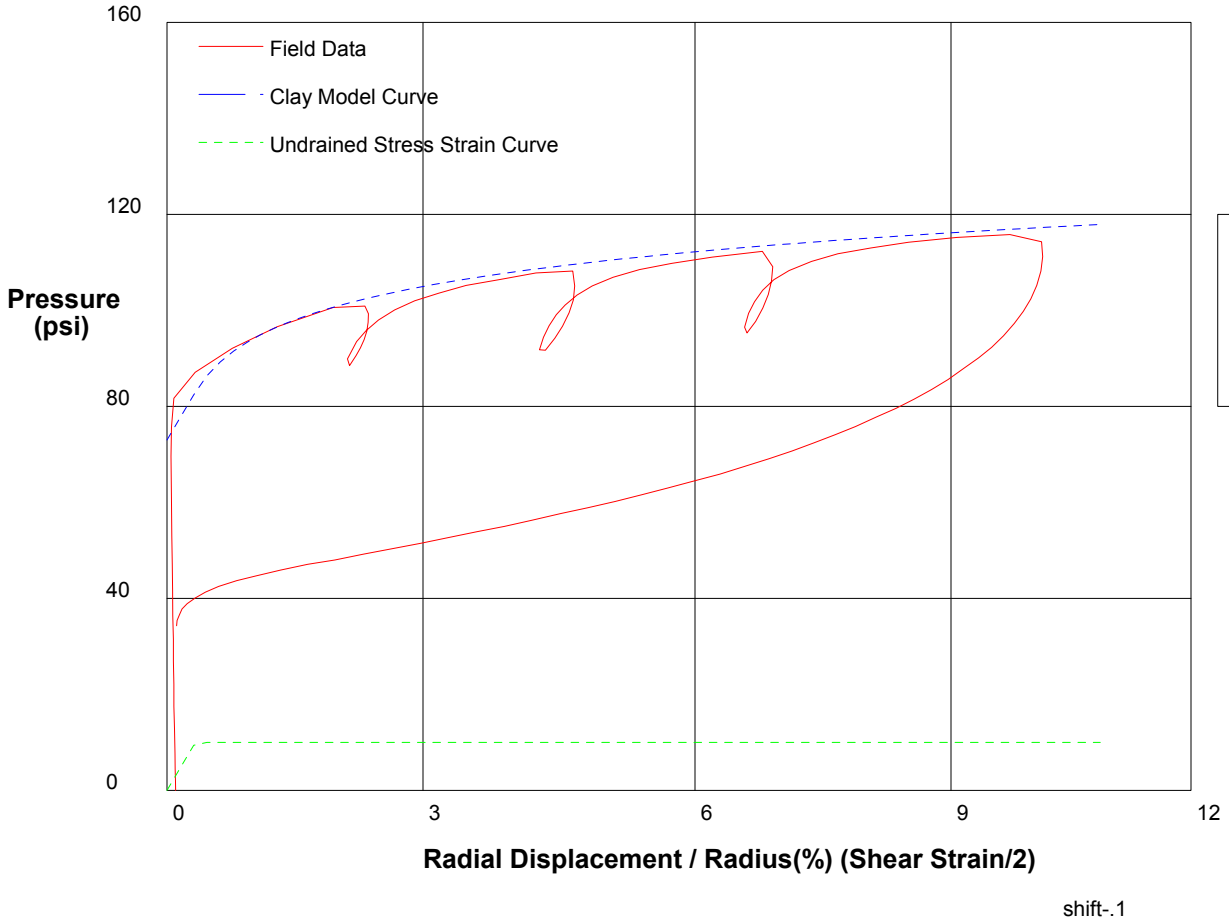
Shear Modulus 2253 psi

Shear Modulus 1922 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 99ft	File C:\DATA\ISE-787\DOT153.P

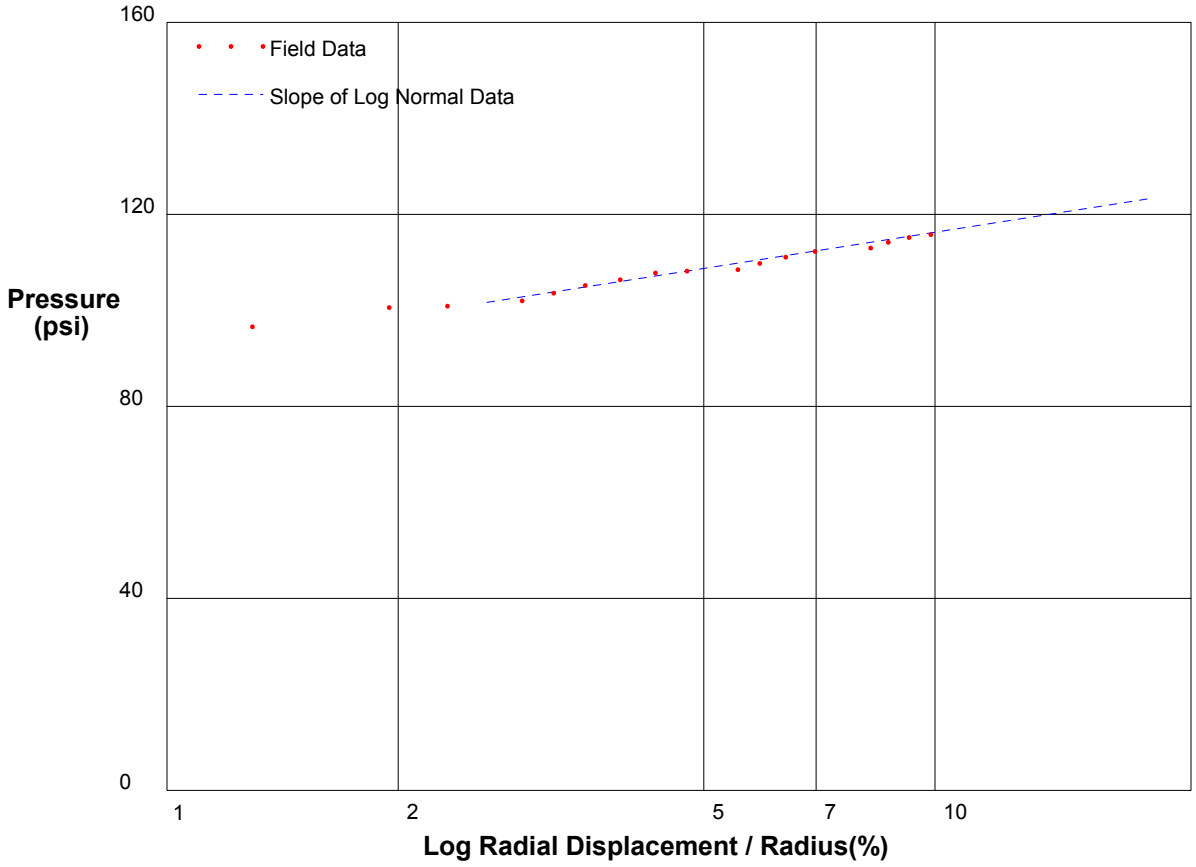


GIBSON'S CLAY MODEL

Shear Strength	10 psi
Insitu Stress	73 psi
Shear Modulus	1500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 99ft	File C:\DATA\ISE-787\DOT153.P

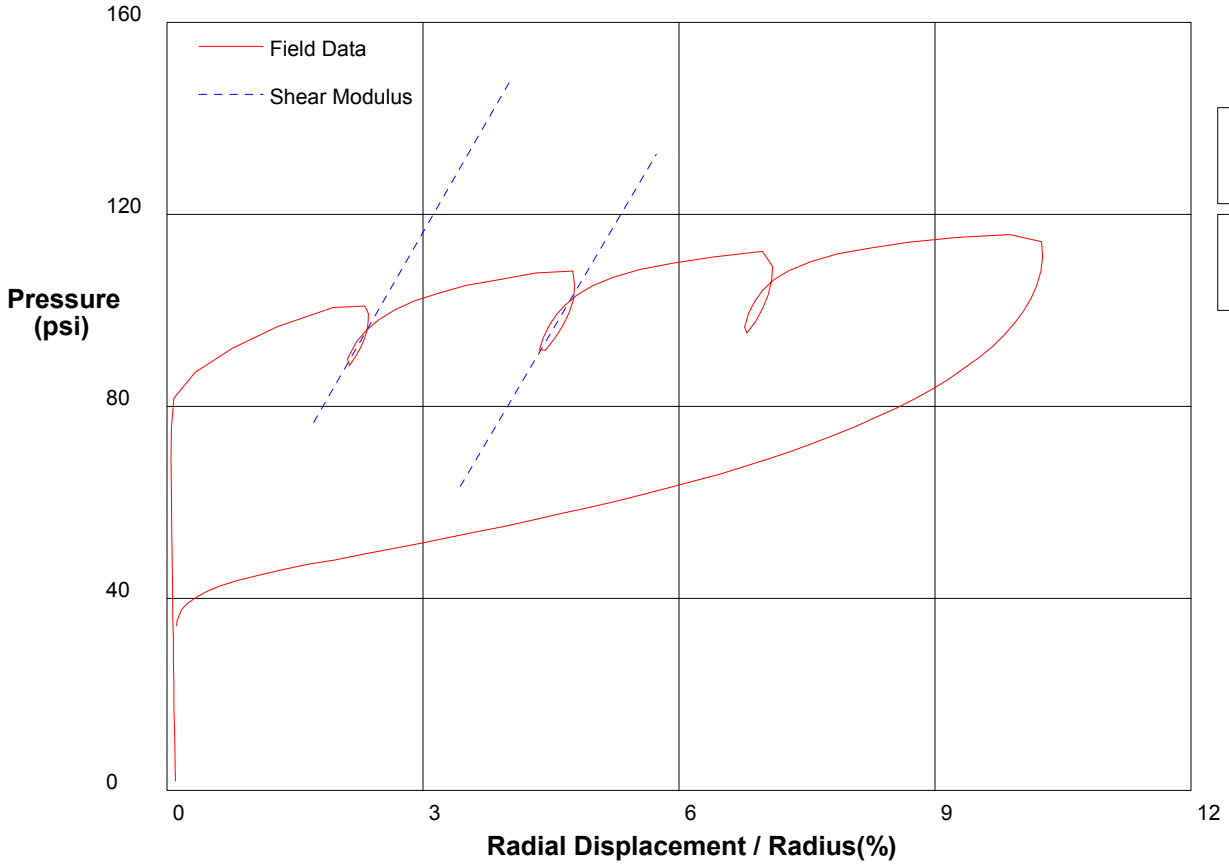


Shear Strength 10.8 psi
Limit Pressure 131 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 99ft	File C:\DATA\ISE-787\DOT153.P



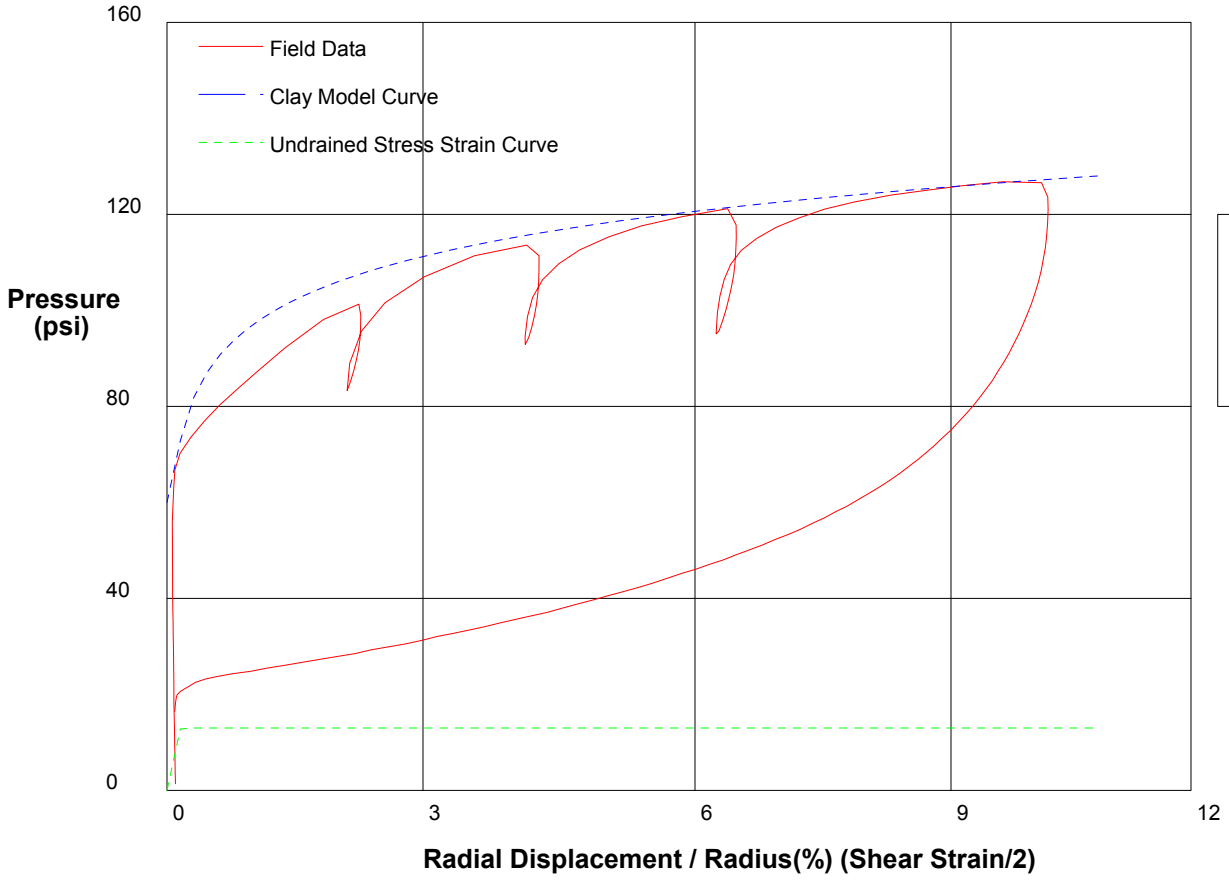
Shear Modulus 1505 psi

Shear Modulus 1545 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 101ft	File C:\DATA\ISE-787\DOT154.P



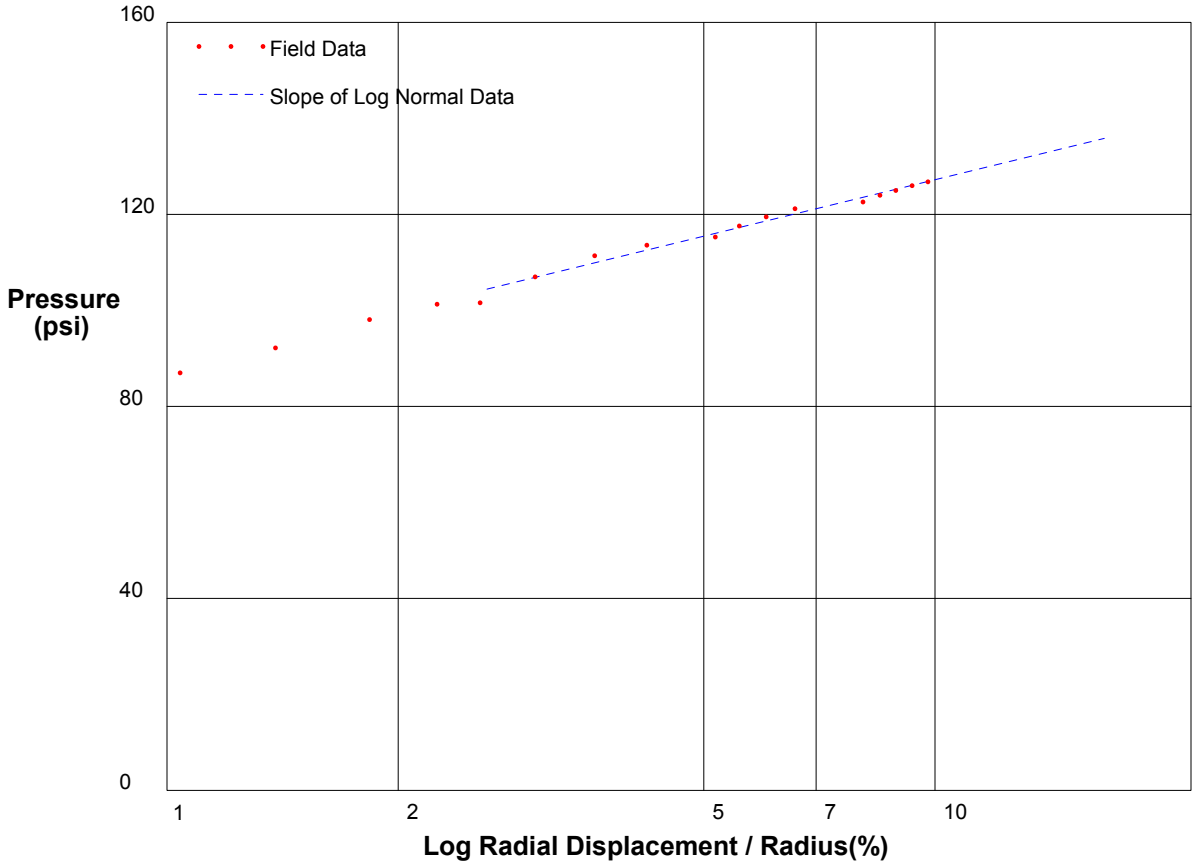
GIBSON'S CLAY MODEL

Shear Strength	13 psi
Insitu Stress	60 psi
Shear Modulus	4100 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 101ft	File C:\DATA\ISE-787\DOT154.P



Shear Strength 16.9 psi
Limit Pressure 151 psi

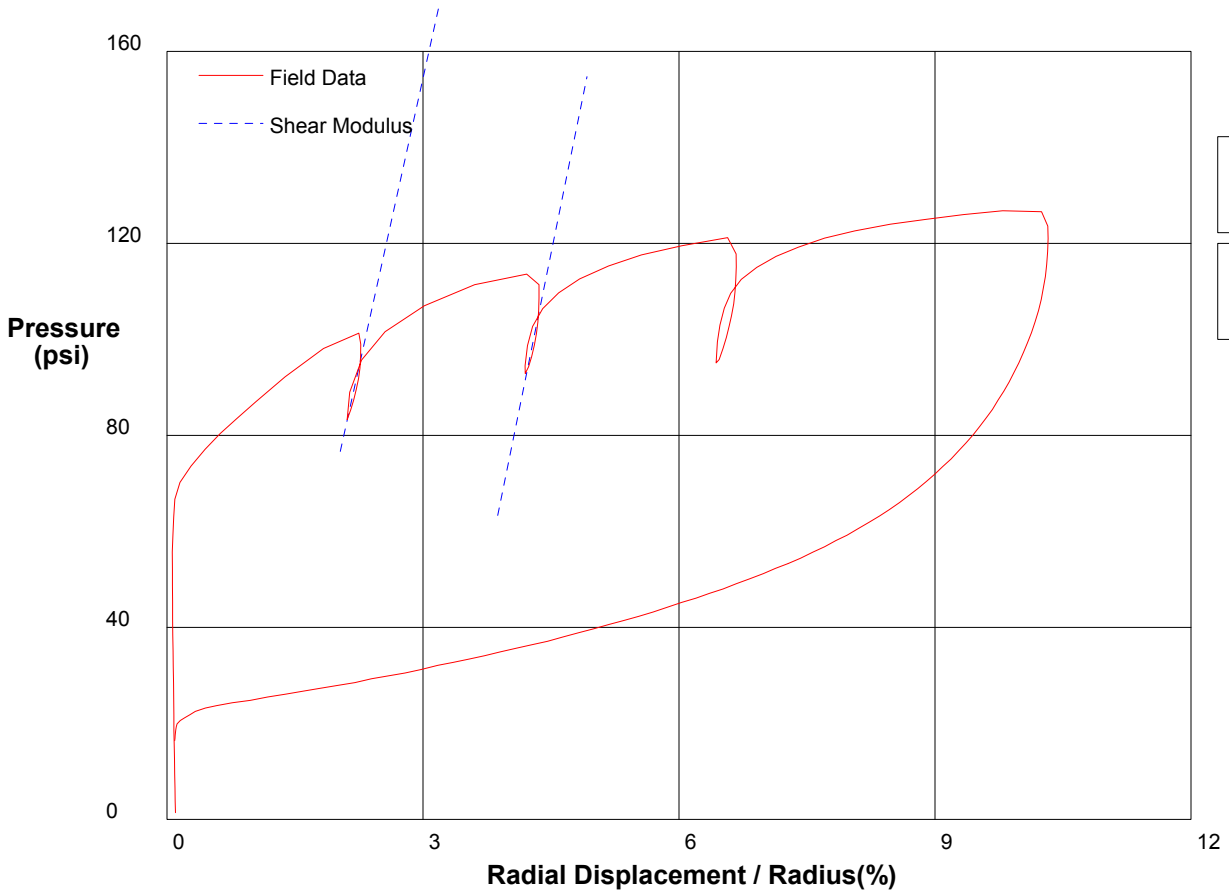
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/9/2008**

Hole No. TH-28B-PMT-08 Depth 101ft **File C:\DATA\ISE-787\DOT154.P**



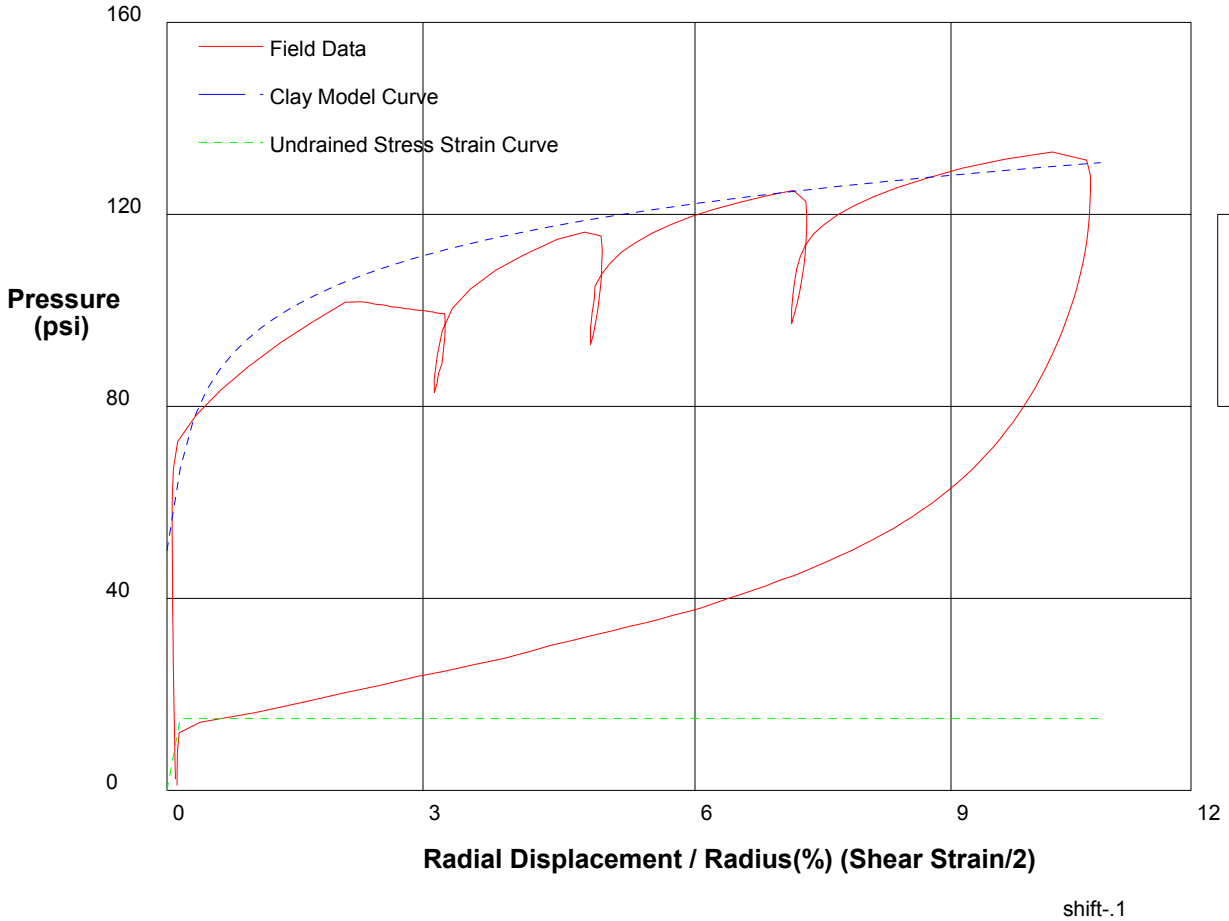
Shear Modulus 4364 psi

Shear Modulus 4012 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 103ft	File C:\DATA\ISE-787\DOT155.P

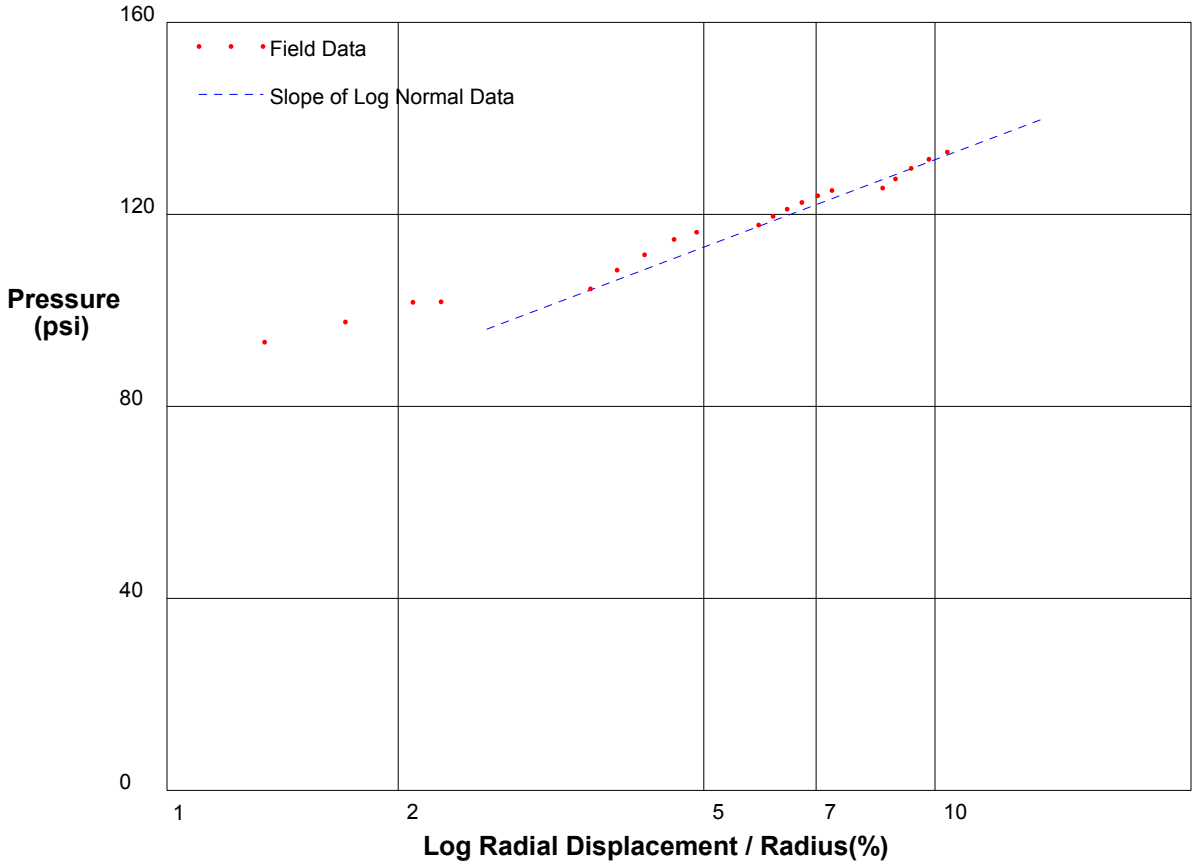


GIBSON'S CLAY MODEL

Shear Strength	15	psi
Insitu Stress	50	psi
Shear Modulus	5500	psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 103ft	File C:\DATA\ISE-787\DOT155.P



Shear Strength 26.2 psi
Limit Pressure 168 psi

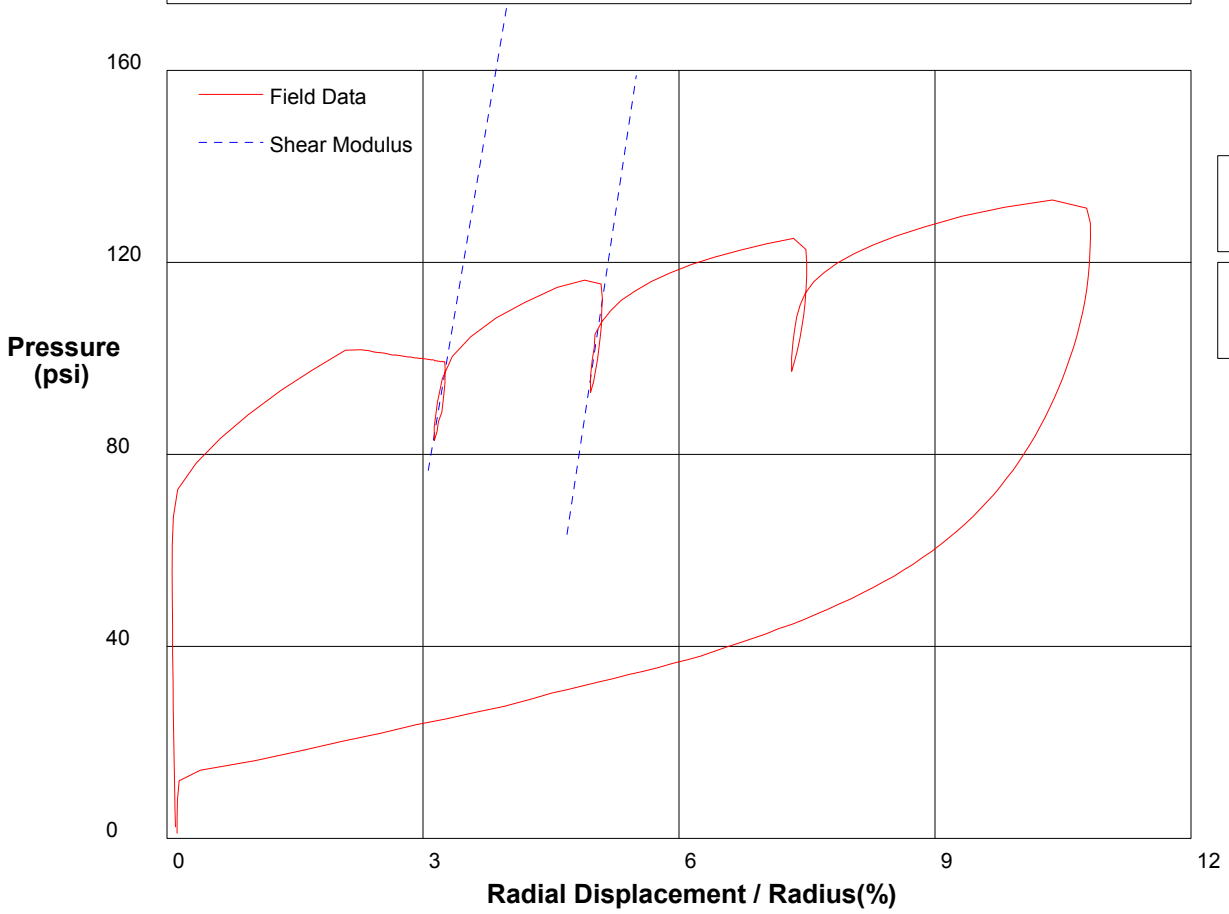
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/9/2008**

Hole No. TH-28B-PMT-08 Depth 103ft **File C:\DATA\ISE-787\DOT155.P**



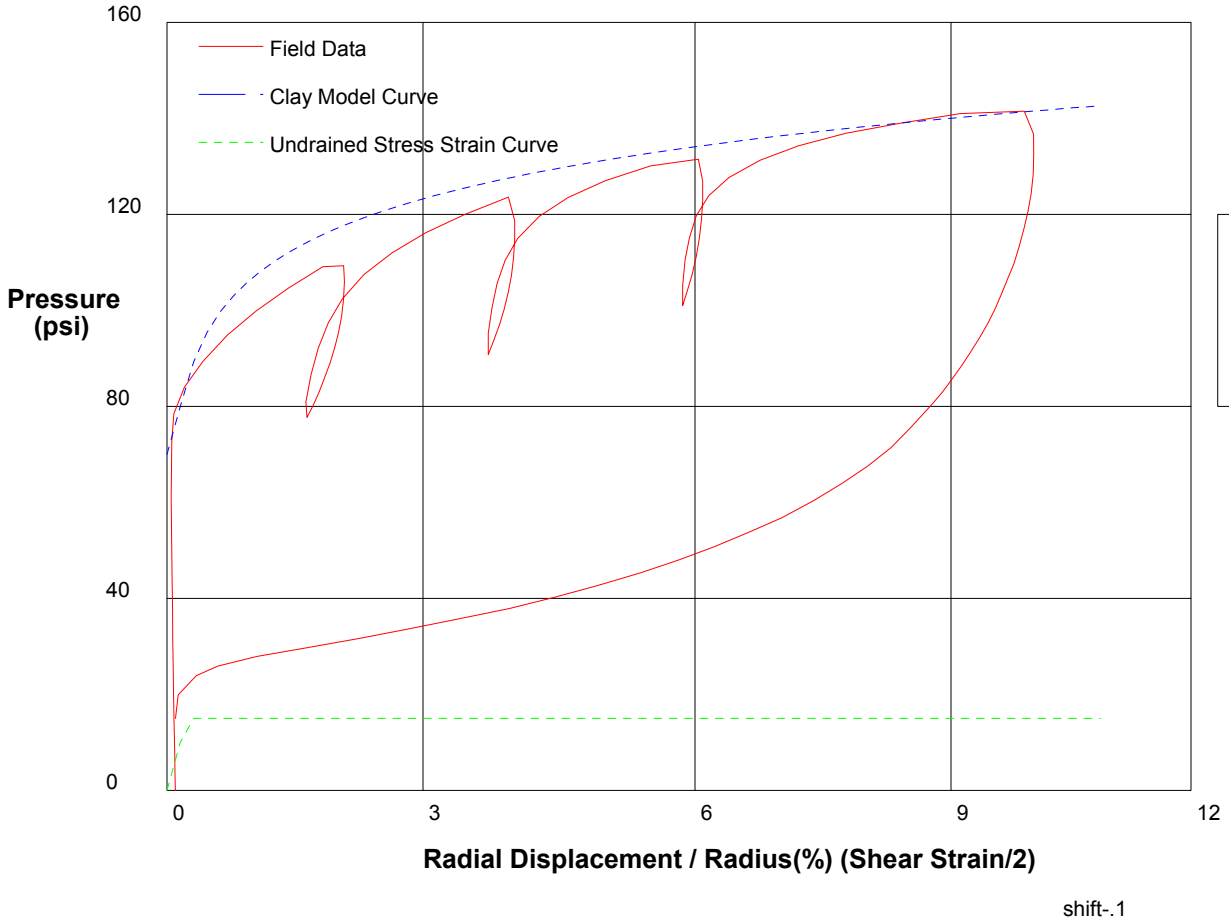
Shear Modulus 5880 psi

Shear Modulus 5258 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 107ft	File C:\DATA\ISE-787\DOT156.P

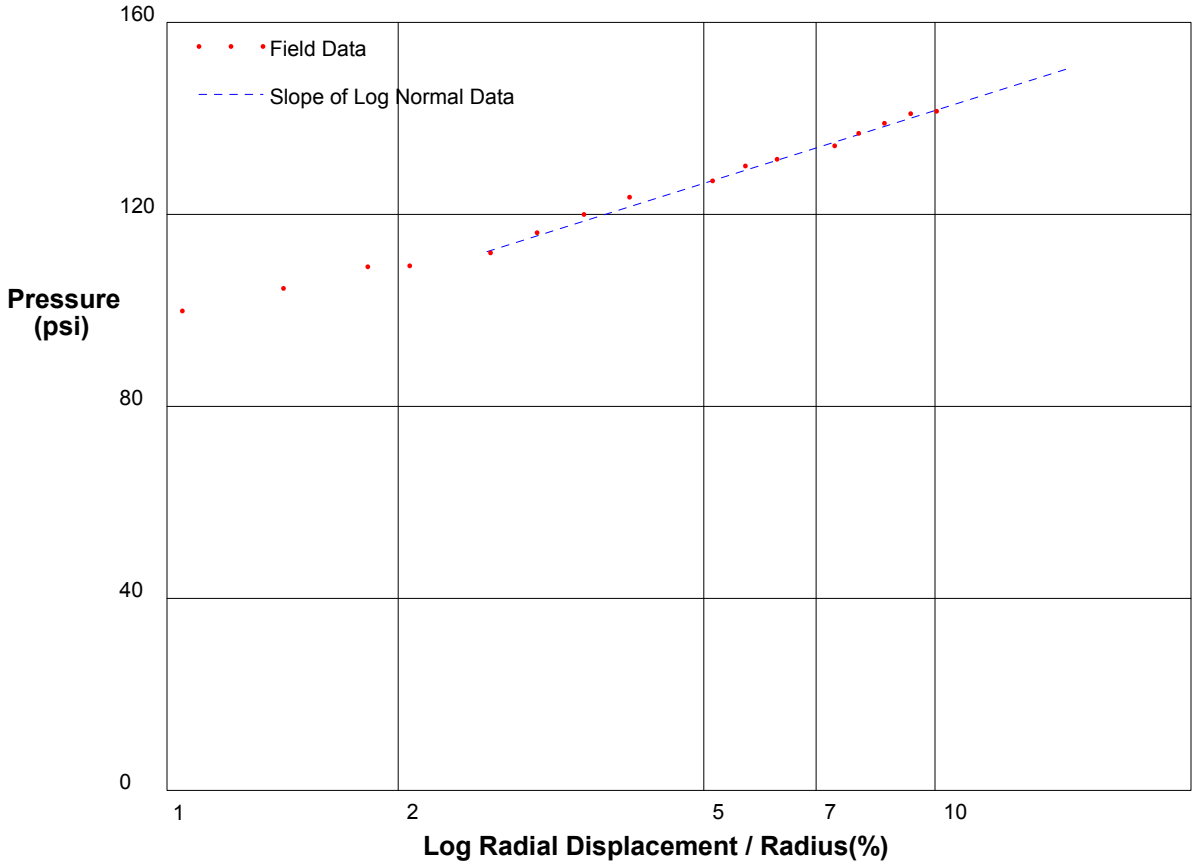


GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	70 psi
Shear Modulus	3200 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 107ft	File C:\DATA\ISE-787\DOT156.P

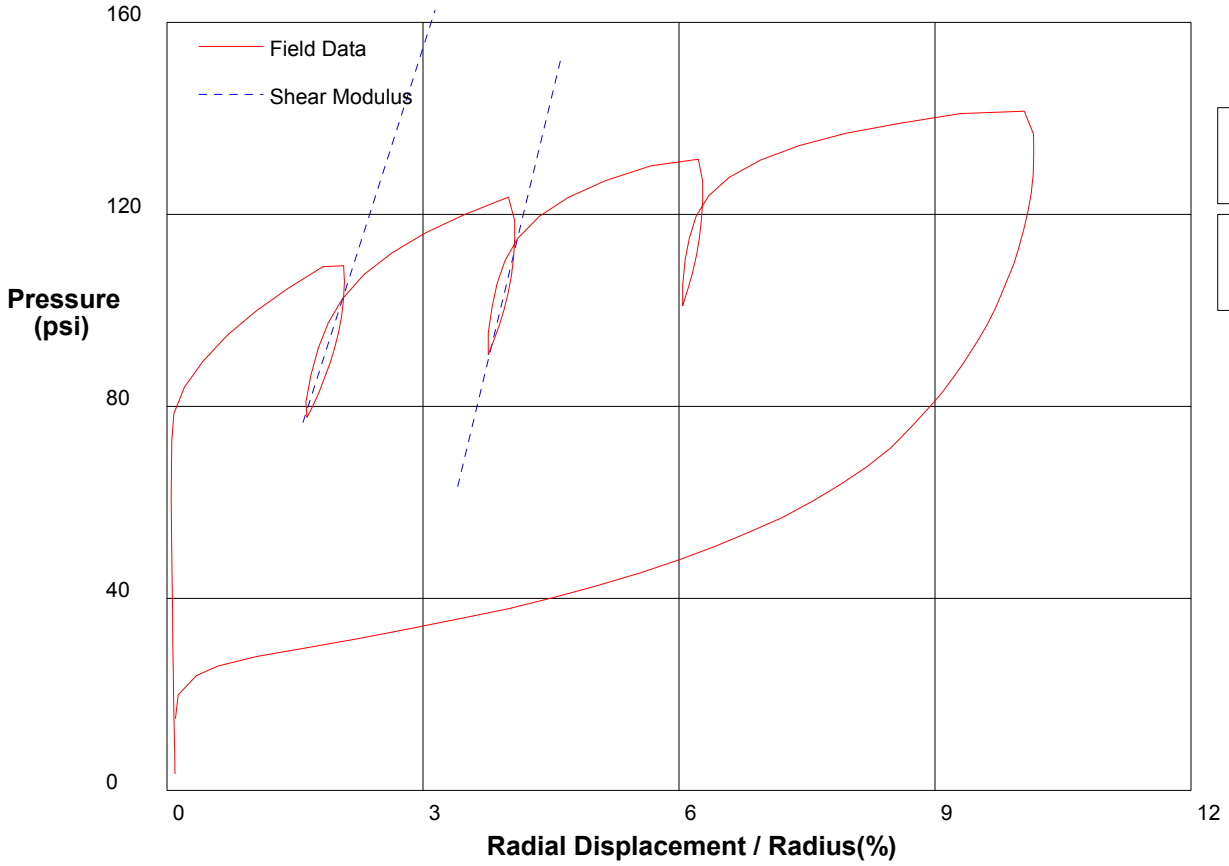


Shear Strength 21.8 psi
Limit Pressure 172 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 107ft	File C:\DATA\ISE-787\DOT156.P



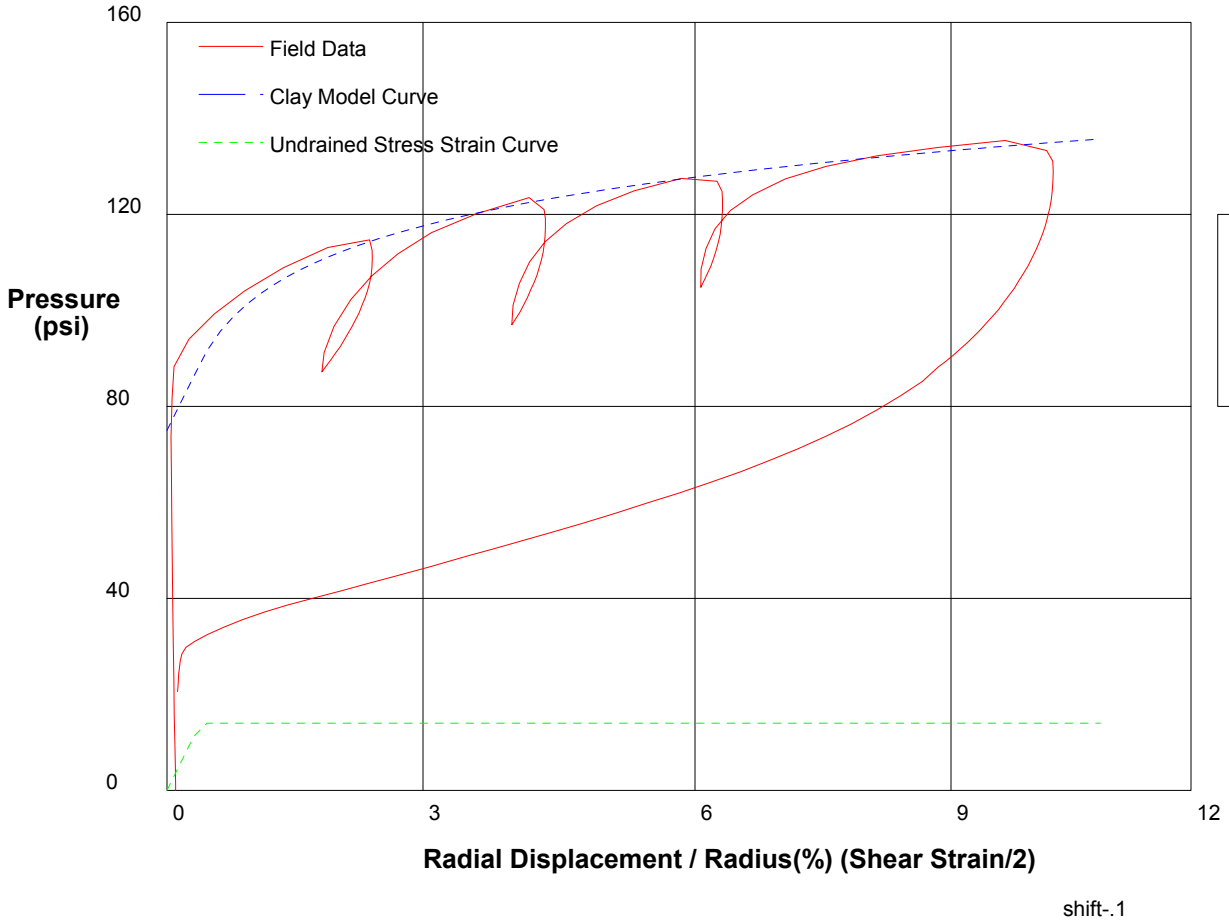
Shear Modulus 3682 psi

Shear Modulus 2774 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 109ft	File C:\DATA\ISE-787\DOT157.P

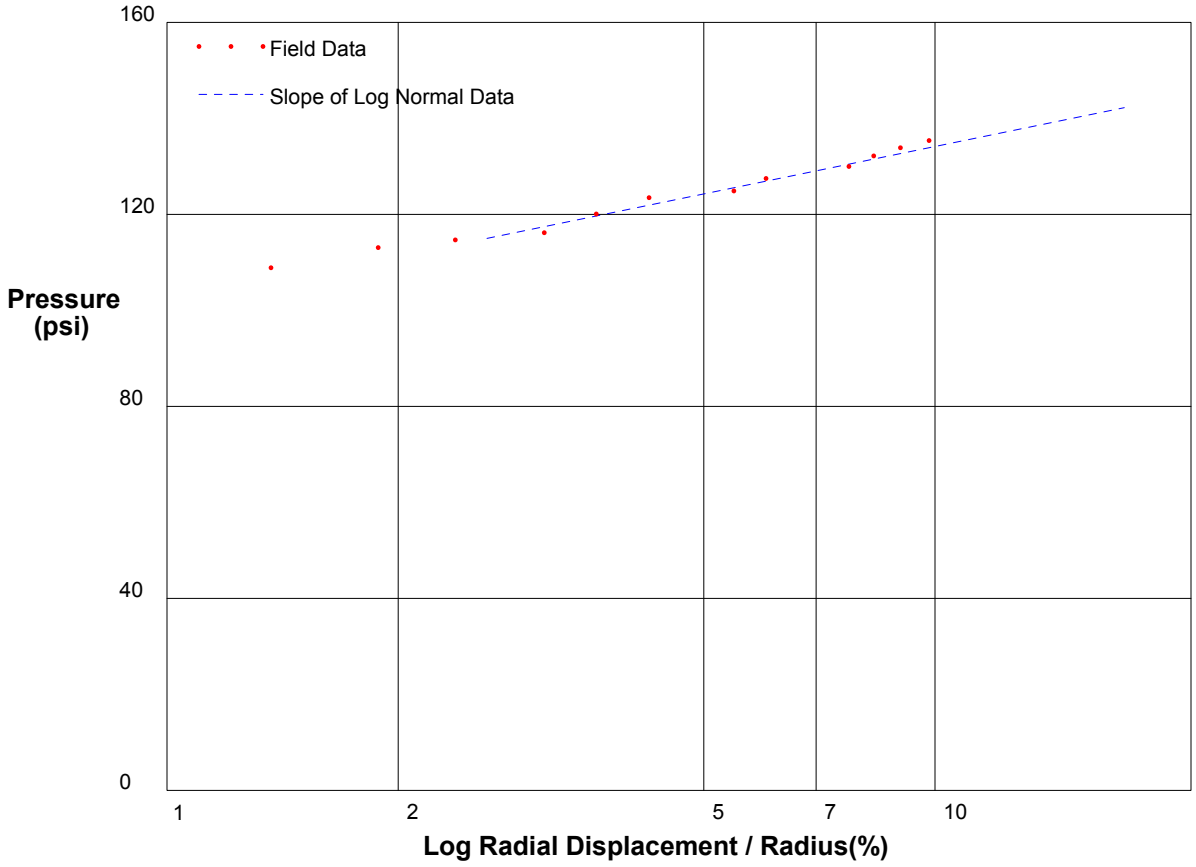


GIBSON'S CLAY MODEL

Shear Strength	14 psi
Insitu Stress	75 psi
Shear Modulus	1800 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 109ft	File C:\DATA\ISE-787\DOT157.P

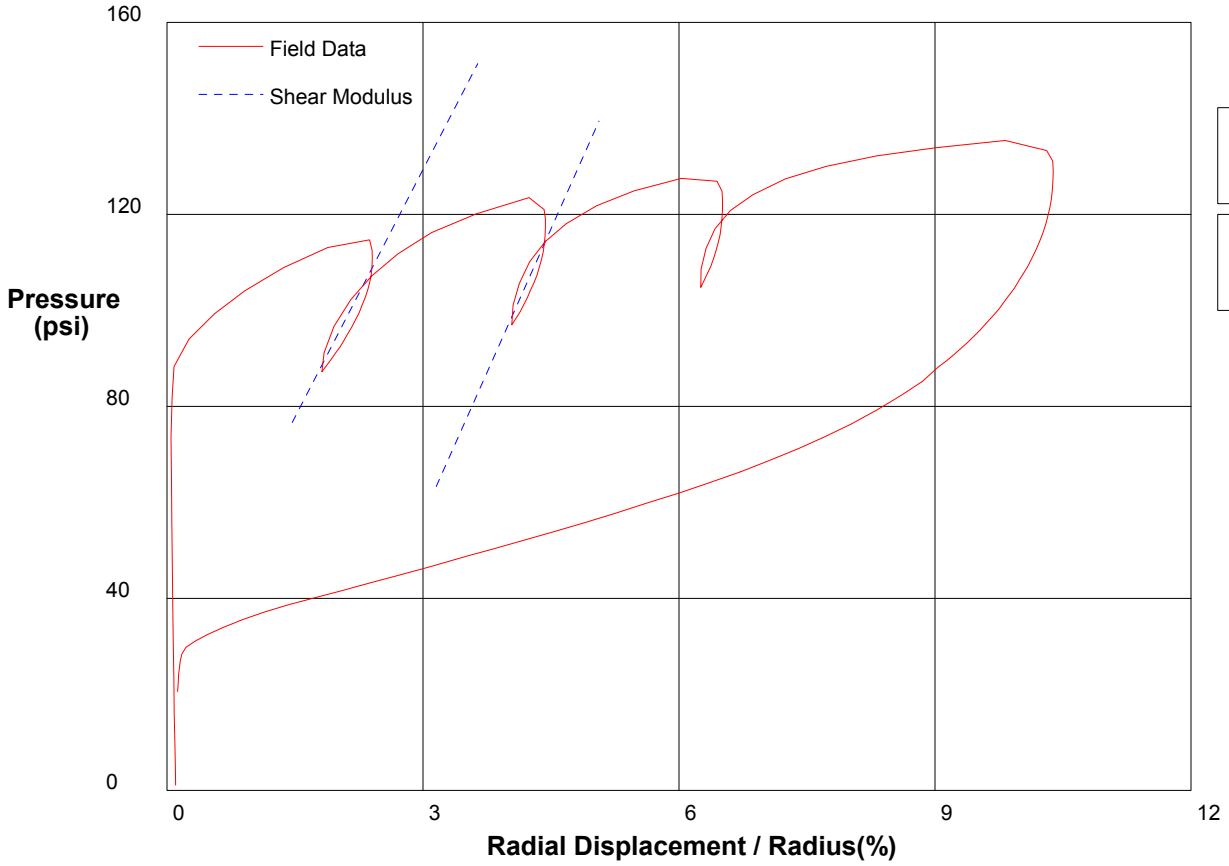


Shear Strength 14.2 psi
Limit Pressure 154 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 109ft	File C:\DATA\ISE-787\DOT157.P



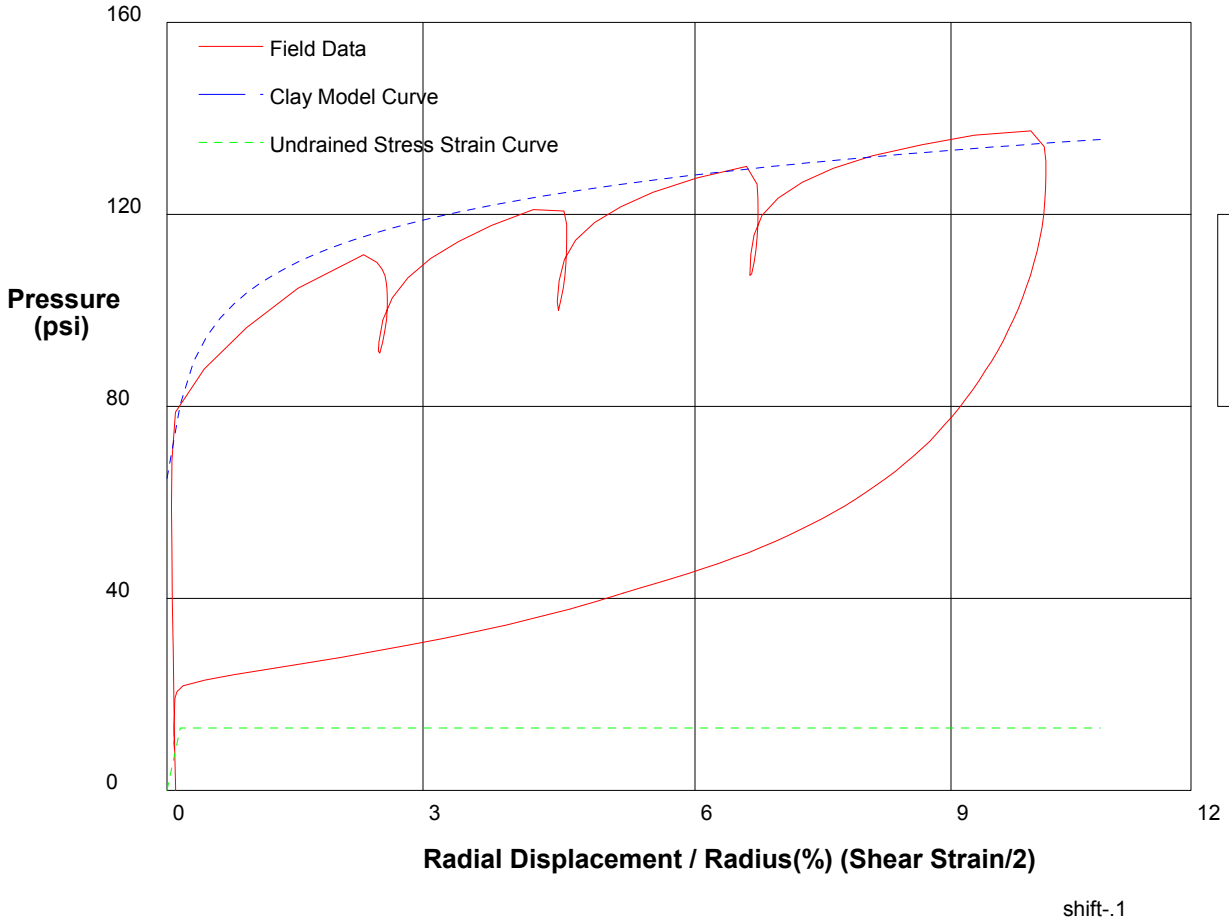
Shear Modulus 1996 psi

Shear Modulus 1720 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 109ft	File C:\DATA\ISE-787\DOT158.P

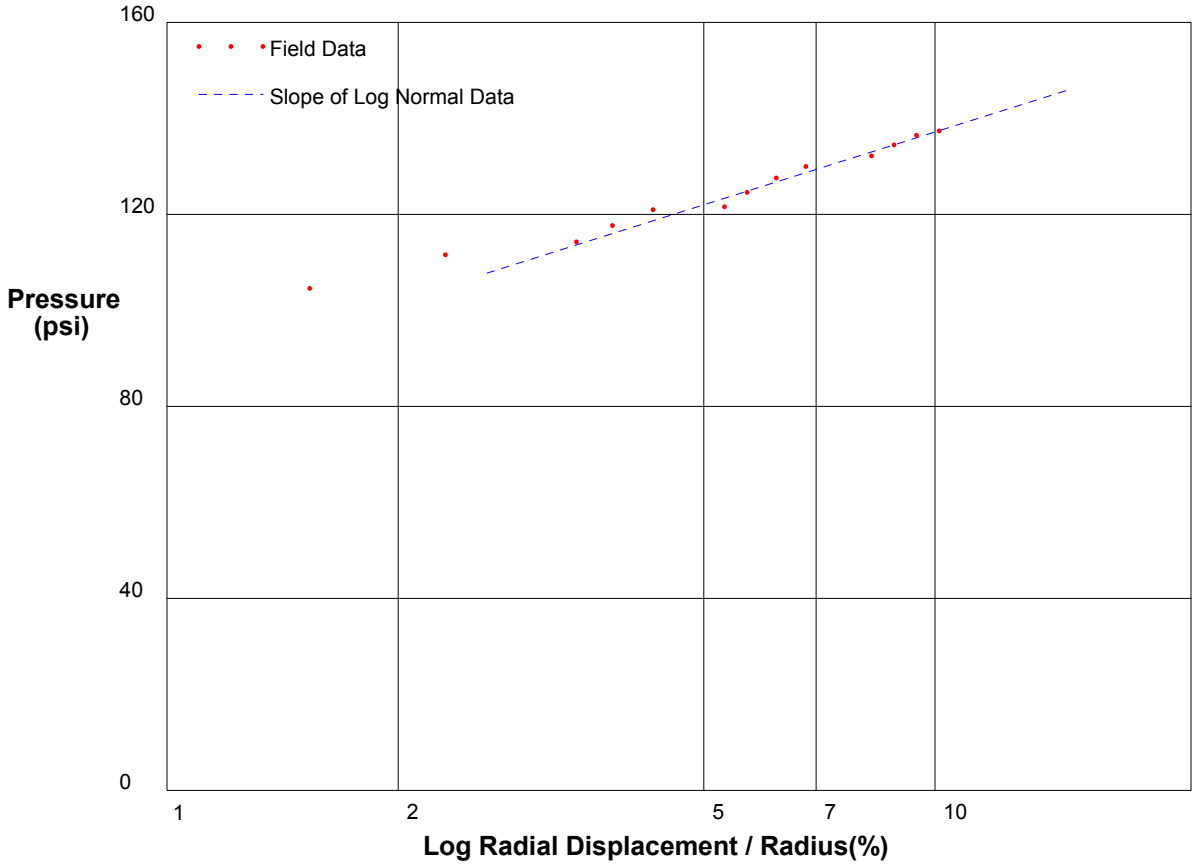


GIBSON'S CLAY MODEL

Shear Strength	13 psi
Insitu Stress	65 psi
Shear Modulus	5000 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 109ft	File C:\DATA\ISE-787\DOT158.P



Shear Strength 21.8 psi
Limit Pressure 168 psi

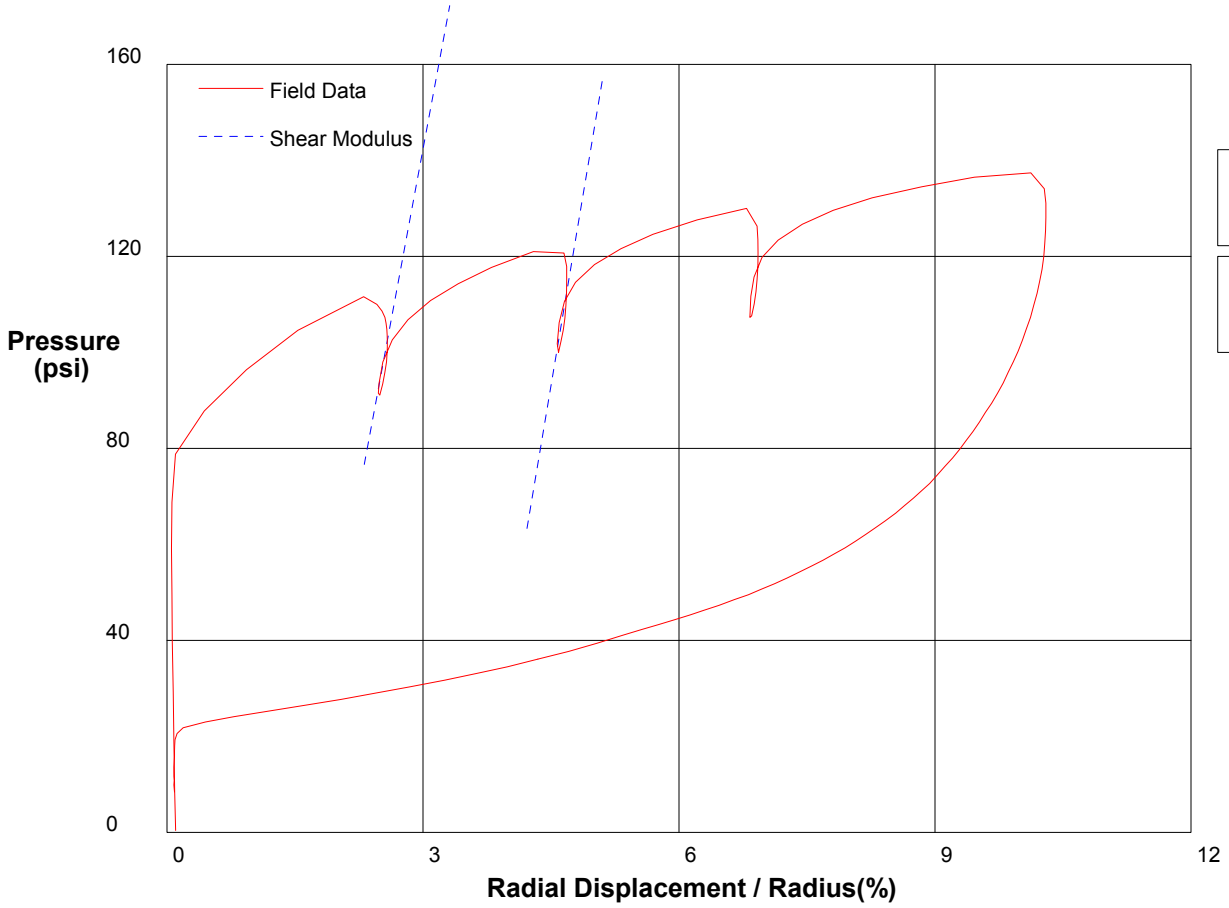
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/9/2008**

Hole No. TH-28B-PMT-08 Depth 109ft **File C:\DATA\ISE-787\DOT158.P**



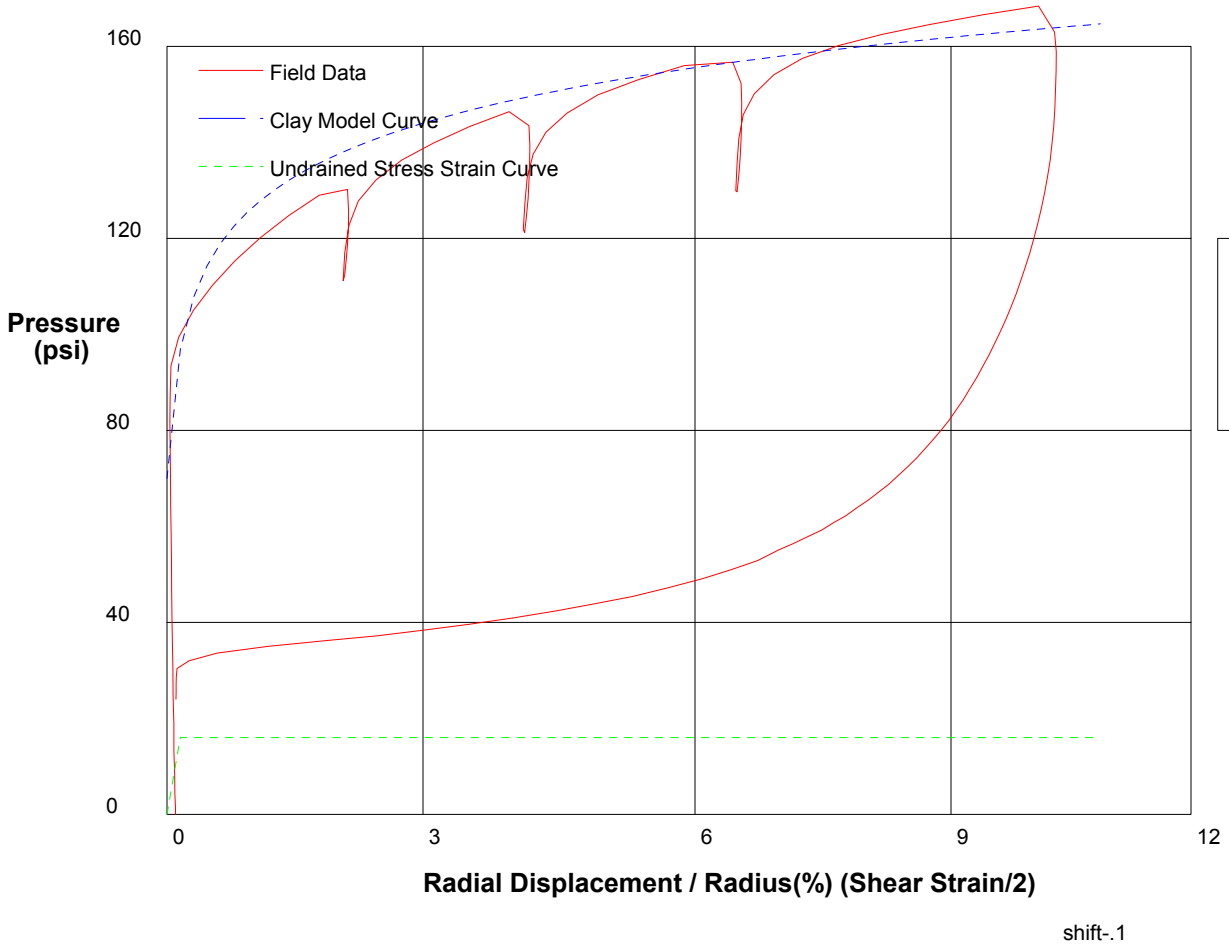
Shear Modulus 5286 psi

Shear Modulus 4777 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 111ft	File C:\DATA\ISE-787\DOT159.P



GIBSON'S CLAY MODEL

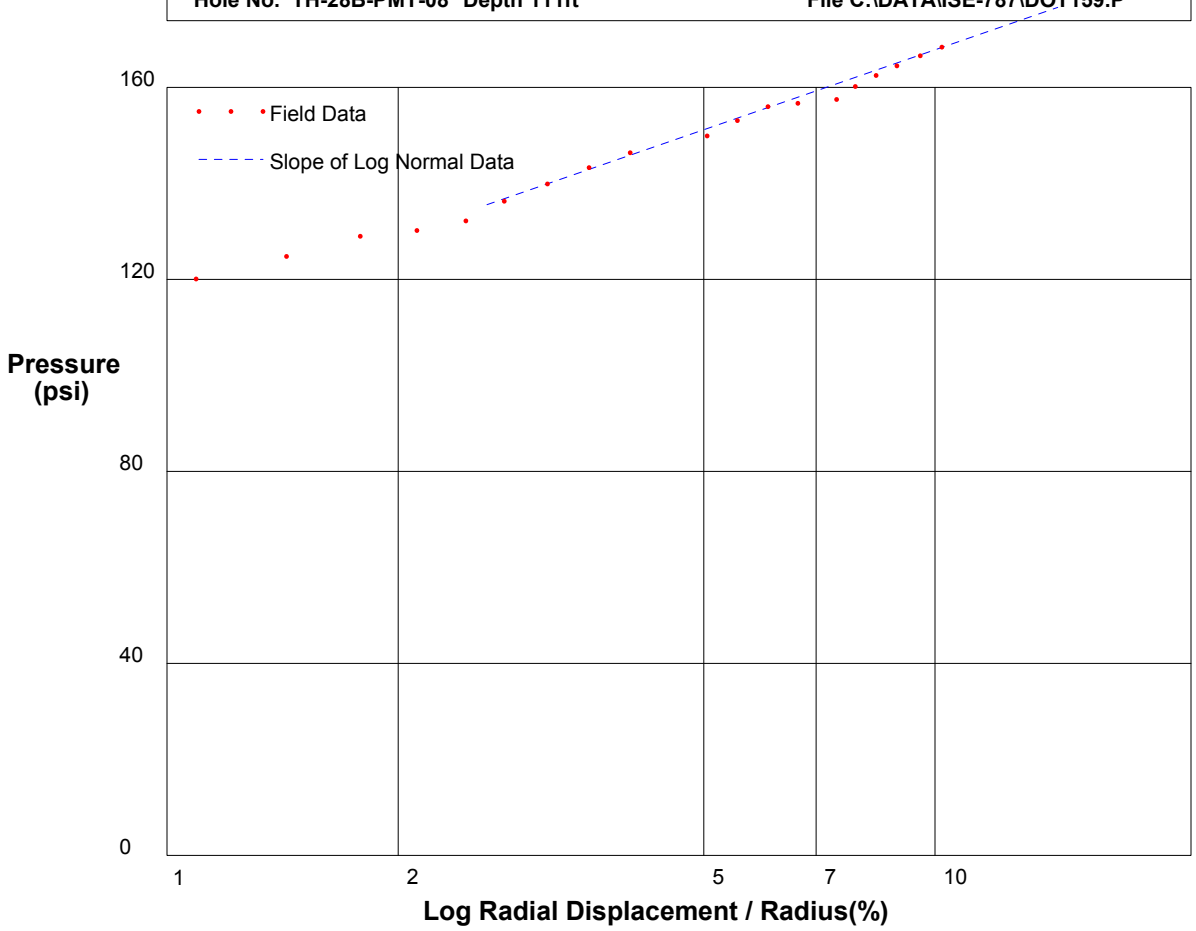
Shear Strength	16 psi
Insitu Stress	70 psi
Shear Modulus	10000 psi

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/9/2008**

Hole No. TH-28B-PMT-08 Depth 111ft **File C:\DATA\ISE-787\DOT159.P**



Shear Strength 24 psi
Limit Pressure 201 psi

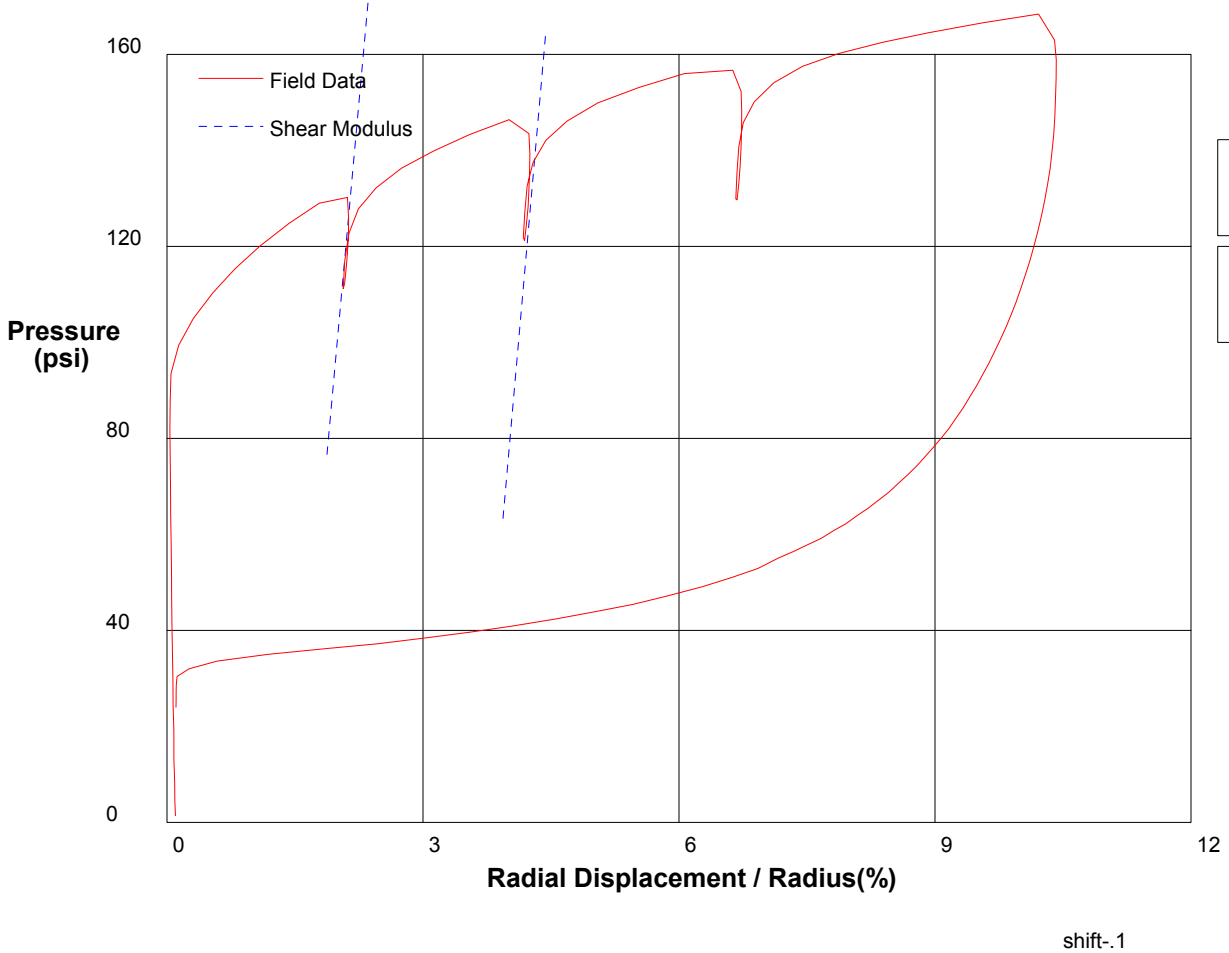
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/9/2008**

Hole No. TH-28B-PMT-08 Depth 111ft **File C:\DATA\ISE-787\DOT159.P**



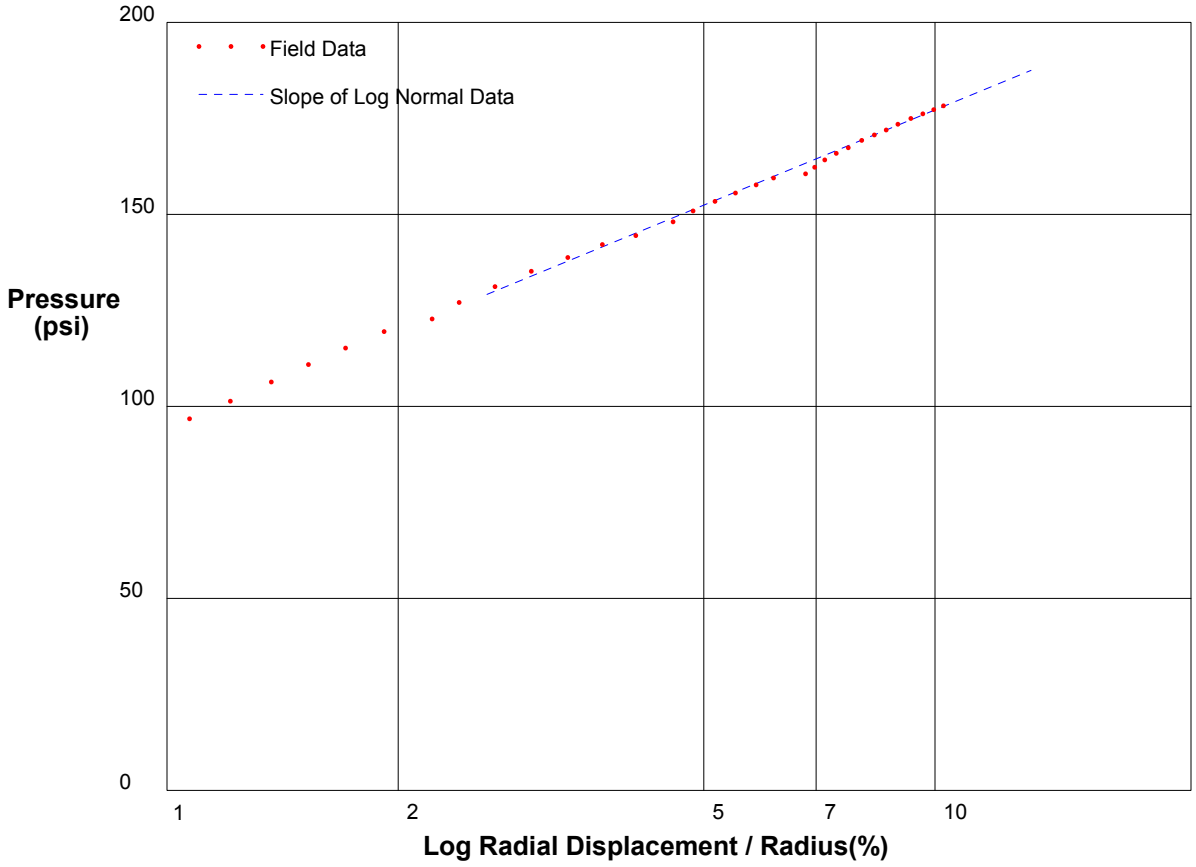
Shear Modulus 10111 psi

Shear Modulus 9777 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 113ft	File C:\DATA\ISE-787\DOT160.P

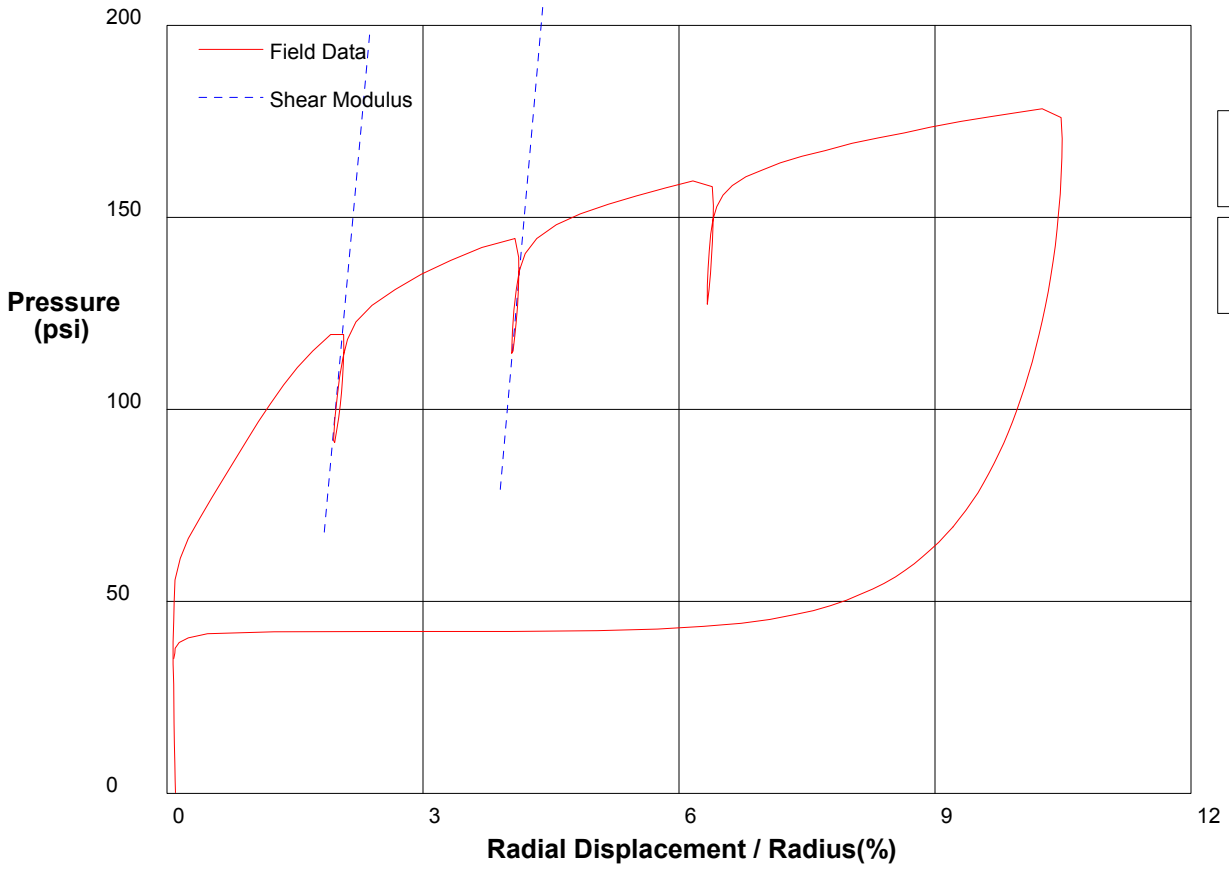


Shear Strength 35.7 psi
Limit Pressure 227 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 113ft	File C:\DATA\ISE-787\DOT160.P



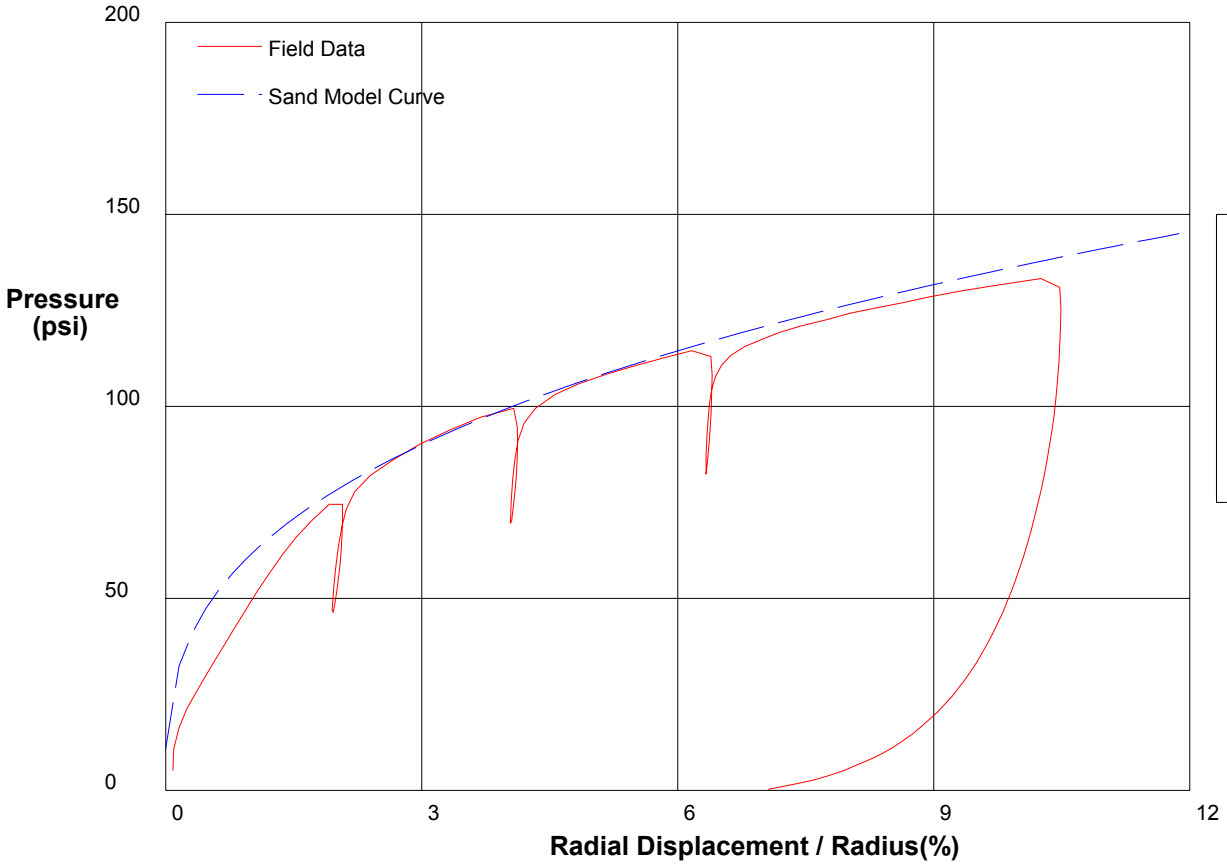
Shear Modulus 12638 psi

Shear Modulus 12222 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 113ft	File C:\DATA\ISE-787\DOT160.P



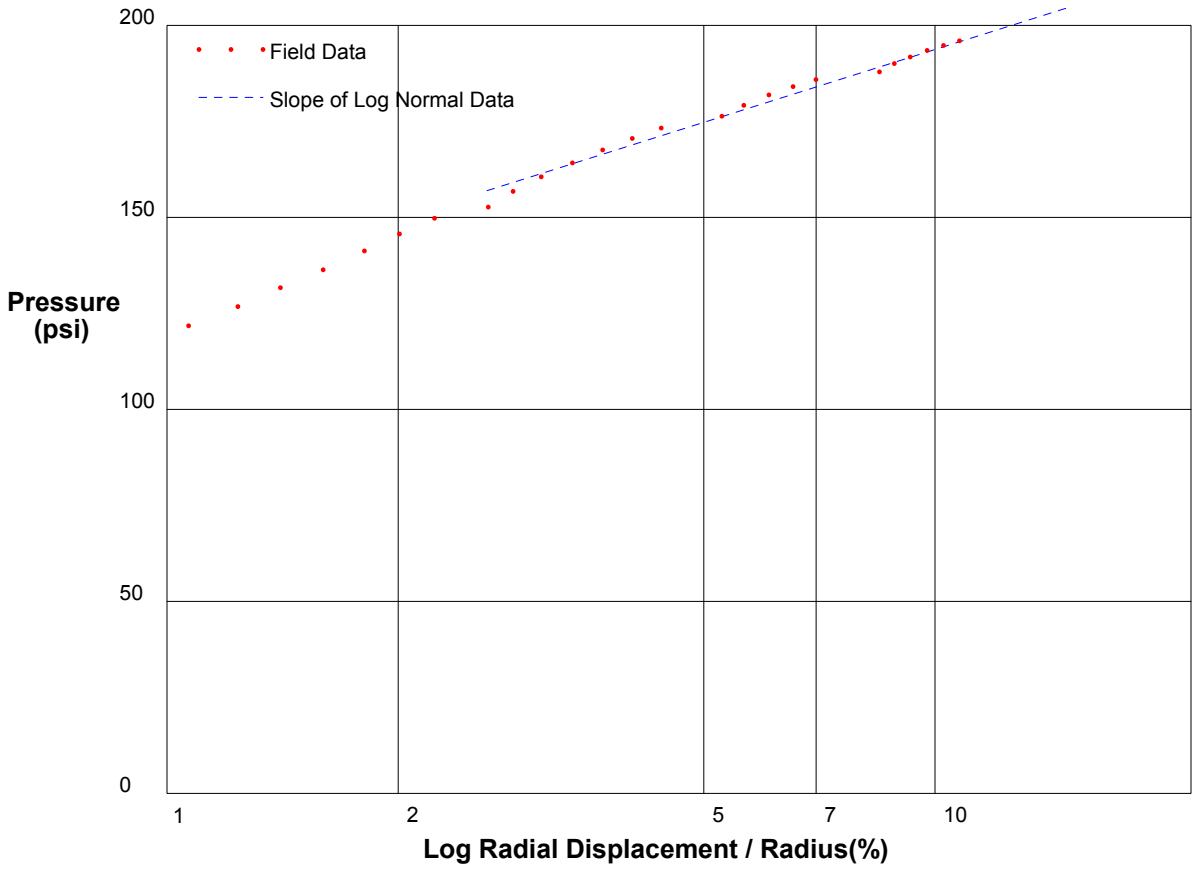
THE In Situ Engineering SAND MODEL

Water Pressure	45 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	11 psi
Shear Modulus	12300 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 117ft	File C:\DATA\ISE-787\DOT161.P



Shear Strength 27.3 psi
Limit Pressure 232 psi

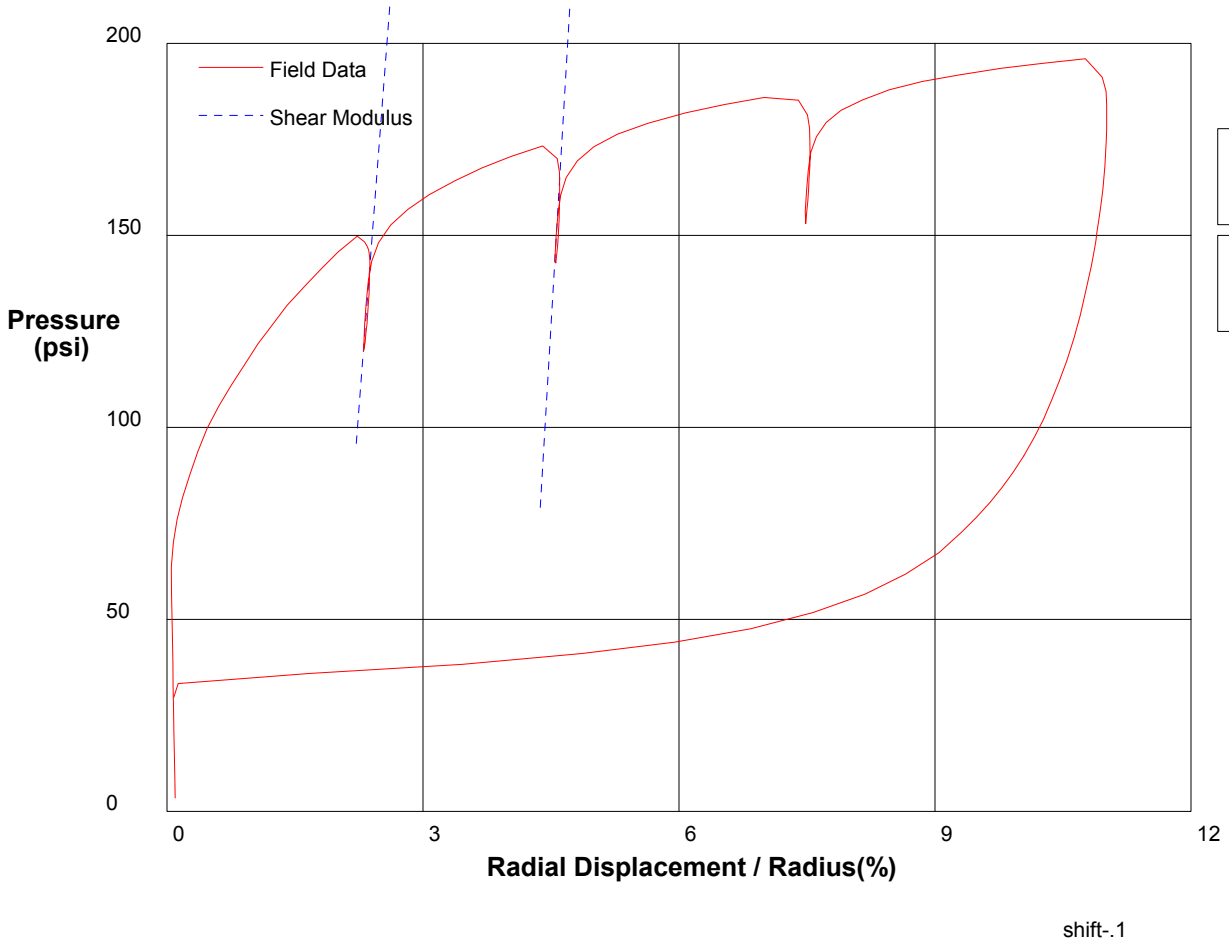
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/9/2008**

Hole No. TH-28B-PMT-08 Depth 117ft **File C:\DATA\ISE-787\DOT161.P**



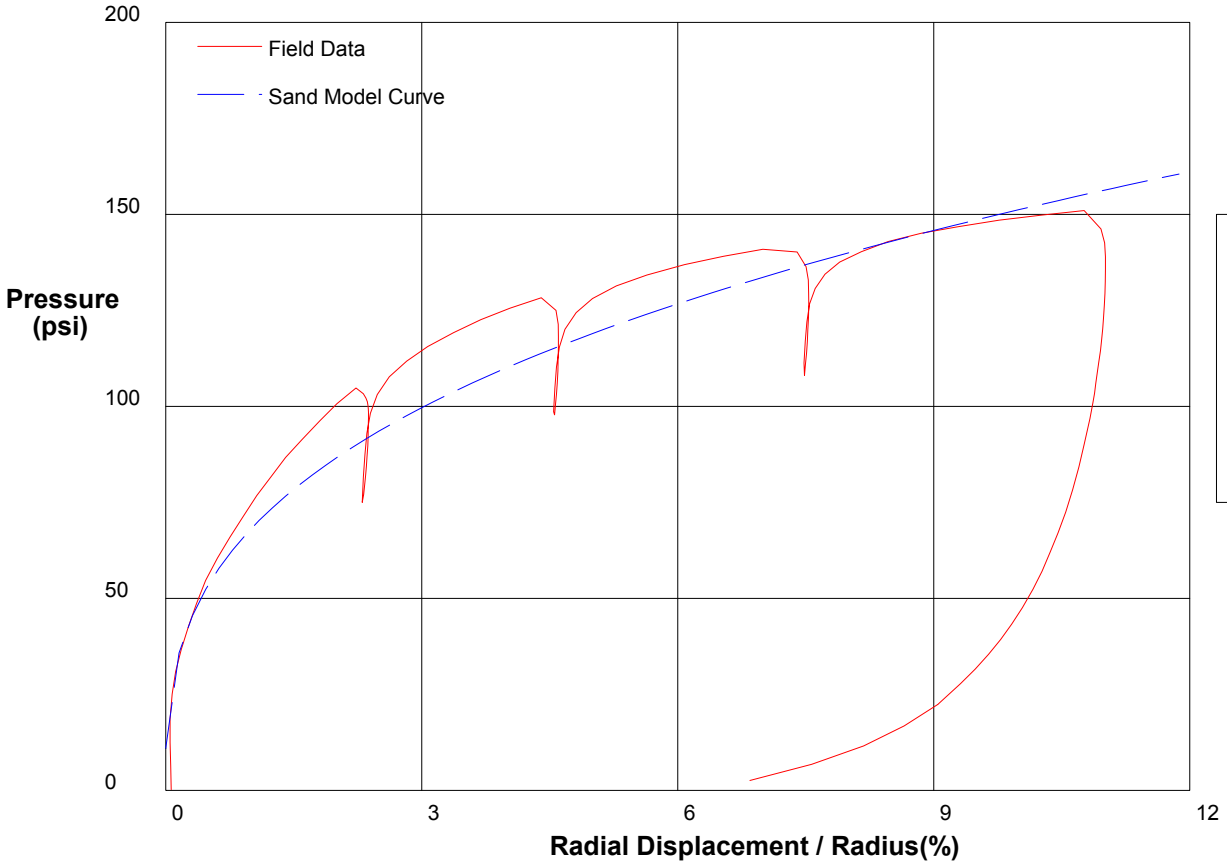
Shear Modulus 18888 psi

Shear Modulus 14521 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 117ft	File C:\DATA\ISE-787\DOT161.P



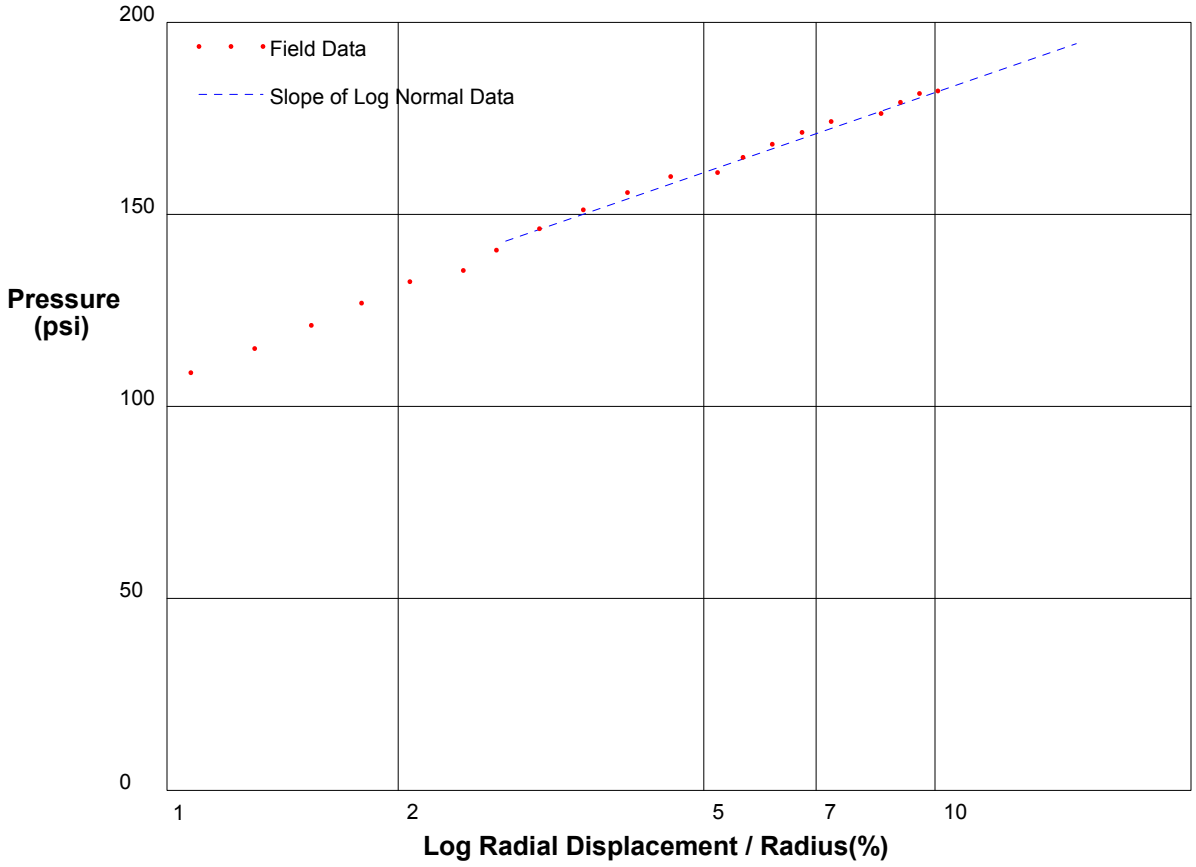
THE In Situ Engineering SAND MODEL

Water Pressure	45 psi
Friction Angle	32 deg
Critical Friction Angle	32 deg
Lateral Stress	11 psi
Shear Modulus	16500 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 119ft	File C:\DATA\ISE-787\DOT162.P



Shear Strength 30 psi
Limit Pressure 224 psi

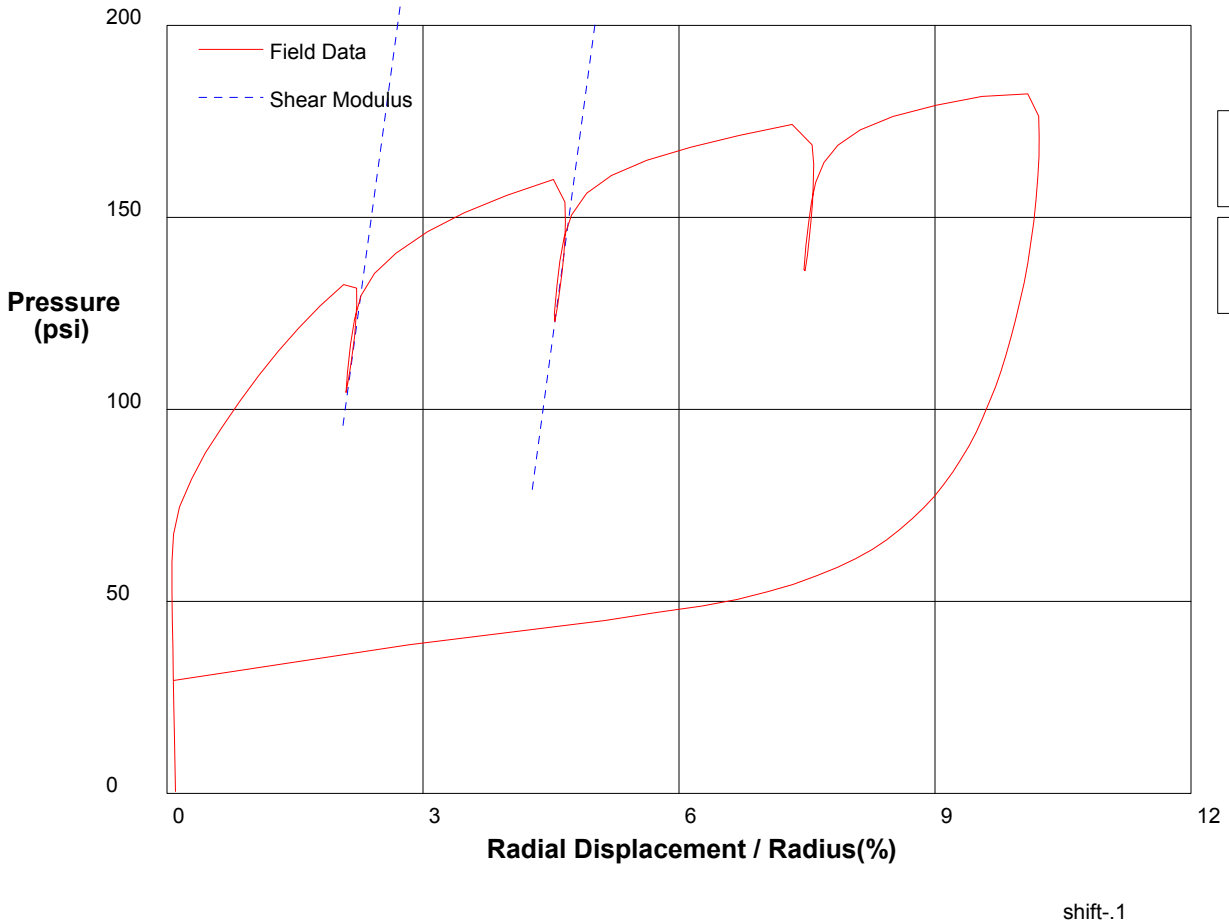
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/9/2008**

