Washington State Department of Transportation

Memorandum

July 12, 2006

TO: D. Stoddard/M. Anderson

FROM: T. M. Allen/P. J. Palmerson
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SUBJECT: SR-2 MP 57.74 to MP 56.85
OL-3485
Fredonia to I-5 I/C Widening Phase 1
Geotechnical Report

We are submitting the attached geotechnical report for the above mentioned project. This report presents the results of the subsurface explorations and geotechnical analysis for design and construction of the proposed project's structures, signals and new roadway.

If you have questions or require further information, please contact Tony Allen at (360) 709-5450 or Pete Palmerson at (360) 709-5418.

TMA/pjp

Attachment: Geotechnical Report

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GEOTECHNICAL REPORT

SR-20

MP 54.74 to 56.85

Fredonia to I-5 Widening Phase 1

Geotechnical Recommendations
OI-3485

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1. Project Location and Description

This report presents the results of our geotechnical investigation and engineering analysis for Phase 1 of the SR-20 Fredonia to I-5 Widening project. A vicinity map illustrating the project location near Fredonia in Skagit County, Washington is presented in Appendix A on Figure 1. The Boring Location Plan, Figures 2A through 2G in Appendix A show the details of the project area with the approximate locations of the geotechnical borings.

This phase of the project proposes to construct two new eastbound lanes on SR-20 from MP 54.74 near the vicinity of SR-536 to MP 56.85. The existing SR-20 will become the westbound lanes. The new roadway will be constructed with two 12-foot wide lanes, a 10-foot exterior shoulder and 4-foot interior shoulder. A 40-foot median will separate the eastbound and westbound lanes. In addition, the existing SR-20 embankment will be widened, the existing EB and WB SR-20 SR-536 ramps will be realigned and a portion of Higgins Slough will also be realigned.

This Geotechnical Report addresses the following elements of the project.

- Removal of the existing Bridge 20/214 and construction of two new Bridges 20/214 North & 20/214 South and bridge approaches.
- The construction of two new Bridges 20/217 South & 20/220 South adjacent to the existing Bridges 20/217 & 20/220, respectively and bridge approaches.
- Removal of the existing Bridge 536/12 and replacement with a new culvert.
- The realignment of Higgins Slough approximately between LR STA 53+00 and LR STA 57+00.
- Construction of the new roadway embankments and widening the existing embankment with an approximate maximum fill height of approximately 9-feet.
- The signalization of the SR-20/SR-536 interchange and the SR-20/Higgins Airport Way intersection.

When the PS&E is completed for this project, our office will provide a *Summary of Geotechnical Conditions* for inclusion in the Special Provisions.

The analyses, conclusions, and recommendations provided in this report are based on the project description, and site conditions existing at the time of the field explorations. The exploratory borings are assumed to be representative of the subsurface conditions throughout the project area. If during construction, subsurface conditions differ from those described in the explorations, we should be advised immediately so that we may reevaluate our recommendations and provide assistance.

It is important to note that the foundation designs for the bridges in this report were performed prior to the performance of a detailed scour study. If subsequent studies indicate the potential for substantial scour at the bridges we should be contacted to reevaluate our recommendations.

2. Regional Geology

The project site is located in the north central portion of the Puget Sound Lowland geomorphic province. The Puget Sound Lowland is an elongated topographic and structural depression

bordered by the Cascade Mountains to the east and the Olympic Mountains on the west. The Puget Lowland owes its present-day geomorphology to the most recent glacial advance and retreat, known as the Vashon Stade of the Fraser Glaciation. This ice sheet filled the Puget Lowlands with as much as 3,000 to 5,000 feet of ice at least four different times during this period.

According to the geologic map reviewed, this portion of SR-20 is underlain by Quaternary age deposits of younger alluvium. These deposits include moderate to well sorted boulders, cobbles, gravels, sands, silts and clays. Organic deposits are common.

3. Site Conditions

This section of SR-20 lies along the meandering Higgins Slough on an alluvial plain northwest of the Skagit River. Indian Slough, Telegraph Slough, Blind Slough and the Swinomish Channel lie west of the site. The mud flats of Padilla Bay are located approximately 2 miles northwest of the beginning of the project.

The topography is locally flat except for the moderate to relatively steep slopes associated with the Higgins Slough channel. The existing roadway is constructed on fill with a maximum fill height of approximately 12 feet at one of the bridge abutments. The bulk of the roadway is constructed on fills from 2 to 6 feet in height. A Burlington Northern Santa Fe Railroad line constructed on an embankment parallels the roadway to the north.

The area is predominantly agricultural with some residential and light commercial adjacent to the roadway.

4. Field Exploration

A subsurface investigation program was performed in order to verify the geology and to determine the geotechnical parameters to be used in design. The subsurface investigation program included site reconnaissance, advancing 12 borings (for Phase 1) and performing laboratory testing on select samples. The locations of the borings are shown on the Boring Location Plans on Figures 2A through 2G in Appendix A. The boring logs are shown in Appendix B and the results of the laboratory testing program are shown in Appendix C.

The subsurface conditions encountered at the site are consistent with the geologic map reviewed. For simplicity and design purposes, the materials encountered in the test borings and observed at the site have been grouped into classification units. The groupings are based primarily on the engineering properties and material classifications. Due to the discontinuous nature of the strata, individual profiles were developed for each structure location. Plan locations of the borings, the location of the proposed bridges and the existing site topography are shown along with the profile view with subsurface information on Figures 3 through 10 in Appendix A.

5. Previous Studies

We have reviewed two Soil Reports prepared by the Northwest Region Materials Laboratory dated June 23, 1993 and March 2, 2001.

The Northwest Region's 1993 report briefly describes the proposed project, the site geology and describes the site soil conditions based on 47 hand holes and 6 holes performed with drill rigs. The report makes embankment design and surfacing recommendations. This report recommends

the use of gravel base and Method B compaction for embankment construction. This Geotechnical Report supersedes those recommendations.

The Northwest Region's 2001 report briefly describes the project and the proposed embankment fills at various locations. The report also addresses the site surficial soil conditions based on a number of hand holes and portable penetrometer holes. This report recommends the use of select borrow for embankment construction. Final earthwork recommendations can be found in Section 9.8 of this report.

6. Site Soil Conditions

The site soil conditions correlate well to the geologic map reviewed. In general, alluvial deposits we encountered in all the borings from the ground surface to the maximum depth explored of 110.5 feet. The site soils consist of soft to stiff, lean to fat clays, very soft to stiff elastic silts, loose to very dense silts and very loose to very dense sands and gravels. The soils and strata encountered at each location are described below.

6.1. Bridge 20/214 North

Two borings, BH-01-05 and BH-02-05 were drilled for this structure. A piezometer was installed in Boring BH-02-05 The locations of the borings are shown on Figures 2B and 3 in Appendix A. Four soil units were encountered were encountered in the borings. The soil units are shown on the attached profile, Figure 4 in Appendix A. In general, loose silt and loose silty sand are present at the ground surface. These materials are present to an elevation of about 5 feet. Below them lies a thick unit of silty sand and poorly graded sand that is medium dense to dense between elevations 5 feet and about -35 feet. The sand transition into a very soft to medium stiff silt and clay layer at about elevation -50 feet. The silt and clay layer is present to about elevation -85 feet where granular soils were again encountered.

6.2. Bridge 20/214 South & Signal Foundation

Two borings, BH-03-05 and BH-04-05 were drilled for this structure. A piezometer was installed in Boring BH-03-05. The locations of the borings are shown on Figures 2B and 5 in Appendix A. Four soil units were encountered in the borings. The soil units are shown on the attached profile, Figure 6 in Appendix A. In general, loose silt, loose silty sand are present at, and just below, the ground surface. These materials are present to an elevation of about –2 feet. BH-03-05 encountered debris consisting of cobbles, boulders and wood to from the ground surface to approximately elevation 0-feet Below them lies a thick unit of silty, well and poorly graded sand that is loose to medium dense between elevations –2 and about –55. The sand transitions into a very soft to stiff silt and clay layer which extends to about elevation –88, where dense granular soils are encountered.

6.3. Bridge 20/217 South & Higgins Slough Realignment

Four borings, BH-05-05, BH-06-05, BH-07-05 and BH-08-05 were drilled at this location. A piezometer was installed in boring BH-07-05. The location of the borings are shown on Figures 2D and 7 in Appendix A. Three soil units were encountered in the borings. The soil units are shown on the attached profile, Figure 8 in Appendix A. In general, loose to dense silty sand and poorly graded sand is present in layers from the ground surface to an elevation about –20 to -40 feet. Below and intermittently interbedded within this sand lies very soft to stiff, lean to fat silts and clays. This material is present to an elevation of approximately –45 feet. Below these fine grained soils lie medium dense to dense silty sands and poorly graded sands, and some sandy silt.

6.4. Bridge 20/220 South

The exploration plan consisted of two borings, BH-09-05 and BH-10-05. A piezometer was installed in BH-10-05. The locations of the borings are shown on Figures 2F and 9 in Appendix A. Three soil units were encountered in the borings. The soil units are shown on the attached profile, Figure 10 in Appendix A. In general, very loose silt and sandy silt were encountered at ground level to approximately elevation -3 feet. Underlying these soils are loose to medium dense poorly graded sand and silty sand with gravel that extends to an approximate elevation of -20 feet. These two layers alternate to an approximate elevation of -50 feet. Below them lies a thick layer of dense to very dense poorly graded sand with gravel and silt to well graded gravel with sand.