Hole No. TH-28B-PMT-08 Depth 119ft **File C:\DATA\ISE-787\DOT162.P**



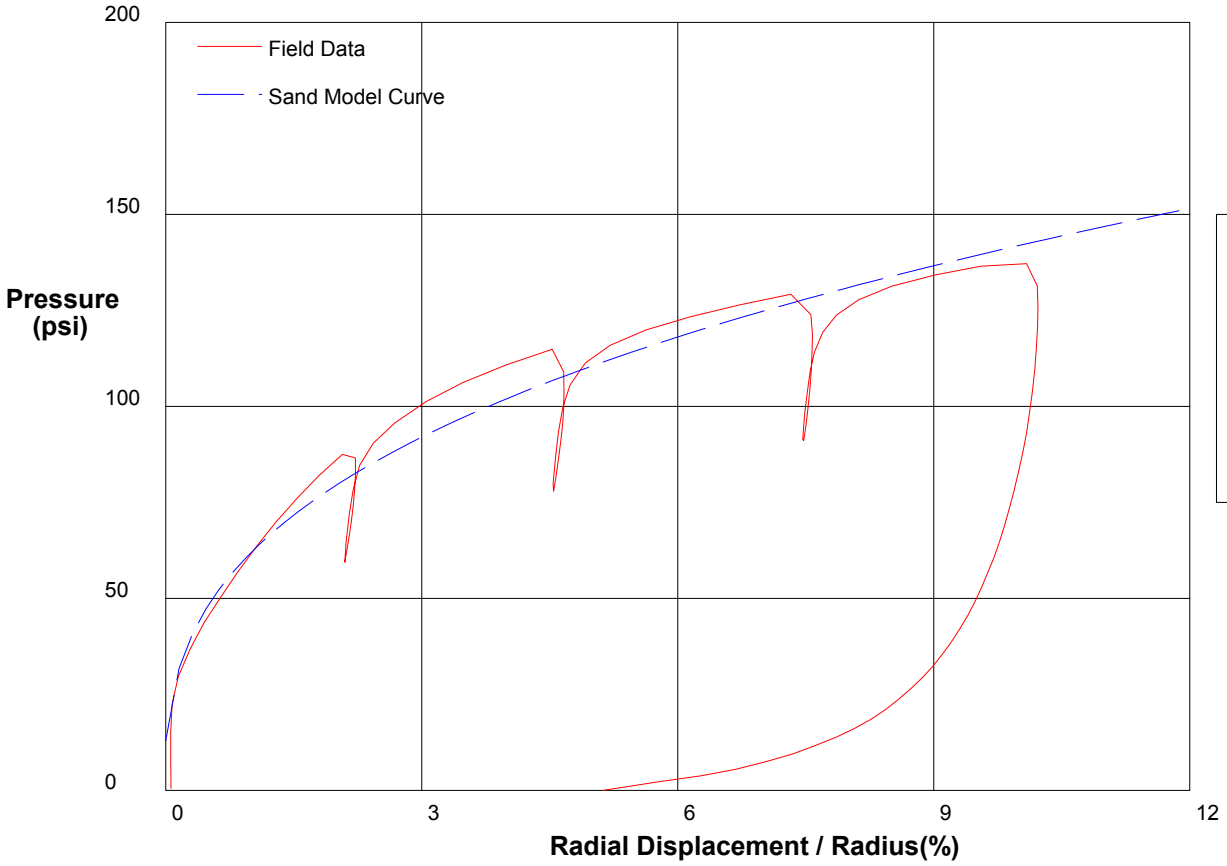
Shear Modulus 8250 psi

Shear Modulus 8140 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 119ft	File C:\DATA\ISE-787\DOT162.P



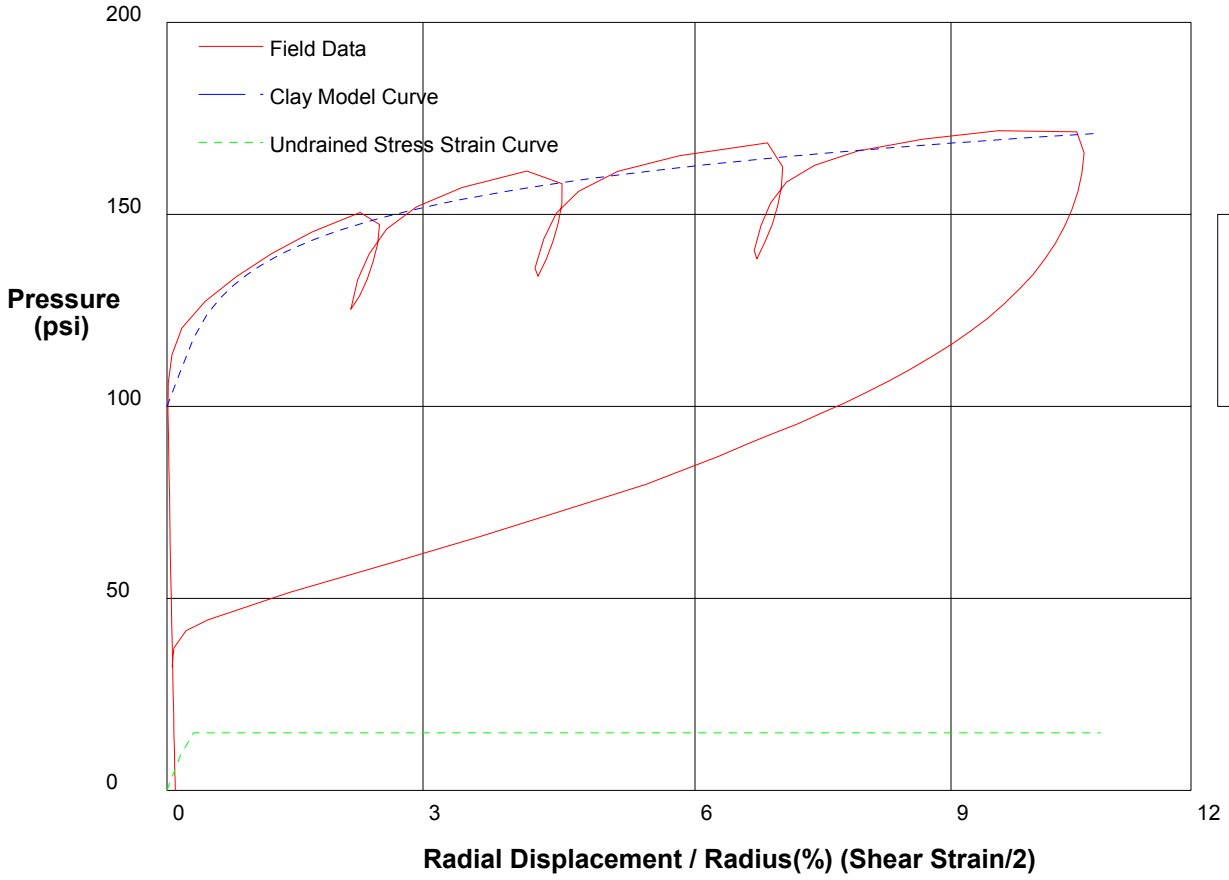
THE In Situ Engineering SAND MODEL

Water Pressure	45 psi
Friction Angle	33 deg
Critical Friction Angle	32 deg
Lateral Stress	13 psi
Shear Modulus	8100 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 121ft	File C:\DATA\ISE-787\DOT163.P



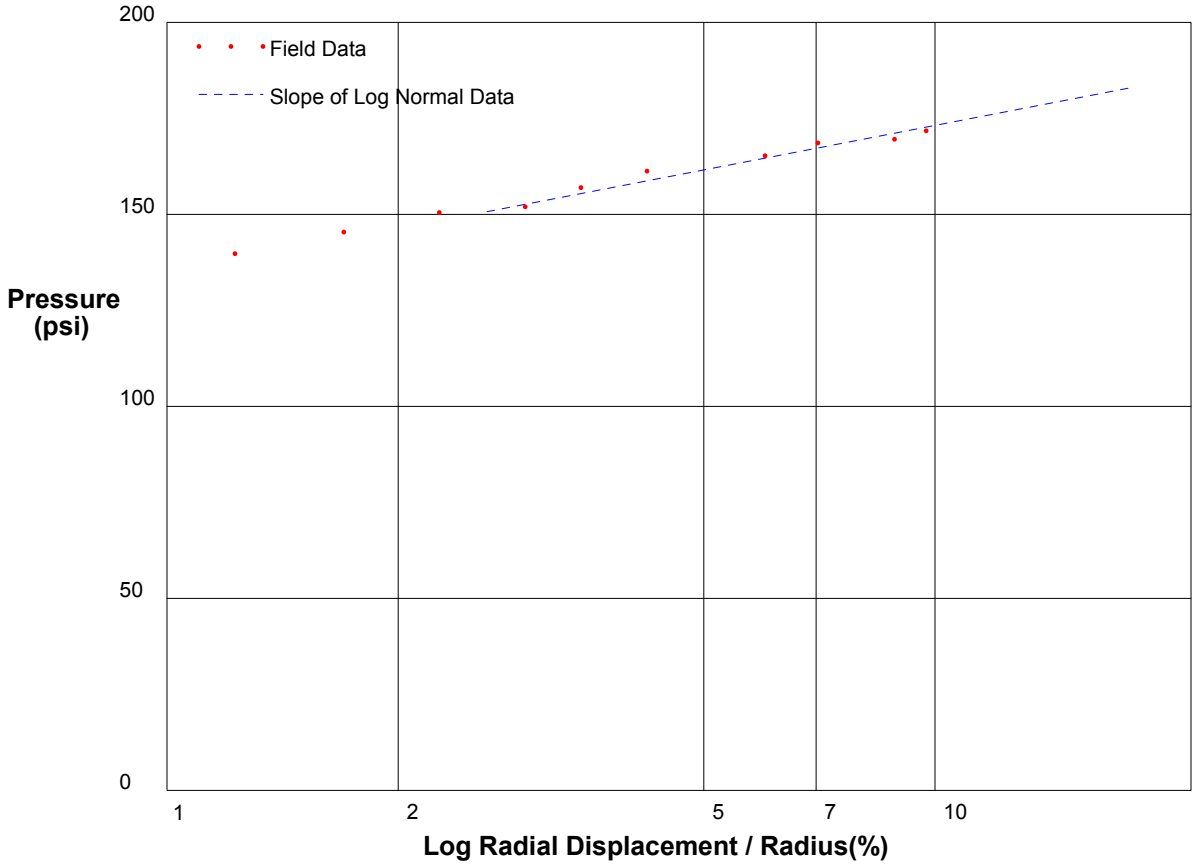
GIBSON'S CLAY MODEL

Shear Strength	15 psi
Insitu Stress	100 psi
Shear Modulus	2900 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 121ft	File C:\DATA\ISE-787\DOT163.P

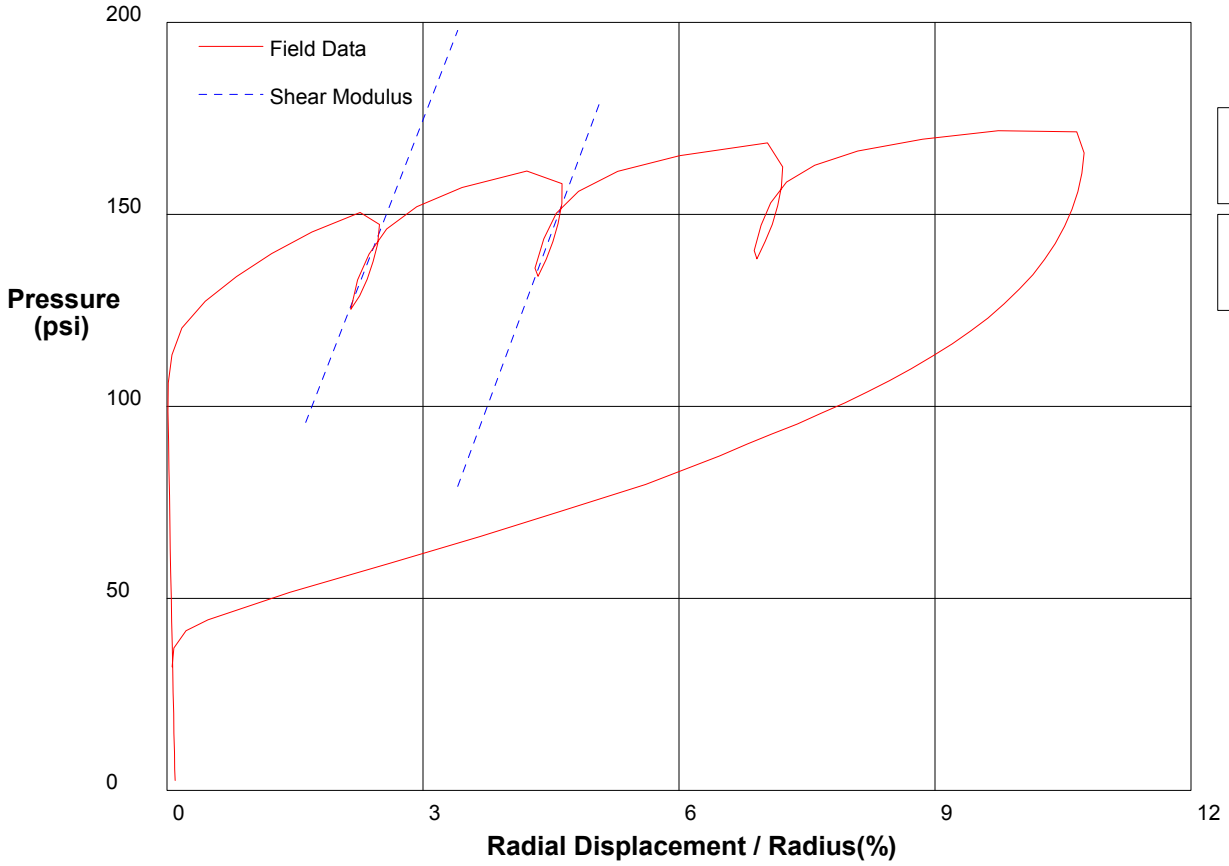


Shear Strength 16.7 psi
Limit Pressure 196 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 121ft	File C:\DATA\ISE-787\DOT163.P



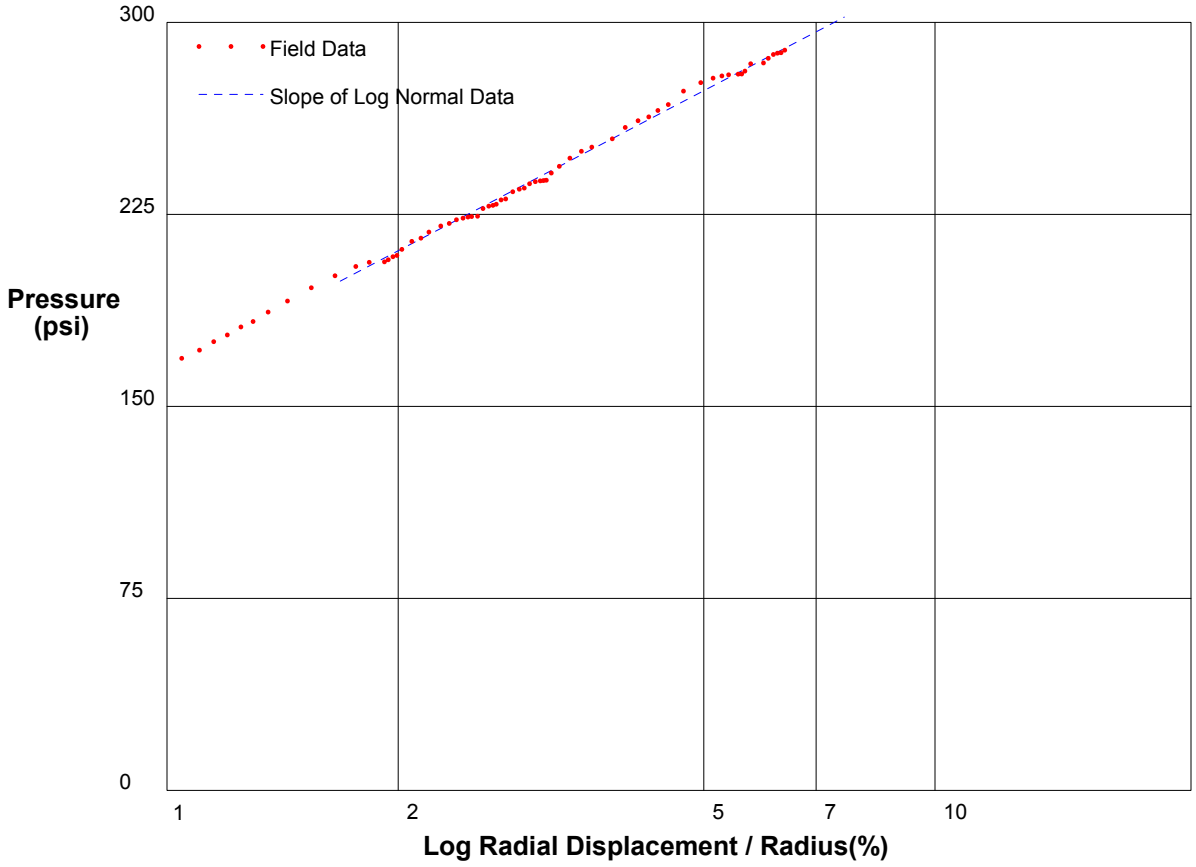
Shear Modulus 3001 psi

Shear Modulus 2865 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 123ft	File C:\DATA\ISE-787\DOT164.P



Shear Strength 68.2 psi
Limit Pressure 416 psi

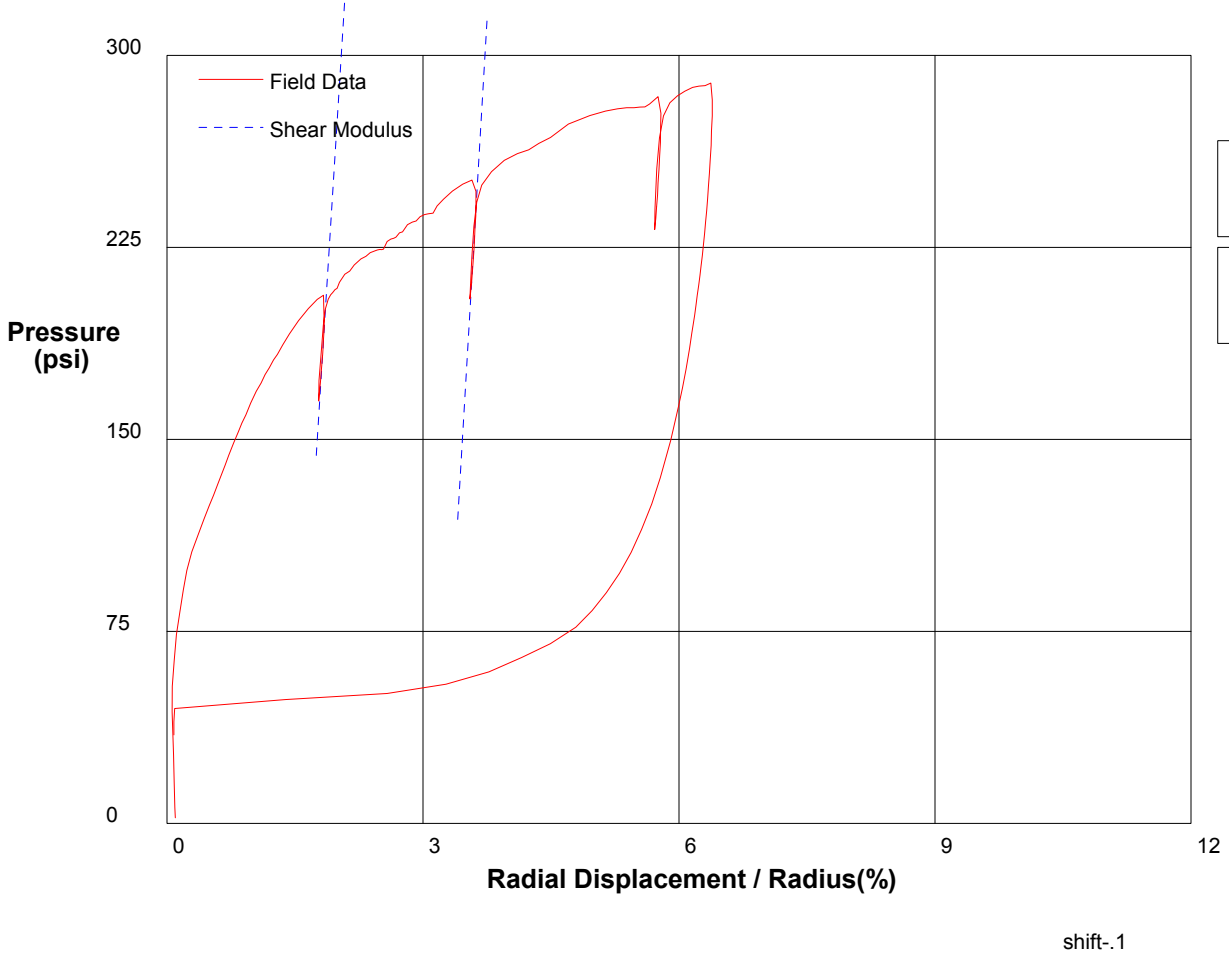
shift-.1

In Situ Engineering

PRESSUREMETER DATA **Washington Department of Transportation**

Grays Harbor, Hoquiam, WA **9/9/2008**

Hole No. TH-28B-PMT-08 Depth 123ft **File C:\DATA\ISE-787\DOT164.P**



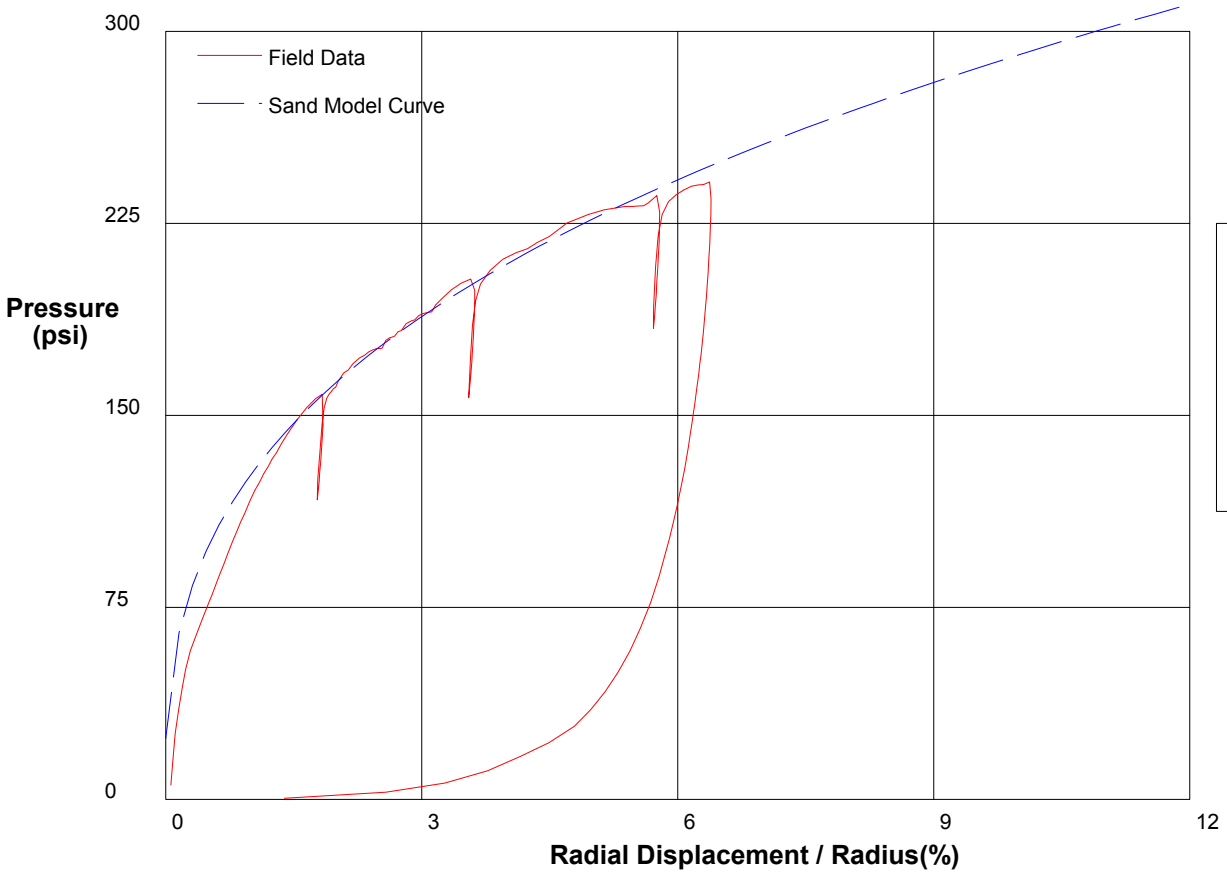
Shear Modulus 28333 psi

Shear Modulus 26666 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 123ft	File C:\DATA\ISE-787\DOT164.P



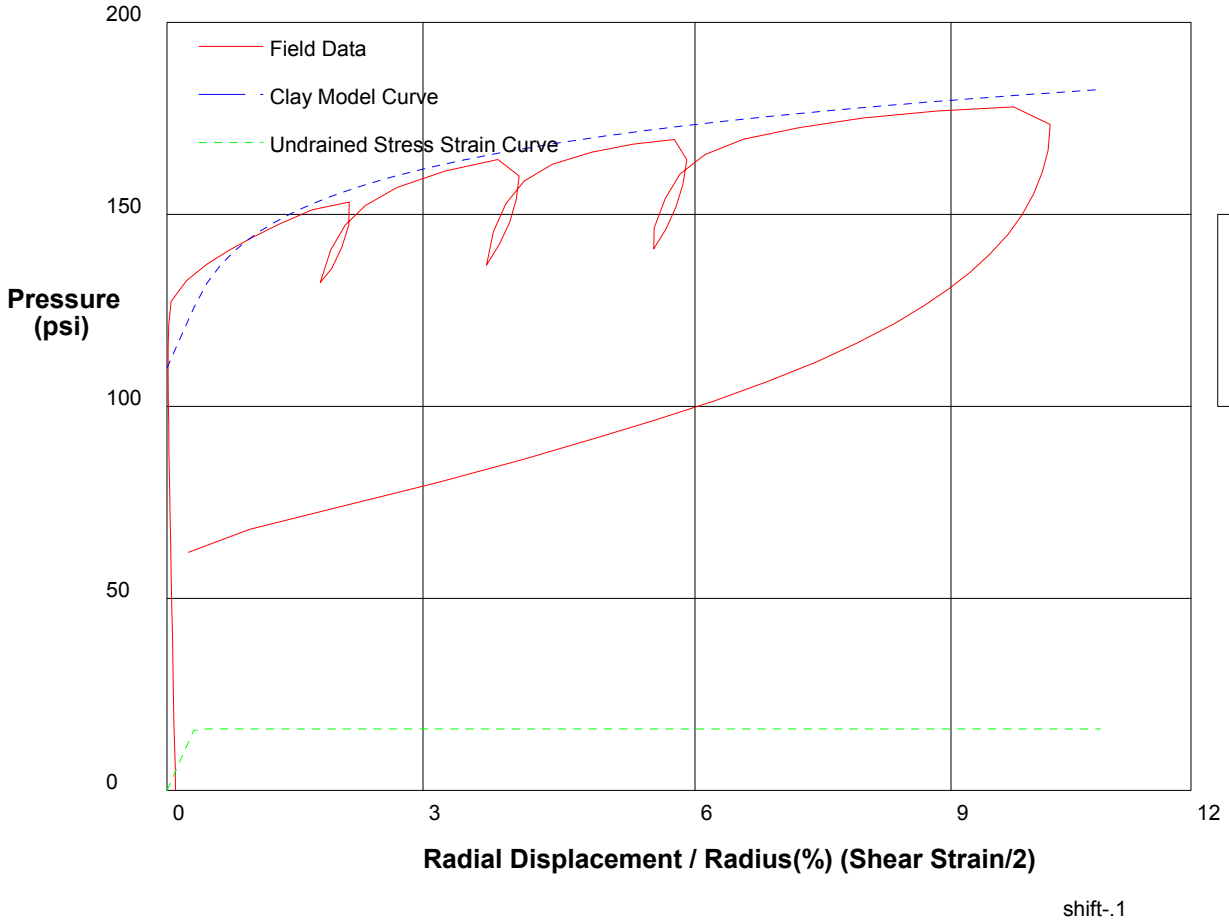
THE In Situ Engineering SAND MODEL

Water Pressure	48 psi
Friction Angle	33 deg
Critical Friction Angle	32 deg
Lateral Stress	24 psi
Shear Modulus	20000 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 125ft	File C:\DATA\ISE-787\DOT165.P

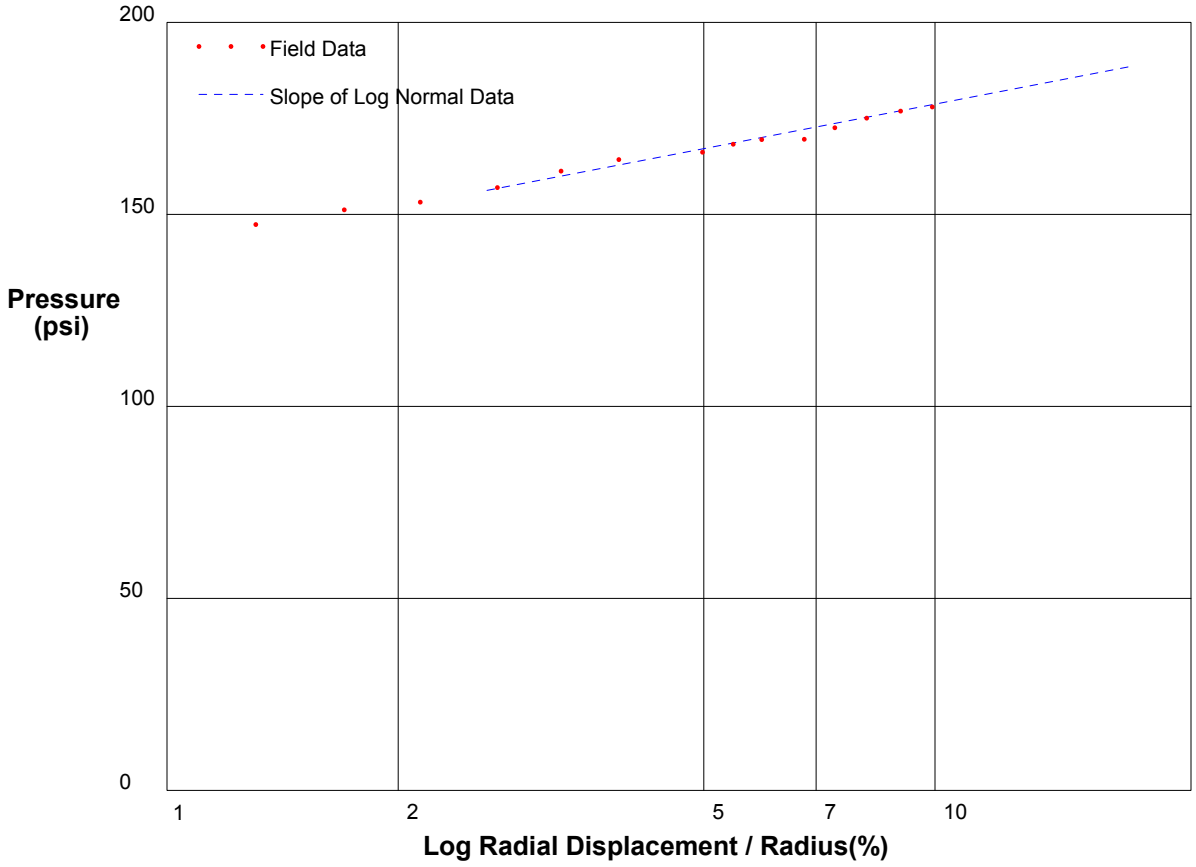


GIBSON'S CLAY MODEL

Shear Strength	16 psi
Insitu Stress	110 psi
Shear Modulus	2500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 125ft	File C:\DATA\ISE-787\DOT165.P

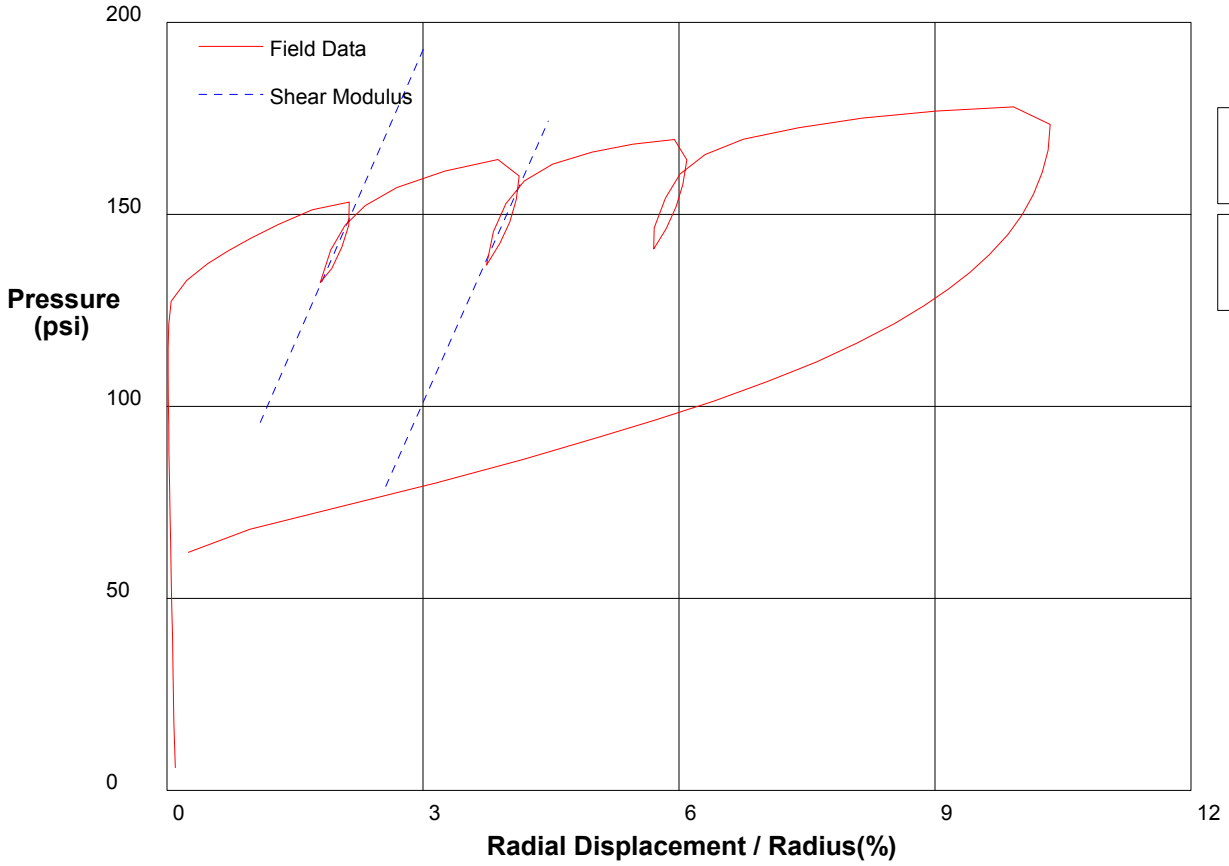


Shear Strength 16.7 psi
Limit Pressure 202 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 125ft	File C:\DATA\ISE-787\DOT165.P



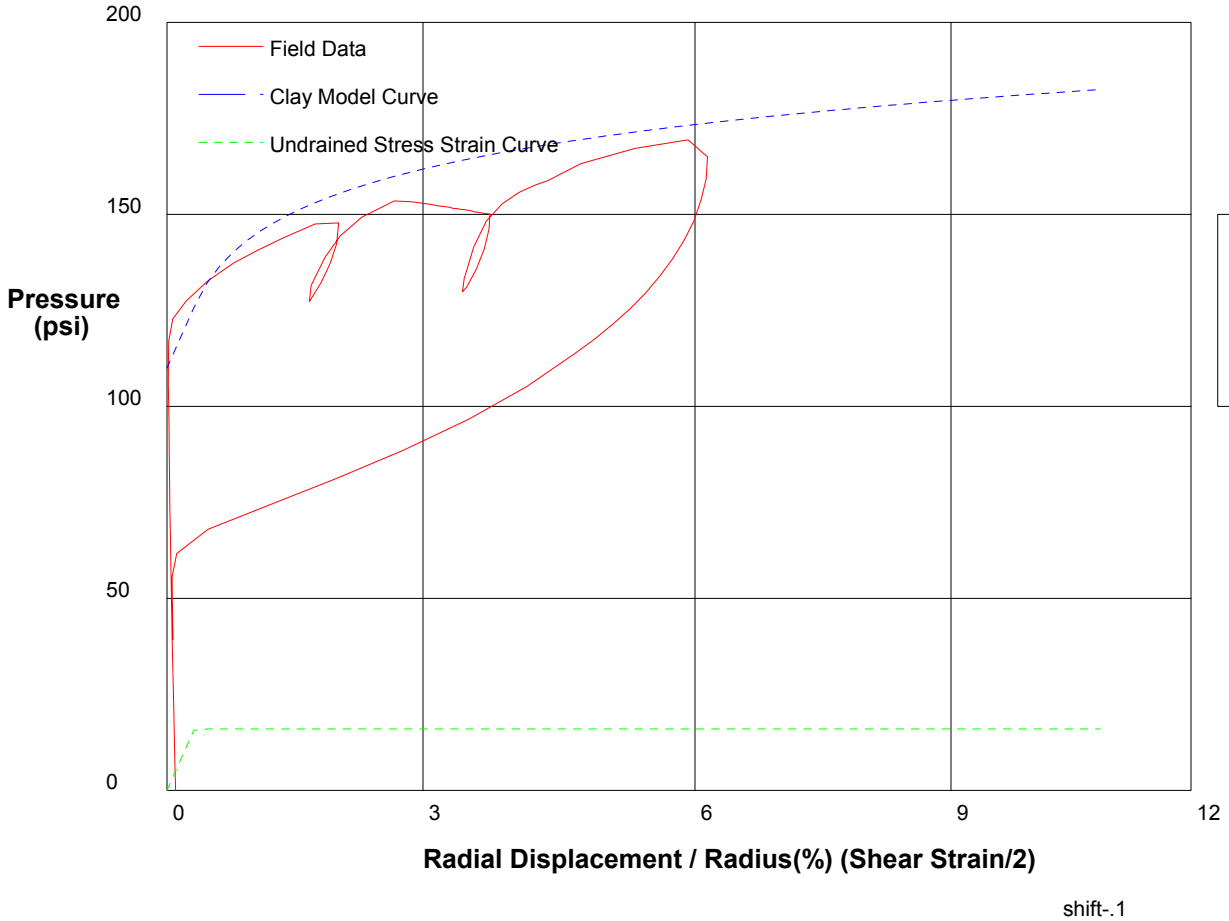
Shear Modulus 2495 psi

Shear Modulus 2544 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 127ft	File C:\DATA\ISE-787\DOT166.P

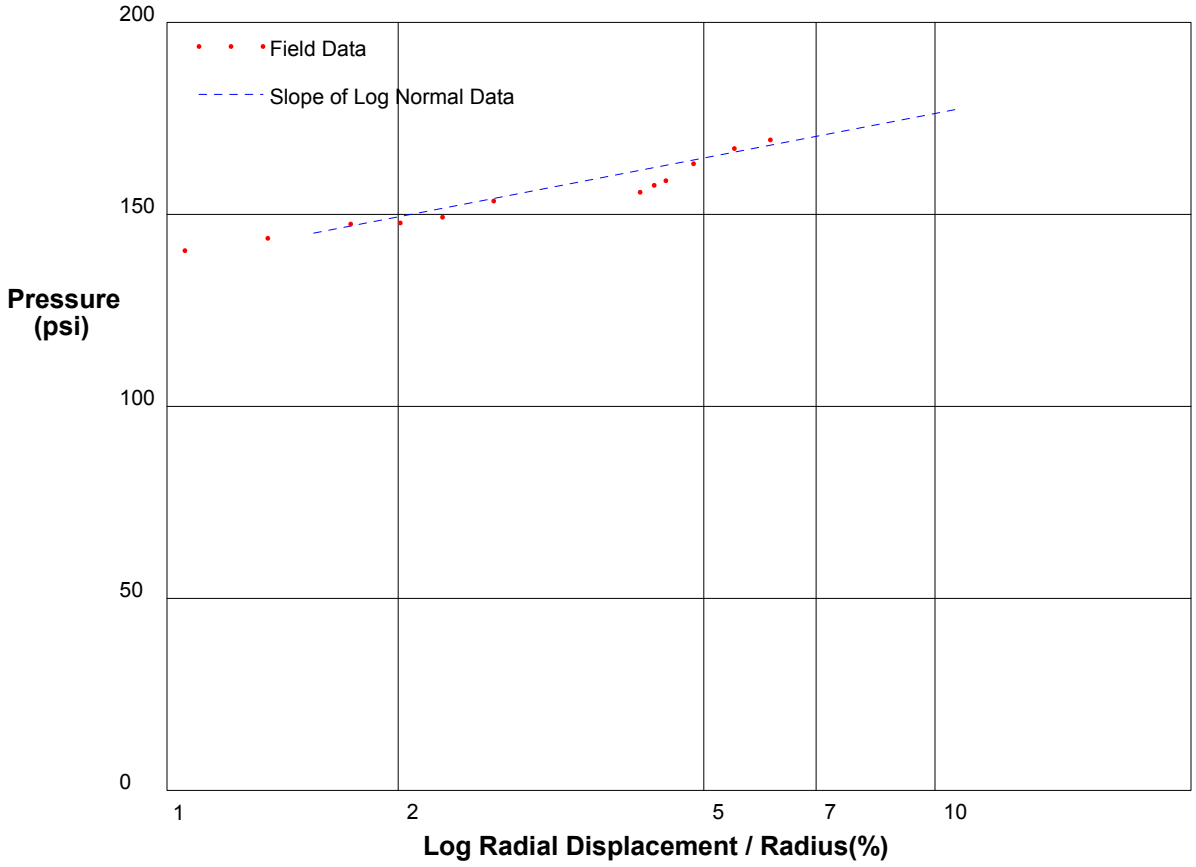


GIBSON'S CLAY MODEL

Shear Strength	16 psi
Insitu Stress	110 psi
Shear Modulus	2500 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 127ft	File C:\DATA\ISE-787\DOT166.P

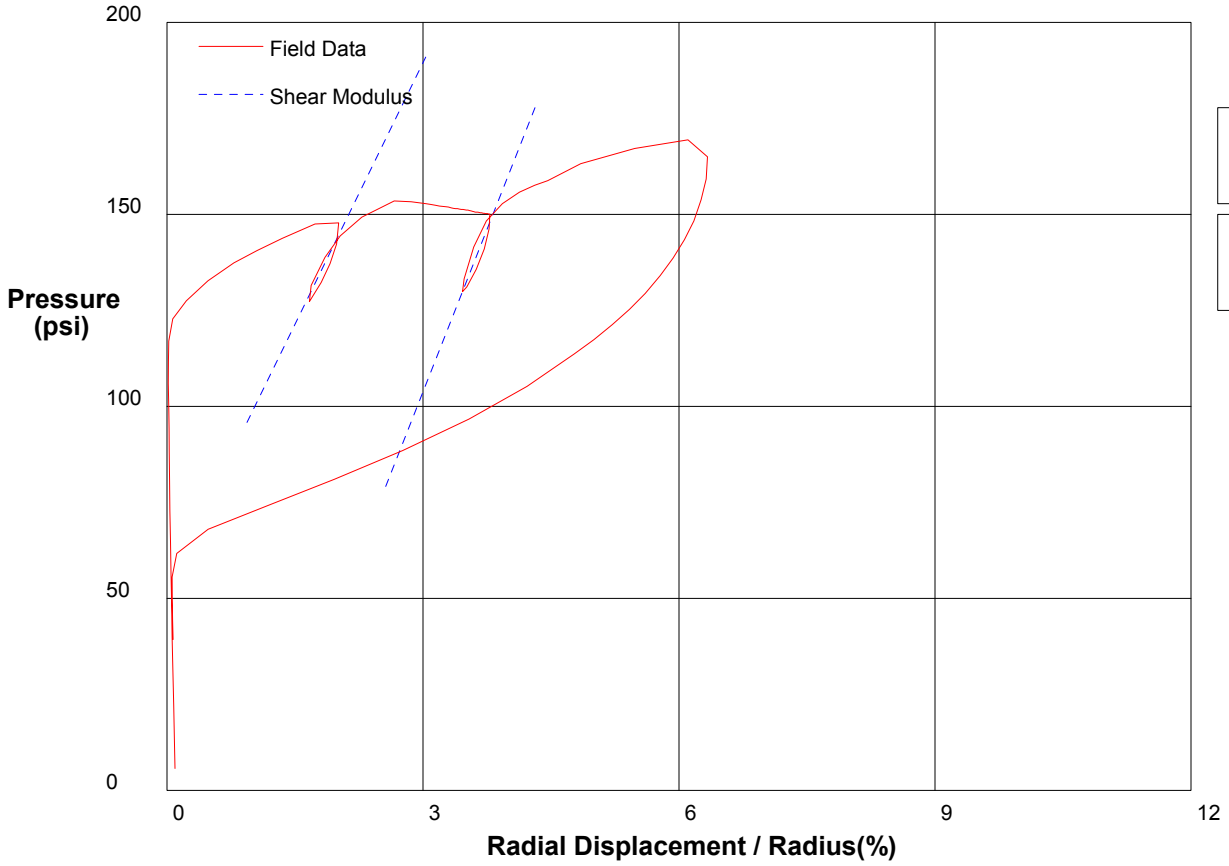


Shear Strength 16.7 psi
Limit Pressure 199 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 127ft	File C:\DATA\ISE-787\DOT166.P



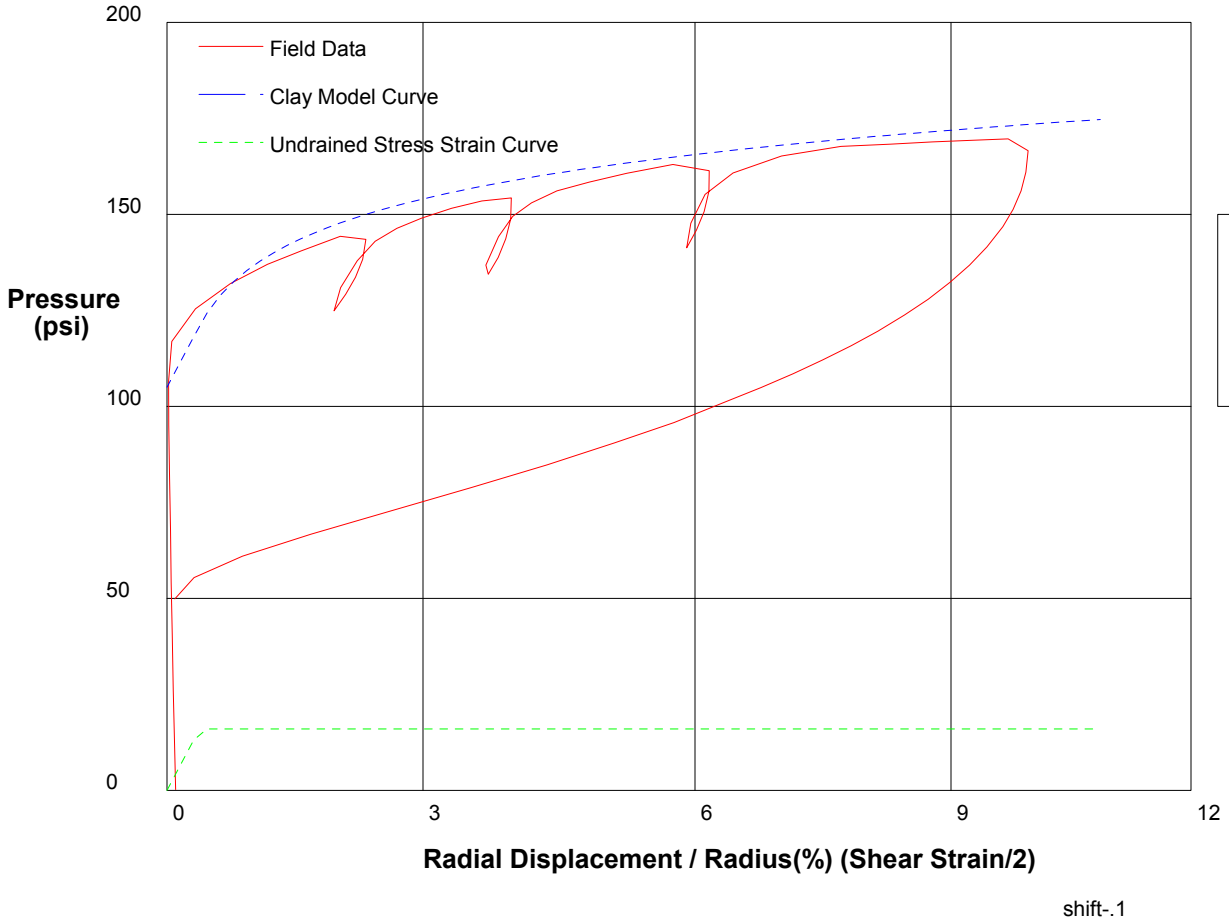
Shear Modulus 2817 psi

Shear Modulus 2271 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 129ft	File C:\DATA\ISE-787\DOT167.P

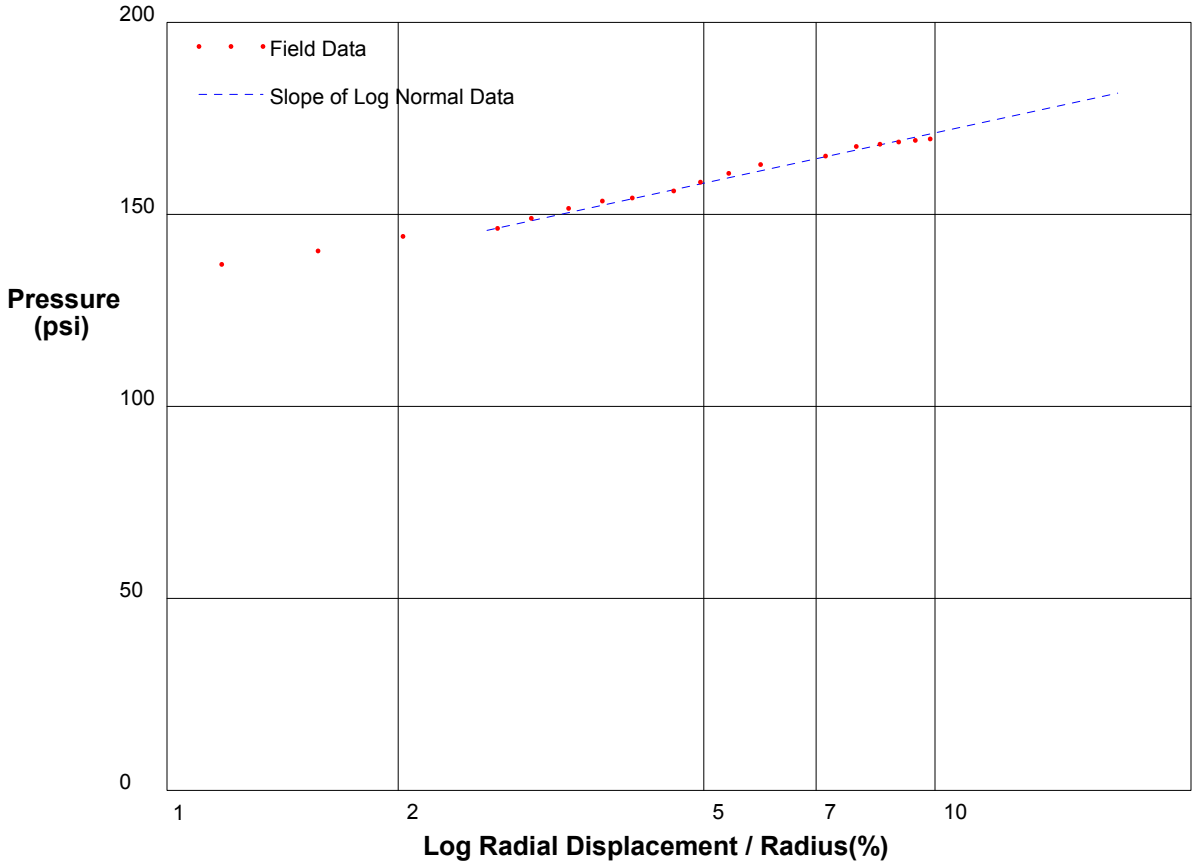


GIBSON'S CLAY MODEL

Shear Strength	16 psi
Insitu Stress	105 psi
Shear Modulus	2100 psi

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 129ft	File C:\DATA\ISE-787\DOT167.P

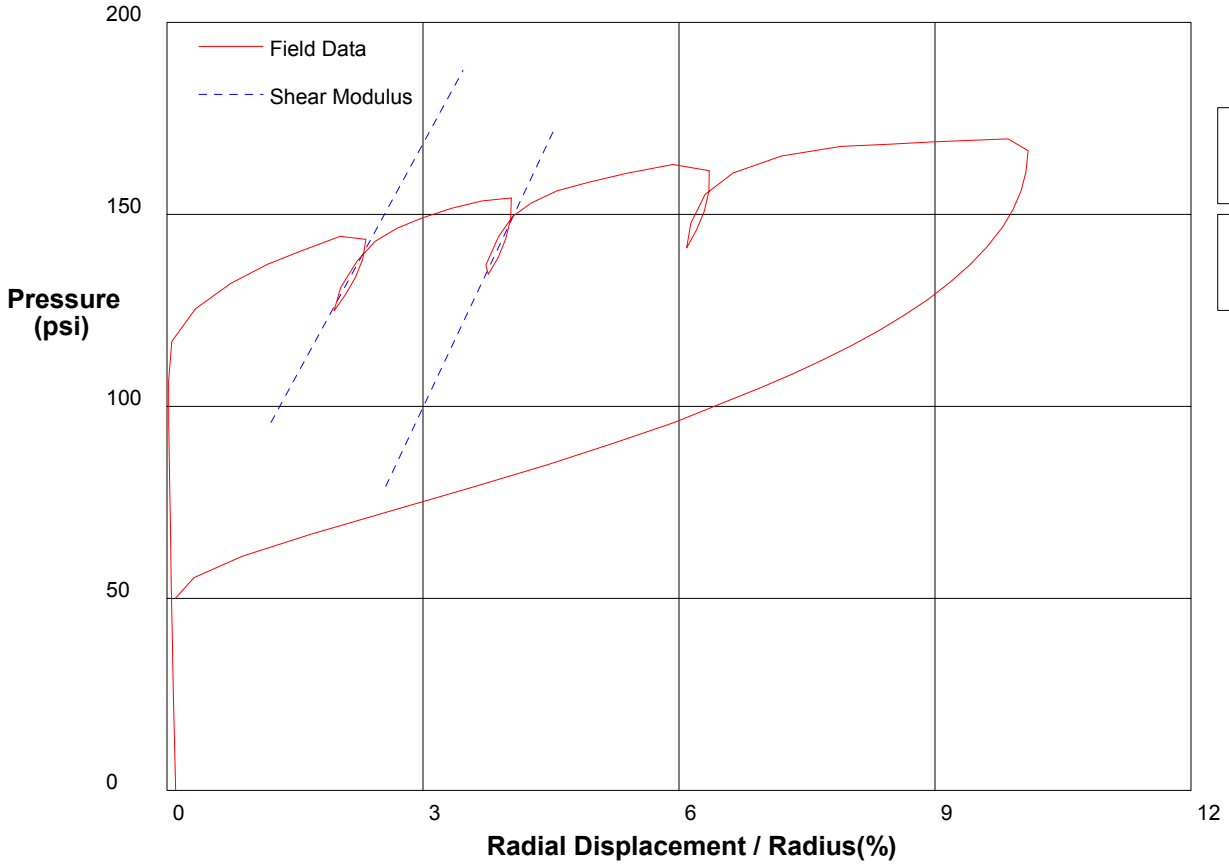


Shear Strength 18.9 psi
Limit Pressure 197 psi

shift-.1

In Situ Engineering

PRESSUREMETER DATA	Washington Department of Transportation
Grays Harbor, Hoquiam, WA	9/9/2008
Hole No. TH-28B-PMT-08 Depth 129ft	File C:\DATA\ISE-787\DOT167.P



Shear Modulus 2353 psi

Shear Modulus 2037 psi

shift-.1

In Situ Engineering

Downhole Shearwave Suspension Logging

SUSPENSION PS VELOCITIES
BORINGS TH-28-SW-08, TH-29A-SW-08, TH-30-SW-08 AND TH-31-SW-08

GRAY'S HARBOR, WASHINGTON

Report 8373-01

September 26, 2008

SUSPENSION PS VELOCITIES
BORINGS TH-28-SW-08, TH-29A-SW-08, TH-30-SW-08 AND TH-31-SW-08

GRAY'S HARBOR, WASHINGTON

Report 8373-01

September 26, 2008

Prepared for:

Landau Associates, Inc.
130 2nd Ave South
Edmonds, WA 98020
(425) 778-0907

Prepared by

GEOVision Geophysical Services
1124 Olympic Drive
Corona, California 92881
(951) 549-1234

TABLE OF CONTENTS

TABLE OF CONTENTS **3**

TABLE OF FIGURES **4**

TABLE OF TABLES **4**

INTRODUCTION **5**

SCOPE OF WORK **6**

INSTRUMENTATION **7**

SUSPENSION INSTRUMENTATION 7

MEASUREMENT PROCEDURES **10**

SUSPENSION MEASUREMENT PROCEDURES 10

DATA ANALYSIS **11**

SUSPENSION ANALYSIS 11

RESULTS **13**

SUSPENSION RESULTS 13

SUMMARY **14**

DISCUSSION OF SUSPENSION RESULTS 14
QUALITY ASSURANCE 15
SUSPENSION DATA RELIABILITY 15

Table of Figures

Figure 1: Concept illustration of P-S logging system 16
Figure 2: Example of filtered (1400 Hz lowpass) record....17
Figure 3. Example of unfiltered record 18
Figure 4: Boring TH-28-SW-08, Suspension R1-R2 P- and S_H-wave velocities....19
Figure 5: Boring TH-29A-SW-08, Suspension R1-R2 P- and S_H-wave velocities 21
Figure 6: Boring TH-30-SW-08, Suspension R1-R2 P- and S_H-wave velocities....23
Figure 7: Boring TH-31-SW-08, Suspension R1-R2 P- and S_H-wave velocities....25

Table of Tables

Table 1 Boring locations and logging dates....6
Table 2 Suspension PS Logging Equipment....7
Table 3. Logging dates and depth ranges 10
Table 4. Boring TH-28-SW-08, Suspension R1-R2 depths and P- and S_H-wave velocities 20
Table 5. Boring TH-29A-SW-08, Suspension R1-R2 depths and P- and S_H-wave velocities....22
Table 6. Boring TH-30-SW-08, Suspension R1-R2 depths and P- and S_H-wave velocities 24
Table 7. Boring TH-31-SW-08, Suspension R1-R2 depths and P- and S_H-wave velocities 26

APPENDICES

APPENDIX A **SUSPENSION VELOCITY MEASUREMENT QUALITY ASSURANCE SUSPENSION SOURCE TO RECEIVER ANALYSIS RESULTS**

APPENDIX B **GEOPHYSICAL LOGGING SYSTEMS - NIST TRACEABLE CALIBRATION PROCEDURES AND CALIBRATION RECORDS**

INTRODUCTION

Boring geophysical measurements were collected in three cased and one uncased boring located at Gray's Harbor, Washington. Geophysical data acquisition was performed on August 25 and 26, 2008 by Robert Steller of **GEO***Vision*. Data analysis and report preparation was performed by Robert Steller and reviewed by John Diehl of **GEO***Vision*. The work was performed under subcontract with Landau Associates, Inc. with Brian Christiansen serving as the point of contact for Landau.

This report describes the field measurements, data analysis, and results of this work.

SCOPE OF WORK

This report presents the results of boring geophysical measurements collected on August 25 and 26, 2008, in three cased and one uncased boring, as detailed below. The purpose of these studies were to supplement stratigraphic information obtained during Landau's soil sampling program and to acquire shear wave velocities and compressional wave velocities as a function of depth.

BORING DESIGNATION	DATES LOGGED	ELEVATION - FEET ABOVE MSL (1)	COORDINATES – FEET (1)	
			NORTHING	EASTING
TB-28-SW-08	8/25/2008	NA	NA	NA
TB-29A-SW-08	8/26/2008	NA	NA	NA
TB-30-SW-08	8/25/2008	NA	NA	NA
TB-31-SW-08	8/26/2008	NA	NA	NA

(1) Coordinates and elevations provided by Landau

Table 1 Boring locations and logging dates

The OYO Model 170 Suspension Logging Recorder and Suspension Logging Probe were used to obtain in-situ horizontal shear and compressional wave velocity measurements at 1.6-foot intervals. The acquired data were analyzed and a profile of velocity versus depth was produced for both compressional and horizontally polarized shear waves.

A detailed reference for the velocity measurement techniques used in this study is:

> Guidelines for Determining Design Basis Ground Motions, Report TR-102293, Electric Power Research Institute, Palo Alto, California, November 1993, Sections 7 and 8.

INSTRUMENTATION

Suspension Instrumentation

Suspension soil velocity measurements were performed in all borings using the PS suspension logging system, manufactured by OYO Corporation, and their subsidiary, Robertson Geologging. This system directly determines the average velocity of a 3.3-foot high segment of the soil column surrounding the boring of interest by measuring the elapsed time between arrivals of a wave propagating upward through the soil column. The receivers that detect the wave, and the source that generates the wave, are moved as a unit in the boring producing relatively constant amplitude signals at all depths.

Winch GEOVision 7-conductor
Sheave - Measuring wheel GEOVision S/N 102
OYO 170 PS Logging unit M/N 3331 S/N 15014
OYO PS Logger Borehole Probe, includes:
Isolation tube, 1m Model 3387B S/N 280068
Weight Model 3302W S/N 470151
OYO PS 170 Source Model 3304 S/N 21050
Receiver/Sensor S/N 30086
Driver Model 3386A S/N 490157

Table 2 Suspension PS Logging Equipment

The suspension system probe consists of a combined reversible polarity solenoid horizontal shear-wave source (S_H) and compressional-wave source (P), joined to two biaxial receivers by a flexible isolation cylinder, as shown in Figure 1. The separation of the two receivers is 3.3 feet, allowing average wave velocity in the region between the receivers to be determined by inversion of the wave travel time between the two receivers. The total length of the probe as used in these surveys is 19 feet, with the center point of the receiver pair 12.1 feet above the bottom end of the probe.

The probe receives control signals from, and sends the receiver signals to, instrumentation on the surface via an armored 7 conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data, using a 3.28-foot circumference sheave fitted with a digital rotary encoder.

The entire probe is suspended in the boring by the cable, therefore, source motion is not coupled directly to the boring walls; rather, the source motion creates a horizontally propagating impulsive pressure wave in the fluid filling the boring and surrounding the source. This pressure wave is converted to P and S_H-waves in the surrounding soil and rock as it passes through the casing and grout annulus and impinges upon the wall of the boring. These waves propagate through the soil and rock surrounding the boring, in turn causing a pressure wave to be generated in the fluid surrounding the receivers as the soil waves pass their location. Separation of the P and S_H-waves at the receivers is performed using the following steps:

1. Orientation of the horizontal receivers is maintained parallel to the axis of the source, maximizing the amplitude of the recorded S_H -wave signals.
2. At each depth, S_H-wave signals are recorded with the source actuated in opposite directions, producing S_H-wave signals of opposite polarity, providing a characteristic S_H-wave signature distinct from the P-wave signal.
3. The 7.0-foot separation of source and receiver 1 permits the P-wave signal to pass and damp significantly before the slower S_H-wave signal arrives at the receiver. In faster soils or rock, the isolation cylinder is extended to allow greater separation of the P- and S_H-wave signals.
4. In saturated soils, the received P-wave signal is typically of much higher frequency than the received S_H-wave signal, permitting additional separation of the two signals by low pass filtering.
5. Direct arrival of the original pressure pulse in the fluid is not detected at the receivers because the wavelength of the pressure pulse in fluid is significantly greater than the dimension of the fluid annulus surrounding the probe, preventing significant energy transmission through the fluid medium.

In operation, a distinct, repeatable pattern of impulses is generated at each depth as follows:

1. The source is fired in one direction producing dominantly horizontal shear with some vertical compression, and the signals from the horizontal receivers situated parallel to the axis of motion of the source are recorded.
2. The source is fired again in the opposite direction and the horizontal receiver signals are recorded.
3. The source is fired again and the vertical receiver signals are recorded. The repeated source pattern facilitates the picking of the P and S_H-wave arrivals; reversal of the source changes the polarity of the S_H-wave pattern but not the P-wave pattern.

The data from each receiver during each source activation is recorded as a different channel on the recording system. The Suspension PS system has six channels (two simultaneous recording channels), each with a 1024 sample record. The recorded data are displayed as six channels with a common time scale. Data are stored on disk for further processing. Up to 8 sampling sequences can be summed to improve the signal to noise ratio of the signals.

Review of the displayed data on the recorder or computer screen allows the operator to set the gains, filters, delay time, pulse length (energy), sample rate, and summing number to optimize the quality of the data before recording. Verification of the calibration of the Suspension PS digital recorder is performed every twelve months using a NIST traceable frequency source and counter, as outlined in Appendix B.

MEASUREMENT PROCEDURES

Suspension Measurement Procedures

TB-28, TB-30 and TB-31 were logged as 3 inch schedule 40 PVC cased borings, filled with clean water. TB-29A was logged as an uncased boring, filled with bentonite or polymer based drilling mud. Measurements followed the **GEO***Vision* Procedure for P-S Suspension Seismic Velocity Logging, revision 1.31. The probe was positioned with the top of the probe at the top of the casing, and the electronic depth counter was set to 6.6 feet, the distance between the mid-point of the receiver and the top of the probe, minus the height of the casing stick-up, as verified with a tape measure, and recorded on the field logs. The probe was lowered to the bottom of the boring, stopping at 1.6-foot intervals to collect data, as summarized in Table 3.

At each measurement depth the measurement sequence of two opposite horizontal records and one vertical record was performed, and the gains were adjusted as required. The data from each depth were viewed on the computer display, checked, and recorded on disk before moving to the next depth.

Upon completion of the measurements, the probe zero depth indication at the depth reference point was verified prior to removal from the boring.

BORING NUMBER	TOOL AND RUN NUMBER	DEPTH RANGE (FEET)	OPEN HOLE (FEET)	DEPTH TO BOTTOM OF CASING (FEET)	SAMPLE INTERVAL (FEET)	DATE LOGGED
TH-28-SW-08	SUSPENSION PS 1	1.6 – 160.8	173.1	173.1 PVC	1.6	8/25/2008
TH-29A-SW-08	SUSPENSION PS 1	103.4 – 128.0	140.4	105 STEEL	1.6	8/26/2008
TH-29A-SW-08	SUSPENSION PS 2	90.2 – 108.3	-	90 STEEL	1.6	8/26/2008
TH-29A-SW-08	SUSPENSION PS 3	29.5 – 98.4	-	30 STEEL	1.6	8/26/2008
TH-29A-SW-08	SUSPENSION PS 4	9.8 – 36.1	-	10 STEEL	1.6	8/26/2008
TH-30-SW-08	SUSPENSION PS 1	1.6 – 214.9	227.1	227.1 PVC	1.6	8/25/2008
TH-31-SW-08	SUSPENSION PS 1	1.6 – 195.2	207.6	207.6 PVC	1.6	8/26/2008

- PROBE DID NOT TOUCH BOTTOM OF BORING

Table 3. Logging dates and depth ranges

DATA ANALYSIS

Suspension Analysis

Using the proprietary OYO program PSLOG.EXE version 1.0, the recorded digital waveforms were analyzed to locate the most prominent first minima, first maxima, or first break on the vertical axis records, indicating the arrival of P-wave energy. The difference in travel time between receiver 1 and receiver 2 (R1-R2) arrivals was used to calculate the P-wave velocity for that 3.3-foot segment of the soil column. When observable, P-wave arrivals on the horizontal axis records were used to verify the velocities determined from the vertical axis data. The time picks were then transferred into an EXCEL template (EXCEL version 2003 SP2) to complete the velocity calculations based upon the arrival time picks made in PSLOG.

The P-wave velocity over the 7.0-foot interval from source to receiver 1 (S-R1) was also picked using PSLOG, and calculated and plotted in EXCEL, for quality assurance of the velocity derived from the travel time between receivers. In this analysis, the depth values as recorded were increased by 5.2 feet to correspond to the mid-point of the 7.0-foot S-R1 interval. Travel times were obtained by picking the first break of the P-wave signal at receiver 1 and subtracting 3.9 milliseconds, the calculated and experimentally verified delay from source trigger pulse (beginning of record) to source impact. This delay corresponds to the duration of acceleration of the solenoid before impact.

As with the P-wave records, using PSLOG, the recorded digital waveforms were analyzed to locate the presence of clear S_H-wave pulses, as indicated by the presence of opposite polarity pulses on each pair of horizontal records. Ideally, the S_H-wave signals from the 'normal' and 'reverse' source pulses are very nearly inverted images of each other. Digital FFT - IFFT lowpass filtering was used to remove the higher frequency P-wave signal from the S_H-wave signal. Different filter cutoffs were used to separate P- and S_H-waves at different depths, ranging from 600 Hz in the slowest zones to 2000 Hz in the regions of highest velocity. At each depth, the filter frequency was selected to be at least twice the fundamental frequency of the S_H-wave signal being filtered.

Generally, the first maxima were picked for the 'normal' signals and the first minima for the 'reverse' signals, although other points on the waveform were used if the first pulse was distorted. The absolute arrival time of the 'normal' and 'reverse' signals may vary by +/- 0.2 milliseconds, due to differences in the actuation time of the solenoid source caused by constant mechanical bias in the source or by boring inclination. This variation does not affect the R1-R2 velocity determinations, as the differential time is measured between arrivals of waves created by the same source actuation. The final velocity value is the average of the values obtained from the 'normal' and 'reverse' source actuations.

As with the P-wave data, S_H-wave velocity calculated from the travel time over the 7.0-foot interval from source to receiver 1 was calculated and plotted for verification of the velocity derived from the travel time between receivers. In this analysis, the depth values were increased by 5.2 feet to correspond to the mid-point of the 7.0-foot S-R1 interval. Travel times were obtained by picking the first break of the S_H-wave signal at the near receiver and subtracting 3.9 milliseconds, the calculated and experimentally verified delay from the beginning of the record at the source trigger pulse to source impact.

These data and analysis were reviewed by John Diehl as a component of **GEO***Vision*'s in-house QA-QC program.

Figure 3 shows an example of R1 - R2 measurements on a sample filtered suspension record. In Figure 3, the time difference over the 3.3-foot interval of 1.88 milliseconds for the horizontal signals is equivalent to an S_H-wave velocity of 1745 feet/second. Whenever possible, time differences were determined from several phase points on the S_H-waveform records to verify the data obtained from the first arrival of the S_H-wave pulse. Figure 4 displays the same record before filtering of the S_H-waveform record with a 1400 Hz FFT - IFFT digital lowpass filter, illustrating the presence of higher frequency P-wave energy at the beginning of the record, and distortion of the lower frequency S_H-wave by residual P-wave signal.

RESULTS

Suspension Results

Suspension R1-R2 P- and S_H-wave velocities are plotted in Figures 4-7. The suspension velocity data presented in these figures are presented in Tables 4-7. These plots and data are included in the EXCEL analysis files transmitted separately.

P- and S_H-wave velocity data from R1-R2 analysis and quality assurance analysis of S-R1 data are plotted together in Figures A-1 through A-4 to aid in visual comparison. It should be noted that R1-R2 data are an average velocity over a 3.3-foot segment of the soil column; S-R1 data are an average over 7.0 feet, creating a significant smoothing relative to the R1-R2 plots. S-R1 data are presented in Tables A-1 through A-4, and included in the EXCEL analysis file.

Calibration procedures and records for the suspension PS measurement system are presented in Appendix B.

SUMMARY

Discussion of Suspension Results

Suspension PS velocity data are ideally collected in an uncased fluid filled boring, drilled with rotary mud (rotary wash) methods. The data collected in the cased borings were generally of good quality, indicating good coupling of the casing to the surrounding soil by the grout.

Suspension PS velocity data quality is judged based upon 5 criteria:

1. Consistent data between receiver to receiver (R1 – R2) and source to receiver (S – R1) data.
2. Consistent relationship between P-wave and S_H -wave (excluding transition to saturated soils)
3. Consistency between data from adjacent depth intervals.
4. Clarity of P-wave and S_H-wave onset, as well as damping of later oscillations.
5. Consistency of profile between adjacent borings, if available.

These data show good correlation between R1 – R2 and S – R1 data, as well as good correlation between P-wave and S_H-wave velocities. P-wave and S_H-wave onsets are generally clear, and later oscillations are well damped. There are variations in S_H-wave velocities at different depths in the different borings, which may due to horizontal in-homogeneity, or grout intrusion into eroded or soft portions of the cased borings.

Quality Assurance

These boring geophysical measurements were performed using industry-standard or better methods for measurements and analyses. All work was performed under **GEO***Vision* quality assurance procedures, which include:

- Use of NIST-traceable calibrations, where applicable, for field and laboratory instrumentation
- Use of standard field data logs
- Use of independent verification of velocity data by comparison of receiver-to-receiver and source-to-receiver velocities
- Independent review of calculations and results by a registered professional engineer, geologist, or geophysicist.

Suspension Data Reliability

P- and S_H-wave velocity measurement using the Suspension Method gives average velocities over a 3.3-foot interval of depth. This high resolution results in the scatter of values shown in the graphs. Individual measurements are very reliable with estimated precision of +/- 5%. Standardized field procedures and quality assurance checks contribute to the reliability of these data.

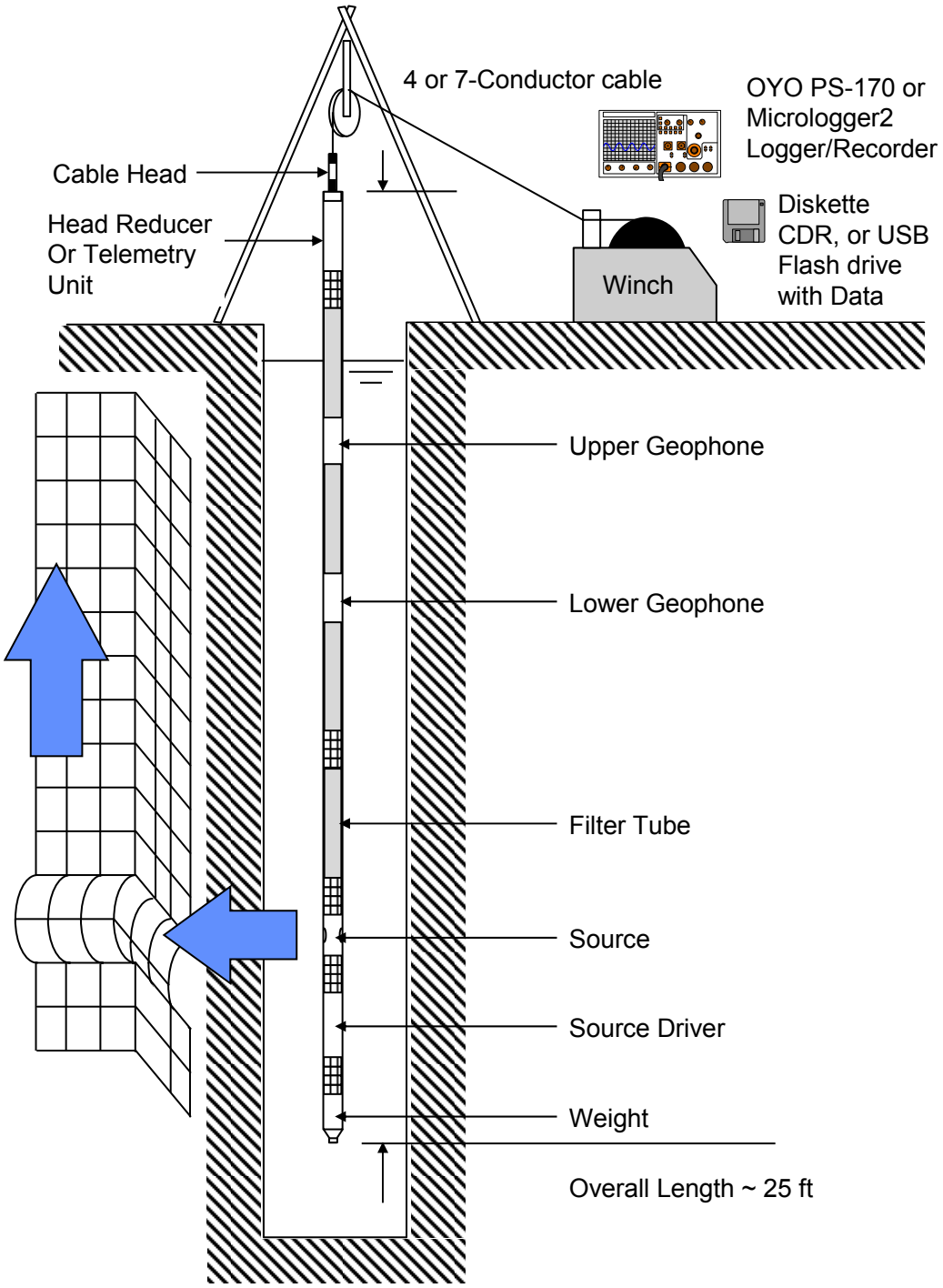


Figure 1: Concept illustration of P-S logging system

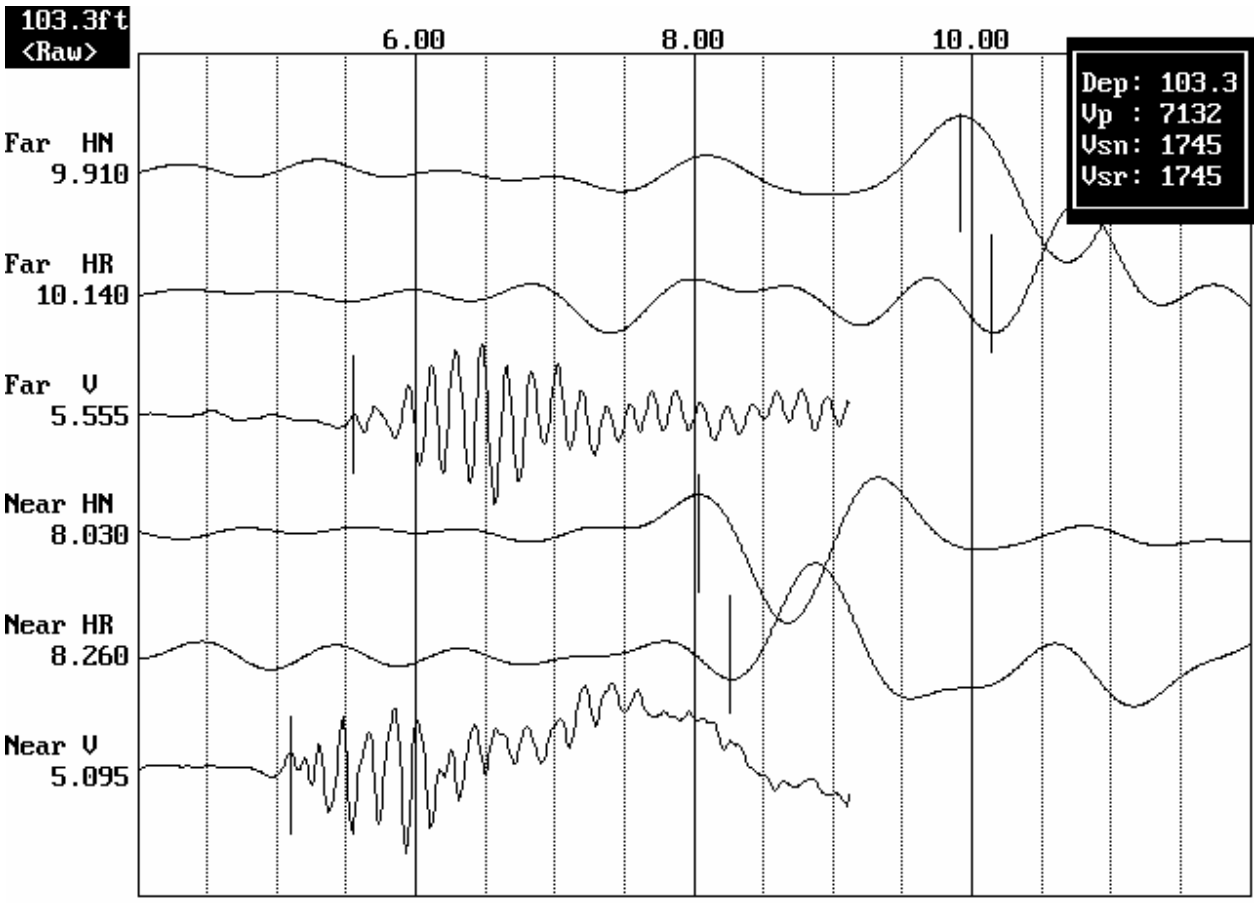


Figure 2: Example of filtered (1400 Hz lowpass) record

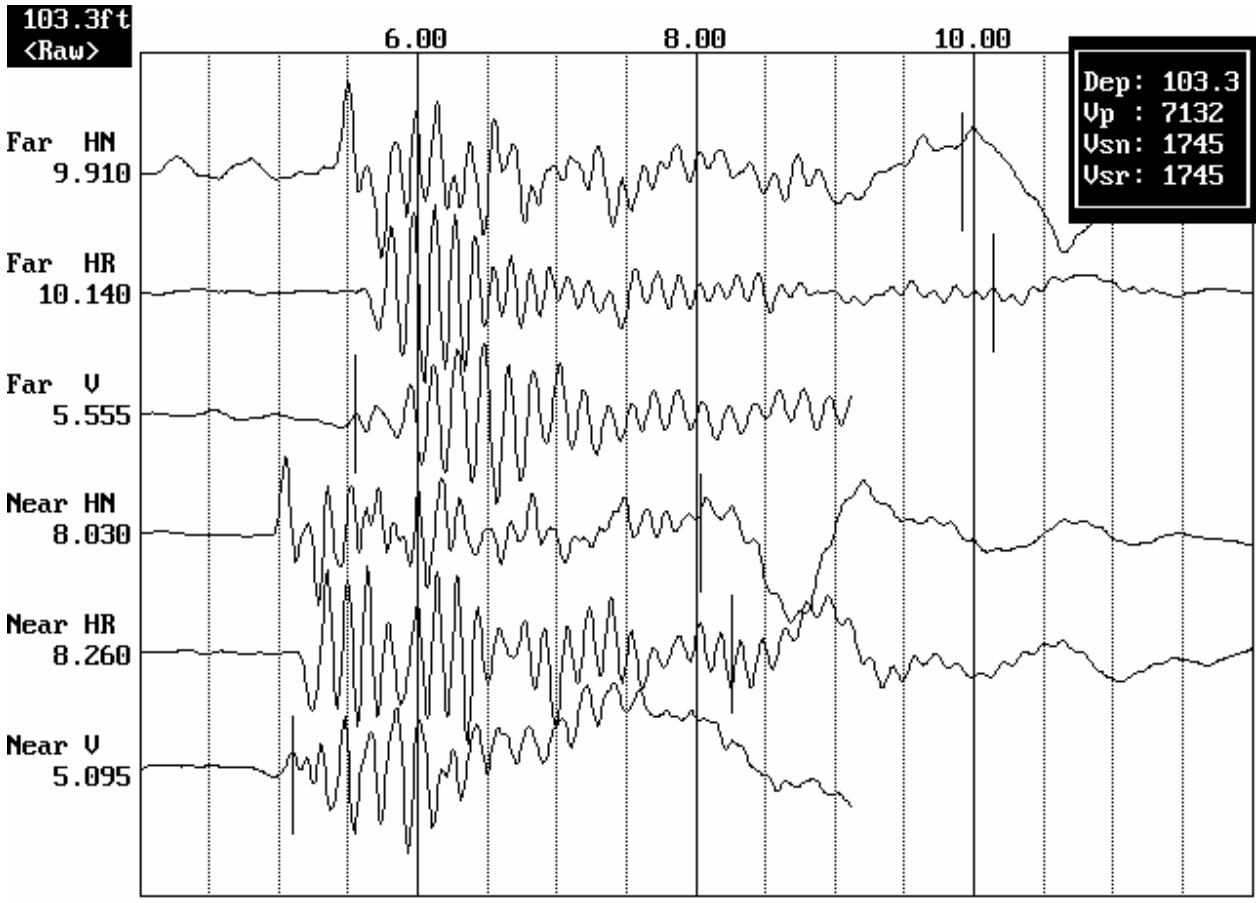


Figure 3. Example of unfiltered record

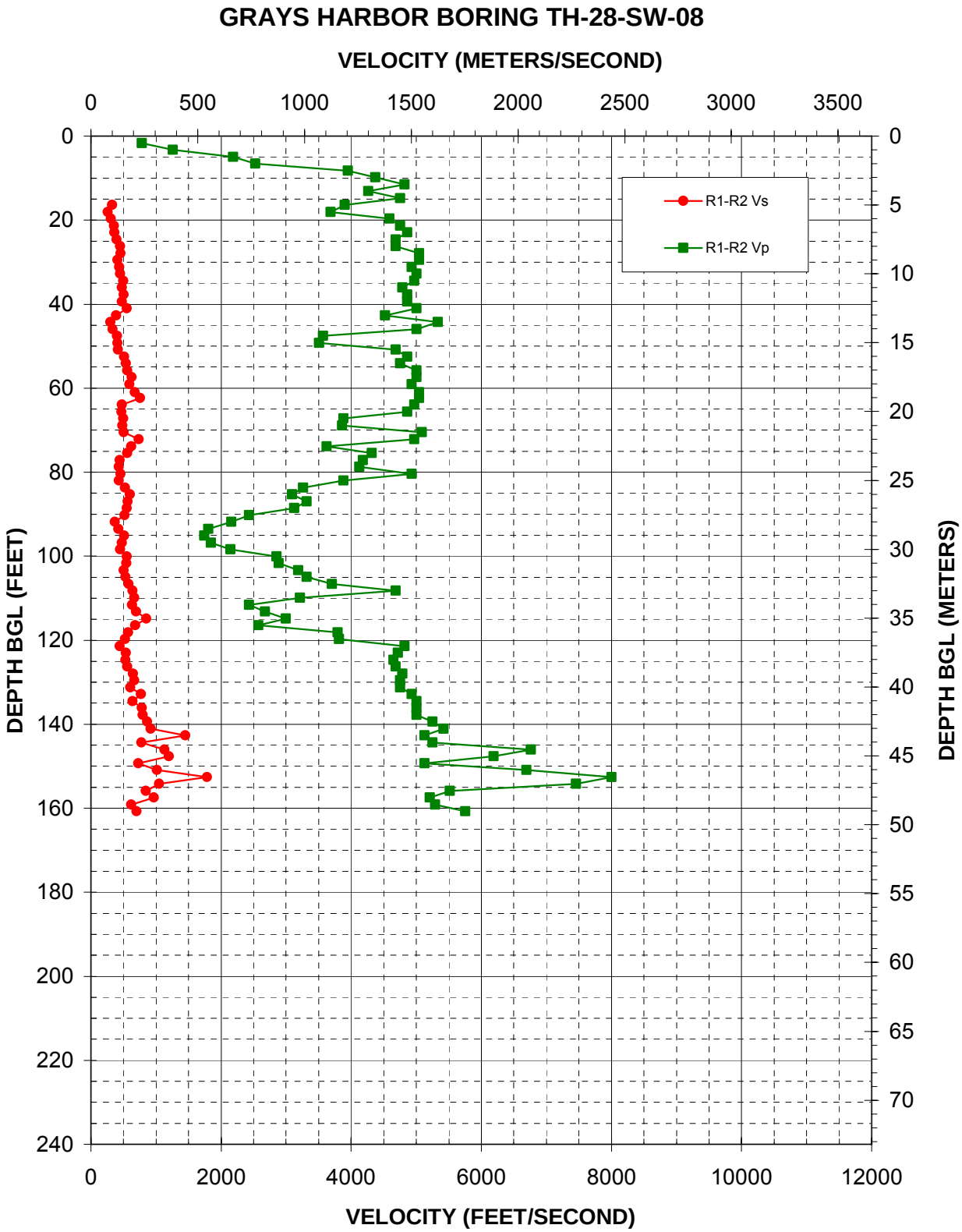


Figure 4: Boring TH-28-SW-08, Suspension R1-R2 P- and S_H-wave velocities

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
1.64		781
3.28		1262
4.92		2187
6.56		2524
8.20		3953
9.84		4374
11.48		4825
13.12		4261
14.76		4755
16.40	330	3906
18.04	257	3686
19.69	307	4589
21.33	353	4755
22.97	362	4861
24.61	398	4687
26.25	446	4687
27.89	454	5047
29.53	411	5047
31.17	439	4934
32.81	453	5009
34.45	495	4971
36.09	475	4790
37.73	503	4861
39.37	474	4861
41.01	551	5009
42.65	391	4525
44.29	299	5335
45.93	336	5009
47.57	404	3566
49.21	410	3509
50.85	418	4687
52.49	511	4861
54.13	538	4755
55.77	556	5009
57.41	628	5009
59.06	594	4934
61.02	673	5047
62.34	754	5047
63.98	475	4971
65.62	469	4861
67.26	497	3883
68.90	484	3860
70.54	505	5087
72.18	737	4971
73.82	622	3625
75.46	556	4317
77.10	440	4179
78.74	427	4127
80.38	454	4934
82.02	432	3883

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
83.66	525	3265
85.30	599	3095
86.94	566	3314
88.58	554	3125
90.22	515	2430
91.86	371	2158
93.50	422	1803
95.14	509	1745
96.78	477	1843
98.43	449	2144
100.07	549	2853
101.71	547	2891
103.35	501	3185
104.99	533	3314
106.63	581	3707
108.27	637	4687
109.91	668	3217
111.55	635	2430
113.19	694	2678
114.83	854	2996
116.47	678	2573
118.11	573	3793
119.75	522	3815
121.39	446	4825
123.03	538	4721
124.67	529	4654
126.31	556	4687
127.95	647	4790
129.59	670	4755
131.23	604	4755
132.87	768	4934
134.51	643	5009
136.15	785	5009
137.80	800	5009
139.44	863	5249
141.08	922	5423
142.72	1452	5126
144.36	776	5249
146.00	1131	6765
147.64	1202	6190
149.28	727	5126
150.92	1013	6696
152.56	1783	8002
154.20	1052	7456
155.84	843	5514
157.48	968	5208
159.12	620	5292
160.76	704	5756

Table 4. Boring TH-28-SW-08, Suspension R1-R2 depths and P- and S_H-wave velocities

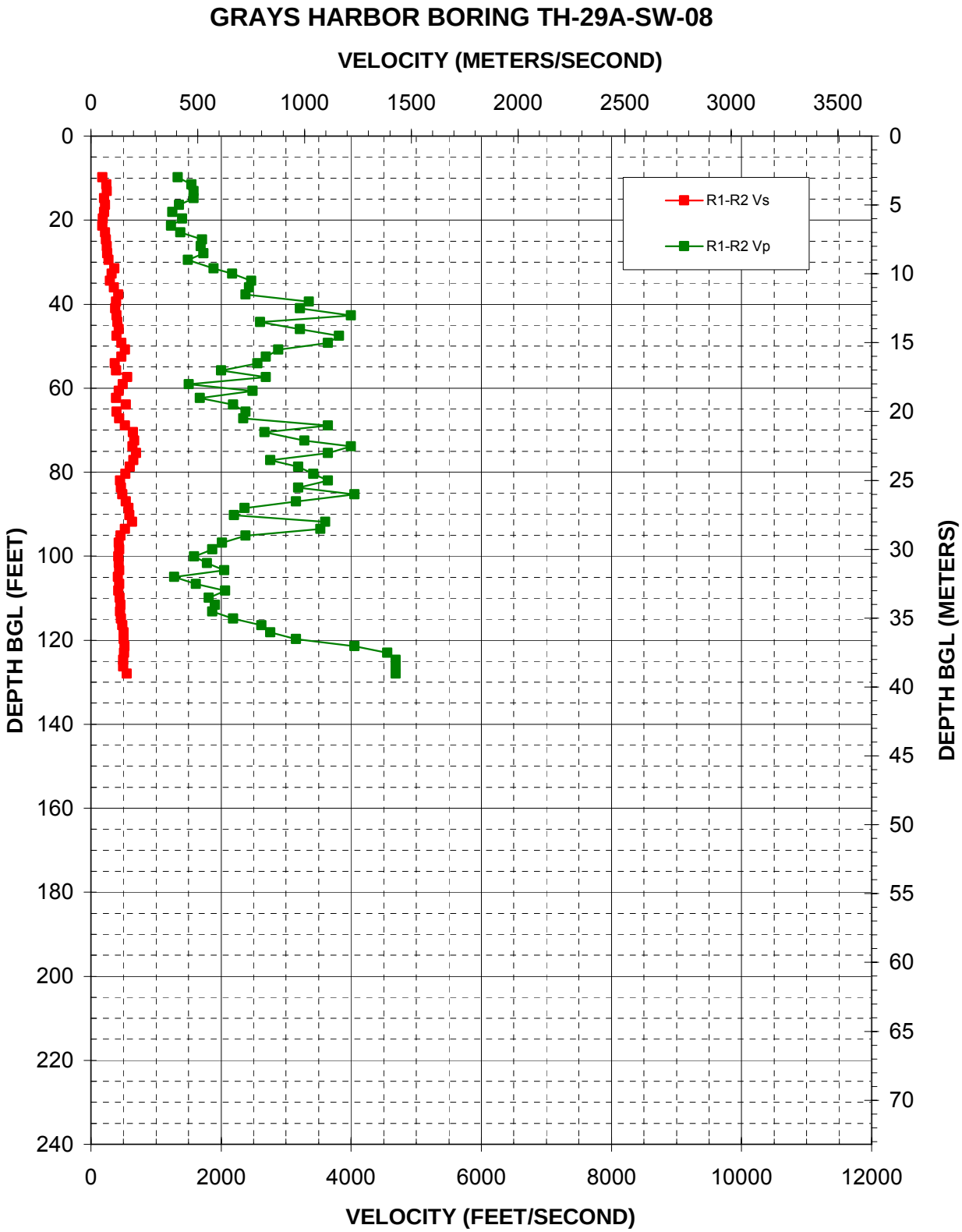


Figure 5: Boring TH-29A-SW-08, Suspension R1-R2 P- and S_H-wave velocities

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
9.84	175	1334
11.48	240	1548
13.12	246	1577
14.76	203	1577
16.40	216	1356
18.04	206	1252
19.69	185	1402
21.33	180	1233
22.97	220	1379
24.61	229	1709
26.25	248	1691
27.89	249	1727
29.53	272	1491
31.50	364	1886
32.81	320	2173
34.45	295	2467
36.09	354	2430
37.73	423	2377
39.37	388	3348
41.01	372	3217
42.65	396	4001
44.29	411	2604
45.93	426	3217
47.57	398	3815
49.21	469	3645
50.85	527	2878
52.49	467	2689
54.13	366	2563
55.77	388	2001
57.41	556	2689
59.06	490	1505
60.70	426	2485
62.34	391	1674
63.98	540	2187
65.62	392	2377
67.26	433	2343
68.90	523	3645
70.54	646	2667
72.51	666	3281
73.82	637	4001
75.46	698	3645
77.10	653	2757
78.74	599	3185
80.38	529	3418
82.02	449	3645
83.66	465	3185
85.30	486	4050
86.94	538	3155
88.58	581	2360
90.22	594	2202

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
91.86	631	3605
93.50	523	3528
95.14	456	2377
96.78	430	2013
98.43	436	1864
100.07	423	1585
101.71	430	1783
103.35	436	2051
104.99	414	1282
106.63	435	1616
108.27	422	2063
109.91	440	1813
111.55	457	1907
113.19	451	1864
114.83	460	2187
116.47	481	2625
118.11	503	2757
119.75	507	3155
121.39	515	4050
123.03	511	4557
124.67	497	4687
126.31	499	4687
127.95	549	4687

Table 5. Boring TH-29A-SW-08, Suspension R1-R2 depths and P- and S_H-wave velocities

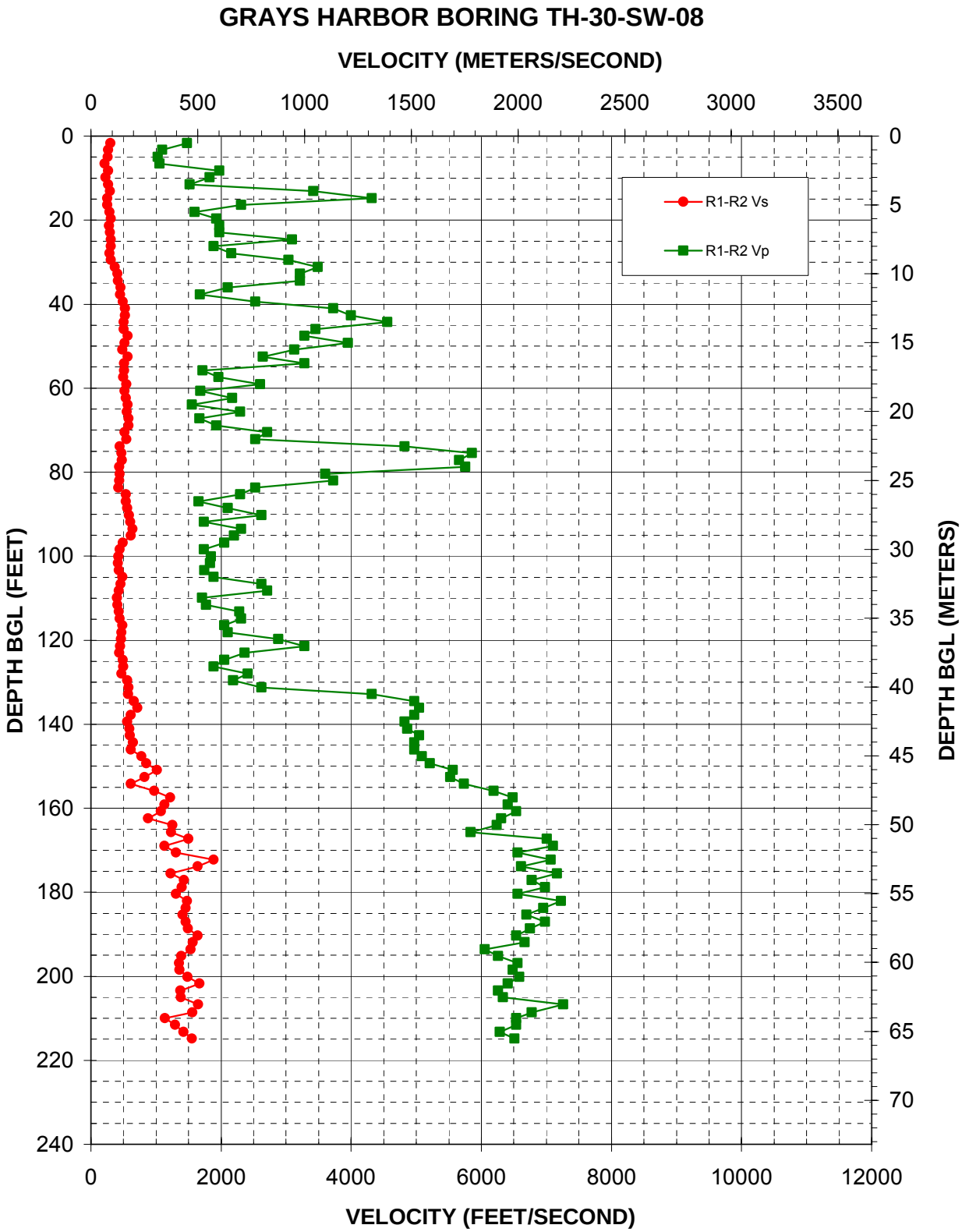


Figure 6: Boring TH-30-SW-08, Suspension R1-R2 P- and S_H-wave velocities

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
1.64	297	1478
3.28	265	1094
4.92	256	1032
6.56	211	1058
8.20	266	1976
9.84	222	1823
11.48	262	1519
13.12	294	3418
14.76	252	4317
16.40	249	2310
18.04	283	1593
19.69	309	1930
21.33	281	1976
22.97	295	1976
24.61	308	3095
26.25	306	1886
27.89	285	2158
29.53	308	3038
31.17	371	3490
32.81	409	3217
34.45	417	3217
36.09	459	2103
37.73	448	1674
39.37	490	2524
41.01	525	3728
42.65	525	4001
44.29	503	4557
45.93	507	3454
47.57	563	3281
49.21	517	3953
50.85	486	3125
52.49	566	2646
54.13	509	3281
55.77	513	1718
57.41	497	1965
59.06	542	2604
60.70	517	1682
62.34	538	2173
63.98	563	1555
65.62	551	2294
67.26	581	1665
68.90	581	1930
70.54	517	2711
72.18	542	2524
73.82	443	4825
75.46	467	5859
77.10	479	5657
78.74	433	5756
80.38	445	3605
82.02	436	3728

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
83.66	421	2524
85.30	540	2294
86.94	540	1657
88.58	558	2103
90.22	583	2625
91.86	605	1736
93.50	640	2310
95.14	616	2202
96.78	488	2051
98.43	442	1736
100.07	422	1843
101.71	414	1833
103.35	429	1745
104.99	484	1886
106.63	459	2625
108.27	427	2711
109.91	404	1709
111.55	409	1773
113.19	427	2278
114.83	445	2310
116.47	484	2051
118.11	469	2103
119.75	464	2878
121.39	453	3281
123.03	433	2360
124.67	488	2051
126.31	495	1886
127.95	472	2412
129.59	562	2187
131.23	581	2625
132.87	570	4317
134.51	660	4971
136.15	715	5047
137.80	612	4971
139.44	556	4825
141.08	593	4861
142.72	598	5047
144.36	648	4971
146.00	611	4971
147.64	777	5087
149.28	850	5208
150.92	1016	5561
152.56	822	5523
154.20	610	5736
155.84	971	6190
157.48	1220	6484
159.12	1131	6408
160.76	1079	6536
162.40	882	6309
164.04	1252	6237

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
165.68	1233	5838
167.32	1498	7010
168.96	1127	7101
170.60	1307	6562
172.24	1886	7071
173.88	1640	6615
175.52	1224	7163
177.17	1433	6779
178.81	1396	6981
180.45	1307	6562
182.09	1478	7227
183.73	1458	6951
185.37	1408	6696
187.01	1458	6981
188.65	1495	6751
190.29	1640	6536
191.93	1570	6668
193.57	1533	6053
195.21	1387	6261
196.85	1353	6562
198.49	1364	6484
200.13	1485	6588
201.77	1665	6408
203.41	1379	6261
205.05	1381	6334
206.69	1649	7258
208.66	1562	6779
209.97	1137	6536
211.61	1297	6536
213.25	1423	6285
214.90	1551	6510

Table 6. Boring TH-30-SW-08, Suspension R1-R2 depths and P- and S_H-wave velocities

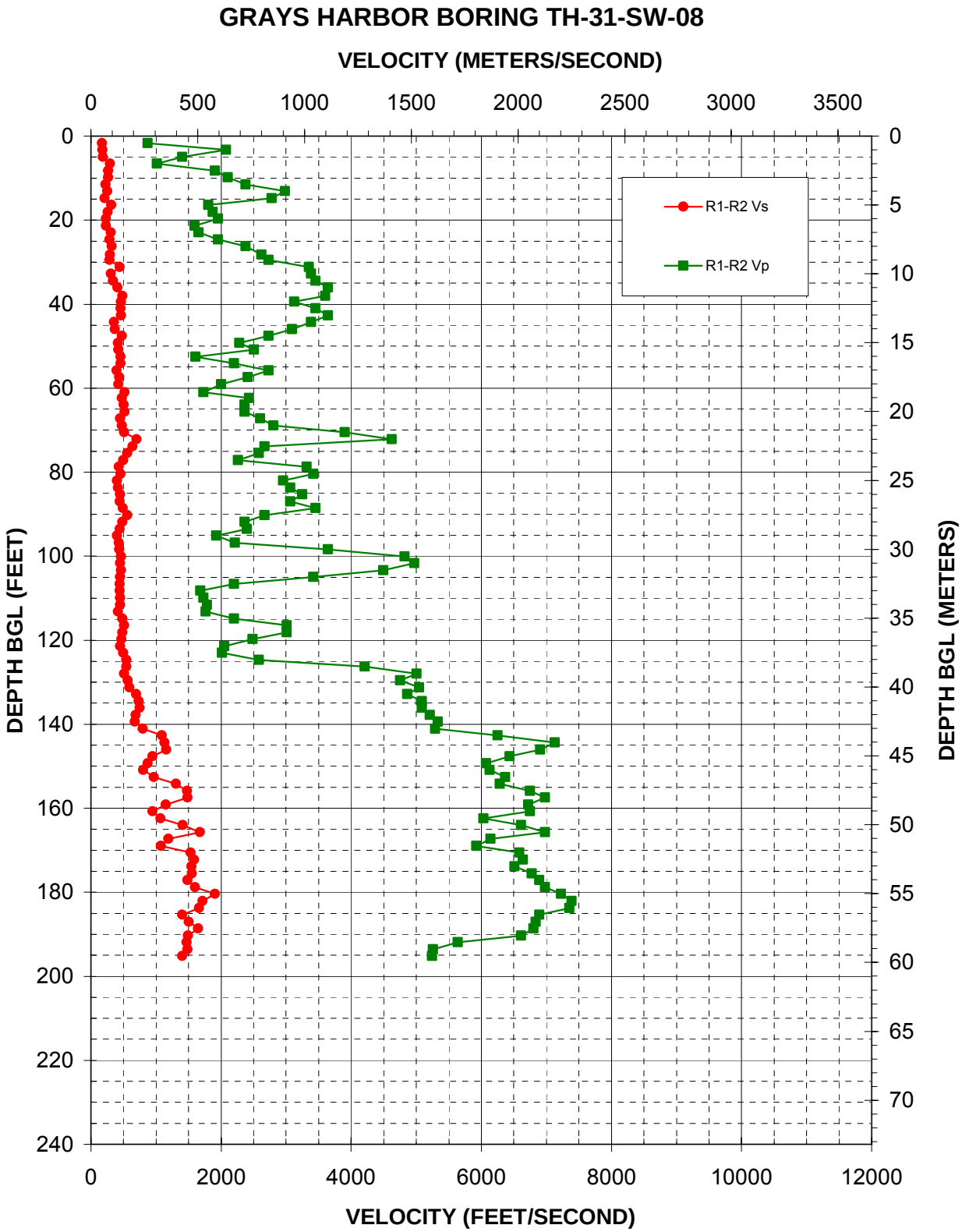


Figure 7: Boring TH-31-SW-08, Suspension R1-R2 P- and S_H-wave velocities

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
1.64	167	873
3.28	180	2076
4.92	181	1402
6.56	294	1013
8.20	264	1907
9.84	262	2103
11.48	222	2377
13.12	250	2983
14.76	213	2780
16.40	315	1803
18.04	256	1875
19.69	229	1953
21.33	229	1593
22.97	305	1657
24.61	285	1953
26.25	322	2377
28.22	291	2625
29.53	285	2734
31.17	443	3348
32.81	307	3382
34.45	343	3454
36.09	409	3645
38.06	482	3605
39.37	461	3125
41.01	457	3454
42.65	464	3645
44.29	354	3382
45.93	371	3095
47.57	477	2734
49.21	418	2278
50.85	422	2504
52.49	454	1608
54.13	454	2202
55.77	392	2734
57.41	433	2412
59.06	421	2001
61.02	517	1727
62.34	474	2430
63.98	507	2360
65.62	517	2360
67.26	448	2604
68.90	477	2804
70.54	509	3906
72.18	702	4621
73.82	643	2667
75.46	558	2583
77.10	495	2263
78.74	430	3314
80.38	459	3418
82.02	404	2956

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
83.66	413	3066
85.30	449	3248
86.94	443	3066
88.58	493	3454
90.22	556	2667
91.86	481	2360
93.50	443	2395
95.14	399	1930
96.78	426	2217
98.43	437	3645
100.07	465	4825
101.71	449	4971
103.35	460	4494
104.99	448	3418
106.63	442	2202
108.27	440	1682
109.91	446	1727
111.55	446	1783
113.19	415	1764
114.83	481	2202
116.47	511	3010
118.11	481	3010
119.75	469	2485
121.39	449	2051
123.03	497	2013
124.67	547	2583
126.31	547	4206
127.95	510	5009
129.59	564	4755
131.23	594	5047
132.87	697	4861
134.51	732	5087
136.15	747	5087
137.80	691	5208
139.44	671	5335
141.08	798	5292
142.72	1090	6249
144.36	1127	7132
146.00	1155	6907
147.64	948	6433
149.28	875	6076
150.92	802	6132
152.56	968	6371
154.20	1305	6285
155.84	1475	6751
157.48	1488	6981
159.12	1151	6723
160.76	944	6751
162.40	1067	6031
164.04	1408	6615

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
165.68	1678	6981
167.32	1189	6144
168.96	1077	5922
170.60	1533	6588
172.24	1585	6641
173.88	1544	6510
175.52	1551	6779
177.17	1488	6893
178.81	1600	6981
180.45	1907	7227
182.09	1718	7389
183.73	1661	7356
185.37	1402	6893
187.01	1505	6835
188.65	1649	6807
190.29	1495	6615
191.93	1468	5637
193.57	1485	5258
195.21	1402	5241

Table 7. Boring TH-31-SW-08, Suspension R1-R2 depths and P- and S_H-wave velocities

APPENDIX A

SUSPENSION VELOCITY MEASUREMENT QUALITY ASSURANCE SUSPENSION SOURCE TO RECEIVER ANALYSIS RESULTS

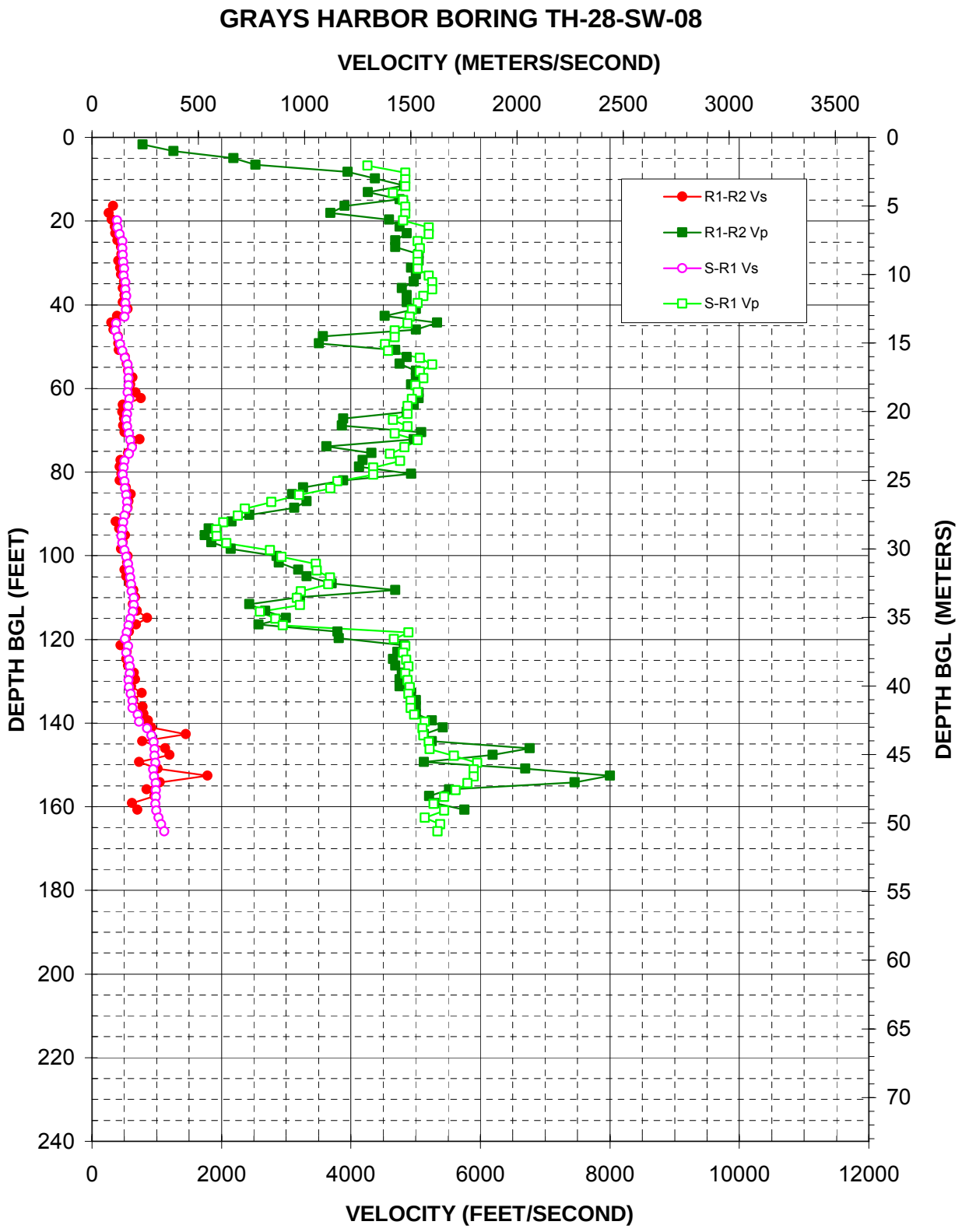


Figure A-1. Boring TH-28-SW-08, R1 - R2 high resolution analysis and S - R1 quality assurance analysis P- and S_H-wave data

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
6.79		4255
8.43		4842
10.07		4842
11.71		4842
13.35		4650
14.99		4809
16.63		4842
18.27		4842
19.91	389	4809
21.56	398	5201
23.20	432	5201
24.84	471	5033
26.48	471	5069
28.12	474	5033
29.76	486	5033
31.40	494	5033
33.04	488	5201
34.68	518	5259
36.32	516	5259
37.96	530	5125
39.60	514	5033
41.24	524	4944
42.88	507	4910
44.52	372	4876
46.16	364	4681
47.80	405	4681
49.44	433	4530
51.08	471	4574
52.72	511	5069
54.36	553	5259
56.00	566	5069
57.64	564	5125
59.28	566	4997
60.93	553	5033
62.57	575	4944
64.21	557	4876
66.17	544	4876
67.49	530	4650
69.13	546	4876
70.77	571	4681
72.41	592	5033
74.05	619	4825
75.69	571	4604
77.33	507	4760
78.97	488	4347
80.61	474	4347
82.25	501	3795
83.89	509	3686
85.53	529	3199
87.17	546	2770

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
88.81	542	2360
90.45	507	2254
92.09	484	2029
93.73	468	1924
95.37	456	1929
97.01	471	2077
98.65	501	2753
100.30	532	2925
101.94	557	3459
103.58	578	3476
105.22	592	3676
106.86	605	3647
108.50	613	3228
110.14	644	3170
111.78	647	3213
113.42	633	2596
115.06	596	2831
116.70	563	2950
118.34	536	4893
119.98	509	4665
121.62	558	4842
123.26	529	4809
124.90	570	4859
126.54	585	4893
128.18	588	4842
129.82	569	4876
131.46	573	4910
133.10	599	4893
134.74	626	4927
136.38	630	4927
138.02	710	4979
139.67	731	5144
141.31	853	5106
142.95	918	5125
144.59	953	5201
146.23	966	5220
147.87	966	5594
149.51	982	5950
151.15	948	5900
152.79	958	5900
154.43	990	5802
156.07	985	5617
157.71	985	5443
159.35	982	5279
160.99	996	5443
162.63	1028	5144
164.27	1072	5380
165.91	1120	5339

Table A-1. Boring TH-28-SW-08, S - R1 quality assurance analysis P- and S_H-wave data

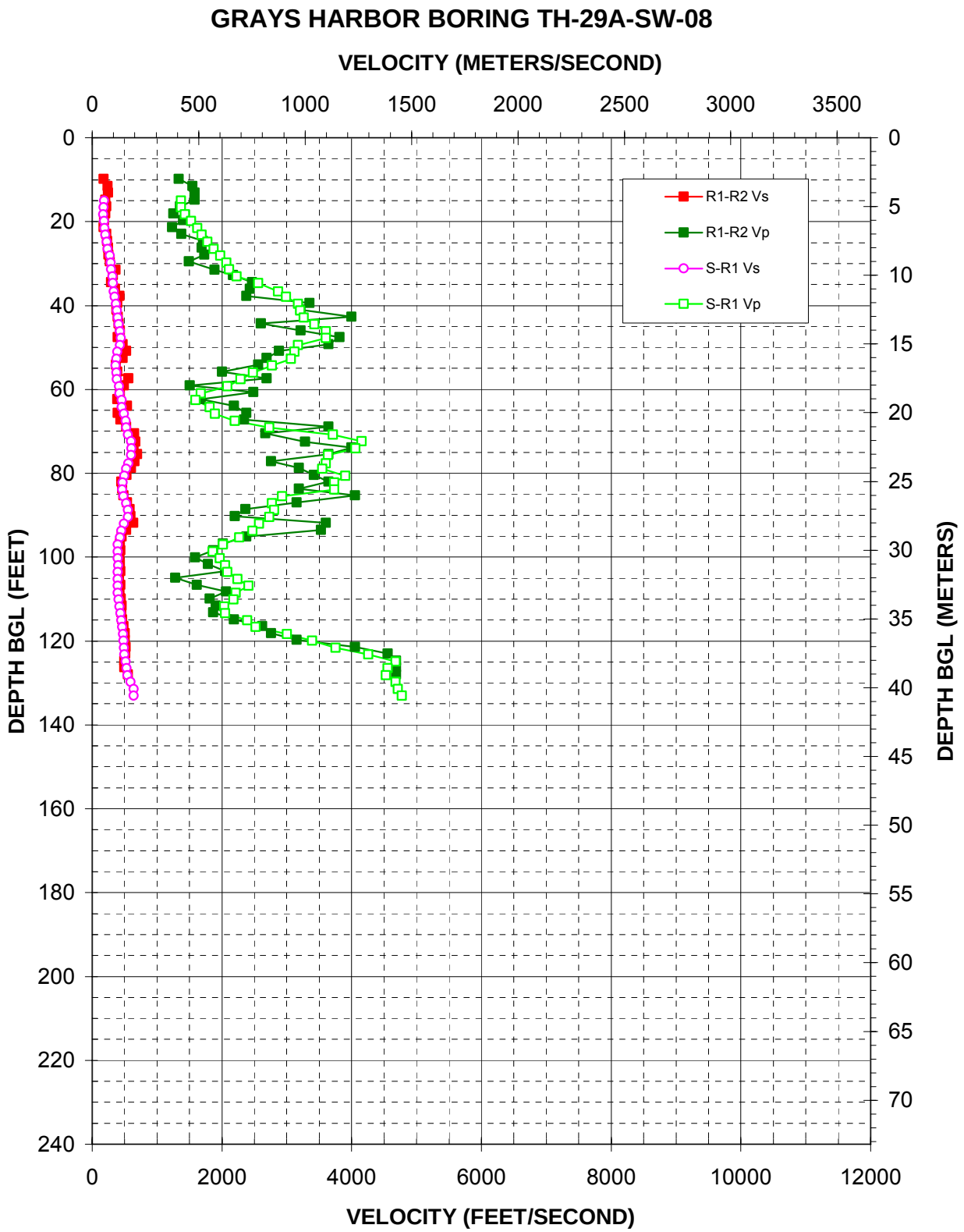


Figure A-2. Boring TH-29A-SW-08, R1 - R2 high resolution analysis and S - R1 quality assurance analysis P- and S_H-wave data

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
14.99	183	1369
16.63	174	1369
18.27	173	1430
19.91	182	1523
21.56	191	1621
23.20	208	1692
24.84	222	1777
26.48	238	1872
28.12	271	1978
29.76	284	2071
31.40	292	2108
33.04	316	2229
34.68	322	2562
36.65	331	2866
37.96	346	2988
39.60	368	3177
41.24	384	3206
42.88	392	3266
44.52	406	3425
46.16	431	3601
47.80	443	3601
49.44	431	3177
51.08	388	3120
52.72	377	3066
54.36	360	2775
56.00	372	2481
57.64	385	2287
59.28	417	2083
60.93	426	1676
62.57	453	1592
64.21	456	1814
65.85	489	1892
67.49	518	2201
69.13	522	2732
70.77	555	3715
72.41	603	4154
74.05	608	4058
75.69	598	3638
77.66	559	3601
78.97	526	3546
80.61	496	3901
82.25	473	3735
83.89	463	3735
85.53	483	2925
87.17	522	2775
88.81	551	2808
90.45	551	2732
92.09	493	2572
93.73	451	2472
95.37	431	2265

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
97.01	397	2018
98.65	397	1857
100.30	397	1967
101.94	399	2047
103.58	397	2083
105.22	394	2243
106.86	394	2413
108.50	394	2215
110.14	406	2180
111.78	420	2035
113.42	437	2047
115.06	449	2388
116.70	463	2516
118.34	479	3000
119.98	483	3392
121.62	493	3755
123.26	500	4255
124.90	514	4681
126.54	530	4559
128.18	542	4530
129.82	592	4681
131.46	641	4712
133.10	641	4776

Table A-2. Boring TH-29A-SW-08, S - R1 quality assurance analysis P- and S_H-wave data

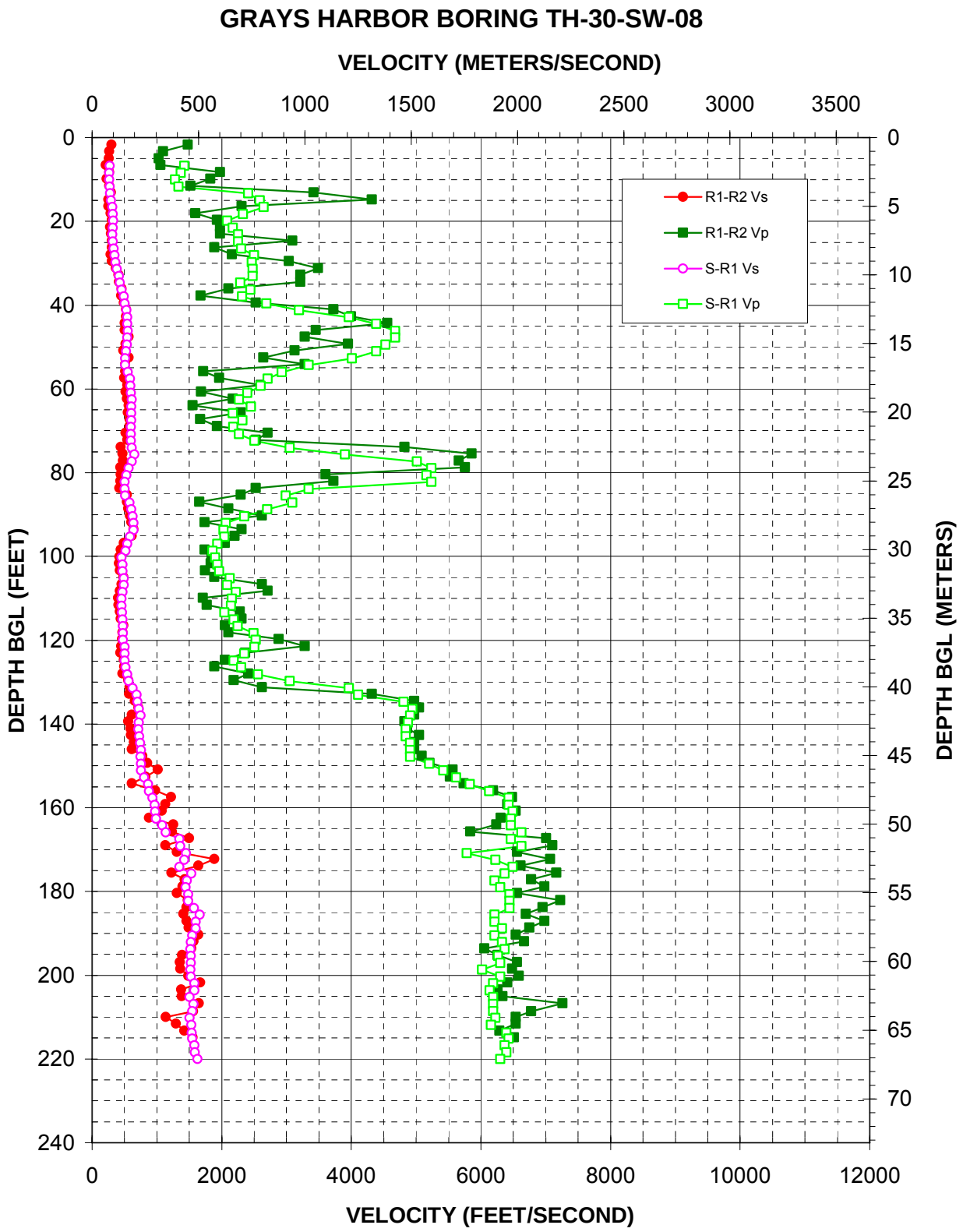


Figure A-3. Boring TH-30-SW-08, R1 - R2 high resolution analysis and S - R1 quality assurance analysis P- and S_H-wave data

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
6.79	270	1424
8.43	262	1369
10.07	263	1284
11.71	274	1337
13.35	281	2413
14.99	295	2591
16.63	311	2649
18.27	317	2333
19.91	324	2083
21.56	317	2174
23.20	311	2258
24.84	317	2258
26.48	330	2302
28.12	348	2499
29.76	363	2464
31.40	383	2481
33.04	413	2481
34.68	429	2287
36.32	453	2446
37.96	488	2317
39.60	507	2690
41.24	532	3191
42.88	544	3967
44.52	544	4388
46.16	549	4681
47.80	542	4681
49.44	538	4530
51.08	526	4388
52.72	508	4012
54.36	511	3343
56.00	549	2925
57.64	588	2711
59.28	592	2600
60.93	598	2396
62.57	613	2265
64.21	608	2455
65.85	608	2174
67.49	608	2325
69.13	600	2180
70.77	600	2265
72.41	598	2507
74.05	616	3053
75.69	653	3901
77.33	616	5015
78.97	566	5240
80.61	532	5162
82.25	507	5240
83.89	507	3343
85.53	508	2988
87.17	580	3093

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
88.81	608	2700
90.45	624	2348
92.09	638	2065
93.73	641	2029
95.37	588	2041
97.01	544	1934
98.65	514	1857
100.30	457	1898
101.94	468	1934
103.58	470	1961
105.22	488	2128
106.86	488	2083
108.50	473	2222
110.14	453	2160
111.78	453	2147
113.42	465	2041
115.06	470	2187
116.70	476	2250
118.34	478	2490
119.98	478	2526
121.62	501	2507
123.26	507	2348
124.90	507	2187
126.54	518	2302
128.18	544	2562
129.82	569	3053
131.46	630	3967
133.10	688	4106
134.74	699	4809
136.38	719	4944
138.02	748	4910
139.67	723	4876
141.31	717	4842
142.95	729	4842
144.59	741	4910
146.23	754	4910
147.87	748	4910
149.51	759	5201
151.15	759	5422
152.79	801	5617
154.43	868	5827
156.07	881	6132
157.71	935	6429
159.35	966	6429
160.99	977	6489
162.63	987	6465
164.27	1082	6465
165.91	1140	6624
167.55	1348	6465
169.19	1363	6624

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
170.83	1454	5783
172.47	1421	6224
174.11	1348	6489
175.75	1530	6371
177.40	1466	6213
179.04	1442	6303
180.68	1484	6441
182.32	1484	6441
183.96	1571	6441
185.60	1660	6213
187.24	1599	6213
188.88	1599	6325
190.52	1547	6213
192.16	1523	6325
193.80	1516	6371
195.44	1523	6269
197.08	1523	6303
198.72	1516	6021
200.36	1523	6303
202.00	1581	6191
203.64	1581	6137
205.28	1507	6191
206.92	1564	6191
208.56	1546	6191
210.20	1507	6224
211.84	1533	6159
213.81	1540	6394
215.12	1546	6429
216.77	1581	6371
218.41	1588	6394
220.05	1625	6303

Table A-3. Boring TH-30-SW-08, S - R1 quality assurance analysis P- and S_H-wave data

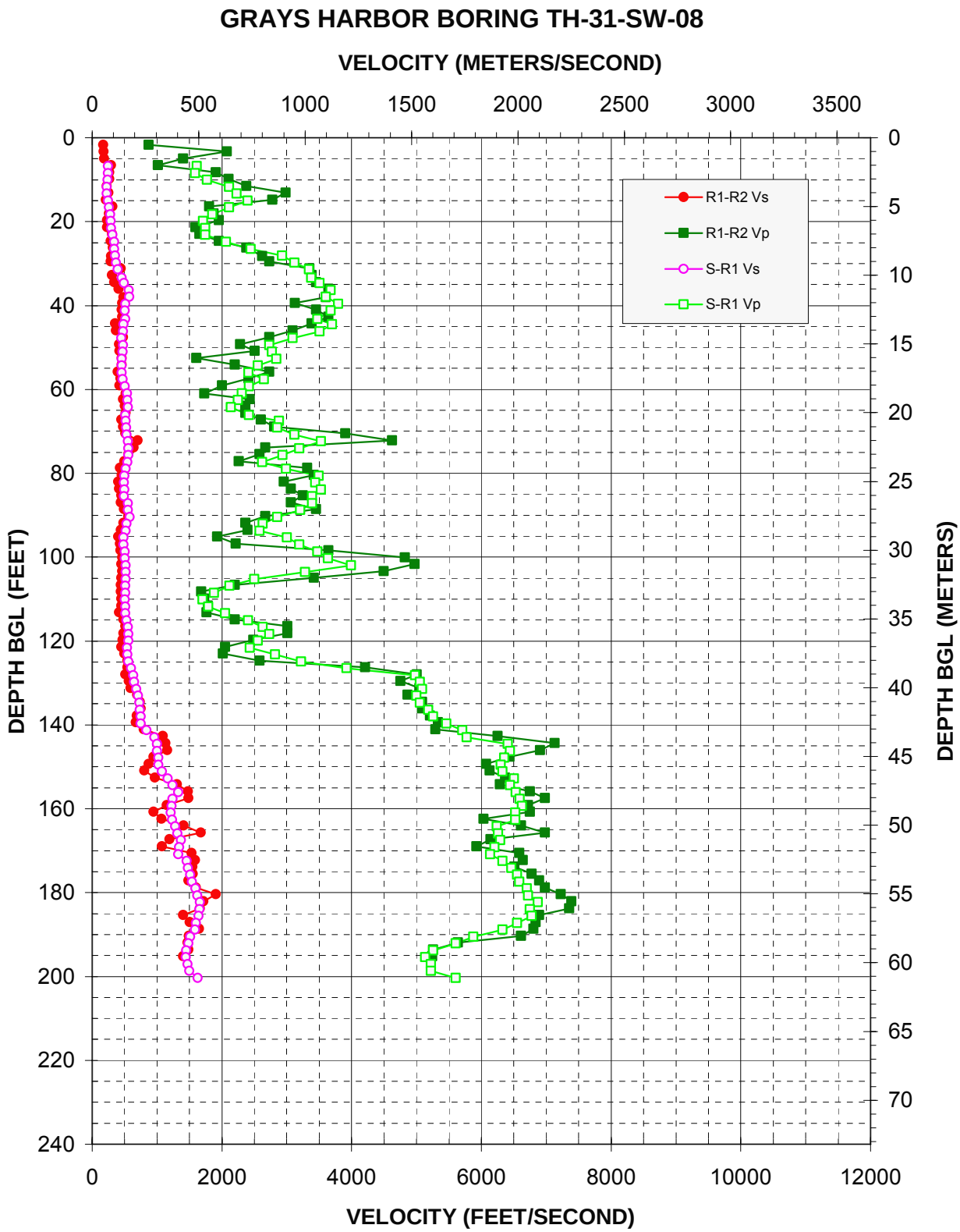


Figure A-4. Boring TH-31-SW-08, R1 - R2 high resolution analysis and S - R1 quality assurance analysis P- and S_H-wave data

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
6.79	249	1614
8.43	247	1585
10.07	236	1769
11.71	227	2108
13.35	224	2229
14.99	243	2396
16.63	261	2108
18.27	278	1853
19.91	284	1708
21.56	296	1742
23.20	313	1742
24.84	342	2065
26.48	342	2446
28.12	357	2925
29.76	367	3120
31.40	394	3343
33.37	457	3375
34.68	493	3510
36.32	566	3676
37.96	571	3601
39.60	511	3795
41.24	507	3676
43.21	511	3476
44.52	484	3695
46.16	476	3510
47.80	450	3093
49.44	476	2732
51.08	468	2775
52.72	454	2843
54.36	454	2553
56.00	457	2413
57.64	468	2649
59.28	501	2421
60.93	540	2310
62.57	544	2250
64.21	555	2141
66.17	511	2421
67.49	514	2877
69.13	524	2854
70.77	534	3120
72.41	551	3528
74.05	559	3191
75.69	559	2938
77.33	544	2620
78.97	516	2988
80.61	498	3493
82.25	491	3442
83.89	496	3528
85.53	489	3392
87.17	551	3392

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
88.81	551	3206
90.45	577	2854
92.09	530	2630
93.73	514	2581
95.37	481	3000
97.01	484	3191
98.65	501	3476
100.30	501	3638
101.94	514	3989
103.58	514	3281
105.22	514	2499
106.86	511	2115
108.50	511	1882
110.14	503	1704
111.78	512	1791
113.42	511	2053
115.06	528	2404
116.70	555	2630
118.34	559	2732
119.98	559	2553
121.62	540	2429
123.26	545	2820
124.90	559	3221
126.54	603	3922
128.18	635	4979
129.82	650	5051
131.46	678	5088
133.10	711	4997
134.74	726	5051
136.38	738	5182
138.02	748	5259
139.67	751	5464
141.31	839	5708
142.95	963	5779
144.59	1002	6412
146.23	1002	6441
147.87	1019	6354
149.51	1019	6297
151.15	1075	6325
152.79	1164	6501
154.43	1238	6441
156.07	1327	6531
157.71	1238	6592
159.35	1227	6624
160.99	1210	6525
162.63	1236	6525
164.27	1284	6235
165.91	1318	6258
167.55	1369	6291
169.19	1342	6202

Depth (feet)	V_s (feet/sec)	V_p (feet/sec)
170.83	1327	6137
172.47	1460	6325
174.11	1478	6465
175.75	1513	6549
177.40	1540	6586
179.04	1596	6699
180.68	1618	6725
182.32	1664	6870
183.96	1656	6751
185.60	1640	6777
187.24	1603	6549
188.88	1588	6325
190.52	1513	5880
192.16	1484	5608
193.80	1454	5255
195.44	1442	5132
197.08	1472	5224
198.72	1500	5224
200.36	1629	5608

Table A-4. Boring TH-31-SW-08, S - R1 quality assurance analysis P- and S_H-wave data

APPENDIX B

BORING GEOPHYSICAL LOGGING SYSTEMS - NIST TRACEABLE CALIBRATION PROCEDURES AND CALIBRATION RECORDS

EDISON ESI

A SOUTHERN CALIFORNIA EDISON Company

Metrology
7300 Fenwick Lane
Westminster, CA 92683
Phone: 866-723-2257

Calibration Report

NVLAP Accredited Calibration

GEOVision Geophysical Services
1151 Pomona Road, Unit P
Corona, CA 92882

TEST NUMBER
550391

NVLAP
Lab Code:105014-0

Manufacturer: Oyo
Model Number: 03331-0000
Description: Seismograph,
Asset Number: 15014
Serial Number: 15014
PO Number: 8200-080122-01

Condition As Found: In Tolerance
Condition As Left: In Tolerance
Calibration Date: 01/25/2008
Calibration Due Date: 01/25/2009
Calibration Interval: 12 Months

Remarks:

The UUT (unit under test) was calibrated using the customer's procedure. The UUT was operated by the customer's personnel and data collection was observed by SCE personnel. The UUT was found to be in tolerance to customer supplied specifications. The reference standards used are in compliance with ISO/IEC 17025:1999 and laboratory accreditation criteria established by NIST/NVLAP under the specific scope of accreditation for lab code 105014-0. Frequency is accredited. Measurement uncertainity is 0.2 x E-12 Hz. Please see attached data.

Standards Utilized

I.D. No.	Mfg.	Model No.	Description	Cal. Date	Due Date
S1-01252	Hewlett Packard	5335A OPT 010,203040	Counter, Universal,	12/28/2007	06/28/2008
S1-01347	Hewlett Packard	3325A	Generator, Function, Synthesizer	10/09/2007	04/09/2008
S1-03686	Fluke	910	Standard, Frequency, Controlled, Gps	01/22/2008	01/22/2009

Procedure: Customer
Temperature: 23° C
Humidity: 37% RH
Test No.: 550391

Calibration Performed By:			Quality Reviewer:
Branson, Craig A CAB	Metrologist	714-895-0714	1/25/08
Name	Title	Phone	Name / Date

This report may not be reproduced, except in full, without written permission of this laboratory. This report may not be used to claim product endorsement by NVLAP or any agency of the US Government. The results stated in this report relate only to the items tested or calibrated. Measurements reported herein are traceable to SI units via national standards maintained by NIST. This calibration is in compliance with NVLAP laboratory accreditation criteria established by NIST/NVLAP under the specific scope of accreditation for lab code 105014-0.

www.edisonmudcats.com www.edisonmetrology.com

Page 1 of 4

GEOVision
geophysical services

SEISMOGRAPH CALIBRATION DATA SHEET REV 4/6/06

INSTRUMENT DATA

SYSTEM MFR:	OYO	MODEL NO.:	3331
SERIAL NO.:	15014	CALIBRATION DATE:	01/25/2008
BY:	ROBERT STELLER	DUE DATE:	01/25/2009
COUNTER MFR:	HEWLETT PACKARD	MODEL NO.:	5335A
SERIAL NO.:	2626A09881	CALIBRATION DATE:	12/28/2007
BY:	SCE #S1-01252	DUE DATE:	6/28/2008
FCTN GEN MFR:	HEWLETT PACKARD	MODEL NO.:	3325A
SERIAL NO.:	2652A25647	CALIBRATION DATE:	10/9/2007
BY:	SCE #S1-01347	DUE DATE:	4/9/2008

SYSTEM SETTINGS:

GAIN:	10
FILTER:	20 KHZ
RANGE:	100 MILLISEC
DELAY:	0
STACK: 1 (STD)	1
PULSE:	1.6
DISPLAY:	NA
SYSTEM: DATE = CORRECT DATE & TIME	01/25/2008, 10:24AM

PROCEDURE:

SET FREQUENCY TO 100.0HZ SQUAREWAVE WITH AMPLITUDE APPROXIMATELY 0.25 VOLT PEAK. RECORD BOTH ON DISK AND PAPER TAPE, IF AVAILABLE. ANALYZE AND PRINT WAVEFORMS FROM ANALYSIS UTILITY. ATTACH PAPER COPIES OF PRINTOUT AND PAPER TAPES, IF AVAILABLE, TO THIS FORM. AVERAGE FREQUENCY MUST BE BETWEEN 99.0 AND 101.0 HZ.

AS FOUND 100.0 AS LEFT 100.0

WAVEFORM	FILE NO	FREQUENCY	TIME FOR 9 CYCLES Hn	TIME FOR 9 CYCLES Hr	TIME FOR 9 CYCLES V	AVERAGE FREQ.
SQUARE	101	100.0	90.0	90.0	90.0	100.0
SQUARE	102	100.0	90.0	90.0	90.0	100.0
SINE	103	100.0	90.0	90.0	90.1	100.0
SINE	104	100.0	90.0	90.1	90.0	100.0

CALIBRATED BY: ROBERT STELLER 1/25/2008 Robt Stel

NAME DATE SIGNATURE

Page 2 of 4

Seismic recorder/Logger Calibration Data Sheet Rev 1.30 4-6-06

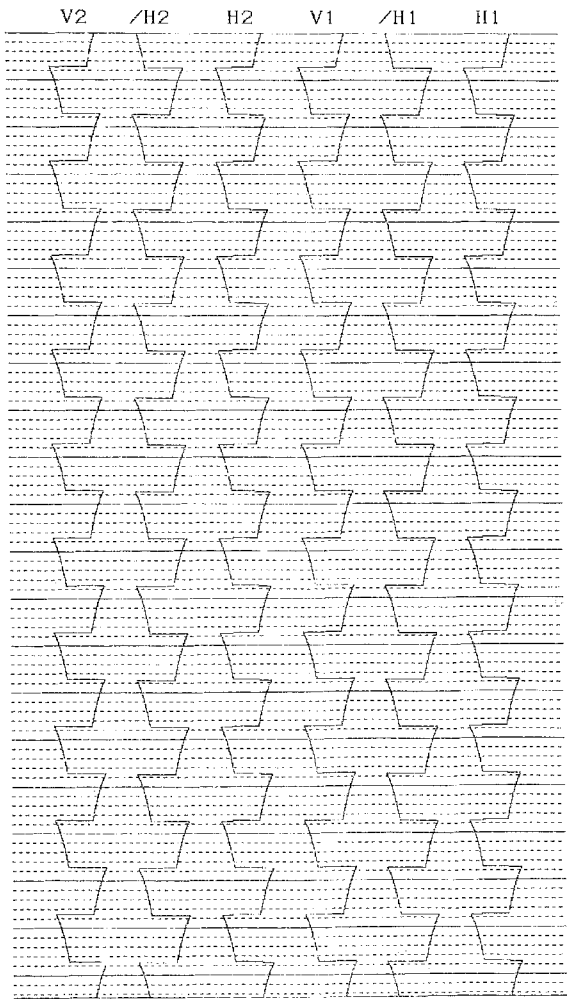
OYO

Suspension 170 1.42 S/N 15014

ID_NO. : 101
HOLE NO. : 0
DEPTH : 0.0 [m]
DATE : 25/01/08 10:30:51 AM
H-SAMPLE RATE: 100 [μSEC]
V-SAMPLE RATE: 100 [μSEC]
PULSE WIDTH : 1.6 [mSEC]
DELAY TIME : 0 [mSEC]

	H1	/H1	V1	H2	/H2	V2
GAIN	X 10	X 10	X 10	X 10	X 10	X 10
LCF[Hz]	5	5	5	5	5	5
HCF[Hz]	20K	20K	20K	20K	20K	20K
STACK	1	1	1	1	1	1

TRACE SIZE : 1
H-TIME SCALE: 1.00 [mSEC/LINE]
V-TIME SCALE: 1.00 [mSEC/LINE]



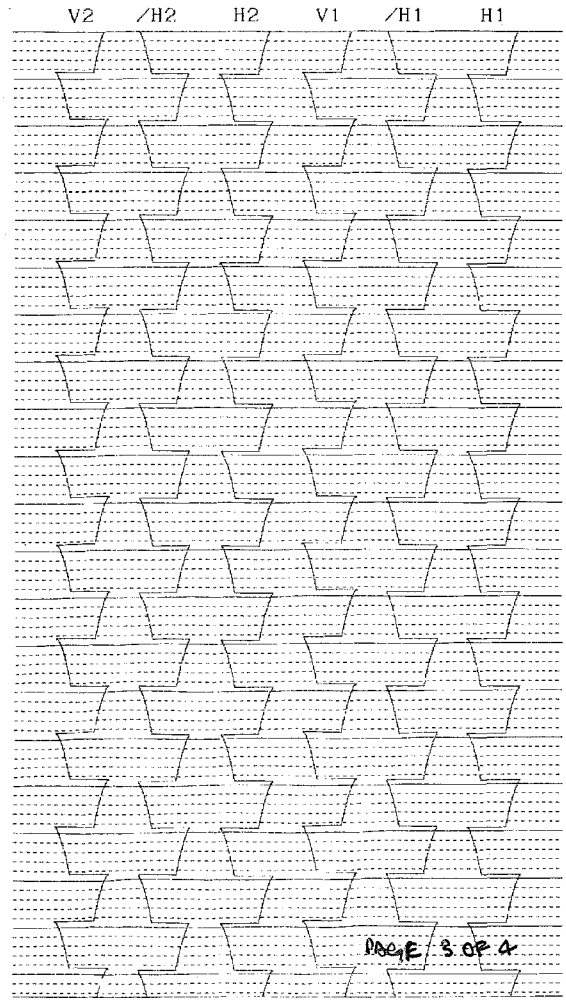
OYO

Suspension 170 1.42 S/N 15014

ID_NO. : 102
HOLE NO. : 0
DEPTH : 0.0 [m]
DATE : 25/01/08 10:31:43 AM
H-SAMPLE RATE: 100 [μSEC]
V-SAMPLE RATE: 100 [μSEC]
PULSE WIDTH : 1.6 [mSEC]
DELAY TIME : 0 [mSEC]

	H1	/H1	V1	H2	/H2	V2
GAIN	X 10	X 10	X 10	X 10	X 10	X 10
LCF[Hz]	5	5	5	5	5	5
HCF[Hz]	20K	20K	20K	20K	20K	20K
STACK	1	1	1	1	1	1

TRACE SIZE : 1
H-TIME SCALE: 1.00 [mSEC/LINE]
V-TIME SCALE: 1.00 [mSEC/LINE]



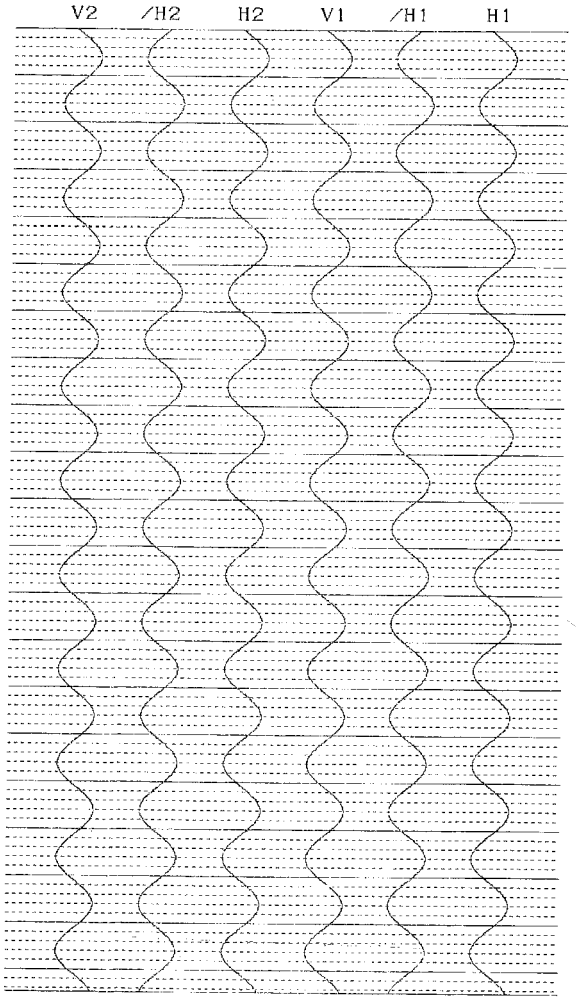
OYO

Suspension 170 1.42 S/N 15014

ID_NO. : 103
HOLE NO. : 0
DEPTH : 0.0 [m]
DATE : 25/01/08 10:32:27 AM
H-SAMPLE RATE: 100 [μSEC]
V-SAMPLE RATE: 100 [μSEC]
PULSE WIDTH : 1.6 [mSEC]
DELAY TIME : 0 [mSEC]

	H1	/H1	V1	H2	/H2	V2
GAIN	X 10	X 10	X 10	X 10	X 10	X 10
LCF [Hz]	5	5	5	5	5	5
HCF [Hz]	20K	20K	20K	20K	20K	20K
STACK	1	1	1	1	1	1

TRACE SIZE : 1
H-TIME SCALE: 1.00 [mSEC/LINE]
V-TIME SCALE: 1.00 [mSEC/LINE]



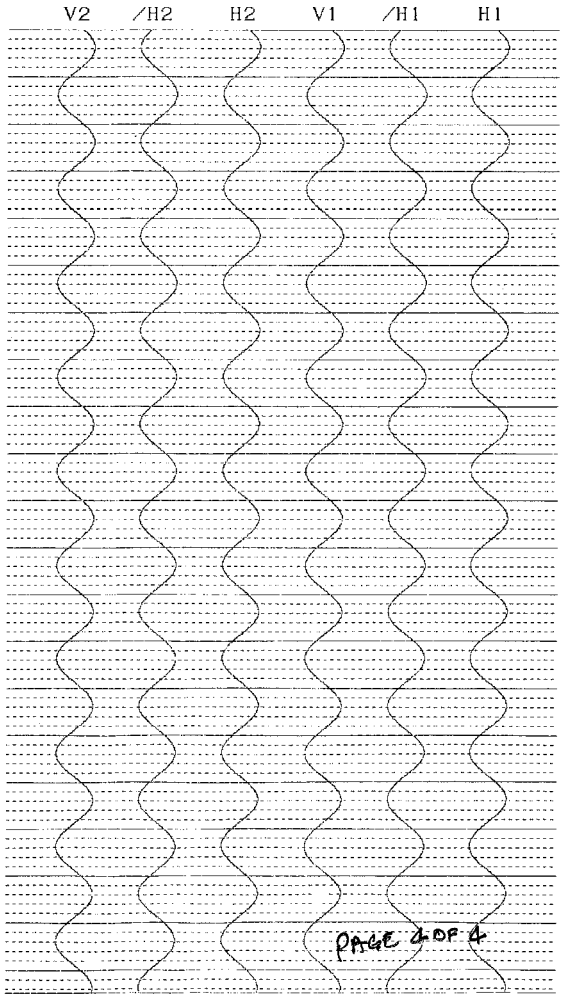
OYO

Suspension 170 1.42 S/N 15014

ID_NO. : 104
HOLE NO. : 0
DEPTH : 0.0 [m]
DATE : 25/01/08 10:33:00 AM
H-SAMPLE RATE: 100 [μSEC]
V-SAMPLE RATE: 100 [μSEC]
PULSE WIDTH : 1.6 [mSEC]
DELAY TIME : 0 [mSEC]

	H1	/H1	V1	H2	/H2	V2
GAIN	X 10	X 10	X 10	X 10	X 10	X 10
LCF [Hz]	5	5	5	5	5	5
HCF [Hz]	20K	20K	20K	20K	20K	20K
STACK	1	1	1	1	1	1

TRACE SIZE : 1
H-TIME SCALE: 1.00 [mSEC/LINE]
V-TIME SCALE: 1.00 [mSEC/LINE]



Vane Shear Tests

TABLE C-1
VANE SHEAR TEST RESULTS
WSDOT PONTOON CONSTRUCTION FACILITY
GRAYS HARBOR, WASHINGTON

Soil Unit	Boring Designation	Sample Depth (ft)	Undrained Shear Strength (tsf)	Corrected Undrained Shear Strength (tsf)	Measured Sensitivity	Sensitivity (range)
Unit 1	B-1	24.5	0.42	0.44	9	Extra sensitive (8-15)
	B-3	24.0	0.25	0.24	8	Sensitive (4-8)
	B-4	24.5	0.41	0.45	10	Extra sensitive (8-15)
	B-11	24.0	0.61	0.53	15	Extra sensitive (8-15)
	B-12	24.0	0.42	0.41	6	Sensitive (4-8)
	B-15	21.5	0.31	0.27	NA [(b)]	NA [(b)]
	B-16	21.5	0.55	0.50	11	Extra sensitive (8-15)
	B-17	24.0	0.80	0.64	14	Extra sensitive (8-15)
Unit 2A	B-17	66.5	0.81	0.90	10	Extra sensitive (8-15)
Unit 2B	B-8	84.0	1.43	1.30	1	No sensitive (0-2)
	B-9	51.5	0.70	0.71	15	Extra sensitive (8-15)
	B-11	86.5	1.80	1.59	1	No sensitive (0-2)
	B-13	61.5	0.84	0.76	NA [(b)]	NA [(b)]
	B-14	41.0	0.57	0.54	12	Extra sensitive (8-15)
Unit 3	B-1 [(a)]	102.5	0.89	0.80	7	Sensitive (4-8)
	B-2	102.5	1.17	0.93	11	Extra sensitive (8-15)
	B-3	104.0	0.45	0.41	7	Sensitive (4-8)
	B-4	96.0	0.86	0.74	105	Quick (> 15)
	B-8	99.0	1.17	1.06	6	Sensitive (4-8)
	B-9	101.5	1.06	1.13	11	Extra sensitive (8-15)
	B-10	106.5	0.75	0.75	12	Extra sensitive (8-15)
	B-12	101.5	0.99	0.78	11	Extra sensitive (8-15)
	B-13	101.5	1.03	1.00	7	Sensitive (4-8)
	B-17	106.5	1.38	1.35	11	Extra sensitive (8-15)

Notes:
(a) One minute remolded test indicated higher undrained shear strength than undisturbed test. One minute remolded undrained shear strength is presented in table.

(b) Bad test - No data from the remolded condition.

FIELD VANE SHEAR TEST REPORT
For use with calibrated drive head

Date 7/19/06

Test Number B-8 (Grays Harbor)	Route SR 520 Grays Harbor Site
Elev. Top of Hole	Sec.
Depth of Test Point (ft.) 89.0' - 85.5'	Line & Sta.
Elev. of Test Point (Tip of Vane)	Offset

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading - _____ lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Reset Gage, Not Reliable

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes)		Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	51	5°	2.3	5°	55	5°	50	5°	
10°	80	10°		10° 7°	70 @14	10° 7°	64	10°	
15°	92	15°		15°		15°		15°	
20°		20°		20°		20°		20°	
25°		25°		25°		25°		25°	
30°		30°		30°		30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			
B Maximum Force Gage Reading for Shaft (lbs.)			%
Net Force (lbs.) (A-B)			Half Unconfined Compressive Strength
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician _____

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

FIELD VANE SHEAR TEST REPORT
For use with calibrated drive head

Date 7/19/06

Test Number B-8	Route SR 520
Elev. Top of Hole	Sec.
Depth of Test Point (ft.) 99'-100.5'	Line & Sta.
Elev. of Test Point (Tip of Vane)	Offset

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-3/8"	0.905

Max. Dial Reading - _____ lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.)

Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes)		Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	50	5° 2	6	5° 2½	12	5° 2½	9	5°	
10°	75	10°		10°		10°		10°	
15°		15°		15°		15°		15°	
20°		20°		20°		20°		20°	
25°		25°		25°		25°		25°	
30°		30°		30°		30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			%
B Maximum Force Gage Reading for Shaft (lbs.)			Half Unconfined Compressive Strength
Net Force (lbs.) (A-B)			
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician _____

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

FIELD VANE SHEAR TEST REPORT

For use with calibrated drive head

Date 7/14/06

Test Number	B-9 S-10	Route	Grays Harbor
Elev. Top of Hole		Sec.	V
Depth of Test Point (ft.)	51.5-53 feet	Line & Sta.	
Elev. of Test Point (Tip of Vane)		Offset	

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading = _____ lbs.

Torque = Applied Torque Arm Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.)

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes)		Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	41	~~5~~ 1°	2	~~5~~ 0.5°	3	~~5~~ 0.5°	3	5°	
~~10~~ 2.5°	45	10°		10°		10°		10°	
15°		15°		15°		15°		15°	
20°		20°		20°		20°		20°	
25°		25°		25°		25°		25°	
30°		30°		30°		30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			
B Maximum Force Gage Reading for Shaft (lbs.)			
Net Force (lbs.) (A-B)			Half Unconfined Compressive Strength
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician Vinny

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

FIELD VANE SHEAR TEST REPORT

For use with calibrated drive head

Date 7/18/06

Test Number	B-9	Route	Grays Harbor
Elev. Top of Hole		Sec.	
Depth of Test Point (ft.)	101.5 - 103.0 ft.	Line & Sta.	
Elev. of Test Point (Tip of Vane)		Offset	

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading - 68 lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes)		Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	42	~~5~~ 1.5	3	~~5~~ 2°	6	~~5~~ 1.5°	4	5°	
10°	67	10°		10°		10°		10°	
~~5~~ 11°	68	15°		15°		15°		15°	
20°		20°		20°		20°		20°	
25°		25°		25°		25°		25°	
30°		30°		30°		30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			
B Maximum Force Gage Reading for Shaft (lbs.)			%
Net Force (lbs.) (A-B)			Half Unconfined Compressive Strength
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician Vinny/Brian

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

Crank Rate = 1 turn in 5 sec.

FIELD VANE SHEAR TEST REPORT

For use with calibrated drive head

Date 7/6/06

Test Number B-10 Grays Harbor-	Route Special Projects Construction Facility
Elev. Top of Hole	Sec.
Depth of Test Point (ft.) 106.5-108 feet	Line & Sta.
Elev. of Test Point (Tip of Vane)	Offset

1100

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading = _____ lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

0.5
6.5
3.5
3.5

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.)

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute) 1108		Remolded Condition (5 Minutes) 1103		Remolded Condition (10 Minutes) 1123		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	1.5	5° 2.5	4 Failed	5° 2.5	8 Failed	5° 2.5	7	5°	
10°	1.5	10°		10°		10°		10°	
15°	1.5	15°		15°		15°		15°	
20°	1.5	20°		20°		20°		20°	
25°	6	25°		25°		25°		25°	
30°	29	30°		30°		30°		30°	
35°	45	35°		35°		35°		35°	
40°	66	40°		40°		40°		40°	
45°	79	45°		45°		45°		45°	
50°	90	50°		50°		50°		50°	
55°	92	Failed							

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			% Half Unconfined Compressive Strength
B Maximum Force Gage Reading for Shaft (lbs.)			
Net Force (lbs.) (A-B)			
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) / *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician _____

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

FIELD VANE SHEAR TEST REPORT
For use with calibrated drive head

Date 7/13/06

Test Number B-11	Route
Elev. Top of Hole	Sec.
Depth of Test Point (ft.) ~~21.5~~ ~~23.5~~ 24	Line & Sta.
Elev. of Test Point (Tip of Vane)	Offset

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8	0.905

Max. Dial Reading - _____ lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes) 4 @ 7 TURNS		Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	58	5°	2	5°	3	5°	5	5°	
10°	75	10°	2	10°	2	10°	4	10°	
15°	67	15°		15°	1	15°	3	15°	
20°	60	20°		20°		20°		20°	
25°	~~60~~ 55	25°		25°		25°		25°	
30°	50	30°		30°		30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed - 4 max Condition @ 7 turns	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			
B Maximum Force Gage Reading for Shaft (lbs.)			%
Net Force (lbs.) (A-B)			Half Unconfined Compressive Strength
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician SSB

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

Checked _____

FIELD VANE SHEAR TEST REPORT

For use with calibrated drive head

Date 7/24

Test Number B-11	Route
Elev. Top of Hole 86.5	Sec.
Depth of Test Point (ft.)	Line & Sta.
Elev. of Test Point (Tip of Vane)	Offset

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading - _____ lbs.

Applied Torque Arm x Net Max. Dial
Torque = Length (in.) Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition 225 118 MAX @ 5 REV		Remolded Condition (1 Minute) BAD TEST		Remolded Condition (5 Minutes)		Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	54	5°	0	5°	57	5°	57	5°	
10°	84	10°	0	10°	78	10°	71	10°	
15°	103	15°	TOO MUCH	15°	78	15°	72	15°	
20°	116	20°		20°	78	20°	72	20°	
25°	112	25°		25°		25°	70	25°	
30°		30°	TORQUE	30°		30°	70	30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			%
B Maximum Force Gage Reading for Shaft (lbs.)			Half Unconfined Compressive Strength
Net Force (lbs.) (A-B)			
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity=_____= Shear Strength (Remolded)			lbs./Sq. Ft.

Technician JJB

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

FIELD VANE SHEAR TEST REPORT
For use with calibrated drive head

Date 7/12/00

Test Number	B-12	Route	Gray Harbor
Elev. Top of Hole		Sec.	
Depth of Test Point (ft.)	24 feet	Line & Sta.	
Elev. of Test Point (Tip of Vane)	25.5 feet	Offset	

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading - 51 lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes)		Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	47	~~5°~~ 2°	6	~~5°~~ 2°	7	~~5°~~ 2°	8	5°	
~~10°~~ 7°	51	10°		10°		10°		10°	
15°		15°		15°		15°		15°	
20°		20°		20°		20°		20°	
25°		25°		25°		25°		25°	
30°		30°		30°		30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			% Half Unconfined Compressive Strength
B Maximum Force Gage Reading for Shaft (lbs.)			
Net Force (lbs.) (A-B)			
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician Vinny

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

4.5
9.7
101.5

FIELD VANE SHEAR TEST REPORT

For use with calibrated drive head

Date 2/12/06

Test Number	B-125-28	Route	Grays Harbor
Elev. Top of Hole		Sec.	
Depth of Test Point (ft.)	101.5	Line & Sta.	
Elev. of Test Point (Tip of Vane)	103.0	Offset	

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading - _____ lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes)		Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
0 5°	48	~~5~~ 2.5°	3	2° ~~5°~~	6	~~5~~ 1.5°	5	5°	
10.5 10.5°	64	10°		10°		10°		10°	
15°		15°		15°		15°		15°	
20°		20°		20°		20°		20°	
25°		25°		25°		25°		25°	
30°		30°		30°		30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			% Half Unconfined Compressive Strength
B Maximum Force Gage Reading for Shaft (lbs.)			
Net Force (lbs.) (A-B)			
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician Anty

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

FIELD VANE SHEAR TEST REPORT
For use with calibrated drive head

Date 7/11/06

Test Number B13 - GRAYS HARBOR	Route
Elev. Top of Hole ~~19.0~~	Sec.
Depth of Test Point (ft.) 19.0	Line & Sta.
Elev. of Test Point (Tip of Vane)	Offset

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading - _____ lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes)		Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	0	5°	0	5°		5°		5°	
10°	0	10°	0	10°		10°		10°	
15°	0	15°	0	15°		15°		15°	
20°	0	20°	0	20°		20°		20°	
25°	0	25°	0	25°		25°		25°	
30°	0	30°		30°		30°		30°	
35°	0	35°		35°		35°		35°	
40°	0	40°		40°		40°		40°	
45°	0	45°		45°		45°		45°	
50°	0	50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			% Half Unconfined Compressive Strength
B Maximum Force Gage Reading for Shaft (lbs.)			
Net Force (lbs.) (A-B)			
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity=_____= Shear Strength (Remolded)			lbs./Sq. Ft.

Technician _____

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

FIELD VANE SHEAR TEST REPORT

For use with calibrated drive head

Date _____

Test Number B-13	Route
Elev. Top of Hole	Sec.
Depth of Test Point (ft.) 61.5	Line & Sta.
Elev. of Test Point (Tip of Vane)	Offset

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading - _____ lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes)		Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	11 ~~10~~ 8	5°	0	5°		5°		5°	
10°	45	10°	0	10°		10°		10°	
15°	54	15°		15°		15°		15°	
20°	52.5	20°		20°		20°		20°	
25°	51	25°		25°		25°		25°	
30°	49	30°		30°		30°		30°	
35°	48.5	35°		35°		35°		35°	
40°	48	40°		40°		40°		40°	
45°	47	45°		45°		45°		45°	
50°	46	50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			% Half Unconfined Compressive Strength
B Maximum Force Gage Reading for Shaft (lbs.)			
Net Force (lbs.) (A-B)			
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) "Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician _____

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

8:30
9:15
10:45

FIELD VANE SHEAR TEST REPORT

For use with calibrated drive head

Date 7/12

Test Number B-13	Route
Elev. Top of Hole	Sec.
Depth of Test Point (ft.) 101,5	Line & Sta.
Elev. of Test Point (Tip of Vane)	Offset

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading - _____ lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes)		Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	22	5°	4	5°	9	5°	9	5°	
10°	59	10°	4	10°	9	10°	8	10°	
15°	66	15°	4	15°	9	15°	6	15°	
20°	61	20°		20°	8	20°	5	20°	
25°	58	25°		25°	6	25°		25°	
30°	55	30°		30°	5	30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations 8 max	Undisturbed Condition 12 max	Remolded Condition 12 max	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			% Half Unconfined Compressive Strength
B Maximum Force Gage Reading for Shaft (lbs.)			
Net Force (lbs.) (A-B)			
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician _____

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

Date 7/7/06

FIELD VANE SHEAR TEST REPORT

For use with calibrated drive head

Test Number B-14 41 feet	Route WSDOT Gray Harbor
Elev. Top of Hole	Sec.
Depth of Test Point (ft.) 41 feet	Line & Sta.
Elev. of Test Point (Tip of Vane)	Offset

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	~~3-5/8"~~	0.905

Max. Dial Reading = _____ lbs.

Applied Torque = Torque Arm Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.)

2 x .5
3.5 x .5
17

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		10 Remolded Condition (5 Minutes)		1100 Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	35	~~5~~ 2°	3°	~~5~~ 1.5°	3	1.0° ~~5°~~	1	5°	
8.5° ~~10°~~	37 Failed	10°	Failed	10°		10°		10°	
15°		15°		15°		15°		15°	
20°		20°		20°		20°		20°	
25°		25°		25°		25°		25°	
30°		30°		30°		30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			
B Maximum Force Gage Reading for Shaft (lbs.)			%
Net Force (lbs.) (A-B)			Half Unconfined Compressive Strength
Applied Torque (T)=force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician Robby

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

FIELD VANE SHEAR TEST REPORT

For use with calibrated drive head

Date 7/11/06

Test Number	B-15	Route	WSDOT - Grays Harbor
Elev. Top of Hole		Sec.	
Depth of Test Point (ft.)	21.5-23 feet	Line & Sta.	
Elev. of Test Point (Tip of Vane)		Offset	

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading - _____ lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes)		Remolded Condition (10 Minutes)		Friction Vane Shaft.	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	1.5	5°		5°		5°		5°	
10°	1.6	10°		10°		10°		10°	
15°	1.5	15°		15°		15°		15°	
20°	1.5	20°		20°		20°		20°	
25°	1.5	25°		25°		25°		25°	
30°	1.75	30°		30°		30°		30°	
35°	1.75	35°		35°		35°		35°	
40°	1.75	40°		40°		40°		40°	
45°	2.0	45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			% Half Unconfined Compressive Strength
B Maximum Force Gage Reading for Shaft (lbs.)			
Net Force (lbs.) (A-B)			
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician Vinny / Brian

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

FIELD VANE SHEAR TEST REPORT
For use with calibrated drive head

Date 7/19/06

24/4039-320

Test Number B-16	Route Grays Harbor
Elev. Top of Hole	Sec.
Depth of Test Point (ft.) 21.5-23'	Line & Sta.
Elev. of Test Point (Tip of Vane)	Offset

VANE DATA midpoint on arm

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-3/8	0.905

Max. Dial Reading - 68 lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute) 10:09		Remolded Condition (5 Minutes) 10:15		Remolded Condition (10 Minutes) 10:26		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	55	1.5°	3.5	1.5°	6	1.5°	6	5°	
10° 95°	68	10°		10°		10°		10°	
15°		15°		15°		15°		15°	
20°		20°		20°		20°		20°	
25°		25°		25°		25°		25°	
30°		30°		30°		30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			% Half Unconfined Compressive Strength
B Maximum Force Gage Reading for Shaft (lbs.)			
Net Force (lbs.) (A-B)			
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician Vinny / Robert

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

FIELD VANE SHEAR TEST REPORT # 244039.020 Date 7/19/06
For use with calibrated drive head

Test Number	B-17	Route	Grays Harbor
Elev. Top of Hole		Sec.	
Depth of Test Point (ft.)	24-25.5 feet	Line & Sta.	
Elev. of Test Point (Tip of Vane)		Offset	

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading - 98 lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes) 8.54		Remolded Condition (10 Minutes)		Friction Vane Shaft 5.04	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	70	~~1.5~~ 0	4	~~1.5~~ 5	6	~~1~~ 0	7	5°	
10°	98	10°		10°		10°		10°	
15°		15°		15°		15°		15°	
20°		20°		20°		20°		20°	
25°		25°		25°		25°		25°	
30°		30°		30°		30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			
B Maximum Force Gage Reading for Shaft (lbs.)			%
Net Force (lbs.) (A-B)			Half Unconfined Compressive Strength
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician Vinny Robert

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

FIELD VANE SHEAR TEST REPORT

For use with calibrated drive head

Date 7/20/06

Test Number	B-17	Route	Grays Harbor
Elev. Top of Hole		Sec.	
Depth of Test Point (ft.)	66.5'	Line & Sta.	
Elev. of Test Point (Tip of Vane)		Offset	

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading - 52 lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.)

Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes)		Remolded Condition (10 Minutes)		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	47	~~5°~~ 15°	3	~~5°~~ 1°	5	~~5°~~ 1°	4	5°	
~~10°~~ 8°	52	10°		10°		10°		10°	
15°		15°		15°		15°		15°	
20°		20°		20°		20°		20°	
25°		25°		25°		25°		25°	
30°		30°		30°		30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			
B Maximum Force Gage Reading for Shaft (lbs.)			%
Net Force (lbs.) (A-B)			Half Unconfined Compressive Strength
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician _____

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

FIELD VANE SHEAR TEST REPORT
For use with calibrated drive head

Date 7/20/06

244039.000

Test Number	B-17 5-89	Route	Grays Harbor
Elev. Top of Hole		Sec.	
Depth of Test Point (ft.)	106.5 - 108'	Line & Sta.	
Elev. of Test Point (Tip of Vane)		Offset	

VANE DATA

CHECK ONE

Torque Arm Length	Vane Diameter	Vane Constant
6"	2"	5.17
12"	2-1/2"	2.59
18"	3-5/8"	0.905

Max. Dial Reading - 89 lbs.

Applied Torque Arm Torque = Length (in.) x Net Max. Dial Reading (lbs.)

Ultimate Shear Strength (S) = Vane Constant x Applied Torque (T)
(lbs./Sq. Ft.) (in./lbs.) Crank Rate - 1 turn/5 sec.

NOTE: Rate of rotation is to be one turn of the crank every five seconds. Dial reading to be recorded every 5°, as listed below. (10 turns of crank = 5° of rotation)

Undisturbed Condition		Remolded Condition (1 Minute)		Remolded Condition (5 Minutes) 5:19		Remolded Condition (10 Minutes) 5:29:30		Friction Vane Shaft	
Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading	Degree of Rotation	Dial Reading
5°	41	15°	3	20°	6	25°	8	5°	
10°	69	10°		10°		10°		10°	
15°	88	15°		15°		15°		15°	
20° 15.5°	89	20°		20°		20°		20°	
25°		25°		25°		25°		25°	
30°		30°		30°		30°		30°	
35°		35°		35°		35°		35°	
40°		40°		40°		40°		40°	
45°		45°		45°		45°		45°	
50°		50°		50°		50°		50°	

Readings and Calculations	Undisturbed Condition	Remolded Condition	Natural Water Content
A Maximum Force Gage Reading for Vane (lbs.)			% Half Unconfined Compressive Strength
B Maximum Force Gage Reading for Shaft (lbs.)			
Net Force (lbs.) (A-B)			
Applied Torque (T)=Force x Torque Arm (inches-lbs.)			
Ultimate Shear Strength (S)=lbs./Sq.Ft.			
Shear Strength (Undisturbed) *Sensitivity= _____ = Shear Strength (Remolded)			lbs./Sq. Ft.

Technician Vinny/Joe

Checked _____

*Degree of Sensitivity: 2 = Insensitive, 4 = Moderately Sensitive, 8 = Extra Sensitive

Dissipation Tests

TABLE C-2
CPT DISSIPATION TEST RESULTS
WSDOT PONTOON CONSTRUCTION FACILITY
GRAYS HARBOR, WASHINGTON

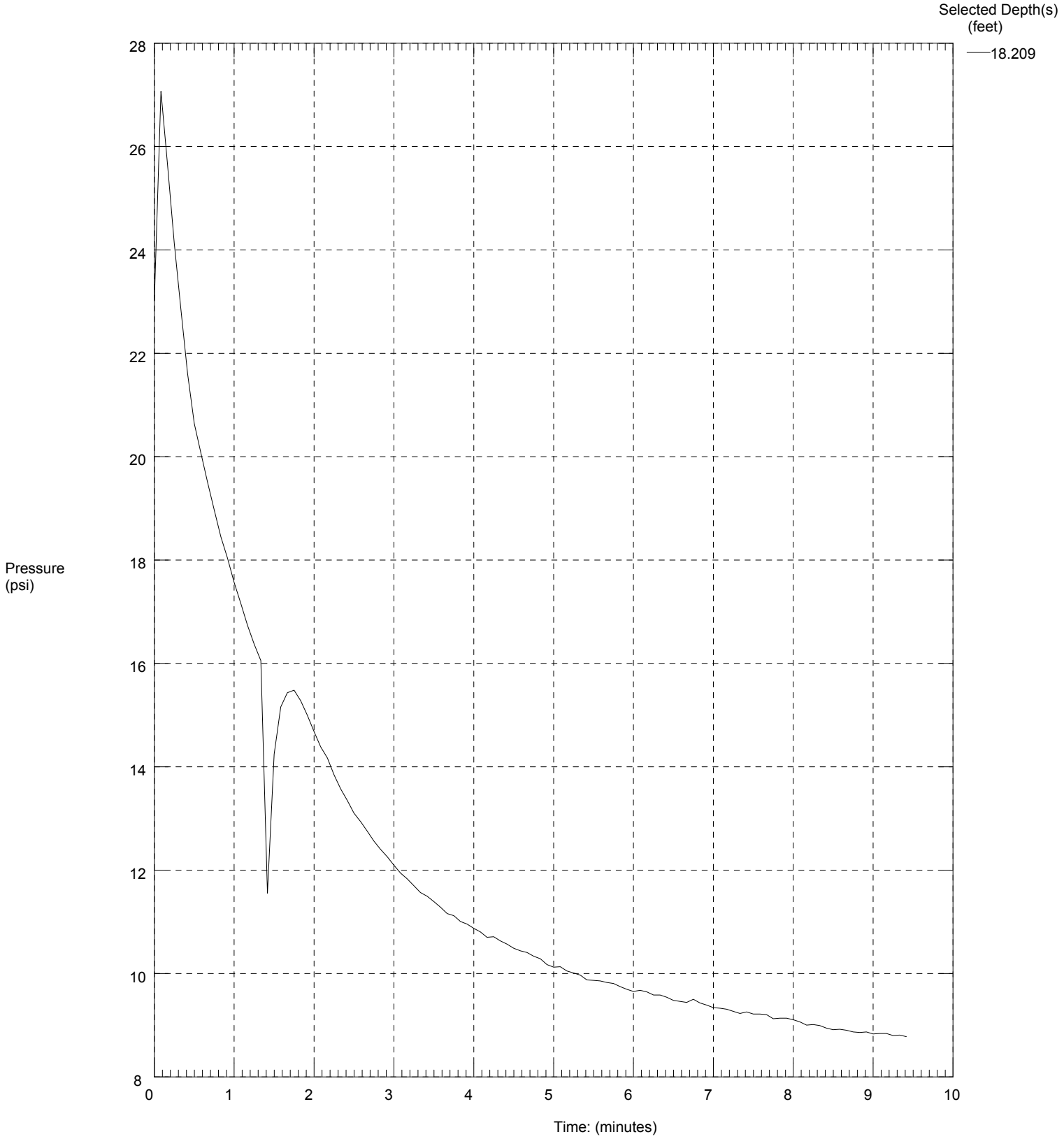
Soil Unit	Sounding Designation	Test Depth (ft)	Horizontal Coefficient of Consolidation (ft^2/day)	Soil Type
Unit 1	CPT-1	18.3	11.9	Sand
	CPT-2	30.2	51.5	Sand
	CPT-2A	21.0	4.6	Silt
	CPT-2C	17.9	11.9	Sand
	CPT-3 [(a)]	7.5	0.8	Silt
	CPT-3	17.2	11.0	Silt
	CPT-3A [(a)]	8.9	0.2	Silt
	CPT-3A	17.2	8.8	Silt
	CPT-4	8.5	1.8	Silt
	CPT-4	18.3	5.2	Silt
	CPT-5 [(a)]	17.2	0.3	Silt
	CPT-6 [(a)]	10.2	0.5	Silt
	CPT-7	10.3	1.2	Silt
	CPT-7	25.8	8.5	Silt
	CPT-8 [(a)]	8.7	0.9	Silt
	CPT-8	18.7	2.1	Silt
	CPT-9	5.7	9.9	Silt
	CPT-9	14.6	3.9	Silt
	CPT-10	12.3	5.3	Silt
	CPT-11	12.0	10.5	Silt
	CPT-12	9.0	7.0	Silt
	CPT-13	15.7	1.7	Silt
	CPT-14	15.3	2.4	Silt
	CPT-15	14.3	4.1	Silt
	CPT-16	15.3	9.2	Silt
	CPT-17	25.1	21.1	Silt
	CPT-18	26.9	2.9	Silt
	CPT-19	16.4	8.2	Silt
	CPT-20	11.5	16.4	Silt
	CPT-21	15.1	6.1	Silt
	CPT-22	15.6	2.1	Silt
	CPT-23	22.0	2.5	Silt
Unit 3	CPT-1	109.0	2.3	Silt
	CPT-2A	89.5	63.4	Sand
	CPT-2B [(a)]	108.0	0.4	Silt
	CPT-3A	111.5	1.4	Silt
	CPT-3A	126.8	3.5	Silt
	CPT-4	117.5	1.5	Silt
	CPT-5	137.4	3.6	Sand
	CPT-6	126.3	1.0	Silt
	CPT-7	106.6	1.5	Silt
	CPT-8	117.3	1.2	Silt
	CPT-10	105.0	2.2	Silt
	CPT-11	106.5	2.5	Silt
	CPT-12	106.3	2.3	Silt
	CPT-13	102.4	1.8	Silt
	CPT-14	110.4	4.3	Silt
	CPT-15	109.1	4.3	Silt
	CPT-17	102.4	1.5	Silt
	CPT-17	109.6	5.4	Silt
	CPT-18	104.0	6.7	Silt
	CPT-19	109.4	2.2	Silt
	CPT-21	103.5	4.8	Silt
	CPT-23	111.2	2.1	Silt

Note:
(a) Horizontal coefficient of consolidation determined from tests reaching 20 percent of consolidation.

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-1
Elevation: 0

CPT Date/Time: 01-21-06 13:19
Location: CPT-1-06
Job Number: XL-2344



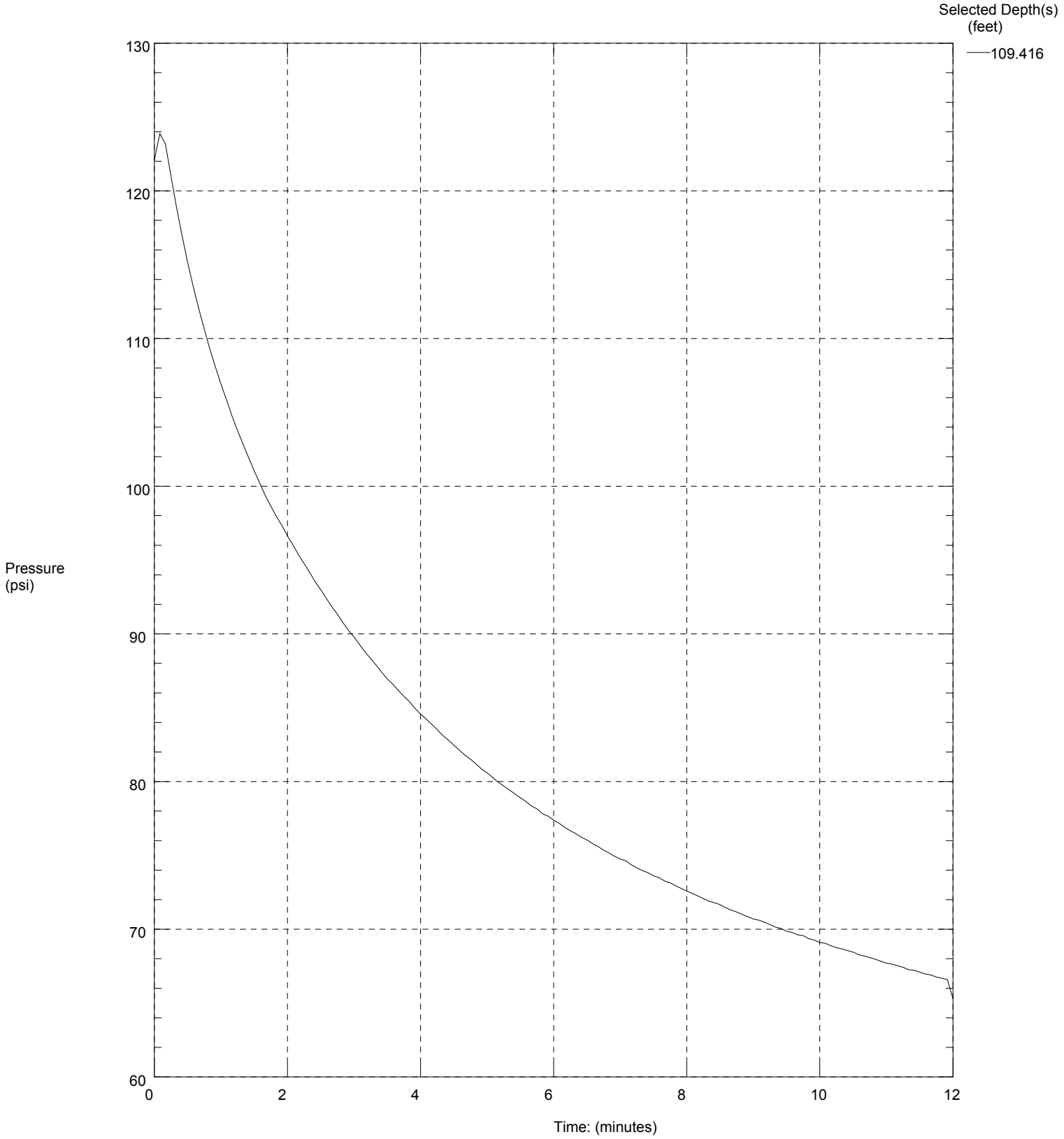
Maximum Pressure = 27.069 psi
Hydrostatic Pressure = 7.903 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-1
Elevation: 0

CPT Date/Time: 01-21-06 13:19
Location: CPT-1-06
Job Number: XL-2344

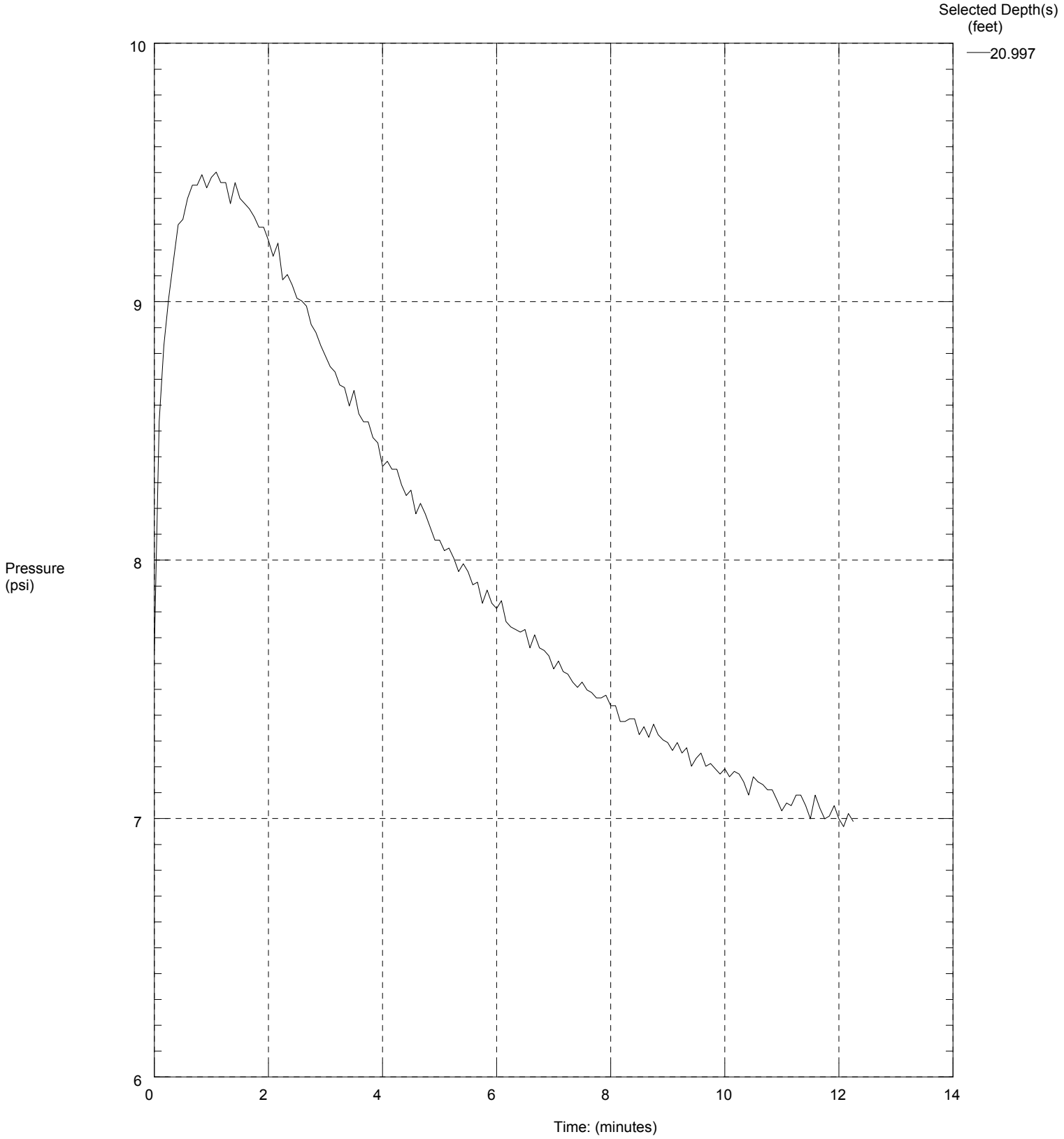


Maximum Pressure = 123.882 psi
Hydrostatic Pressure = 47.487 psi

WSDOT GEOTECH DIVISION

Operator Vince Johnson
Sounding: CPT-2A
Elevation: 0

CPT Date/Time: 01-18-06 09:14
Location: 9.7' W of CPT-2
Job Number: XL-2344



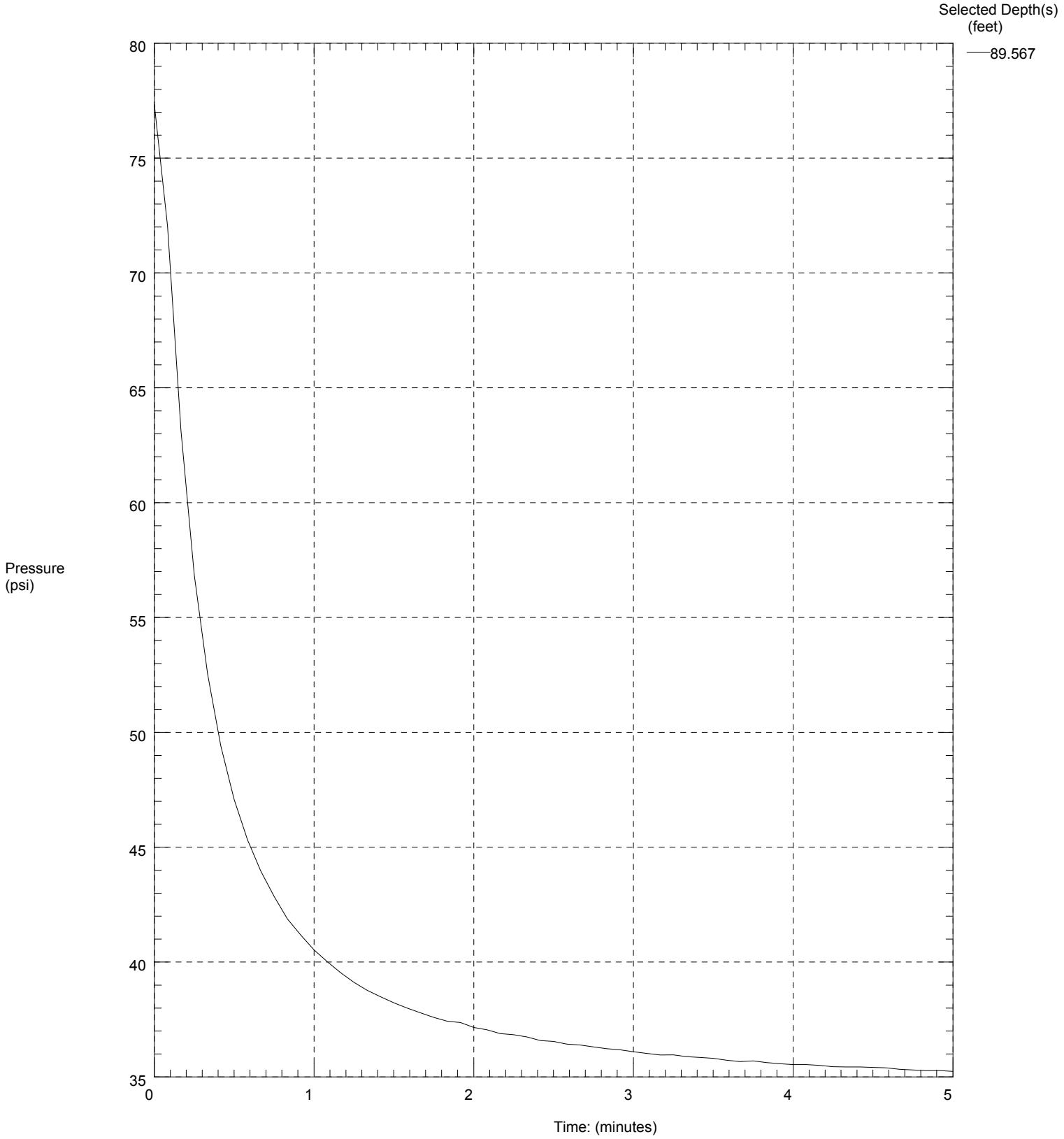
Maximum Pressure = 9.501 psi
Hydrostatic Pressure = 9.113 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Vince Johnson
Sounding: CPT-2A
Elevation: 0

CPT Date/Time: 01-18-06 09:14
Location: 9.7' W of CPT-2
Job Number: XL-2344



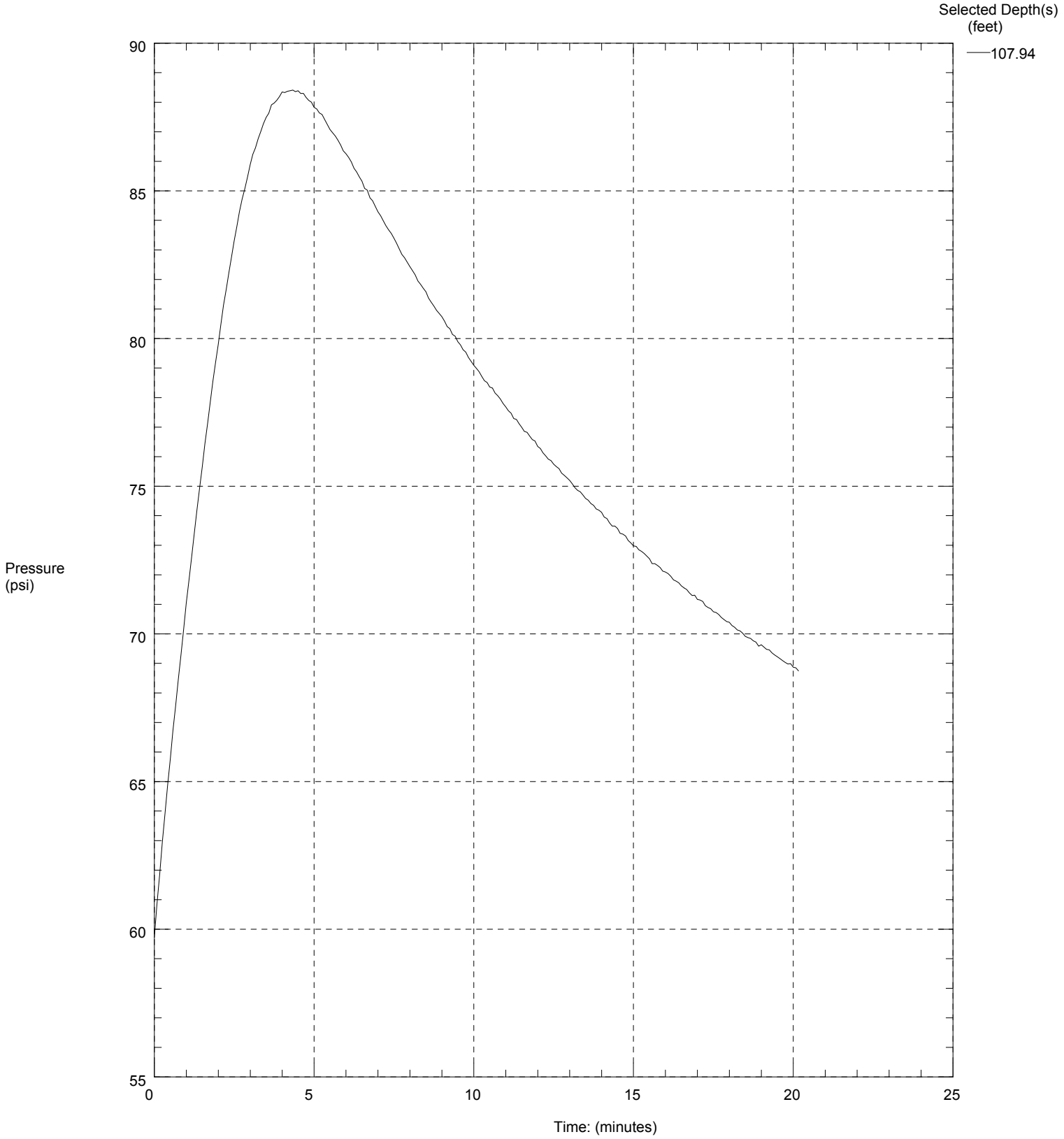
Maximum Pressure = 77.332 psi
Hydrostatic Pressure = 38.872 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Vince Johnson
Sounding: CPT-2B
Elevation: 0

CPT Date/Time: 01-18-06 11:10
Location: 9.7' E of CPT-2
Job Number: XL-2344



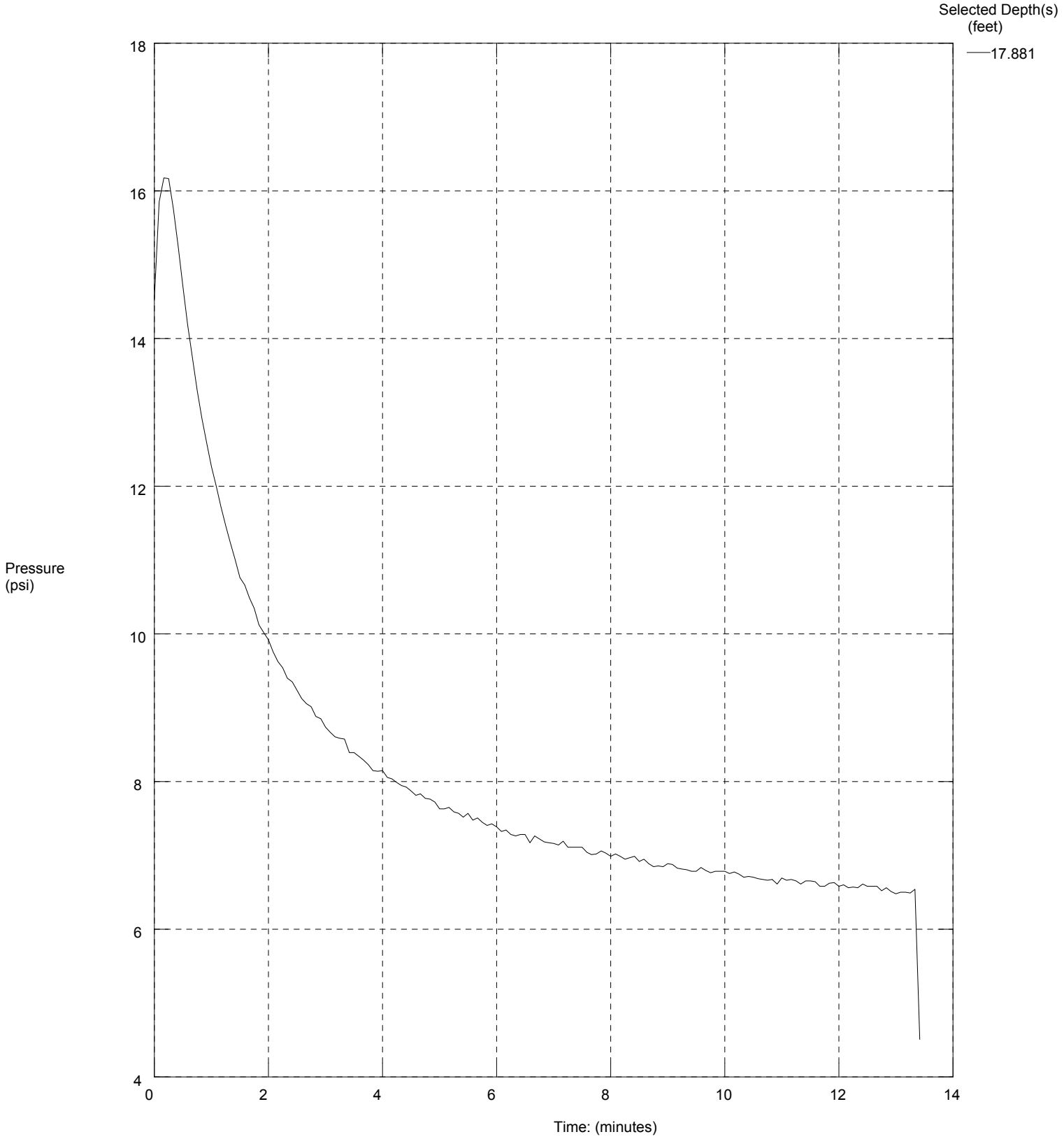
Maximum Pressure = 88.41 psi
Hydrostatic Pressure = 46.846 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Vince Johnson
Sounding: CPT-2C
Elevation: 0

CPT Date/Time: 01-18-06 13:57
Location: 22.8' E of CPT-2
Job Number: XL-2344



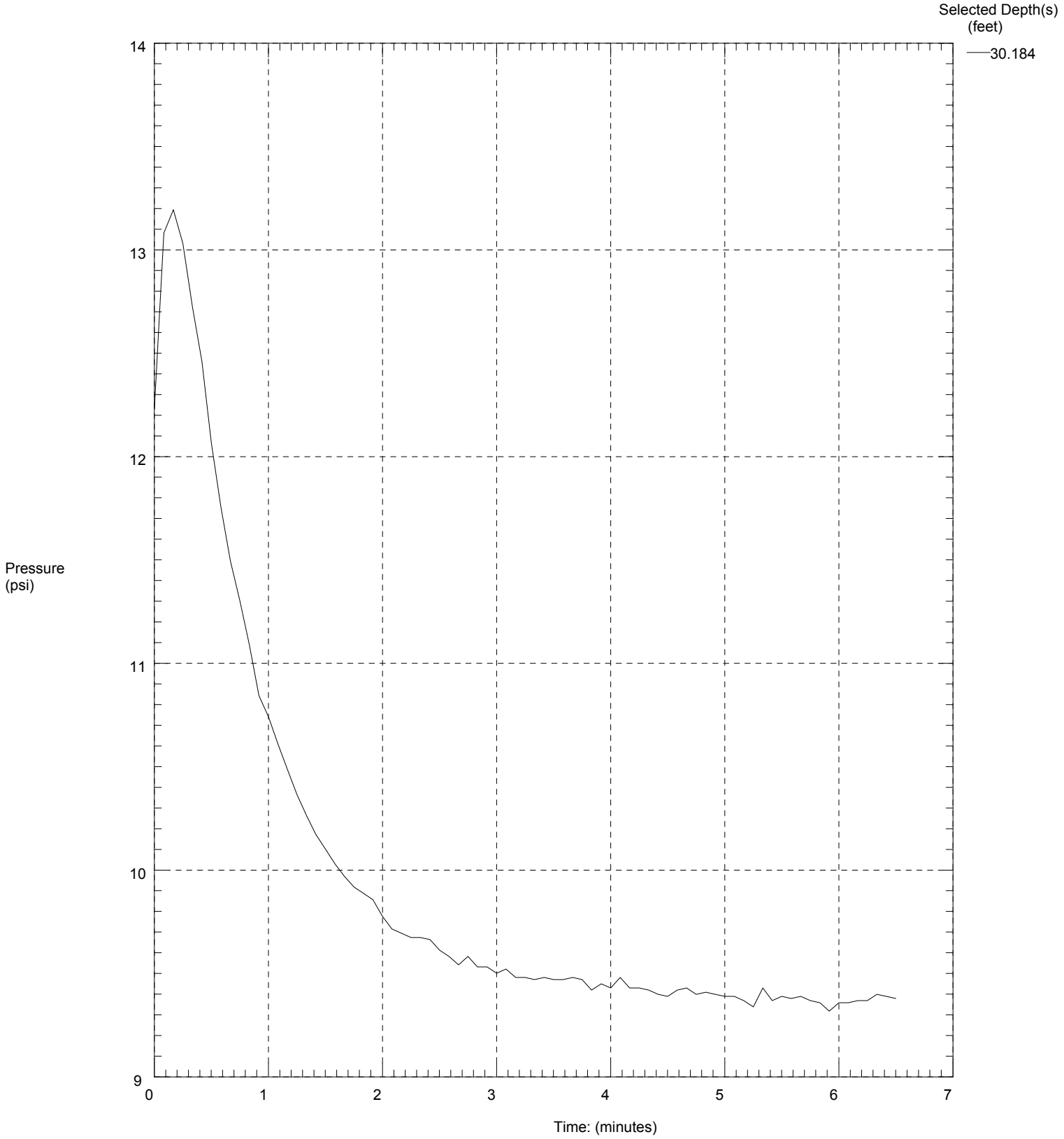
Maximum Pressure = 16.174 psi
Hydrostatic Pressure = 7.76 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Vince Johnson
Sounding: CPT-2
Elevation: 0