6.5. Bridge 536/12 and Ramp Realignment

One boring, BH-18-06, was performed at the location indicated on the Boring Location Plan, Figure 2B in Appendix A. The boring encountered approximately 7 feet of loose silt over medium dense poorly graded, well graded and silty sand to the maximum depth explored of 50.5 feet. Groundwater was encountered at approximately elevation 5 feet.

6.6. Higgins Airport Way Signalization

One boring, BH-19-06, was performed at the location indicated on the Boring Location Plan, Figure 2E in Appendix A. The boring encountered loose to medium dense, silty and poorly graded sand to the maximum depth explored of 25.5 feet.

7. Surface Water and Groundwater

As previously noted Higgins Slough meanders through the project limits and Indian Slough, Telegraph Slough, Blind Slough and the Swinomish Channel lie west of the site. The Skagit River lies southeast of the site and Padilla Bay is located northwest of the project. Ground and surface water depends heavily on rainfall, snowmelt, agricultural activities and tidal influences. During wet seasons it is not uncommon to see large ponds of water at the ground surface. In addition, due to the flat topography, it is our understanding that cross culverts in this area change flow direction depending on surface water elevations and tidal fluctuations.

Groundwater was observed in the test holes at the time of drilling at the depth shown on the boring logs. Piezometers were installed in borings BH-02-05, BH-03-05, BH-07-05 and BH-10-05 in order to monitor groundwater levels in the project area. The table below indicates the elevation of the water table as measured at the time of drilling, as well as subsequent measurements in the piezometers. It is anticipated that groundwater conditions will change in response to rainfall, time of year, tidal fluctuations and other factors.

Boring	Ground Elevation (ft)	Groundwater Elevation (ft)	Date Measured
BH-01-05	13.5	7.5	5/20/2005
BH-02-05	14.1	4.2	5/24/2005
		3.1	5/22/2006

Boring	Ground Elevation (ft)	Groundwater Elevation (ft)	Date Measured
BH-03-05	13	4.4	5/4/2005
BH-04-05	10	Not Measured	
BH-05-05	8	4.8	5/25/2005
BH-06-05	14.2	Not Measured	
BH-07-05	14.6	4.7	5/3/2005
		6.3	5/22/2006
BH-08-05	14.2	4.2	4/27/2005
BH-09-05	13.1	8.6	6/28/2005
BH-10-05	12.7	8.2	6/1/2005
		7.7	5/22/2006
BH-18-06	8*	5	4/18/2006
BH-19-06	12*	Not Measured	

Boring and Groundwater Elevation Information
***Elevation estimated from site data**

8. Seismological Considerations

8.1. Site Seismicity

Seismic activity in this area is largely attributed to the Cascadia subduction zone, where the Juan de Fuca oceanic plate is being thrust under the North America plate, and related shallow crustal faults. While the seismicity of Washington is not as well understood as other areas of western North America, seismologists believe that the local subduction zone has created great interplate earthquakes in the past (Modified Mercalli Intensities up to VIII), and is capable of future great earthquakes (Atwater, 1987).

8.2. Design Earthquake Parameters

An acceleration coefficient of 0.25g is recommended for seismic design of the structures on this project in accordance with the WSDOT Geotechnical Design Manual (GDM). The recommended acceleration coefficient is based on expected ground motion at the project site that has a 10 percent probability of being exceeded in a 50 year period.

Design response spectra presented in the AASHTO guide specification are considered appropriate for seismic design of the structures on this project. A Type II soil profile response spectrum is recommended for seismic design of the project except as noted below.

At Bridge 20/217 the subsurface soils have the potential to liquefy during the design seismic event. Due to the potential liquefaction at this site we recommend that a decoupled analysis be performed to bracket the anticipated shears, moments and deflections in the structure. Early in the seismic event the site soils are not liquefied and an AASHTO Type II profile response spectrum is considered appropriate. The attached Deep Foundation System Analysis Program (DFSAP) input parameters in Appendix E should be used for this analysis.

After the onset of liquefaction, the soil strength and stiffness degrades. We recommend that a section analysis be performed using an AASHTO Type III soil profile response spectrum to simulate the site soil conditions after liquefaction has occurred. The analysis with the Type III response spectrum will model the longer period response associated with the liquefied soil and should result in greater deflections within the structure. The attached DFSAP parameters should be used for this second analysis with the "softer" response spectrum.

8.3. Liquefaction Potential

The liquefaction potential of saturated soils is evaluated mainly on soil gradation, density, and the depth of the deposit. The potential for liquefaction is highest for loose, fine to medium grained sands and silty sands. Increasing fines content (i.e., silt and clay) decreases the potential for liquefaction. Conversely, clean coarse grained granular soils are less susceptible to liquefaction due to their high permeability. The potential for liquefaction also decreases with increasing density and depth.

We have evaluated the potential for liquefaction of the project soils based on the SPT data obtained from the field explorations and the percentages of silt. Our analysis indicates that there is the potential for liquefaction at the site. Site specific liquefaction is addressed below for each structure.

8.4. Liquefaction Induced Lateral Spreading

We have evaluated the potential for lateral spreading of the project soils at the bridge approaches based on the estimated equivalent undrained residual shear strength data. Our analysis indicates that the potential for lateral spreading is low.

9. Geotechnical Recommendations

9.1. General Foundation Recommendations

Due to the site soil conditions deep foundations are required. Driven piles have the potential to cause settlement in the existing, adjacent structures. Through discussions with the Bridge and Structures Office it is recommended that drilled shaft be used adjacent to existing structures. It is also believed that it will be to the State's advantage to maintain consistent foundation types throughout the project. Therefore, we recommend the use of drilled shafts for the bridge structures. Enclosed in Appendix D are ultimate capacity charts for strength, service and extreme event limit states in English units. The charts show the load that can be applied at the top of the shaft. The weight of the shaft has not been deducted from the compressive capacity in the figures and is not included in the uplift. The capacities or loads shown in the figures are those that can be applied at the top of shaft. The net weight of the shaft should be treated as a load applied to the top of the shaft.

The charts in Appendix D are for shafts with 6-foot (7-foot for 20/214 South) diameters. Separate plots for ultimate skin friction (Q_s) and ultimate end bearing (Q_b) are provided on the

charts. At a given depth on the figures, the factored resistance (Q′) can be determined by adding the ultimate skin friction multiplied by its resistance factor (ϕ_s) and the ultimate end bearing multiplied by its resistance factor (ϕ_b) as shown in the following equation:

$$Q' = Q_s \cdot \phi_s + Q_b \cdot \phi_b$$

We recommend that the following resistance factors be used when evaluating the different limit states.

Limit State	Resistance Factor ϕ		
	Skin Friction Qs	End Bearing Qb	Uplift
Strength	0.55	0.50	0.45
Service	1.00	1.00	N/A
Extreme	1.00	1.00	0.75

Resistance Factors for Drilled Shaft Design

The proposed bottom of the shaft caps are near the groundwater table. Construction of cofferdams with seals should be anticipated at all the bridges.

9.2. Shaft Casing and Slurry Recommendations

The following table should be used for the fill-ins for the drilled shaft bridge special provision (BSP). These casing type and limits are based on recommendations by the WSDOT/ADSC Task Force.

Bridge Number	Pier Number	Casing Type	Elevation of Bottom of Required Casing (ft)	Upper and Lower Elevation Limits for Concurrent Casing Placement with Excavation (ft)
20/214 North	1 (all)	Temporary	-5.0	2.5 to -5.0
20/214 North	2 (all)	Temporary	-5.0	3.0 to -5.0
20/214 South	1 (all)	Temporary	-10.0	1.5 to -10.0
20/214 South	2 (all)	Temporary	-10.0	1.5 to -10.0
20/217 South	1 (all)	Temporary	-30.0	5.0 to -30.0
20/217 South	2 (all)	Temporary	-30.0	5.0 to -30.0
20/220 South	1 (all)	Temporary	-42.0	6.0 to -42.0
20/220 South	2 (all)	Temporary	-42.0	6.0 to -42.0

Temporary Casing Recommendations for Drilled Shafts

Excavation in advance of the casing should not exceed 2 feet. Slurry should be used in all shafts.

9.3. *Abutments*

We recommend designing the abutments for gravel borrow backfill. For passive pressure resistance at the foundation toe and active pressure acting on the abutments, the following soil properties should be used to estimate the forces.

Parameter	Value
Unit Weight (γ) Piers 1 and 2	130 pcf
Soil Friction (ϕ_f) Piers 1 and 2	36°
Active Earth Pressure (k_a) Piers 1 and 2	0.26
Passive Earth Pressure (k_p) Piers 1 and 2	3.5
Coefficient of Sliding (tan ϕ_f) Pier 1 & 2	0.7

Earth Pressure Parameters for Abutment Wall Design

9.4. *Bridge #20/214 North Geotechnical Recommendations*

The existing Bridge #20/214 will be removed and the new Bridge #20/214 North will be constructed in approximately the same place. The new bridge will be a single span, 68-foot long structure with a 38-foot wide roadway. The roadway alignment changes only slightly and the profile remains the same.

9.4.1. Approach Embankments

The existing approach fill consists of approximately 2 to 3 feet of fill. The existing profile will not change. Minor amounts of new fill will be required from the rework of the embankment necessary after bridge removal and abutment construction and sliver fills placed at the existing fill margins. The on site soils will be moisture sensitive. We recommend that gravel borrow compacted to 95% of the maximum density be used for all new approach embankments and where the existing embankment is excavated to construct the new abutments. The on site soils excavated during structure excavation should be wasted. We anticipate any settlement of the approach fills will be negligible.