CPT Date/Time: 01-18-06 07:51
Location: CPT-2-06
Job Number: XL-2344



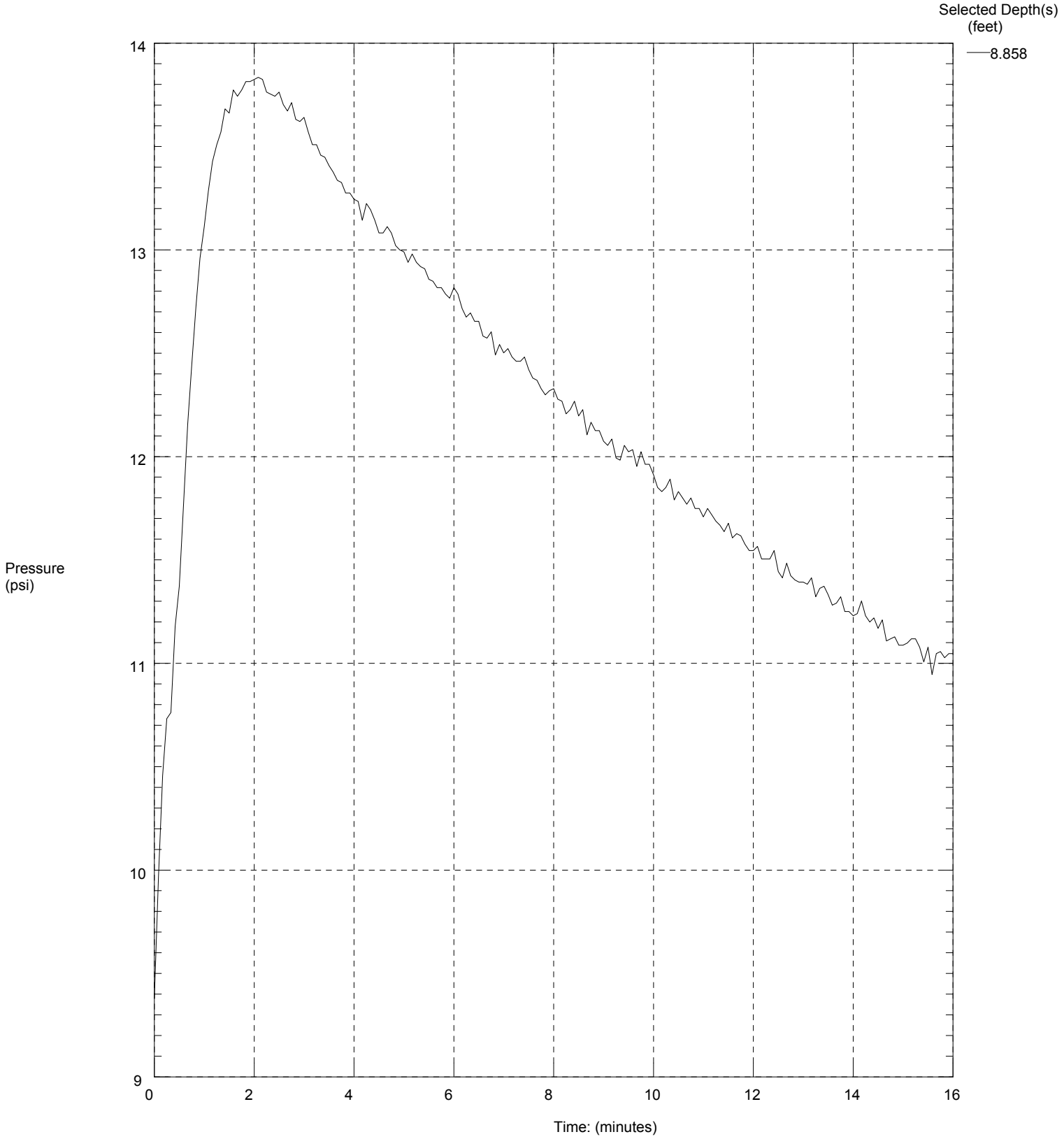
Maximum Pressure = 13.194 psi
Hydrostatic Pressure = 13.1 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-3A
Elevation: 0

CPT Date/Time: 01-19-06 11:40
Location: 9' E of CPT-3
Job Number: XL-2344



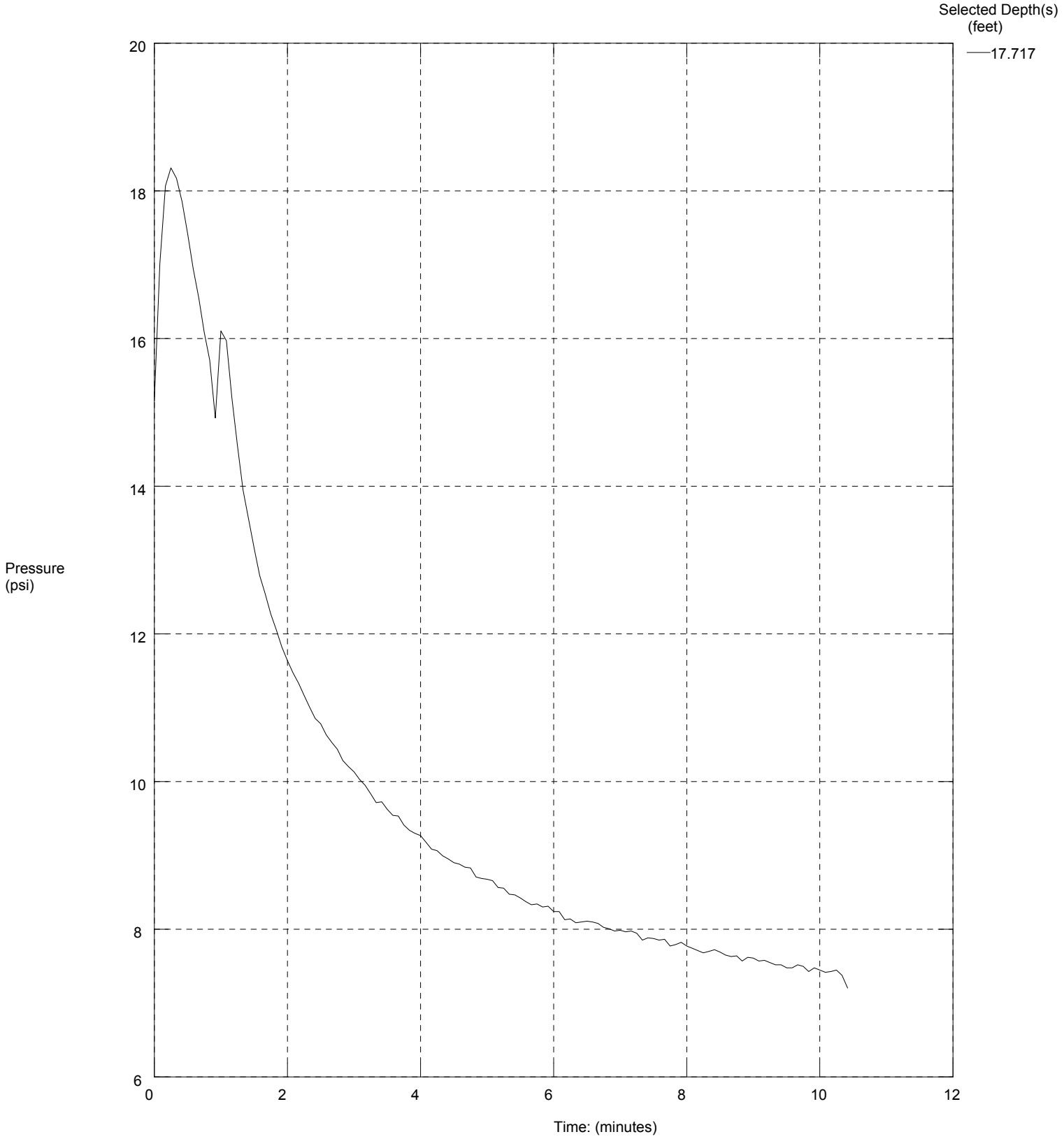
Maximum Pressure = 13.835 psi
Hydrostatic Pressure = 3.844 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-3A
Elevation: 0

CPT Date/Time: 01-19-06 11:40
Location: 9' E of CPT-3
Job Number: XL-2344



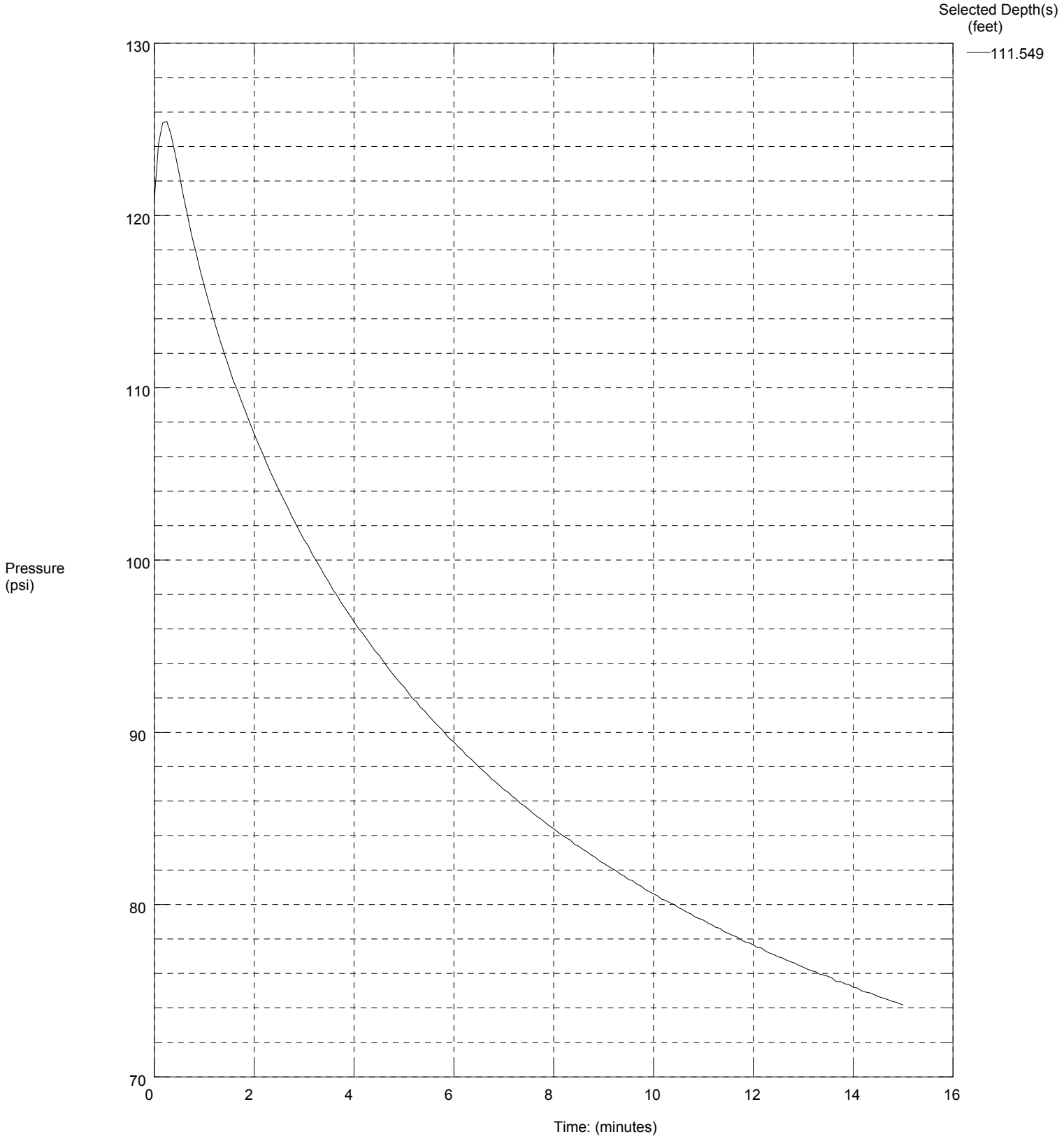
Maximum Pressure = 18.311 psi
Hydrostatic Pressure = 7.689 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-3A
Elevation: 0

CPT Date/Time: 01-19-06 11:40
Location: 9' E of CPT-3
Job Number: XL-2344

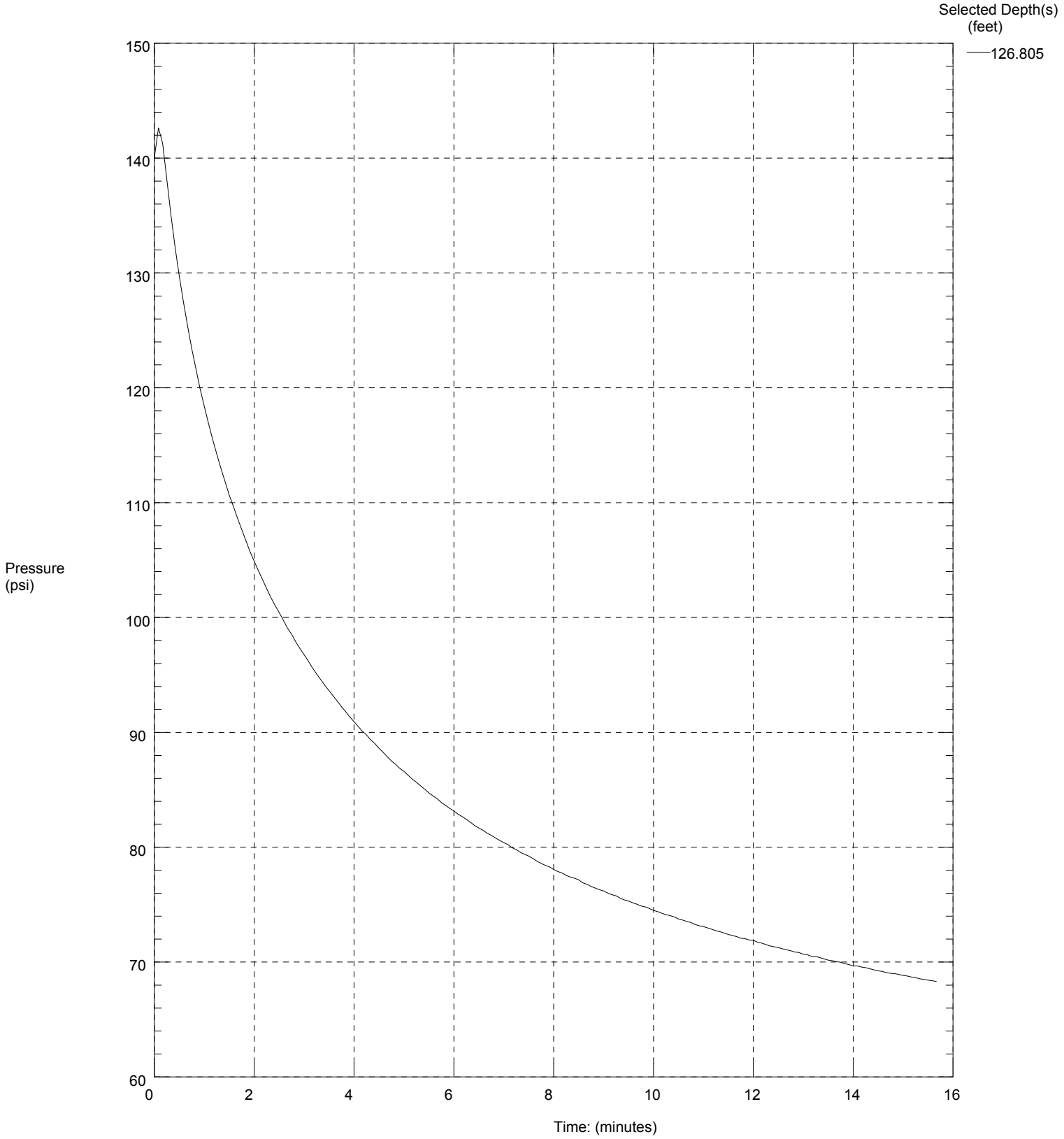


Maximum Pressure = 125.458 psi
Hydrostatic Pressure = 48.412 psi

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-3A
Elevation: 0

CPT Date/Time: 01-19-06 11:40
Location: 9' E of CPT-3
Job Number: XL-2344

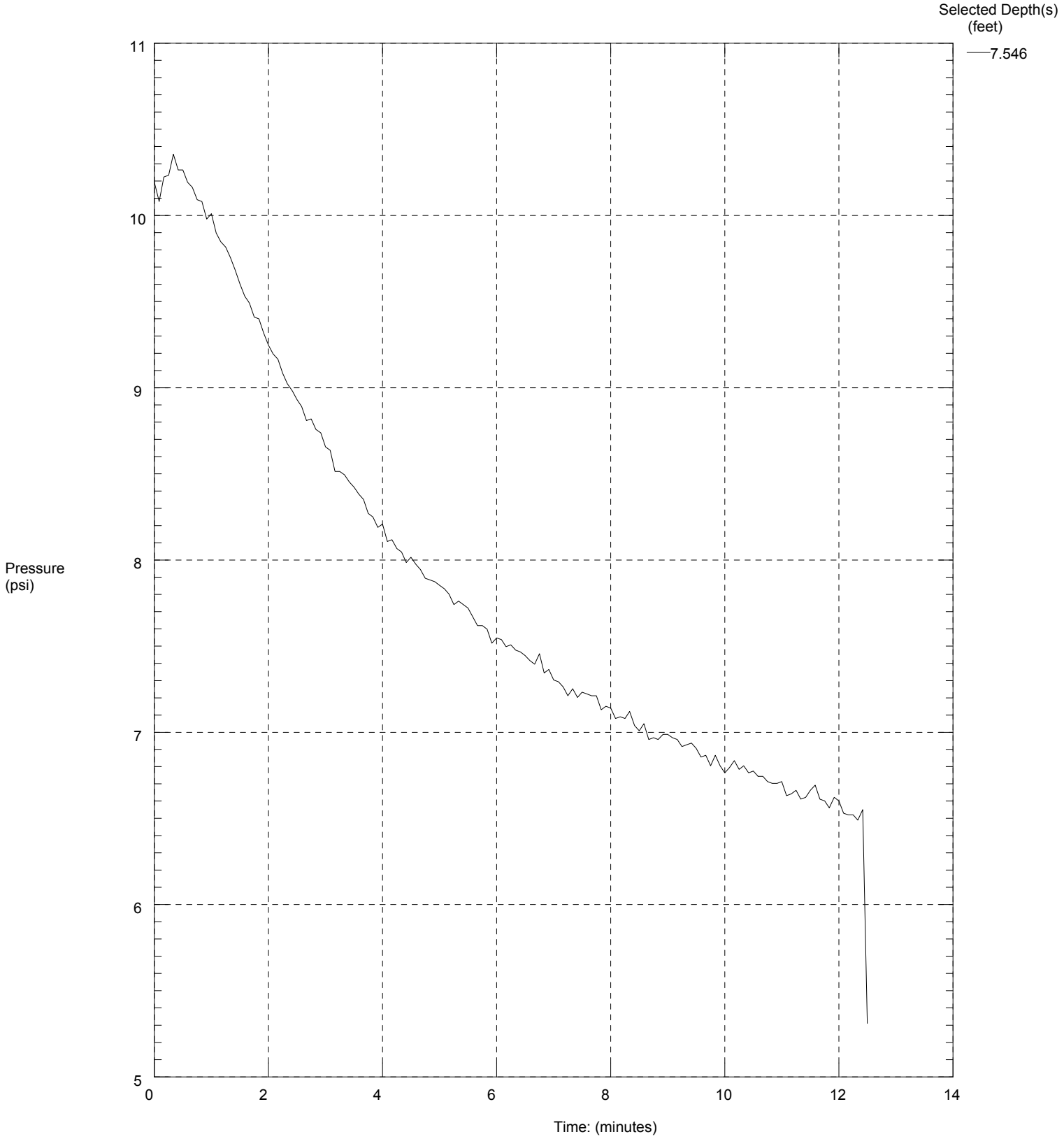


Maximum Pressure = 142.63 psi
Hydrostatic Pressure = 55.033 psi

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-3
Elevation: 0

CPT Date/Time: 01-19-06 08:16
Location: CPT-3-06
Job Number: XL-2344



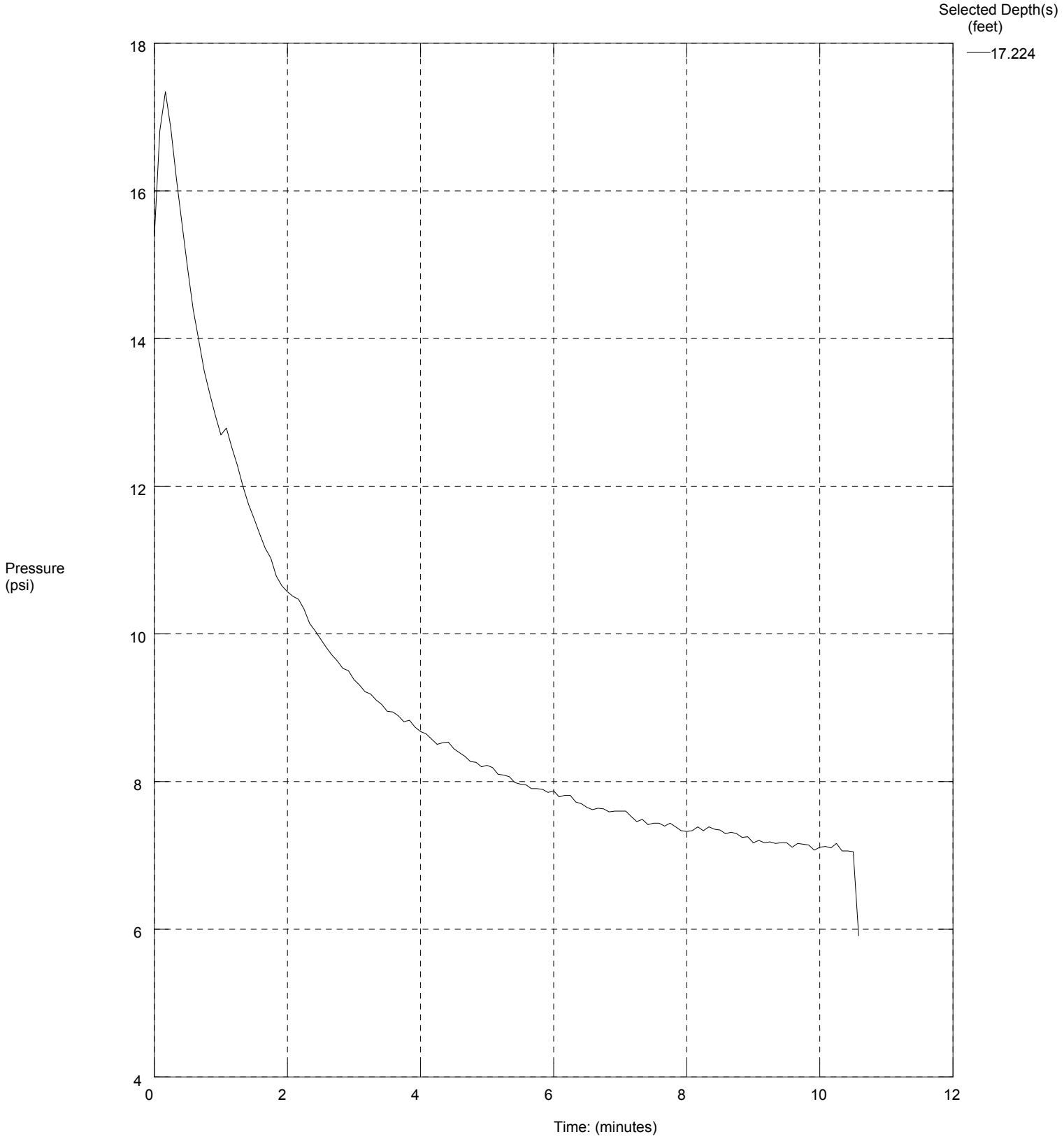
Maximum Pressure = 10.356 psi
Hydrostatic Pressure = 3.275 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-3
Elevation: 0

CPT Date/Time: 01-19-06 08:16
Location: CPT-3-06
Job Number: XL-2344



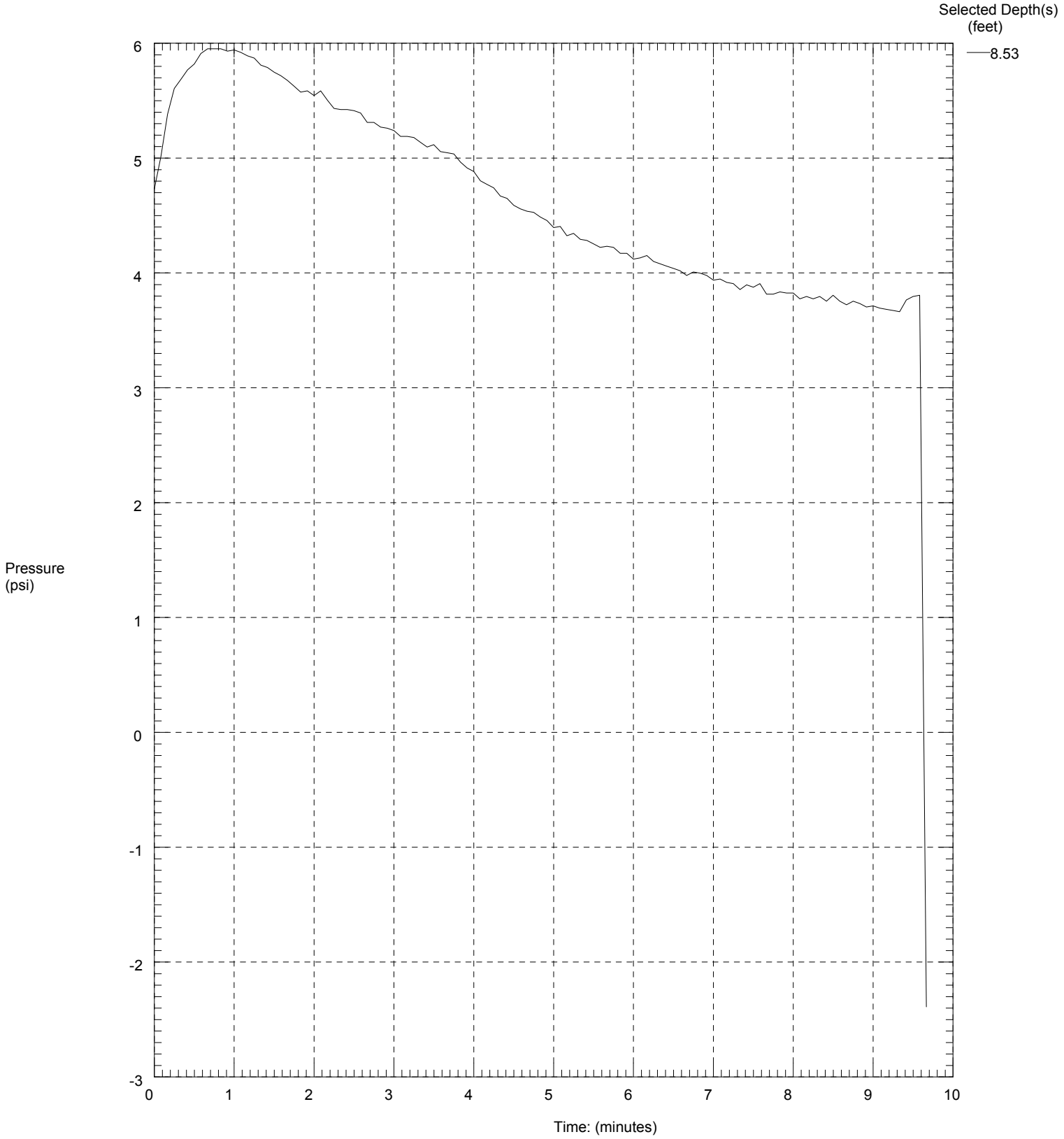
Maximum Pressure = 17.344 psi
Hydrostatic Pressure = 7.475 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-4
Elevation: 0

CPT Date/Time: 01-21-06 09:12
Location: CPT-4-06
Job Number: XL-2344

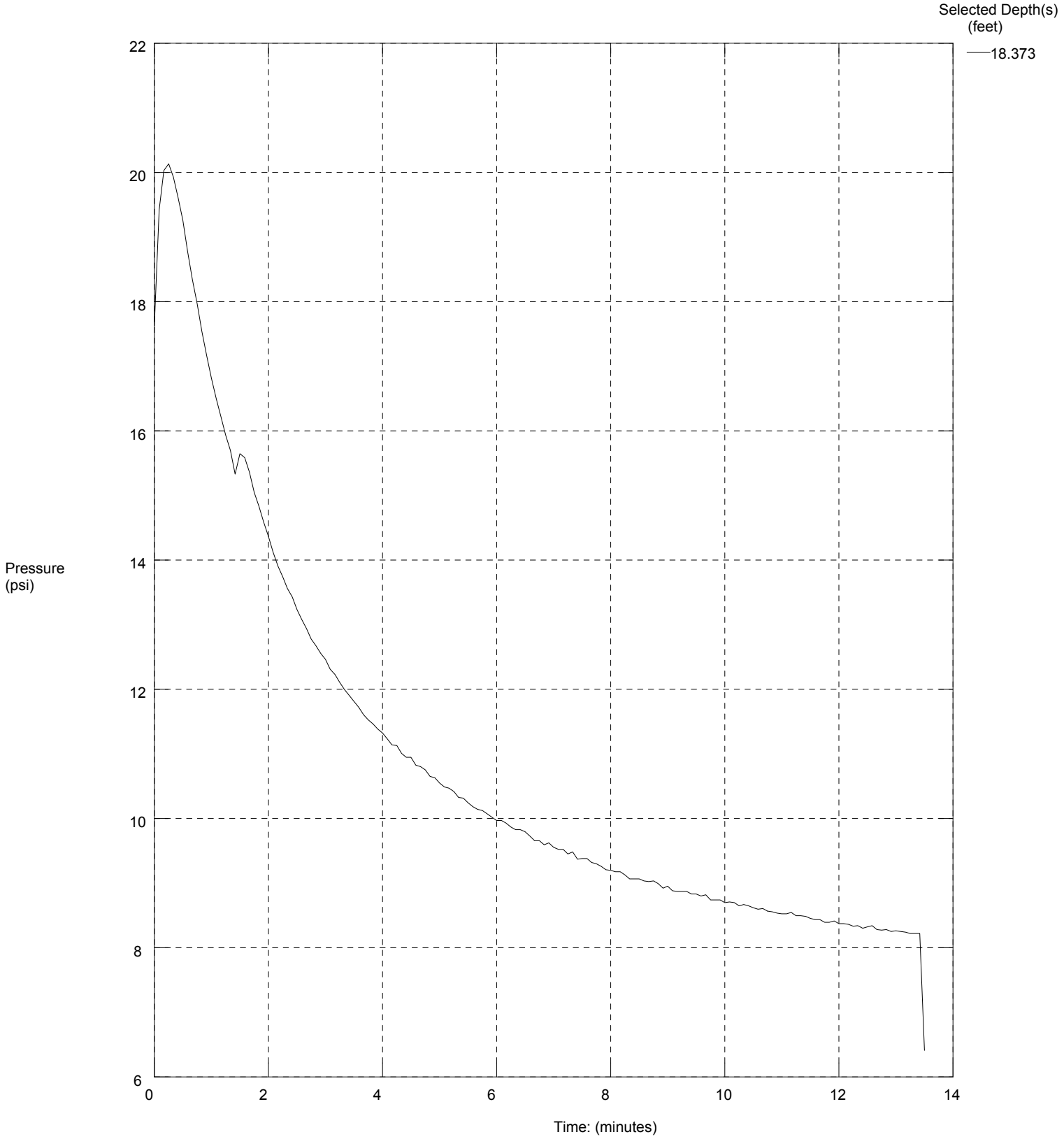


Maximum Pressure = 5.951 psi
Hydrostatic Pressure = 3.702 psi

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-4
Elevation: 0

CPT Date/Time: 01-21-06 09:12
Location: CPT-4-06
Job Number: XL-2344

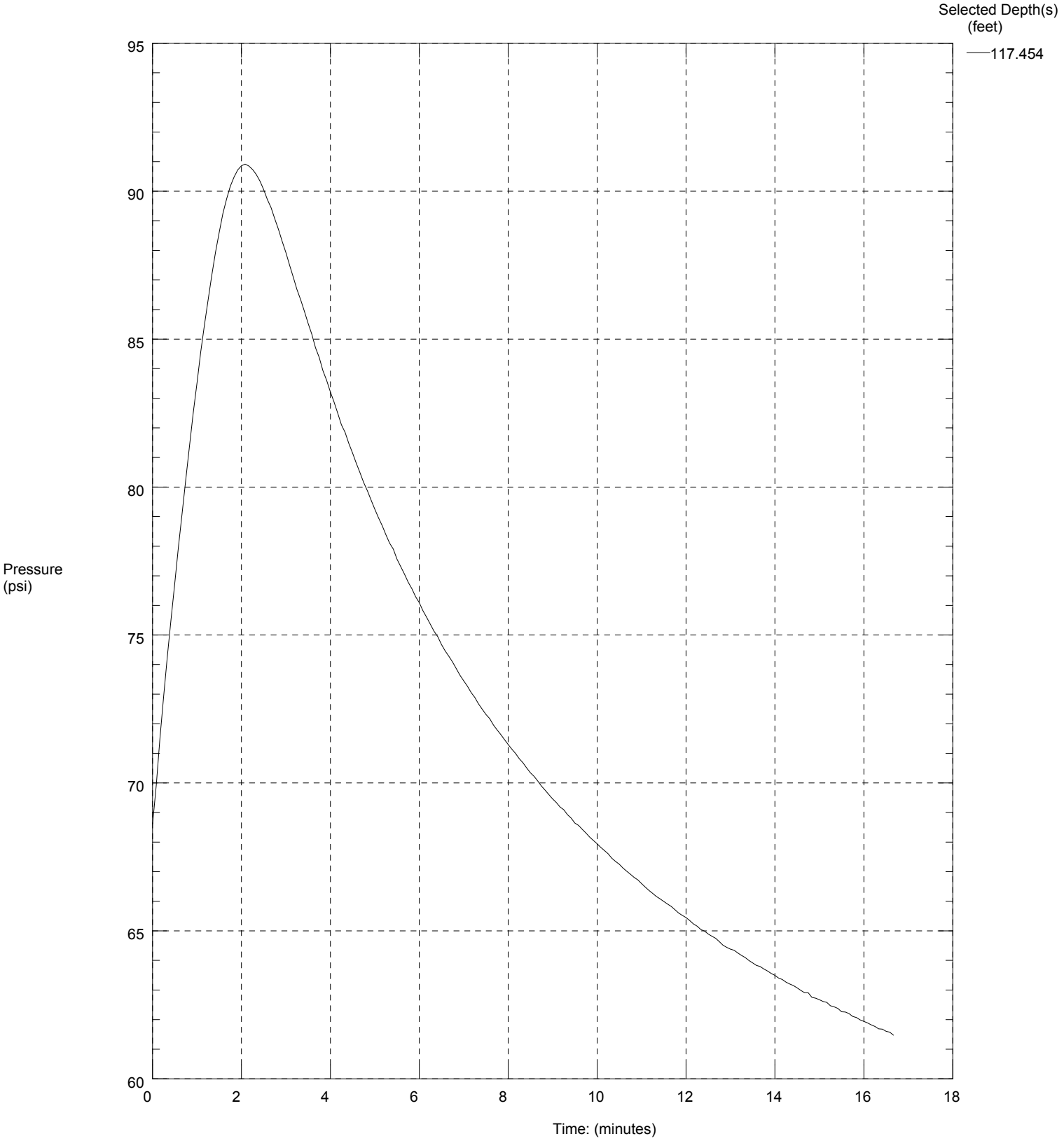


Maximum Pressure = 20.132 psi
Hydrostatic Pressure = 7.974 psi

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-4
Elevation: 0

CPT Date/Time: 01-21-06 09:12
Location: CPT-4-06
Job Number: XL-2344



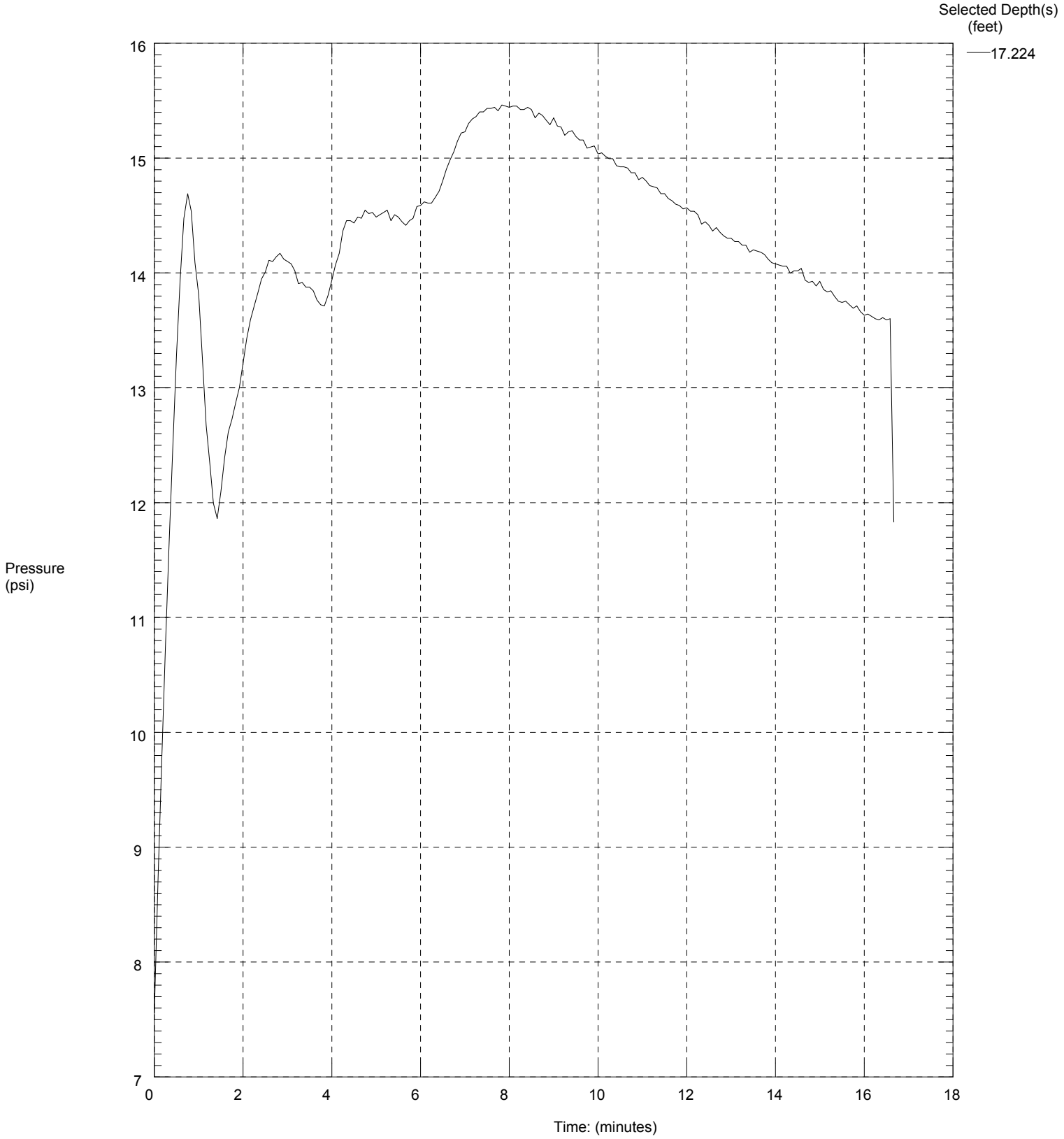
Maximum Pressure = 90.912 psi
Hydrostatic Pressure = 50.975 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-5
Elevation: 0

CPT Date/Time: 01-22-06 09:24
Location: CPT-5-06
Job Number: XL-2344

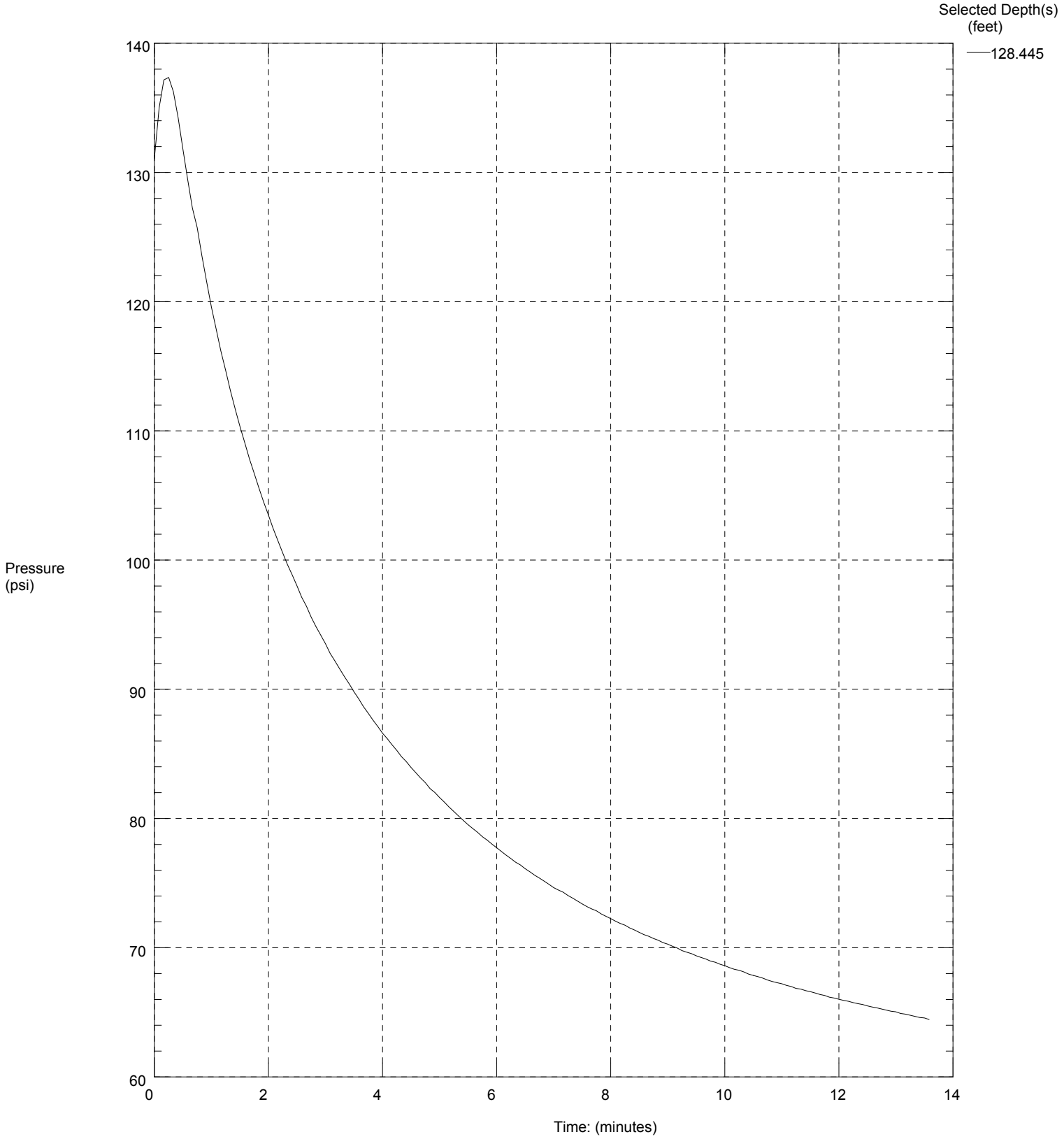


Maximum Pressure = 15.462 psi
Hydrostatic Pressure = 7.475 psi

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-5
Elevation: 0

CPT Date/Time: 01-22-06 09:24
Location: CPT-5-06
Job Number: XL-2344

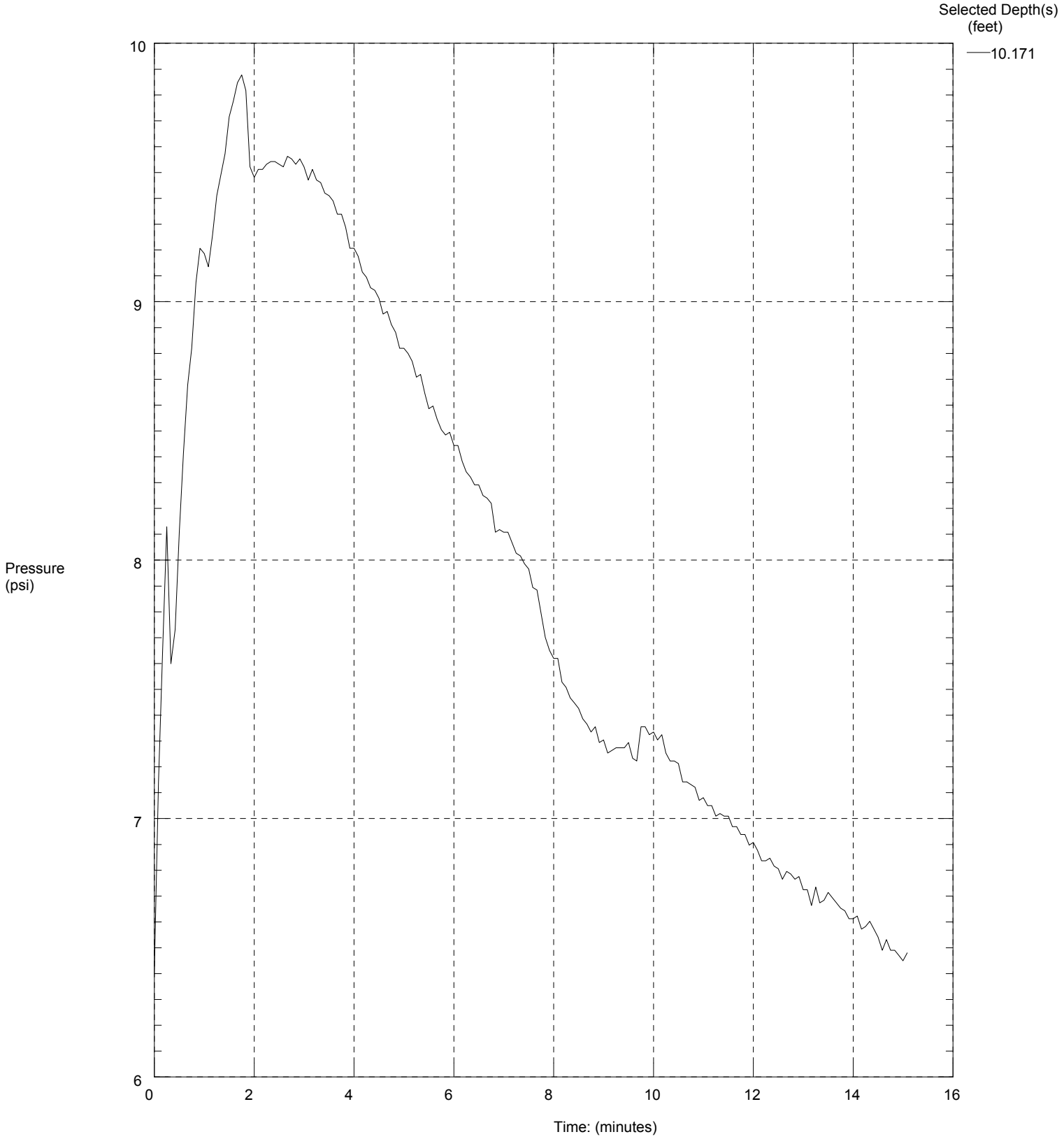


Maximum Pressure = 137.35 psi
Hydrostatic Pressure = 55.745 psi

WSDOT GEOTECH DIVISION

Operator Vince Johnson
Sounding: CPT-6
Elevation: 0

CPT Date/Time: 01-20-06 13:18
Location: CPT-6-06
Job Number: XL-2344



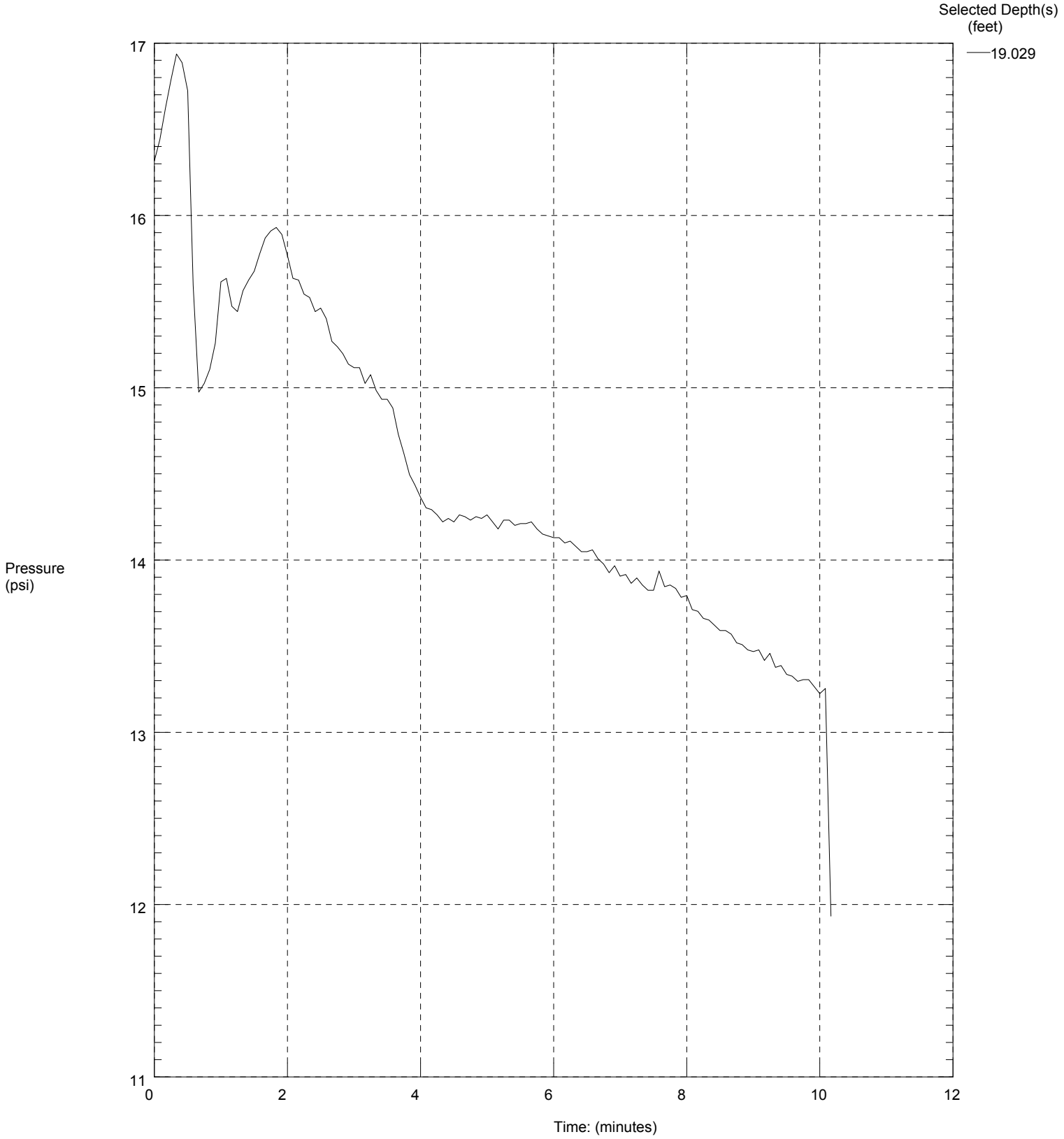
Maximum Pressure = 9.878 psi
Hydrostatic Pressure = 4.414 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Vince Johnson
Sounding: CPT-6
Elevation: 0

CPT Date/Time: 01-20-06 13:18
Location: CPT-6-06
Job Number: XL-2344

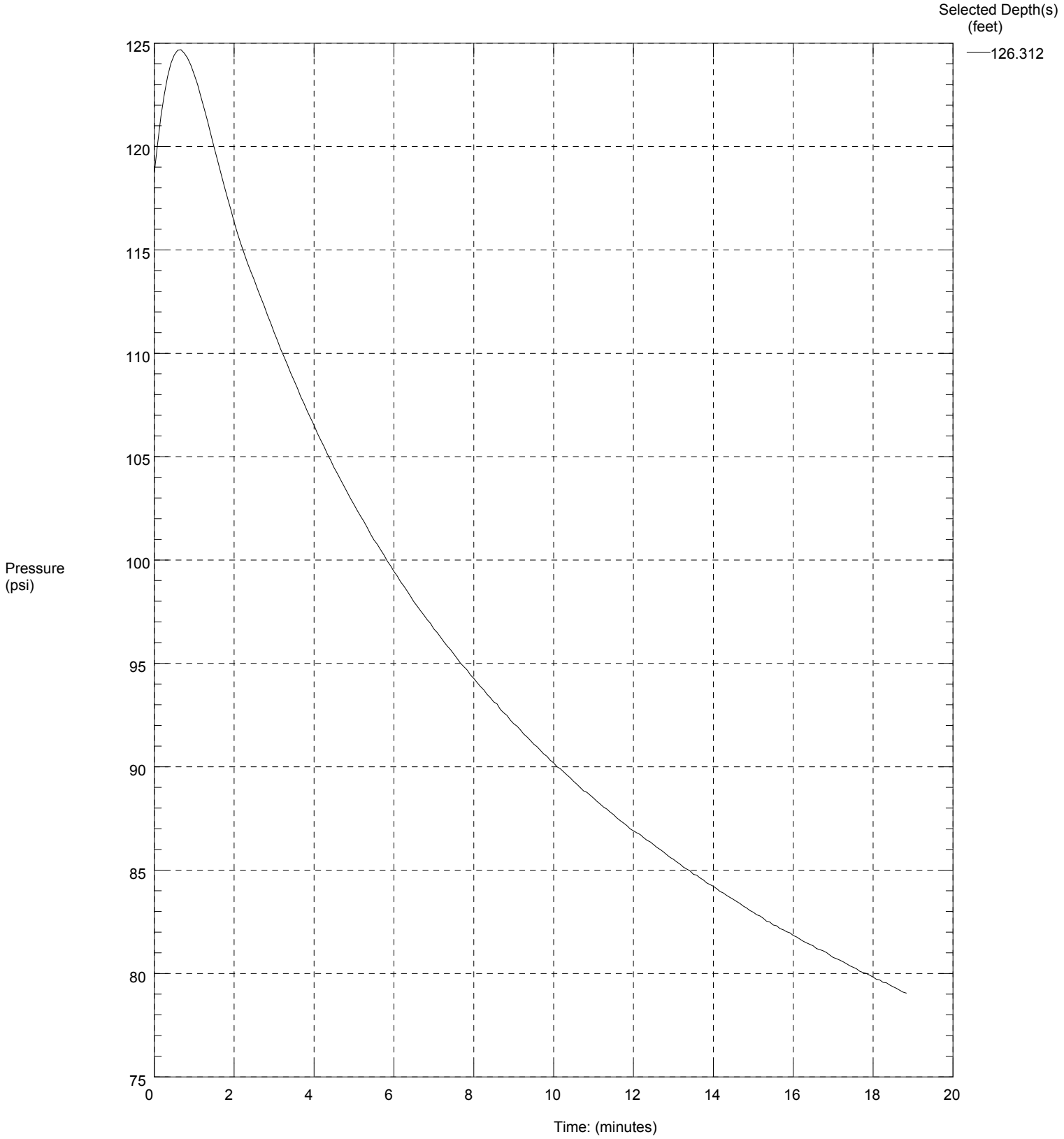


Maximum Pressure = 16.937 psi
Hydrostatic Pressure = 8.259 psi

WSDOT GEOTECH DIVISION

Operator Vince Johnson
Sounding: CPT-6
Elevation: 0

CPT Date/Time: 01-20-06 13:18
Location: CPT-6-06
Job Number: XL-2344

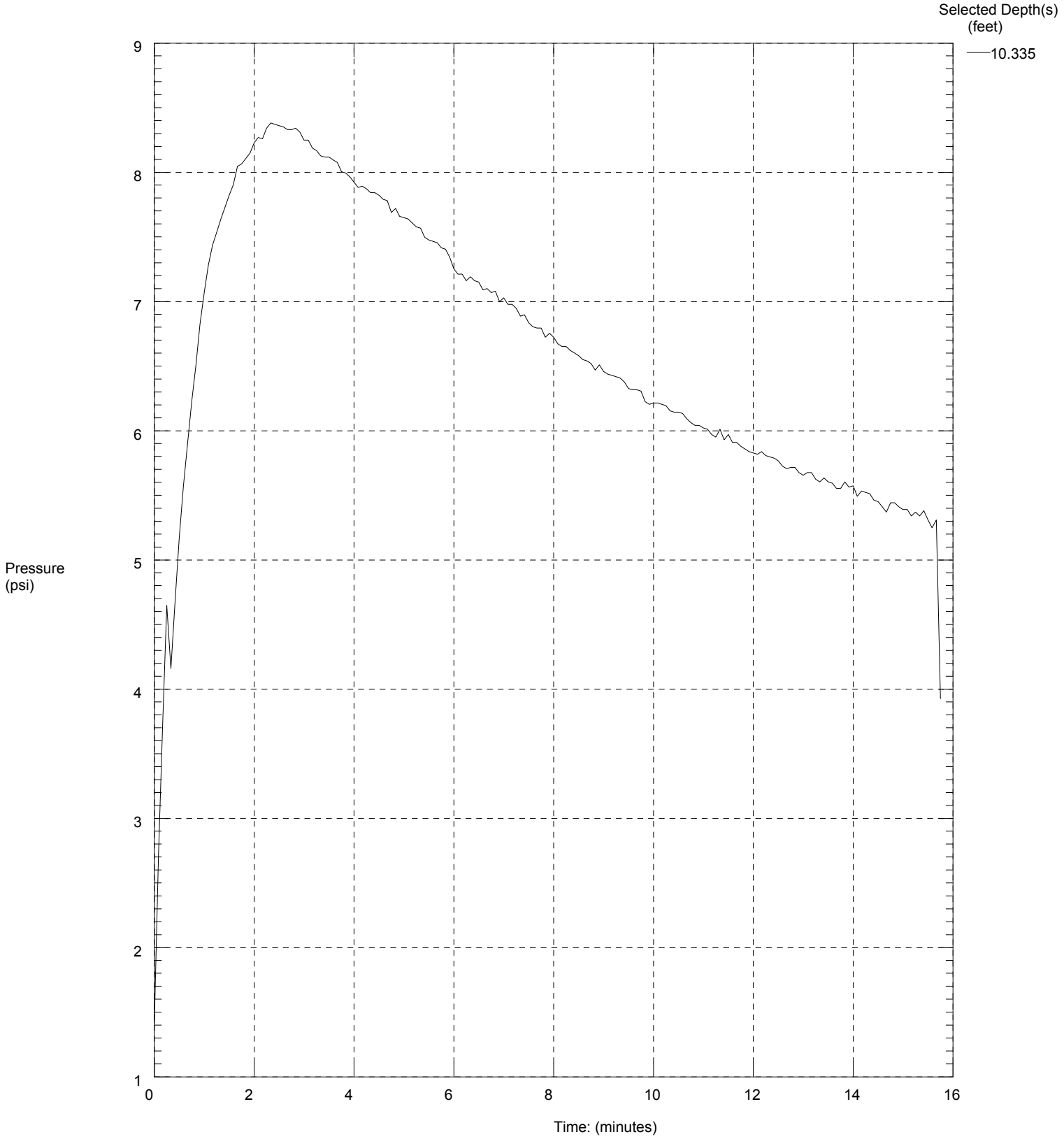


Maximum Pressure = 124.685 psi
Hydrostatic Pressure = 54.819 psi

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-7
Elevation: 0

CPT Date/Time: 01-23-06 07:55
Location: CPT-7-06
Job Number: XL-2344

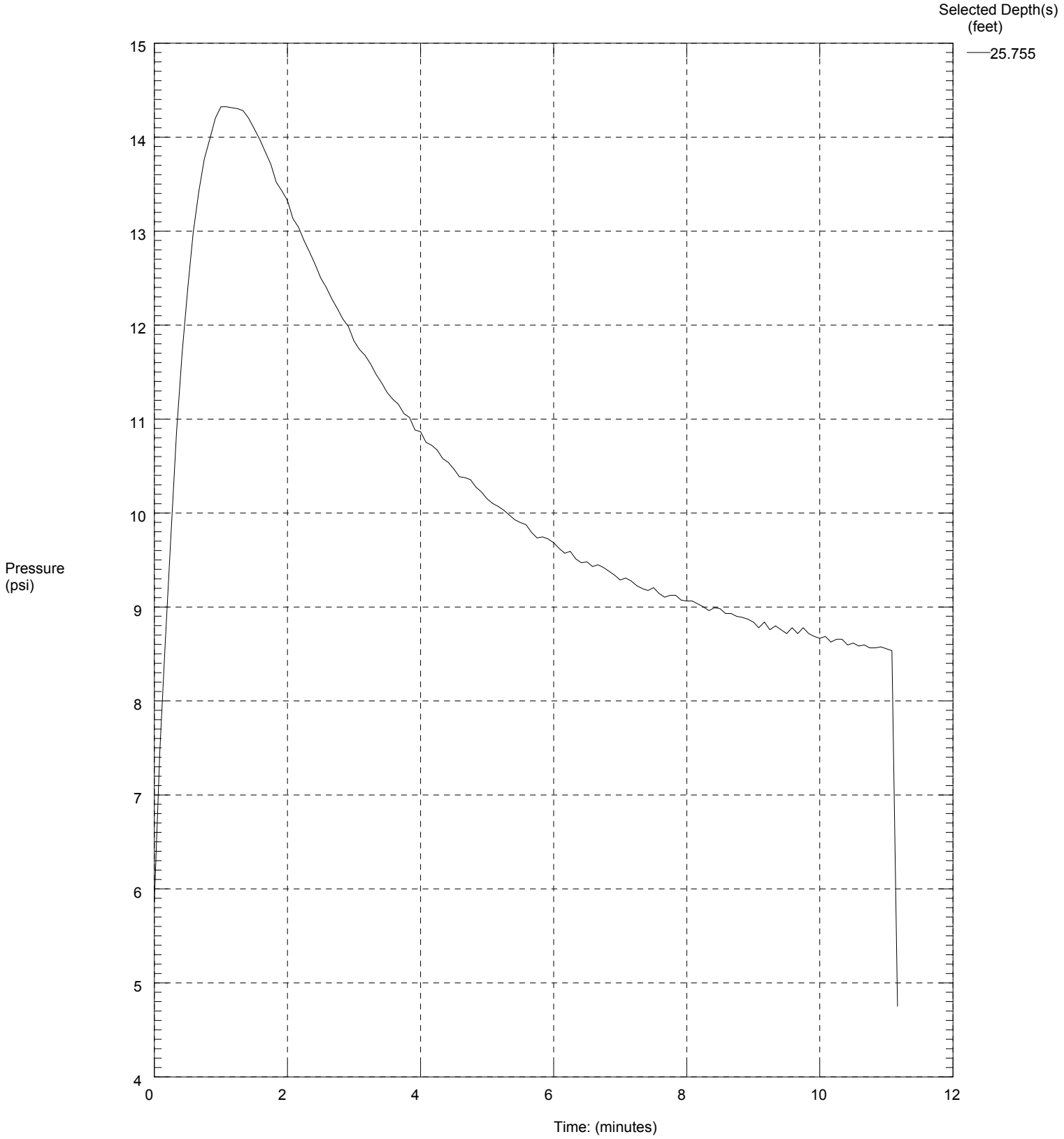


Maximum Pressure = 8.382 psi
Hydrostatic Pressure = 4.485 psi

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-7
Elevation: 0

CPT Date/Time: 01-23-06 07:55
Location: CPT-7-06
Job Number: XL-2344

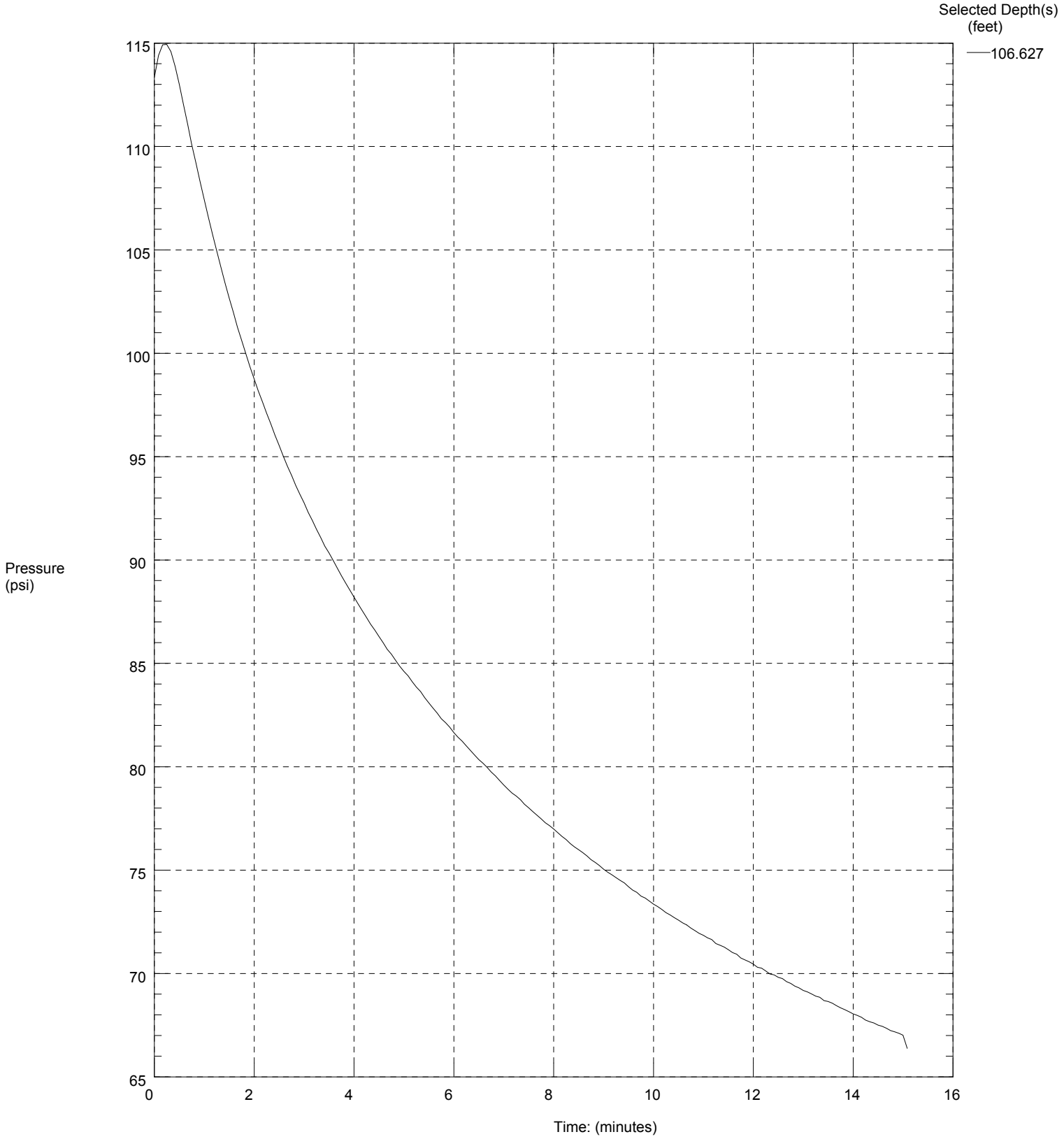


Maximum Pressure = 14.323 psi
Hydrostatic Pressure = 11.178 psi

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-7
Elevation: 0

CPT Date/Time: 01-23-06 07:55
Location: CPT-7-06
Job Number: XL-2344



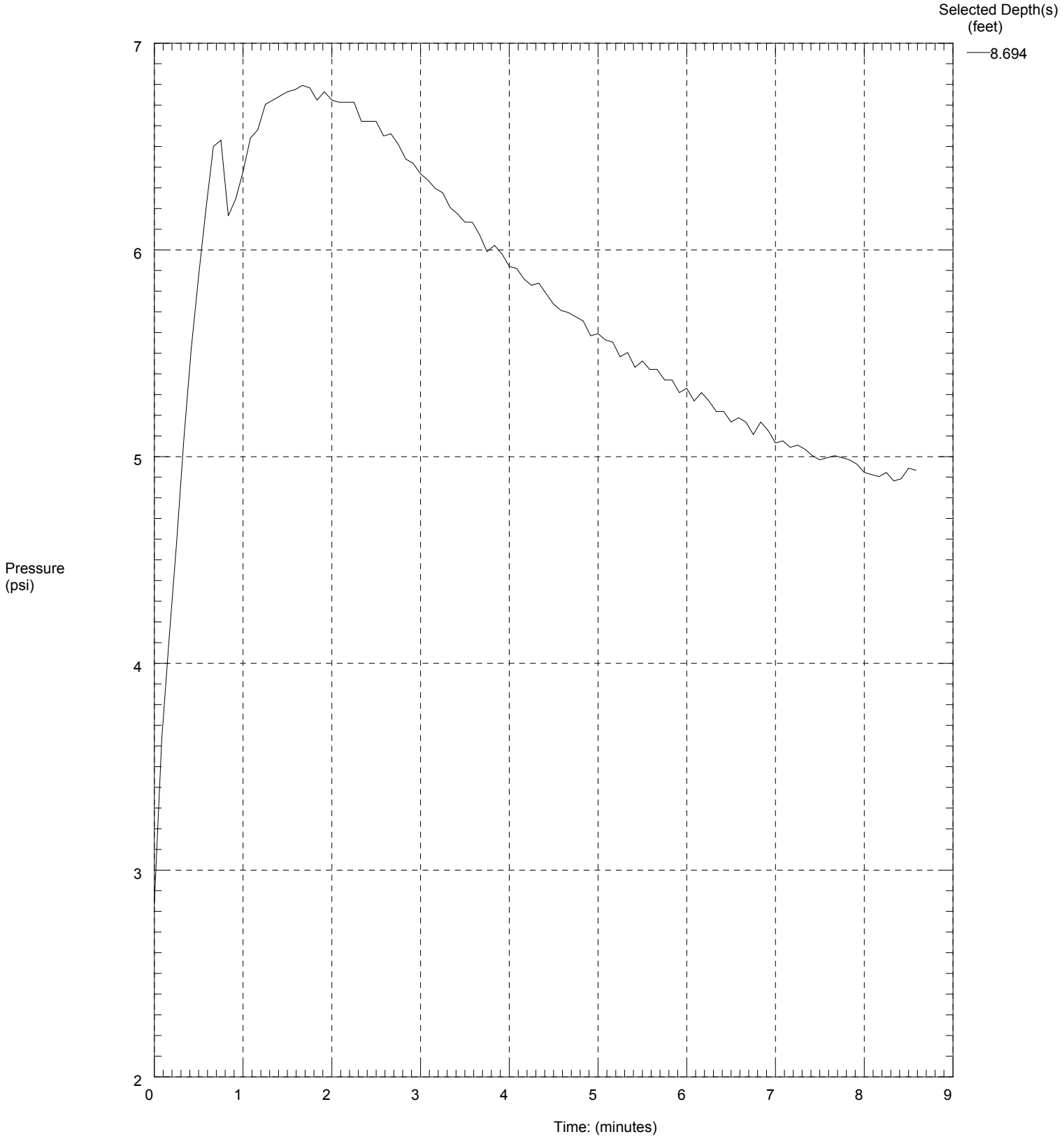
Maximum Pressure = 114.94 psi
Hydrostatic Pressure = 46.276 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-8
Elevation: 0

CPT Date/Time: 01-24-06 15:24
Location: CPT-8-06
Job Number: XL-2344

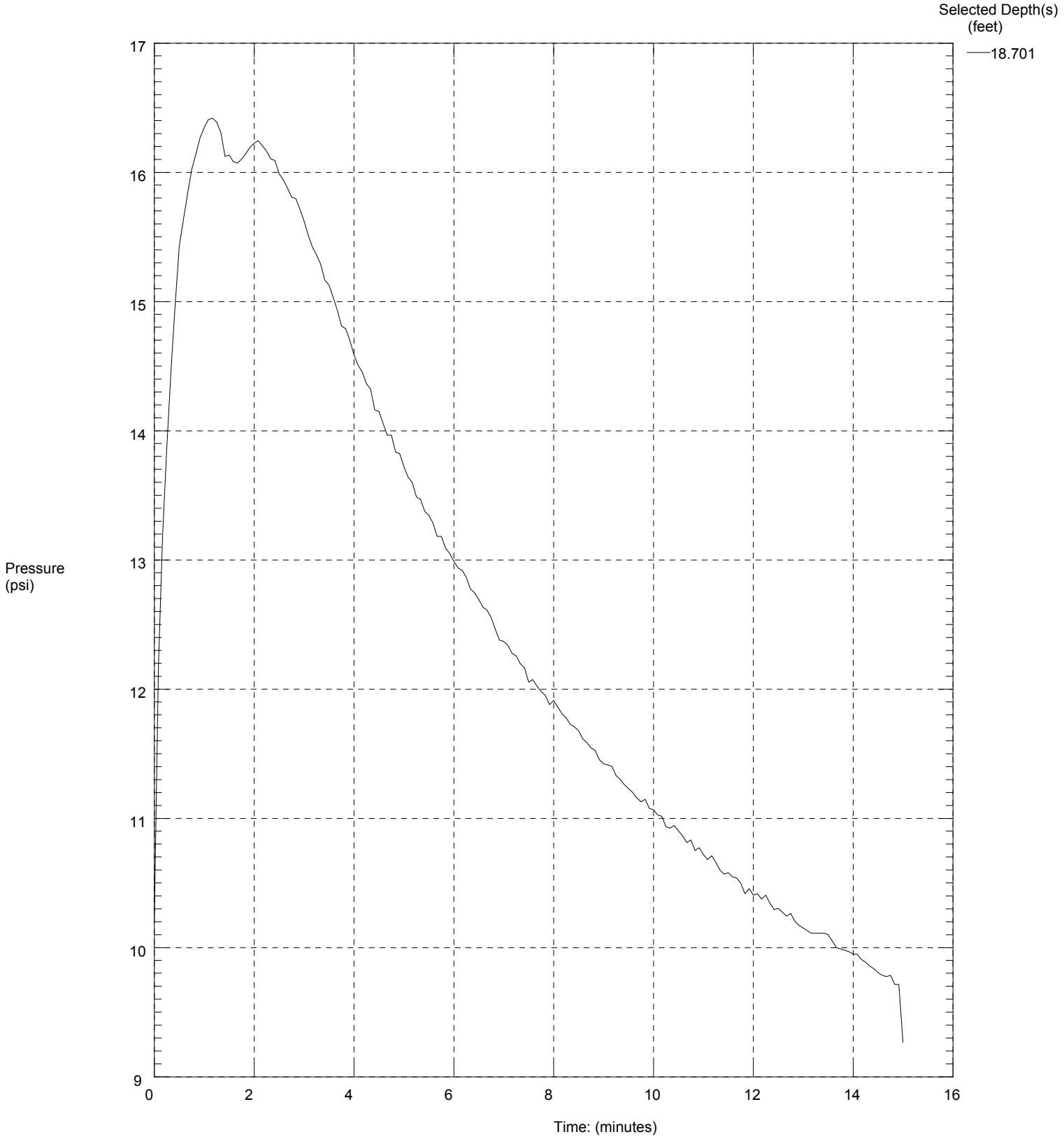


Maximum Pressure = 6.795 psi
Hydrostatic Pressure = 3.773 psi

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-8
Elevation: 0

CPT Date/Time: 01-24-06 15:24
Location: CPT-8-06
Job Number: XL-2344



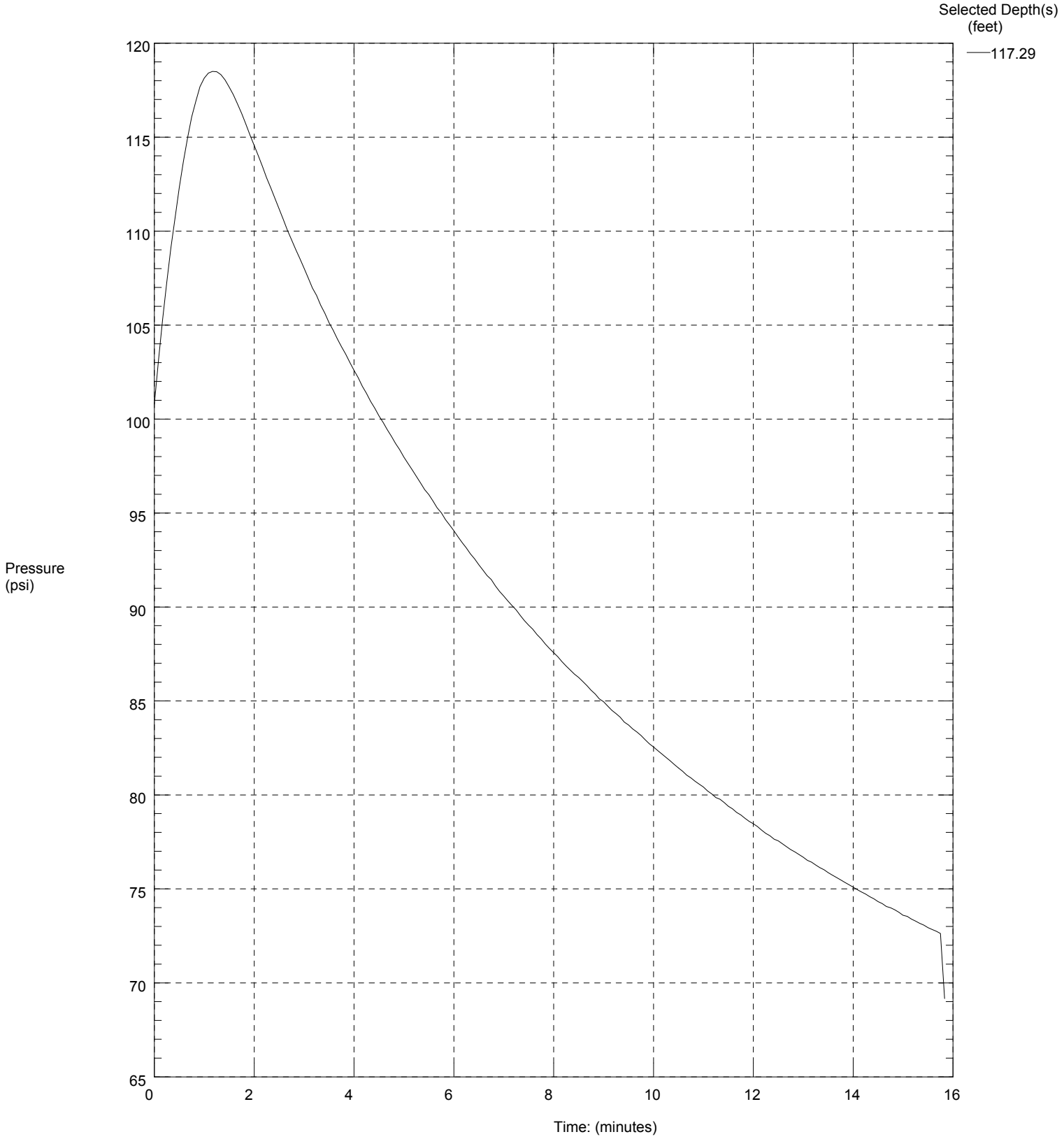
Maximum Pressure = 16.419 psi
Hydrostatic Pressure = 8.116 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-8
Elevation: 0

CPT Date/Time: 01-24-06 15:24
Location: CPT-8-06
Job Number: XL-2344



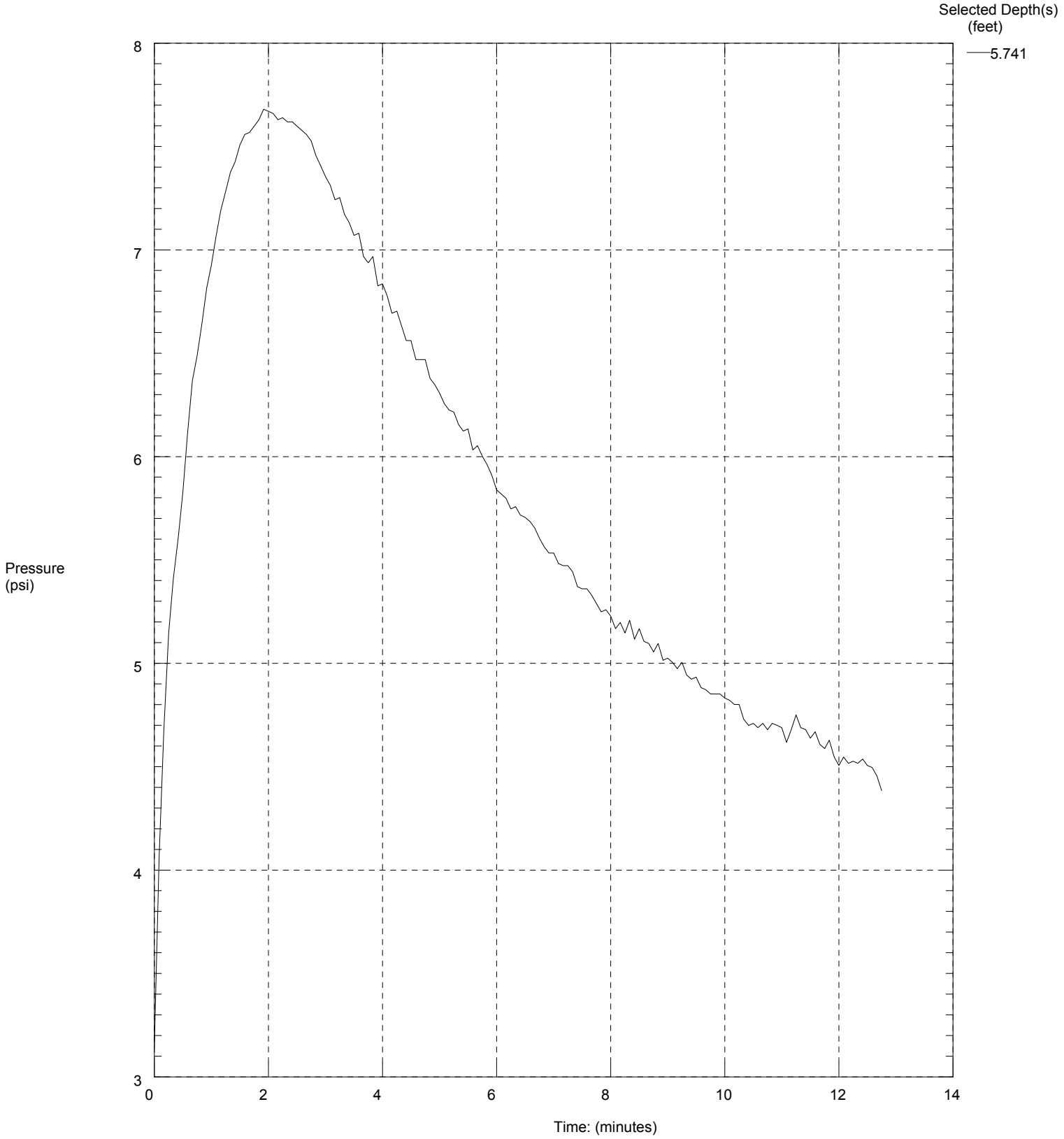
Maximum Pressure = 118.5 psi
Hydrostatic Pressure = 50.904 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-9
Elevation: 0

CPT Date/Time: 01-24-06 09:32
Location: CPT-9-06
Job Number: XL-2344



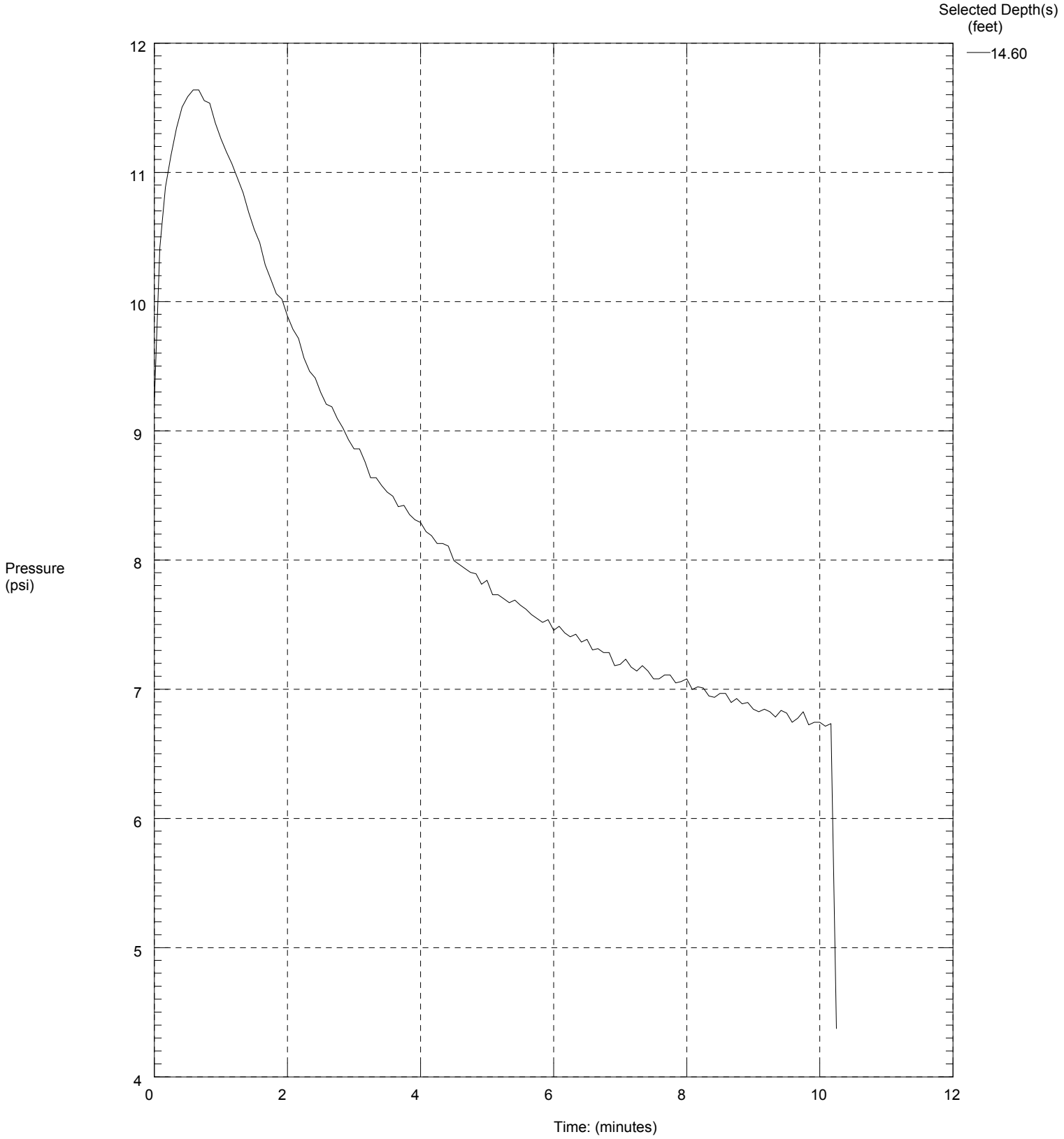
Maximum Pressure = 7.68 psi
Hydrostatic Pressure = 2.492 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-9
Elevation: 0

CPT Date/Time: 01-24-06 09:32
Location: CPT-9-06
Job Number: XL-2344

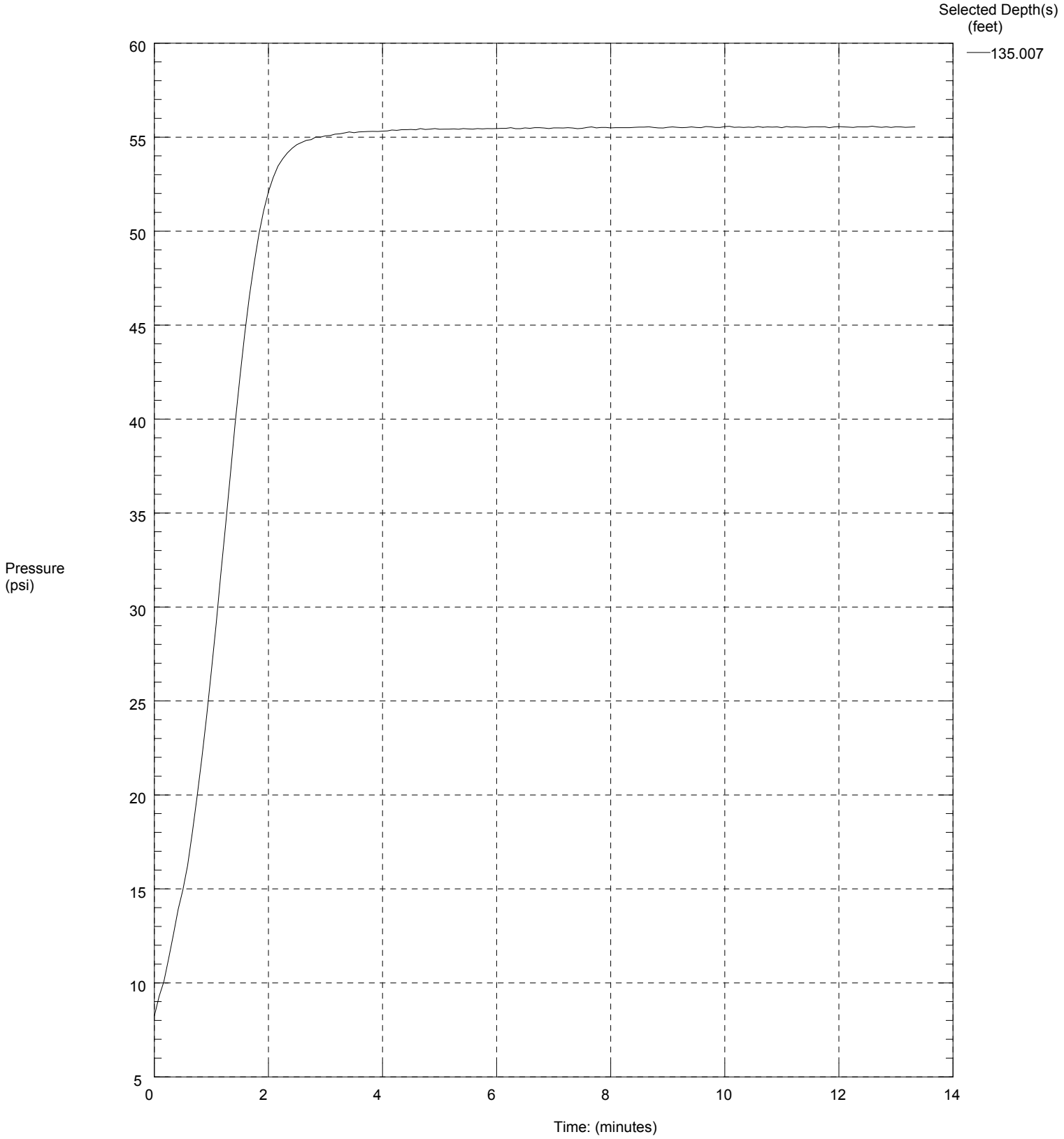


Maximum Pressure = 11.637 psi
Hydrostatic Pressure = 6.336 psi

WSDOT GEOTECH DIVISION

Operator Brian Hilts
Sounding: CPT-9
Elevation: 0

CPT Date/Time: 01-24-06 09:32
Location: CPT-9-06
Job Number: XL-2344



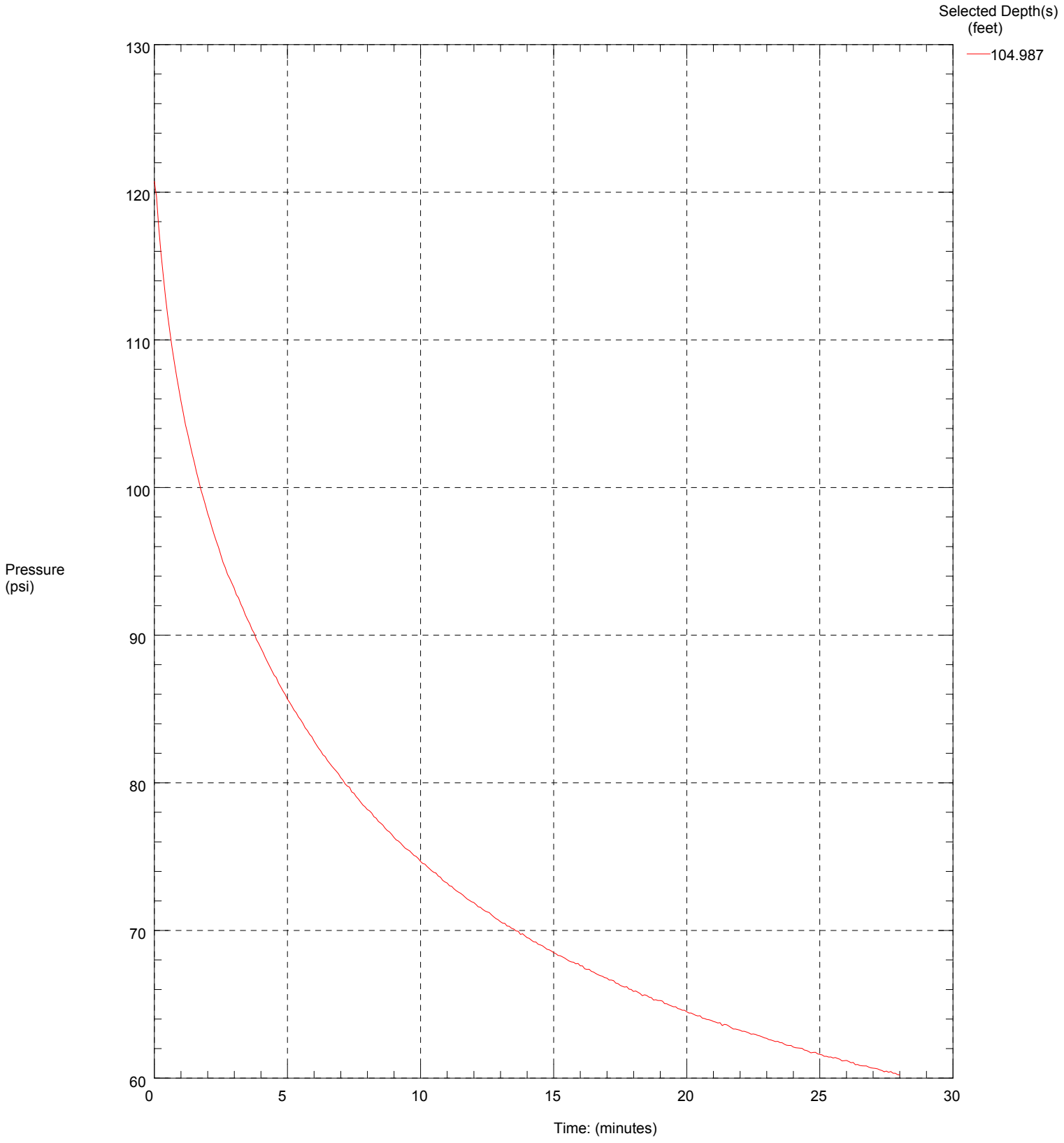
Maximum Pressure = 55.583 psi
Hydrostatic Pressure = 58.593 psi

SR 520 Bridge Pontoon Const. Site Investigation
Grays Harbor - Hoquaim WA

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-10a-06
Elevation: UNKNOWN

CPT Date/Time: 07-19-06 10:34
Location: CPT-10A-06
Job Number: XL-2672

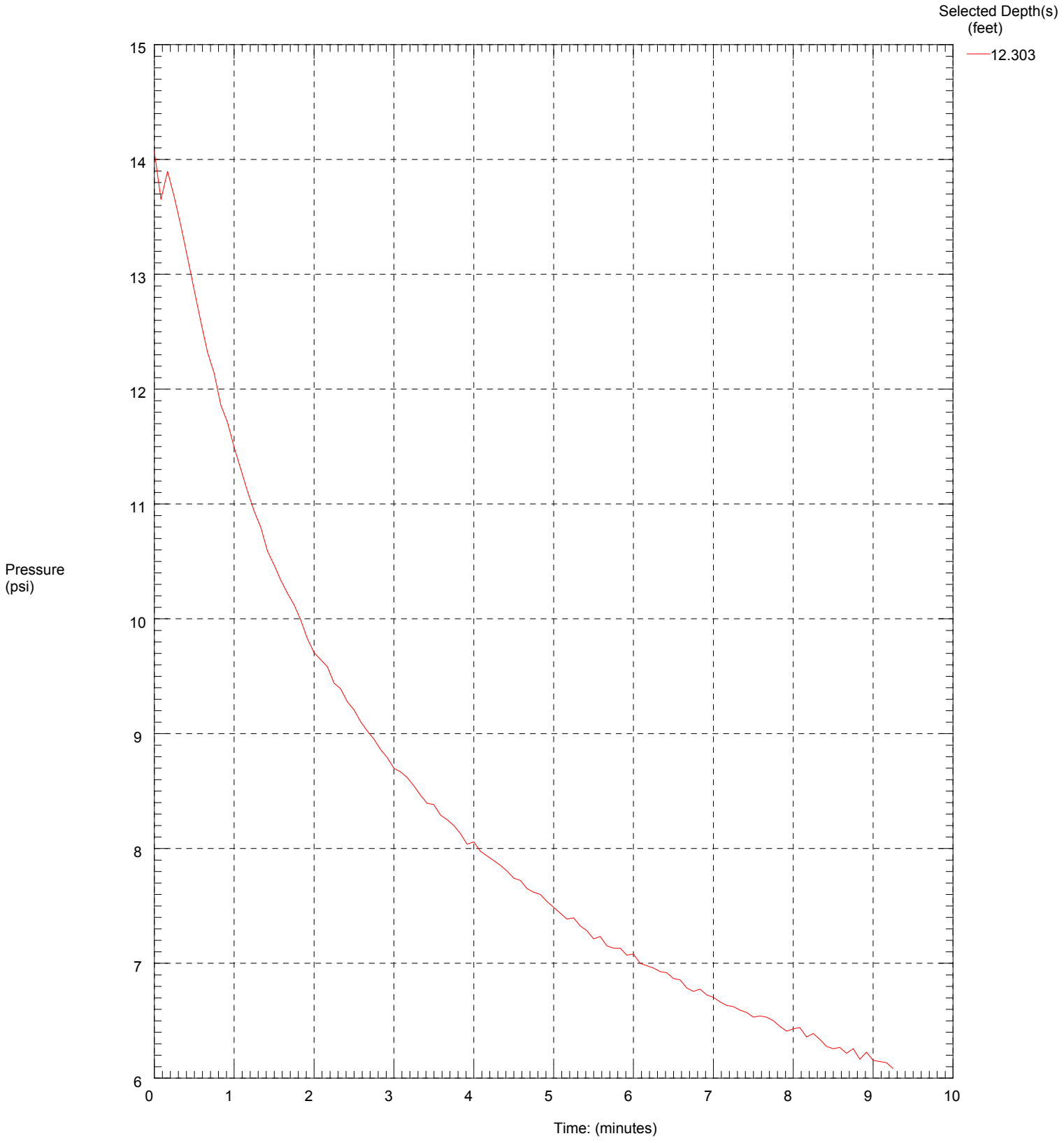


Maximum Pressure = 120.728 psi
Hydrostatic Pressure = 45.564 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-10-06
Elevation: UNKNOWN

CPT Date/Time: 07-19-06 08:15
Location: CPT-10-06
Job Number: XL-2672

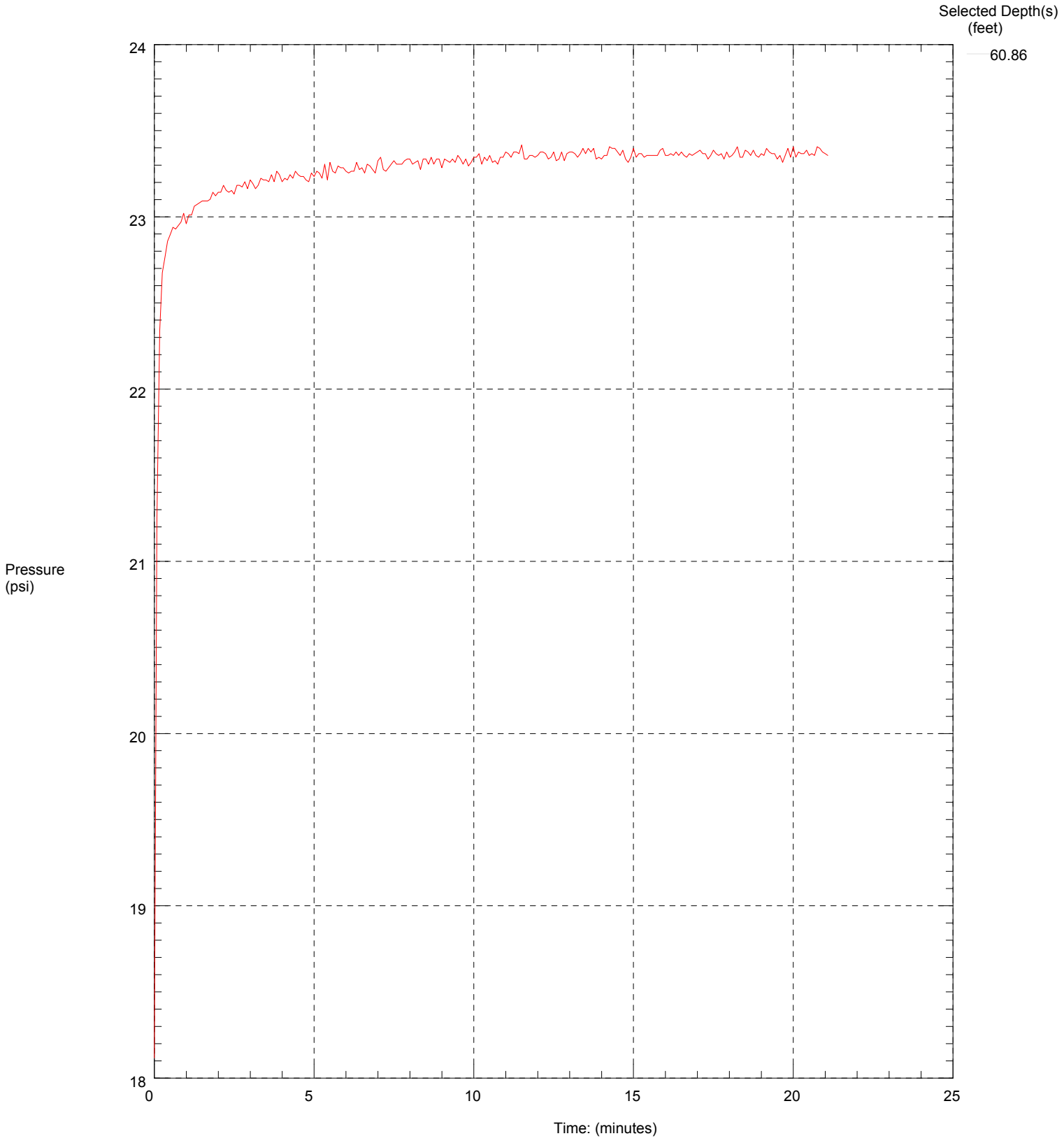


Maximum Pressure = 14.069 psi
Hydrostatic Pressure = 5.34 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-10-06
Elevation: UNKNOWN

CPT Date/Time: 07-19-06 08:15
Location: CPT-10-06
Job Number: XL-2672

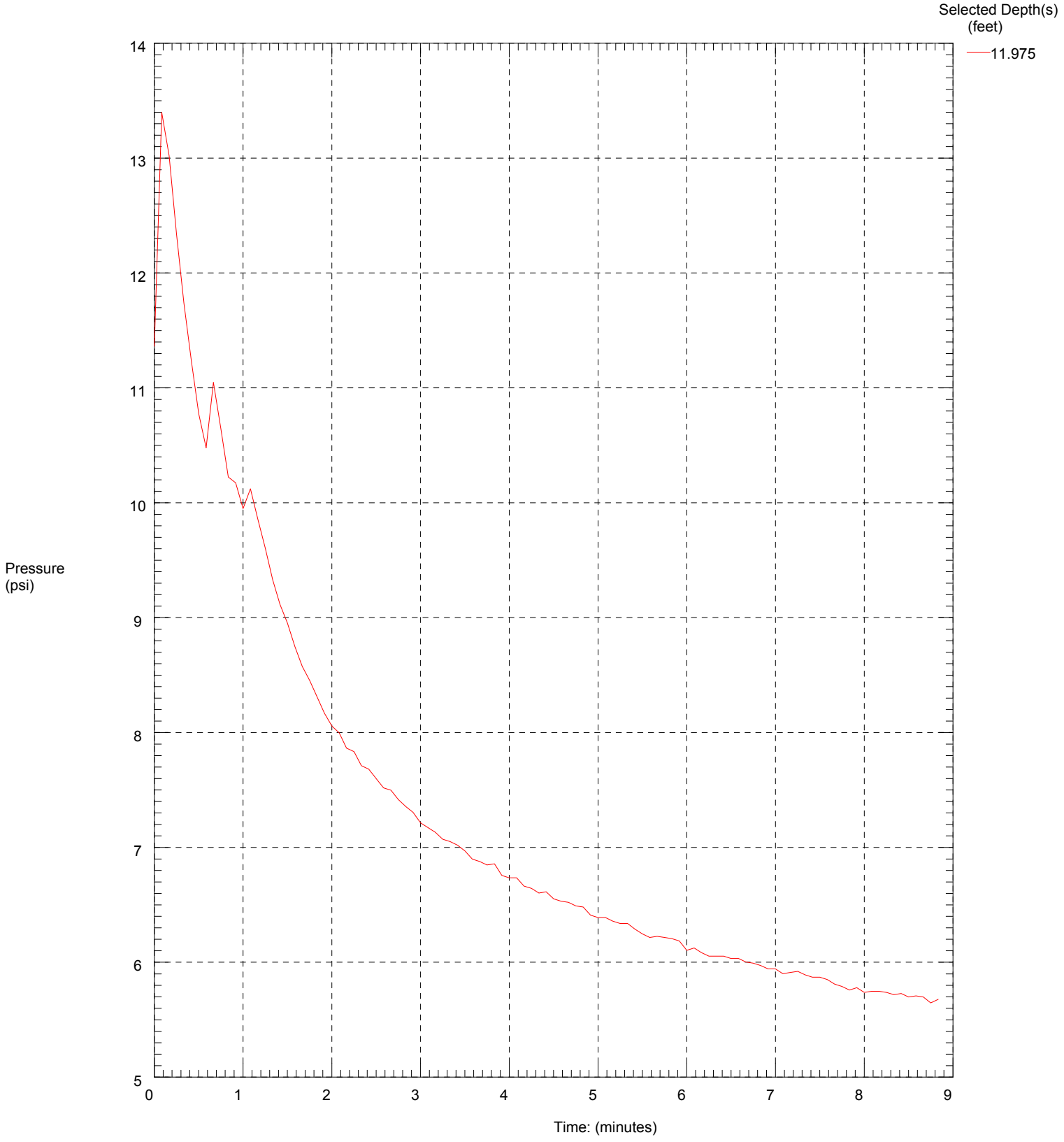


Maximum Pressure = 23.417 psi
Hydrostatic Pressure = 26.413 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-11-06
Elevation: UNKNOWN

CPT Date/Time: 07-18-06 10:58
Location: CPT-11-06
Job Number: XL-2672

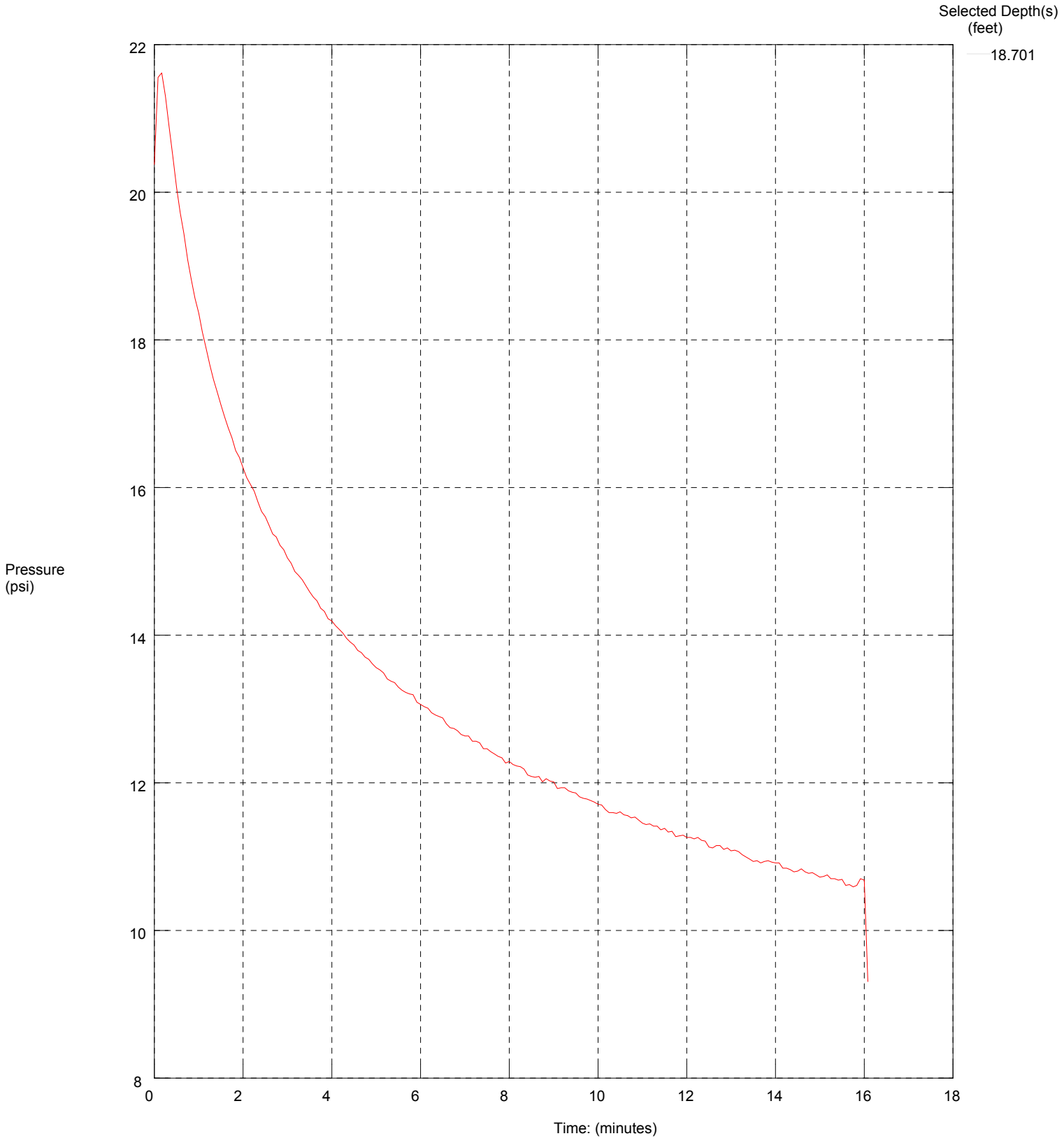


Maximum Pressure = 13.397 psi
Hydrostatic Pressure = 5.197 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-11-06
Elevation: UNKNOWN

CPT Date/Time: 07-18-06 10:58
Location: CPT-11-06
Job Number: XL-2672

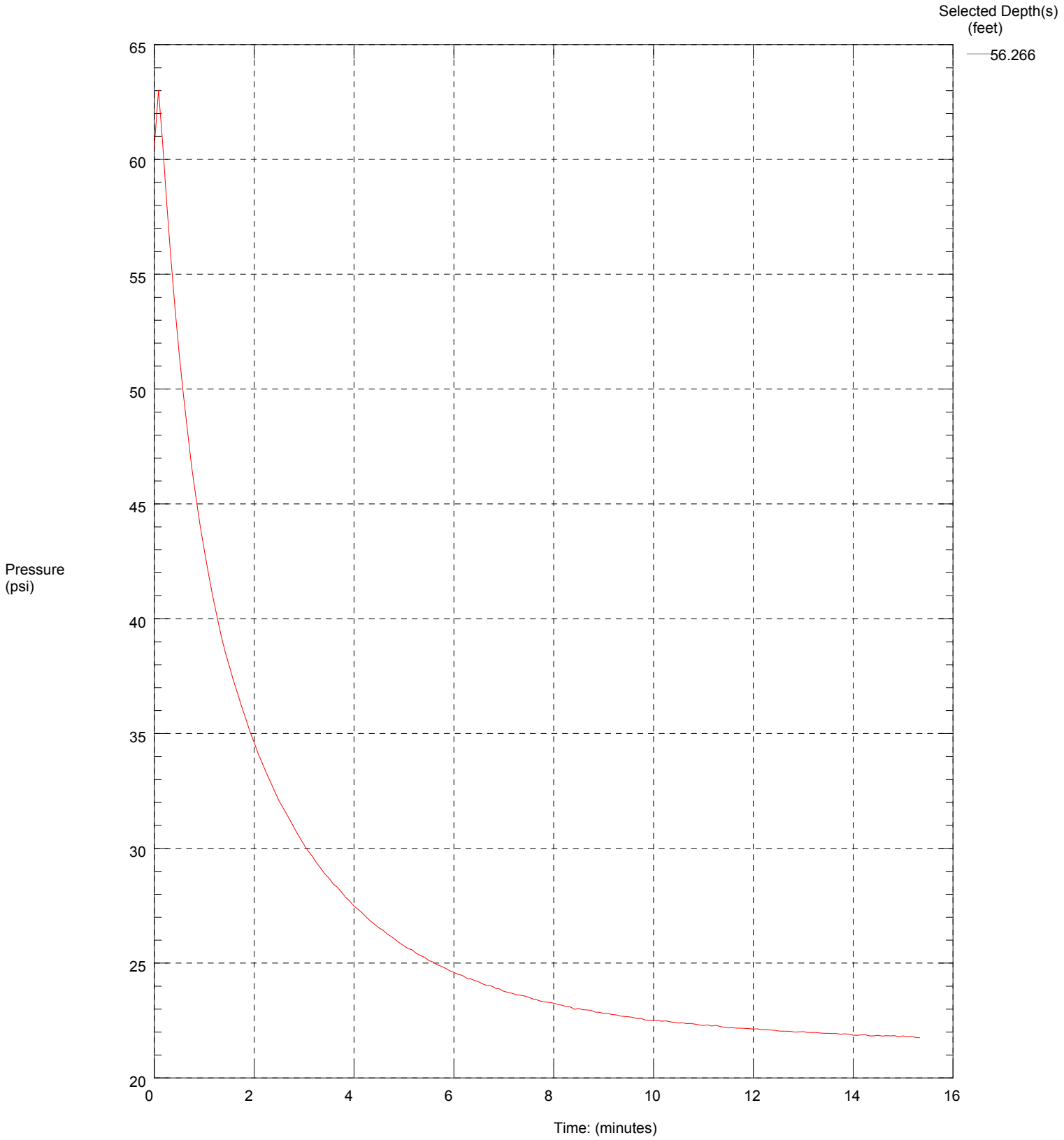


Maximum Pressure = 21.617 psi
Hydrostatic Pressure = 8.116 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-11-06
Elevation: UNKNOWN

CPT Date/Time: 07-18-06 10:58
Location: CPT-11-06
Job Number: XL-2672

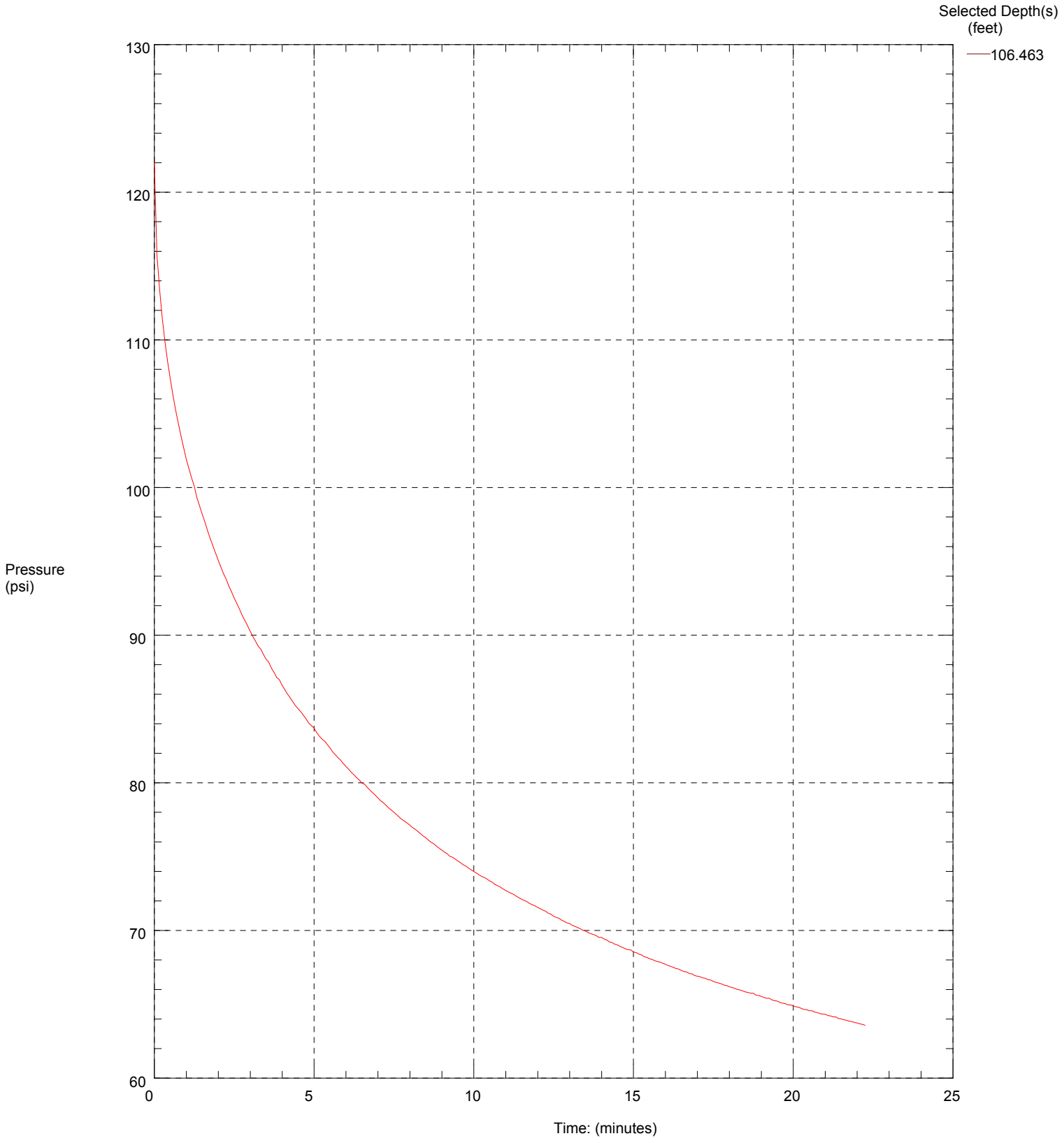


Maximum Pressure = 63.009 psi
Hydrostatic Pressure = 24.419 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-11-06
Elevation: UNKNOWN

CPT Date/Time: 07-18-06 10:58
Location: CPT-11-06
Job Number: XL-2672

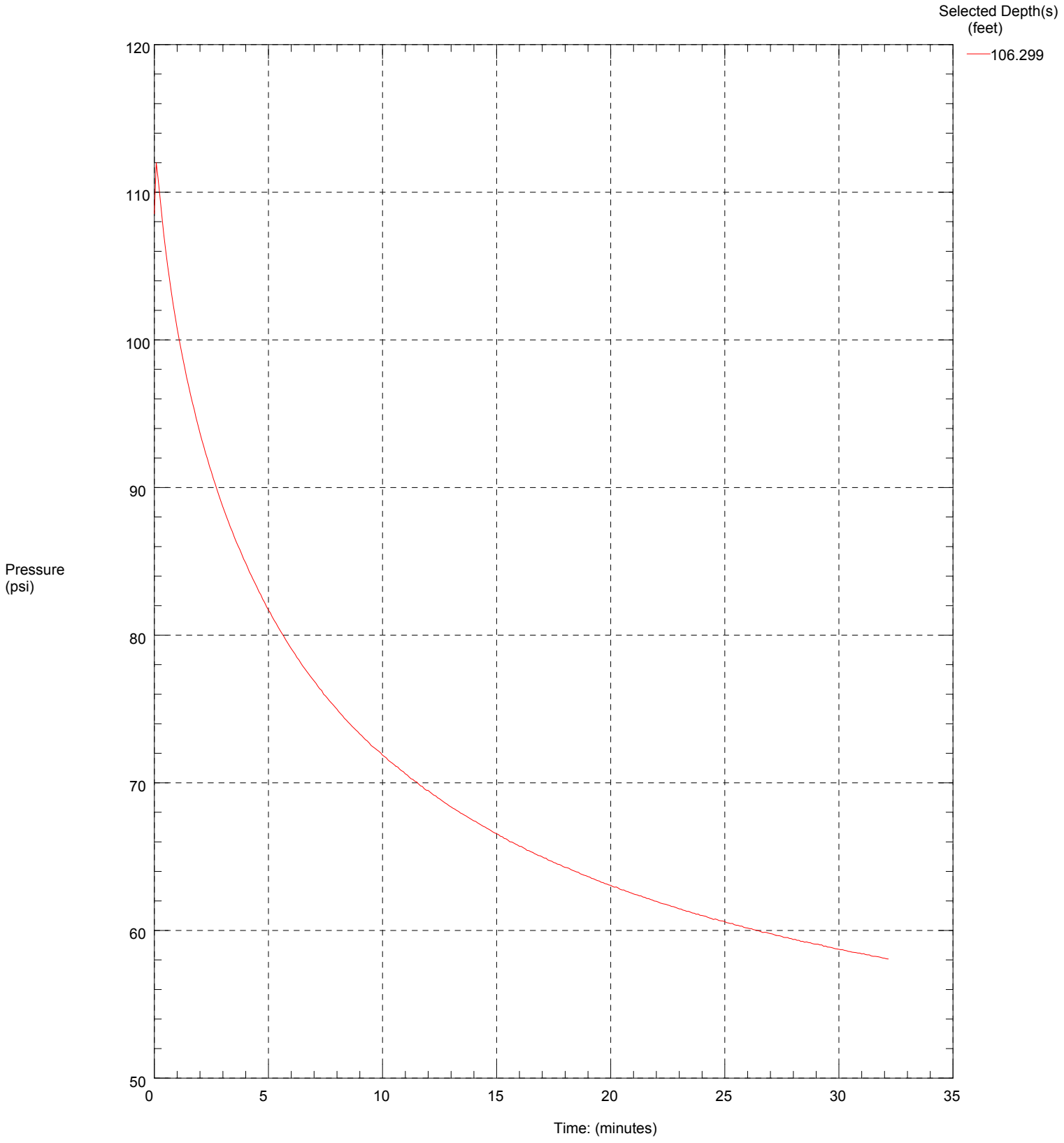


Maximum Pressure = 122.02 psi
Hydrostatic Pressure = 46.205 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-12b-06
Elevation: UNKNOWN

CPT Date/Time: 07-26-06 13:16
Location: CPT-12B-06
Job Number: XL-2672

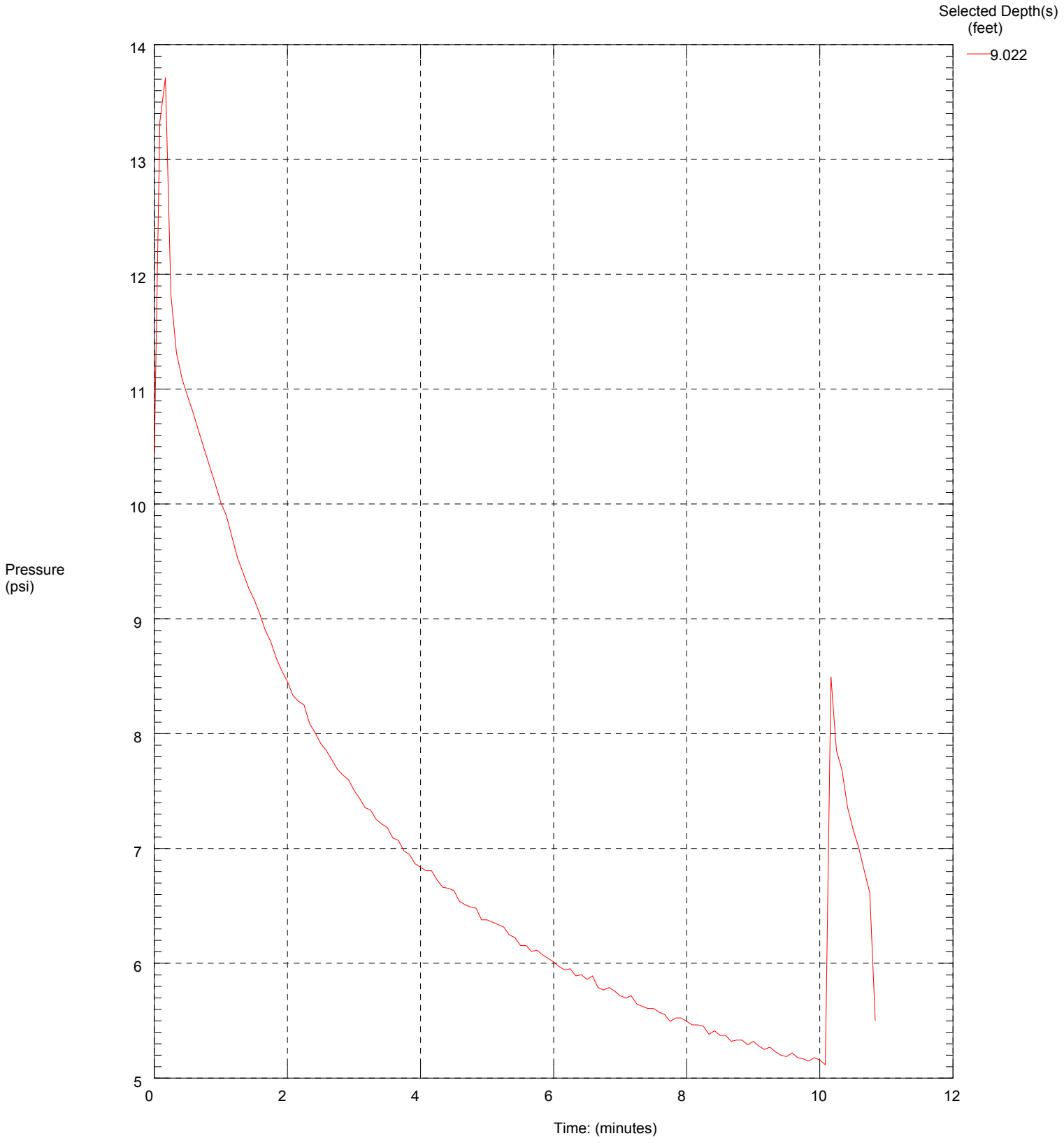


Maximum Pressure = 112.0 psi
Hydrostatic Pressure = 46.134 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-12-06
Elevation: Unknown

CPT Date/Time: 07-13-06 08:13
Location: CPT-12-06
Job Number: XL-2672

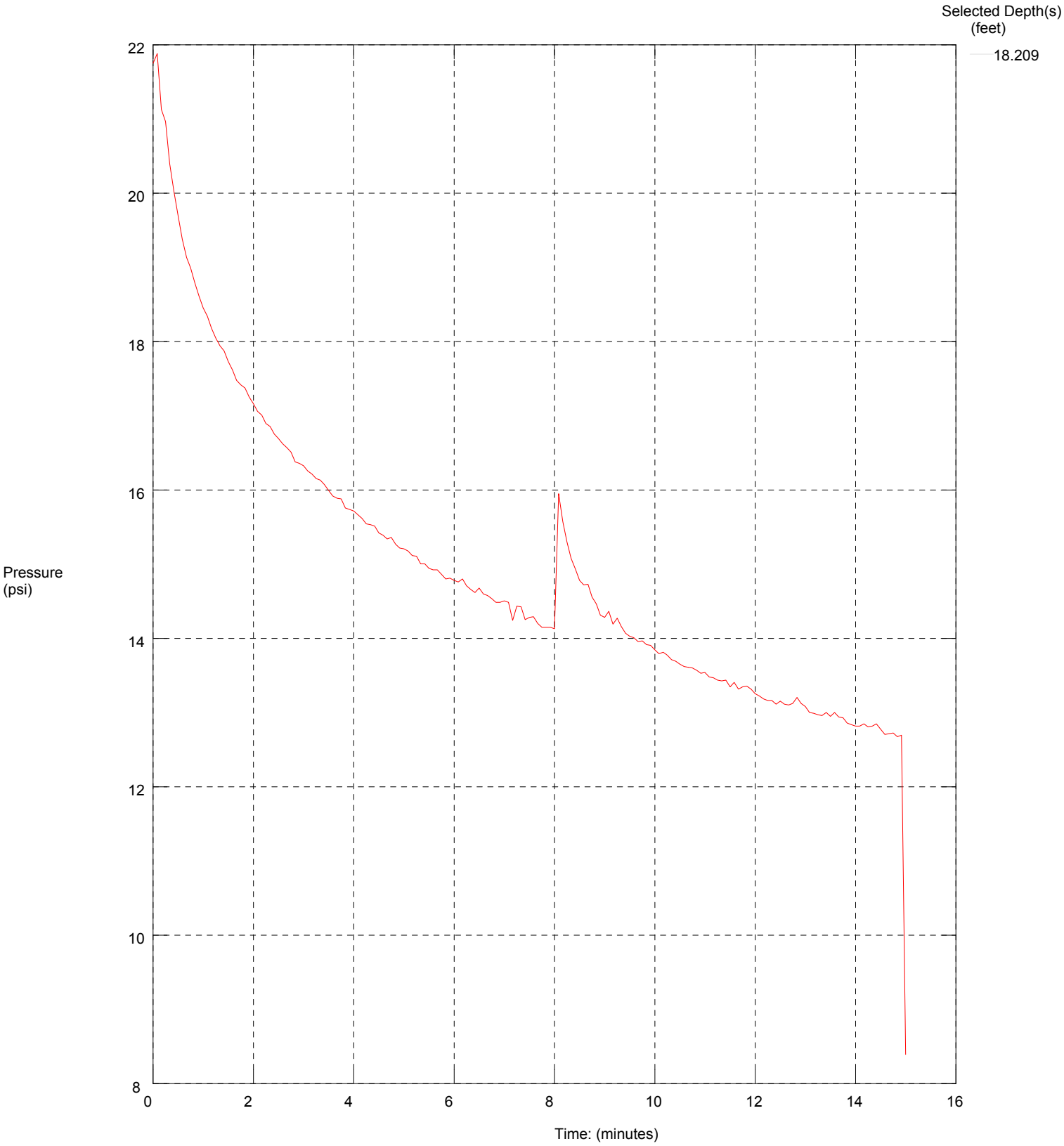


Maximum Pressure = 13.713 psi
Hydrostatic Pressure = 3.916 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-12-06
Elevation: Unknown

CPT Date/Time: 07-13-06 08:13
Location: CPT-12-06
Job Number: XL-2672

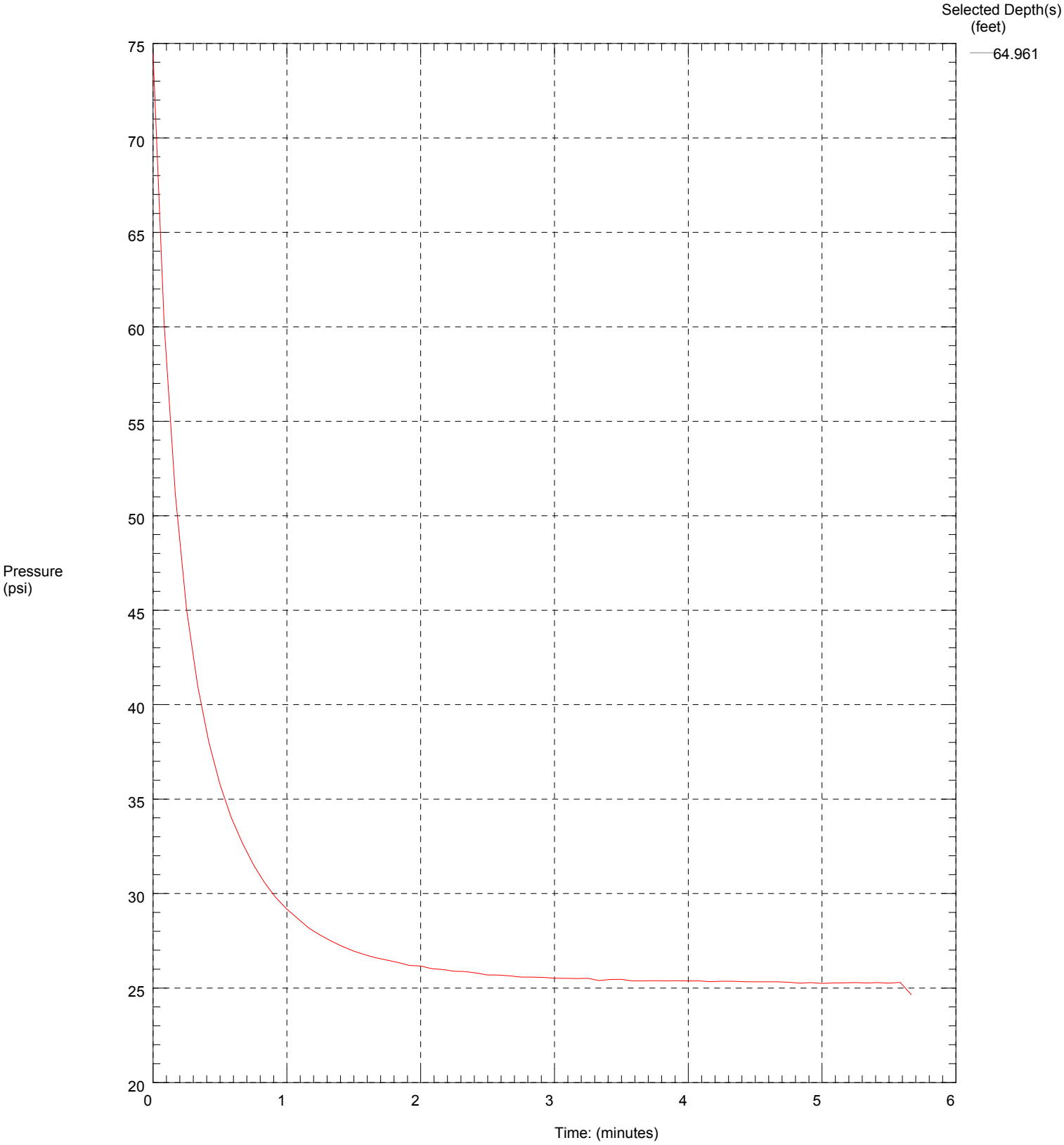


Maximum Pressure = 21.881 psi
Hydrostatic Pressure = 7.903 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-12-06
Elevation: Unknown

CPT Date/Time: 07-13-06 08:13
Location: CPT-12-06
Job Number: XL-2672

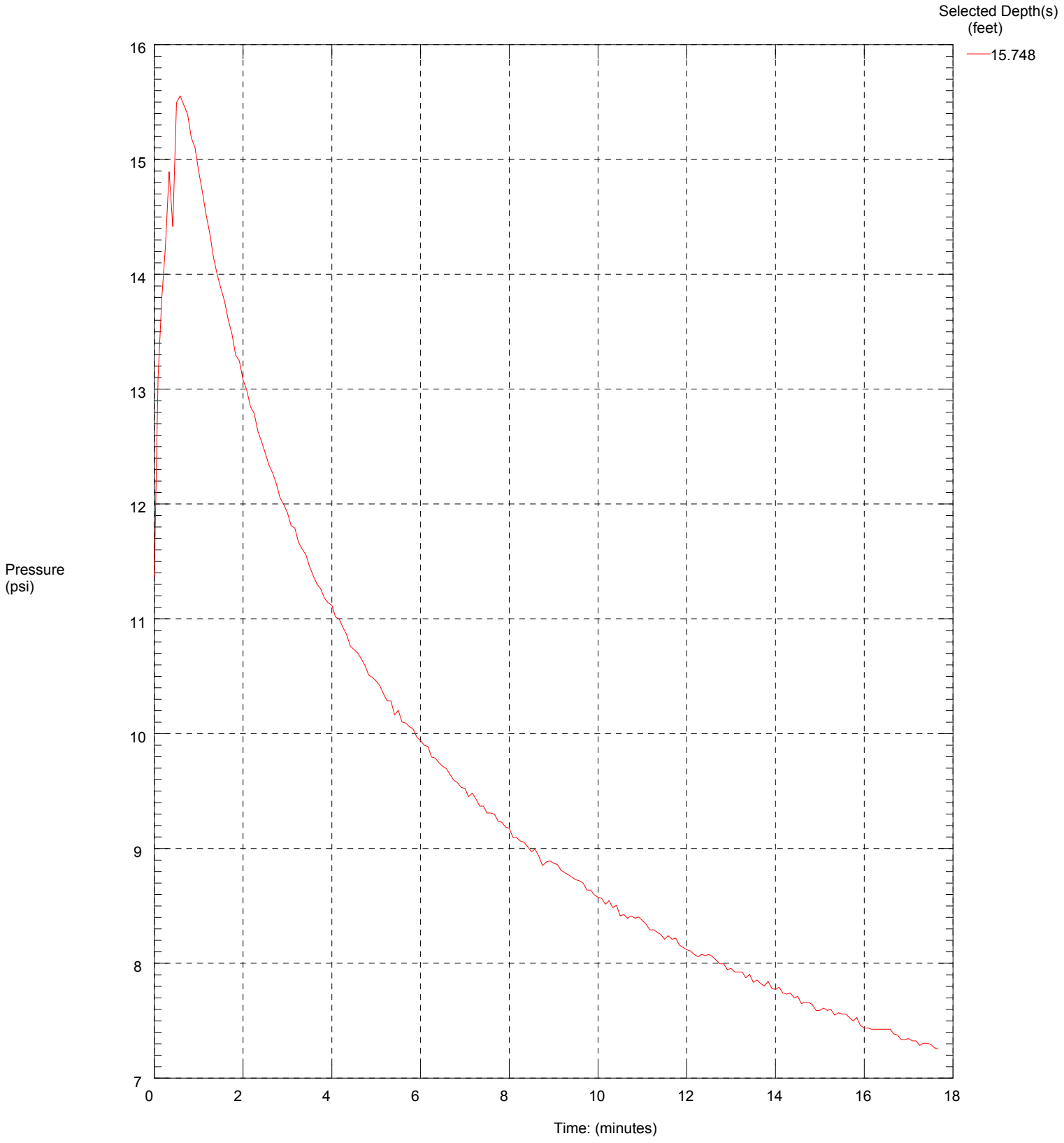


Maximum Pressure = 74.463 psi
Hydrostatic Pressure = 28.193 psi

WSDOT Geotechnical Division

Operator Danny Henderson
Sounding: CPT-13-06
Elevation: Unknown

CPT Date/Time: 08-01-06 08:54
Location: CPT-13-06
Job Number: XL-2672

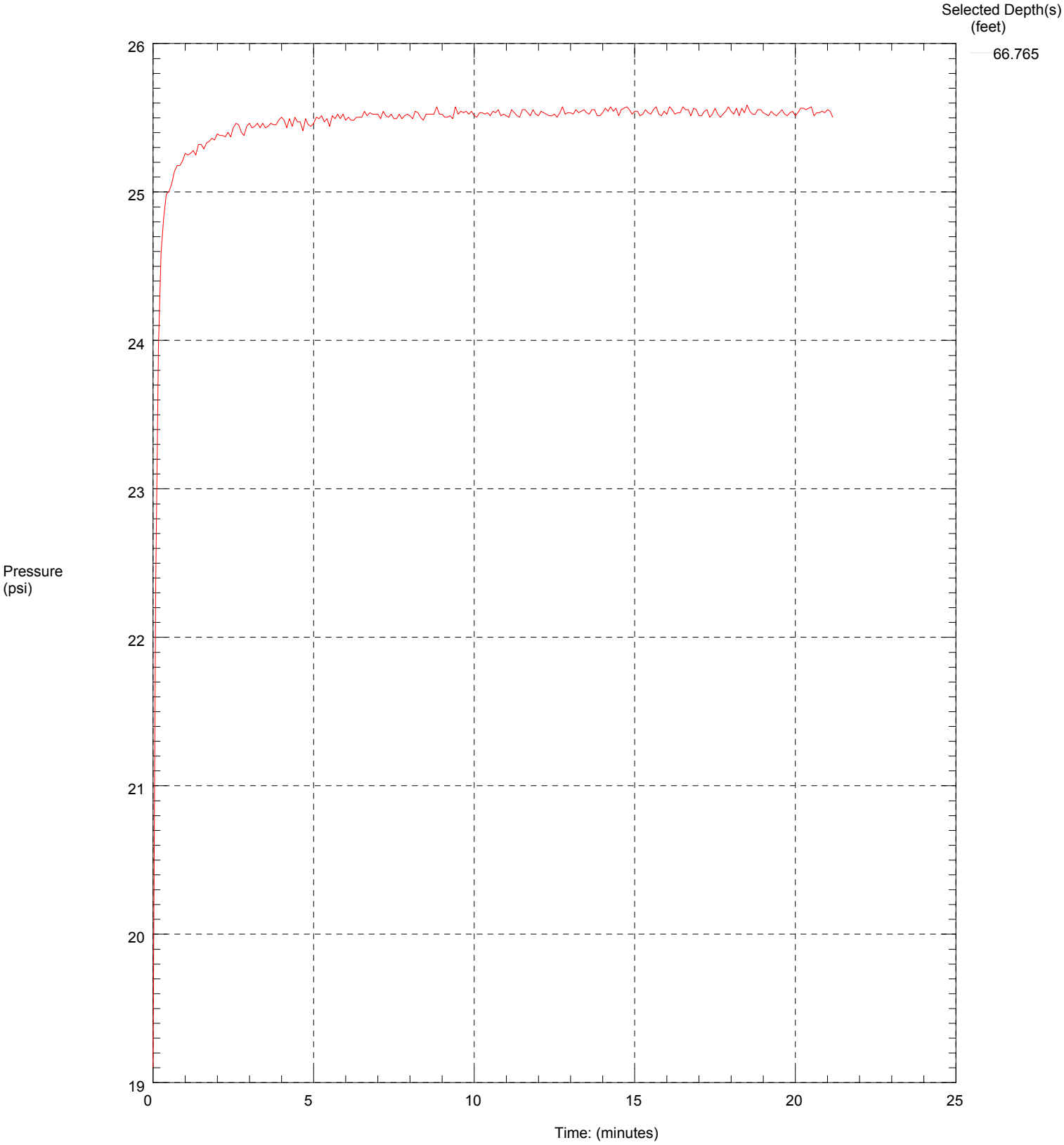


Maximum Pressure = 15.554 psi
Hydrostatic Pressure = 6.835 psi

WSDOT Geotechnical Division

Operator Danny Henderson
Sounding: CPT-13-06
Elevation: Unknown

CPT Date/Time: 08-01-06 08:54
Location: CPT-13-06
Job Number: XL-2672

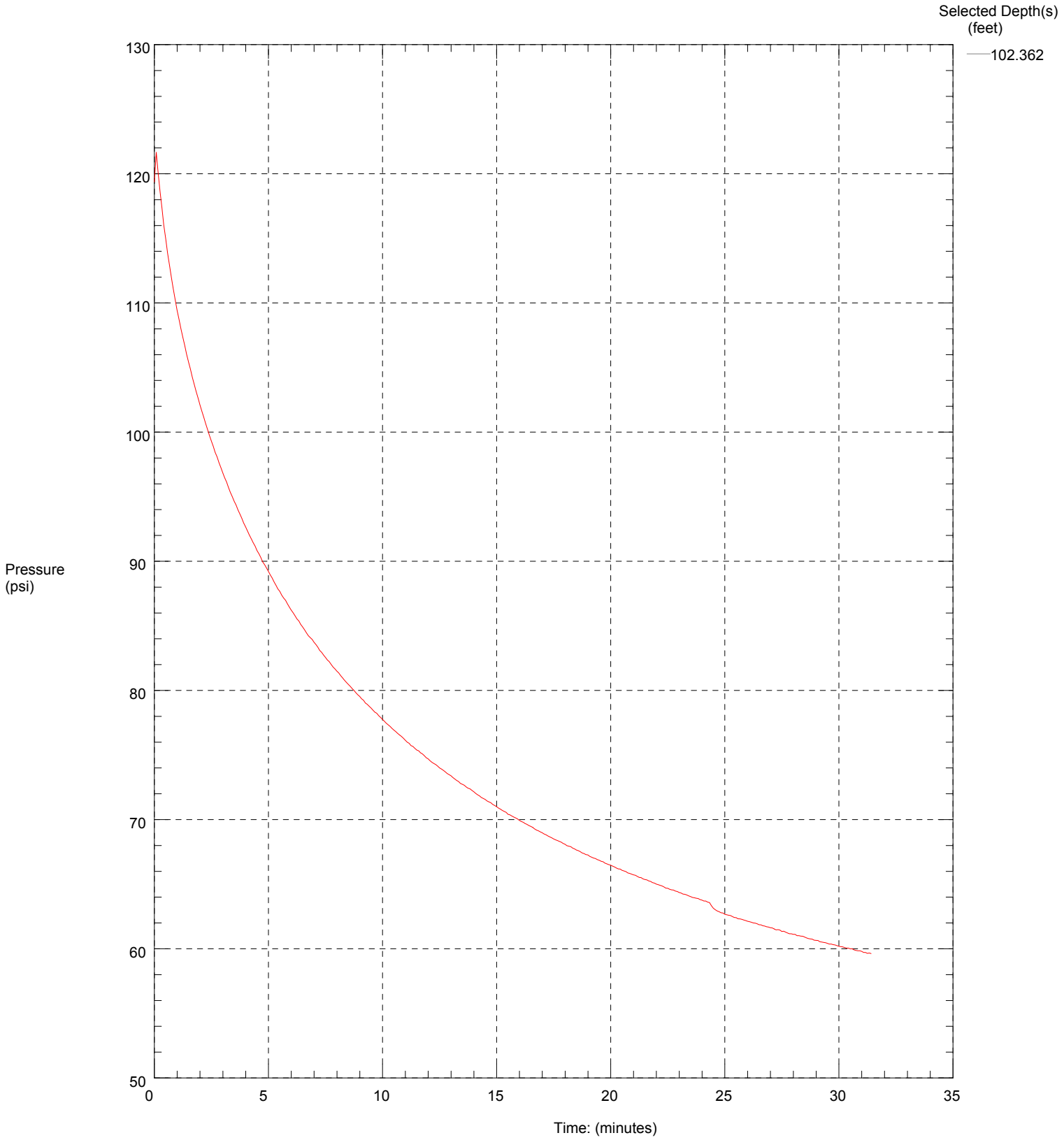


Maximum Pressure = 25.584 psi
Hydrostatic Pressure = 28.976 psi

WSDOT Geotechnical Division

Operator Danny Henderson
Sounding: CPT-13-06
Elevation: Unknown

CPT Date/Time: 08-01-06 08:54
Location: CPT-13-06
Job Number: XL-2672

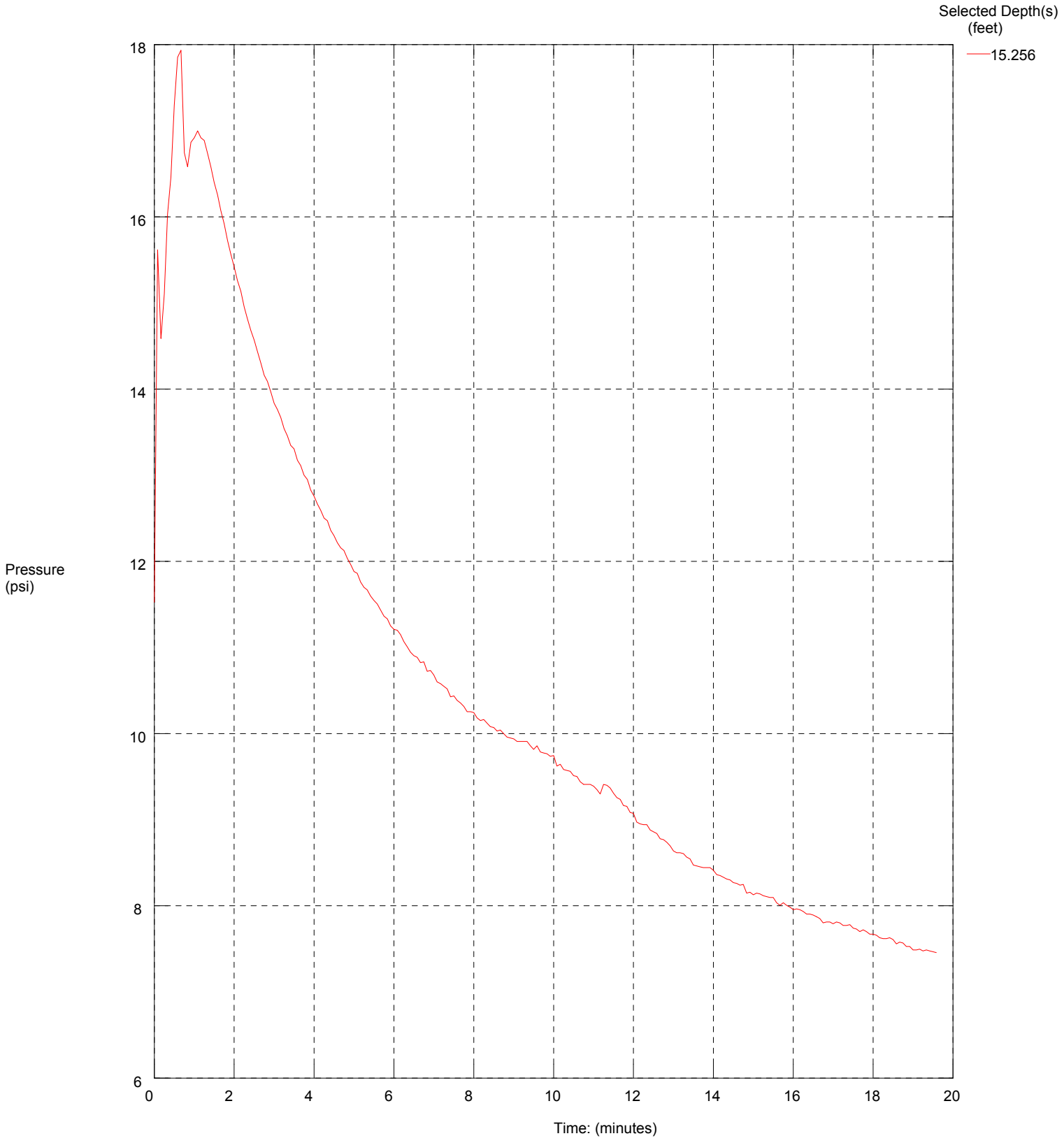


Maximum Pressure = 121.664 psi
Hydrostatic Pressure = 44.425 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-14-06
Elevation: UNKNOWN

CPT Date/Time: 07-27-06 12:18
Location: CPT-14-06
Job Number: XL-2672

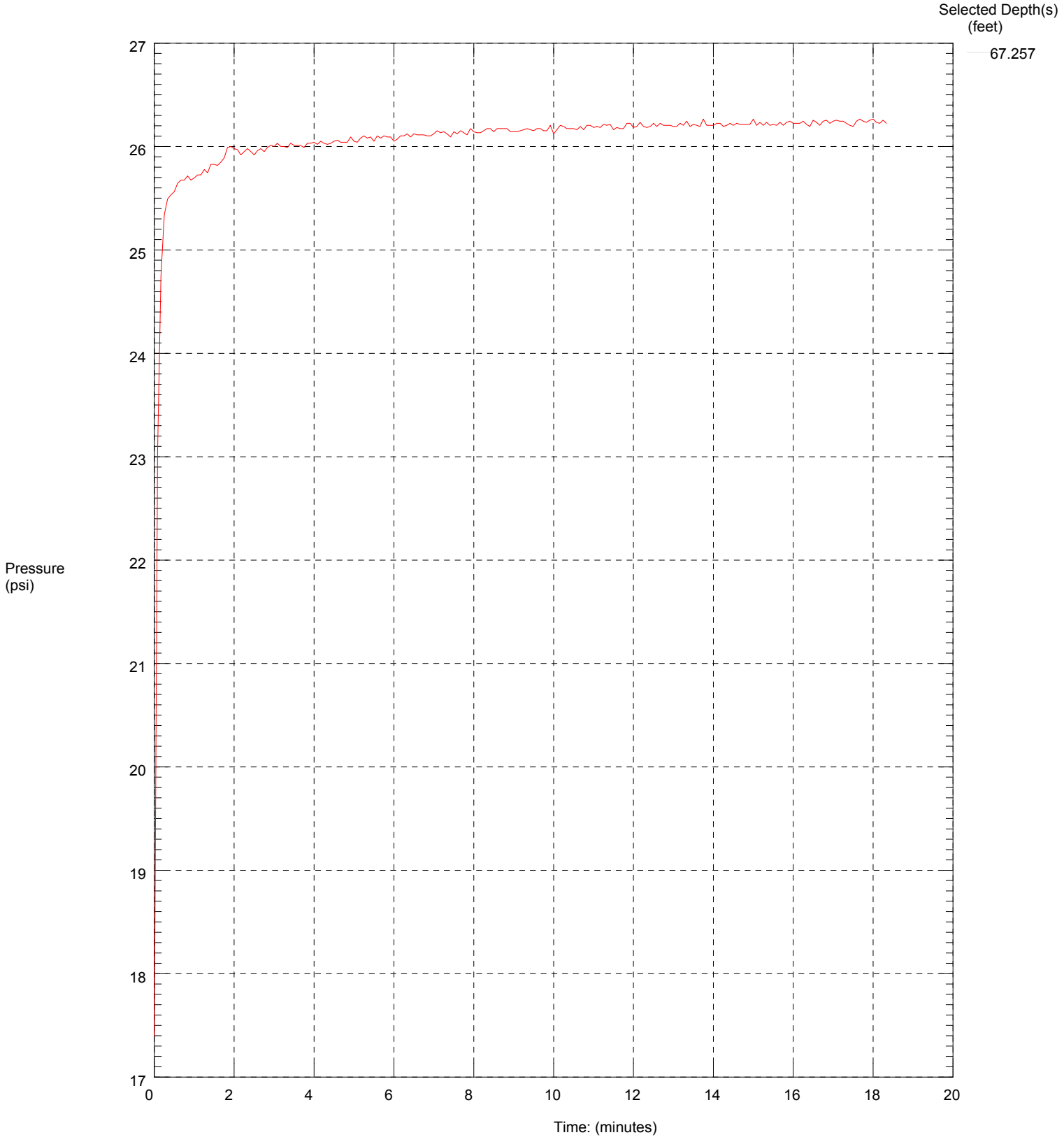


Maximum Pressure = 17.934 psi
Hydrostatic Pressure = 6.621 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-14-06
Elevation: UNKNOWN

CPT Date/Time: 07-27-06 12:18
Location: CPT-14-06
Job Number: XL-2672

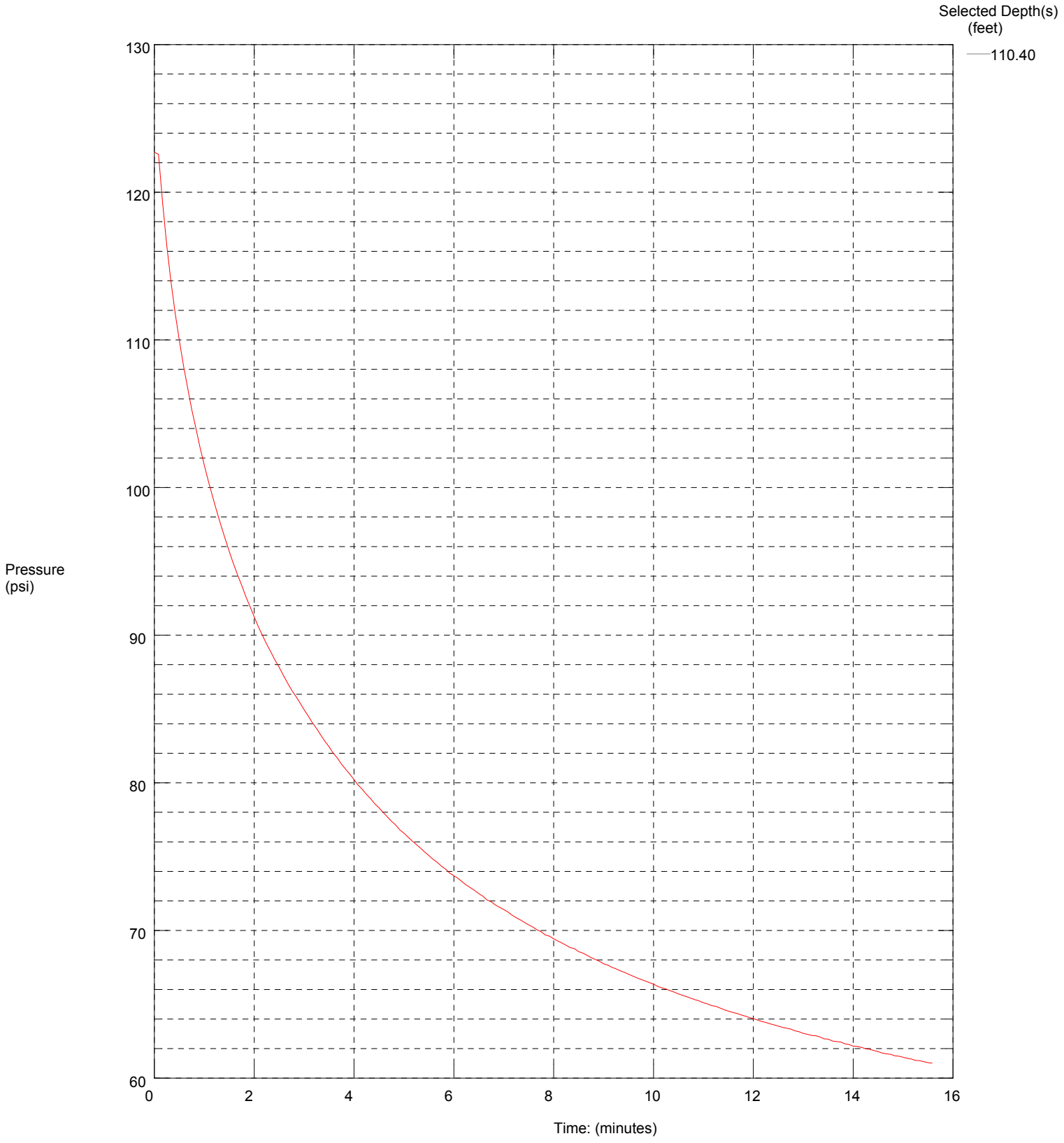


Maximum Pressure = 26.266 psi
Hydrostatic Pressure = 29.19 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-14-06
Elevation: UNKNOWN

CPT Date/Time: 07-27-06 12:18
Location: CPT-14-06
Job Number: XL-2672

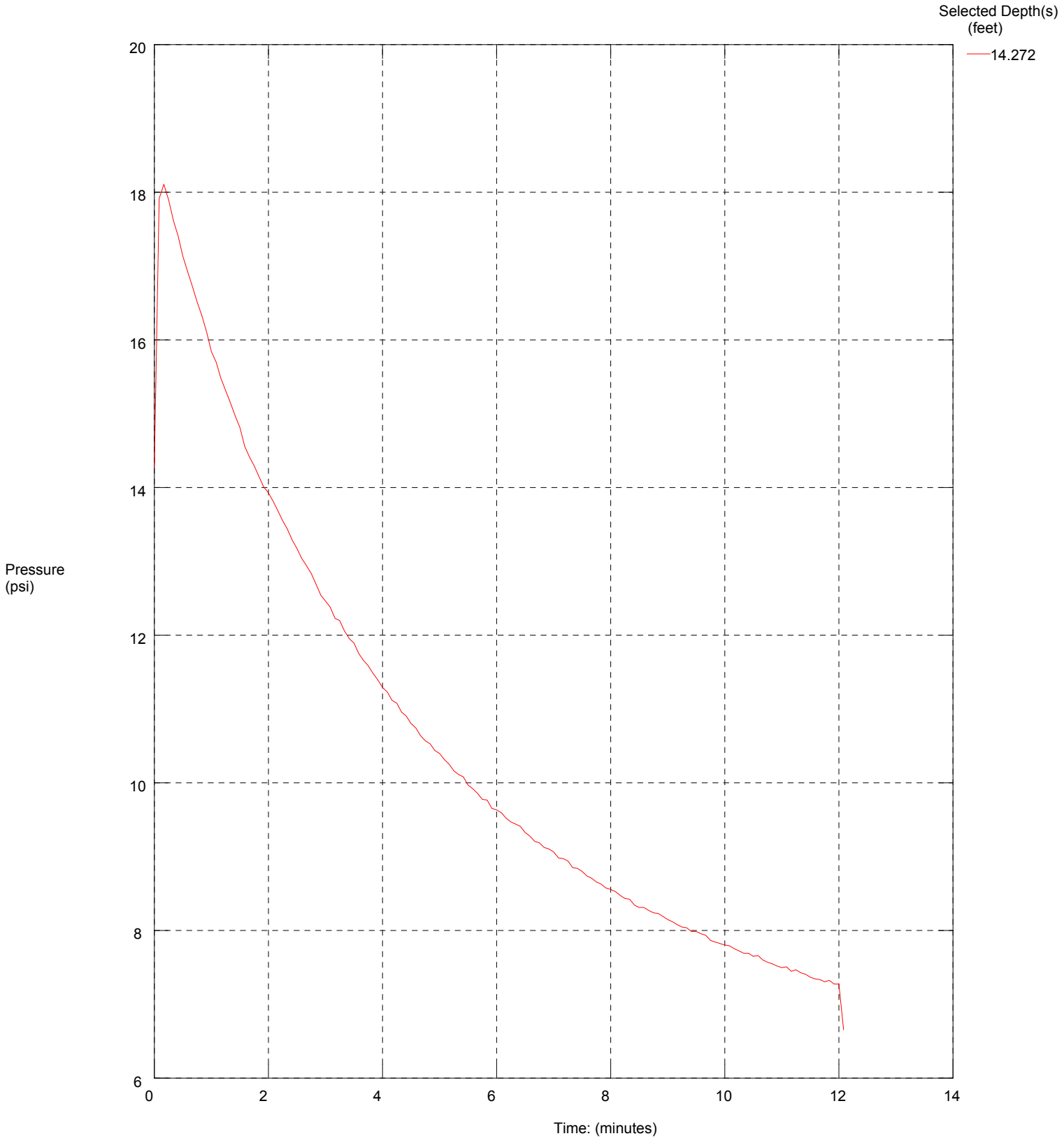


Maximum Pressure = 122.712 psi
Hydrostatic Pressure = 47.914 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-15-06
Elevation: Unknown

CPT Date/Time: 07-31-06 13:36
Location: CPT-15-06
Job Number: XL-2672

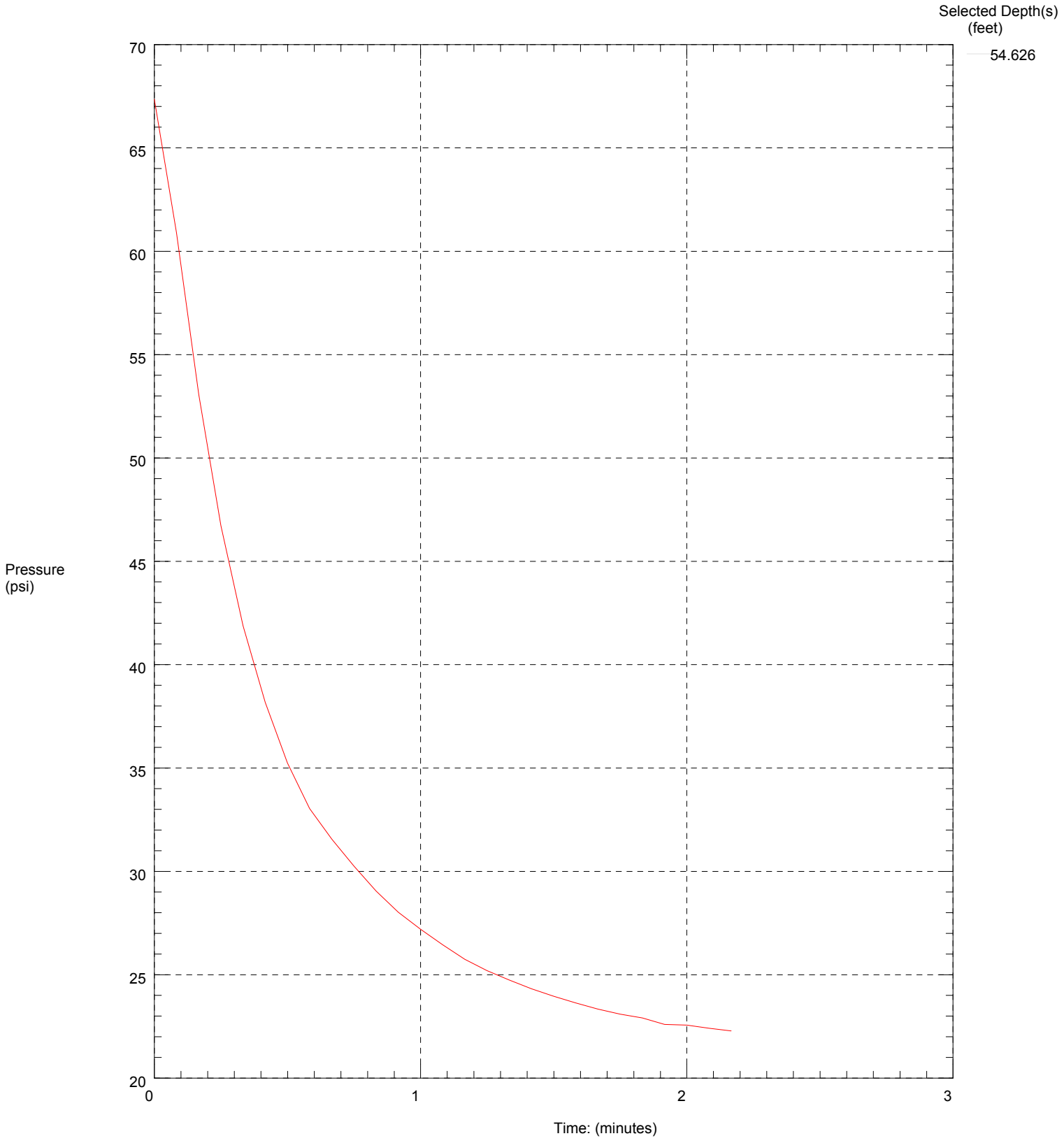


Maximum Pressure = 18.107 psi
Hydrostatic Pressure = 6.194 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-15-06
Elevation: Unknown

CPT Date/Time: 07-31-06 13:36
Location: CPT-15-06
Job Number: XL-2672

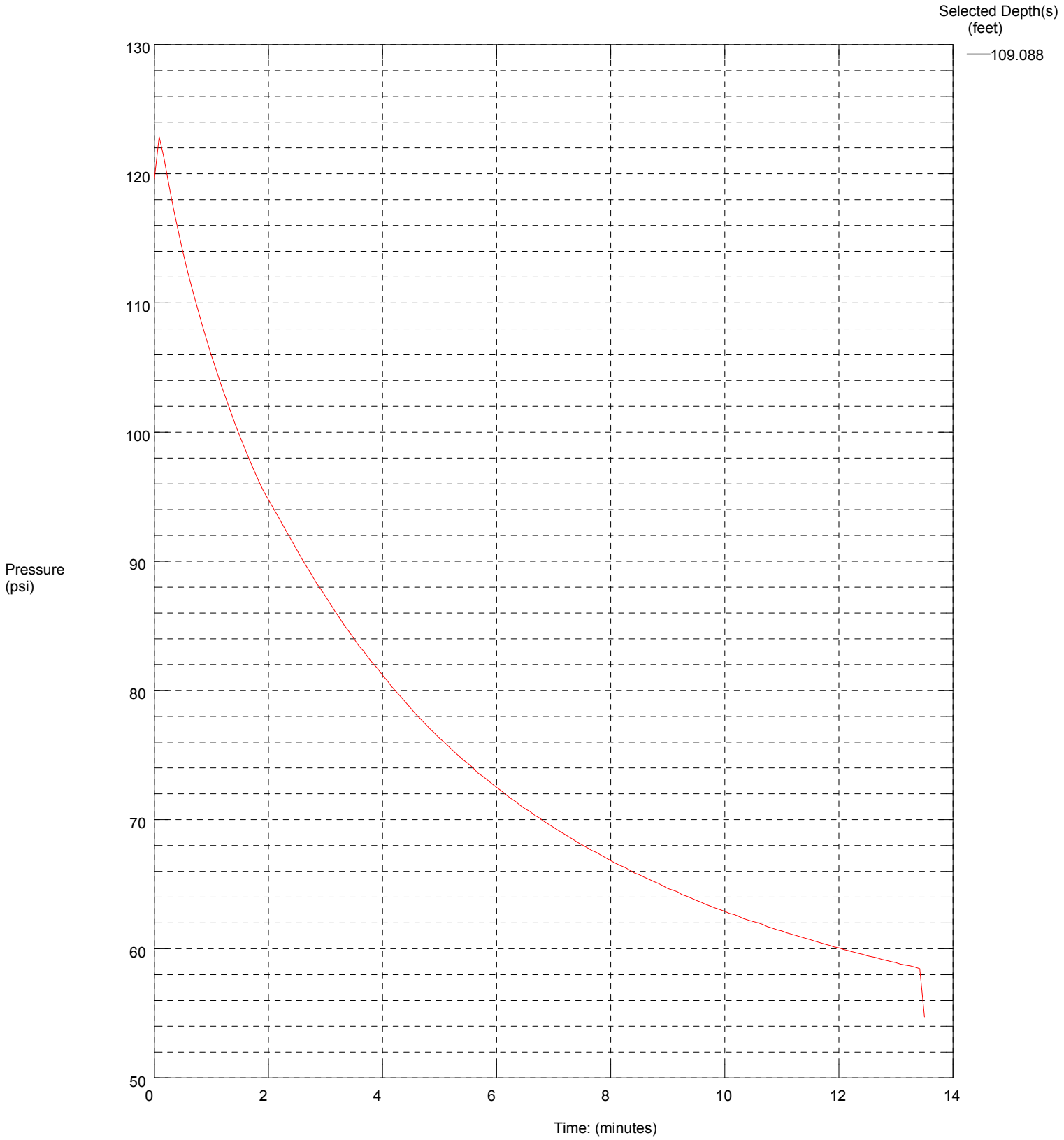


Maximum Pressure = 67.353 psi
Hydrostatic Pressure = 23.708 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-15-06
Elevation: Unknown

CPT Date/Time: 07-31-06 13:36
Location: CPT-15-06
Job Number: XL-2672

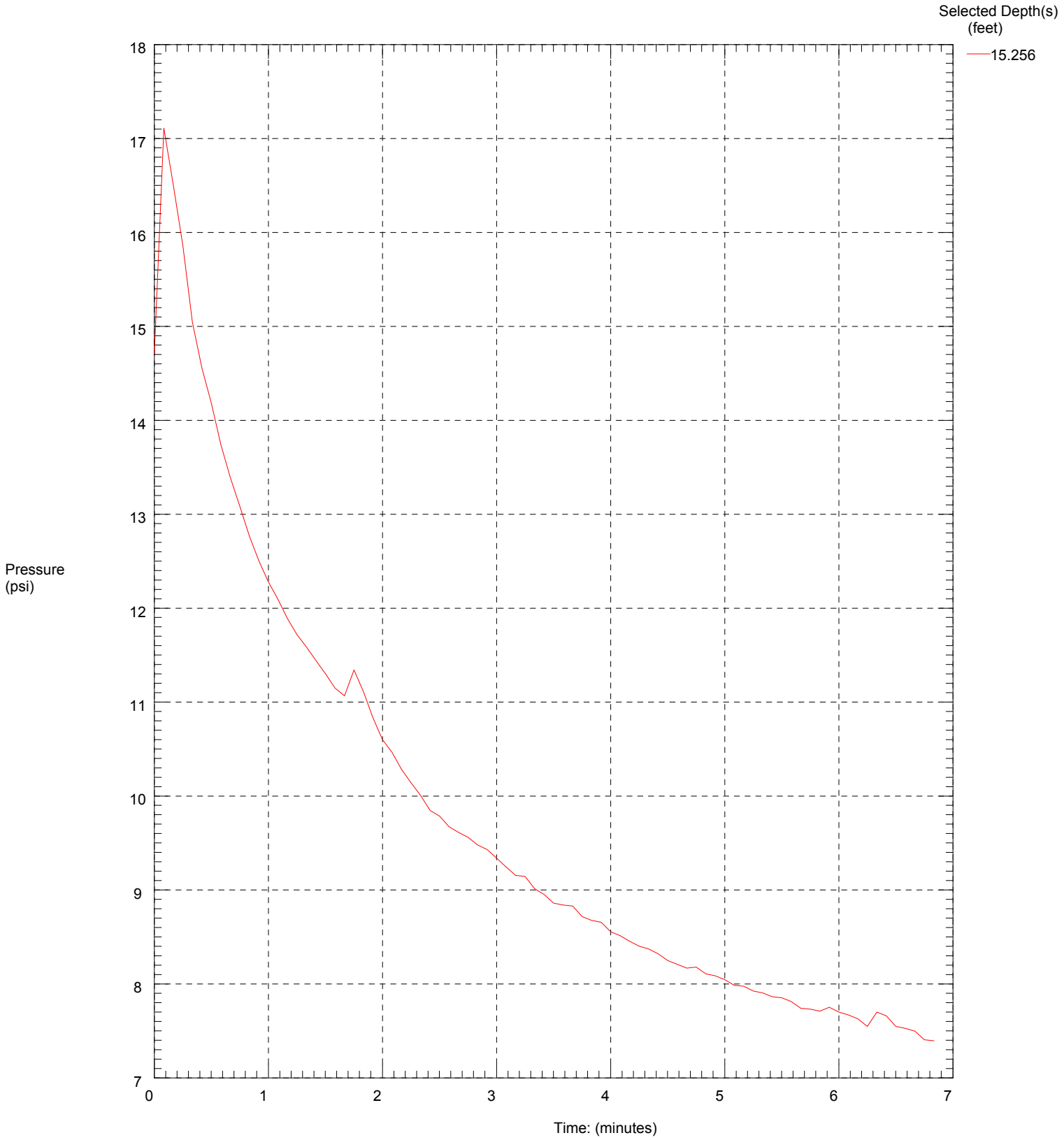


Maximum Pressure = 122.854 psi
Hydrostatic Pressure = 47.344 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-16-06
Elevation: UNKNOWN

CPT Date/Time: 07-19-06 15:12
Location: CPT-16-06
Job Number: XL-2672

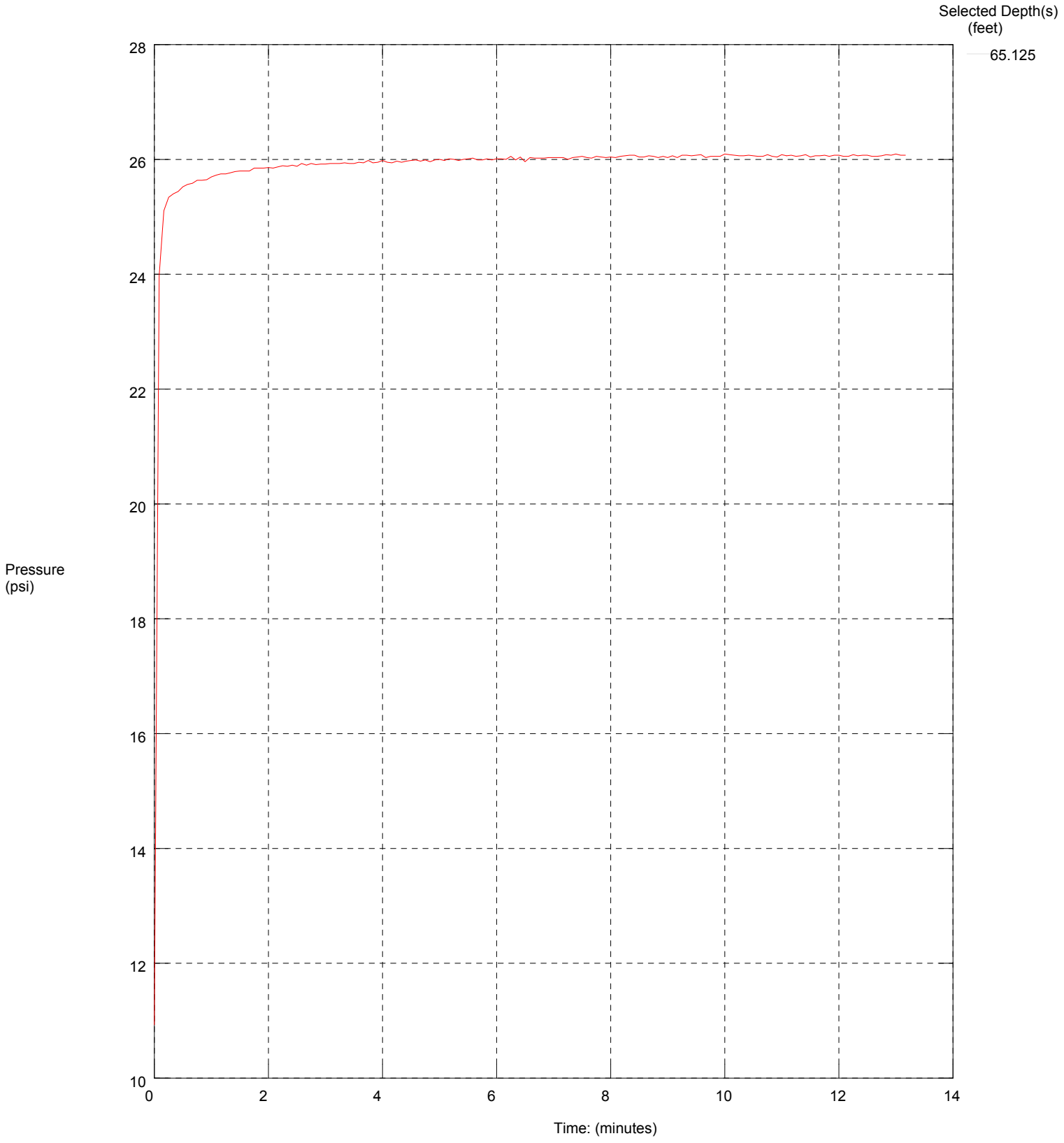


Maximum Pressure = 17.11 psi
Hydrostatic Pressure = 6.621 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-16-06
Elevation: UNKNOWN

CPT Date/Time: 07-19-06 15:12
Location: CPT-16-06
Job Number: XL-2672

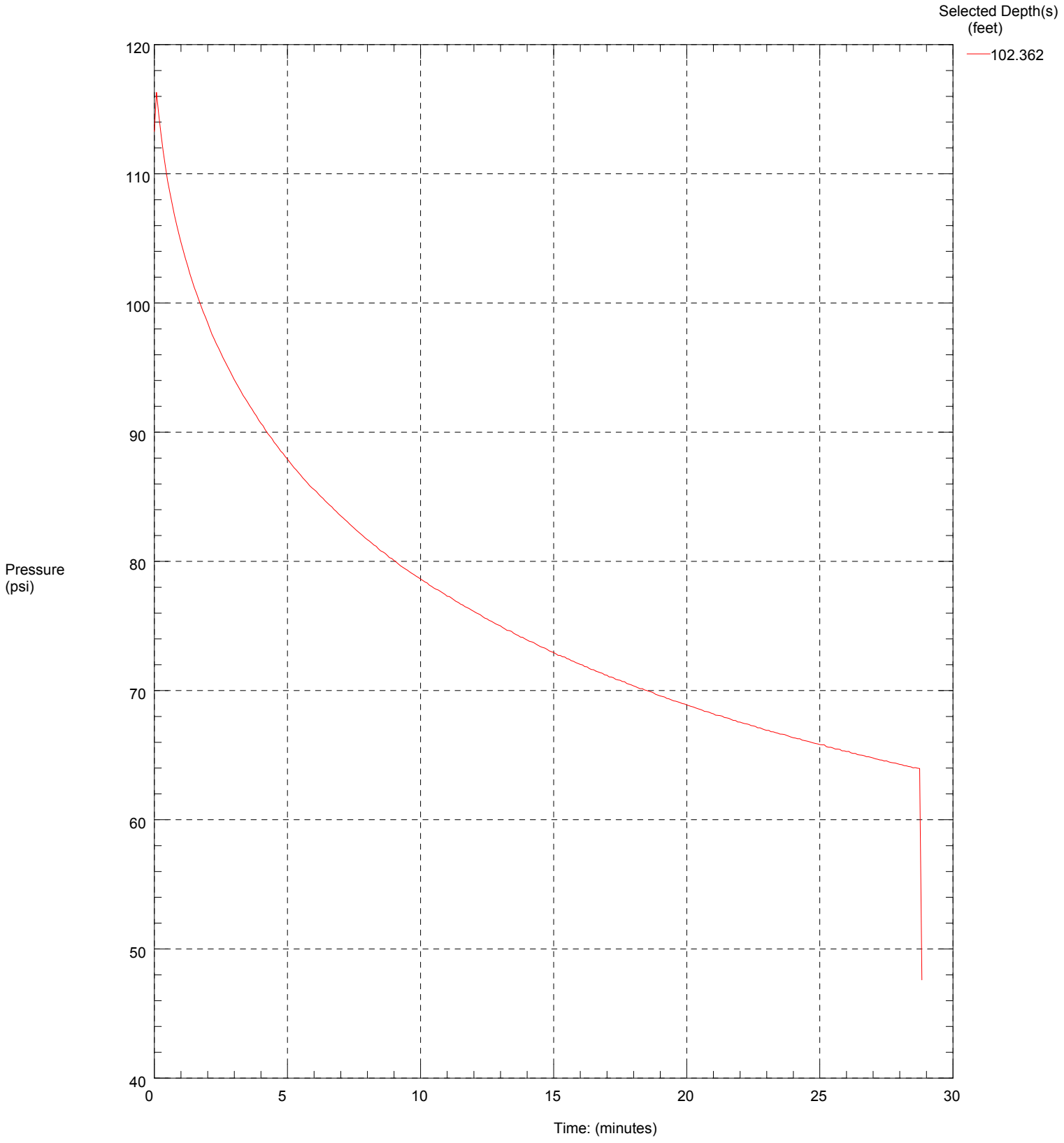


Maximum Pressure = 26.093 psi
Hydrostatic Pressure = 28.264 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT17a-06
Elevation: Unknown

CPT Date/Time: 07-26-06 07:46
Location: CPT-17A-06
Job Number: XL-2672

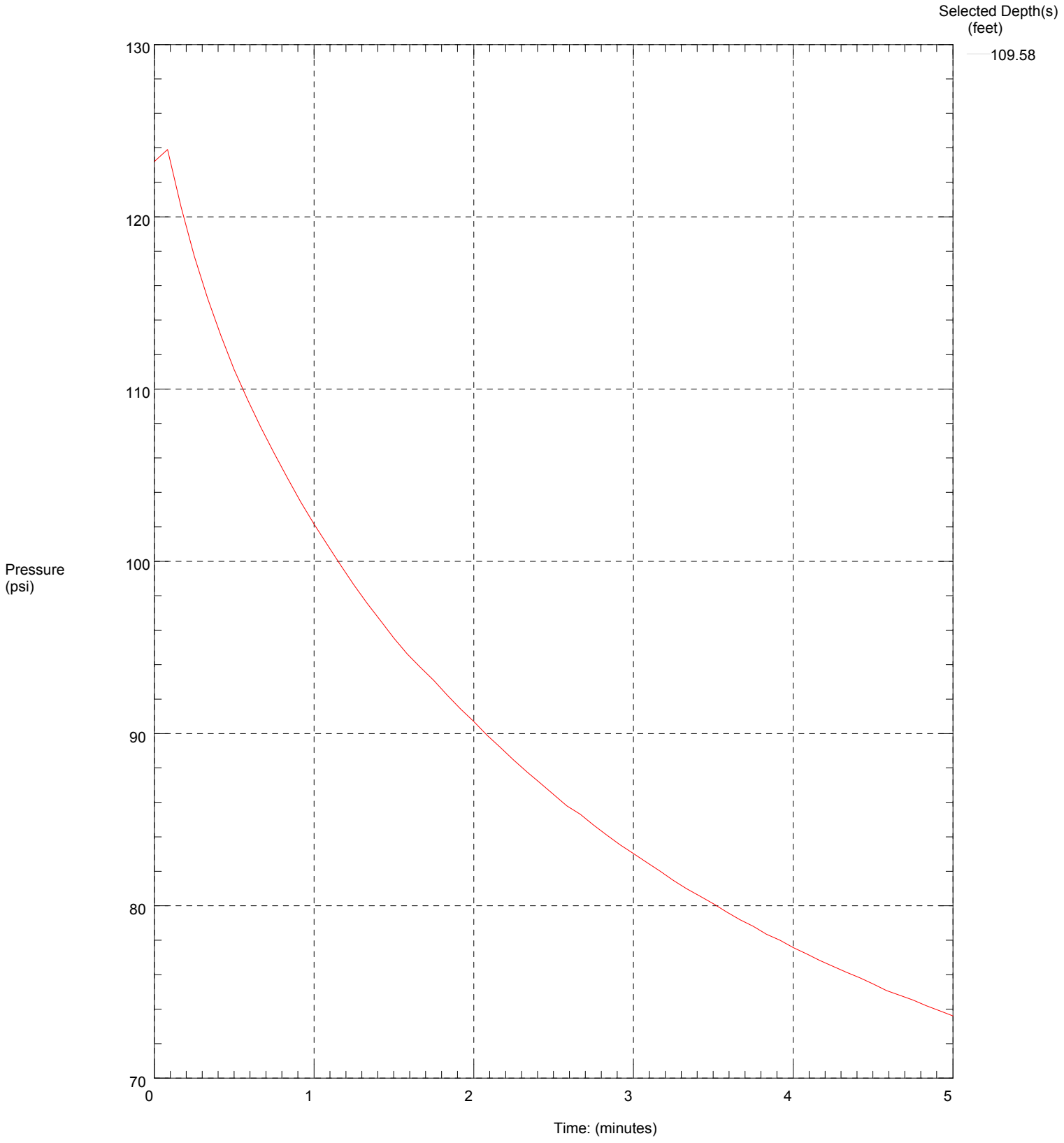


Maximum Pressure = 116.303 psi
Hydrostatic Pressure = 44.425 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT17a-06
Elevation: Unknown

CPT Date/Time: 07-26-06 07:46
Location: CPT-17A-06
Job Number: XL-2672

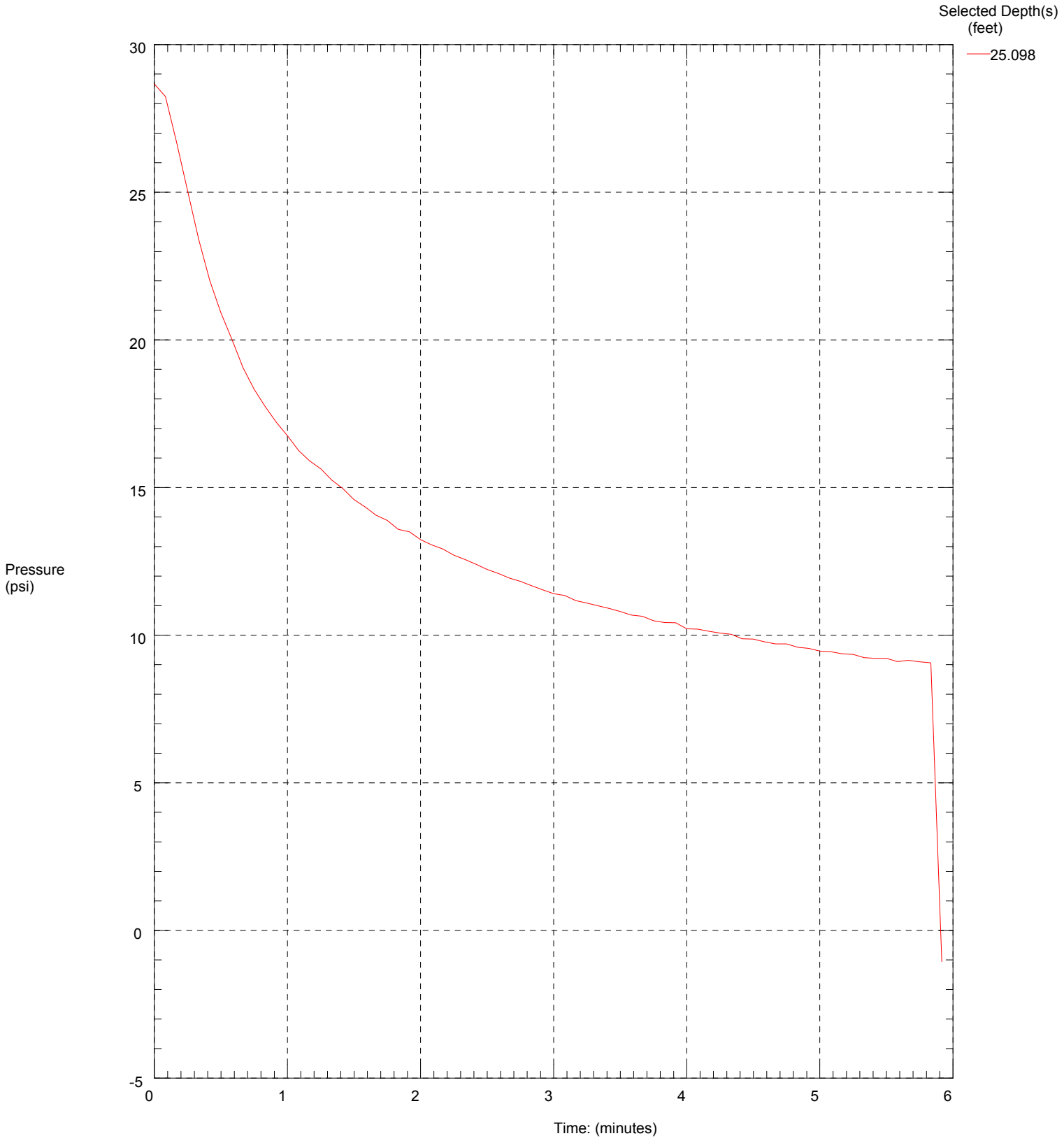


Maximum Pressure = 123.912 psi
Hydrostatic Pressure = 47.558 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-17-06
Elevation: Unknown

CPT Date/Time: 07-25-06 13:28
Location: CPT-17-06
Job Number: XL-2672

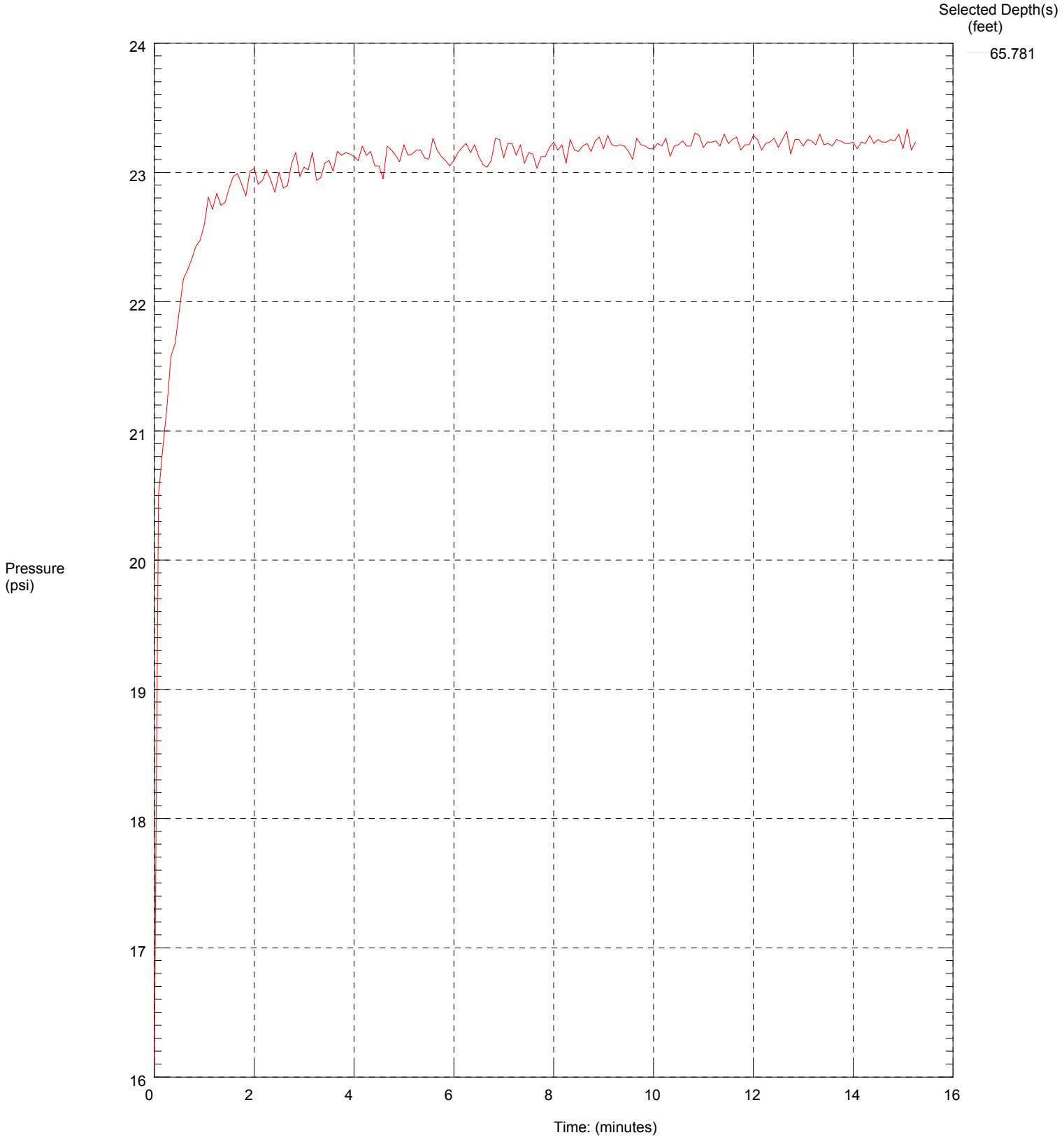


Maximum Pressure = 28.666 psi
Hydrostatic Pressure = 10.893 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-17-06
Elevation: Unknown

CPT Date/Time: 07-25-06 13:28
Location: CPT-17-06
Job Number: XL-2672

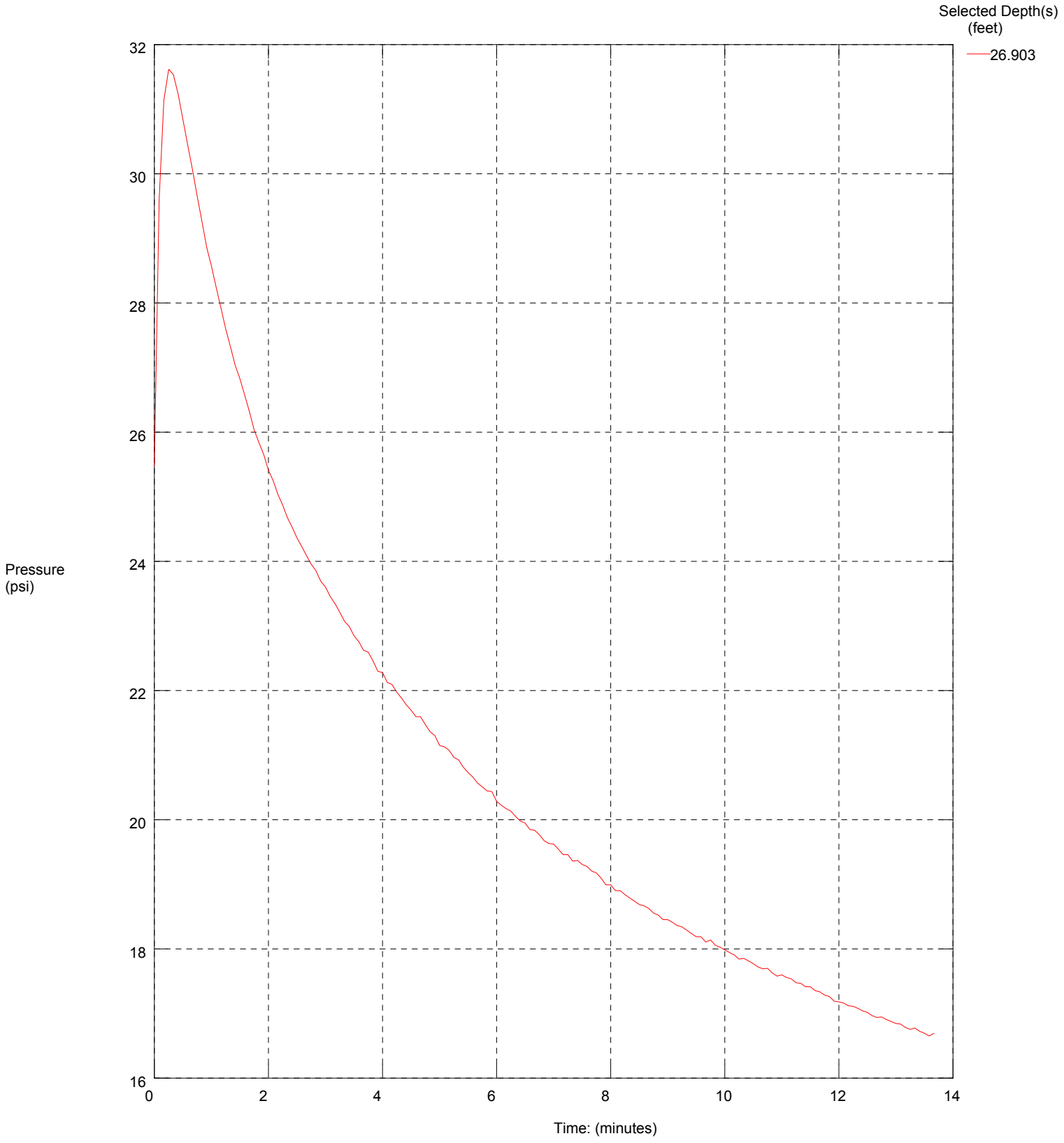


Maximum Pressure = 23.336 psi
Hydrostatic Pressure = 28.549 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-18-06
Elevation: Unknown