9.4.2. Approach Slabs

Based on the height of the fill at the abutments and low anticipated settlements, from a geotechnical standpoint approach slabs are not necessary at this structure, but may be necessary for other reasons such as ADT or design speed.

9.4.3. Shafts

Attached on Figure 1 in Appendix D is the nominal axial skin friction and end bearing chart for 6-foot drilled shafts. Our analysis indicates the potential for liquefaction to occur at this site during the design seismic event is low.

For the service limit state, the settlement of the shaft foundations tipped near elevation -30 feet will be on the order of 2-inches. Approximately 0.5-inches will occur during construction and the remaining 1.5-inches will occur over time. We anticipate approximately 1-inch of differential settlement between Piers 1 and 2. If the shafts cannot develop adequate capacity above elevation -30 feet, they should have a minimum tip elevation of -85 feet to avoid tipping the shafts in the soft silt and clay layer.

Soil parameters for input into DFSAP for analysis of the lateral capacity of the drilled shafts are shown on Figure 1 in Appendix E.

9.5. Bridge #20/214 South Geotechnical Recommendations

The new bridge will be a single span 100-foot long structure with a 38-foot wide roadway. The new structure will be constructed on the newly constructed eastbound lanes of SR-20 adjacent to the 20/214N bridge replacement.

9.5.1. Approach Embankments

The south approach will be constructed with a maximum fill height of 7.3 feet. The north approach has fill heights on the order of 3.5 feet. For the Bridge Approach Embankments at the 20/214 South bridge, we recommend placement of a soil stabilization fabric at the base of the proposed fill. Fabric placement is addressed in the Construction Considerations section of this report. The on site soils will be moisture sensitive. We recommend that gravel borrow compacted to 95% of the maximum density be used for all new approach embankments and where the existing embankment is excavated to construct the new abutments. The on site soils excavated during structure excavation should be wasted. We estimate up to 3 inches of settlement in the approach fill.

9.5.2. Approach Slabs

Based on the height of the fill at the abutments and low anticipated settlements, from a geotechnical standpoint approach slabs are not necessary at this structure, but may be necessary for other reasons such as ADT or design speed.

9.5.3. Shafts

Attached on Figure 1 in Appendix D is the nominal axial skin friction and end bearing chart for 6-foot drilled shafts. Our analysis indicates the potential for liquefaction to occur at this site during the design seismic event is low.

For the service limit state, the settlement of the shaft foundations tipped near elevation -30 feet will be on the order of 3-inches. Approximately 1-inch will occur during construction and the remaining 2-inches will occur over time. We anticipate approximately 1.5-inches of differential settlement between Piers 1 and 2. If the shafts cannot develop adequate capacity above elevation -30 feet, they should have a minimum tip elevation of -90 feet to avoid tipping the shafts in the soft silt and clay layer.

Soil parameters for input into DFSAP for analysis of the lateral capacity of the drilled shafts are shown on Figure 1 in Appendix E.

9.6. Bridge #20/217 South Geotechnical Recommendations

The new bridge will be a single span 52-foot long structure with a 38-foot wide roadway. The new structure will be constructed on the newly widened section of SR-20 adjacent to the existing 20/217 North bridge.

9.6.1. Approach Embankments

The proposed embankments are constructed very near existing grade with minimal amounts of fill. Higgins Slough however will be realigned at this location as shown on Figure 2D. This will require approximately 9-feet of fill adjacent to Pier 1 of the proposed structure. The on site

soils will be moisture sensitive. We recommend that gravel borrow compacted to 95% of the maximum density be used for all new approach embankments and where the existing embankment is excavated to construct the new abutments. The on site soils excavated during structure excavation should be wasted. We anticipate approximately 2-inches of settlement at this location. Due to the nature of the underlying soils, this settlement should occur during construction. Post construction settlement should be negligible.

9.6.2. Approach Slabs

Based on the height of the fill at the abutments and low anticipated settlements, from a geotechnical standpoint approach slabs are not necessary at this structure, but may be necessary for other reasons such as ADT or design speed.

9.6.3. Shafts

Attached on Figures 2 and 3 in Appendix D are the nominal axial skin friction and end bearing charts for 6-foot drilled shafts. Our analysis indicates the potential for liquefaction to occur at this site during the design seismic event is high. The following downdrag loads should be used for evaluating the axial capacity for the design seismic event.

Shaft Diameter (ft)	Downdrag Load Per Shaft (tons)
6	481

Extreme Event Downdrag Loads for 20/217 South

We estimate the settlement of the drilled shafts to be less than 1-inch for the Service Limit State with the bulk of the settlement occurring during construction. Post construction settlement should be negligible. In the design seismic event it is possible that up to 6-inches of settlement could occur with up to 3 to 4 inches of differential settlement.

Soil parameters for input into DFSAP for analysis of the lateral capacity of the drilled shafts are shown on Figure 2 in Appendix E.

9.7. Bridge #20/220 South Geotechnical Recommendations

The new bridge will be a single span 64-foot long structure with a 38-foot wide roadway. The new structure will be constructed on the newly constructed eastbound lanes of SR-20 adjacent to the existing 20/220 North bridge.

9.7.1. Approach Embankments

Minor amounts of new fill, less than five feet in height will be required, to construct the new approach sections. The on site soils will be moisture sensitive. We recommend that gravel borrow compacted to 95% of the maximum density be used for all new approach embankments and where the existing embankment is excavated to construct the new abutments. The on site soils excavated during structure excavation should be wasted. We anticipate any settlement of the approach fills will be negligible.

9.7.2. Approach Slabs

Based on the height of the fill at the abutments and low anticipated settlements, from a geotechnical standpoint approach slabs are not necessary at this structure, but may be necessary for other reasons such as ADT or design speed.

9.7.3. Shafts

Attached on Figure 4 in Appendix D is the nominal axial skin friction and end bearing chart for 6-foot drilled shafts. Our analysis indicates the potential for liquefaction to occur at this site during the design seismic event is low.

For the service limit state, the settlement of the shaft foundations will be on the order of 1-inch. We anticipate less than 0.5-inches of differential settlement between Piers 1 and 2.

Soil parameters for input into DFSAP for analysis of the lateral capacity of the drilled shafts are shown on Figure 2 in Appendix E.

9.8. Earthwork

In general, the bulk of the work on this project entails the construction of embankment fills. The cuts primarily involve ditch and channel excavations and small cuts in existing fill to reconstruct roadway sections. With respect to slope stability, we recommend that cut and fill slopes be constructed with slope ratios of 2:1 (H:V) or flatter.

In order to minimize the effects of settlement to the new roadway and structures, and to minimize the potential for settlement induced downdrag loads on the new foundations, we recommend a 30-day settlement period for fills in excess of 5 feet. The contractor should not be allowed to construct foundation elements or prepare subgrade during the settlement period.

During construction, it is likely that unsuitable foundation materials will be encountered. To minimize over excavation where unsuitable materials may be encountered during construction, we recommend the use of a soil stabilization fabric for fills in excess of 5 feet. These areas do not need to be cleared and grubbed. The area to be covered by the soil stabilization fabric should be graded to a smooth, uniform condition free from ruts, potholes, and protruding objects such as rocks or sticks. The contractor may construct a working platform, up to 2 feet in thickness, in lieu of grading the existing ground surface. A working platform is required where stumps or other protruding objects which cannot be removed without excessively disturbing the subgrade are present. All stumps should be cut flush with the ground surface and covered with at least 6-inches of select borrow placed by Method C compaction before placement of the soil stabilization fabric.

The realignment of the slough between Bradshaw Road and Bridge 20/217 South will entail filling in the existing channel with up to 13 feet of fill. Based on our settlement analysis we anticipate up to 2.5-inches of settlement at the deepest fill. The bulk of this settlement should occur during the 30-day settlement period and post construction settlement should be negligible. We recommend the newly realigned slough be constructed with side slopes of 2:1 (H:V) or flatter. In addition, we recommend the Region or HQ Hydraulics Division be contacted regarding the necessary slope protection in the channel.

9.9. Signal Foundations

We understand that new signal foundations are proposed at the SR-20 and SR-536 interchange and at SR-20 and Higgins Airport Road at the approximate locations shown on Figures 2B and

2E in Appendix A. We recommend the foundations be designed with an allowable lateral bearing pressure of 1000 pounds per square foot.

The luminaires proposed at SR-20 and Higgins Airport Road can be constructed with the new standard plan foundation for luminaires. A copy of the standard plan is shown on Figure 11 in Appendix A.

We anticipate that the luminaire and signal foundations will encounter groundwater during construction. We recommend the use of BSP2003041.FB8 for luminaire and signal foundation construction.

9.10. Bridge 536/12 Removal & Culvert Construction

The project proposes to remove the existing 536/12 bridge and replace it with two approximately 60-inch culverts. We anticipate the new fill for the culvert construction and the SR-20/SR-536 interchange realignment will settle up to 1.5-inches during the construction period, with minimal post construction settlement.

Due to the existing embankment for SR-536, there will be a substantial component of differential settlement. We estimate approximately 1.5-inches of settlement at the inlet and outlet, and approximately 0.5-inches at the existing embankment. If the project office wishes to reduce the amount of differential settlement, the new fill should be constructed with no culverts and subjected to the 30-day settlement period. At the end of the period the culverts can be constructed.