CPT Date/Time: 07-27-06 08:55
Location: CPT-18-06
Job Number: XL-2672

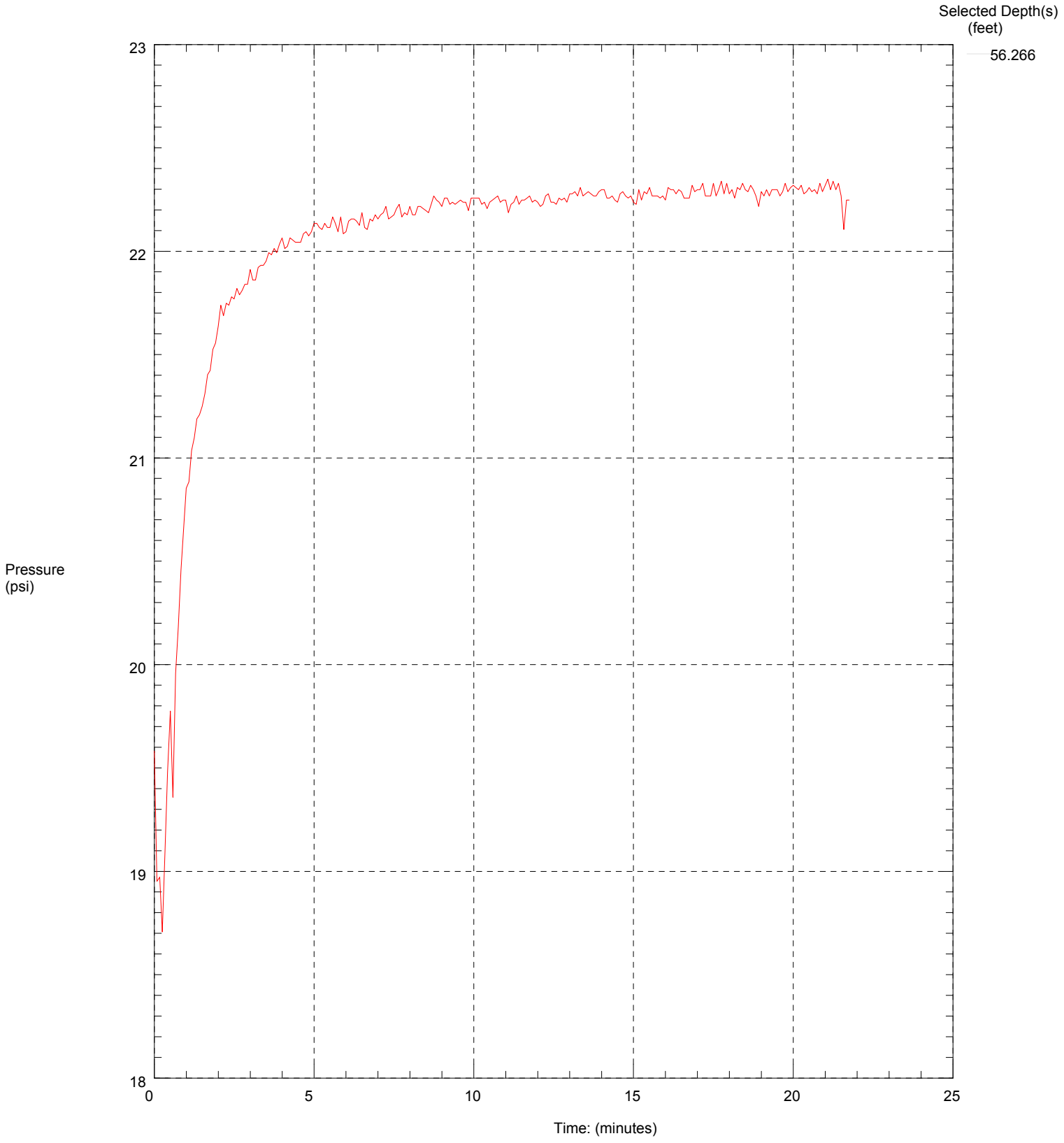


Maximum Pressure = 31.616 psi
Hydrostatic Pressure = 11.676 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-18-06
Elevation: Unknown

CPT Date/Time: 07-27-06 08:55
Location: CPT-18-06
Job Number: XL-2672

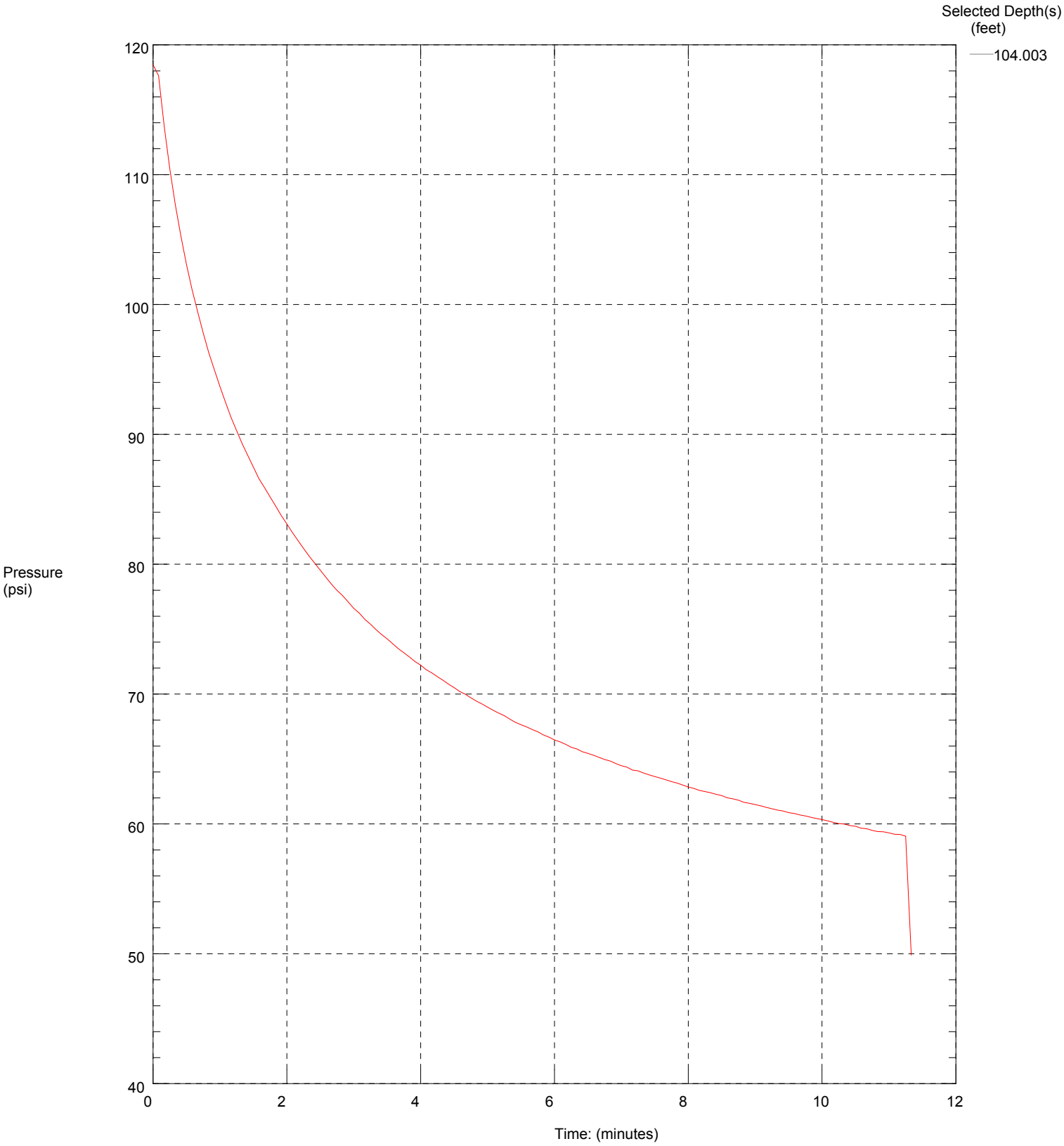


Maximum Pressure = 22.349 psi
Hydrostatic Pressure = 24.419 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-18-06
Elevation: Unknown

CPT Date/Time: 07-27-06 08:55
Location: CPT-18-06
Job Number: XL-2672

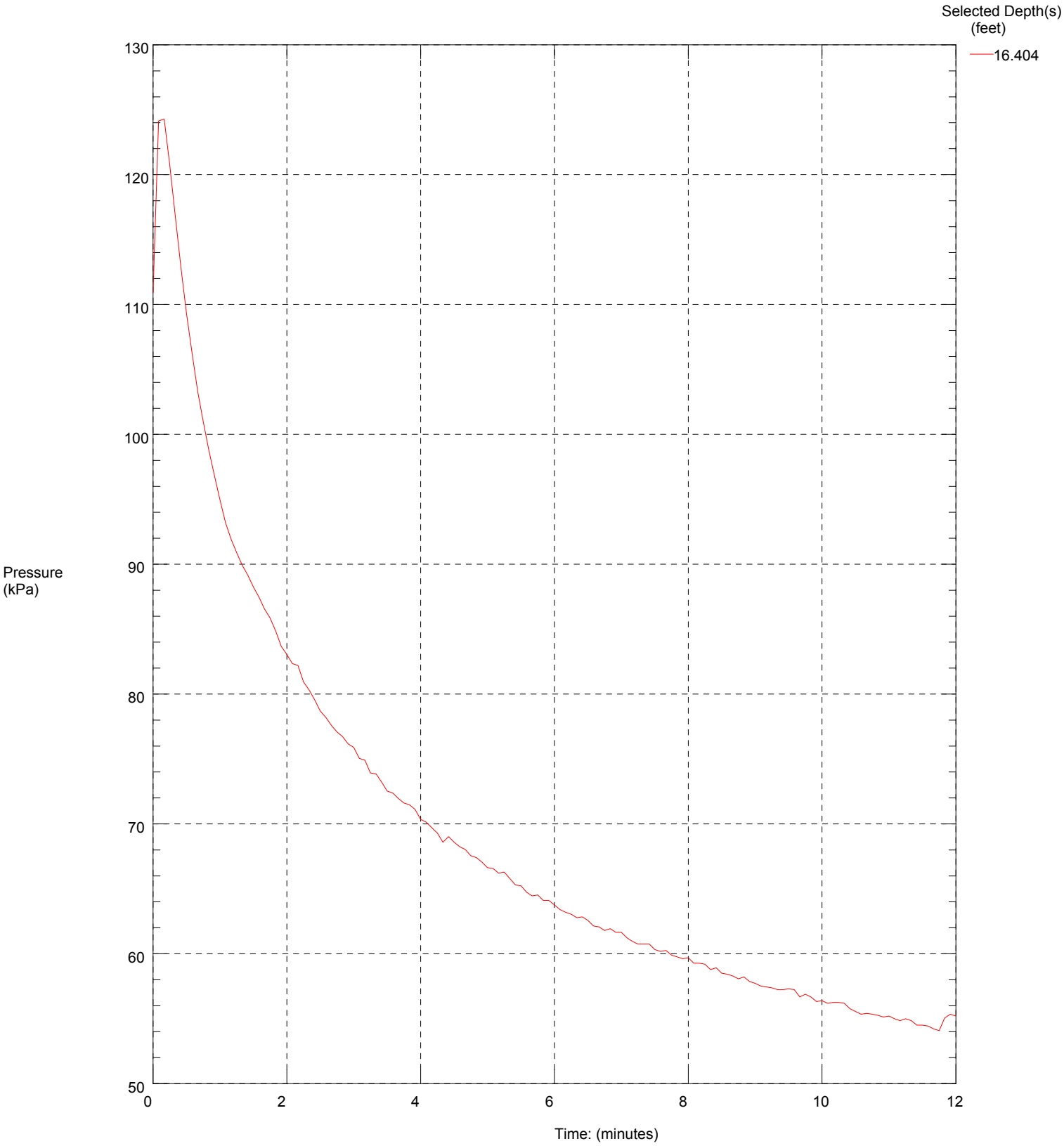


Maximum Pressure = 118.47 psi
Hydrostatic Pressure = 45.137 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-19-06
Elevation: Unknown

CPT Date/Time: 07-25-06 08:10
Location: CPT-19-06
Job Number: XL-2672

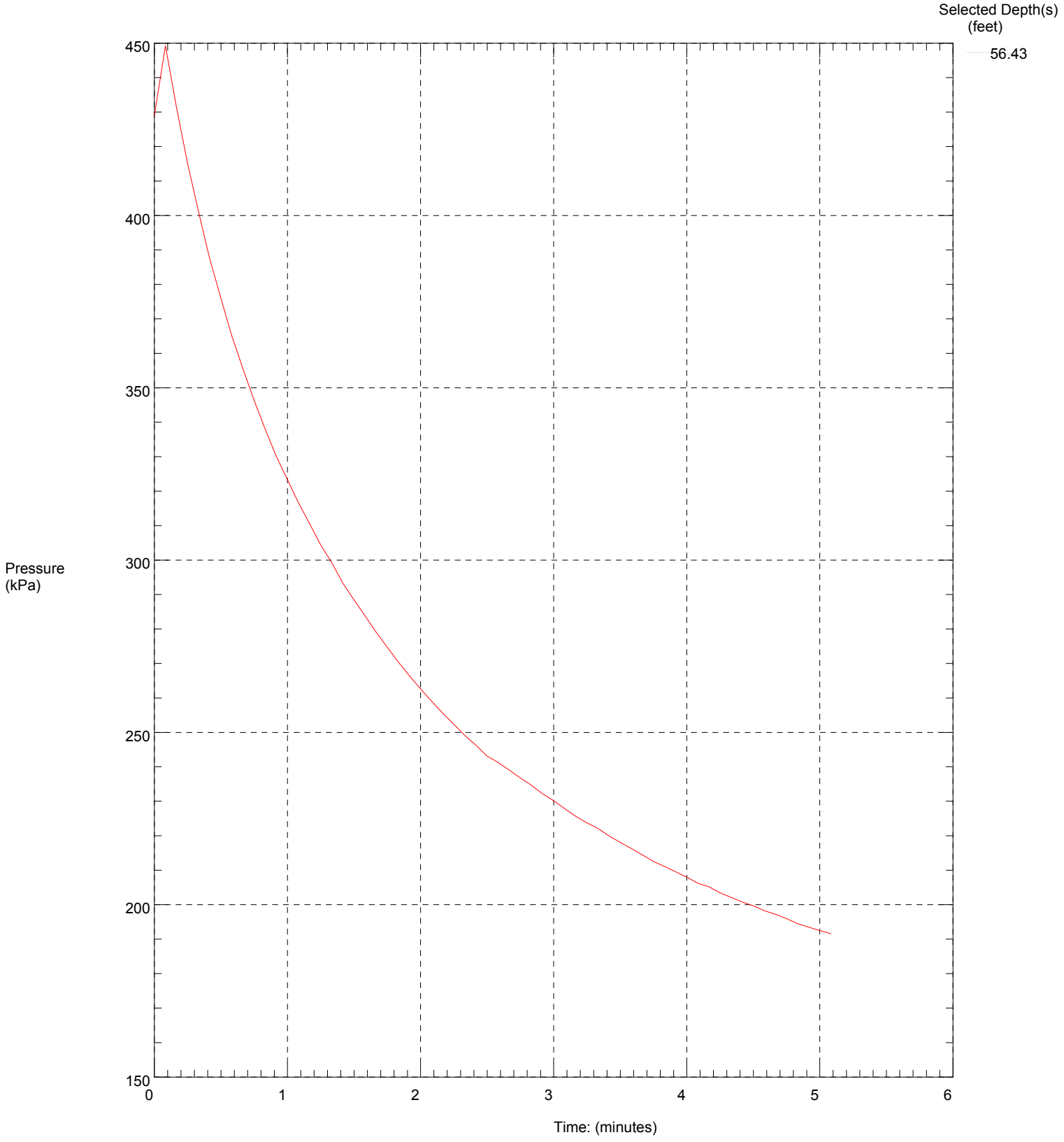


Maximum Pressure = 124.28 kPa
Hydrostatic Pressure = 49.088 kPa

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-19-06
Elevation: Unknown

CPT Date/Time: 07-25-06 08:10
Location: CPT-19-06
Job Number: XL-2672

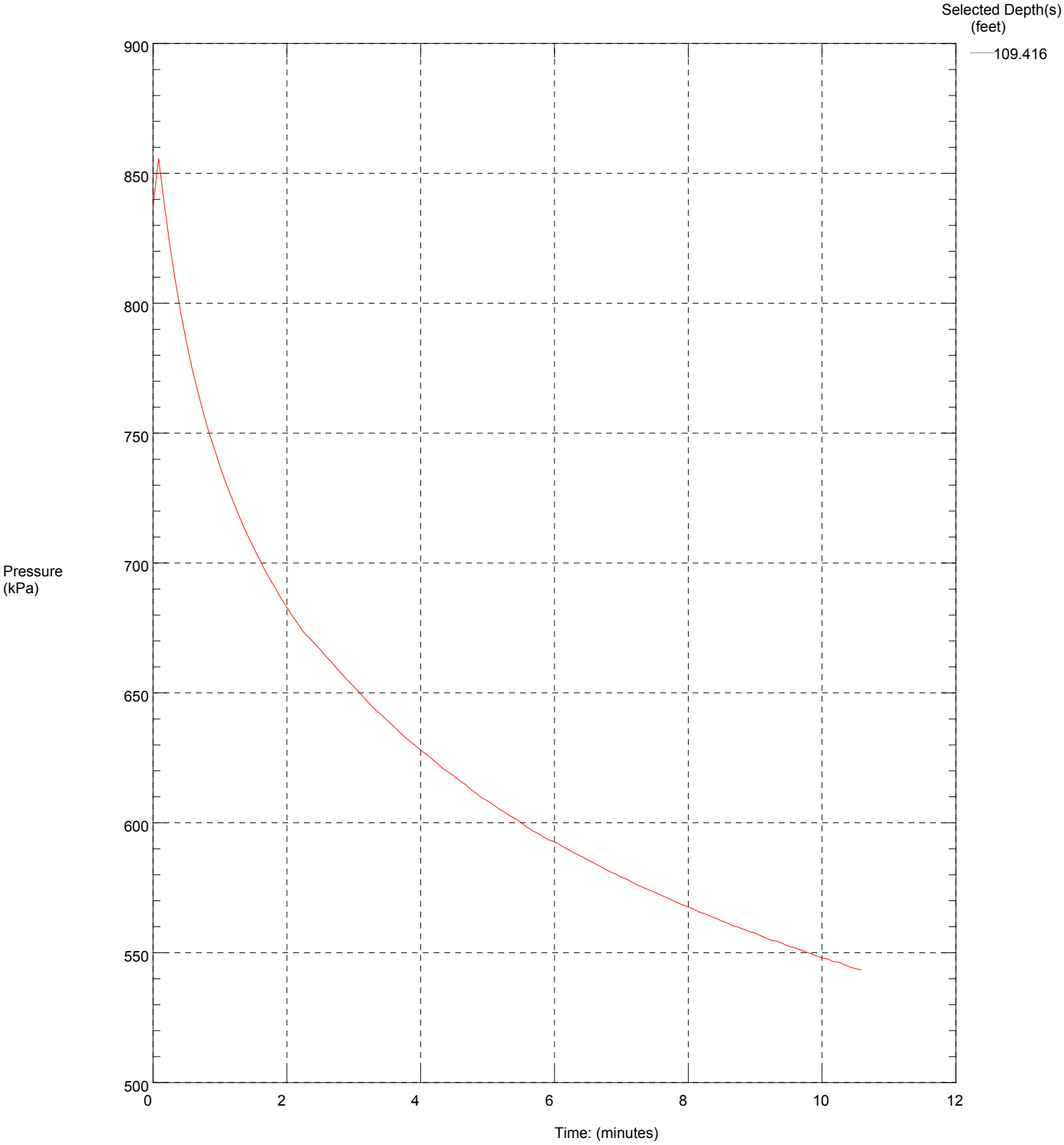


Maximum Pressure = 449.218 kPa
Hydrostatic Pressure = 168.863 kPa

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-19-06
Elevation: Unknown

CPT Date/Time: 07-25-06 08:10
Location: CPT-19-06
Job Number: XL-2672

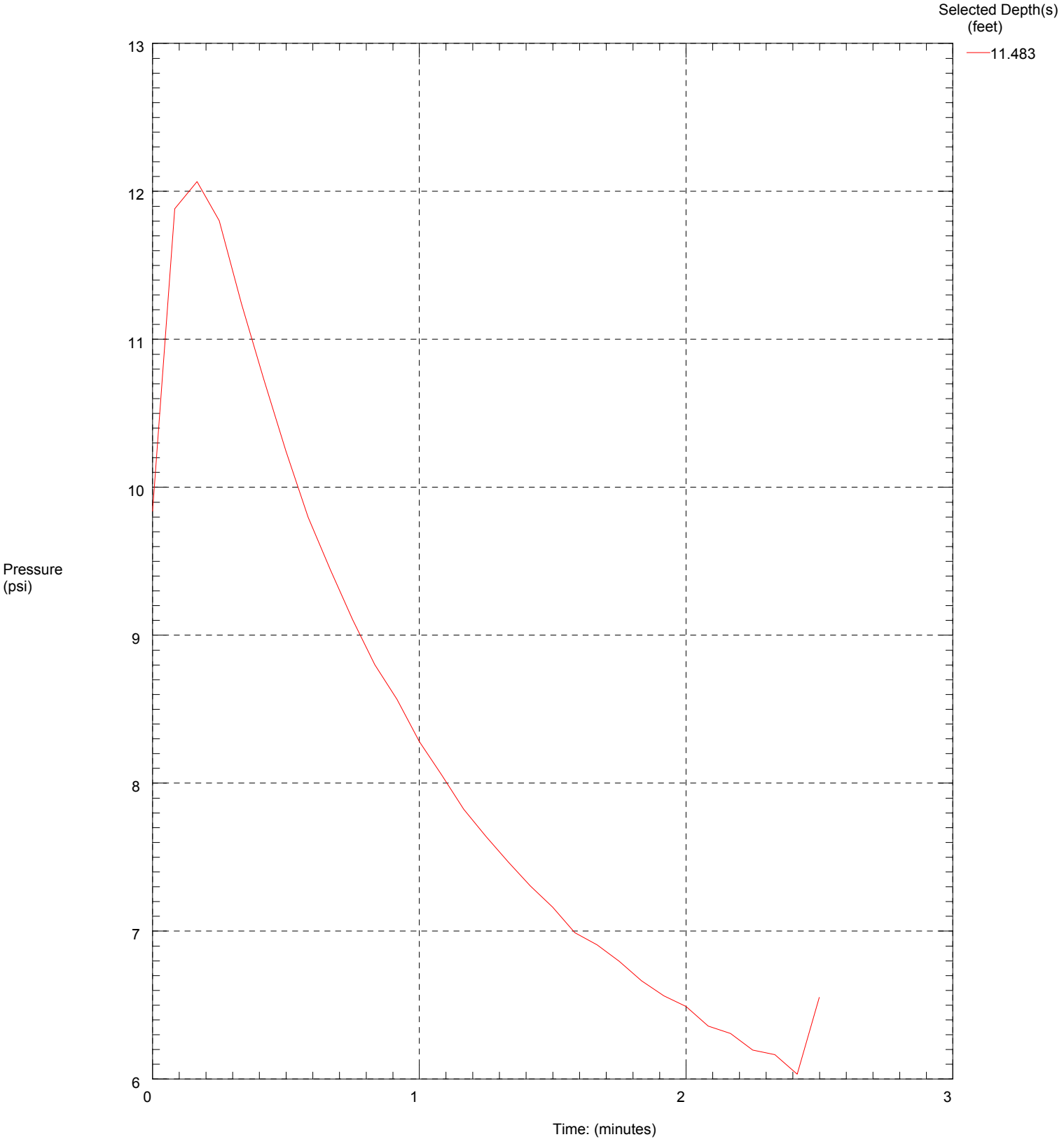


Maximum Pressure = 855.653 kPa
Hydrostatic Pressure = 327.42 kPa

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-20-06
Elevation: UNKNOWN

CPT Date/Time: 07-26-06 11:15
Location: CPT-20-06
Job Number: XL-2672

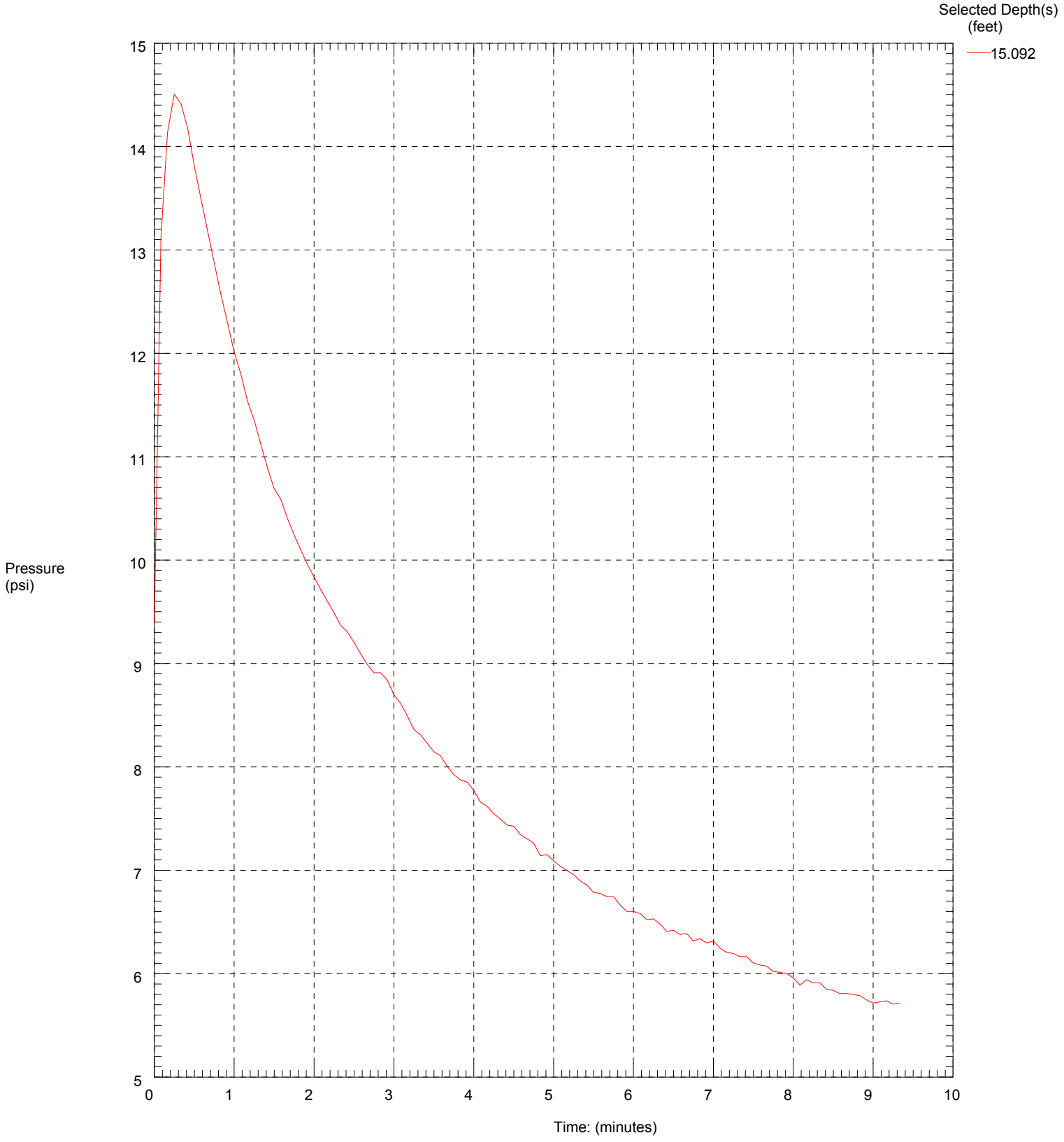


Maximum Pressure = 12.065 psi
Hydrostatic Pressure = 4.984 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-21-06
Elevation: Unknown

CPT Date/Time: 07-12-06 12:21
Location: CPT-21
Job Number: XL-2672

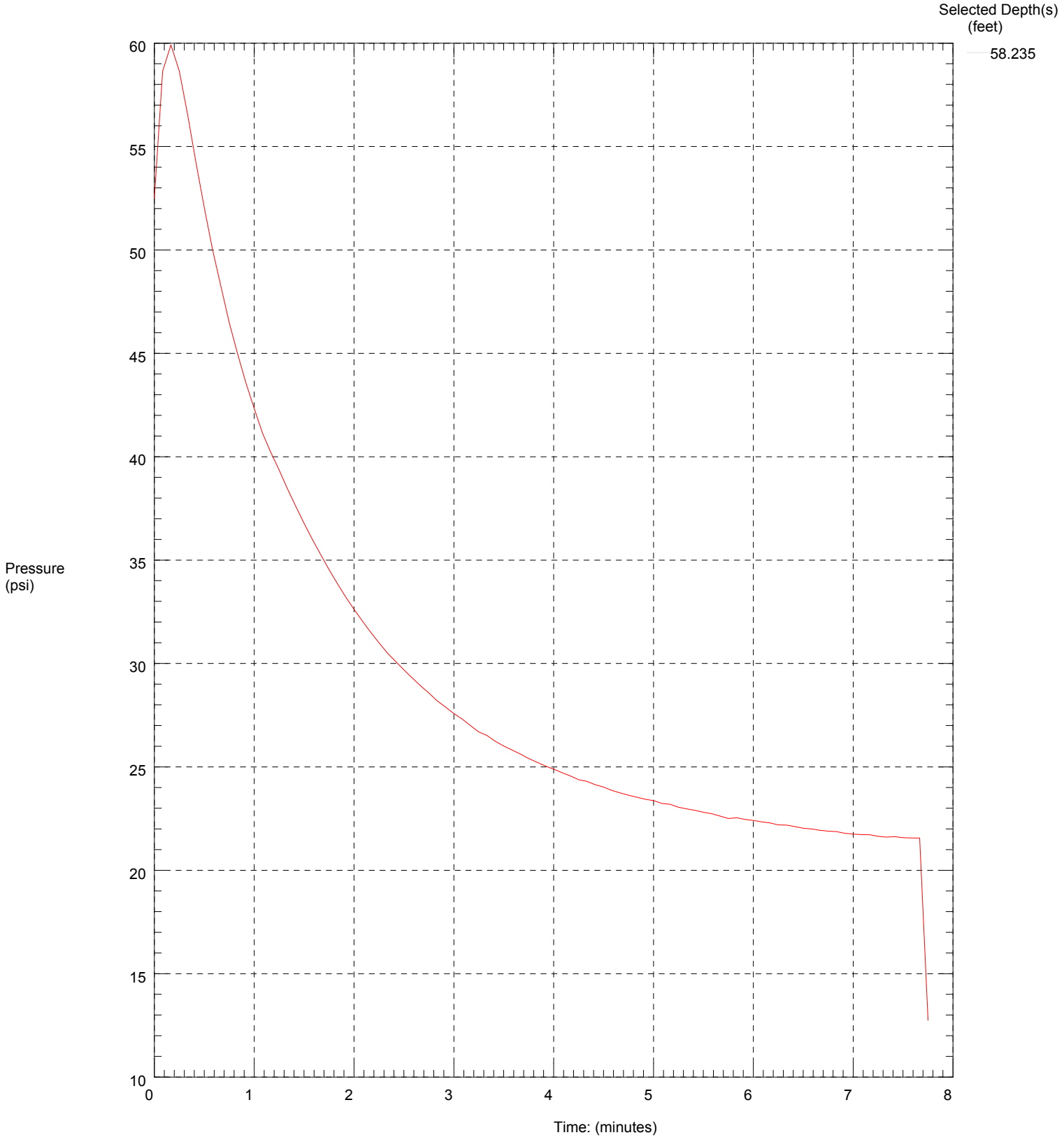


Maximum Pressure = 14.506 psi
Hydrostatic Pressure = 6.55 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-21-06
Elevation: Unknown

CPT Date/Time: 07-12-06 12:21
Location: CPT-21
Job Number: XL-2672

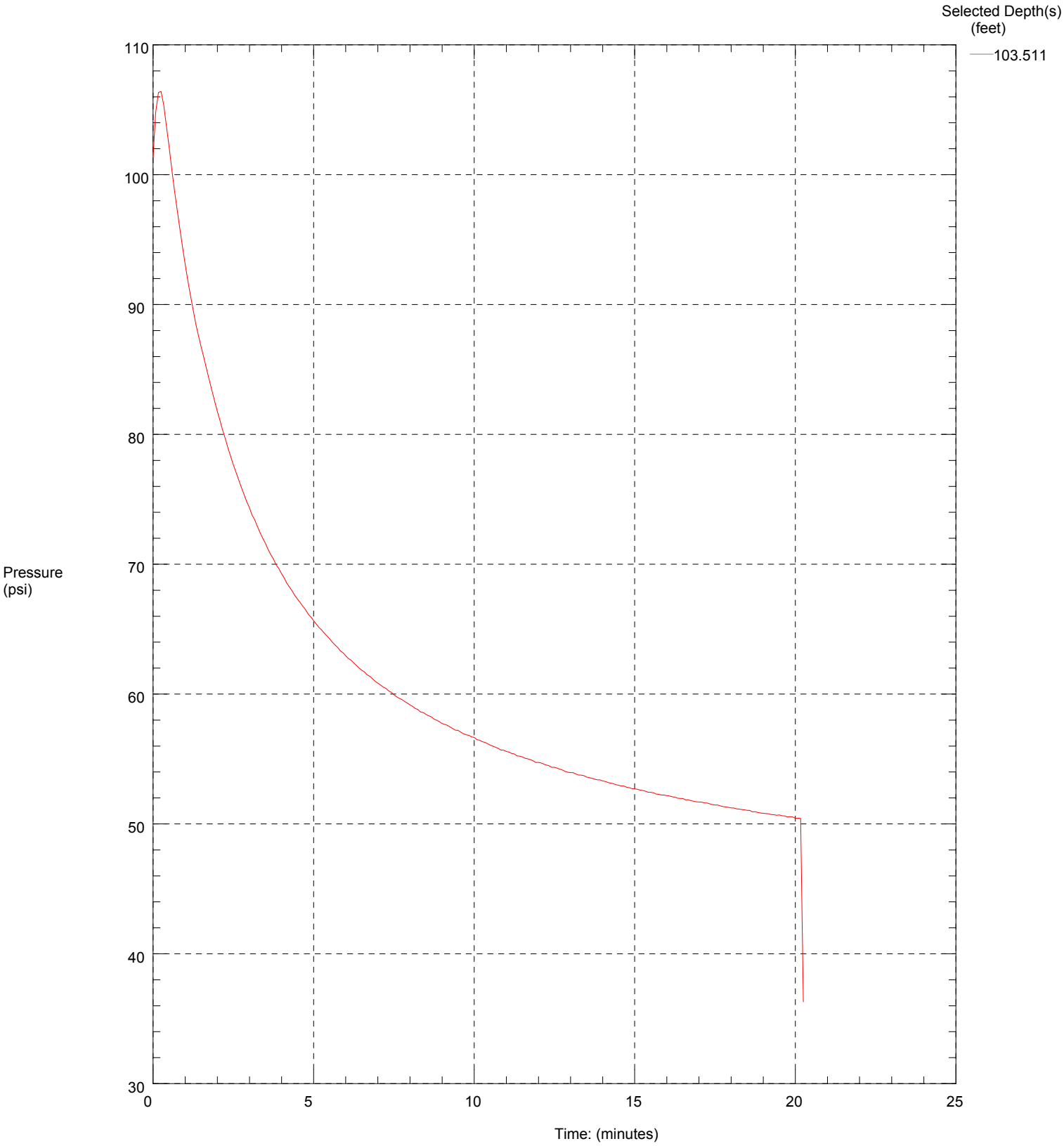


Maximum Pressure = 59.916 psi
Hydrostatic Pressure = 25.274 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-21-06
Elevation: Unknown

CPT Date/Time: 07-12-06 12:21
Location: CPT-21
Job Number: XL-2672

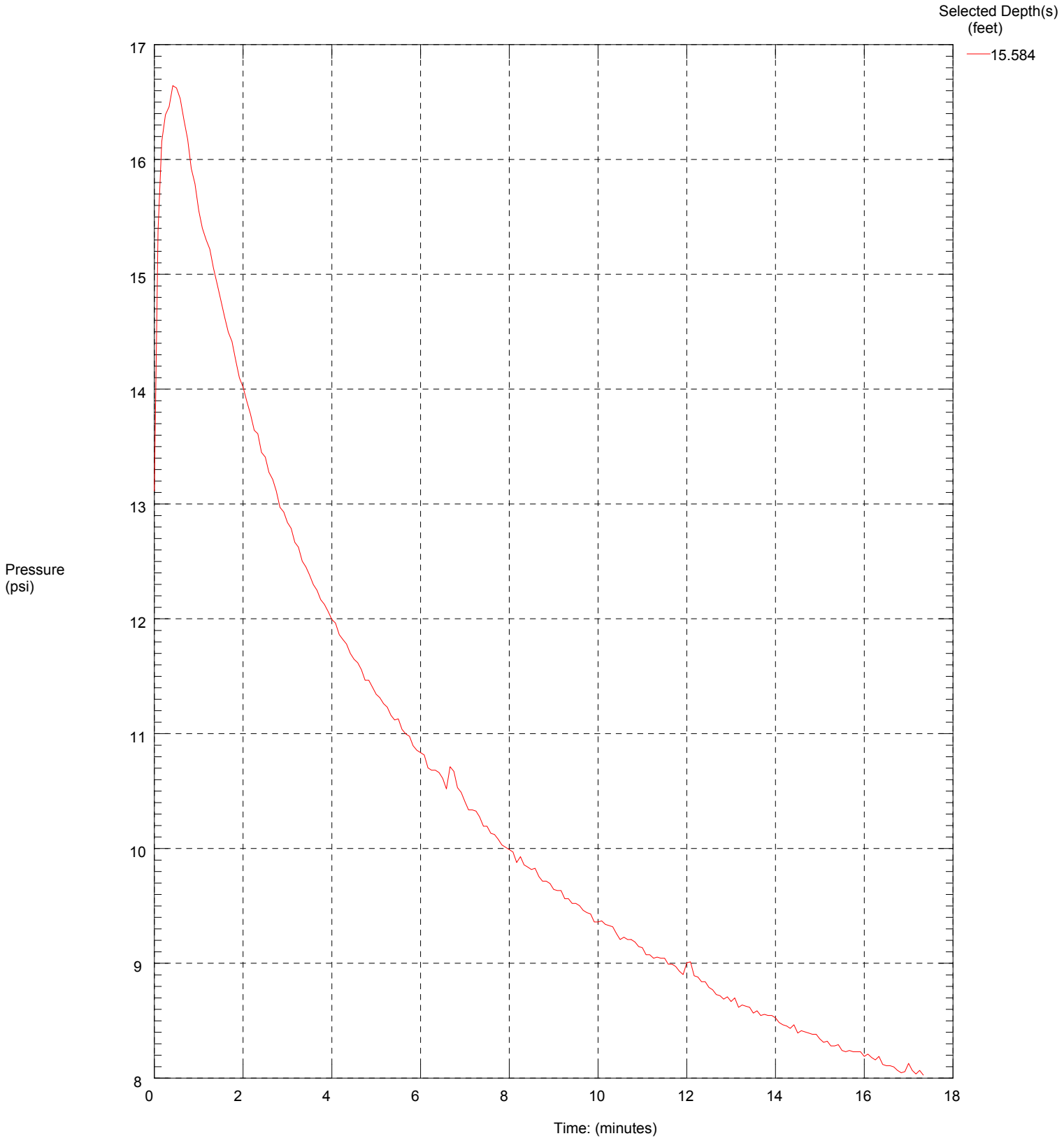


Maximum Pressure = 106.405 psi
Hydrostatic Pressure = 44.924 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-22-06
Elevation: UNKNOWN

CPT Date/Time: 07-18-06 14:55
Location: CPT-22-06
Job Number: XL-2672

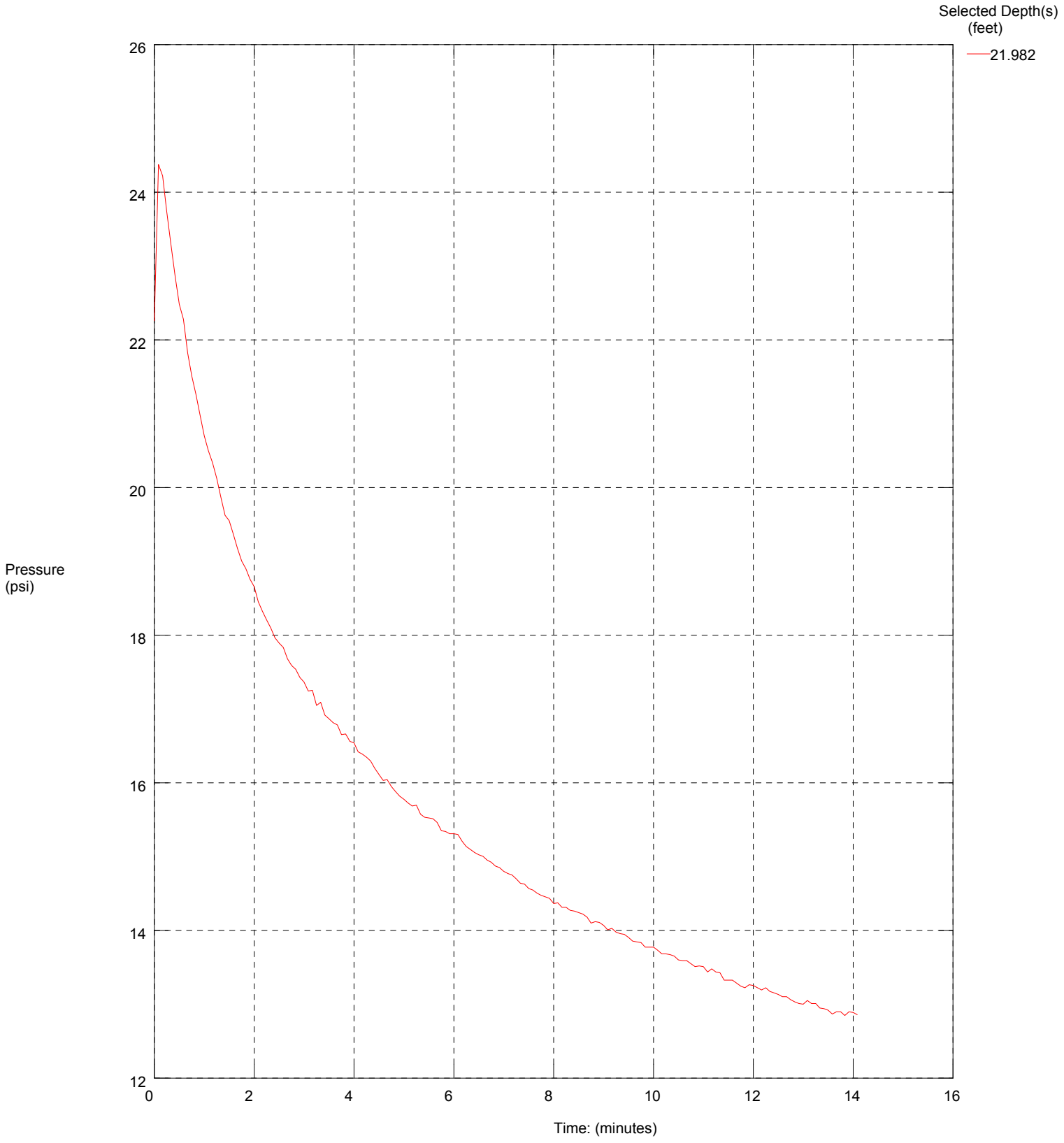


Maximum Pressure = 16.642 psi
Hydrostatic Pressure = 6.763 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-23-06
Elevation: Unknown

CPT Date/Time: 07-14-06 08:49
Location: CPT-23-06
Job Number: XL-2672

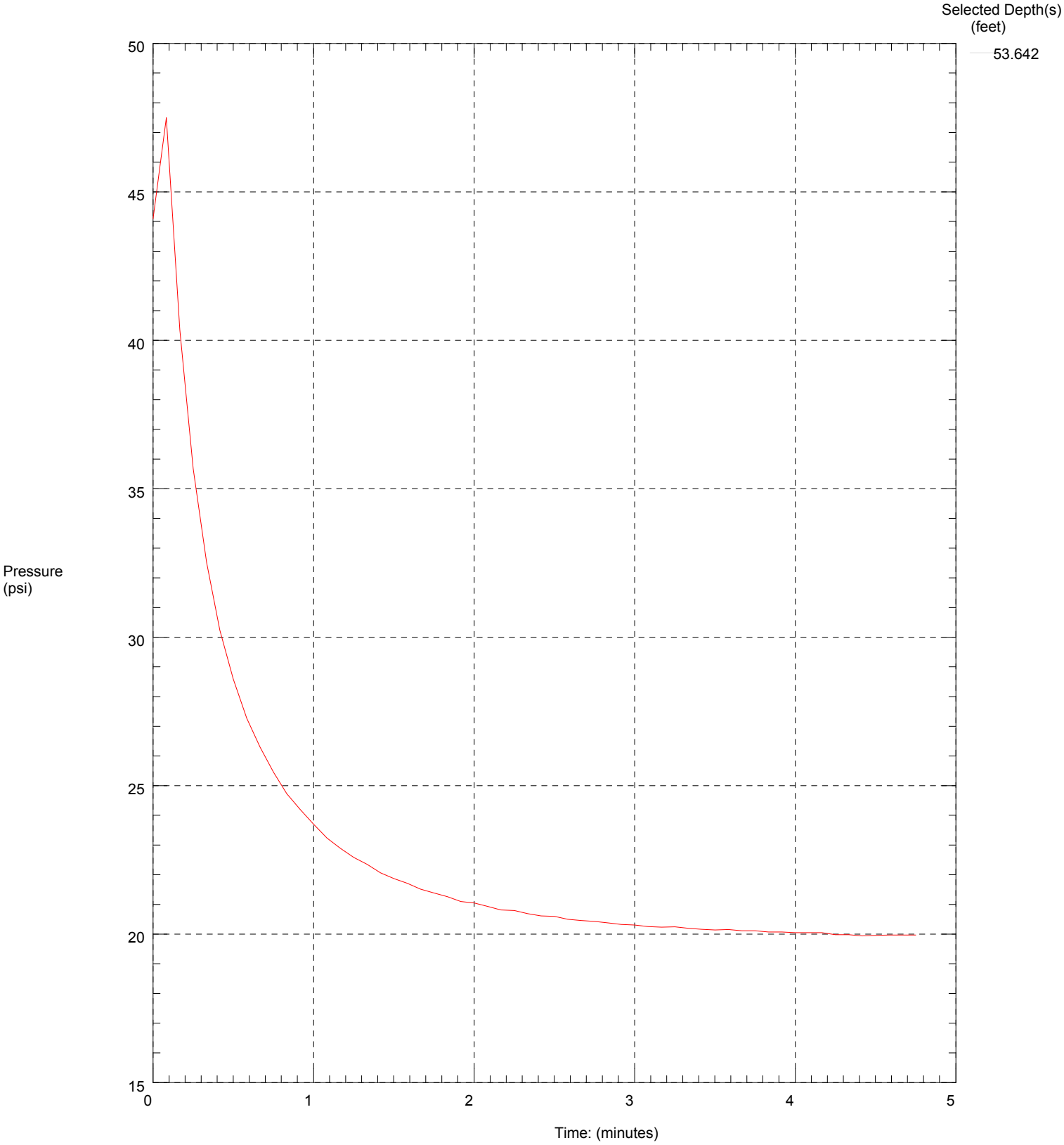


Maximum Pressure = 24.373 psi
Hydrostatic Pressure = 9.54 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-23-06
Elevation: Unknown

CPT Date/Time: 07-14-06 08:49
Location: CPT-23-06
Job Number: XL-2672

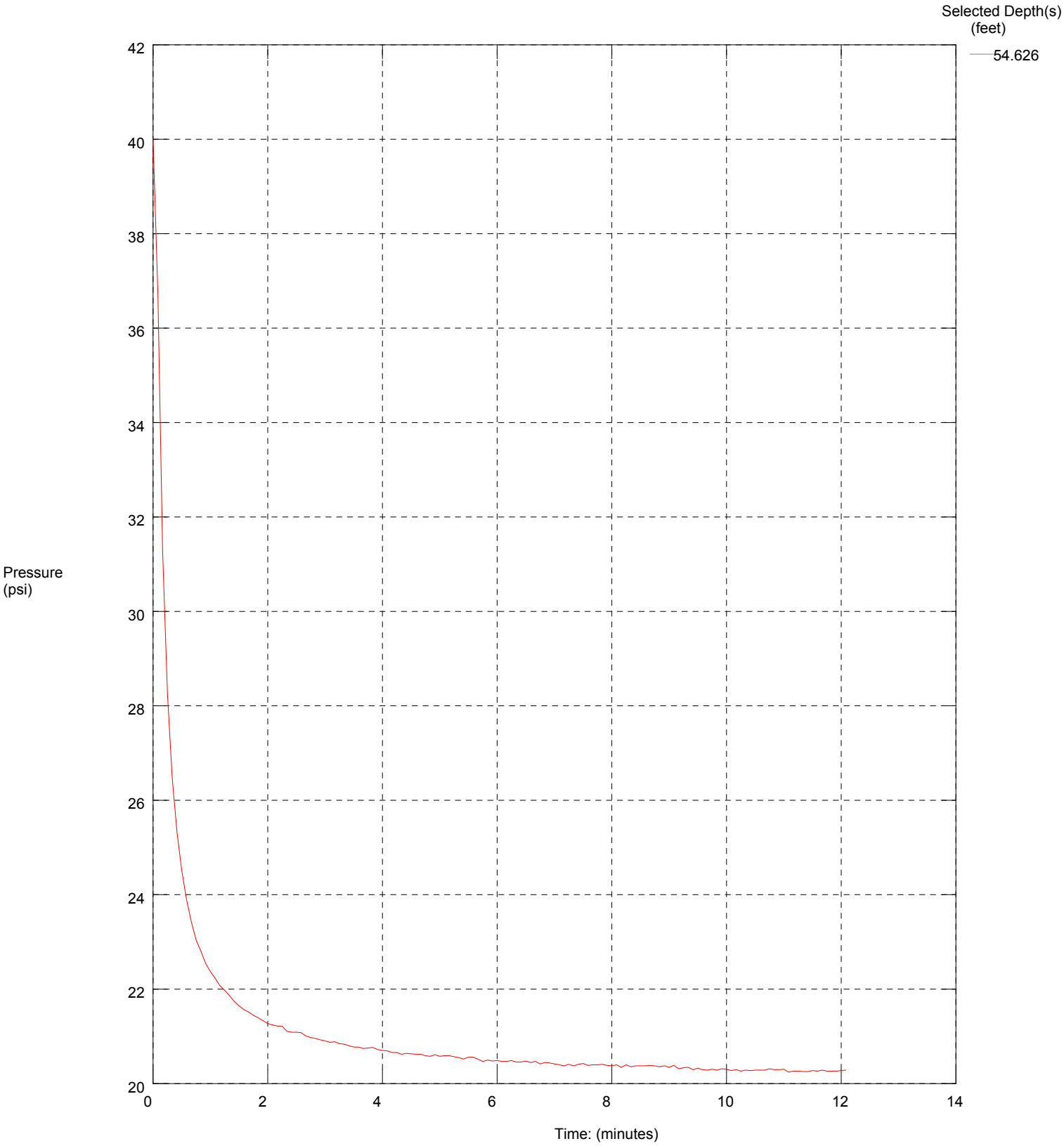


Maximum Pressure = 47.496 psi
Hydrostatic Pressure = 23.281 psi

WSDOT Geotechnical Division

Operator Brian Hilts
Sounding: CPT-23-06
Elevation: Unknown

CPT Date/Time: 07-14-06 08:49
Location: CPT-23-06
Job Number: XL-2672

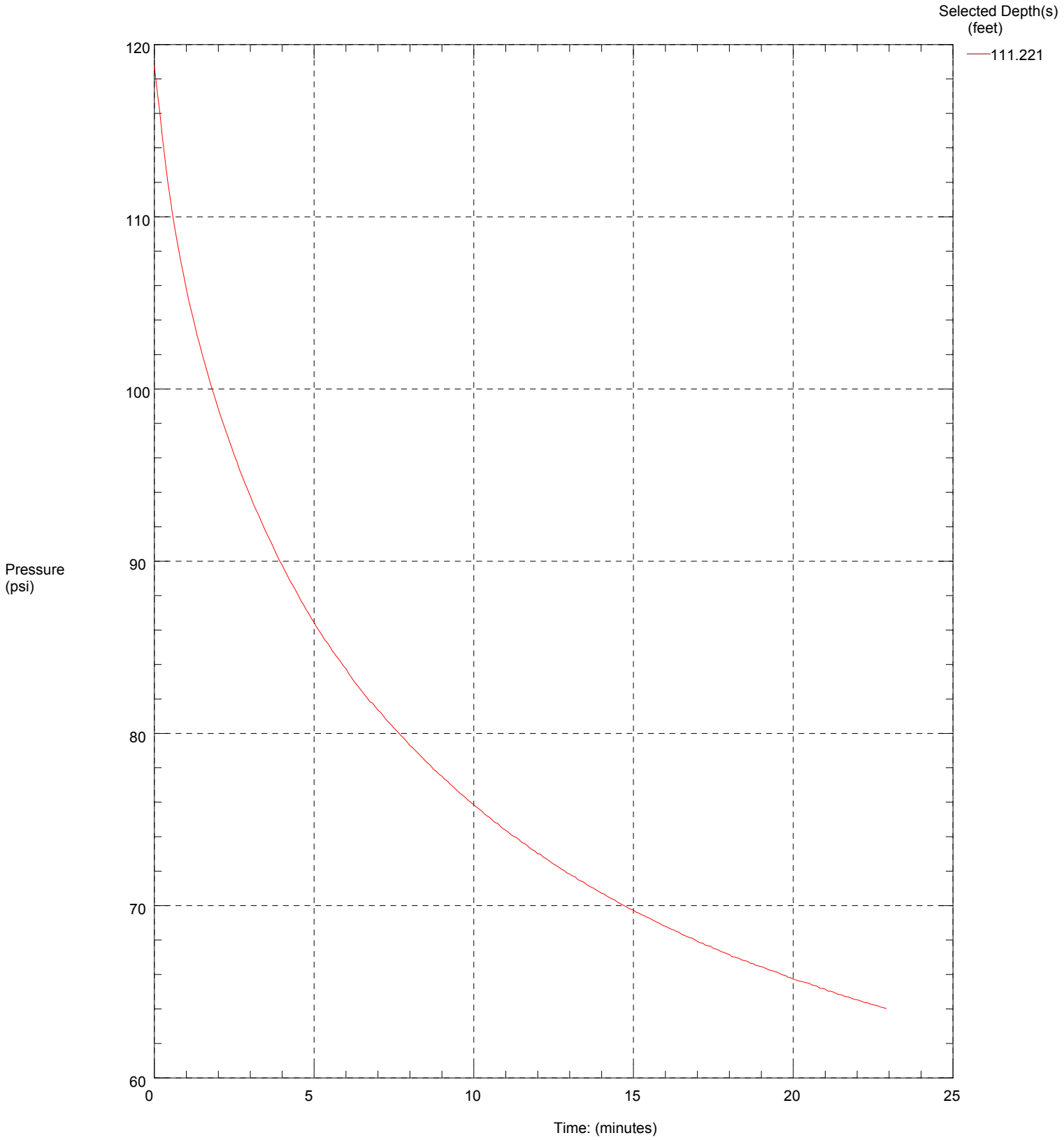


Maximum Pressure = 40.009 psi
Hydrostatic Pressure = 23.708 psi

WSDOT Geotechnical Division

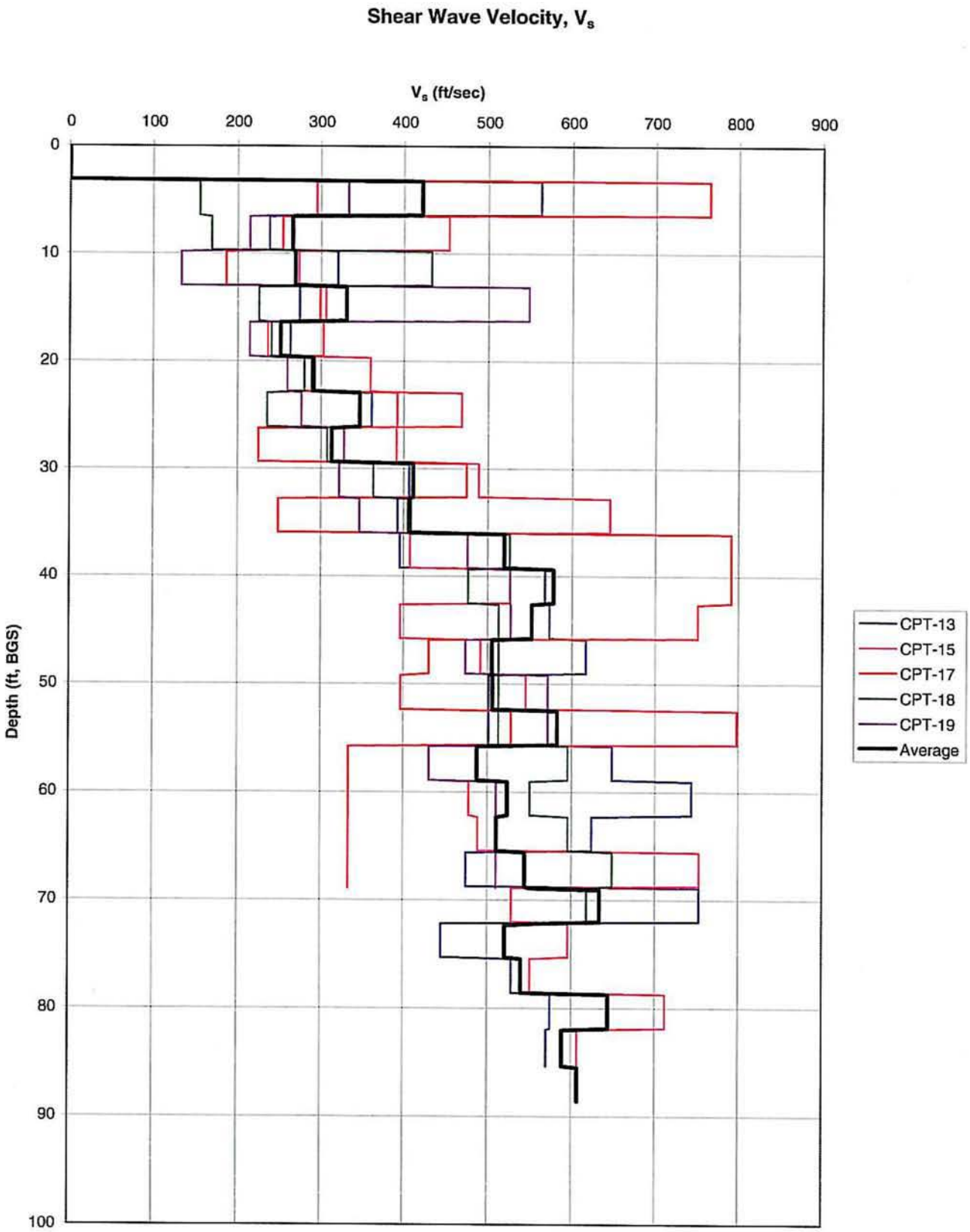
Operator Brian Hilts
Sounding: CPT-23-06
Elevation: Unknown

CPT Date/Time: 07-14-06 08:49
Location: CPT-23-06
Job Number: XL-2672



Maximum Pressure = 118.775 psi
Hydrostatic Pressure = 48.27 psi

Shear Wave Velocity From CPT



Source: S:\SHAREDOC\Example1.xls Sheet Title

1/17/07 Document2

LANDAU ASSOCIATES

WSDOT Pontoon Construction Facility Grays Harbor, Washington	Shear Wave Velocity From CPT	Figure C-1

APPENDIX D

Information from Reviewed Literature

APPENDIX D
INFORMATION FROM REVIEWED LITERATURE

As described in Section 2.0, we reviewed available literature related to the subject site. This appendix includes the following items obtained from the reviewed literature, which are relevant to the project.

- Information obtained from the 1976 Roger Lowe Associates report:
  - Boring Logs
  - Plate 2 (titled Dike Construction): The plate shows the site grade prior to filling and the dike elevation
  - Plate 3 (titled Generalized Section X-X)
  - Plate 4 (titled Generalized Section Y-Y)
- A drawing titled "Proposed Dredge Fill,"dated December 1981. It shows the limits of proposed additional dredge fill.
- A drawing titled "Effluent Outfall Details," dated May 1984, obtained from the IDD package. It shows the dike elevation at 18 ft MLLW (old datum).

APPENDIX A

FIELD EXPLORATIONS AND LABORATORY TESTING

PORT OF GRAYS HARBOR IDD NO. 1

Field Explorations

Subsurface soil conditions at the site were explored by drilling 12 borings at the locations shown on Plate 2 of this report. Of these borings, five were relatively shallow, extending to depths of 39.5 to 44.5 feet. Four of the holes were drilled to depths between 59.5 and 74.5 feet, while the remaining three borings were extended to depths of between 133.5 and 155.5 feet to determine the location and elevation of the top of the dense sand and gravel layer expected to underlie the site. Borings 5 and 7 appeared to be unnecessary and would have been costly due to site mobility and access problems. Borings 2A and 3A were drilled adjacent to Borings 2 and 3, respectively, to better define the characteristics of the near-surface loose sand and silt strata.

All borings were drilled with truck-mounted equipment using hollow stem augers or rotary wash techniques with drilling mud, depending on the soil conditions encountered. A member of our engineering geology staff continually examined and classified the materials recovered, noted drilling resistances or other indicators of changes in soil conditions, and selected intervals for obtaining samples. The soils have been classified using the Unified System, which is described on Plate A-1.

Samples were obtained in the field using either our 2 3/8-inch I.D. sampler, which obtains relatively less disturbed samples, or a 1 3/8-inch I.D. standard split spoon sampler whose resistance to driving has been correlated with soil conditions for many cases. The samplers were driven using a 140-pound weight falling freely through 30 inches. The number of blows required to drive the sampler one foot is indicated on the exploration logs adjacent to the sample notations. In addition, a number of undisturbed samples were obtained by using 3-inch O.D. thin-walled steel sample tubes pushed into many of the looser or softer strata encountered.

The samples were sealed to limit moisture loss, labeled and returned to our laboratory for testing purposes. After the laboratory testing, the descriptions on the field logs were revised as appropriate. The revised logs are presented on Plates A-2 through A-27 in this appendix.

In addition to the borings, five test pits were excavated on November 24, 1976, at the locations shown on Plate 2 by an International 2400B backhoe provided by the Port of Grays Harbor to determine the characteristics of the near-surface fill materials. The logs of these test pits are shown on Plates A-28 through A-30.

Laboratory Testing

Samples obtained in the field were examined in our laboratory and representative samples were chosen for moisture content, unit weight, sieve and hydrometer grain size analyses, consolidation tests, maximum and minimum density tests and direct shear determinations. The results of these tests are presented in Appendix B of this report.

UNIFIED SOIL CLASSIFICATION SYSTEM

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

NOTE: DUAL SYMBOLS INDICATE BORDERLINE SOIL CLASSIFICATION

KEY TO SAMPLE DATA

25.2 | 91.7 | 35

- 35 → BLOWS REQUIRED TO DRIVE SAMPLER 12 INCHES WITH 140 LB. HAMMER: MAXIMUM STROKE 30 INCHES. (P INDICATES PUSHED)
- 91.7 → DRY DENSITY, (PCF)
- 25.2 → MOISTURE CONTENT, (% OF DRY DENSITY)
- DEPTH OR ELEVATION (FEET)

SAMPLE RECOVERY

- UNDISTURBED
- DISTURBED
- NO RECOVERY

SAMPLER TYPE

- HD - 3 INCH SPLIT TUBE SAMPLER
- TW - 3 INCH THIN WALL SAMPLER
- SPT - 2 INCH SPLIT TUBE SAMPLER
- C - ROCK CORE
- B - BULK DISTURBED SAMPLE

GRAPHIC LOG

- SM — LETTER SYMBOL FOR SOIL TYPE
- DISTINCT CONTACT BETWEEN SOIL STRATA
- GRADUAL CHANGE BETWEEN SOIL STRATA
- BOTTOM OF BORING

ROGER LOWE ASSOCIATES

UNIFIED SOIL CLASSIFICATION SYSTEM AND KEY TO SAMPLE DATA

BORING 1

GROUND SURFACE = EL. 9.4 (MLLW)

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GW	GRAY TO BLACK, WELL-GRADED QUARRY-RUN BASALT WITH TRACE OF COARSE TO MEDIUM SAND, 18 INCH MAXIMUM SIZE (VERY DENSE TO DENSE, MOIST) (DIKE FILL)
5					
					GRAY SANDY SILT (SOFT, SATURATED)
10			8	ML	
	65.6	58.9	5	SM	GRAY SILTY FINE SAND WITH OCCASIONAL WOOD CHIPS (VERY LOOSE, SATURATED)
15					
			3	ML	GRAY SANDY SILT (VERY SOFT, SATURATED)
20					
	76.9	52.8	4		
25			P*		
			10		
30				SM	GRAY SILTY FINE SAND (VERY LOOSE, SATURATED)
	35.7	85.4	7		
35					
			P*	SP	GRAY MEDIUM TO FINE SAND, TRACE OF SILT (VERY LOOSE, SATURATED)
40					

CONTINUED ON PLATE A-3

BORING 1 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
40				SP	
	48.1	72.1	9	ML	GRAY SANDY SILT WITH OCCASIONAL SHELLS (FIRM, SATURATED)
45					
			5		BECOMES SOFT WITH OCCASIONAL WOOD CHIPS
50					
	64.2	59.5	7	SM	GRAY SILTY FINE SAND WITH SOME WOOD CHIPS AND SHELLS (VERY LOOSE, SATURATED)
55					
			12		
60			P*		
65					

BOTTOM OF BORING AT 61.0 FT.
COMPLETED 10/17/76

* 3-INCH O.D. THIN WALLED TUBE SAMPLE

BORING 2

GROUND SURFACE = EL. 13.4 (MLLW)

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GW	GRAY TO BLACK, WELL-GRADED QUARRY-RUN BASALT WITH TRACE OF COARSE TO MEDIUM SAND, 18-INCH MAXIMUM SIZE (VERY DENSE TO DENSE, MOIST) (DIKE FILL)
5					
10					
15					
20			2	ML	GRAY SANDY SILT (VERY SOFT, SATURATED)
25					
	46.9	73.0	22		
30				SM	GRAY SILTY FINE SAND WITH SOME GRASS ROOTS, WOOD CHIPS AND SHELLS (LOOSE, SATURATED)
35			P	SP	GRAY MEDIUM TO FINE SAND, TRACE OF SILT (VERY LOOSE, SATURATED)
	47.9	70.3	4	ML	GRAY SANDY SILT (VERY SOFT, SATURATED)
40					

CONTINUED ON PLATE A-5

BORING 2 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
40					
	47.5	69.7	6	ML	
45					
	37.7	75.7	8	SM	GRAY SILTY FINE SAND (VERY LOOSE, SATURATED)
50					
55					
			8	ML	GRAY SANDY SILT WITH SOME WOOD CHIPS (SOFT, SATURATED)
60					
65					
			39	SP	GRAY MEDIUM TO FINE SAND, OCCASIONAL SILT SEAMS, WITH SOME WOOD CHIPS (MODERATELY LOOSE, SATURATED)
70					
	49.3	66.8	9	ML	GRAY SANDY SILT (FIRM, SATURATED)
75					
80					

CONTINUED ON PLATE A-6

BORING 2 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
120					
125			15	ML	GRAY SANDY SILT (FIRM, SATURATED)
130					
135					
140			30		BECOMES STIFF
145					
150				SP	GRAY MEDIUM TO COARSE SAND, SOME MEDIUM TO COARSE GRAVEL (VERY DENSE, SATURATED)
155			166/10"		
160					

BOTTOM OF BORING AT 155.5 FT.
COMPLETED 10/24/76

BORING 2 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
80				ML	
			39	SP	GRAY MEDIUM TO FINE SAND, TRACE OF SILT (MODERATELY LOOSE, SATURATED)
85					
90					
	59.2	63.0	12	ML	GRAY SANDY SILT (FIRM, SATURATED)
95					
100					
105					
	58.2	64.3	13		
110					
115					
120					

CONTINUED ON PLATE A-7

BORING 2-A

GROUND SURFACE = EL. 12.7 (MLLW)

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GW	GRAY TO BLACK, WELL-GRADED QUARRY-RUN BASALT WITH TRACE OF COARSE TO MEDIUM SAND, 18-INCH MAXIMUM SIZE (DENSE TO VERY DENSE, MOIST) (DIKE FILL)
5					
10					
15			P*	ML	GRAY SANDY SILT (VERY SOFT, SATURATED)
	80.3	53.9	P*		
20					
	75.2	54.2	P*		
25					
			1	SM	GRAY SILTY FINE SAND (VERY LOOSE, SATURATED)
			P*	ML	GRAY SANDY SILT (VERY SOFT, SATURATED)
30					
	52.9	70.9	5		BECOMES SOFT, WITH SOME SHELLS AND WOOD CHIPS
35					
			5		BOTTOM OF BORING AT 39.5 FT. COMPLETED 11/2/76
40					

* 3-INCH O.D. THIN WALLED TUBE SAMPLE

BORING 3

GROUND SURFACE = EL. 11.8 (MLLW)

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GW	GRAY TO BLACK WELL-GRADED QUARRY-RUN BASALT WITH TRACE OF COARSE TO MEDIUM SAND, 18-INCH MAXIMUM SIZE (DENSE TO VERY DENSE, MOIST) (DIKE FILL)
5					
10			1	ML	GRAY SANDY SILT WITH TRACE OF WOOD CHIPS (VERY SOFT, SATURATED)
15					
	30.9		P*		
20					
	57.9	63.9	4	SM	GRAY SILTY FINE SAND (VERY LOOSE, SATURATED)
25					
			7		
			P*		
30					
	58.7	65.0	4		WITH SOME GRASS ROOTS
35					
	52.0	69.2	P*		
40					

CONTINUED ON PLATE A-10

BORING 3 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
40			P*	SM	GRAY SILTY FINE SAND (VERY LOOSE, SATURATED
45	49.1	71.0	8		
50			32		
			P*	SP	GRAY FINE TO MEDIUM SAND, TRACE OF SILT (MODERATELY DENSE, SATURATED)
55			52		
60	28.2	89.7	64		
65					

BOTTOM OF BORING AT 60.5 FT.
COMPLETED 10/17/76

* 3-INCH O.D. THIN WALLED TUBE SAMPLE

BORING 3-A

GROUND SURFACE = EL. 12.6 (MLLW)

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GW	GRAY TO BLACK WELL-GRADED QUARRY-RUN BASALT WITH TRACE OF COARSE TO FINE SAND, 18-INCH MAXIMUM SIZE (DENSE TO VERY DENSE, MOIST) (DIKE FILL)
5					
10					
			P*	ML	GRAY SANDY SILT (VERY LOOSE, SATURATED)
15	57.6		P*		
20			P*		
	75.1	52.6	P*		
25			5	SP	GRAY MEDIUM TO FINE SAND, TRACE OF SILT, WITH SOME WOOD CHIPS AND SHELLS (VERY LOOSE, SATURATED)
			15		BECOMES LOOSE, NO WOOD CHIPS OR SHELLS
30					
	35.0	88.6	6		BECOMES VERY LOOSE, WITH SOME WOOD CHIPS AND SHELLS
35					
			P*		BOTTOM OF BORING AT 39.5 FT. COMPLETED 11/2/76
40					

* 3-INCH THIN WALLED TUBE SAMPLE

BORING 4

GROUND SURFACE = EL. 10.6 (MLLW)

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				GW	GRAY TO BLACK WELL-GRADED QUARRY-RUN BASALT WITH TRACE COARSE TO MEDIUM SAND, 18-INCH MAXIMUM SIZE (DENSE TO VERY DENSE, MOIST) (DIKE FILL)
5					
			6	ML	GRAY SANDY SILT (SOFT, SATURATED)
10	70.0	88.2	P*		
15	30.6	73.2	P*		
			5		
20					
	75.7	54.0	5		
25					
			18	SP	GRAY MEDIUM TO FINE SAND, TRACE OF SILT (LOOSE, SATURATED)
30					
	38.8	81.3	P*		
35					
			22	ML	GRAY SANDY SILT (STIFF, SATURATED)
40					

CONTINUED ON PLATE A-13

BORING 4 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
40				ML	
			6	SP	GRAY MEDIUM TO FINE SAND, TRACE OF SILT (VERY LOOSE, SATURATED)
45					
	44.2	76.4	6	SM	GRAY SILTY FINE SAND, SOME WOOD CHIPS AND SHELLS (VERY LOOSE, SATURATED)
50					
			11		NO SHELLS
55					
	57.5	65.0	13		BECOMES LOOSE
60					

BOTTOM OF BORING AT 59.5 FT.
COMPLETED 11/1/76

* 3-INCH O.D. THIN WALLED TUBE SAMPLE

BORING 6

GROUND SURFACE = EL. 8.9 (MLLW)

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				ML	TOP SOIL 6" THICK GRAY SANDY SILT WITH SOME GRASS ROOTS AND WOOD CHIPS (VERY SOFT, SATURATED)
5	74.8	54.7	0		
			HAMMER WEIGHT		
10					
	74.0	53.9	4		
15					
	50.4	71.5	6	SM	GRAY SILTY FINE SAND WITH SOME GRASS ROOTS (VERY LOOSE, SATURATED)
20					
			35	SW	GRAY COARSE TO FINE SAND WITH SOME WOOD CHIPS (MODERATELY DENSE, SATURATED)
25					
			26		BECOMES MODERATELY LOOSE, WITH SOME SHELLS
30					
	35.2	87.5	P*		
35					
			9	ML	GRAY SANDY SILT WITH SOME SHELLS (FIRM, SATURATED)
40					

CONTINUED ON PLATE A-15

BORING 6 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
40				ML	
	40.7	38.1	14	SM	GRAY SILTY FINE SAND (LOOSE, SATURATED)
45					
			28	SP	GRAY FINE TO MEDIUM SAND, TRACE OF SILT (MODERATELY LOOSE, SATURATED)
50					
			P*		
55					
			55		BECOMES MODERATELY DENSE
60					
	28.5	95.8	51		
65					
70					
	60.0	62.6	17	ML	GRAY SANDY SILT (STIFF, SATURATED)
75					

BOTTOM OF BORING AT 74.5 FT.
COMPLETED 10/19/76

* 3-INCH THIN WALLED TUBE SAMPLE

BORING 8

GROUND SURFACE = EL. 12.5 (MLLW)

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0			13	GM	BROWN GRAVEL-SAND-SILT MIXTURE WITH WOOD CHIPS, GRASS ROOTS AND SHELLS (LOOSE TO VERY LOOSE, MOIST) (FILL)
			6		
			9		
5			2		
				ML	GRAY SANDY SILT WITH SHELLS (VERY SOFT, SATURATED)
			2		
10					
	74.6	54.7	4		WITH SOME WOOD CHIPS
15					
			14	SP	GRAY MEDIUM TO FINE SAND, TRACE OF SILT WITH SOME WOOD CHIPS AND SHELLS (LOOSE, SATURATED)
20					
	27.8	95.6	61		BECOMES MODERATELY DENSE, NO SHELLS
25					
			36		BECOMES MODERATELY LOOSE
30					
	29.6	92.6	15	SM	GRAY SILTY FINE SAND (LOOSE, SATURATED)
35					
	25.5	102.2	78	SP	GRAY MEDIUM TO FINE SAND, TRACE OF SILT (MODERATELY DENSE, SATURATED)
40					

CONTINUED ON PLATE A-17

BORING 8 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
40				SP	
			8	ML	GRAY SANDY SILT (SOFT, SATURATED)
45					BOTTOM OF BORING AT 44.5 FT. COMPLETED 10/25/76

BORING 9

GROUND SURFACE = EL. 11.2 (MLLW)

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				SM	BROWN SILTY FINE SAND WITH WOOD CHIPS AND GRASS ROOTS (LOOSE, MOIST) (DREDGED FILL)
			13		
5					
	82.2	52.0	0	ML	GRAY SANDY SILT WITH SOME SHELLS AND WOOD CHIPS (VERY SOFT, SATURATED)
10					
	61.6	60.4	4		
15					
			11	SM	GRAY SILTY FINE SAND WITH SOME WOOD CHIPS (VERY LOOSE, SATURATED)
20					
	67.5	58.0	P*	ML	GRAY SANDY SILT (VERY SOFT, SATURATED)
25					
	49.0	75.0	7	SP	GRAY FINE TO MEDIUM SAND, TRACE OF SILT WITH SOME WOOD CHIPS (VERY LOOSE, SATURATED
30					
			9		WITH SOME SHELLS
35					
			25		BECOMES LOOSE
40					

CONTINUED ON PLATE A-19

BORING 9 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
40				SP	GRAY FINE TO MEDIUM SAND, TRACE OF SILT (LOOSE, SATURATED)
	28.8	94.5	19		
45					
			6	ML	GRAY SANDY SILT WITH SOME WOOD CHIPS (SOFT, SATURATED)
50					
			49	SP	GRAY FINE TO MEDIUM SAND, TRACE OF SILT WITH SOME WOOD CHIPS (MODERATELY DENSE, SATURATED)
55					
			P*		
60					
	23.6	99.1	31		NO WOOD CHIPS
65					
70					
			101		BECOMES DENSE
75					
80					

CONTINUED ON PLATE A-20

BORING 9 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
80					
	27.3	93.3	47	SP	GRAY FINE TO MEDIUM SAND, TRACE OF SILT (MODERATELY LOOSE, SATURATED)
85					
90					
			16	ML	GRAY SANDY SILT WITH SMALL PIECES OF DECAYED WOOD (FIRM, SATURATED)
95	77.3	48.5	P*		
100					
	61.0	61.4	13		
105					
110					
115			12		
120					

CONTINUED ON PLATE A-21

BORING 10

GROUND SURFACE = EL. 12.2 (MLLW)

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0	50.5	65.3	7	SM	BROWN SILTY FINE SAND WITH WOOD CHIPS AND GRASS ROOTS (VERY LOOSE, MOIST) (DREDGED FILL)
			4	ML	GRAY SANDY SILT WITH WOOD CHIPS AND GRASS ROOTS (SOFT, SATURATED)
5			5		
10			4		
	59.6	63.0	P*		
15					
			4	SM	GRAY SILTY FINE SAND WITH WOOD CHIPS (VERY LOOSE, SATURATED)
20					(TIP OF GROUNDWATER OBSERVATION WELL AT 19.7 FOOT DEPTH)
			2		
25					
			13		
30			P*	ML	GRAY SANDY SILT (SOFT, SATURATED)
			6	SM	GRAY SILTY FINE SAND WITH OCCASIONAL WOOD CHIPS (VERY LOOSE, SATURATED)
35					
	27.4	92.5	50	SP	GRAY FINE TO MEDIUM SAND, TRACE OF SILT WITH OCCASIONAL WOOD CHIPS (MODERATELY LOOSE, SATURATED)
40					

CONTINUED ON PLATE A-23

BORING 10 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
40				SP	
			9	ML	GRAY SANDY SILT WITH OCCASIONAL WOOD CHIPS (FIRM, SATURATED)
45					
	57.8		7	SP	GRAY FINE TO MEDIUM SAND, TRACE OF SILT WITH SOME SHELLS (VERY LOOSE, SATURATED)
50					
			34		BECOMES MODERATELY LOOSE WITH SOME WOOD CHIPS AND NO SHELLS
55					
			P*		
60					
	36.9		27		BECOMES LOOSE
65					
70					
			41		BECOMES MODERATELY LOOSE
75					
80					

CONTINUED ON PLATE A-24

BORING 10 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
80				SP	
	55.7	63.4	8	ML	GRAY SANDY SILT (FIRM, SATURATED)
85					
90					
	72.1		15		
95					
100					
			15		
105					
110					
			17		BECOMES STIFF
115					
120					

CONTINUED ON PLATE A-25

BORING 10 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
120				ML	GRAY SANDY SILT (STIFF, SATURATED)
	50.7	66.0	24		
125					
130					
			61	SP	GRAY FINE TO MEDIUM SAND, TRACE OF SILT (MODERATELY DENSE, SATURATED)
135					
			88		
140					
			115	GW	GRAY COARSE TO FINE GRAVEL WITH SOME COARSE TO FINE SAND (DENSE, SATURATED)
145					
150					
155					

BOTTOM OF BORING AT 153.0 FT.
COMPLETED ON 10/29/76

* 3-INCH THIN WALLED TUBE SAMPLE

BORING 11

GROUND SURFACE = EL. 18.0 (MLLW)

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0			30	PT	HIGH CONCENTRATION OF WOOD CHIPS IN SILTY SAND MATRIX (VERY LOOSE, MOIST) (FILL)
5			9		
			10		
10			12		
	52.5	62.6	5	ML	GRAY SANDY SILT WITH SOME WOOD CHIPS (SOFT, SATURATED)
15					
	32.8		27	SP	GRAY FINE TO MEDIUM SAND, TRACE OF SILT, OCCASIONAL WOOD CHIPS (LOOSE, SATURATED)
20					(TIP OF GROUNDWATER OBSERVATION WELL AT 19.3 FOOT DEPTH)
	31.0	90.0	20		
25					
			11		BECOMES VERY LOOSE WITH SOME SHELLS
30					
	39.7	80.8	P*		
35					
			25	ML	GRAY SANDY SILT (STIFF, SATURATED)
40					

BOTTOM OF BORING AT 39.5 FT.; COMPLETED 10/26/76

*3-INCH THIN WALLED TUBE SAMPLE

BORING 12

GROUND SURFACE = EL. 15.1 (MLLW)

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
0				SM	DARK GRAY SILTY FINE SAND WITH GRASS ROOTS AND WOOD CHIPS (VERY LOOSE, MOIST) (DREDGED FILL)
	44.1		4		
5					
			7	ML	GRAY SANDY SILT (SOFT, SATURATED)
			P*		
10	54.9	65.9	P*		
			3		BECOMES VERY SOFT WITH SOME WOOD CHIPS
15	52.8	66.6	P*		
20					
	84.9	49.9	P*		
25					
			9	SP	GRAY FINE TO MEDIUM SAND, TRACE OF SILT, SOME WOOD CHIPS (VERY LOOSE, SATURATED)
30					
	36.1	76.0	8		
35					
					BOTTOM OF BORING AT 39.5 FT. COMPLETED 11/3/76
40					

* 3-INCH THIN WALLED TUBE SAMPLE

TEST PIT 1

DEPTH (FT.)	DESCRIPTION
	GROUND SURFACE = EL. 13± (MLLW)
0 - 1.0	DARK BROWN SANDY SILT WITH GRASS AND ROOTS (MOIST, ML) (FILL)
1.0 - 1.5	LIGHT BROWN SILTY FINE SAND (MOIST, SM) (FILL)
1.5 - 5.0	ORANGE BROWN SANDY GRAVEL, SOME SILT (MOIST TO SATURATED, GP) (ABANDONED RAILROAD SPUR BASE FILL)

BOTTOM OF TEST PIT AT 5.0 FEET; COMPLETED 11/24/76
GROUNDWATER ENCOUNTERED AT 4.0 FEET

TEST PIT 2

DEPTH (FT.)	DESCRIPTION
	GROUND SURFACE = EL. 12± (MLLW)
0 - 2.0	4 INCHES TOPSOIL, GRASS, ROOTS (ML), LIGHT BROWN SILTY FINE SAND (MOIST, SM) (DREDGED FILL)
2.0 - 4.0	DARK BROWN TO BLACK SANDY SILT WITH WOOD CHIPS, SMALL PIECES OF WOOD AND FIBERS (WET, OL)
4.0 - 5.0	GRAY-BROWN SANDY SILT (SOFT TO VERY SOFT, SATURATED, ML)

BOTTOM OF TEST PIT AT 5.0 FEET; COMPLETED 11/24/76
GROUNDWATER ENCOUNTERED AT 4.0 FEET

TEST PIT 3

DEPTH (FT.)	DESCRIPTION
	GROUND SURFACE = EL. 10.5± (MLLW)
0 - 1.5	LIGHT BROWN SILTY FINE SAND (MODERATELY LOOSE, MOIST, SM) (DREDGED FILL)
1.5 - 3.0	DARK BROWN COMPRESSED BARK, WOOD CHIPS AND WOOD WASTE (MOIST, PT)
3.0 - 7.0	GRAY SANDY SILT (VERY SOFT TO SOFT, WET, ML)

BOTTOM OF TEST PIT AT 7.0 FEET; COMPLETED 11/24/76
GROUNDWATER LEVEL NOT ENCOUNTERED

TEST PIT 4

DEPTH (FT.)	DESCRIPTION
	GROUND SURFACE = EL. 14± (MLLW)
0 - 1.0	LIGHT BROWN SILTY FINE SAND (MODERATELY DENSE, MOIST, SM) (DREDGED FILL)
1.0 - 2.0	GRAY SANDY SILT (STIFF, MOIST, ML)

BOTTOM OF TEST PIT AT 2.0 FEET; COMPLETED 11/24/76
GROUNDWATER LEVEL NOT ENCOUNTERED

TEST PIT 5

DEPTH (FT.)	DESCRIPTION
	GROUNDWATER = EL. 12.5± (MLLW)
0 - 4.0	LIGHT BROWN TO DARK BROWN SANDY SILT MATRIX WITH VERY HIGH PERCENTAGE OF BARK, WOOD CHIPS AND WOOD WASTES (MOIST, ML/PT) (FILL DERIVED FROM ADJACENT MILL WASTES)
4.0 - 7.0	GRAY SANDY SILT (VERY SOFT, WET TO SATURATED, ML)

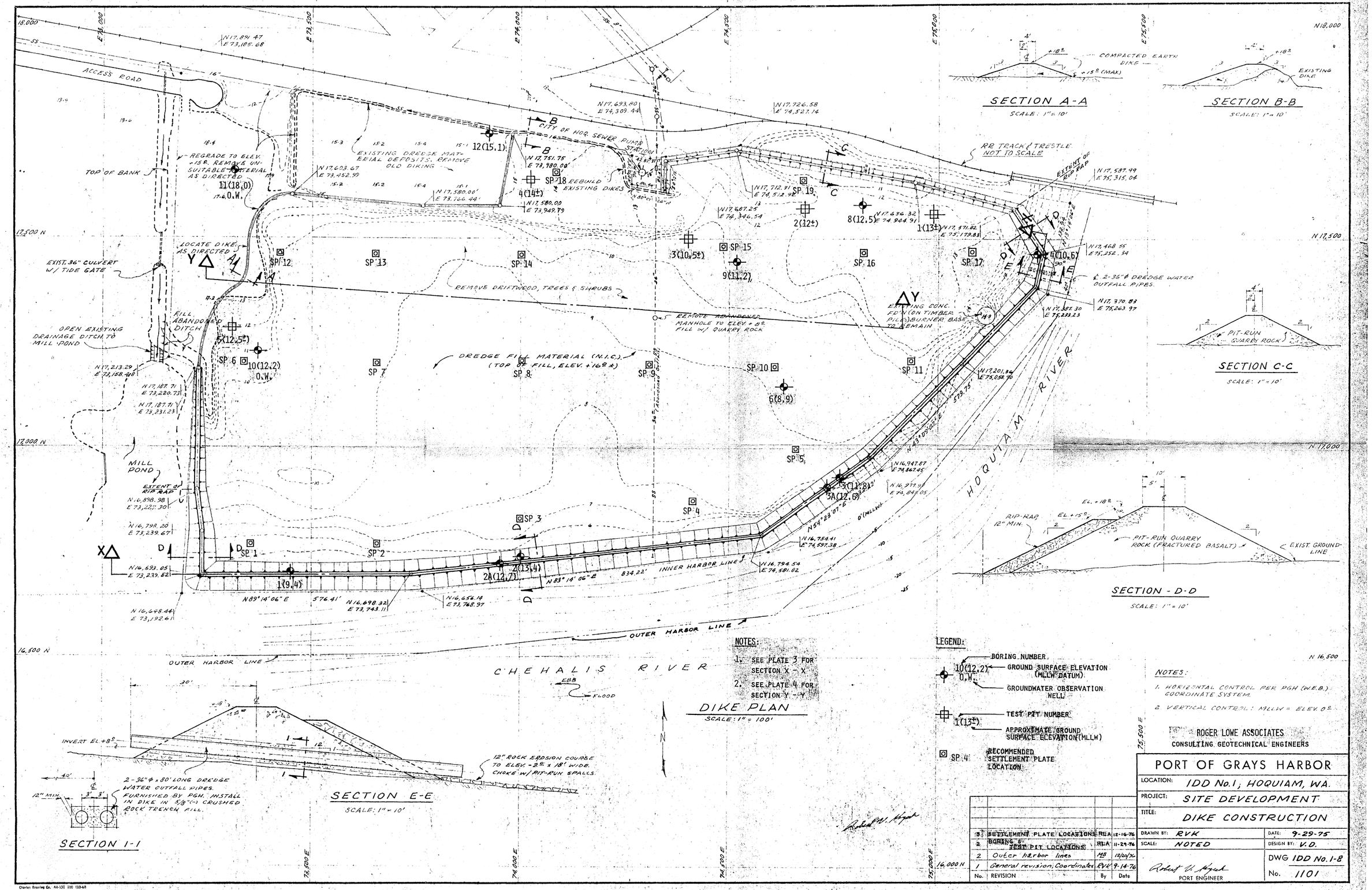
BOTTOM OF TEST PIT AT 7.0 FEET; COMPLETED 11/24/76
GROUNDWATER LEVEL ENCOUNTERED AT 4.5 FEET

BORING 9 CONTINUED

DEPTH IN FEET	MOISTURE CONTENT	DRY DENSITY (PCF)	BLOWS PER FOOT	GRAPHIC LOG	SOIL DESCRIPTION
120				ML	
125	8.0	135.3	161	GP	GRAY SANDY GRAVEL, TRACE OF SILT (VERY DENSE, SATURATED)
130					
	6.0		172		
135					

BOTTOM OF BORING AT 133.5 FT.
COMPLETED 10/22/76

* 3-INCH THIN WALLED TUBE SAMPLE



SECTION A-A

SCALE: 1" = 10'

SECTION B-B

SCALE: 1" = 10'

SECTION C-C

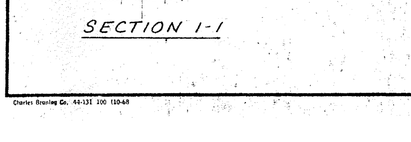
SCALE: 1" = 10'

SECTION - D-D

SCALE: 1" = 10'

SECTION E-E

SCALE: 1" = 10'



SECTION 1-1

NOTES:

1. SEE PLATE 3 FOR SECTION X - X
2. SEE PLATE 4 FOR SECTION Y - Y

DIKE PLAN

SCALE: 1" = 100'

LEGEND:

- 10(12.2) O.W. — BORING NUMBER; GROUND SURFACE ELEVATION (MLLW DATUM); GROUNDWATER OBSERVATION WELL
- 1(13±) — TEST PIT NUMBER; APPROXIMATE GROUND SURFACE ELEVATION (MLLW)
- SP 4 — RECOMMENDED SETTLEMENT PLATE LOCATION

NOTES:

1. HORIZONTAL CONTROL PER PGH (W.E.B.) COORDINATE SYSTEM.
2. VERTICAL CONTROL: MLLW = ELEV. 0±

ROGER LOWE ASSOCIATES
CONSULTING GEOTECHNICAL ENGINEERS

No.	REVISION	By	Date
3	SETTLEMENT PLATE LOCATIONS	RLA	12-16-76
2	BORING & TEST PIT LOCATIONS	RLA	11-29-76
2	Outer harbor lines	MB	12/20/76
1	General revision; Coordinates	RVK	9-14-76

PORT OF GRAYS HARBOR

LOCATION: IDD No.1, HOQUIAM, WA.

PROJECT: SITE DEVELOPMENT

TITLE: DIKE CONSTRUCTION

DRAWN BY: RVK — DATE: 9-29-75

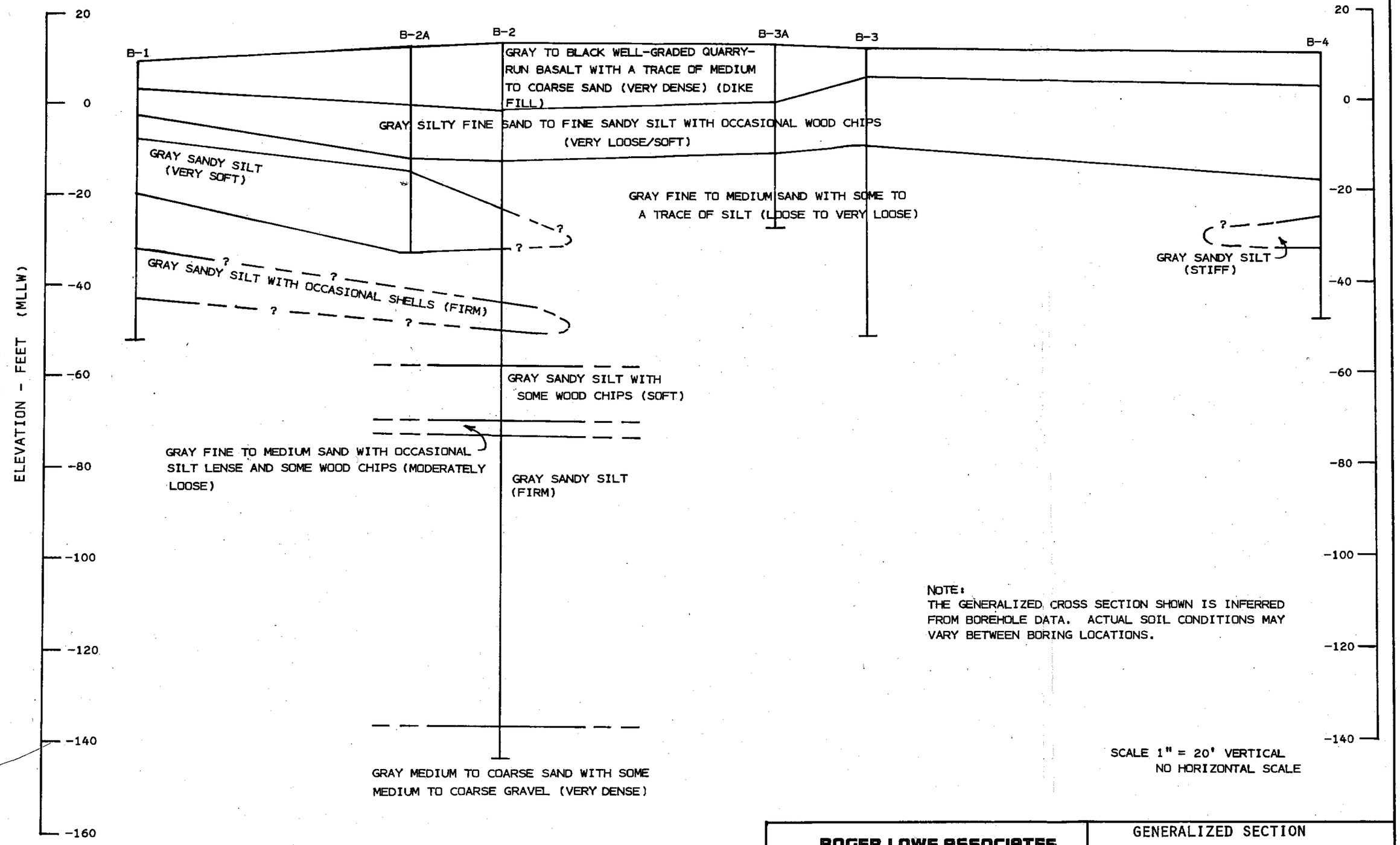
SCALE: NOTED — DESIGN BY: V.D.