We have performed pH and resistivity testing of the native soils at the site for selection of culvert material. The results of our testing are shown in the table below. Import fill should also be tested prior to final selection of culvert material.

Boring	Depth (ft)	pH	Resistivity (Ohm-sec)
BH-18-06	9	5.7	3,400
BH-18-06	12	4.1	2,200

pH & Resistivity Values of Native Soil

10. Construction Considerations

At the existing 20/214 bridge, we recommend the complete removal of the steel piles in the abutment supports. Steel piles on the interior piers can be completely removed or removed in accordance with *Section 2-02.3(1)* of the *2006 Standard Specifications.* In addition, there are a number of timber piles remaining under the existing bridge. If these piles are not removed, they will become obstructions if conventional shaft drilling equipment is used. In any case, all pile removal should occur prior to drilled shaft construction. Do to the nature of the deposits, we anticipate shaft drilling will encounter timber piles and wood deposits (high probability) and boulders (moderate to low probability).

Due to high groundwater, it is likely that cofferdams and seals or dewatering will be necessary to construct the foundations. In the boring at Pier 1 (BH-03-05) at 20/214 South, wood and other debris was encountered. We do not know the lateral extent of this deposit. Driving sheetpiles through this deposit may not be possible.

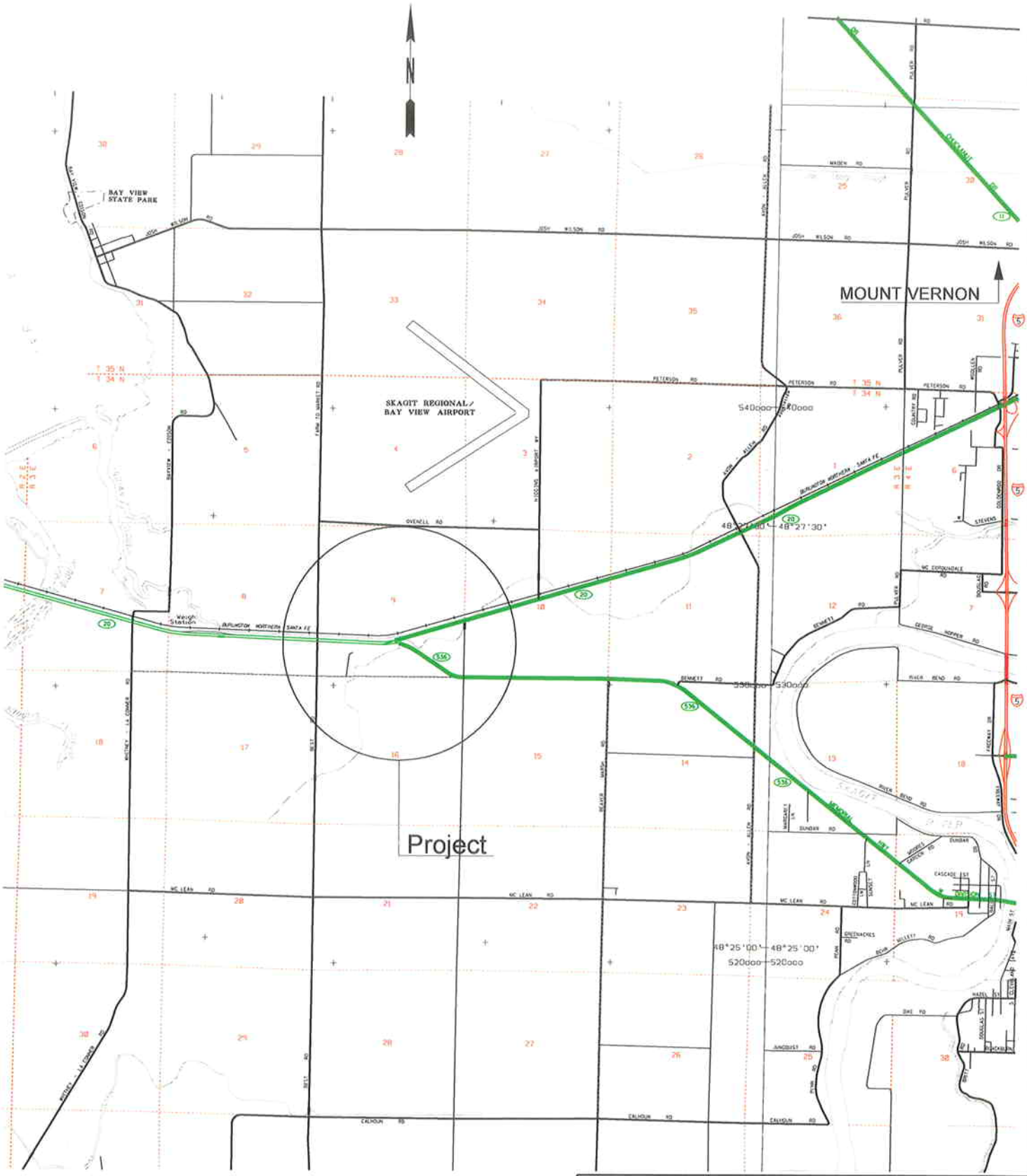
At the bridge 516/12 removal, in addition to the piles currently supporting the bridge, timber piles from a previous structure will also be encountered. These timber piles, if not removed, will make excavation difficult.

We recommend performing a preconstruction survey and performing construction monitoring of the existing 20/217 North and 20/220 North bridges. The contractor(s) should be required to perform all work without damaging these structures. These two bridges will be particularly sensitive to vibration induced settlements. Care should be taken to minimize vibrations near these bridges.

We anticipate the use of slurry will be required for drilled shafts. The contractor should be aware that the groundwater level is influenced by tidal fluctuations and other factors.

Because the bulk of the cuts on this project are shallow, and will tend to have high organic contents, we recommend cut material generated on this project be considered unsuitable for fill and backfill materials. We understand that all embankment fill on this project will be select or gravel borrow. It may be worthwhile to consider using lower quality material (common borrow) to backfill Higgins Slough at the realignment section outside the roadway prism.

Prior to, or during construction, our office should be contacted to decommission the piezometers installed on this project



JOB OL-3485 S.R. 20

SR 20 Fredonia to I-5 Phase 1

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

GEOTECHNICAL DIVISION

DATE 5/2006

SCALE N.T.S. VERT. HORIZ.

SHEET ___ OF ___

DRAWN BY WM

Figure 1: Vicinity Map

T.34N. R.3E. W.M.

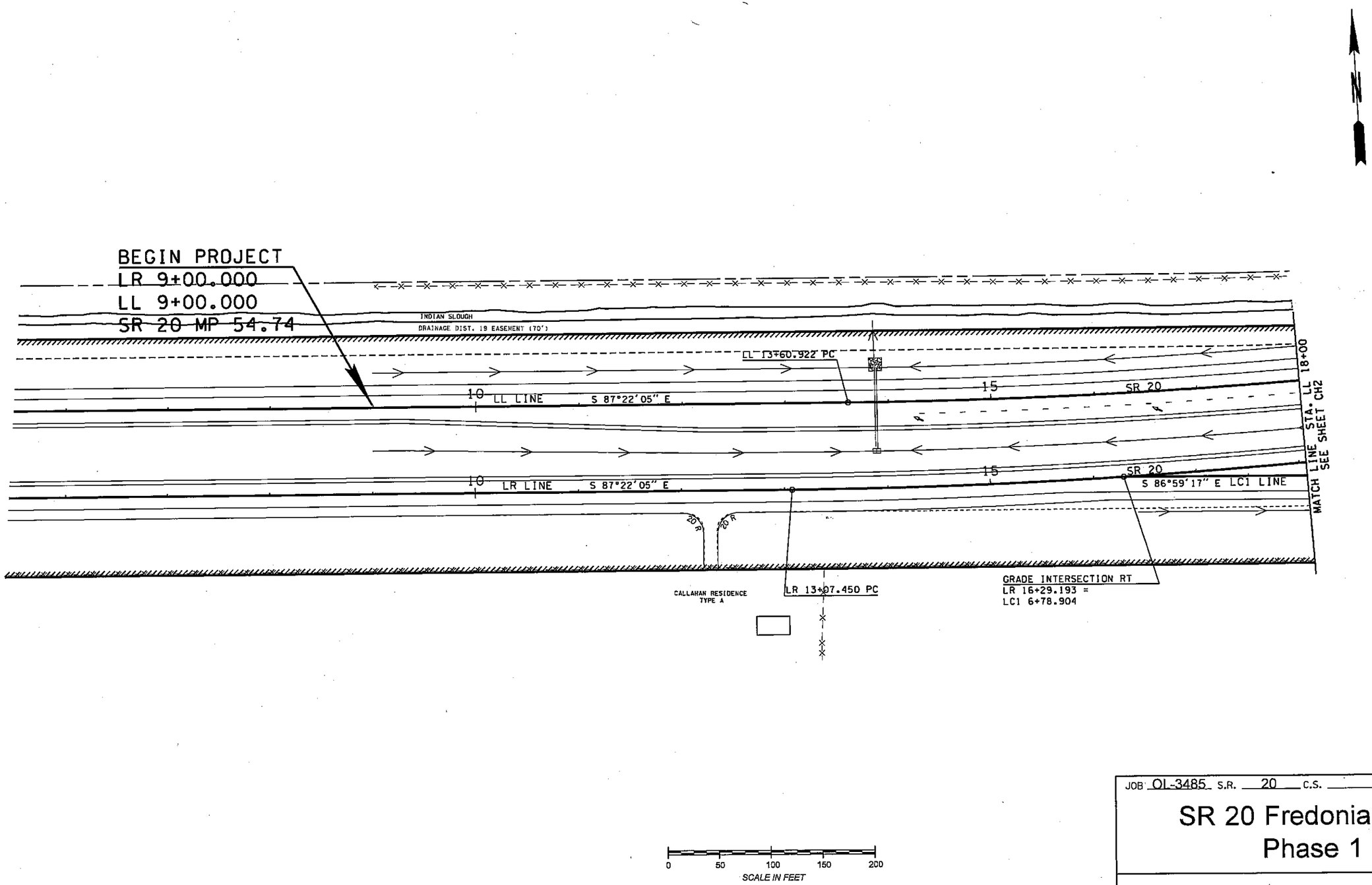


Figure 2A: Boring Location Plan

JOB OL-3485 S.R. 20 C.S. _____

SR 20 Fredonia to I-5
Phase 1

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 5/2006
SCALE 1=100' VERT.
1=100' HORIZ.
SHEET ___ OF ___
DRAWN BY WM

T.34N. R.3E. W.M.

Remove Existing Bridge #20/214
Construct New Bridge #20/214N

Approximate Location of
Type III Signal Foundation

BH-1-05
BH-2-05
BH-3-05
BH-4-05
BH-10-06

Construct New
Bridge #20/214S

INDIAN SLOUGH
KIM BUSI. TYPE D
MATCH LINE STA. LL 18+00 - SEE SHEET CH1
MATCH LINE STA. LL 31+00 SEE SHEET CH3
LL LINE
LR LINE
LC1 LINE
LC2 LINE
S 86°59'17" E
LC1 12+91.076 PC
LL 23+32.613 PI
LR 22+79.141 PI
GRADE INTERSECTION RT
LR 27+40.642 =
LC2 10+00.000
LC1 20+23.597 PI
LC2 13+41.503 PT
LC2 12+23.147 PI
LC2 15+07.641 PC
SR 20
SR 536
SR 536 S 66°35'56" E
HIGGINS SLOUGH
DRAINAGE DIST. 19 EASEMENT (70')
DRAINAGE DIST. 19 EASEMENT (60')
HARLOW RESIDENCE TYPE A
MATCH LINE STA. LC1 22+50 SEE SHEET CH3

SR 20 / SR 536 INTERCHANGE

Realign EB SR-20 to
EB SR-536 Offramp

Remove Existing Bridge #536/12
Construct New Culvert

0 50 100 150 200
SCALE IN FEET

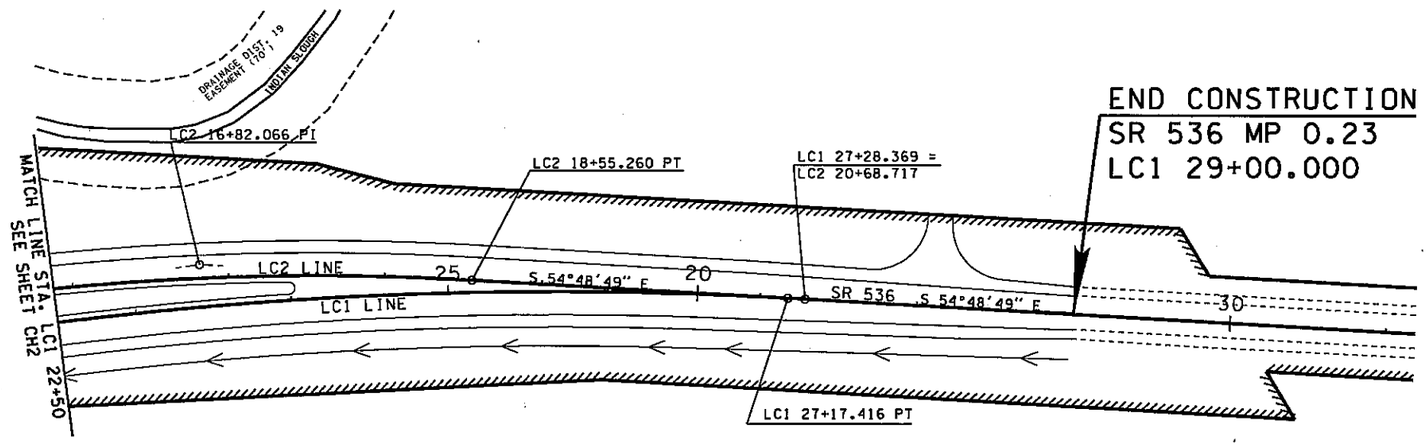
JOB OL-3485 S.R. 20 C.S. _____

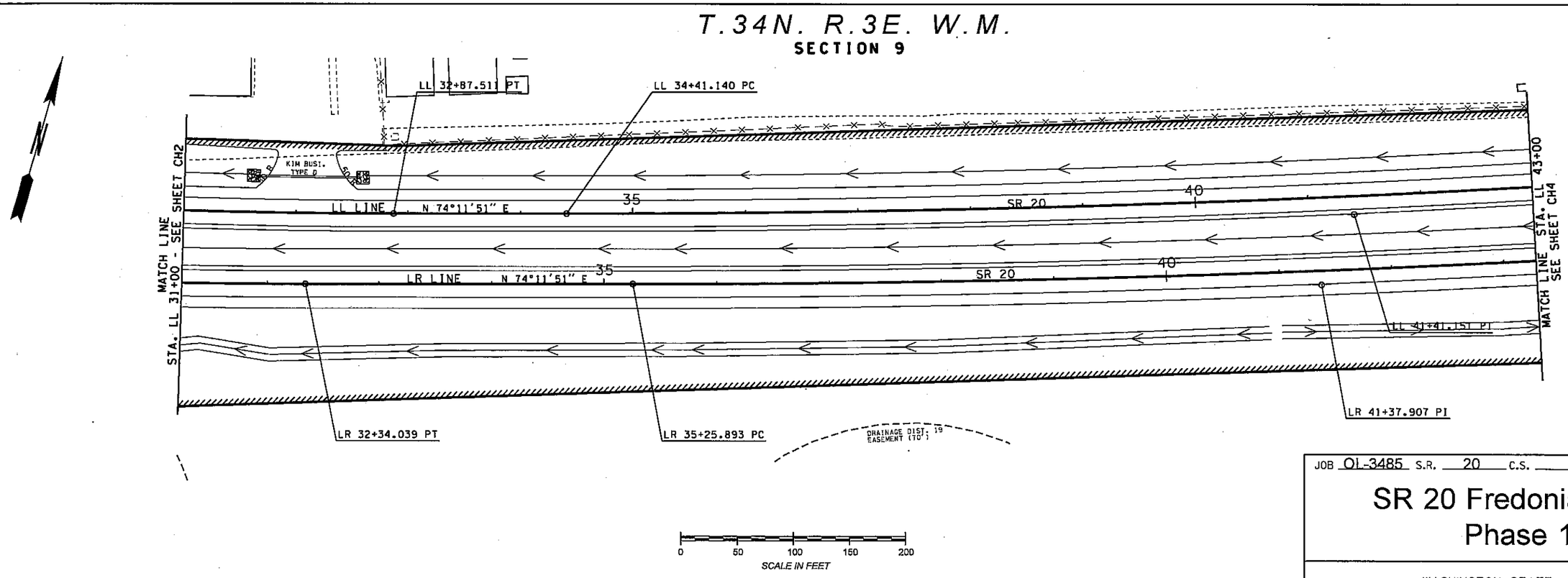
SR 20 Fredonia to I-5
Phase 1

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 5/2006
SCALE 1=100' VERT.
1=100' HORIZ.
SHEET ___ OF ___
DRAWN BY WM

Figure 2B: Boring Location Plan





JOB OL-3485 S.R. 20 C.S. _____

SR 20 Fredonia to I-5
Phase 1

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 5/2006
SCALE 1=100' VERT.
1=100' HORIZ.
SHEET ___ OF ___
DRAWN BY WM