DWG IDD No.1-8

No. 1101

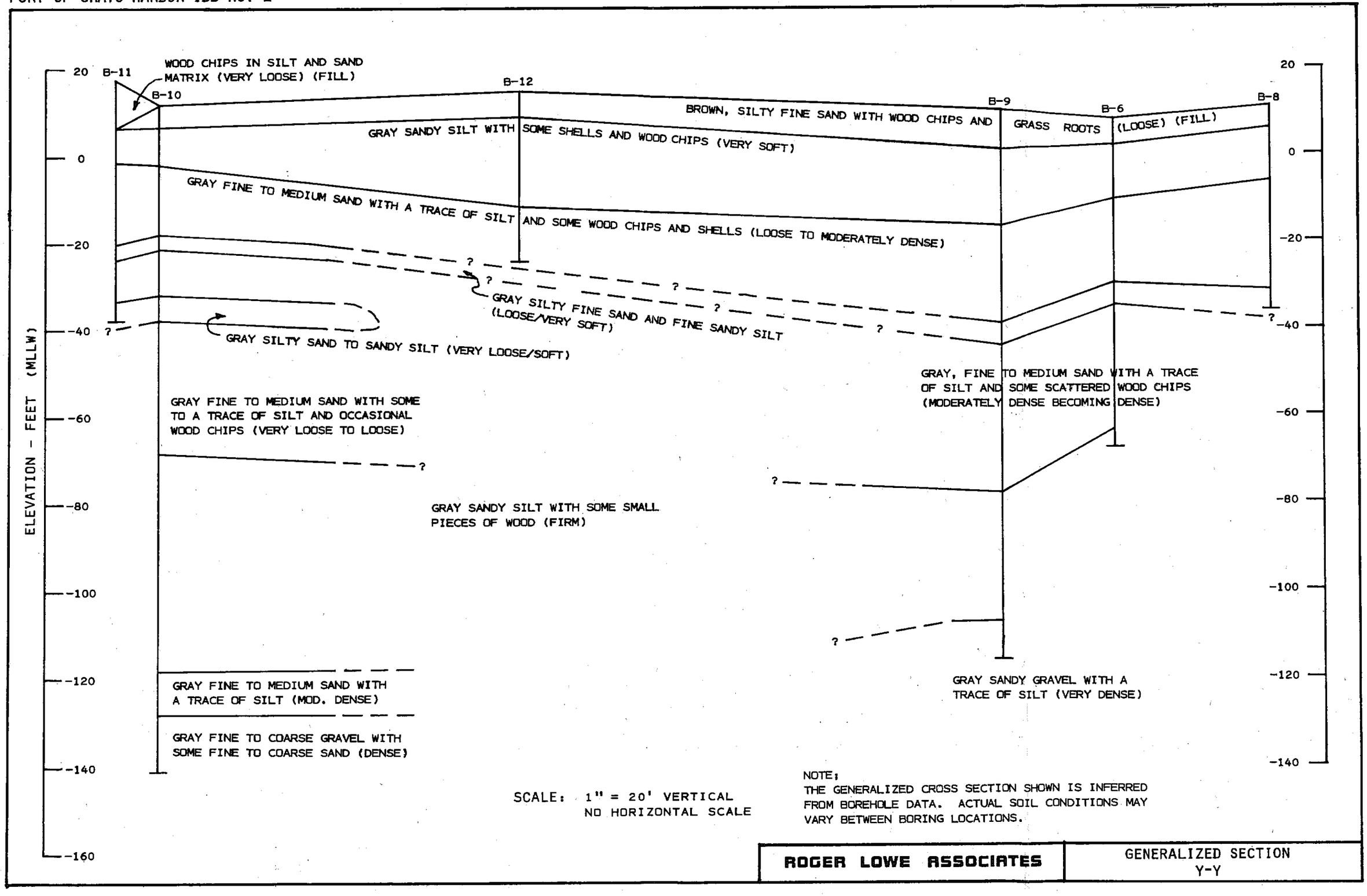
PORT ENGINEER

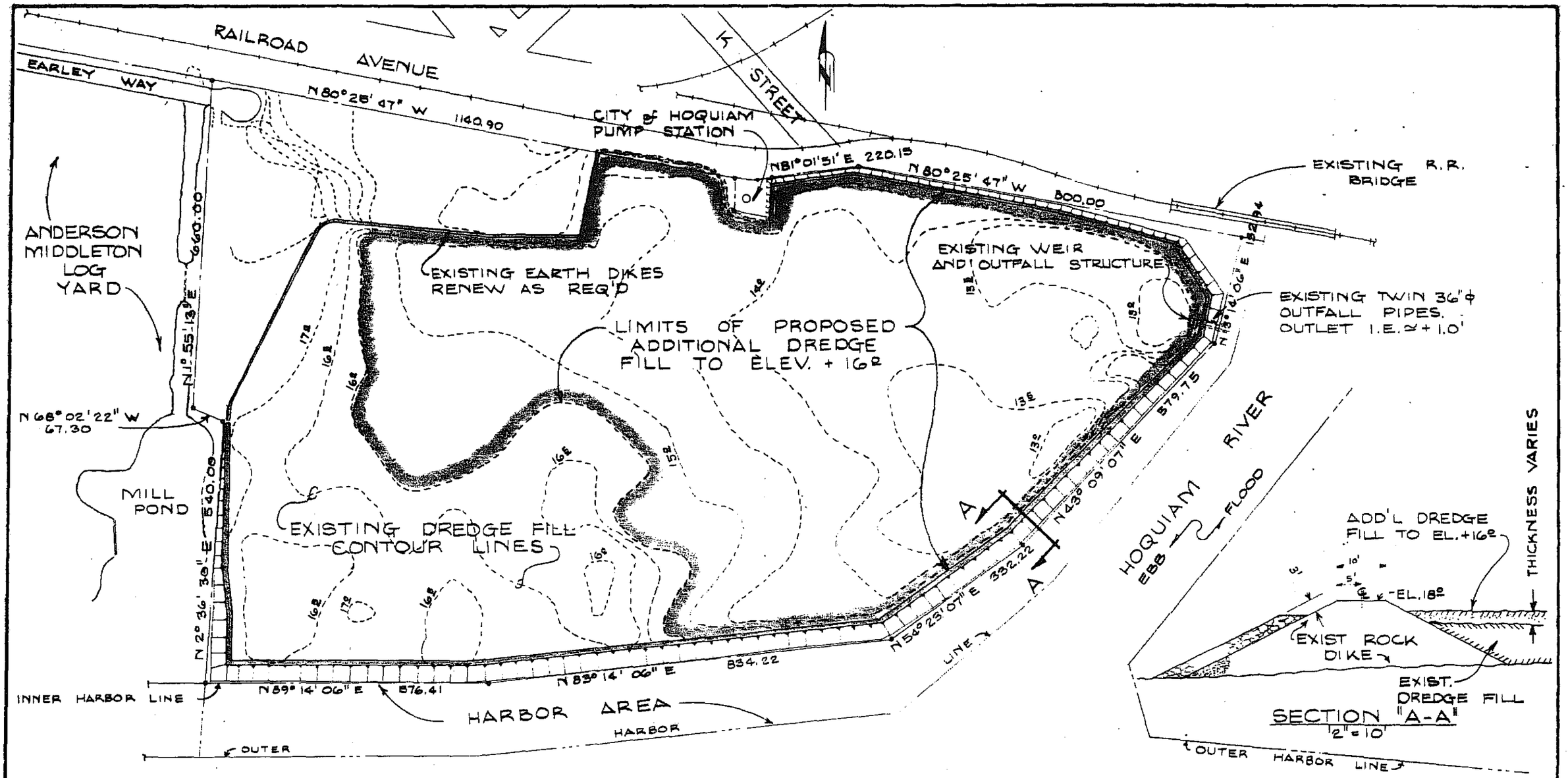
Charles Brunig Co. 44-131 100 10-68



ROGER LOWE ASSOCIATES

GENERALIZED SECTION
X-X

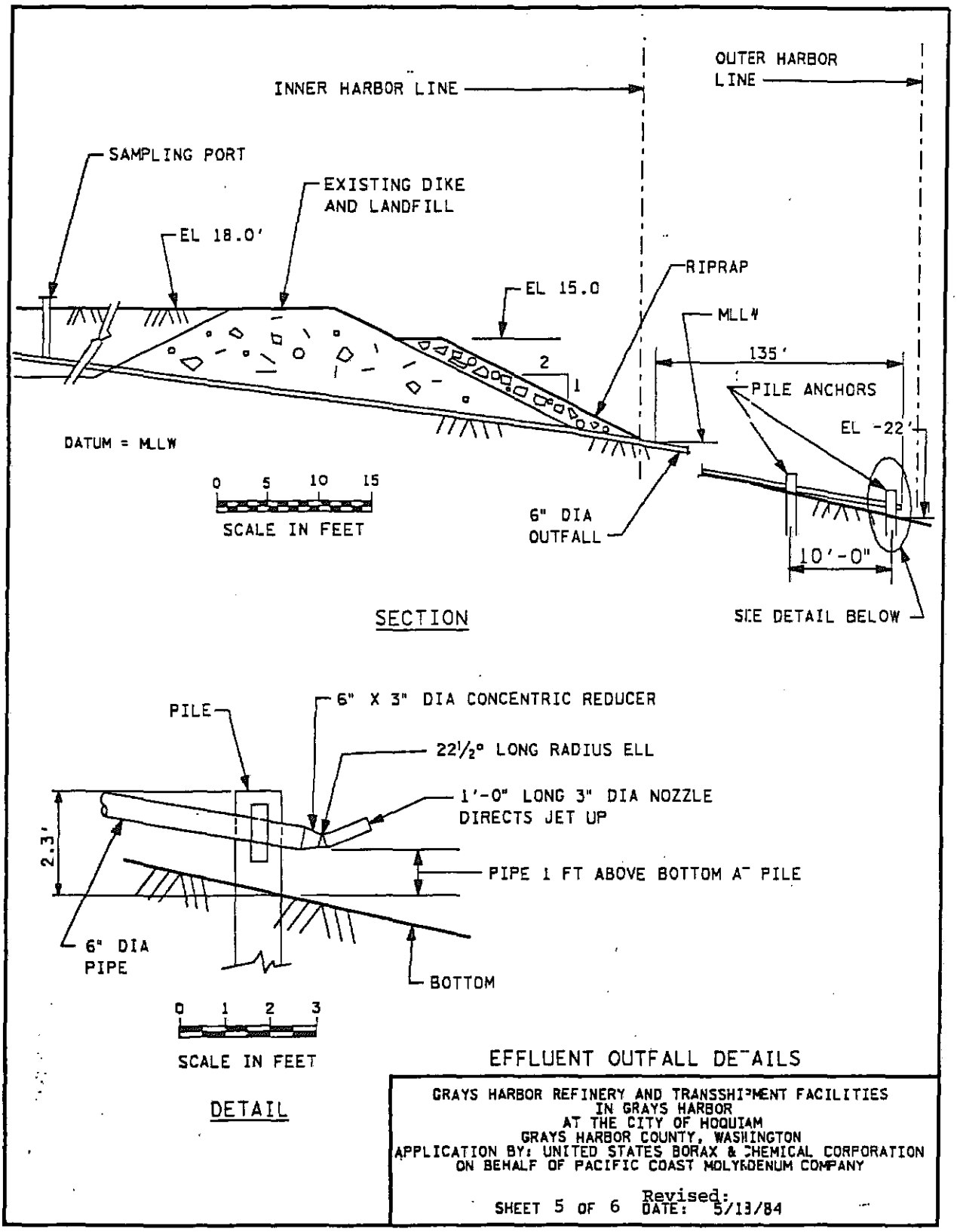

ELEVATION - FEET (MLLW)
20
0
-20
-40
-60
-80
-100
-120
-140
-160
B-11
B-10
B-12
B-9
B-6
B-8
WOOD CHIPS IN SILT AND SAND MATRIX (VERY LOOSE) (FILL)
BROWN, SILTY FINE SAND WITH WOOD CHIPS AND GRASS ROOTS (LOOSE) (FILL)
GRAY SANDY SILT WITH SOME SHELLS AND WOOD CHIPS (VERY SOFT)
GRAY FINE TO MEDIUM SAND WITH A TRACE OF SILT AND SOME WOOD CHIPS AND SHELLS (LOOSE TO MODERATELY DENSE)
GRAY SILTY FINE SAND AND FINE SANDY SILT (LOOSE/VERY SOFT)
GRAY SILTY SAND TO SANDY SILT (VERY LOOSE/SOFT)
GRAY, FINE TO MEDIUM SAND WITH A TRACE OF SILT AND SOME SCATTERED WOOD CHIPS (MODERATELY DENSE BECOMING DENSE)
GRAY FINE TO MEDIUM SAND WITH SOME TO A TRACE OF SILT AND OCCASIONAL WOOD CHIPS (VERY LOOSE TO LOOSE)
GRAY SANDY SILT WITH SOME SMALL PIECES OF WOOD (FIRM)
GRAY FINE TO MEDIUM SAND WITH A TRACE OF SILT (MOD. DENSE)
GRAY FINE TO COARSE GRAVEL WITH SOME FINE TO COARSE SAND (DENSE)
GRAY SANDY GRAVEL WITH A TRACE OF SILT (VERY DENSE)
SCALE: 1" = 20' VERTICAL
NO HORIZONTAL SCALE
NOTE;
THE GENERALIZED CROSS SECTION SHOWN IS INFERRED FROM BOREHOLE DATA. ACTUAL SOIL CONDITIONS MAY VARY BETWEEN BORING LOCATIONS.
ROGER LOWE ASSOCIATES
GENERALIZED SECTION
Y-Y



NOTES:

1. VERT. DATUM: M.L.L.W. = 0
2. APPROXIMATE ADDITIONAL DREDGE FILL QUANTITY IS 100,000 YARDS
3. ADDITIONAL DREDGE FILL IS TO BE SAND AND GRAVEL FROM CHANNEL AND BERTH MAINTENANCE PROJECTS.

PROPOSED DREDGE FILL		
INDUSTRIAL DEVELOPMENT DISTRICT Nº 1 PORT of GRAYS HARBOR		
DATE: DEC. 17, 1981	SCALE 1" = 200'	SK-14-8104-1
PORT ENGINEER:		



EFFLUENT OUTFALL DETAILS

GRAYS HARBOR REFINERY AND TRANSSHIPMENT FACILITIES
IN GRAYS HARBOR
AT THE CITY OF HOQUIAM
GRAYS HARBOR COUNTY, WASHINGTON
APPLICATION BY: UNITED STATES BORAX & CHEMICAL CORPORATION
ON BEHALF OF PACIFIC COAST MOLYBDENUM COMPANY

SHEET 5 OF 6 Revised: DATE: 5/13/84

[215,51OUTFALL.DGN

APPENDIX E

Results of Seismic Numerical Analyses

APPENDIX E
DETAILS AND RESULTS OF SEISMIC NUMERICAL ANALYSIS

This appendix describes details and results of our seismic numerical analyses performed for the subject site. Our seismic numerical analyses include the following:

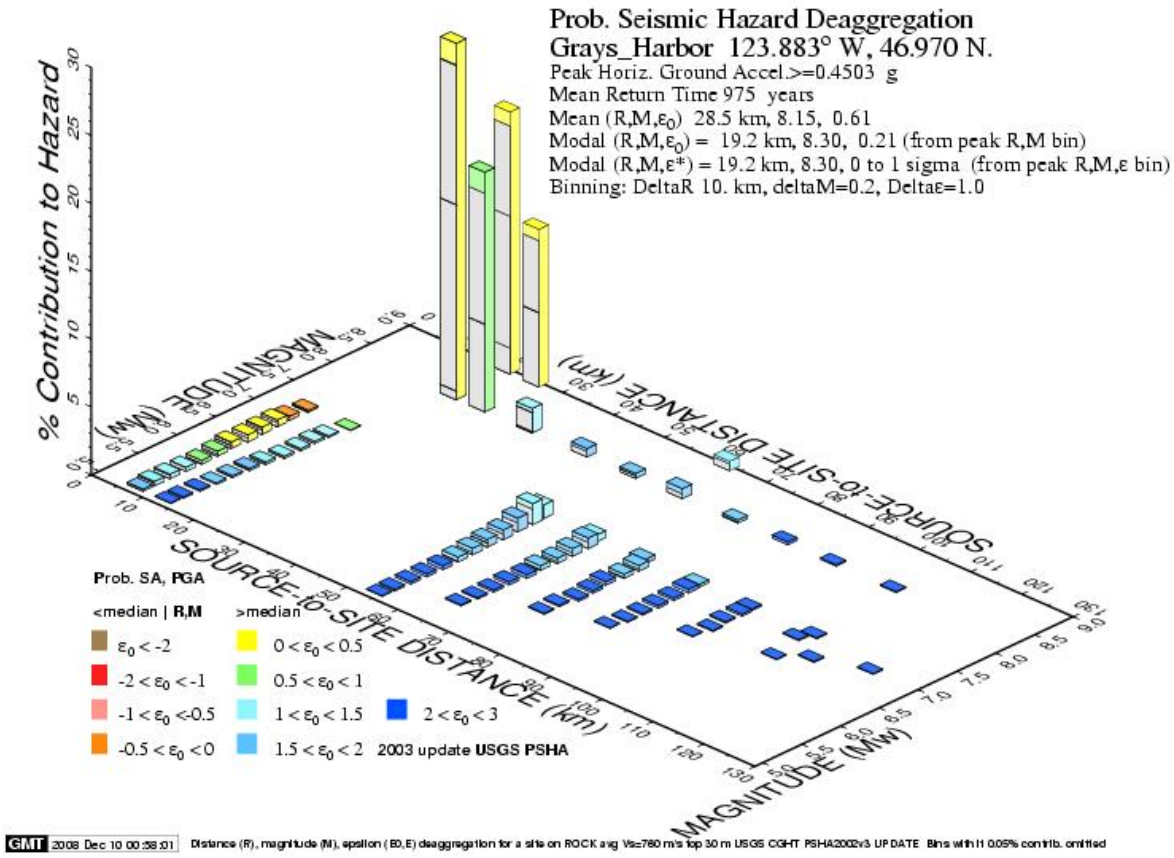
- Site Specific Response Analysis
- Liquefaction Analysis
- Lateral Spreading Analysis.

For verification purposes, independent liquefaction and lateral spreading (free field case only) analyses using the OpenSees computer program (Pacific Earthquake Engineering Research Center 2006) were performed by Dr. Pedro Arduino. The results of OpenSees are summarized in a report attached to this appendix. Dr. Steve Kramer provided verbal consultation to Landau Associates and to Dr. Arduino. Additionally, Dr. Peter Byrne provided verbal consultation to Landau Associates and reviewed some of our free field FLAC2D (Itasca Consulting Group, Inc. 2008) models. In FLAC2D, we used a non-linear, effective stress constitutive model called UBCSAND that can predict excess pore pressure generation and simulates soil behavior in case of liquefaction. The UBCSAND constitutive model was developed by Dr. Byrne and has been used in major projects as described subsequently.

The following sections present the procedures and results of seismic numerical analyses.

SELECTION OF SITE-SPECIFIC RESPONSE ANALYSIS PARAMETERS

The first step in the seismic numerical analysis was to obtain the target outcrop spectrum developed by the U.S. Geological Survey (USGS website 2007) for the subject site, corresponding to the 1,000-year design earthquake. According to the USGS website, the major seismic sources that would impact the project site are the Cascadian Subduction Zone. The distances between the project site and the main sources are about 22 and 24 kilometers (km), and those sources are capable of generating earthquakes with magnitudes 8.3 and 9.0. The magnitude and distance contributions of different sources to the mean peak horizontal acceleration at the project site are shown on the diagram below.

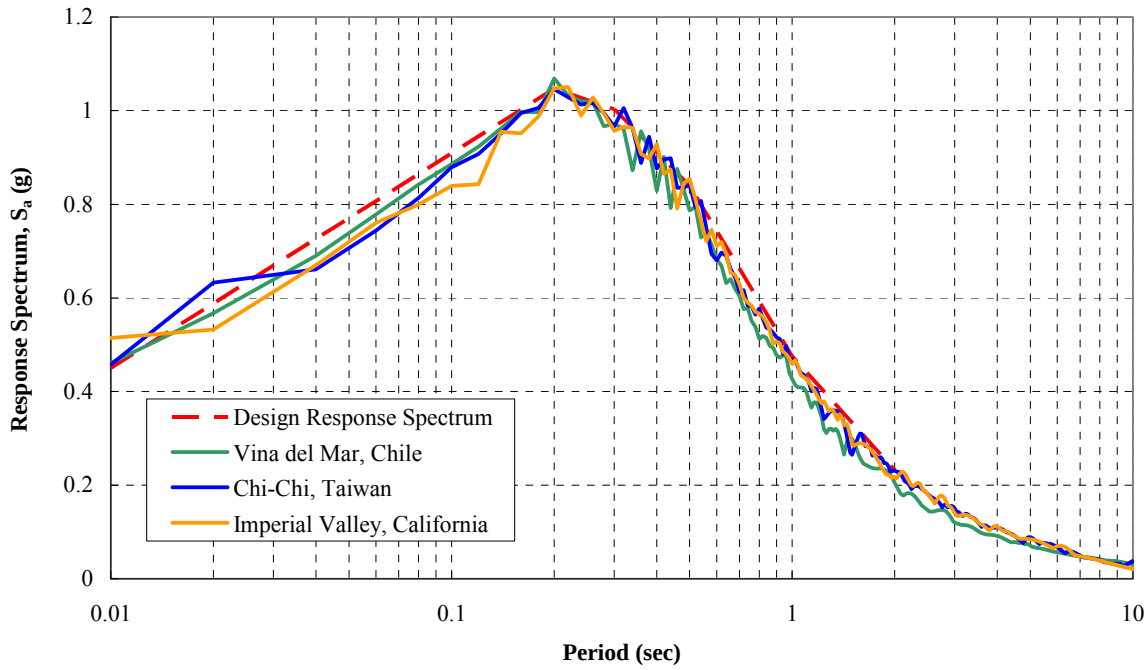


According to the USGS website, bedrock outcrop spectral accelerations (S_a) corresponding to the design earthquake are shown on the diagram below (indicated as "Design Response Spectrum"). However, a time domain analysis in FLAC2D or OpenSees requires time history of the earthquake motion at the base of the model. Based on the design earthquake magnitude and distance, the target earthquake *significant duration* was estimated to be in the range of 40 to 55 seconds based on an empirical equation developed by Abrahamson and Silva (1996). We could not find actual earthquake time histories that match the target *significant duration*. Therefore, we used EZ-FRISK (Risk Engineering 2006) software to alter three existing earthquake motions (Vina del Mar, Chi-Chi, and Imperial Valley) to match the design response spectrum and to closely match the target *significant duration*. The pertinent characteristics of the three earthquake motions are presented in the following table.

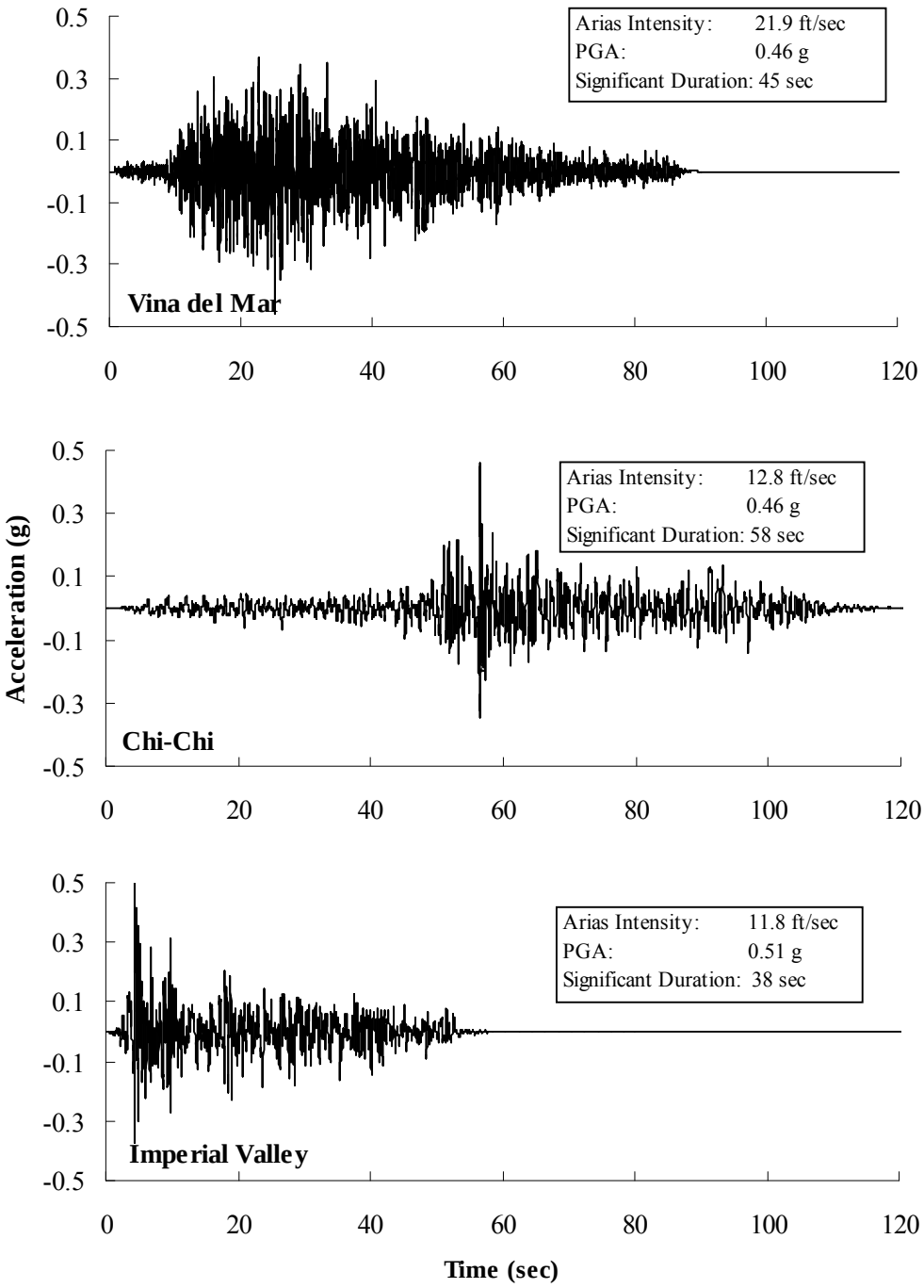
Motions Used in Seismic Analysis

Earthquake (Location)	Year	Fault Mechanism	Moment Magnitude
Vina Del Mar (Chile)	1985	Reverse fault	7.8
Chi-Chi (Taiwan)	1999	Strike-Slip	7.6
Imperial Valley (California)	1940	Strike-Slip	7.0

The response spectra of the altered earthquake motions are compared with the design response spectrum on the diagram below.



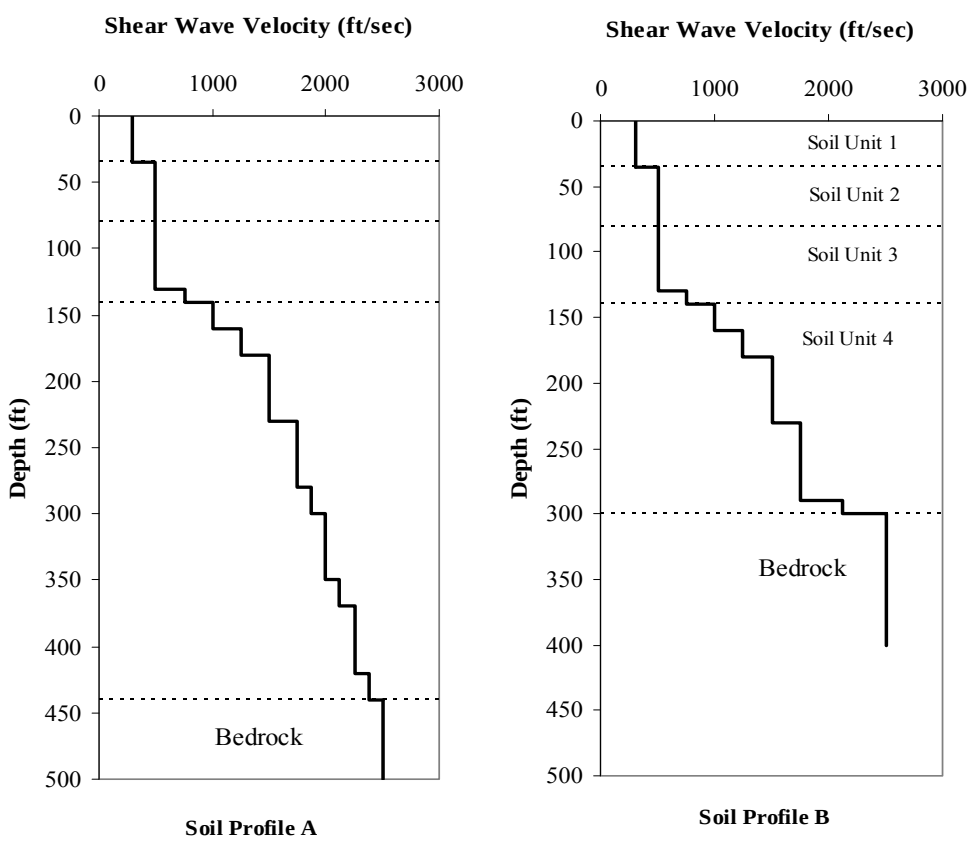
The corresponding time histories of the altered outcrop earthquake motions along with the critical earthquake motion parameters are presented below.



Each of the altered time histories of the three motions were input as an outcrop motion in the site response analysis using SHAKE2000 software (Ordonez 2000) to estimate "within" motions at the elevation of the base of the D-MOD2000, FLAC2D, and OpenSees models for liquefaction evaluation. The SHAKE2000 analysis was based on the assumption that bedrock is at about 300 feet (ft) below ground surface (BGS) as discussed below.

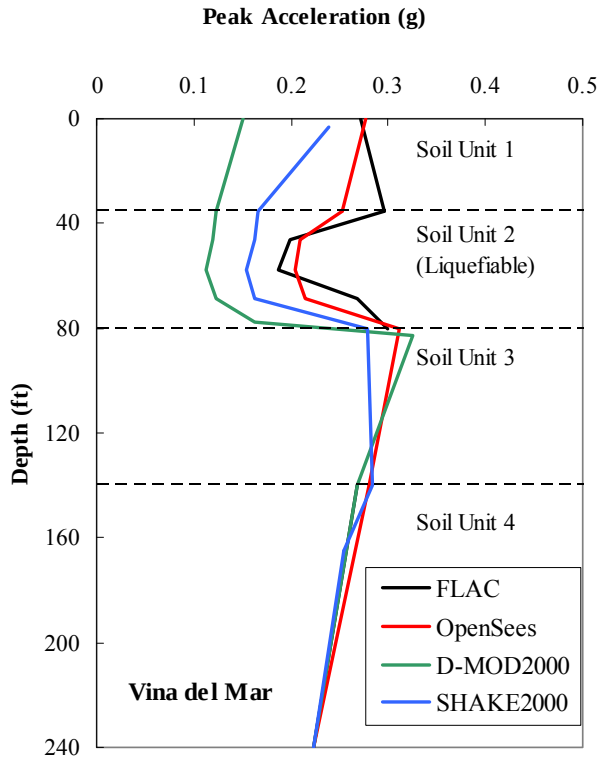
Because none of the borings at the site penetrated Soil Unit 4, the thickness of this soil unit and the depth to the bedrock is unknown. The thickness of Soil Unit 4 would impact the results of the seismic analysis. Therefore, we performed a sensitivity analysis using two different soil profiles as shown on the figure below. In Soil Profile A, the bedrock is assumed to be at 440 ft BGS whereas in Soil Profile B, the bedrock is assumed at a depth of 300 ft BGS. The assumed shear wave velocities are also shown on the figure. The shear wave velocities were measured from the ground surface to a depth of 220 ft using the suspension logging method (refer to Appendix C for more details about the testing method and the shear wave measurements). Below the depth of 220 ft, we estimated shear wave velocity values by extrapolation based on the effective overburden pressure. The shear wave velocity at the bedrock level is 2,500 ft/second.

For each soil profile, a site response analysis was performed with SHAKE2000 and the peak ground acceleration at the surface was calculated to be 0.21g for Soil Profile A and 0.24g for Soil Profile B. As such, we conservatively assumed the bedrock at depth 300 ft, consistent with Soil Profile B.



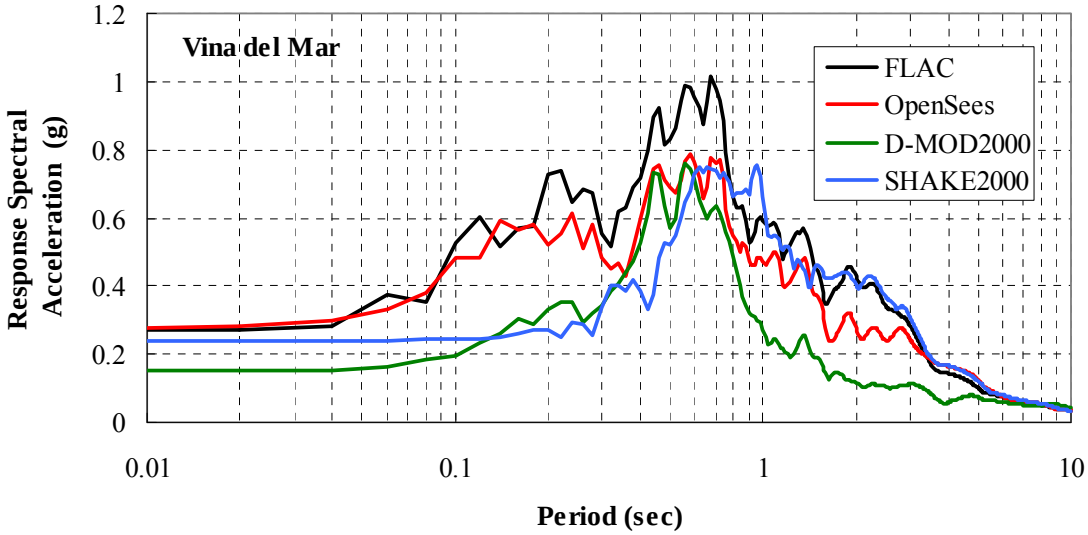
ONE-DIMENSIONAL SITE SPECIFIC RESPONSE ANALYSIS

One-dimensional liquefaction and site response analyses were performed using FLAC2D, OpenSees, SHAKE2000, and D-MOD2000 computer programs in order to compare the results obtained using these different software programs. To reduce the analysis time, the height of the soil column in all models was set at 240 ft. The "within" Vina del Mar motion, extracted from the SHAKE2000 analysis of the previous section, was used as the input motion at the base of the soil profiles. The diagram below plots peak accelerations at different depths. A relatively good match between the various methods was accomplished within Soil Units 3 and 4.



As shown on the diagram above, D-MOD2000 and SHAKE2000 underestimate peak ground acceleration above the liquefiable soils (i.e., Soil Unit 2) as compared to the results from FLAC and OpenSees. This can be attributed to the fact that neither of these programs model the dilative behavior of liquefied sandy soils at large strains, whereas the soil models in FLAC2D and OpenSees allow for dilation at relatively higher strains. Dilation increases the stiffness of the soil and, therefore, reduces damping. As such, it is our opinion that FLAC2D and OpenSees capture the behavior of liquefiable soils more realistically than SHAKE2000 and D-MOD2000.

The acceleration response spectra of the one-dimensional models at the ground surface are shown in the diagram below for the Vina del Mar input motion. FLAC2D and OpenSees provide a relatively good match to each other, while response spectra from D-MOD2000 and SHAKE2000 analyses are generally lower, especially for periods below 0.4 seconds.



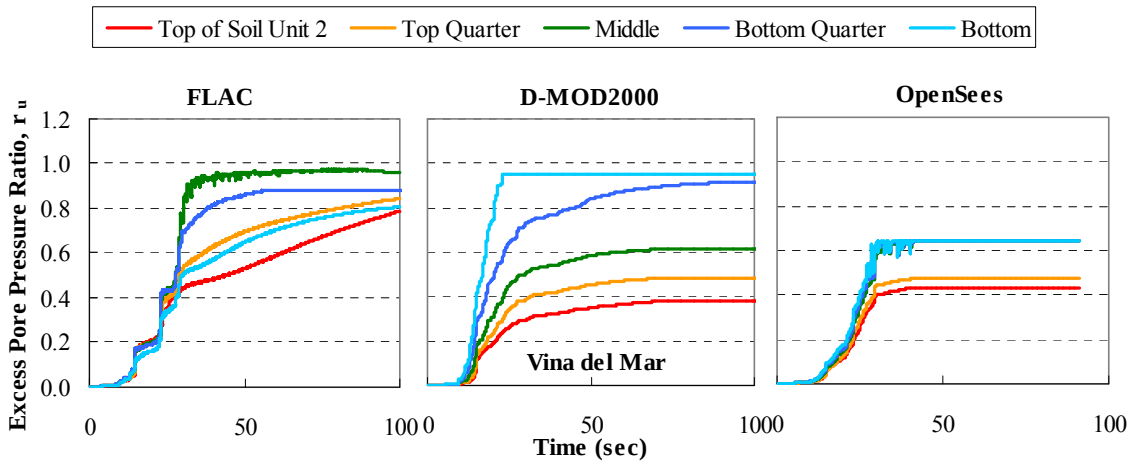
Based on the results of the one-dimensional analysis presented above, we decided to use FLAC2D to perform the site specific response analysis for the other motions. The design results of our site specific response analysis using FLAC2D along with the code-based spectra are presented on Figure 19 and 20 of the report. Also, refer to Section 5.3.2 in the main text for more information about the site specific response analysis.

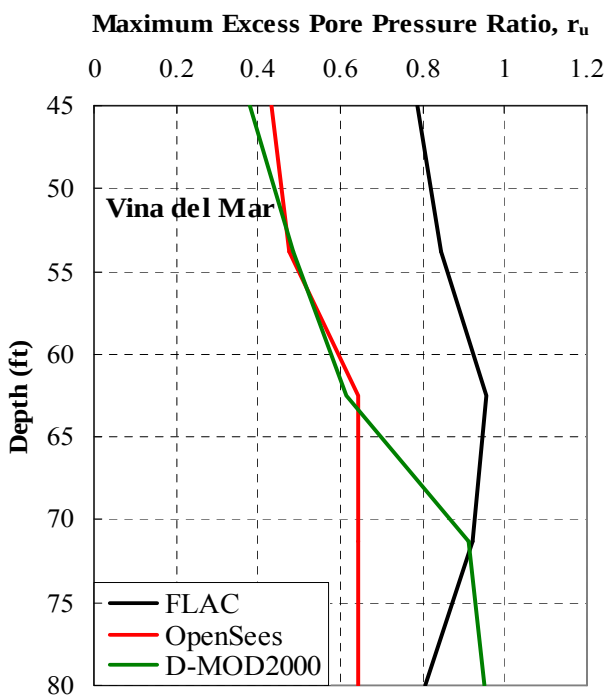
LIQUEFACTION AND LATERAL SPREADING ANALYSES

For the one-dimensional analysis described above (except the SHAKE2000 analysis), excess pore pressure ratio (r_u) was monitored within Soil Unit 2. In literature, the r_u parameter is defined as the ratio of excess pore pressure (Δu) to initial effective confining stress (Kramer 1996). The r_u = 1.0 condition defines the point of initial liquefaction. However, for some computer programs (e.g., D-MOD2000), r_u is defined in terms of the vertical effective stress. For this study, r_u is defined in terms of vertical effective stress.

The liquefaction results using the Vina del Mar motion are summarized in the two plots below. The first plot below presents the results of the one-dimensional liquefaction (in terms of r_u) using the

three computer programs shown on the diagram[1]. The second plot shows the r_u values at the end of the earthquake motion (time = 100 seconds), plotted as a function of depth.





[1] Note in the report by Dr. Arduino, r_u is defined in terms of the mean effective stress rather than the vertical effective stress.

The first diagram above shows that the time at which r_u reaches its maximum is different within the thickness of Soil Unit 2B, in the case of the FLAC2D and the D-MOD2000 analyses. The second diagram above illustrates a trend of increasing r_u with depth.

Our two-dimensional liquefaction/lateral spreading analysis was performed using FLAC2D for free field conditions using the three motions described above. The same analysis was performed for only the Vina del Mar motion using OpenSees, as described in the attached report. The FLAC2D r_u values for each of the three motions described above are presented on Figure 21 of this report, showing the extent of liquefaction. A similar figure is presented in the report by Dr. Arduino. The FLAC2D lateral spreading results are presented in Section 5.3.3 of the main text. A comparison between FLAC2D and OpenSees lateral spreading results are also presented in Section 5.3.3 of the main text.

It is important to note that the extent of liquefaction predicted by the **one-dimensional** FLAC2D analysis (refer to the r_u plot above) is less than the extent of liquefaction based on the **two-dimensional** FLAC2D analysis. This issue is further discussed in the following section.

COMMENTS ON INITIATION OF LIQUEFACTION

As mentioned above, the $r_u = 1.0$ condition defines the point of initial liquefaction. Typically for one-dimensional analysis, r_u is defined in terms of initial effective vertical stress. However, for a two-dimensional analysis like FLAC2D and OpenSees, r_u should be defined in terms of the initial minor effective stress (Kramer, S., 2008, personal communication). To be consistent with the one-dimensional analysis, we presented the r_u values of the two-dimensional analysis using the effective vertical stress as shown on Figure 21. Therefore, the r_u values of about 0.7 or more shown on Figure 21 (in terms of effective vertical stress) would correspond to $r_u = 1.0$ or more in terms of effective minor stress. As such, the extent of liquefaction based on our FLAC2D model is greater than what is shown on Figure 21. It is important to note that r_u values above 1.0 can develop (Idriss and Boulanger 2008).

Also, it is important to note that r_u values at the same locations within the two-dimensional model are different than the one-dimensional one. The likely reasons are the site slope that exerts shear stresses on the site soils and this effect can extend several hundred feet away from the slope (Byrne 2008a), and the lateral deformations associated with lateral spreading. Therefore, for the subject site, the conclusion about the extent of liquefaction based on the two-dimensional model could be different and probably more realistic than the extent of liquefaction based on the one-dimensional analysis. Additionally, the liquefaction extent based on the two-dimensional FLAC2D analysis is relatively consistent with the liquefaction extent based on the simplified approach presented in Section 5.3.3.1 of the main text.

THE USE OF FLAC2D IN MAJOR PROJECTS

The use of FLAC2D with the constitutive model UBCSAND has been used in several major projects to assess deformations and loads associated with liquefaction and lateral spreading. Some of these projects are listed below (Byrne 2008b).

- Dams
  - BC Hydro Cheakamus Dam, Canada
  - BC Hydro John Hart Dam, Canada
  - BC Hydro Stratchcona Dam, Canada
  - Corps of Engineers Tuttle Creek Dam in Kansas, USA
  - Hindmarsh Valley Dam, South Australia
  - A number of Tailings dams in Chile, Argentina ,Peru, and Guatemala
- Tunnels
  - George Massey Tunnel beneath the Fraser River, Canada
  - BART tunnel , San Francisco – Oakland, USA
- Retrofit of bridge foundations
  - Port Mann on the Fraser River, Canada
  - Buckland Taylor Oak Street , Fraser River, Canada
  - Trow Knight Street, Fraser River, Canada
- New bridge foundations
  - Golden Ears, Fraser River, Canada
  - Buckland Taylor RAV Line Bridge, Fraser River, Canada.

REFERENCES

Abrahamson, N.A. and W.J. Silva. 1996. Empirical ground motion models, report to Brookhaven National Laboratory.

Byrne, M.P. 2008a. Email message from Dr. Peter Byrne, to Reda Mikhail, Landau Associates. Re: *UBCSAND Projects*. December 12.

Byrne, M. P. 2008b. Email message from Dr. Peter Byrne, to Reda Mikhail, Landau Associates. Re: *UBCSAND Projects*. December 4.

Idriss, I.M. and R.W. Boulanger. 2008. *Soil Liquefaction During Earthquakes*, Earthquake Engineering Research Institute (EERI), MNO-12, 237 pp.

Itasca Consulting Group, Inc. 2008. FLAC Software. Version 6.0.

Kramer, S.L. 1996. *Geotechnical Earthquake Engineering.* Prentice Hall. Upper Saddle River, New Jersey. Pp. 653.

Kramer, S.L. 2008. Personal communication (conversation with Reda Mikhail, Landau Associates, Edmonds, Washington). Dr. Steve Kramer. Re: r_u values. December 8.

Matasović, Neven, and Gustovo Ordóñez. 2007. *D-MOD2000*, GeoMotions, LLC, Computer Software.

Ordonez, G.A. 2000. SHAKE2000 Computer Software.

Pacific Earthquake Engineering Research Center. 2006. OpenSees Software, Version 1.7.3.

Risk Engineering. 2006. EZ-FRISK Software. Version 7.25.

USGS website. 2007. *Seismic Design Values for Buildings*. http://earthquake.usgs.gov/research/hazmaps/design/index.php. U.S. Geological Survey. Accessed in September 2008.

GRAYS HARBOR SR520 PONTOON CONSTRUCTION PROJECT

OPENSEES SIMULATIONS

BY PEDRO ARDUINO, PHD

INTRODUCTION

This report presents results obtained using the computational framework OpenSees in support of the design of the Grays Harbor SR520 Pontoon facility. The report includes a brief description of the computational framework OpenSees, the finite element mesh used in the analysis, modeling strategy, input motion, and simulation results. The main objective of the project is to evaluate lateral deformations in the vicinity of the proposed structure.

OPENSEES BACKGROUND

OpenSees (Open System for Earthquake Engineering Simulation) is an open-source computational program developed at the Pacific Earthquake Engineering Research (PEER) Center, with funding primarily from the National Science Foundation. The source code of OpenSees is written in C++ and is publicly available at (http://opensees.berkeley.edu).

OpenSees was developed with emphasis on accurate simulation of the static/dynamic response of structural and/or soil systems with potentially highly nonlinear material behavior. OpenSees is an implicit finite element program, with an extensive set of one-dimensional (1D) to three-dimensional (3D) modeling and static and dynamic time domain analysis capabilities.

Soil Elements

OpenSees has two groups of soil elements. The first group consists of general 2D and 3D solid elements, which can be used to simulate dry or drained or totally undrained soil response (i.e. total stress response). Some of these elements are more suitable for fully saturated, totally undrained soil which behaves as nearly incompressible (due to the low compressibility of water). The second group consists of coupled solid-fluid elements in which both the solid phase displacements and the fluid phase pressures and displacements are primary variables. In this project nearly incompressible elements are use. The incompressibility condition allows the estimation of pore water pressures during dynamic cases.

Soil Material Models

A number of soil plasticity models are available, including the classical Mohr-Coulomb, von Mises, Drucker-Prager, and Cam Clay models. The Manzari-Dafalias model is based on bounding-surface plasticity and is capable of reproducing soil dilatancy effects. The Multi-Yield Pressure-Dependent (MYPD02, for sands and gravel) and Multi-Yield Pressure-Independent (MYPI, for clays) models are based on nested-surface plasticity (See the OpenSees online manual for a list of references on soil plasticity models, http://opensees.berkeley.edu/OpenSees/manuals/usermanual/). The two latter models are employed in this project and are described in more detail below

Multi-Yield Pressure-Dependent 02 Model (MYPD02)

Based on the original multi-surface-plasticity framework of Prevost (1985), this model incorporates a non-associative flow rule and a strain-space mechanism (Yang et al. 2003) in order to reproduce the salient cyclic mobility response features of soil liquefaction. Following standard convention, it is assumed that material elasticity is linear and isotropic, and that nonlinearity and anisotropy result from plasticity (Hill 1950). The yield function is selected as a conical (Drucker-Prager) surface in principal stress space. In the context of multi-surface plasticity (Iwan 1967, Mroz 1967), the hardening zone is defined by a number of similar yield surfaces with a common apex (at along the hydrostatic axis). The outermost surface is designated as the failure surface, the size of which is related to the friction angle. The failure surface or outermost yield surface defines the limiting stress state for the material. The yield surfaces sizes may be defined by matching a piecewise linear approximation of the nonlinear shear stress-strain curve, i.e., the backbone curve (Yang et al. 2003).

Multi-Yield Pressure-Independent Model (MYPI)

This model is based on the conventional multi-surface-plasticity framework (Iwan 1967). The yield function is selected as a cylindrical (i.e. von Mises type) surface in principal stress space. The outermost surface is designated as the failure surface, the size of which is related to undrained shear strength or cohesion of the soil. The yield surfaces sizes may be defined by matching a piecewise linear approximation of the nonlinear shear stress-strain curve (backbone curve, Yang et al. 2003). Note that volumetric response is elastic as there is no cap on the yield function. The hardening rule is the same as that used in the MYPD02 model. Plastic flow only occurs in the deviatoric plane, and the flow rule is associative.

OPENSEES MESH

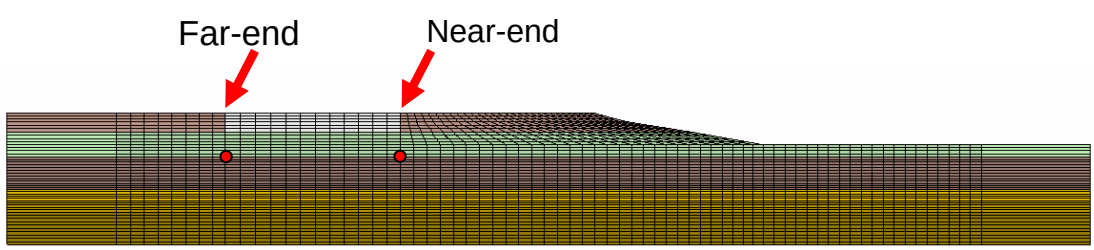


Figure 1 – OpenSees mesh

A representative finite element mesh was developed using the pre-prost processor GiD. Quadrilateral elements were used to represent the soil domain. The elements near the left and right sides of the model (i.e., left and right side columns) were given larger width and thickness. At each elevation the nodes of these elements were slaved in the horizontal and vertical directions. This was done to enforce a 1D free-field condition at the ends. To

avoid boundary effect these columns were placed at a reasonable distance from the region of interest. Several meshes were developed with different sizes, number of elements, and dimensions before we reached the mesh shown in Figure 1.

The MYPD02 and MYPI constitutive models were used to simulate the nonlinear soil behavior. Silts (brown in Figure 1) were modeled using the MYPI constitutive model. Sands (green in Figure1) and gravels (light-brown in Figure 1) were modeled using the MYPD02 constitutive model. Parameters for each case were determined using correlations with relative density and field information provided by Landau and presented in Table 1. Nested yield surfaces were selected to match the G/Gmax curves used by Landau in a parallel numerical study performed using FLAC and DMOD. Pore water pressures were allowed to build-up only in the loose sand (green in Figure 1).

The ground water table was assumed 7.00ft below the top of the slope. Under these conditions the right side of the soil domain was submerged. The effect of water in the submerged portion of the mesh was modeled using equivalent nodal forces

Table 1 Soil Properties

Soil Description	Depth to the Top of the Layer (ft)	Layer Thickness (ft)	Shear wave Velocity, Vs (ft/sec)	Unit weight, γ (pcf)	Corrected SPT Value, N60	Relative Density, Dr %	Undrained Shear Strength, cu (psf)
Silt	0	35	300	105	-	-	750
Sand	35	45	500	115	8	45	
Silt	80	50	500	105	-	-	1750
Silt	130	10	750	105	-	-	1750
Gravel	140	20	1000	140	57	78	
Gravel	160	20	1250	140	100	85	
Gravel	180	60	1500	140	85	85	

SIMULATION STRATEGY

The simulation process included two phases: (a)application of gravity, and (b)application of dynamic excitation.

In phase (a) gravity was applied assuming elastic soil properties. Once the initial effective stress field was generated the soil response was changed to “elasto-plastic” and several static steps were performed to ensure equilibrium under “plastic conditions”. Figure 2 shows the resulting vertical effective stress field after gravity was applied.

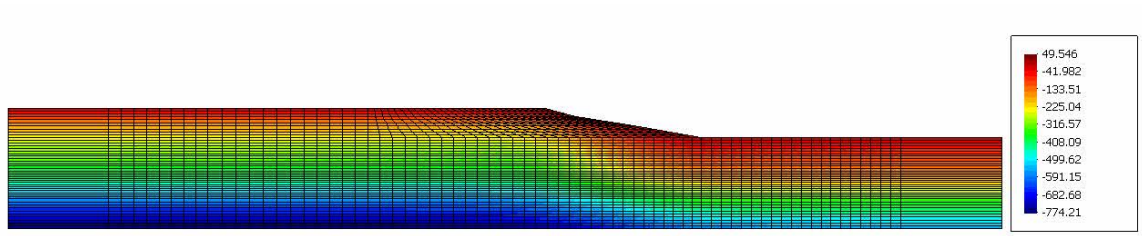


Figure 2 Vertical effective stresses after application of gravity

In phase (b) a earthquake acceleration time history was applied as a uniform excitation at the base of the model. To ensure equilibrium under plastic conditions each time step was subdivided into several sub-steps. A Newmark integrator was used in the simulation and a small amount of Rayleigh damping (0.5%) was added to ensure damping of small elastic vibrations

INPUT MOTION (APPLIED TO RIGID BASE)

A scaled version of the Viña del Mar motion was used in the OpenSees simulations. Figure 2 shows the acceleration, velocity and displacement time histories. Figure 3 shows the input motion response spectrum.

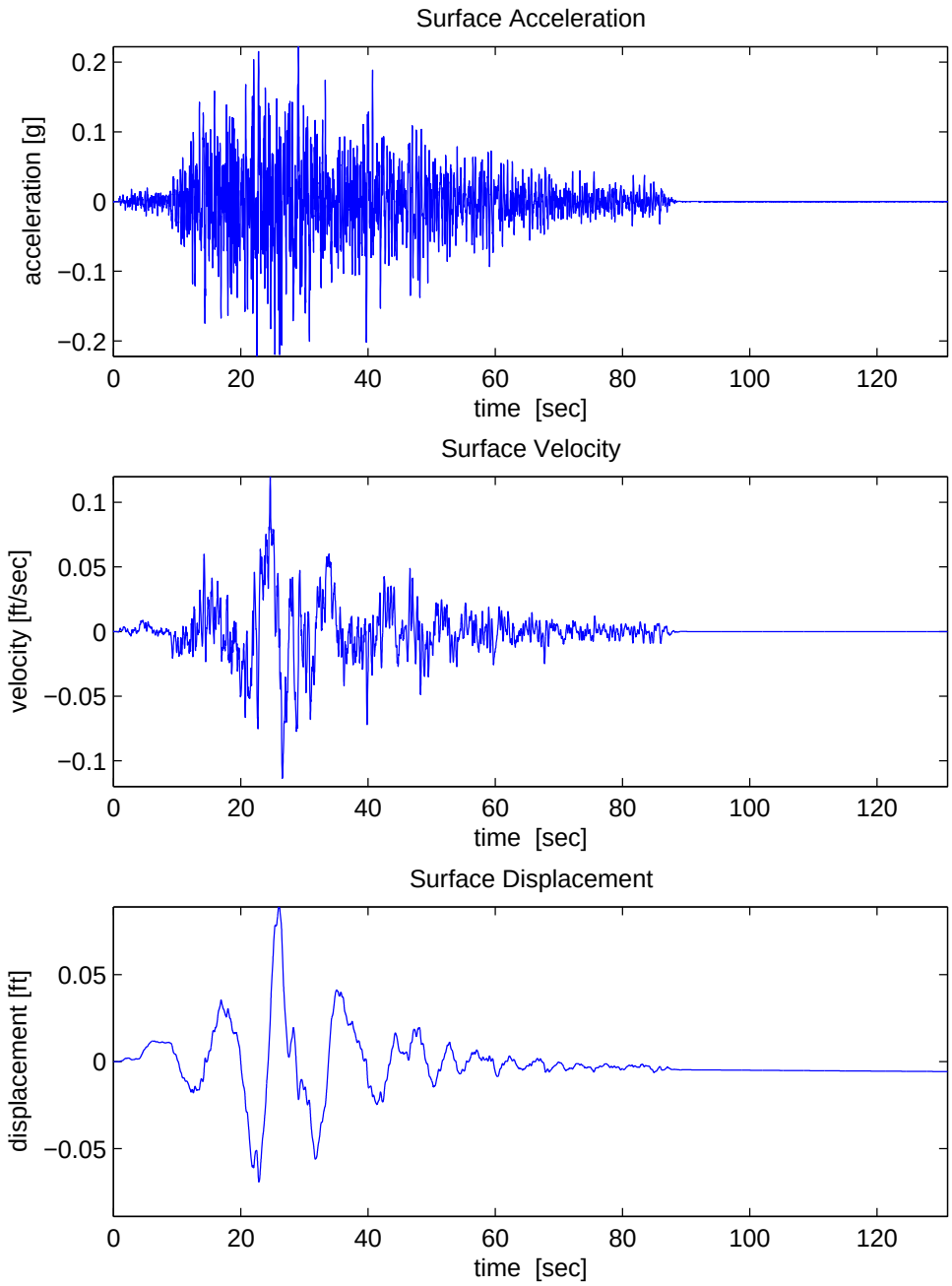


Figure 2: Input acceleration, velocity and displacement time histories

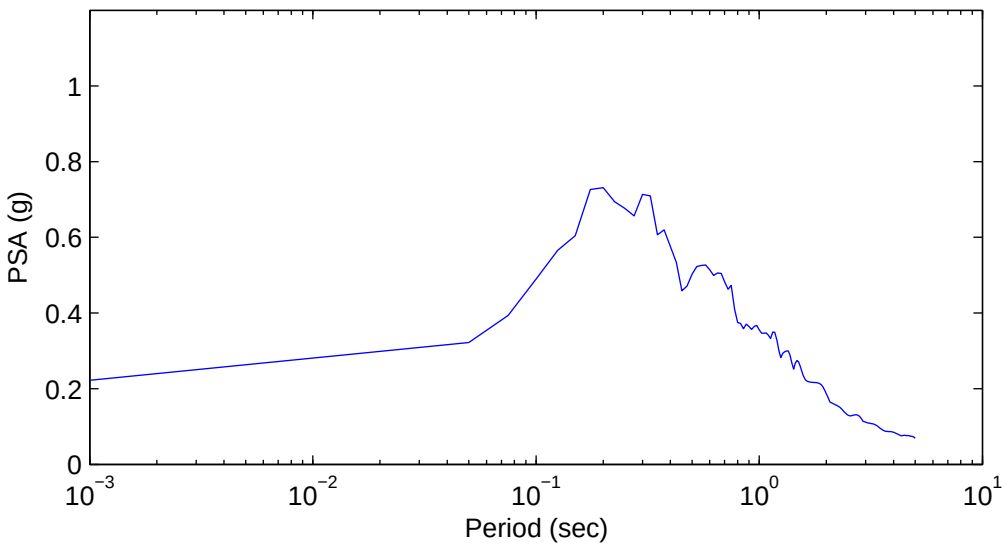


Figure 2: Input motion response spectrum

VALIDATION

A validation study was performed to ensure the results were consistent with results obtained using other tools. For this purpose OpenSees results corresponding to the right and left sides of the model (i.e. free field response) were compared with results obtained using Shak2000e, FLAC, and DMOD. Maximum accelerations, velocities, displacements, and pore water pressures were compared at different elevations. Appendix B includes results from this analysis.

RESULTS FROM 2D MODEL

Results are presented in terms of pore water pressures and displacements.

Pore pressures in liquefiable layer

Figure 3 shows plots of pore-water pressure ratio for a point located at the bottom of the liquefiable soil near the left side of the model (blue) and a point located at the right side of the model (black). Since the initial effective stresses are smaller at the right side than at the left side, pore water pressures build-up faster at the right side. Therefore, liquefaction (i.e., ru = 1.0) occurs first at the right side of the model resulting in deformations that affect the left side before liquefaction is reached at that location. Figure 4 (a) and (b) show the extent of liquefaction at 18 sec and 27.5 sec. At 18 sec most of the loose sand at the right side and near the slope toe has liquefied (i.e., ru = 1.0). At 27.5 sec most of the loose sand has liquefied. It is also noticed that the pore pressure ratio does not reach ru=1.0 at the top of the loose sand in the left side of the model.

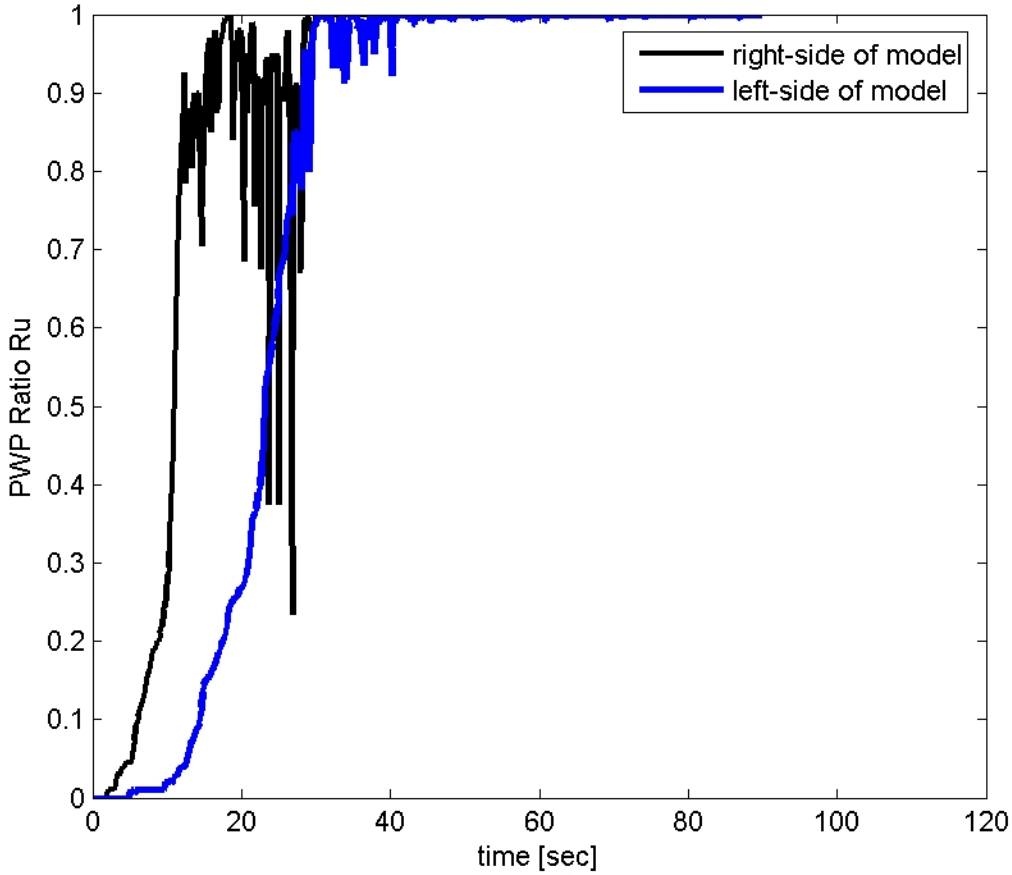
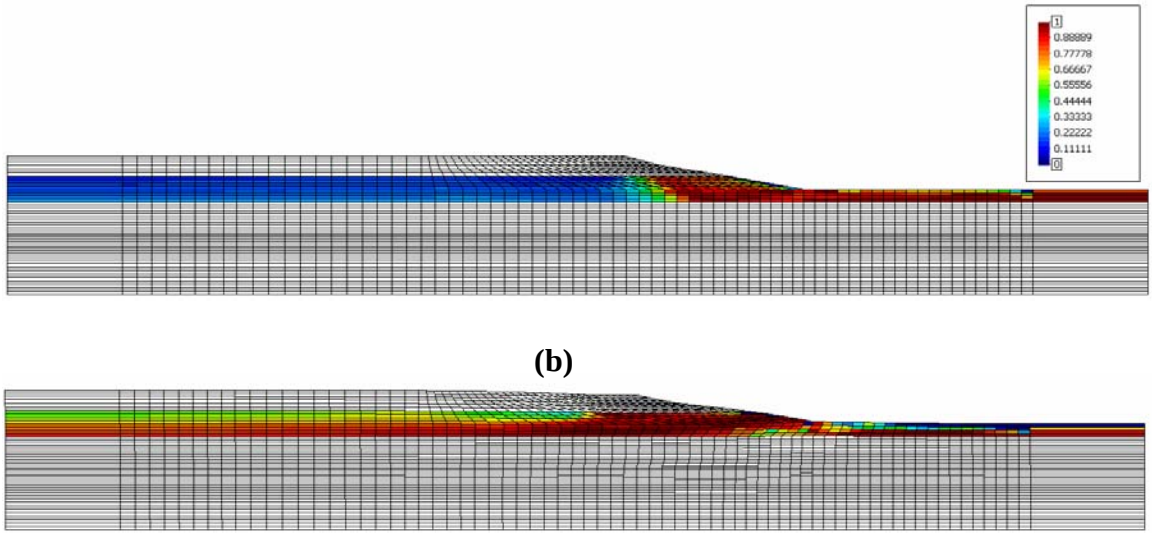


Figure 3 Pore water pressure time histories at model sides

(a)



(b)

Figure4 Contours of pore water pressure ratio at (a)18 sec and (b)27.5 sec

Surface Displacements

Figure 5 shows horizontal displacements time histories corresponding to four points located on the surface. The black lines correspond to the surface free-field horizontal displacement at the left and right sides. The red line corresponds to the surface displacement at the near-end of the structure (Figure 1). The blue line corresponds to the surface displacement at the far-end of the structure. The predicted near-end maximum displacement is around 8.7 ft. The predicted far-end maximum displacement is around 1.0ft. Figure 6 shows contours of horizontal displacement at the end-of-shaking. For clarity the elements representing the location of the structure have been eliminated from the contour plot; however they are included in the analysis. The contours show very large displacements near the slope-toe (22.0ft) which translate into large displacements at the near-end of the structure.

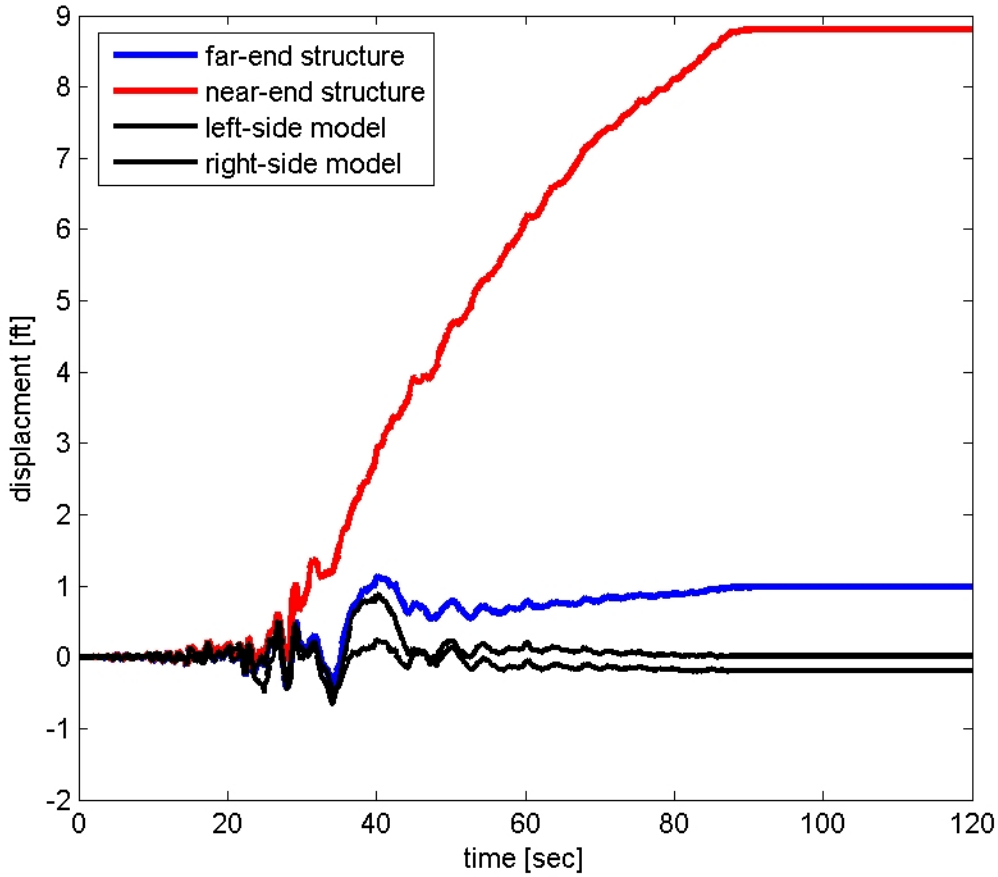


Figure 5 **Surface horizontal displacements at different locations**

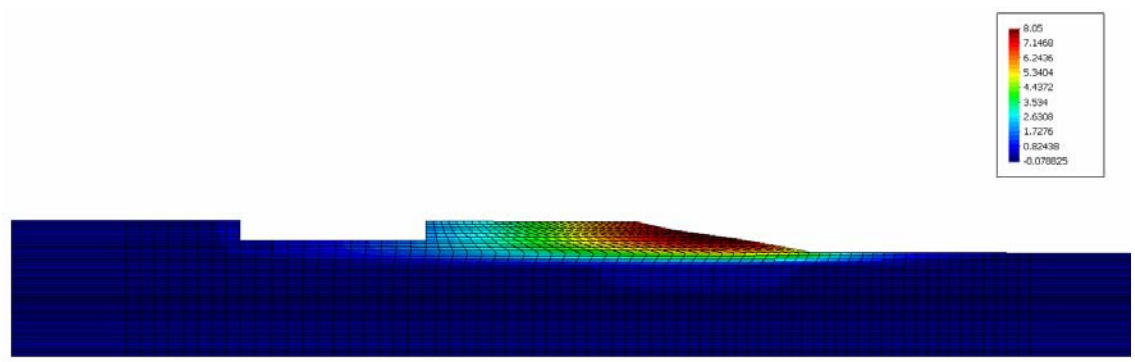


Figure 6 Horizontal displacement contours at the end of shaking

Figure 7 shows predicted surface horizontal displacements versus point distance from the slope crest. Horizontal displacements on the order of 22.0 ft are observed at the slope crest. Smaller values are observed at points located away from the slope crest. In the region of the proposed structure the horizontal displacements range between 8.7 ft (near-end) and 1.0 ft (far end).

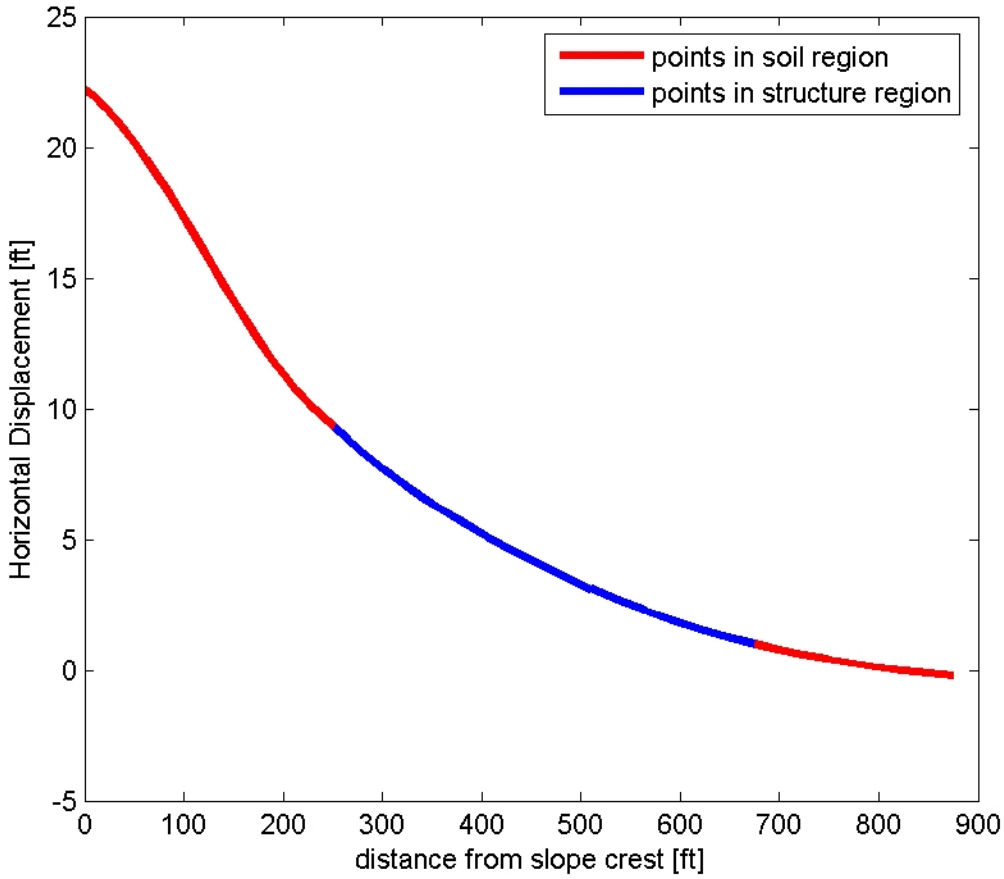
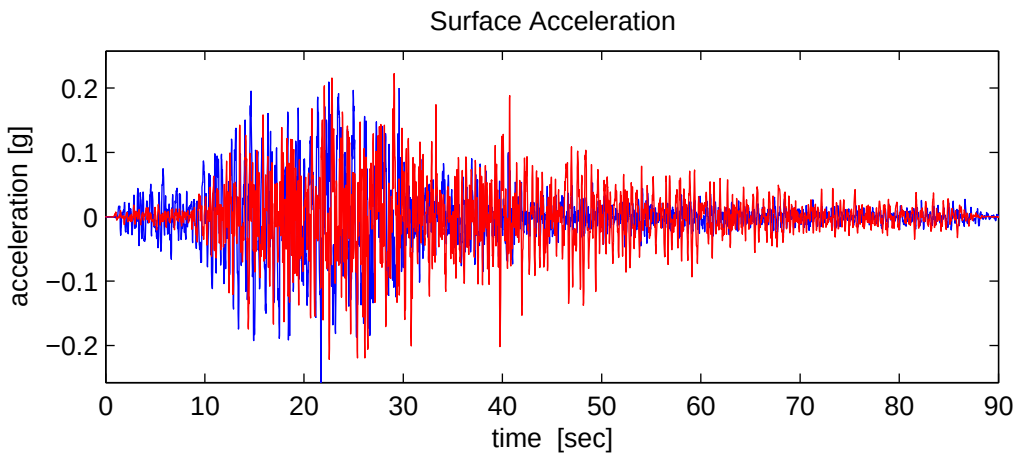


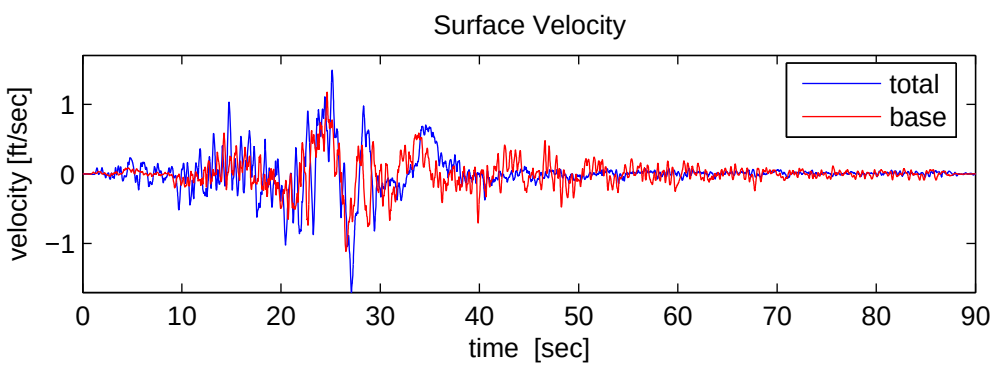
Figure 7 Surface horizontal displacement vs. distance from the slope crest

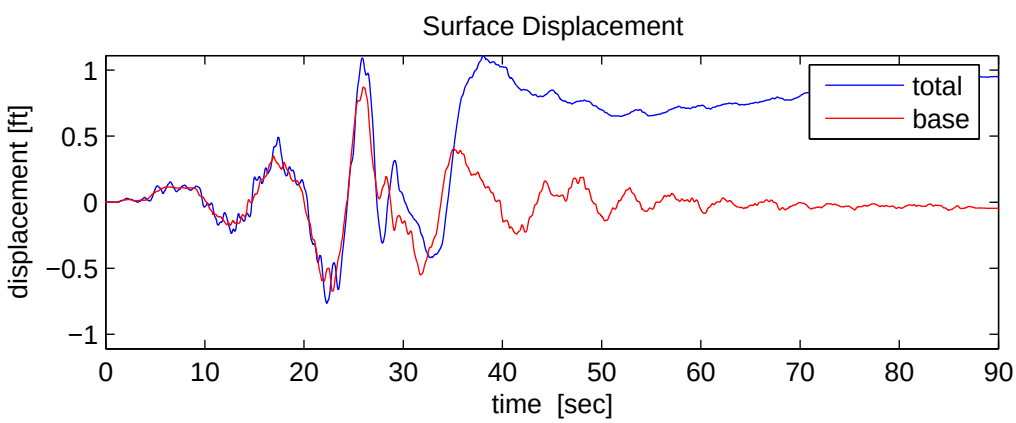
APPENDIX A

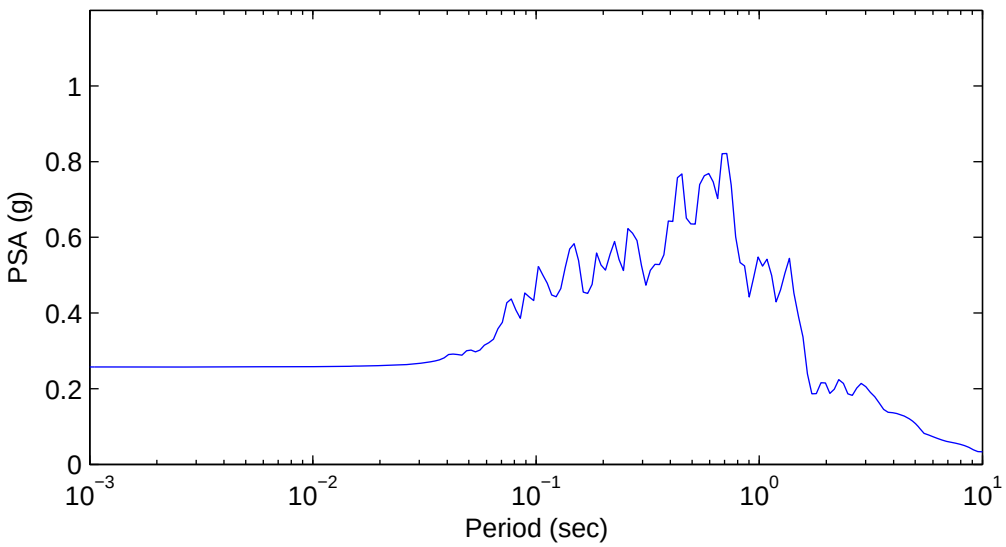
FAR END OF PROPOSED STRUCTURE

Surface response corresponding to point located at left corner of proposed structure

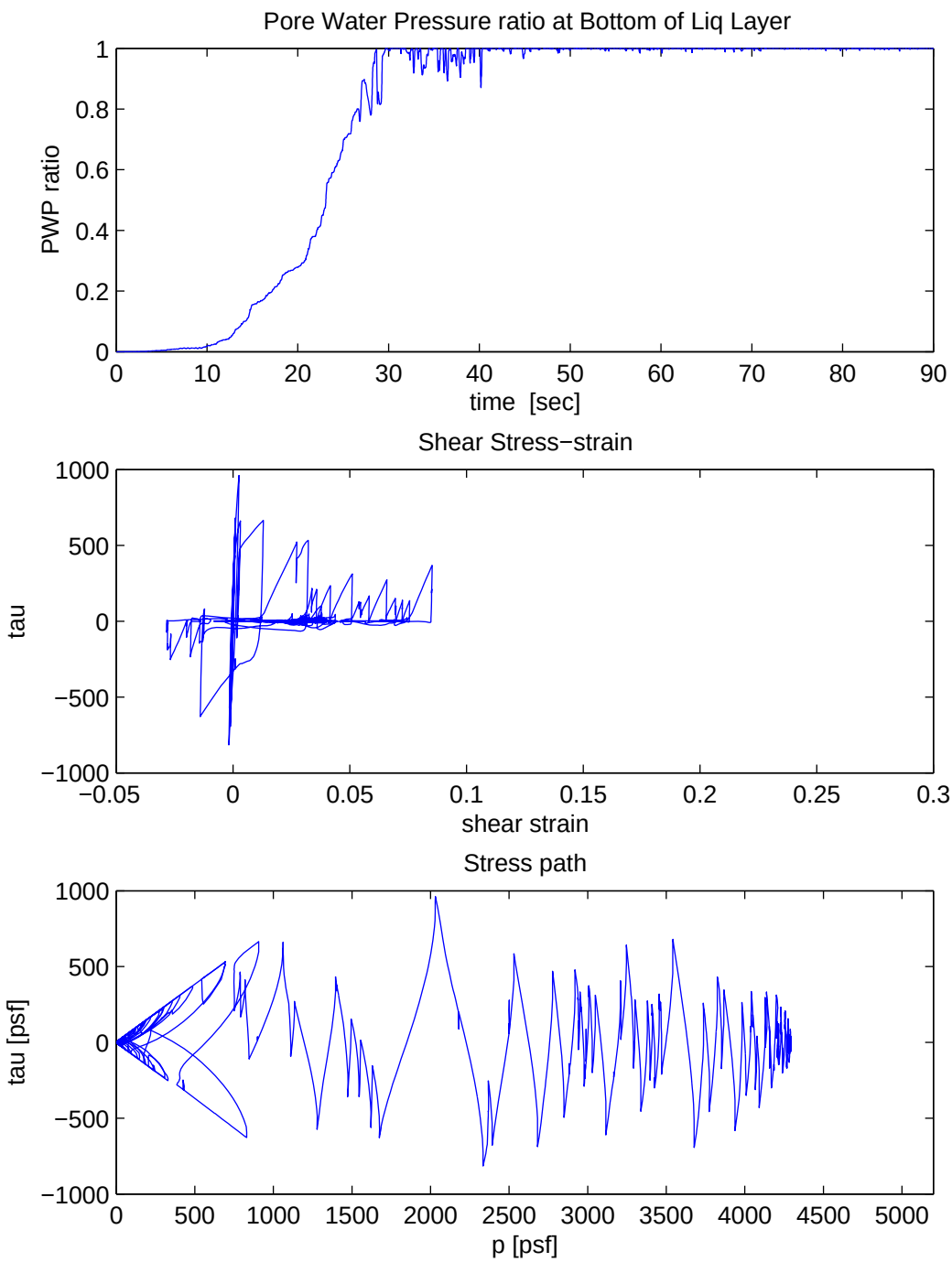






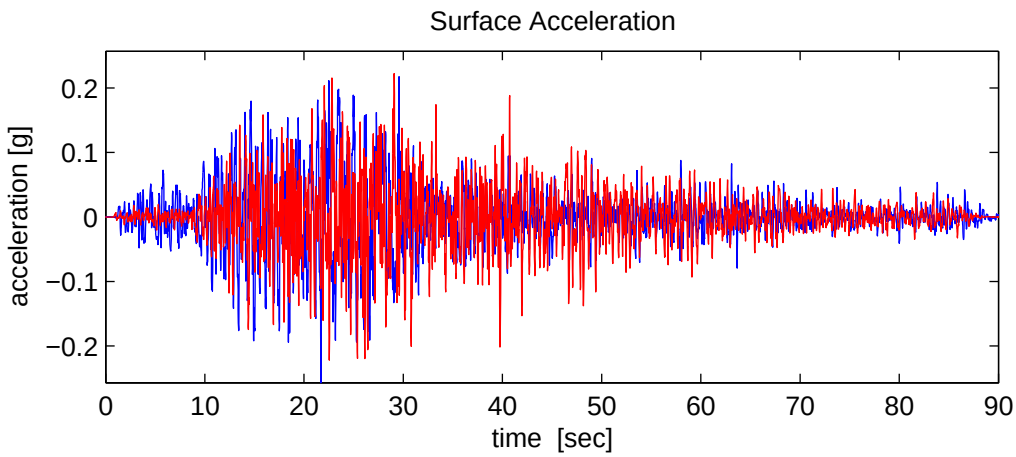

PSA (g)
1
0.8
0.6
0.4
0.2
0
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
Period (sec)

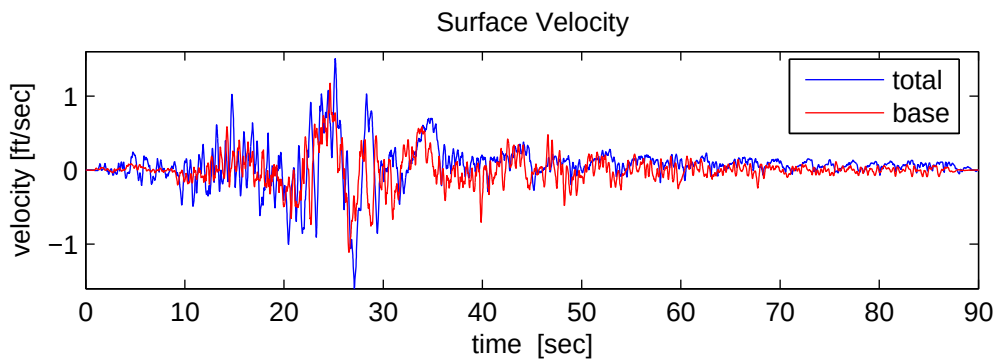
Pore pressure ratio, shear stress vs. shear strain, and stress path corresponding to a point located at the bottom of liquefiable layer below left corner of proposed structure

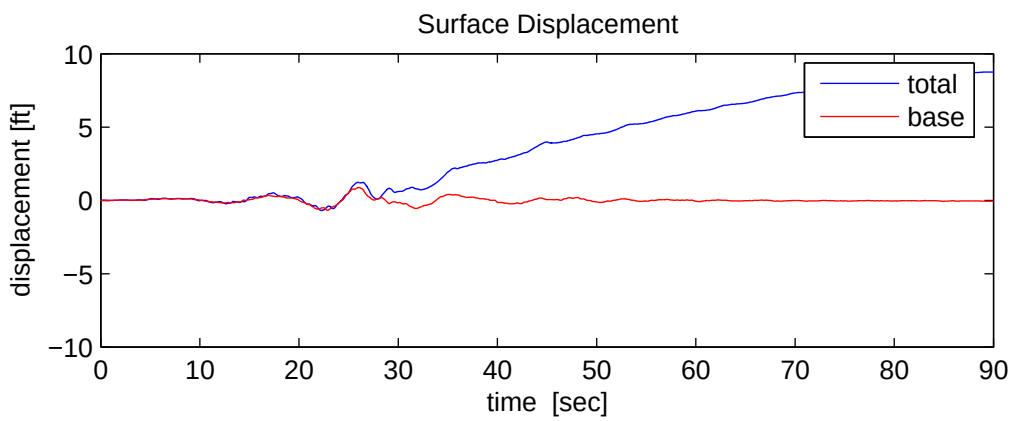


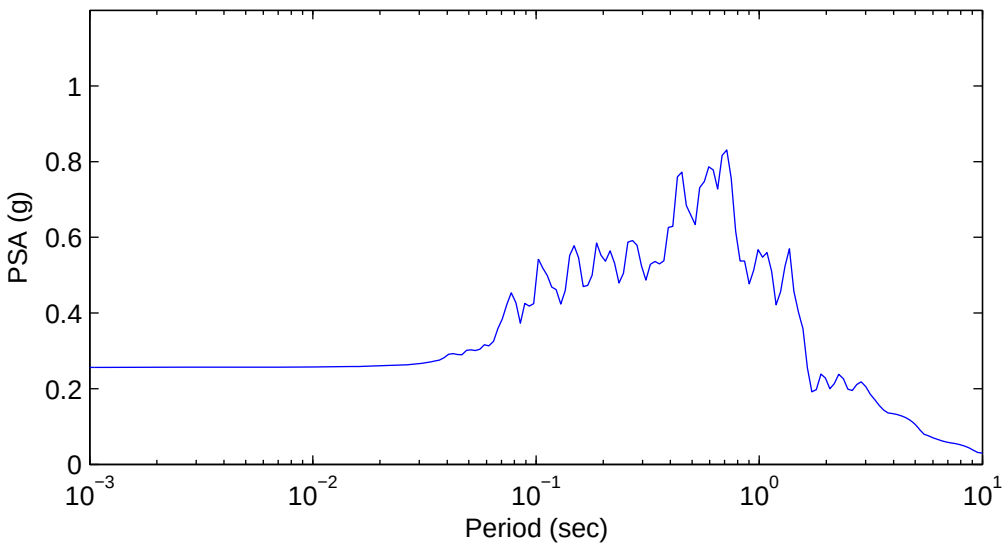
NEAR-END OF PROPOSED STRUCTURE

Surface response corresponding to point located at right corner of proposed structure

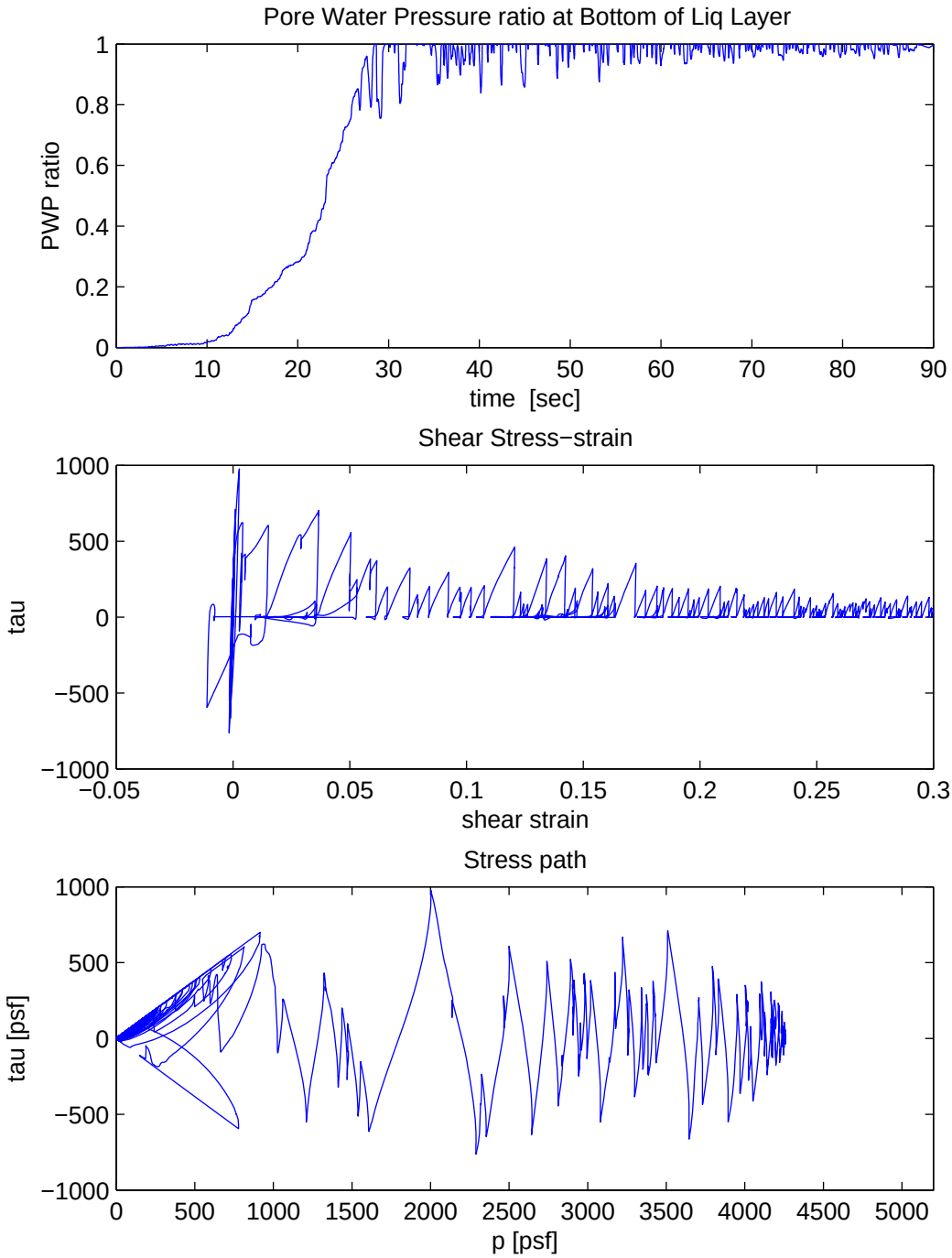




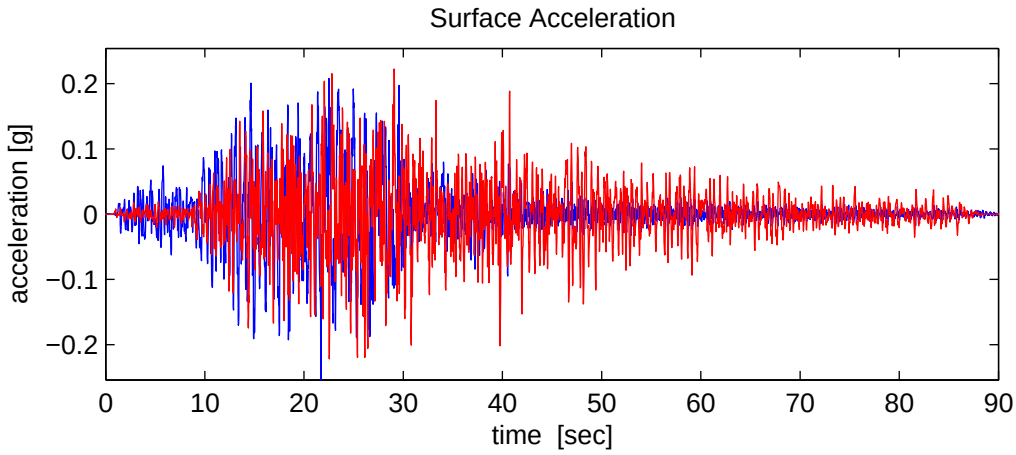


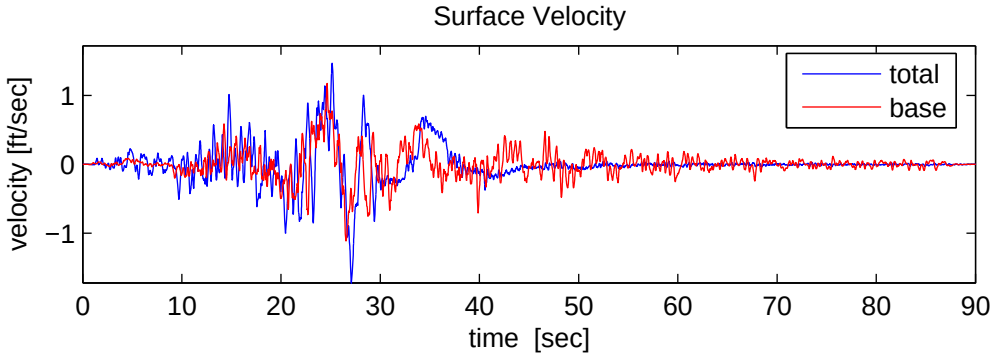

PSA (g)
1
0.8
0.6
0.4
0.2
0
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
Period (sec)

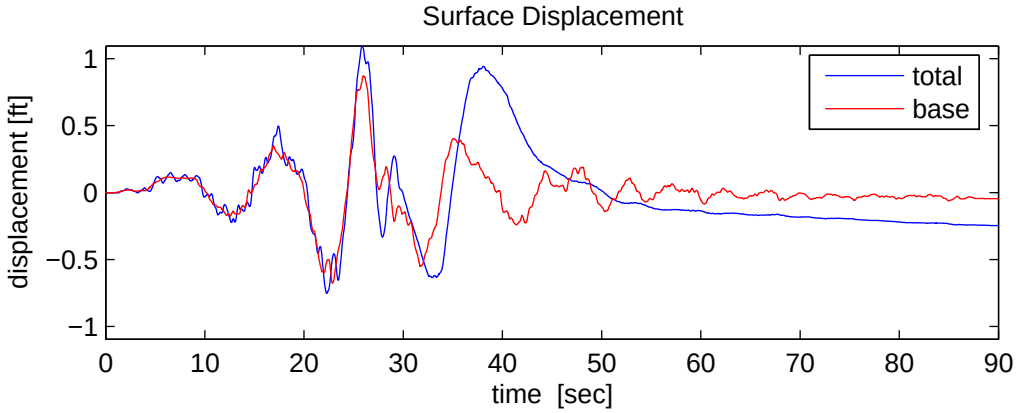
Pore pressure ratio, shear stress vs. shear strain, and stress path corresponding to a point located at bottom of liquefiable layer below right corner of proposed structure

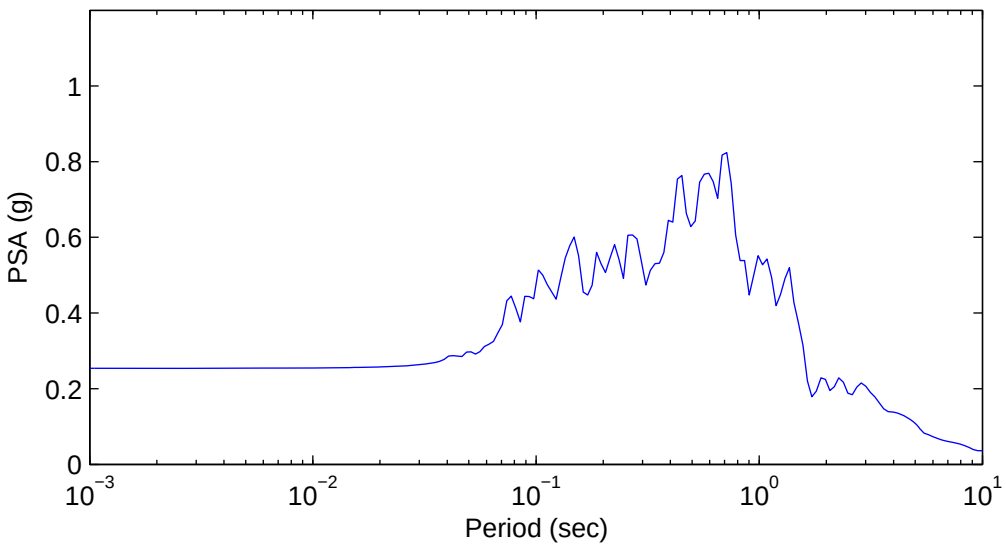


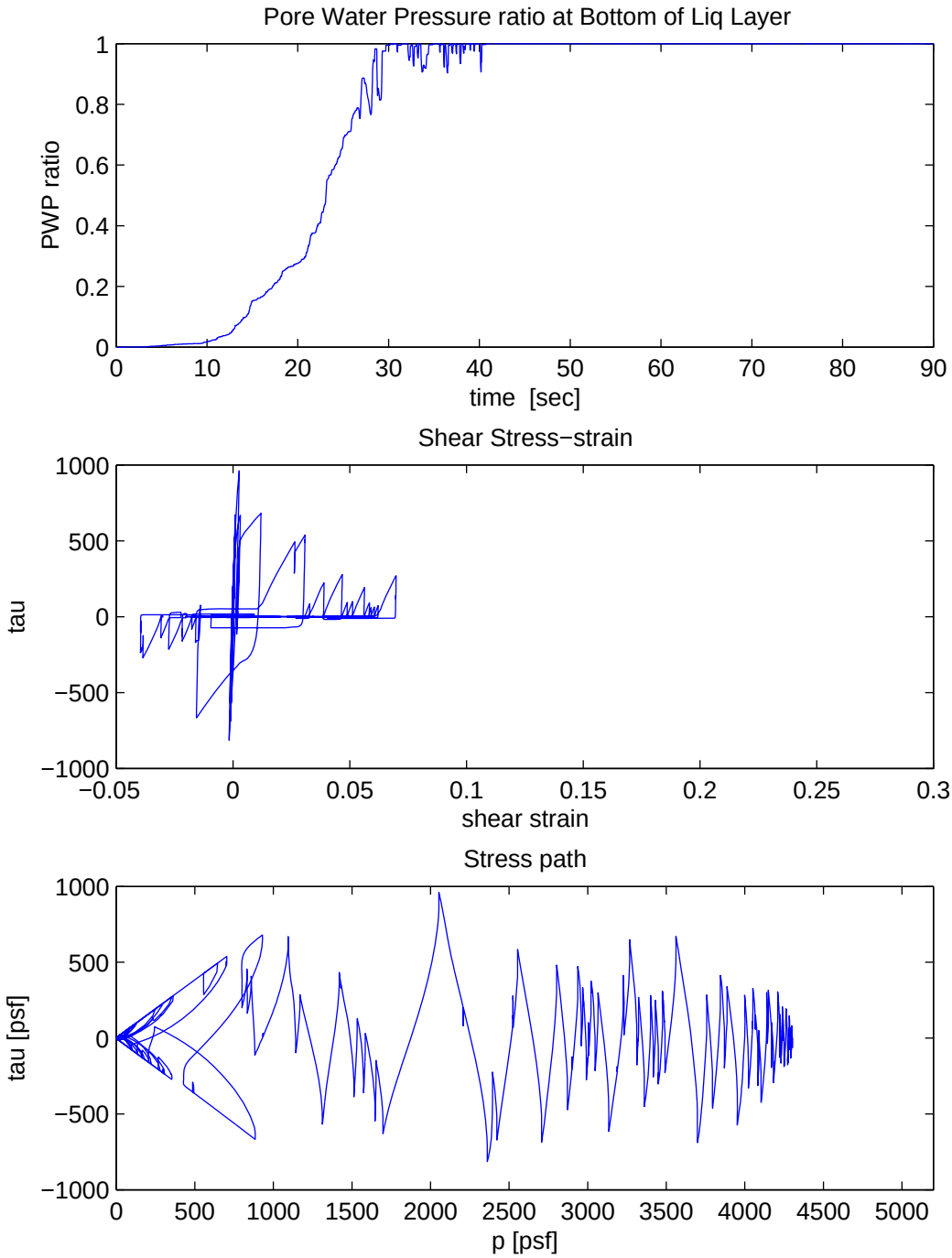
LEFT SIDE OF MODEL



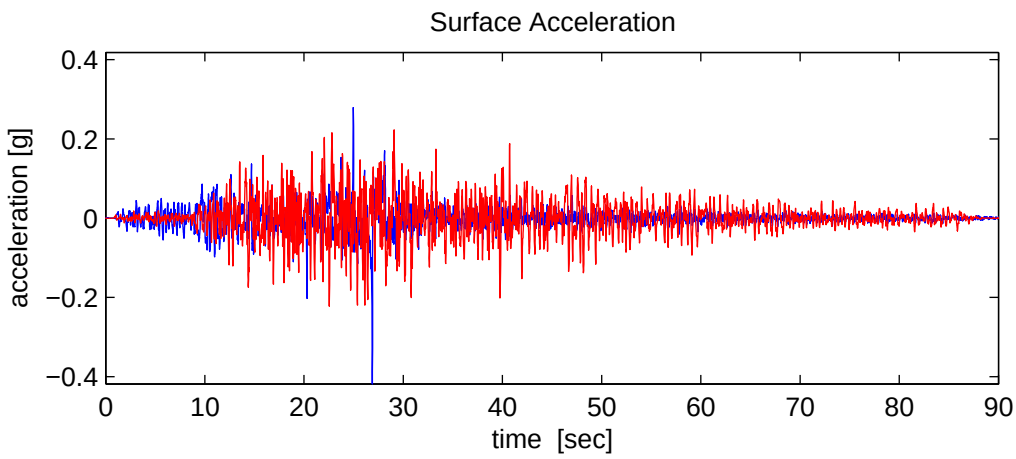


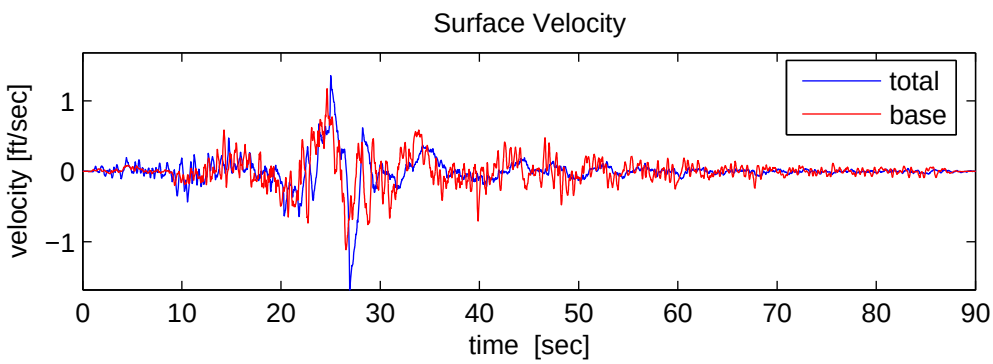


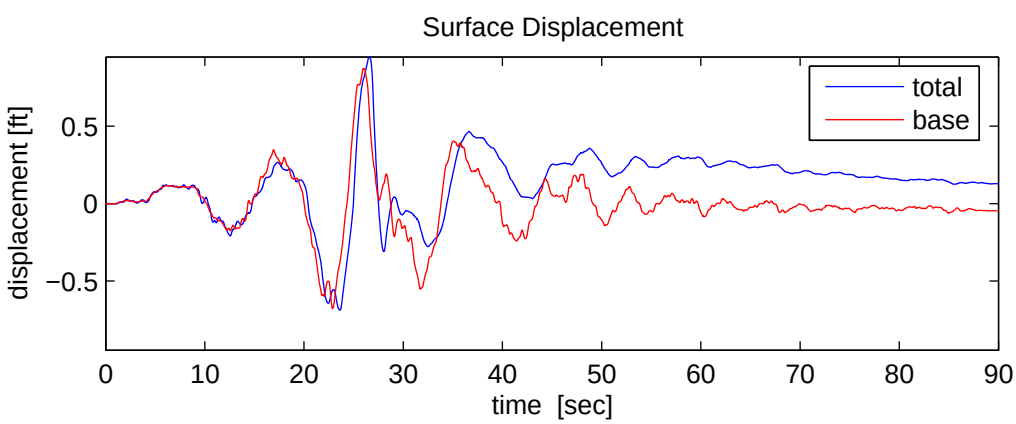

PSA (g)
0
0.2
0.4
0.6
0.8
1
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
Period (sec)