Figure 2C: Boring Location Plan

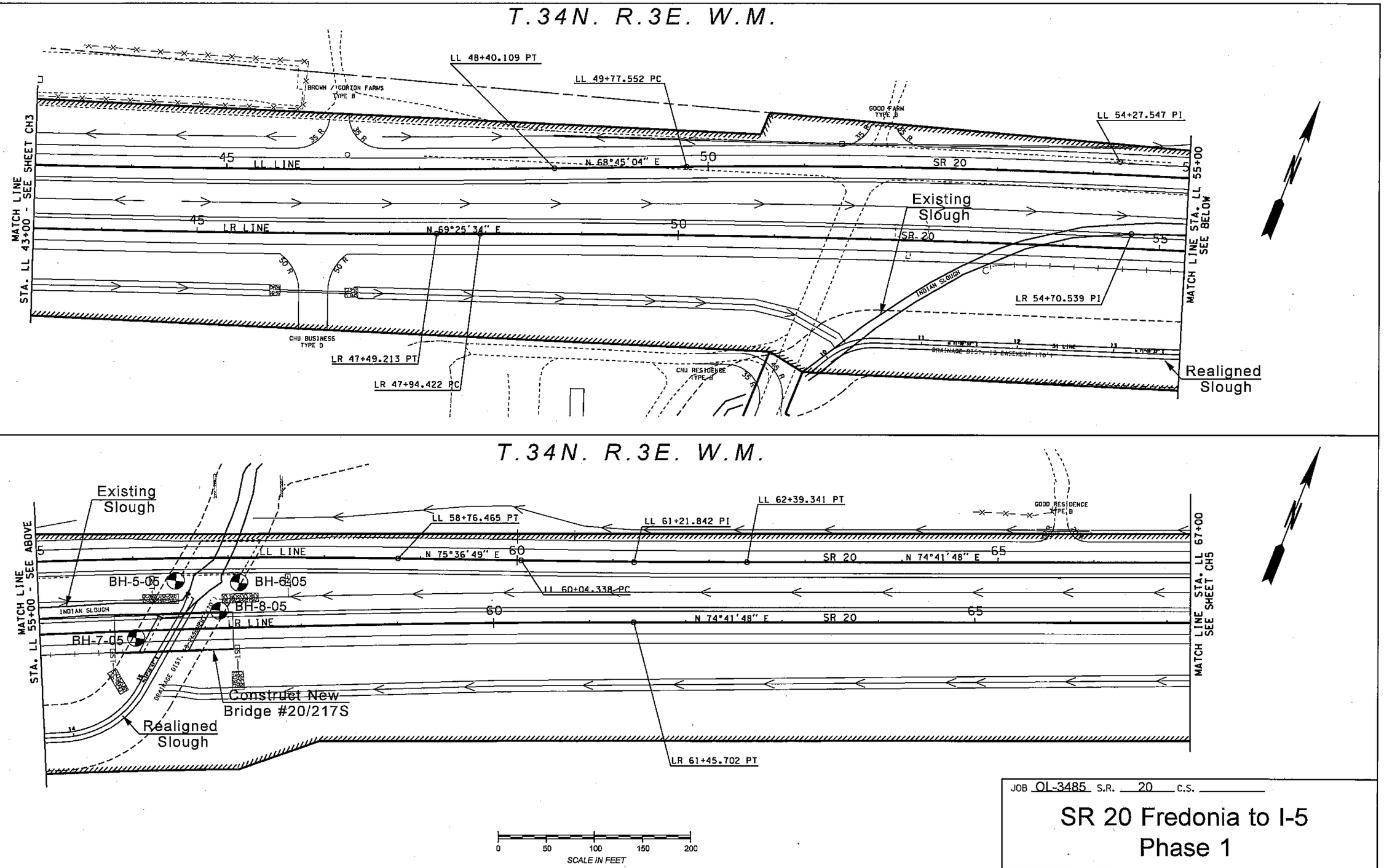


Figure 2D: Boring Location Plan

JOB OL-3485 S.R. 20 C.S. _____

SR 20 Fredonia to I-5
Phase 1

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 5/2006
SCALE 1=100' VERT.
1=100' HORIZ.
SHEET ___ OF ___
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T.34N. R.3E. W.M.

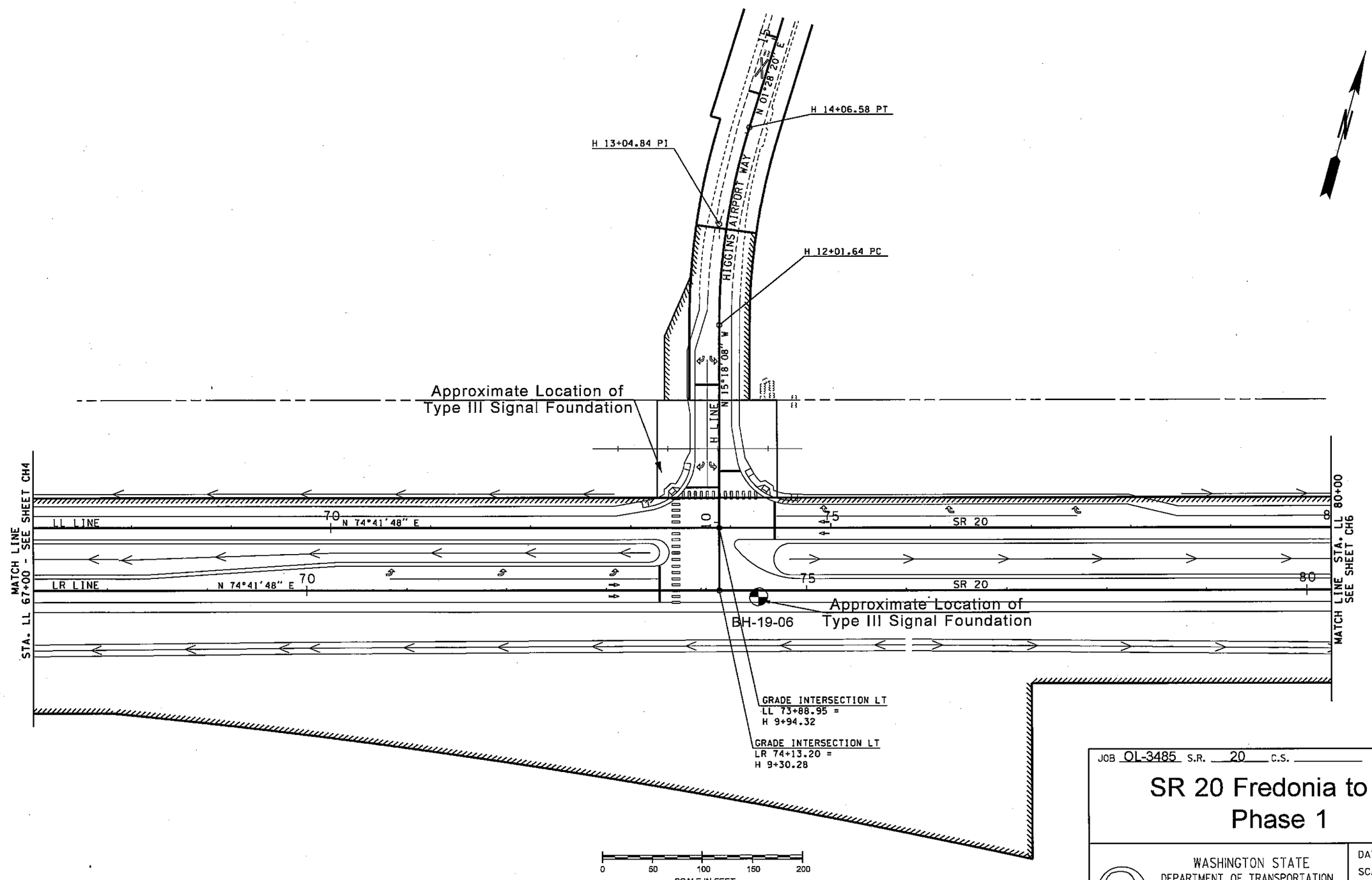


Figure 2E: Boring Location Plan

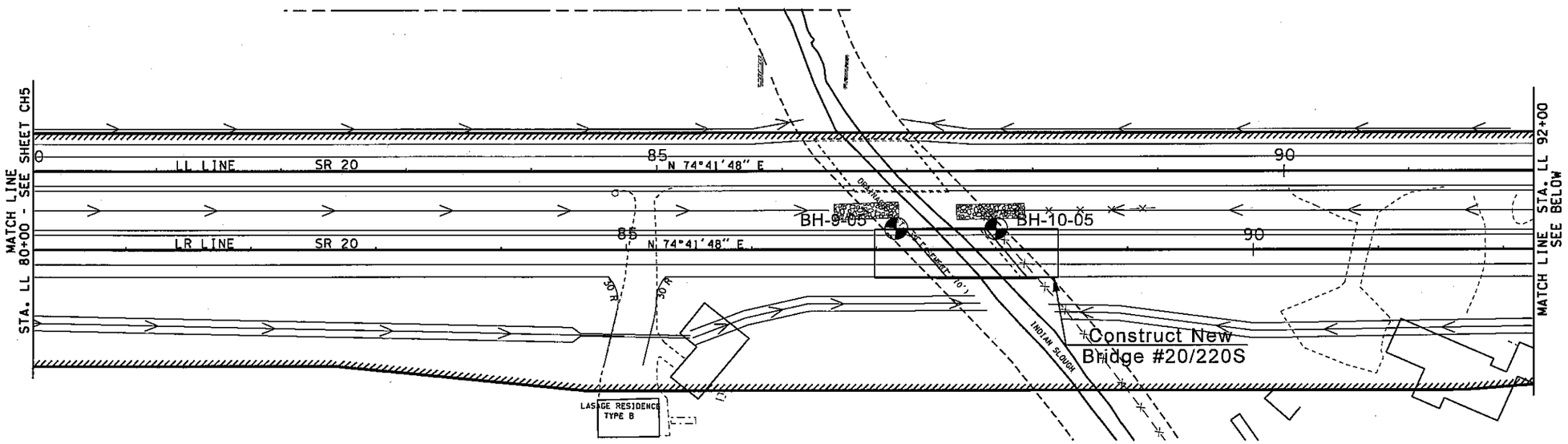
JOB OL-3485 S.R. 20 C.S. _____

SR 20 Fredonia to I-5
Phase 1

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 5/2006
SCALE 1=100' VERT.
1=100' HORIZ.
SHEET ___ OF ___
DRAWN BY WM

T.34N. R.3E. W.M.