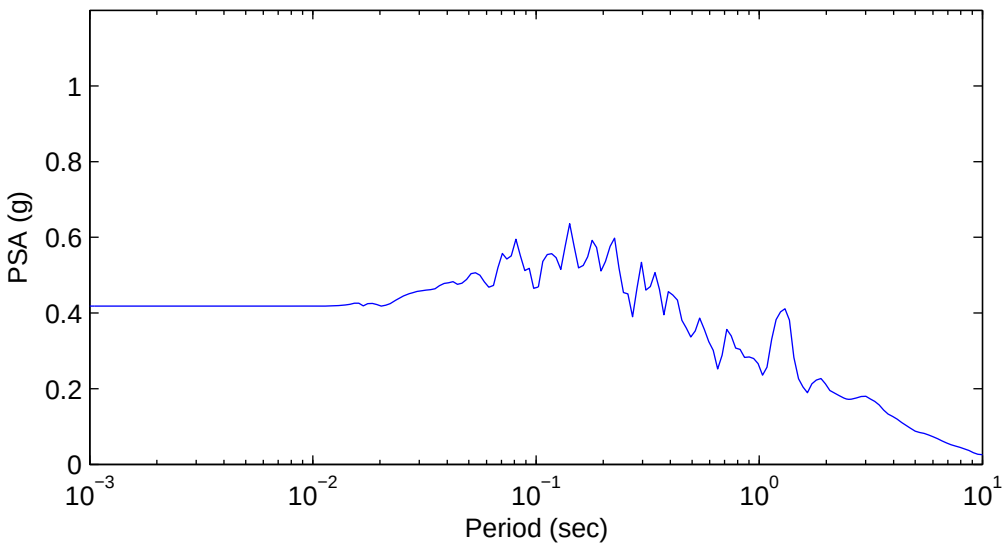

Pore Water Pressure ratio at Bottom of Liq Layer
PWP ratio
time [sec]
Shear Stress−strain
tau
shear strain
Stress path
tau [psf]
p [psf]

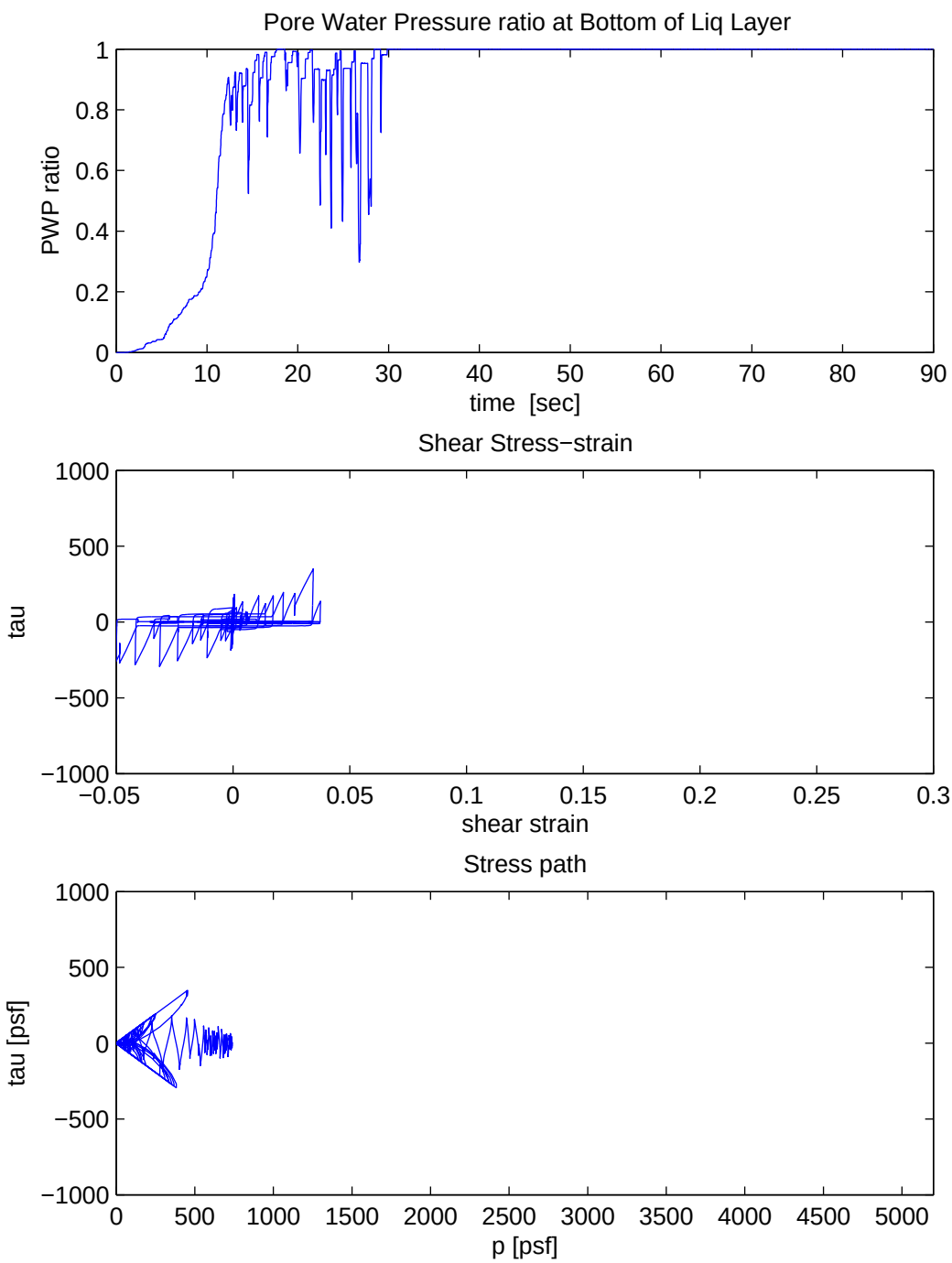
RIGHT SIDE OF MODEL





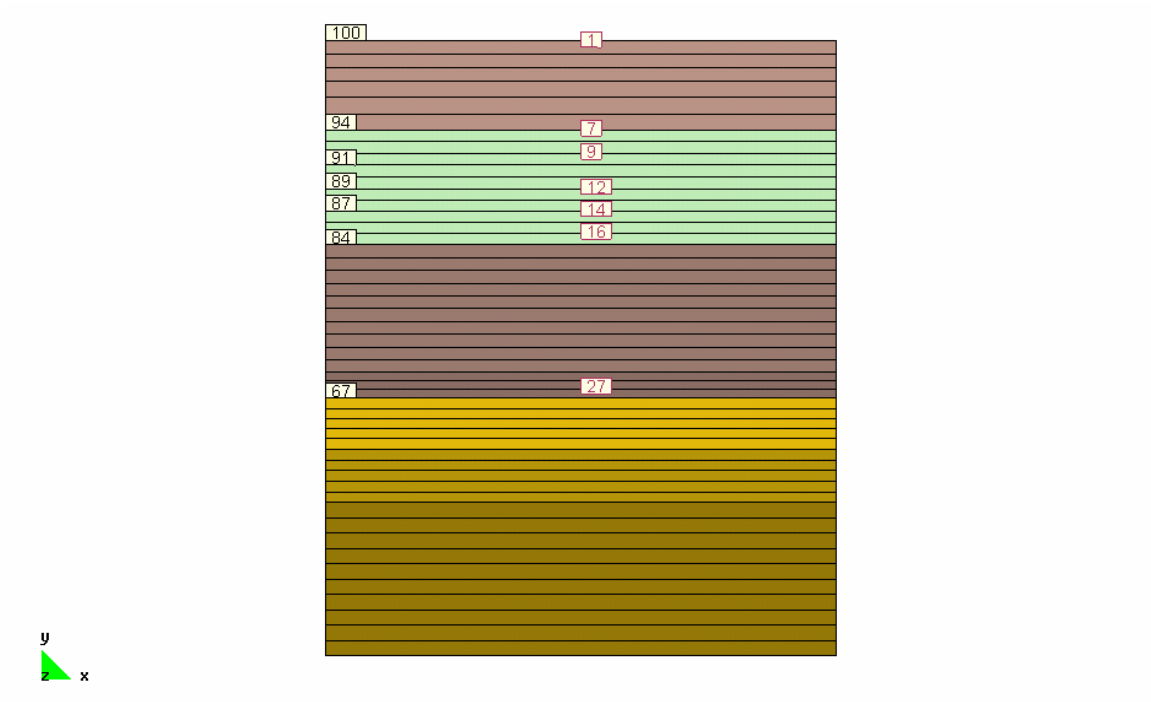



PSA (g)
1
0.8
0.6
0.4
0.2
0
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
Period (sec)

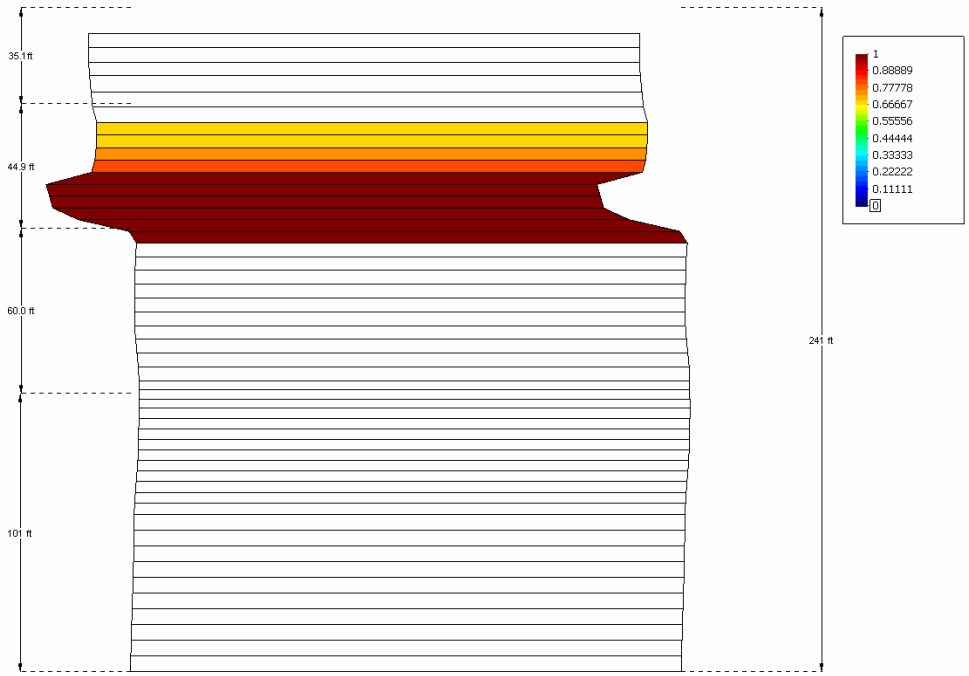

Pore Water Pressure ratio at Bottom of Liq Layer
PWP ratio
time [sec]
Shear Stress−strain
tau
shear strain
Stress path
tau [psf]
p [psf]

APPENDIX B

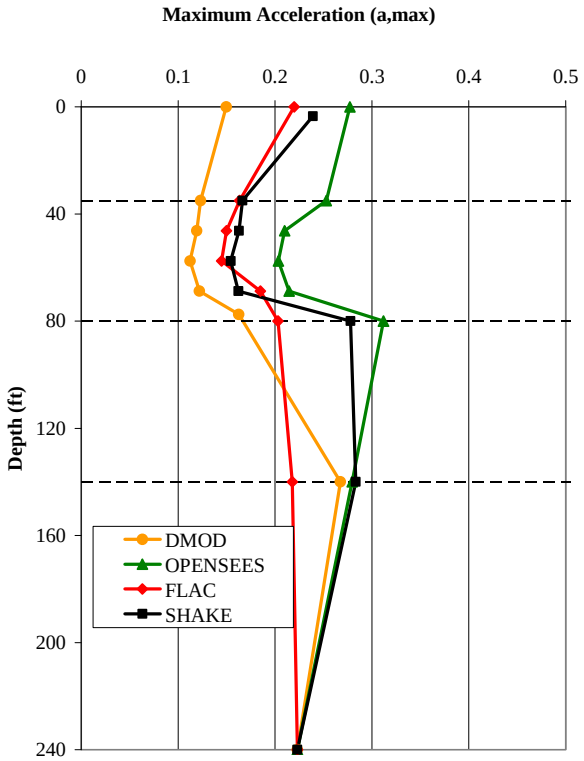
1D MESH (LEFT SIDE OF MODEL)



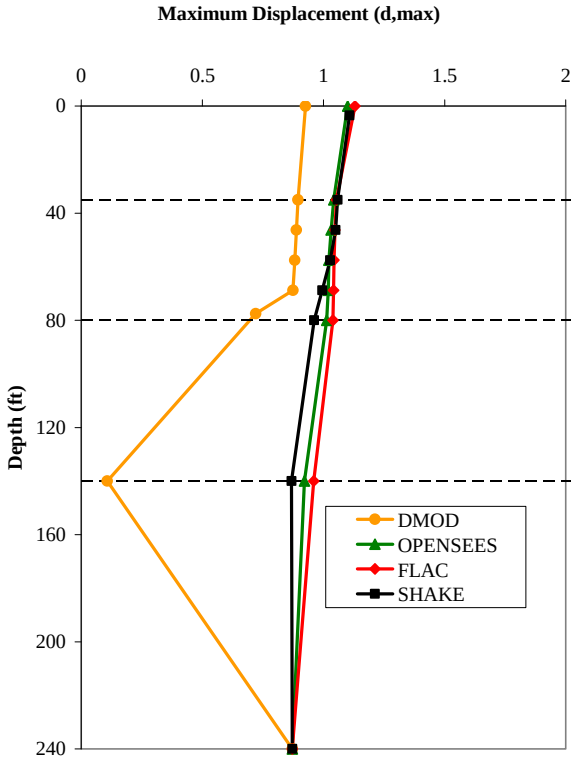
Pore water pressure ratio (Ru)



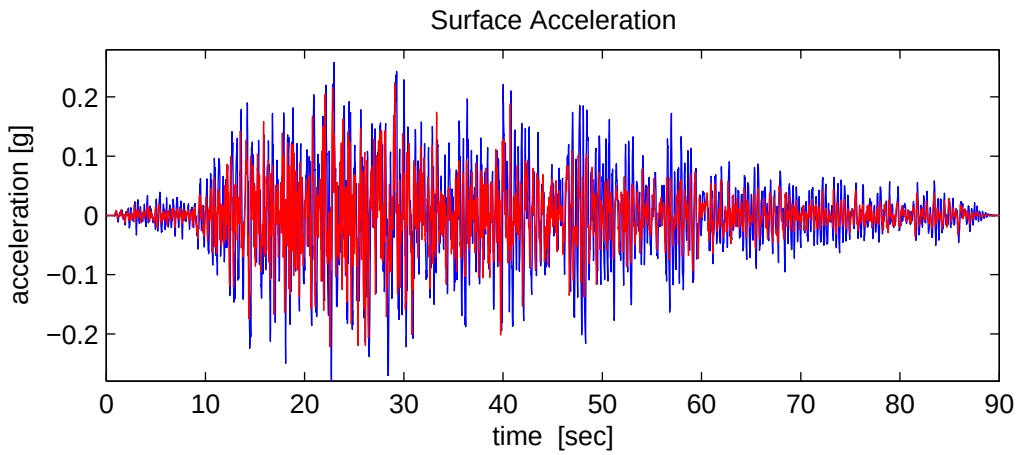
MAXIMUM ACCELERATIONS

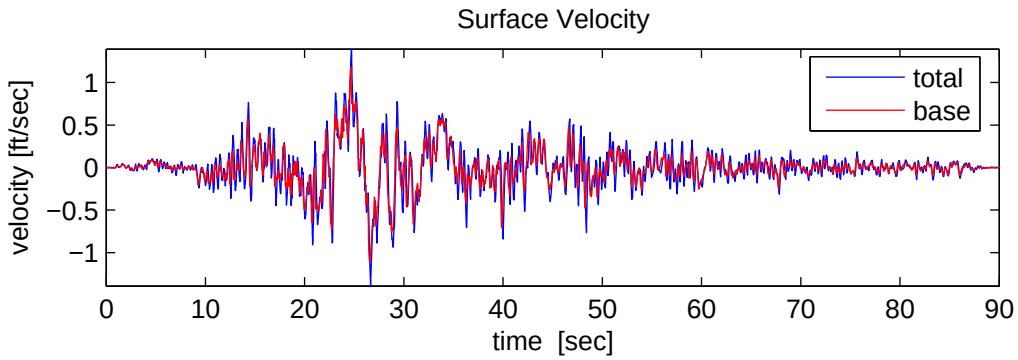


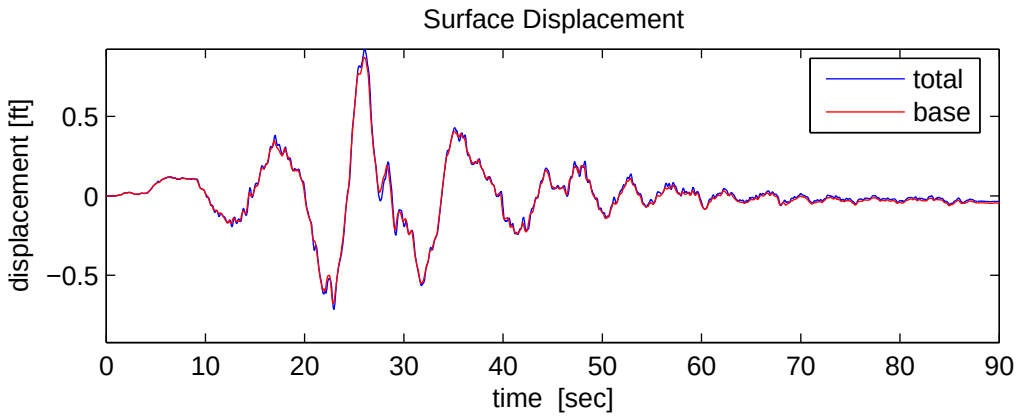
MAXIMUM TOTAL DISPLACEMENTS

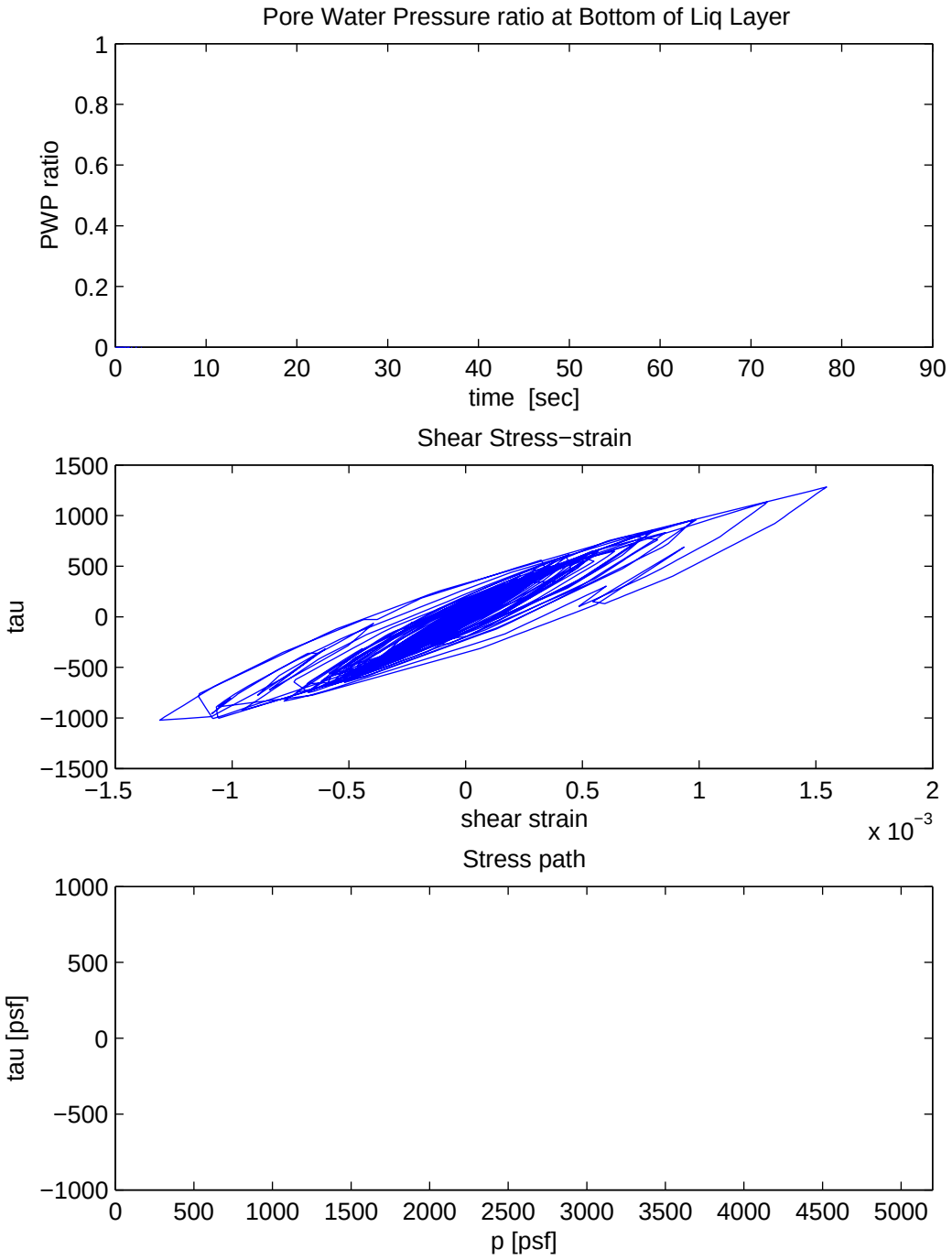


NODE 67, ELEMENT 27

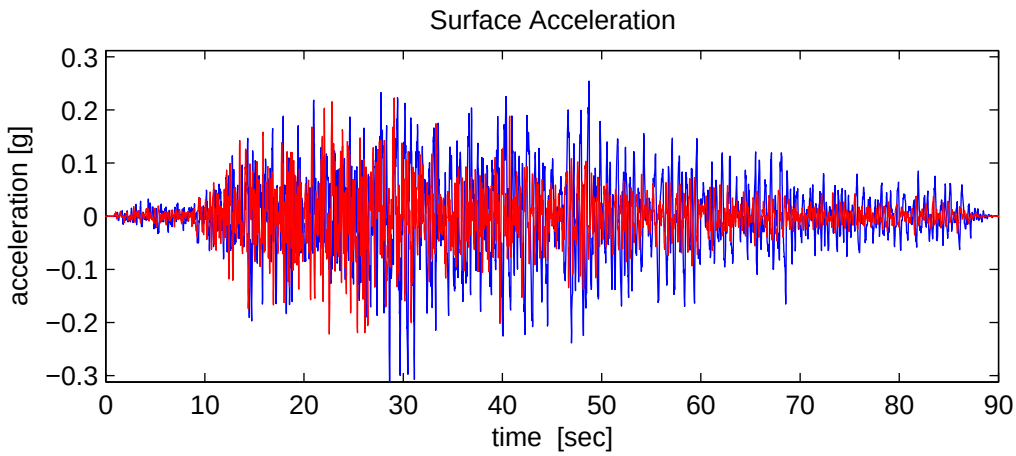


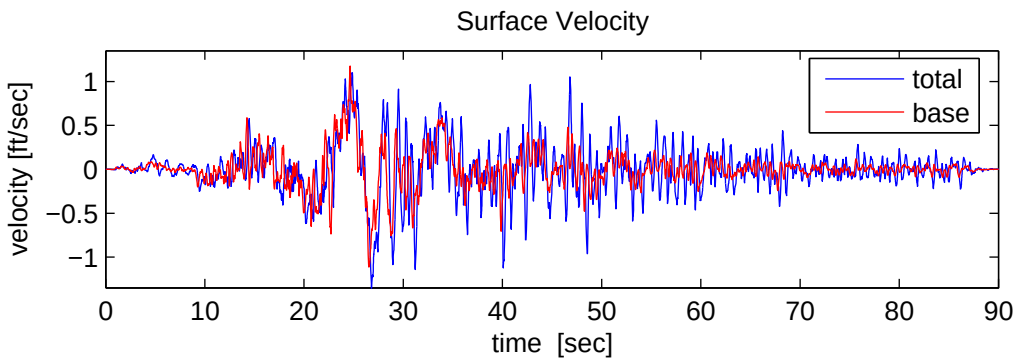


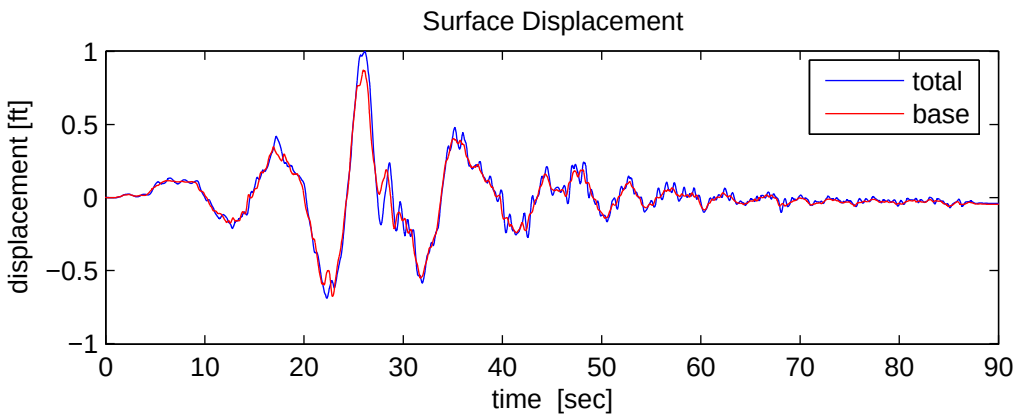


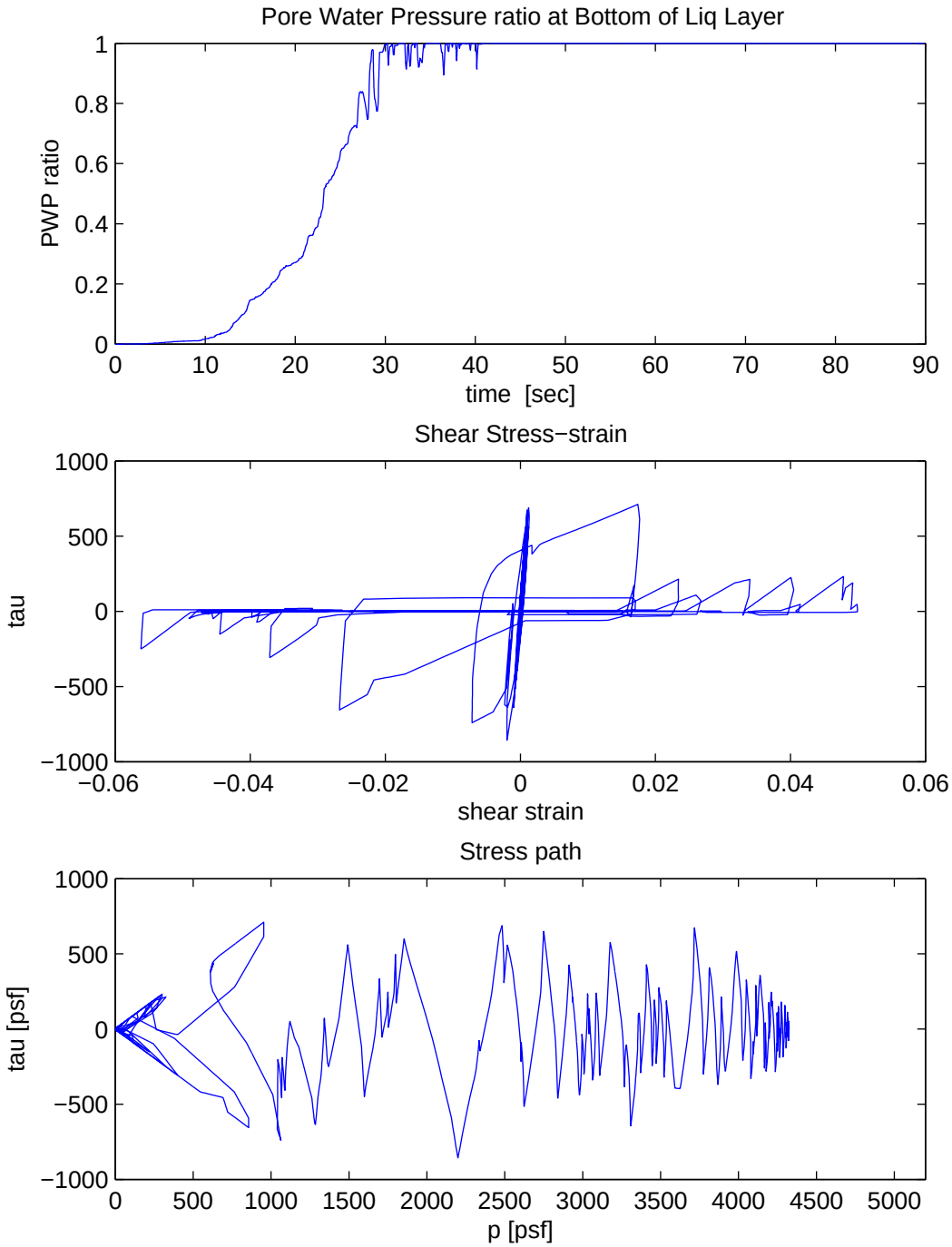

Pore Water Pressure ratio at Bottom of Liq Layer
PWP ratio
time [sec]
Shear Stress−strain
tau
shear strain
x 10^−3
Stress path
tau [psf]
p [psf]

NODE 84, ELEMENT 16

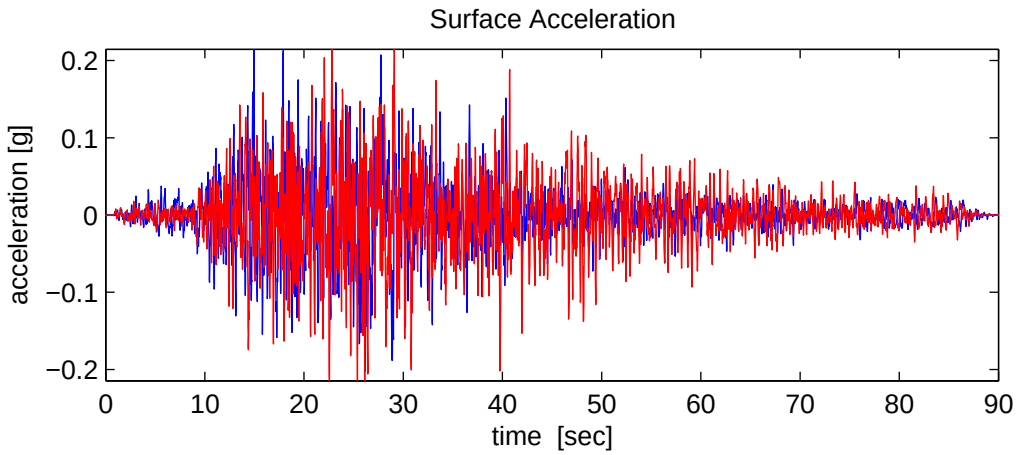


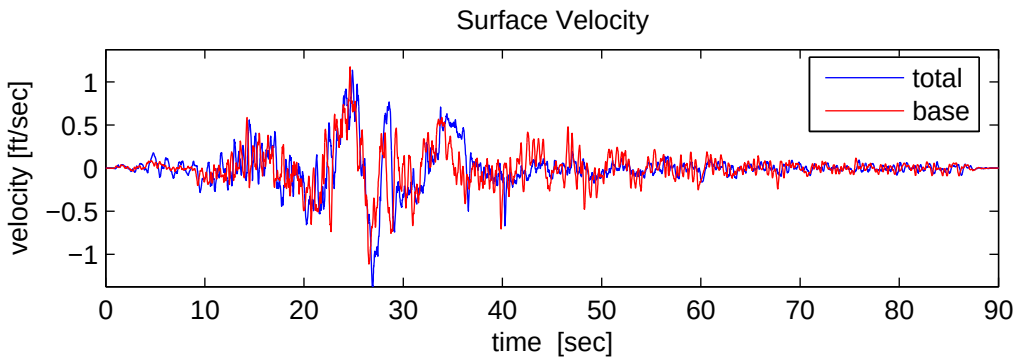


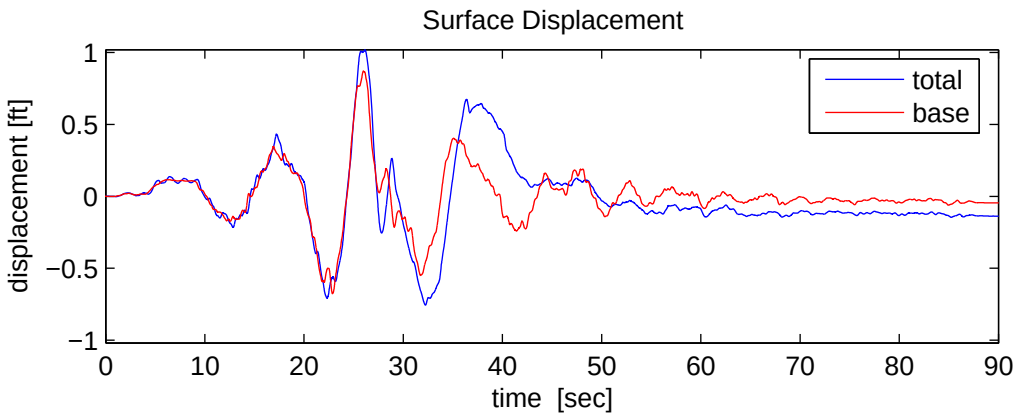


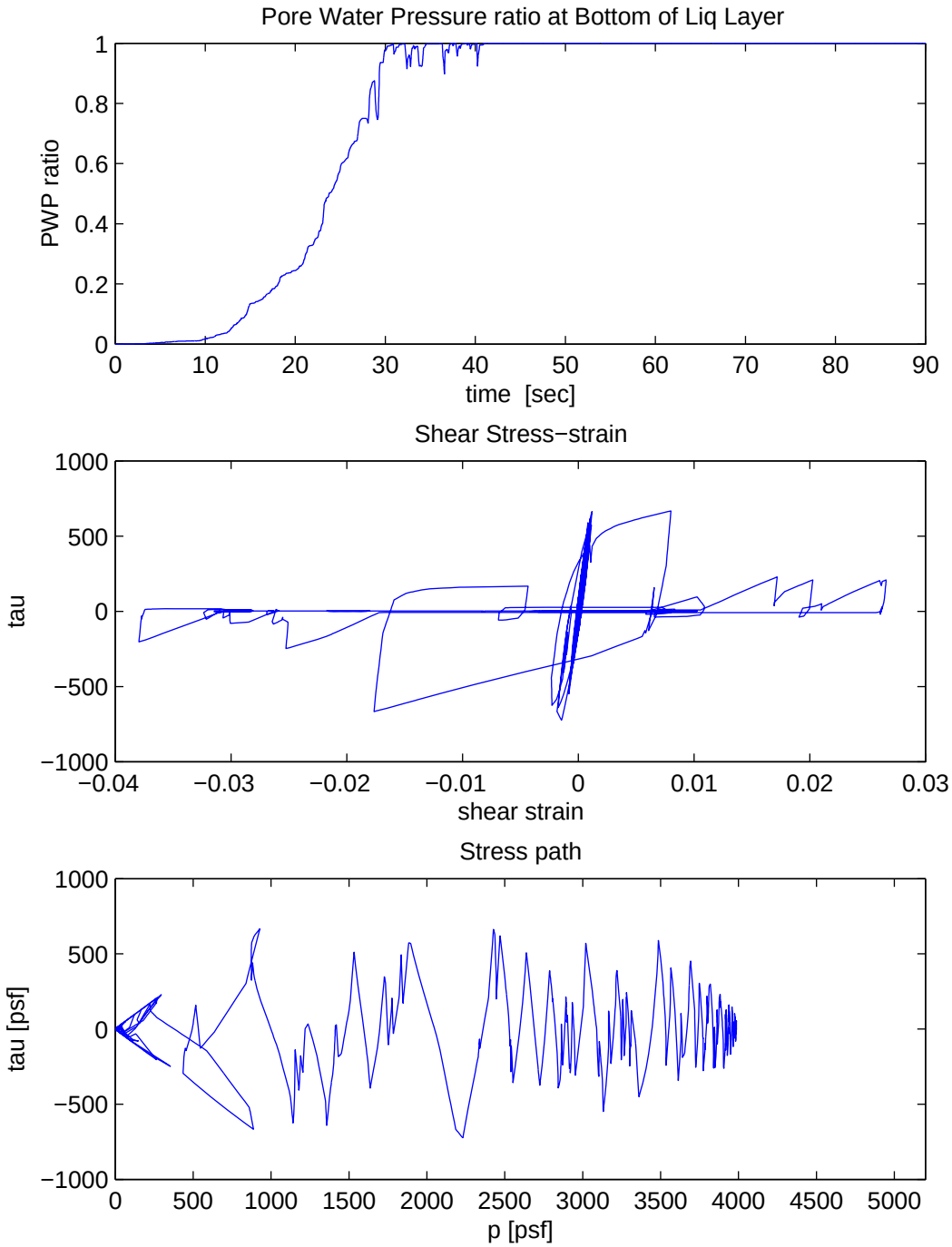

Pore Water Pressure ratio at Bottom of Liq Layer
PWP ratio
time [sec]
Shear Stress−strain
tau
shear strain
Stress path
tau [psf]
p [psf]

NODE 87, ELEMENT 14

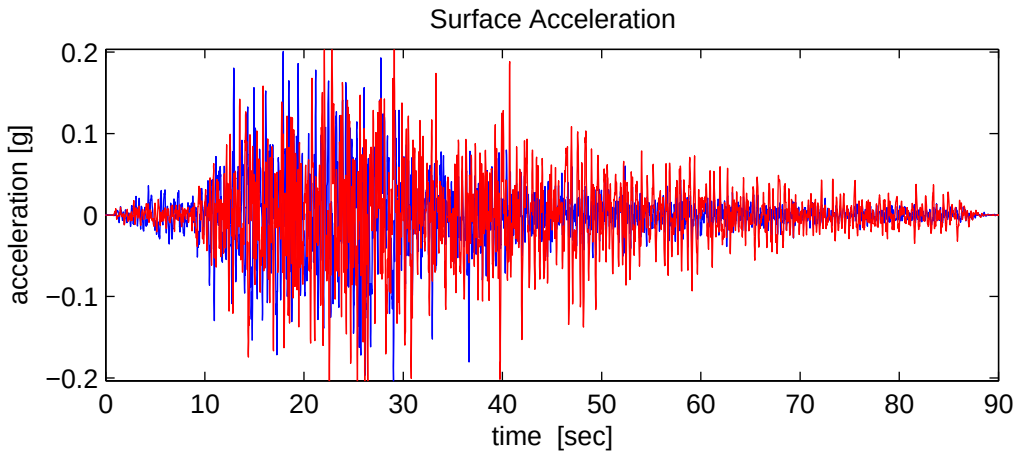


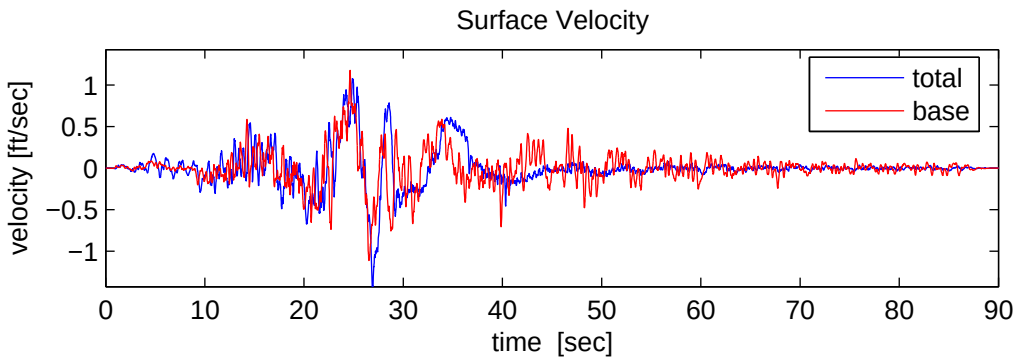


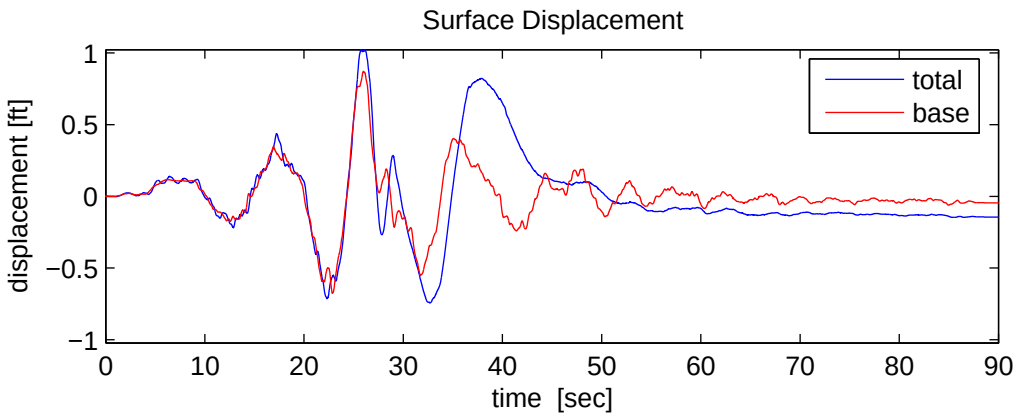


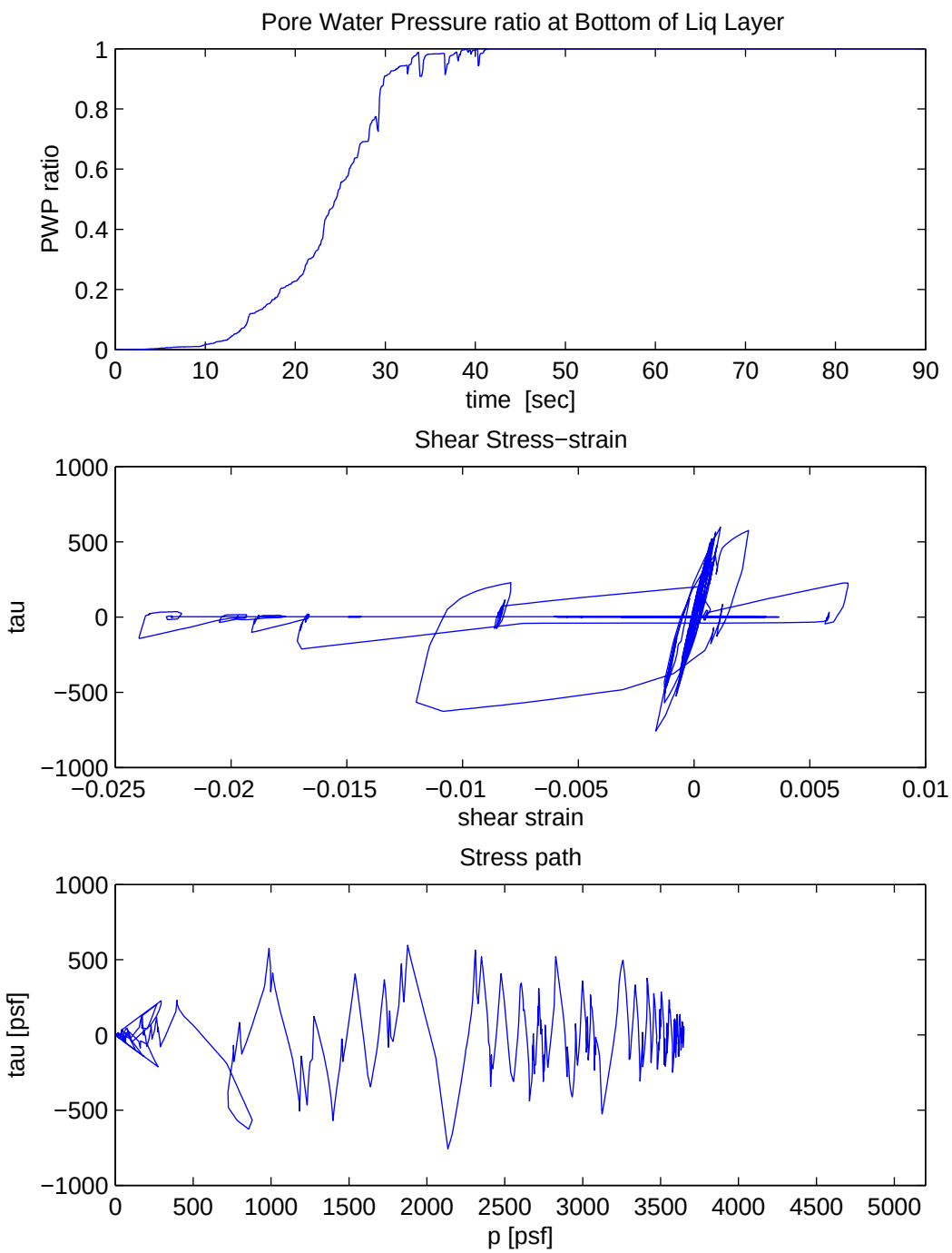

Pore Water Pressure ratio at Bottom of Liq Layer
PWP ratio
time [sec]
Shear Stress−strain
tau
shear strain
Stress path
tau [psf]
p [psf]

NODE 89, ELEMENT 12

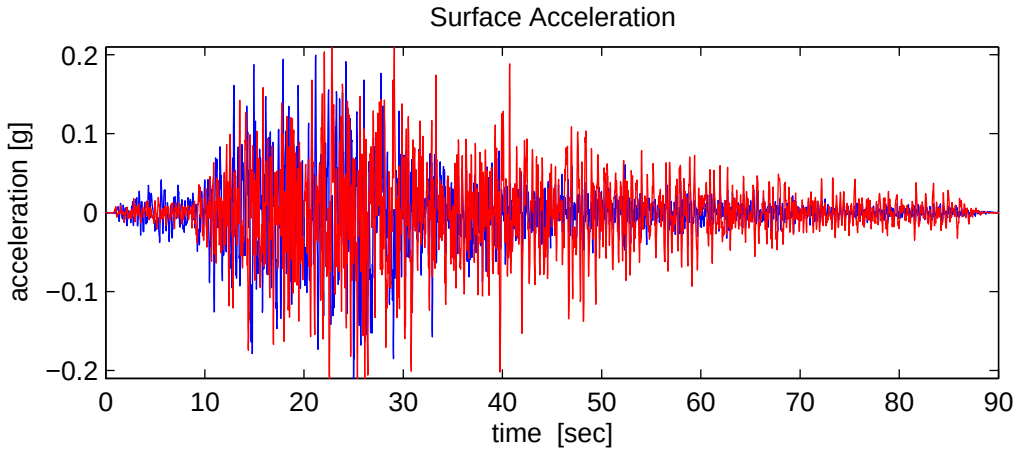


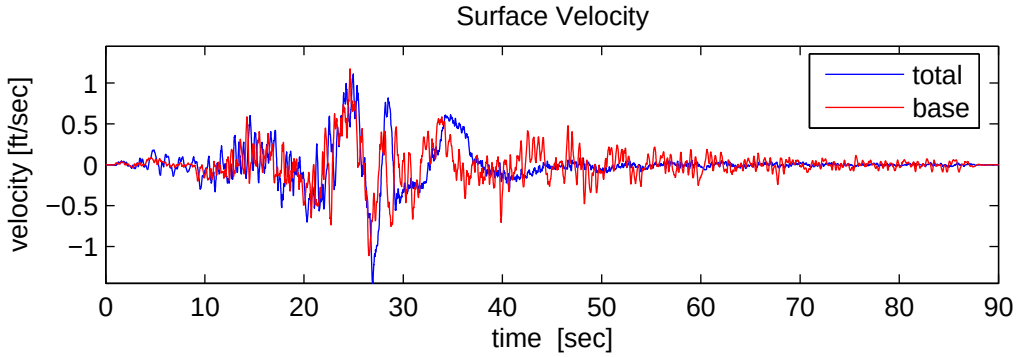


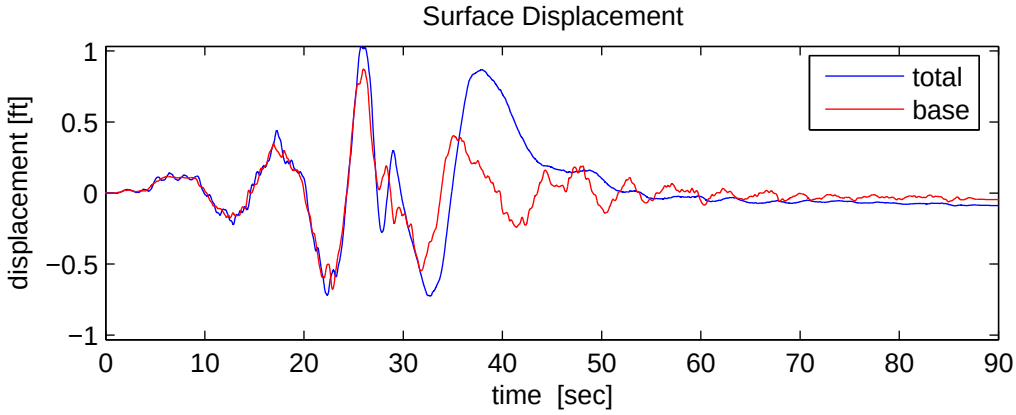


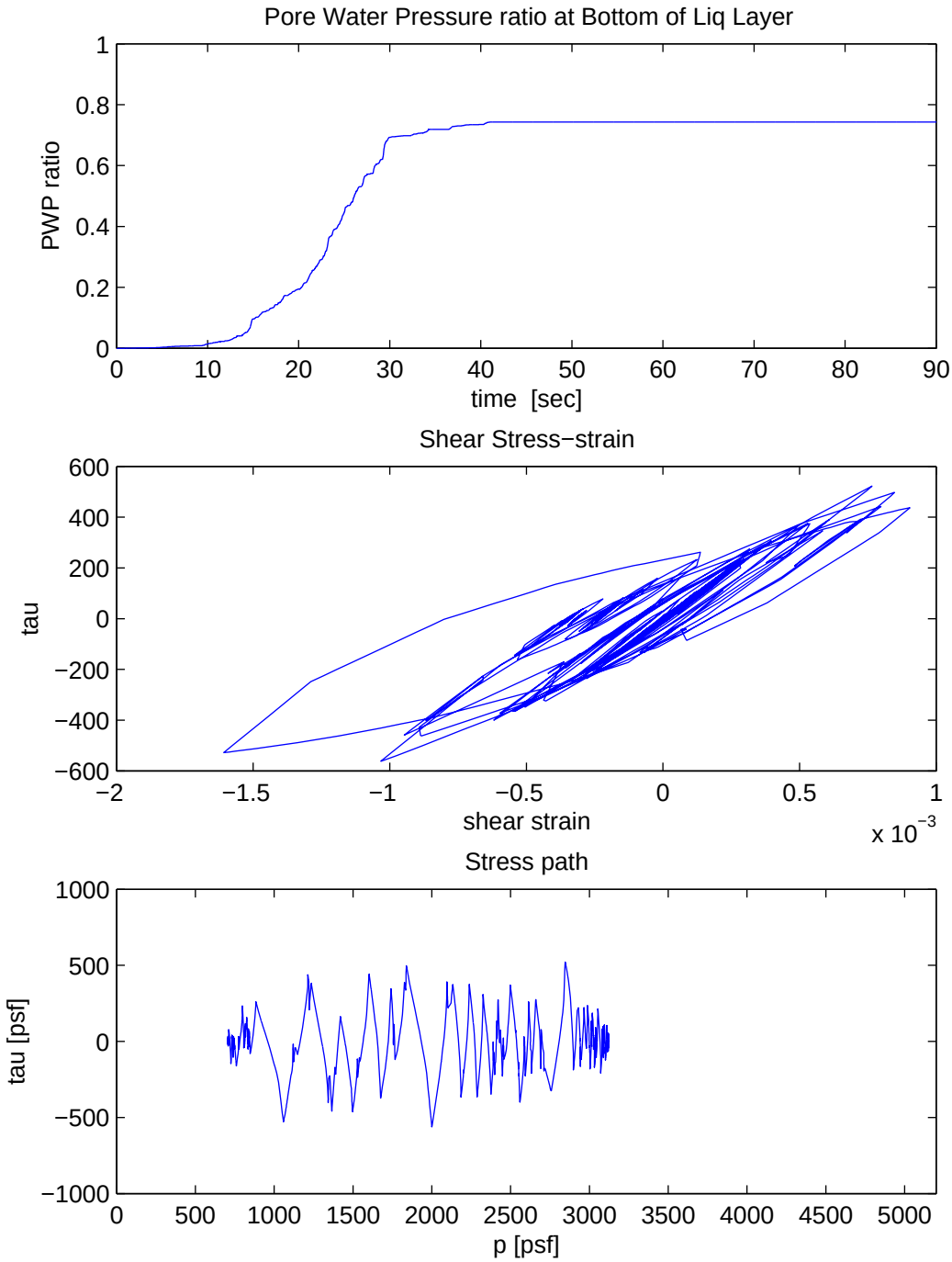

Pore Water Pressure ratio at Bottom of Liq Layer
PWP ratio
time [sec]
Shear Stress−strain
tau
shear strain
Stress path
tau [psf]
p [psf]

NODE 91, ELEMENT 9

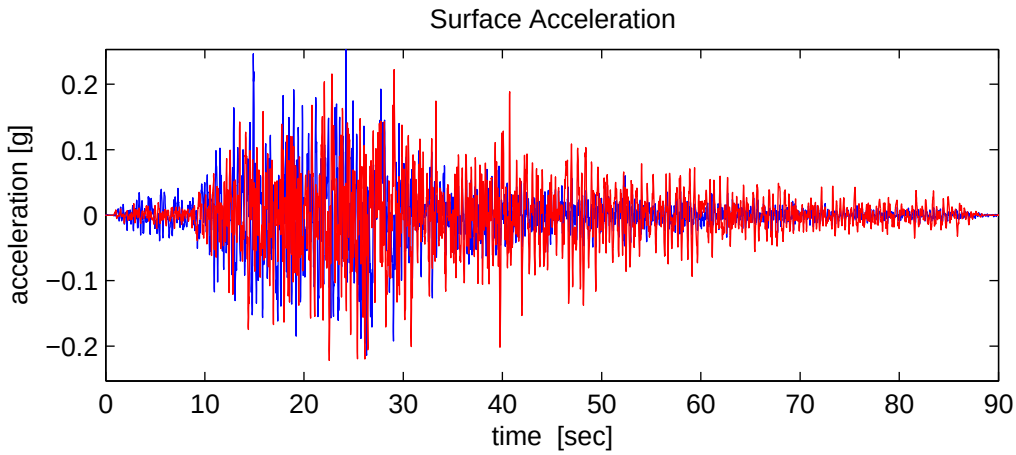


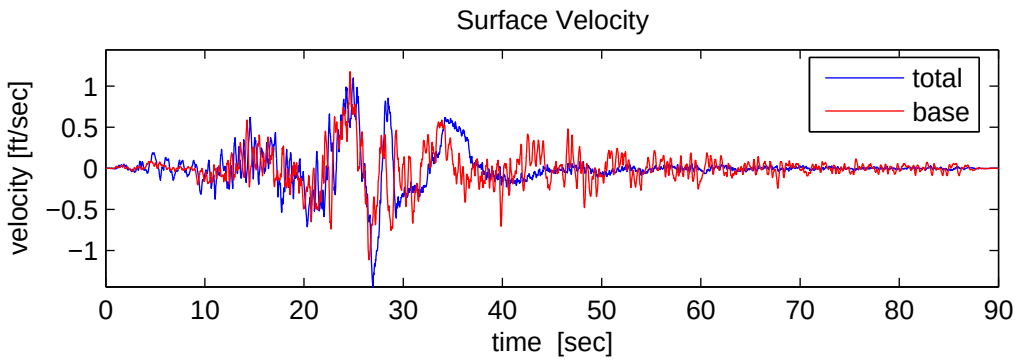


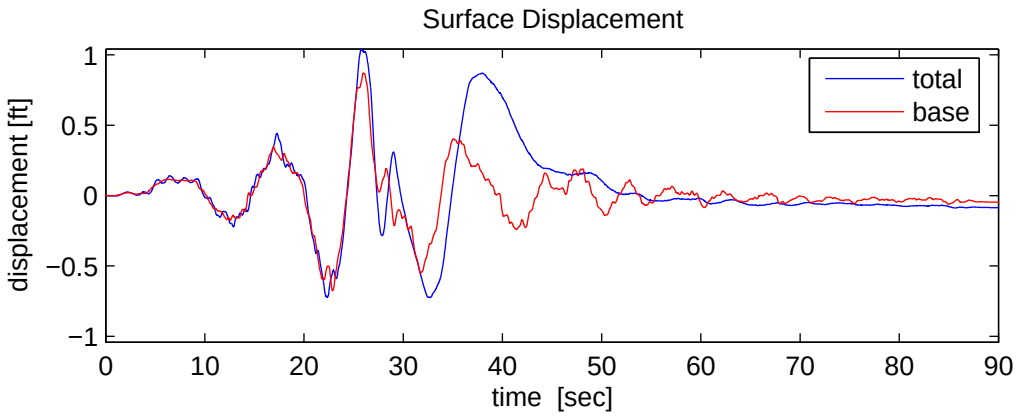


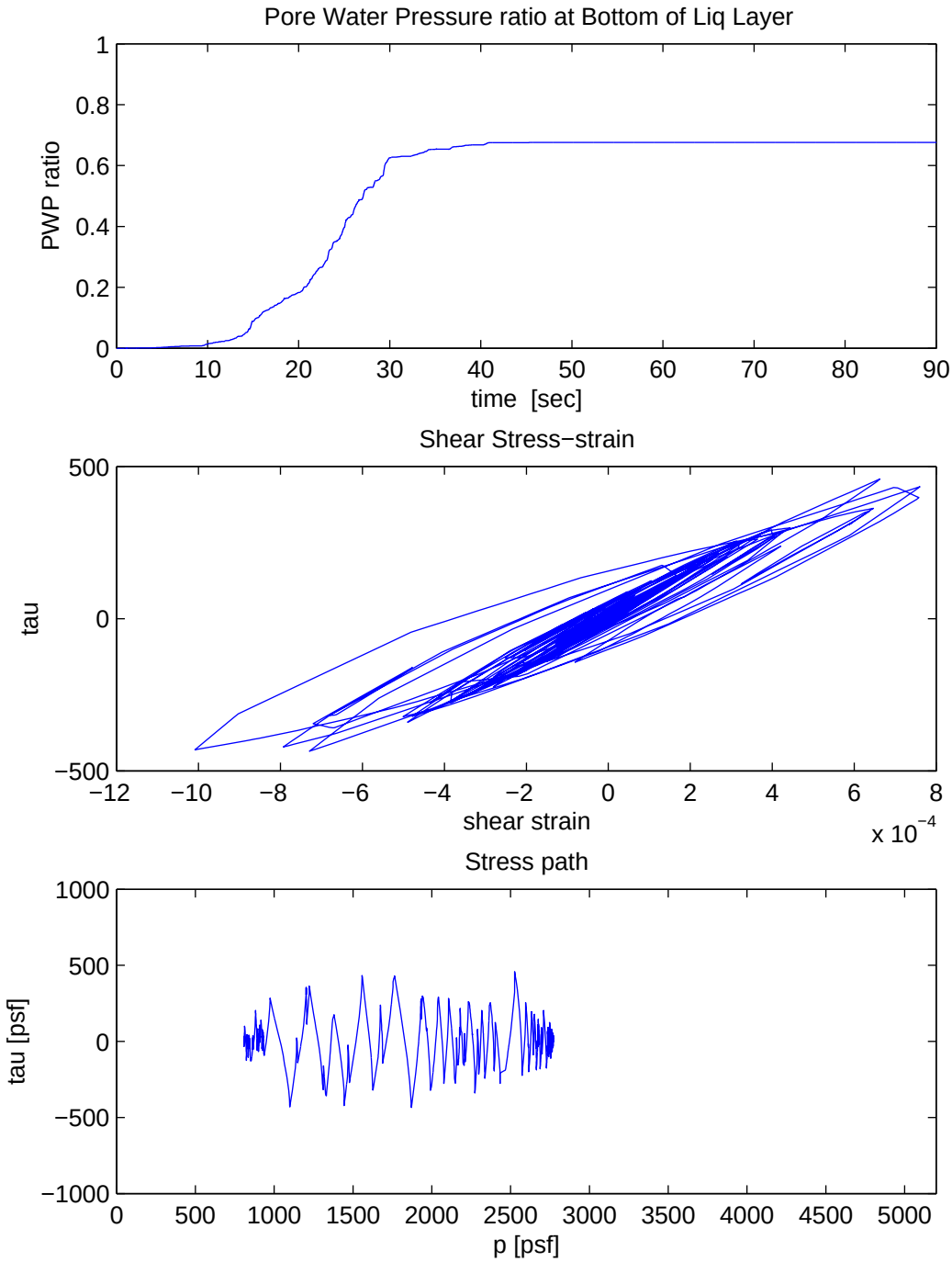

Pore Water Pressure ratio at Bottom of Liq Layer
PWP ratio
time [sec]
Shear Stress−strain
tau
shear strain
x 10^−3
Stress path
tau [psf]
p [psf]

NODE 94, ELEMENT 7

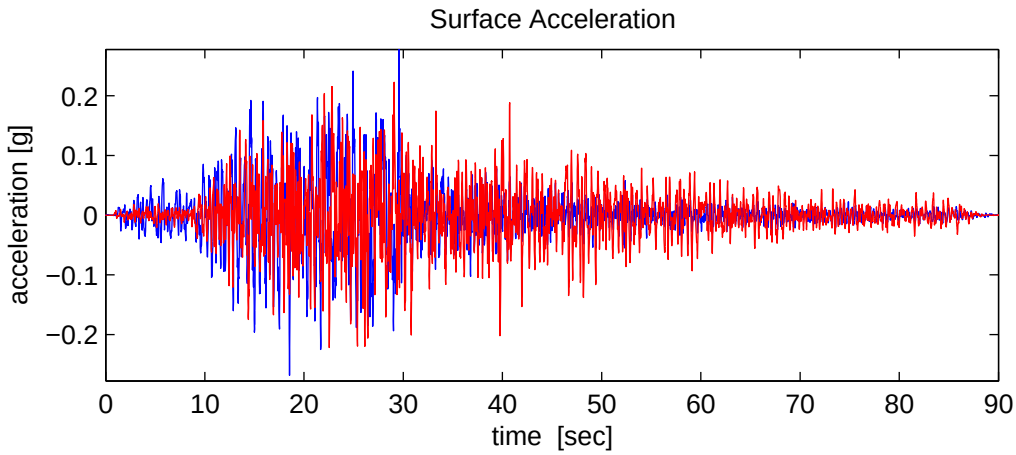


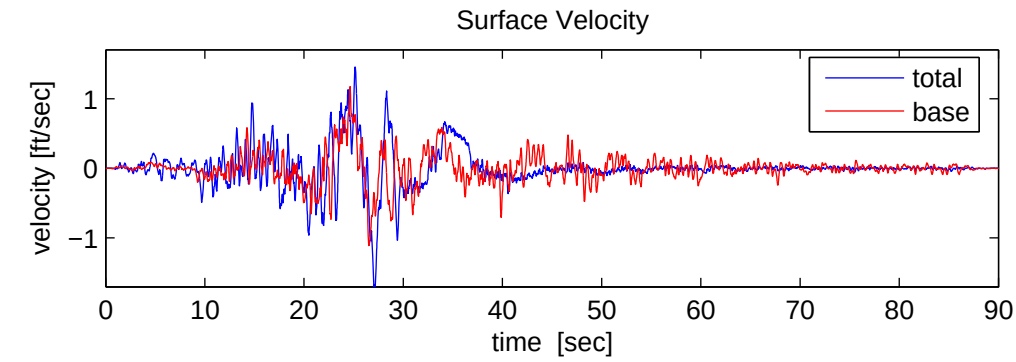


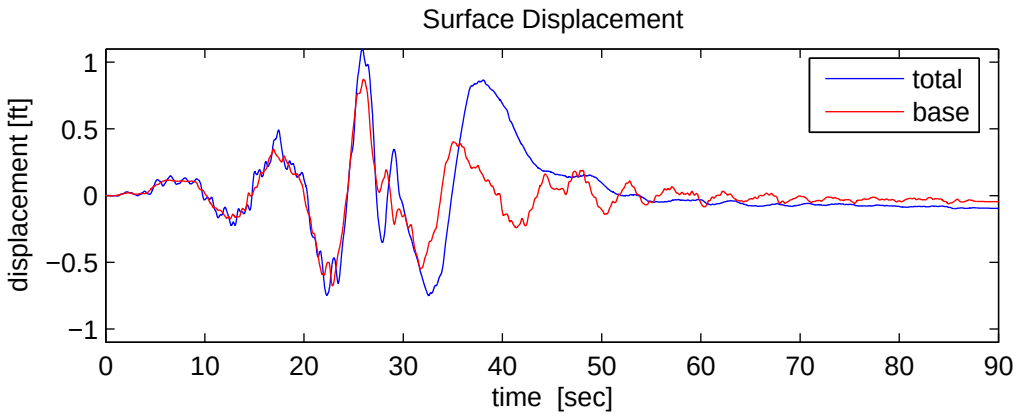


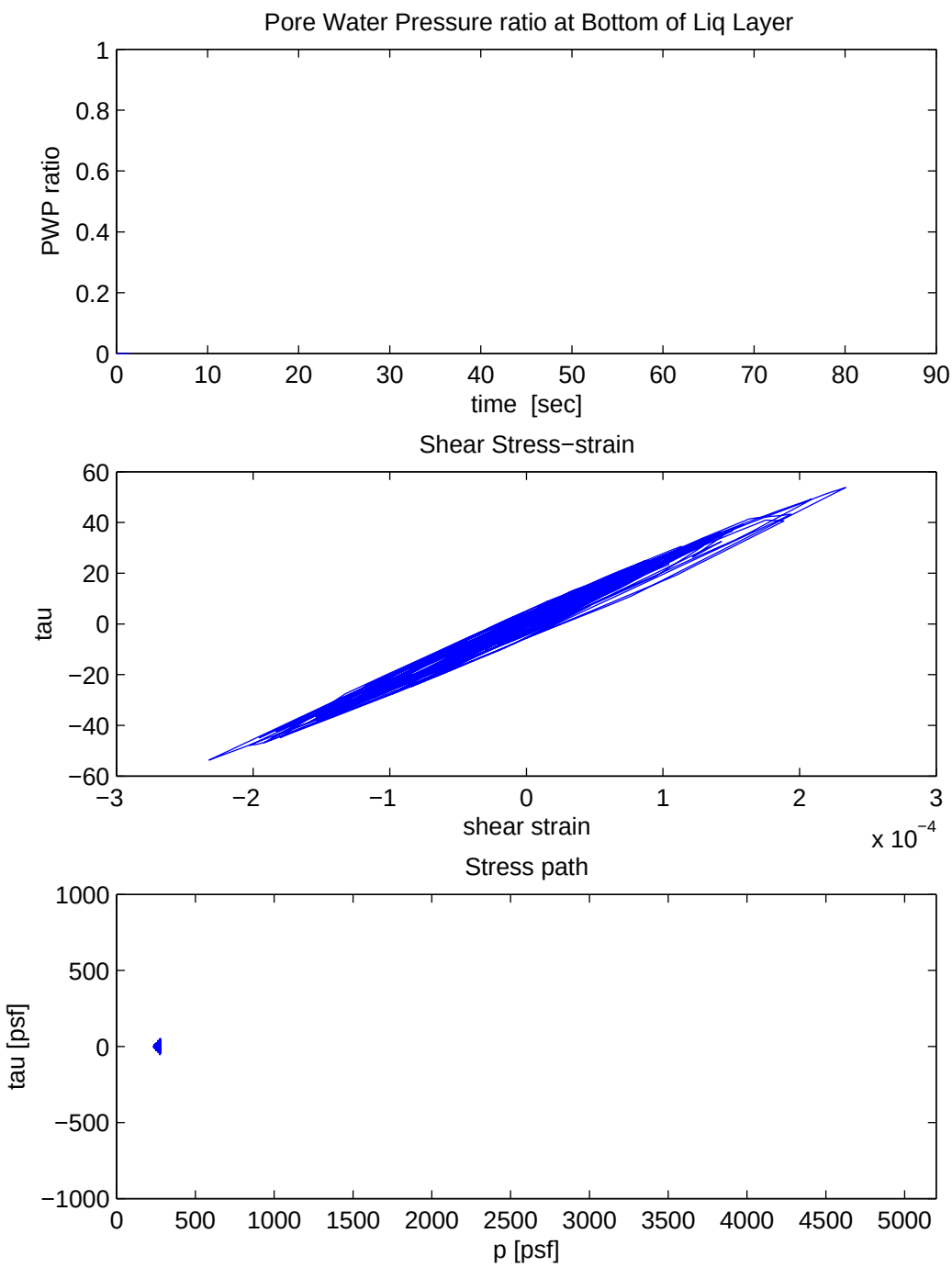

Pore Water Pressure ratio at Bottom of Liq Layer
PWP ratio
time [sec]
Shear Stress−strain
tau
shear strain
x 10^−4
Stress path
tau [psf]
p [psf]

NODE 100, ELEMENT 1








Pore Water Pressure ratio at Bottom of Liq Layer
PWP ratio
time [sec]
Shear Stress−strain
tau
shear strain
x 10^−4
Stress path
tau [psf]
p [psf]

APPENDIX F

Results of Numerical Analyses – Settlement

APPENDIX F
RESULTS OF NUMERICAL ANALYSES - SETTLEMENT

This appendix summarizes the procedures used in the settlement analysis using FLAC3D software (Itasca Consulting Group, Inc. 2006). Backfilling behind the subgrade walls would cause settlement beneath the slab due to the compression of Soil Units 2 and 3. The purpose of this analysis is to estimate downdrag loads on the proposed deep piles due to backfilling behind the subgrade walls of the proposed facility. The fill height to be placed behind the wall would be about 35 feet (ft) in addition to surcharge loading.

RESULTS OF THE PREVIOUS ANALYSES

In the preliminary phase of the project (Landau Associates 2006), we performed a settlement analysis based on soil properties estimated from the results of the *in situ* and laboratory testing and on a simplified elastic solution (Poulos and Davis 1974) to estimate stress distribution within the soil mass. The elastic analysis indicated that settlement-induced downdrag would extend about 80 ft measured inward from the perimeter wall. Typically, simplified elastic solutions do not account for the presence of piles, which may impact the stress distribution within the soil mass.

In the design phase completed in 2007 (Landau Associates 2007), our downdrag analysis was completed using FLAC2D (Itasca Consulting Group, Inc. 2005) to better estimate downdrag loads on piles. Our previous FLAC2D analysis was based on a preliminary pile layout (20 ft on center) provided by the Washington State Department of Transportation (WSDOT). The results of the FLAC2D analysis suggested that downdrag would extend less than 20 ft measured inward from the perimeter wall, about 60 ft less than what was predicted by the simplified elastic analysis.

CURRENT ANALYSIS – FLAC3D

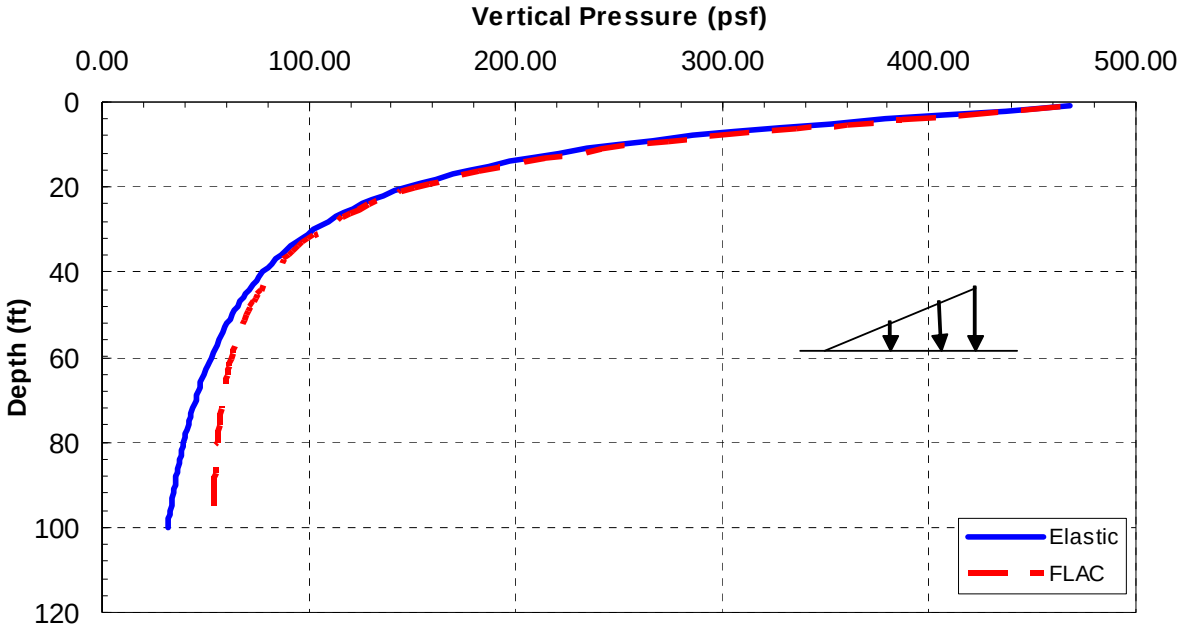
To account for the three dimensional nature of the soil-structure interaction, the analysis for this phase has been completed using FLAC3D rather than FLAC2D. Additionally, our analysis was based on the revised pile layout, which is significantly different than the one used previously in our FLAC2D analysis.

SOIL PROPERTIES – FLAC3D MODEL

The effective stresses on Soil Units 2 and 3 prior to construction would be higher than the effective stresses after the end of construction and during the operation of the facility. This is mainly due to soil removal from within the footprint of the facility. As such, the fill to be placed behind the subgrade walls would cause elastic rather than plastic compression of Soils Units 2 and 3. Therefore, in the FLAC3D model, we used an elastic constitutive model (i.e., soil strength values were not input in the model) for all soil units. The main soil property required for the elastic model is the soil elastic modulus. *In-situ* tests completed for this phase included pressuremeter tests (refer to Appendix C), which measure the soil elastic modulus. The design modulus values are presented in Table 2 of this report. In our FLAC3D analysis, we varied the modulus values, including the values presented in Table 2 of this report, to evaluate the sensitivity of the results to soil modulus.

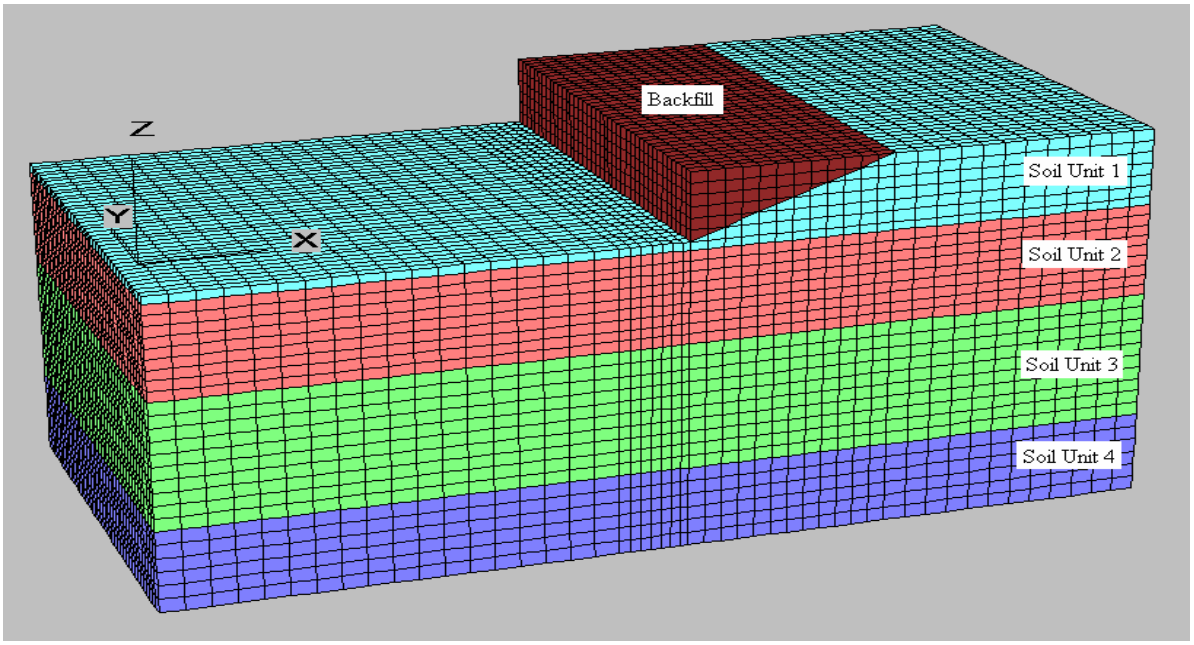
VERIFICATION CASE

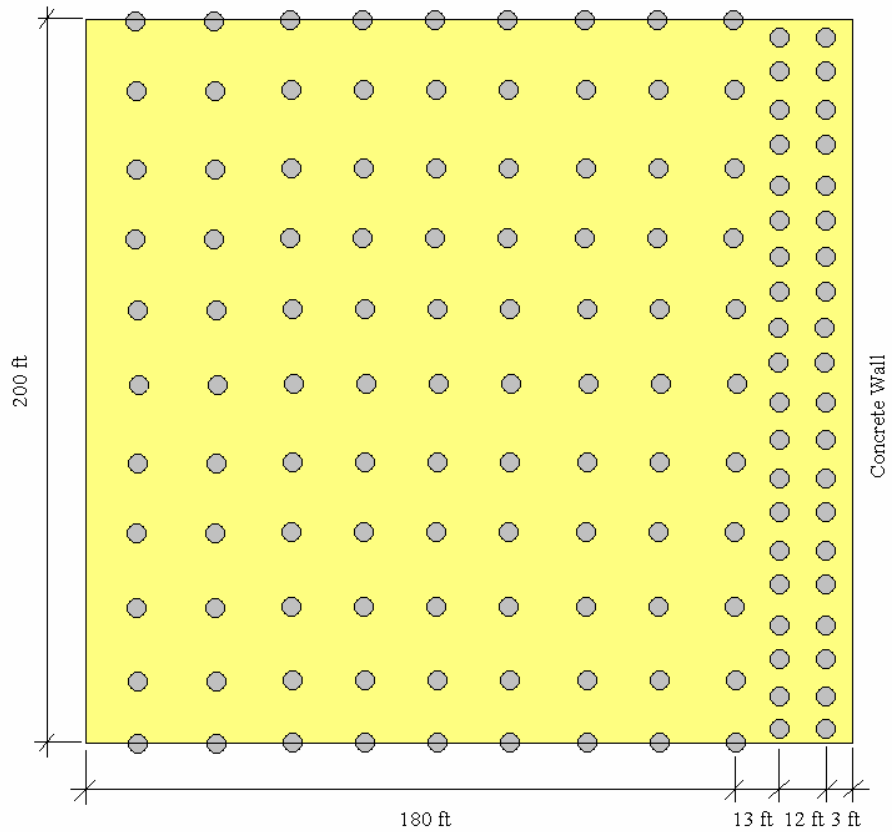
In the previous phase (Landau Associates 2007), we performed a verification case using FLAC2D to compare stress distribution based on FLAC2D versus the one based on elastic solution (Poulos and Davis 1974). In this verification case, we used triangular loading to simulate the fill loading behind the wall. The diagram below compares the results based on the FLAC2D analysis and those based on the elastic solution. As shown on the diagram, the FLAC results are quite comparable to the elastic solution results.



FLAC 3D MODEL – PROPOSED FACILITY

In the FLAC3D analysis, we did not model the entire facility. A 3-dimensional view of the entire model and a plan view of the pile supported basin are presented below. The pile layout was based on the preliminary drawings provided by WDSOT. Note that the spacing of the perimeter piles along the perimeter wall is 10 ft on center.

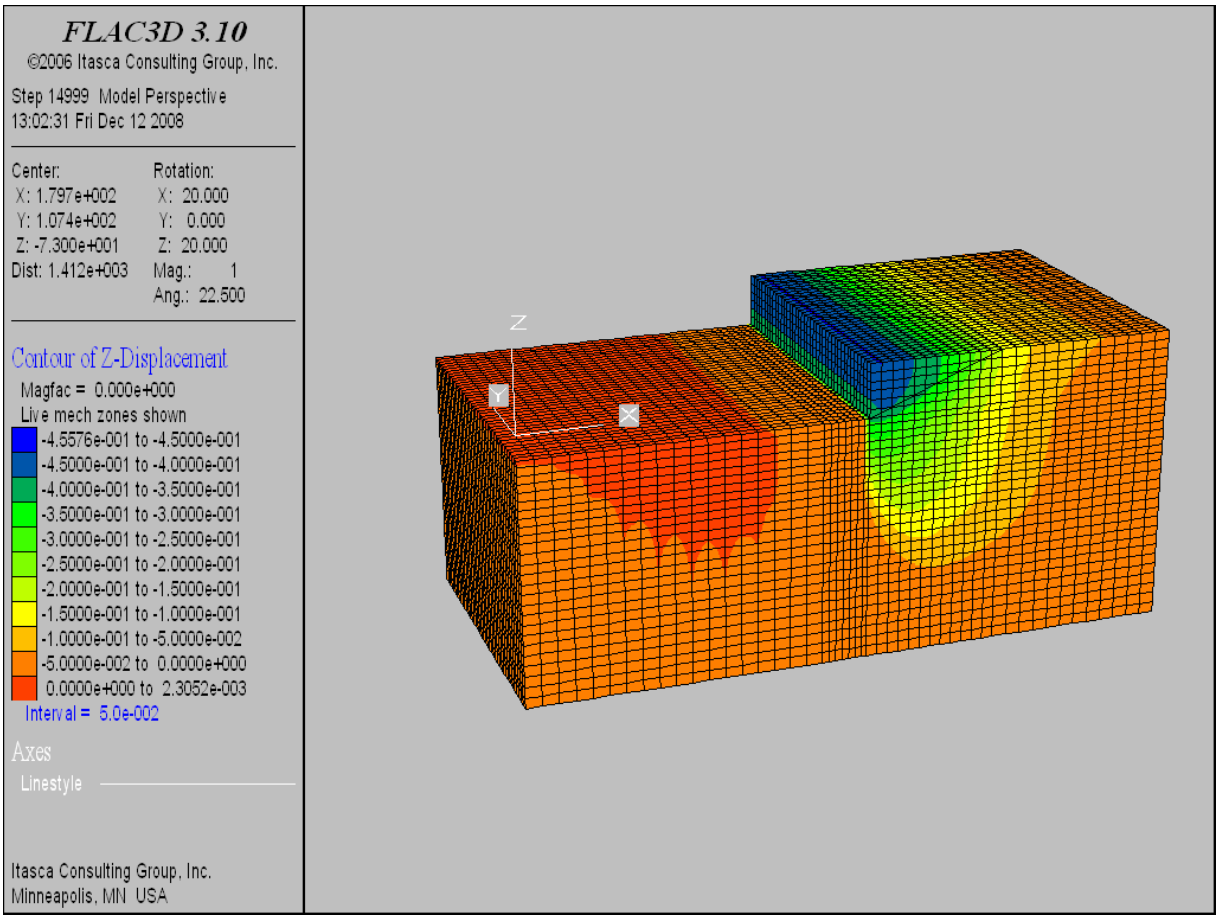




The selection of the plan dimensions of the casting basin floor was based on the assumptions that the influence of the fill to be placed behind the subgrade wall would not extend more than 100 ft measured inward from the subgrade wall and that conditions along the boundaries would not impact the settlement along the middle of the basin floor. The FLAC3D model was constructed assuming the following construction sequence:

- Dewatering (groundwater table at Elevation -19 ft)
- Excavation
- Installation of piles
- Installation of 1.5-ft and 4-ft concrete slab
- Installation of the subgrade wall
- Backfill behind the wall including surcharge loads.

Contours of settlement due to backfilling are shown on the diagram blow. Recommended downdrag loads based on the FLAC3D analysis are presented in Section 5.5.2.1 of the main text.



REFERENCES

Itasca Consulting Group, Inc. 2006. FLAC3D Software. Version 3.1.

Itasca Consulting Group, Inc. 2005. FLAC Software. Version 5.0.

Landau Associates. 2007. Report: *Geotechnical Design Study WSDOT Special Projects Construction Site, Grays Harbor, Washington*. Prepared for WSDOT. March 29.

Landau Associates. 2006. *Geotechnical and Hydrogeologic Study, Bridge Pontoon Construction Facility, Grays Harbor, Washington.* Prepared for WSDOT. May 31.

Poulos, H. G. and Davis, E. H. 1974. *Elastic Solutions for Soil and Rock Mechanics*. John Wiley & Sons, Inc. New York. pp. 411.

SR 520 Bridge Replacement and HOV Project

Document Name: Draft Geotechnical Design Study, WSDOT SR 520 Pontoon Construction Project, Grays Harbor Washington
Document Lead: Chad McMullen, Reda Mikhail, Dennis Stettler
Submittal Date: December 15, 2008
Contract & Task Order: Y-9761, Task BD.03 12.6

Review Request Date: December 23, 2008
Review Due: January 15, 2009
Review Submitted: January 27, 2009

This section to be completed by REVIEWER						This section to be completed by AUTHOR	
Comment No.	Page / Sheet #	Line No. (if applicable)	Comment	Reviewer	Comment Type [1]	Status Code [2]	Remarks
	3 1	19	This paragraph states that wood waste was dumped on the northwest corner of the site. The second paragraph of section 4.4.1 on page 4-2 refers to Figure 17 which shows wood waste encountered across much of the northern portion of the site., In addition, it is my understanding that a sawmill was formerly located on the northeast portion of the site. This data needs to be reconciled.	William Hegge			
			Is the use of geosynthetics still being considered as a means to limit site settlements? If so, then the report needs to mention the potential conflict of placing the geosynthetics prior to the utilities.	C. Heathman			
	Title Page		I believe that the title page should read "Prepared for WSDOT…."	C. Lavra			
	4-1		The third paragraph in section 4.1 states that … "28 test pits designated TP-1-08 through TP-27-08" were dug. Were there 27 or 28?	C. Lavra			
	5-7		Section 5.3.3, 2nd paragraph - How does the 80 ft as a limit for liquefaction compare to the 50 ft limit that Tony Allen mentioned in our meeting about the two new sites?	Eric Ferluga			
	Pg. 5-10		*Section 5.3.3.3 - Were empirical analyses of lateral spreading conducted? Should show the results of those empirical analyses (e.g., Youd, et al.) in comparison to the FLAC analyses. In my opinion, numerical analyses such as FLAC can be very questionable if the model used has not been calibrated in some way to real world performance. I see no evidence that the consultant did that.*	Tony Allen		S	
	Pg. 5-11		*Section 5.3.3.3 - The report claims that the OpenSees and FLAC lateral spreading results are reasonably consistent, and that therefore we can have greater confidence in the accuracy of the FLAC prediction. I dissagree. The differences in deformation predictions between the two numerical models are rather striking (4 ft vs. 9 ft at one end of the facility, and 0 vs. 2 ft at the other end of the facility). See my comment 1.*	Tony Allen		S	
	Pg. 5-11		*Section 5.3.3.4 - Does the consultant have evidence that combining wick drains with stone columns will work as anticipated? The report is not clear about the purpose of the wick drains, though I assume that the intent is to use them to improve the amount of densification of the silty soil that occurs when the stone columns are installed. If the consultant intends to use them to prevent pore pressure build up during liquefaction, I would definately not concur with the use of wick drains here. Even for the purpose of improving soil densification, I would question whether improved densification would be accomplished.*	Tony Allen		S	
			General Note - Please state were data was provided from WSDOT (for example pile loads)	Eric Ferluga			
			The report should contain a section on all existing reports (either produced by Landau Associates or others) which were available for review in this investigation.	William Hegge			
	5 12	13	*The 24 inch diameter steel piles may be filled with sand or CDF instead of concrete.*	William Hegge			
	5-12		Section 5.5,1st paragraph - Change the description of the possible pile types to read something like this… "*This option consists of either 24-inch diameter cast-in-place reinforced concrete piles constructed inside driven closed-end steel casing, or 24-inch structural steel pipe piles filled with non-structural concrete or sand.*"	Eric Ferluga			
	5-12		Section 5.5, 2nd paragraph - A better description of the pile layout might be... "*the interior piles under the slab will be spaced at around 20' on-center and the piles under the walls (first two rows from the face of the wall) will be spaced at 10 to 15 ft on-center*". The number of rows spaced at 10-15ft does need to be changed to **2** rows.	Eric Ferluga			

[1] **Comment Type: S= Substantive Comment, G= Graphics Comment. For editorial comments, leave blank.**
[2] **Status Codes: A= Incorporated, B= Alternate Revision Proposed, C= Evaluated / Not Incorporated, D= Response to Question**

Washington State Department of Transportation

Document Name: Draft Geotechnical Design Study, WSDOT SR 520 Pontoon Construction Project, Grays Harbor Washington
Document Lead: Chad McMullen, Reda Mikhail, Dennis Stettler
Submittal Date: December 15, 2008
Contract & Task Order: Y-9761, Task BD.03 12.6

Review Request Date: December 23, 2008
Review Due: January 15, 2009
Review Submitted: January 27, 2009

This section to be completed by REVIEWER						This section to be completed by AUTHOR	
Comment No.	Page / Sheet #	Line No. (if applicable)	Comment	Reviewer	Comment Type [1]	Status Code [2]	Remarks
	5-13		The first paragraph 1 refers to static earth pressure recommendaions in Table 3. Does the earth pressure in this table apply if only the first 1.5' of fill behind the wall is gravel and the rest is select borrow per WSDOT SS 9-03.14(2)?	Brian Harris			
	5-14		Why is the Mononobe-Okabe Kae based on at-rest conditions? The wall will move and flex (except perhaps at the corners) therefore shouldn't Kae be based on active earth pressure conditions? I think by definition Kae is an active pressure. I get Kae = 0.38 for a PGA = 0.44 and a Ka = 0.24.	Eric Ferluga			
	5-15		*The report talks about using Article 3.11.6 to determine surcharge pressures. It would be beneficial to still at least include some conceptual lateral earth pressure diagrams with soil parameters for each unit and basic wall geometry identified so that it is clear what the structural designer needs to assume for their analysis.*	C. Heathman			
	5-15		Section 5.5.1, 1st paragraph on page 5-15 - Why is it practical to design all walls for the seismic pressure of the north wall? It seems that this is too conservative. The majority of walls could be designed for a lower pressure and save some money. My suggestion would be to design the other walls for the Case II - No liquefaction.	Eric Ferluga			
	5-15		Section 5.51 , last paragraph - does this mean that, when looking at the wall, there would be a net outward force associated with the hydrostatic load of the water inside the basin? Or do we design the wall assuming that the lateral force from the water inside the basin is directly transmitted into the backfill?	Eric Ferluga			
	5-16		Section 5.5.2., first paragraph - State that this downdrag analysis is based on the deeper basin (elevation -13.0)	Eric Ferluga			
	5-16		Section 5.5.2., first paragraph - Minimum bottom of excavation elevation is -19.0 for the deep basin and -15.0 for the shallow basin (2.0 ft extra for drainage layer)	Eric Ferluga			
	5-16		Section 5.5.2.1 - State what the perimeter pile spacing was that gives the downdrag loads in the table (I assume it was 10 ft parallel to the wall and 10ft perpendicular to the wall). A sketch might be handy.	Eric Ferluga			
	Pg. 5-16		*Section 5.5.2.1 - My comment here is similar to my Comment #1. I in general do not give greater credence to sophisticated 3D FLAC modeling over conventional analysis procedures unless the numerical model has been calibrated in some way to real world performance for a similar problem. I see no evidence in the report that such calibration efforts were done.*	Tony Allen		S	
	Pg. 5-16		*Section 5.5.2.1 - At the bottom of this page, a downdrag load factor of 1.05 is recommended. What is the basis of this recomendation? For which limit state is this to be used?*	Tony Allen		S	
	5-17		Section 5.5.2.1 - It could be useful to list the pile spacing (in both directions) and values for downdrag done in previous reports (I believe the pile spacing was 20ft parallel to wall and 10 ft perpendicular)	Eric Ferluga			
	5-17		Section 5.5.2.2 - Where do the service loads come from (I am assuming they are factored loads)? I am assuming I gave them to you but I can not track it down.	Eric Ferluga			
	5-17		Section 5.5.2.2 - "Ultimate loads" should be "Ultimate bearing capacity" or "nominal driving resistance (Rndr)" this value is not really a load, but a capacity that the piles need to be driven to based on the applied factored loads (referred to as service loads in the report) divided by the resistance factor (also allowing for downdrag loads).	Eric Ferluga			
	Pg. 5-18		*Section 5.5.2.2 - I am somewhat surprised that the consultant used the Meyerhof method to estimate the static pile resistance, as there are more accurate methods available. Could using this method cause the pile recommendations to be overly conservative? However, note that for all the methods identified in the AASHTO LRFD manual, for pile diameters of 3 ft or more, the capacity estimates can be over-predicted by these methods. Did the consultant consider this? Regarding the use of open ended piles, we would generally not rely on the pile forming a plug with regard to pile capacity estimation, especially for piles that are larger than 24 inches in diameter.*	Tony Allen		S	

[1] **Comment Type: S= Substantive Comment, G= Graphics Comment. For editorial comments, leave blank.**
[2] **Status Codes: A= Incorporated, B= Alternate Revision Proposed, C= Evaluated / Not Incorporated, D= Response to Question**

Document Name: Draft Geotechnical Design Study, WSDOT SR 520 Pontoon Construction Project, Grays Harbor Washington
Document Lead: Chad McMullen, Reda Mikhail, Dennis Stettler
Submittal Date: December 15, 2008
Contract & Task Order: Y-9761, Task BD.03 12.6

Review Request Date: December 23, 2008
Review Due: January 15, 2009
Review Submitted: January 27, 2009

This section to be completed by REVIEWER						This section to be completed by AUTHOR	
Comment No.	Page / Sheet #	Line No. (if applicable)	Comment	Reviewer	Comment Type [1]	Status Code [2]	Remarks
	5 18	24	*If closed ended capacities for the 30-inch and 36-inch steel piles are needed, they will be driven closed ended. WSDOT will not count on a soil plugs forming in these piles for capacity.*	William Hegge			
	5-20		Section 5.5.2.5, 1st paragraph - describe different pile options… "closed end steel pipe piles *or* cast in place reinforced concrete piles (with steel casing) embedded into…"	Eric Ferluga			
	5-20		Section 5.5.2.6 - suggest taking out description of how lateral loads will be resisted and just state that LPILE and DFSAP input parameters are given.	Eric Ferluga			
	5 20	2	*The 24-inch steel piles may be filled with concrete, sand or CDF.*	William Hegge			
	5 20	9	*The life of the project is more than 4 years. The secondary settlement will have an effect if the facility is kept in service longer. The life of the project needs to be defined by the project team to determine if secondary settlements need to be considered.*	William Hegge			
	5 20	24	WEAP analyses were performed for all pile sizes. The text should state this.	William Hegge			
	5-20		Section 5.5.2.6 - DFSAP parameters have been provided as well, state this fact in the text	Eric Ferluga			
	5-21		Section 5.5.2.7, Graphs - show range of Rndr on the graphs (515 to 730 tons).	Eric Ferluga			
	Pg. 5-22		*Section 5.5.2.7 - Assessing pile driveability using 200 blows/ft as a criteria is not consistent with our Standard Specifications, which require that assessment to be done at 100 blows/ft (see Section 6-05.3(9)A of the WSDOT Standard Specifications). Furthermore, if the plan is to assess pile capacity at end of driving, some setup should be considered (again, see the Standard Specifications). This may affect the conclusion drawn regarding the hammer size needed. I would agree that the hammer sizes required seem rather large.*	Tony Allen		S	
	5-22		Section 5-22, Graphs and 1st paragraph on page 5-22 - Label for "ultimate capacity" should be constant throughout report (Ultimate Bearing Capacity, Ultimate Resistance, Nominal Driving Resistance)	Eric Ferluga			
	5 22	1	The use of 200 blows per foot needs to be reviewed with WSDOT if the normal limit of 100 blows per foot is maintained it will impact pile capacities significantly, making a constructability test critical to the deep foundation design.	William Hegge			
	5 23	20	The current concept of possibly filling the piles with sand or CDF instead of concrete or using non reinforced concrete may make the option of partially filling the piles during driving much more feasible. This should be explored further and evaluated in the WEAP analyses.	William Hegge			
	5-23		Section 5-23, 1st paragraph page 5-23 - "ultimate capacity" of 735 tons was stated as 730 tons earlier in report, should be 730 tons.	Eric Ferluga			
	5-24		Section 5.5.2.8 - Minimum bottom of excavation elevation is -19.0 for the deep basin and -15.0 for the shallow basin (2.0 ft extra for drainage layer)	Eric Ferluga			
	5-24		Section 5.5.3, 1st paragraph - Reword the last part of the paragraph to say "WSDOT may allow the piles to have large deflections and break during these loadings"	Eric Ferluga			
	Pg. 5-26		*Section 5.6 - In general, I do not feel that MSE walls are a viable alternative here. The deformations are too large and overall level of safety too low to warrant further consideration. The concept, as I understand it, is to allow the entire facility to move or even float during the design seismic event, but not collapse, in essence forming a boat-like structure. MSE walls simply cannot accomplish that. Furthermore, MSE wall movements of several feet are likely to cause the walls to collapse, posing a danger to anyone immediately above or adjacent to the walls during such an event. I recommend that this entire section be reduced to a brief summary of the consultant's findings and that it provide the recommendation that this option should not be pursued further.*	Tony Allen		S	
	5-26		Section 5.6 - Is this statement based on construction schedule and estimates done by WSDOT? If so, than it probably should be left out of your report. Besides, the current schedule shows both options are similar.	Eric Ferluga			

[1] **Comment Type: S= Substantive Comment, G= Graphics Comment. For editorial comments, leave blank.**
[2] **Status Codes: A= Incorporated, B= Alternate Revision Proposed, C= Evaluated / Not Incorporated, D= Response to Question**

Document Name: Draft Geotechnical Design Study, WSDOT SR 520 Pontoon Construction Project, Grays Harbor Washington
Document Lead: Chad McMullen, Reda Mikhail, Dennis Stettler
Submittal Date: December 15, 2008
Contract & Task Order: Y-9761, Task BD.03 12.6

Review Request Date: December 23, 2008
Review Due: January 15, 2009
Review Submitted: January 27, 2009

This section to be completed by REVIEWER						This section to be completed by AUTHOR	
Comment No.	Page / Sheet #	Line No. (if applicable)	Comment	Reviewer	Comment Type [1]	Status Code [2]	Remarks
	5 28	4	The movements of the MSE walls predicted in this report were judged by WSDOT to be too large for life safety considerations. Therefore the discussion of the MSE walls should state that this option should not be considered for further design.	William Hegge			
	5 29 to 32		The diagrams on these pages do not identify which walls are being shown. The diagrams should be titled. It might be useful to show a site plan with the location of the cross section also.	William Hegge			
	5-33		*The report should mention that geosynthetic walls could also be used (rather than welded wire), because these can also be built to full height and have a settlement waiting period prior to construction of the final fascia.*	C. Heathman			
	5-35		Section 5.6.4 - Replace "HDR" with "Structural Engineer"	Eric Ferluga			
	5-37		Section 5.6.5 - Suggest rephrasing first sentence to read something similar to "Conceptual level estimates done by WSDOT appear to show that the MSE wall/mat slab alternative is more economical than a deep pile/concrete wall alternative." I believe current schedule shows no or very little advantage.	Eric Ferluga			
	5-37		Section 5.7, 1st sentence - Change "will be installed" to "could be installed"	Eric Ferluga			
	5 37	21	The need to plan for addressing "bad conditions" in the mat foundation alternative should be explored further and a risk and cost assigned to it for CEVP purposes.	William Hegge			
	5 38	21	The section on batch plant foundations is too conceptual. It contains no design recommendations. The estimated foundation sizes and loads should be obtained from the WSDOT civil design section. The report should present geotechnical recommendations for both deep and shallow foundations. The report should state whether the existing pile capacities are correct for the batch plant piles and provide new capacity charts if they are not.	William Hegge			
	Table 3		List Ko in the table (at-rest earth pressure coefficient)	Eric Ferluga			
	Table 3		List both Kae in the table (Mononobe-Okabe and due to Lateral Spreading)	Eric Ferluga			
	Civil Section - General.		Review indicates that comments/issues previously submitted for the Civil portion have been addressed. Noticed that site fill emphasized the more permeable section, which is consistent with direction for this site.	Jim Slavicek			
	6-2		Section 6.1, Last Paragraph - Consultant mentions providing a gravel balnket to provide slope stability if needed. Is there a recommendation for depth of gravel required to support side slopes?	S. Weber			
	6 14	21	The potential settlement of the trench backfill is effectivelydescribed as "minor" or "greater than minor". Please provide a range of potential settlement values that may occur.	William Hegge			

Comment Resolution Signatures

Manager Approval of Comment Resolution — **Date**

Reviewer Approval of Comment Resolution — **Date**

[1] **Comment Type: S= Substantive Comment, G= Graphics Comment. For editorial comments, leave blank.**
[2] **Status Codes: A= Incorporated, B= Alternate Revision Proposed, C= Evaluated / Not Incorporated, D= Response to Question**

Washington State Department of Transportation