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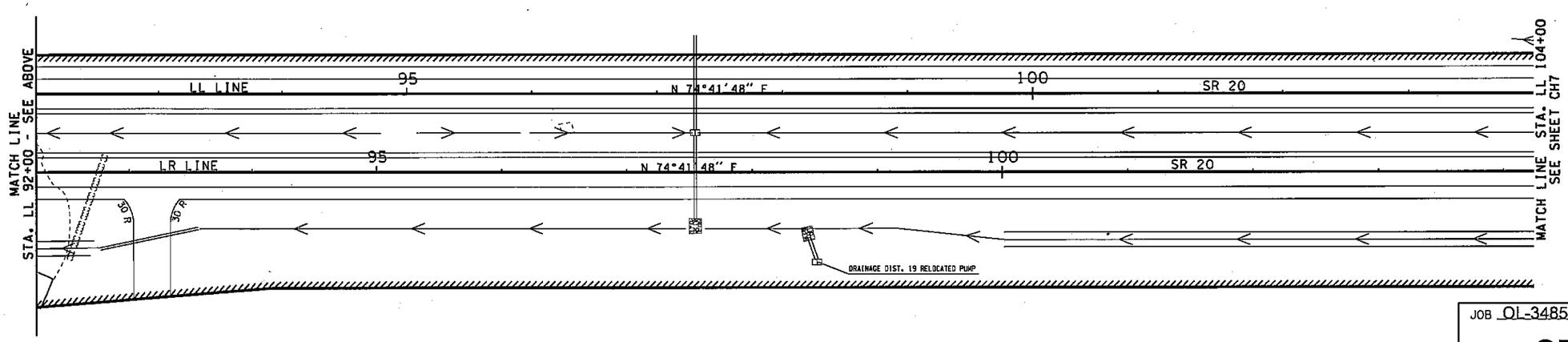


0 50 100 150 200
SCALE IN FEET

Figure 2F: Boring Location Plan

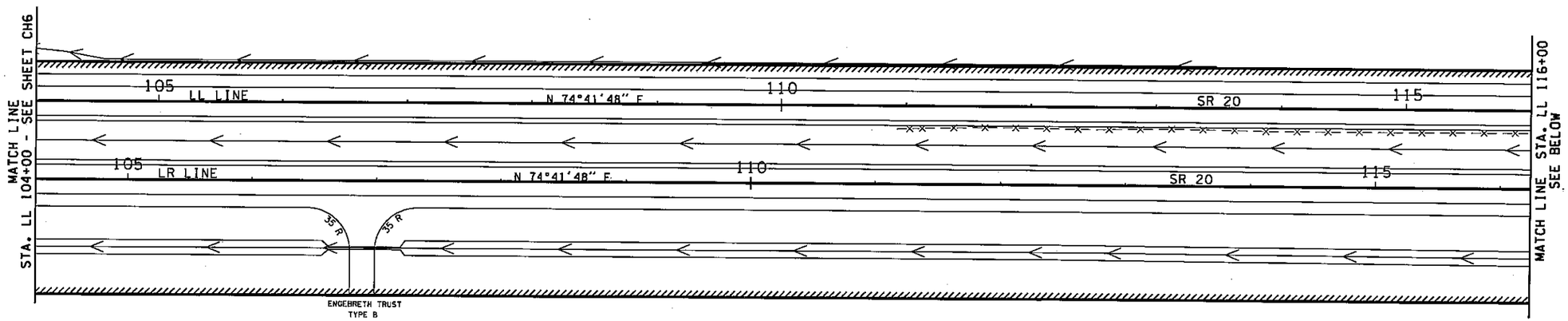
JOB OL-3485 S.R. 20 C.S. _____

SR 20 Fredonia to I-5
Phase 1

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 5/2006
SCALE 1=100' VERT.
1=100' HORIZ.
SHEET ___ OF ___
DRAWN BY WM

T.34N. R.3E. W.M.



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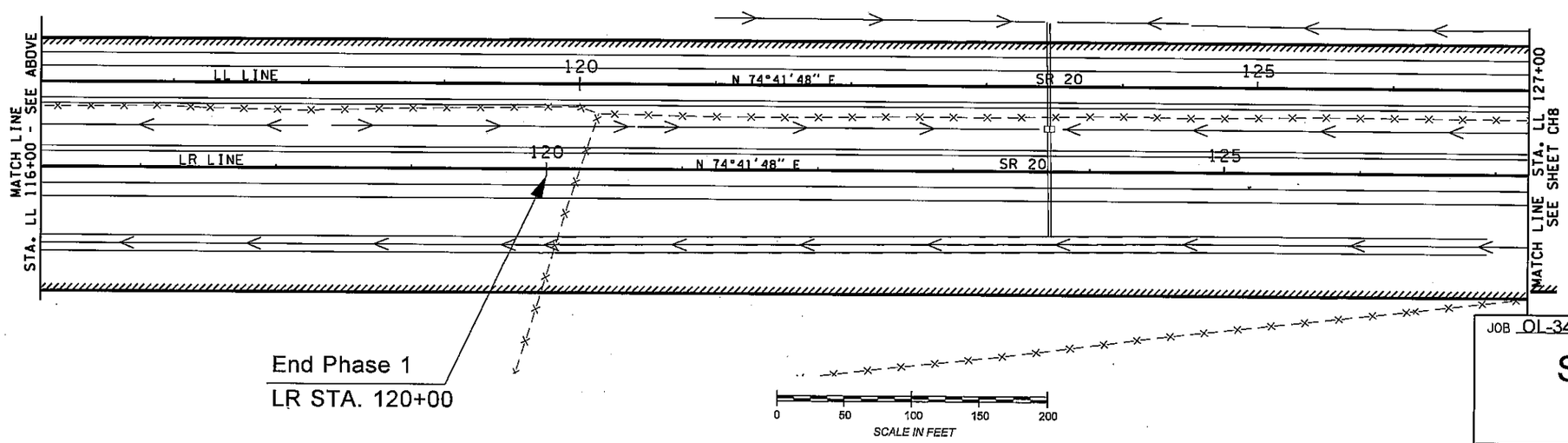

Figure 2G: Boring Location Plan

JOB OL-3485 S.R. 20 C.S. _____

SR 20 Fredonia to I-5
Phase 1

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 5/2006
SCALE 1=100' VERT.
1=100' HORIZ.
SHEET ___ OF ___
DRAWN BY WM

SEC. 9, T.34N., R.3E., W.M.
SKAGIT COUNTY
SR 20

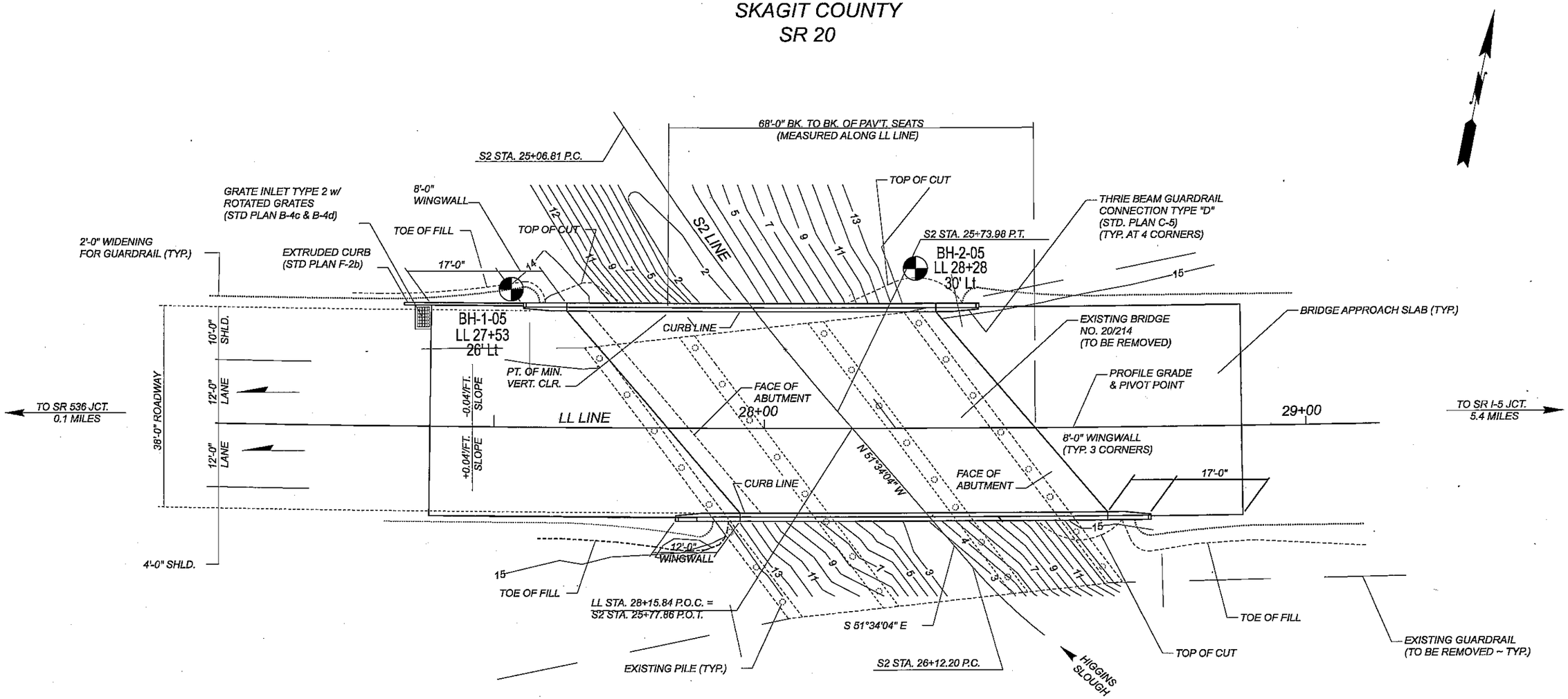

Figure 3: Plan

JOB OL-3485 S.R. 20 C.S. _____

SR 20 Fredonia to I-5
Sr 20 Over Higgins Slough
Bridge #20/214N Replacement

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 9/2005
SCALE 1=20' VERT.
1=20' HORIZ.
SHEET ____ OF ____
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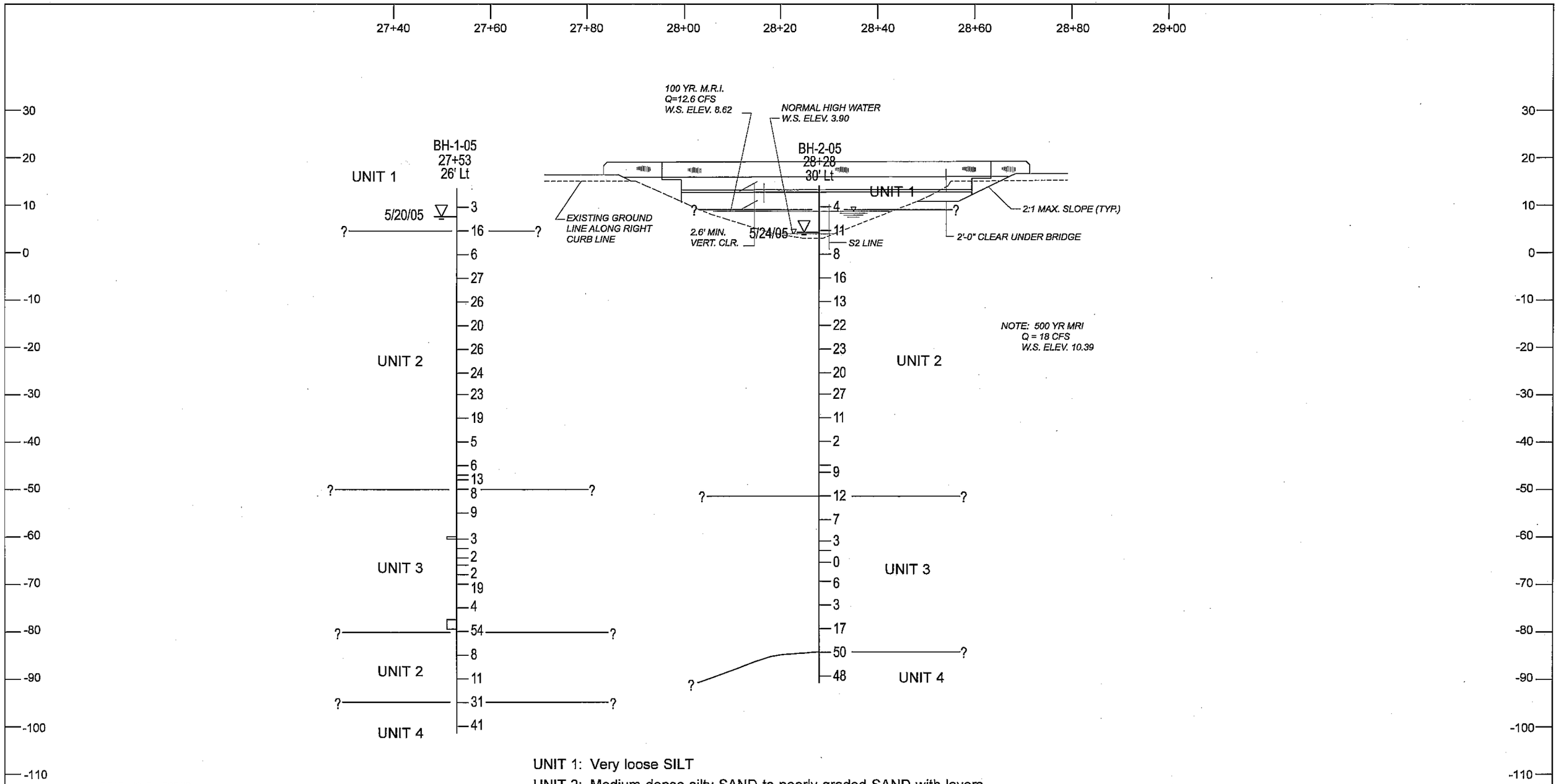

UNIT 1: Very loose SILT

UNIT 2: Medium dense silty SAND to poorly graded SAND with layers of well graded SAND and very loose to loose silty SAND.

UNIT 3: Very soft to medium stiff lean to fat CLAY with lenses of well graded SAND.

UNIT 4: Dense silty SAND with gravel.

TEST HOLE LEGEND

H-I-98 TEST HOLE NUMBER
110+55 TEST HOLE STATION
26 ft.Rt. TEST HOLE OFFSET

23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)
UNDISTURBED SAMPLE
W.L. 8-6-86 WATER LEVEL & DATE
? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
INDICATES INTACT ROCK
86% INDICATES CORE SAMPLE TAKEN
ROCK QUALITY DESIGNATION

DATUM
NAVD 1988

Figure 4: Profile

JOB OL-3485 S.R. 20 C.S.

SR 20 Fredonia to I-5
Sr 20 Over Higgins Slough
Bridge #20/214N Replacement

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 9/2005
SCALE 1=20' VERT.
1=20' HORIZ.
SHEET ___ OF ___
DRAWN BY WM

SEC. 9, T.34N., R.3E., W.M.
SKAGIT COUNTY
SR 20

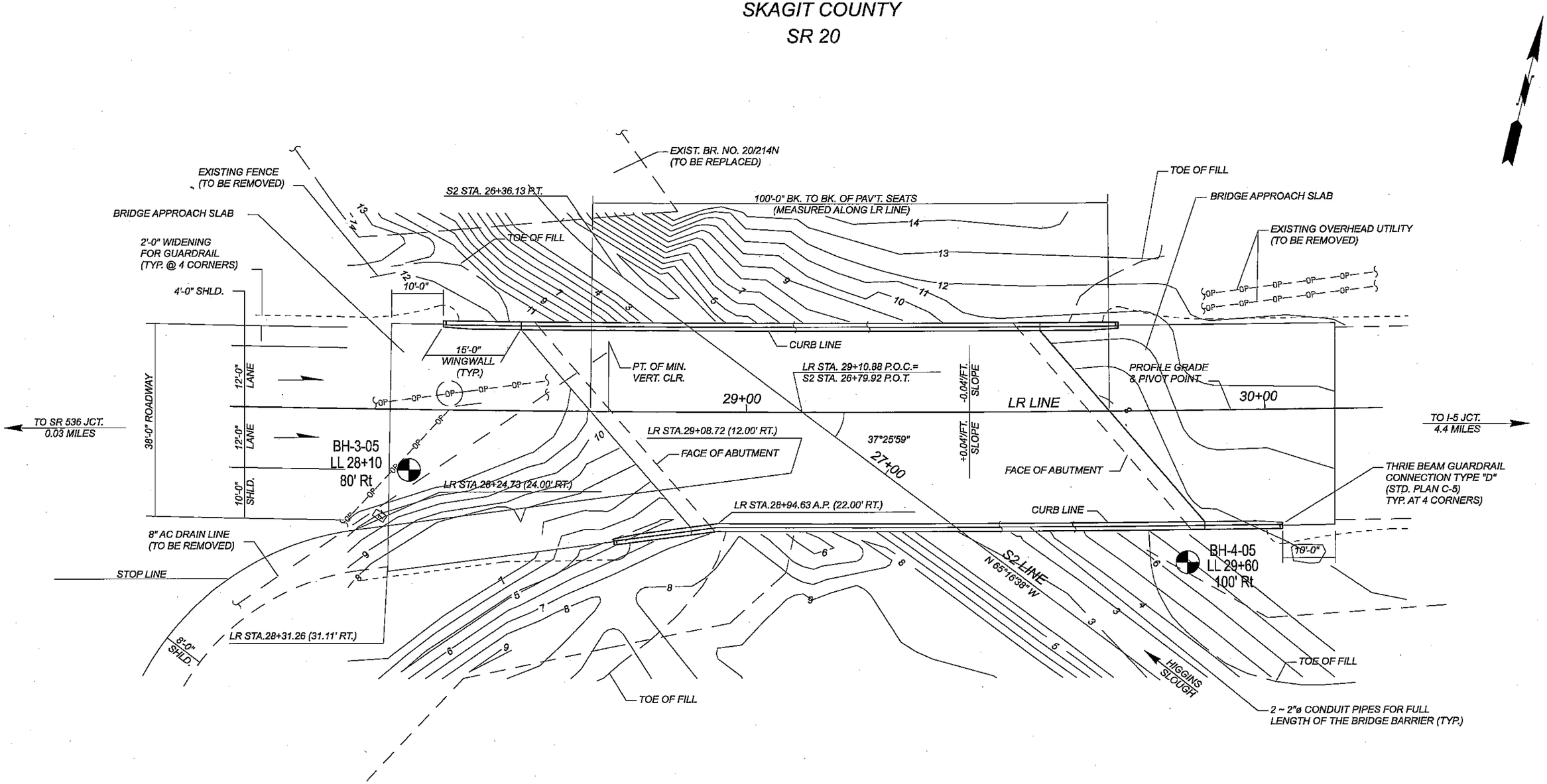

Figure 5: Plan

JOB OL-3485 S.R. 20 C.S.

SR 20 Fredonia to I-5
Over Higgins Slough
Bridge #20/214S

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 9/2005
SCALE 1=20' VERT.
1=20' HORIZ.
SHEET ___ OF ___
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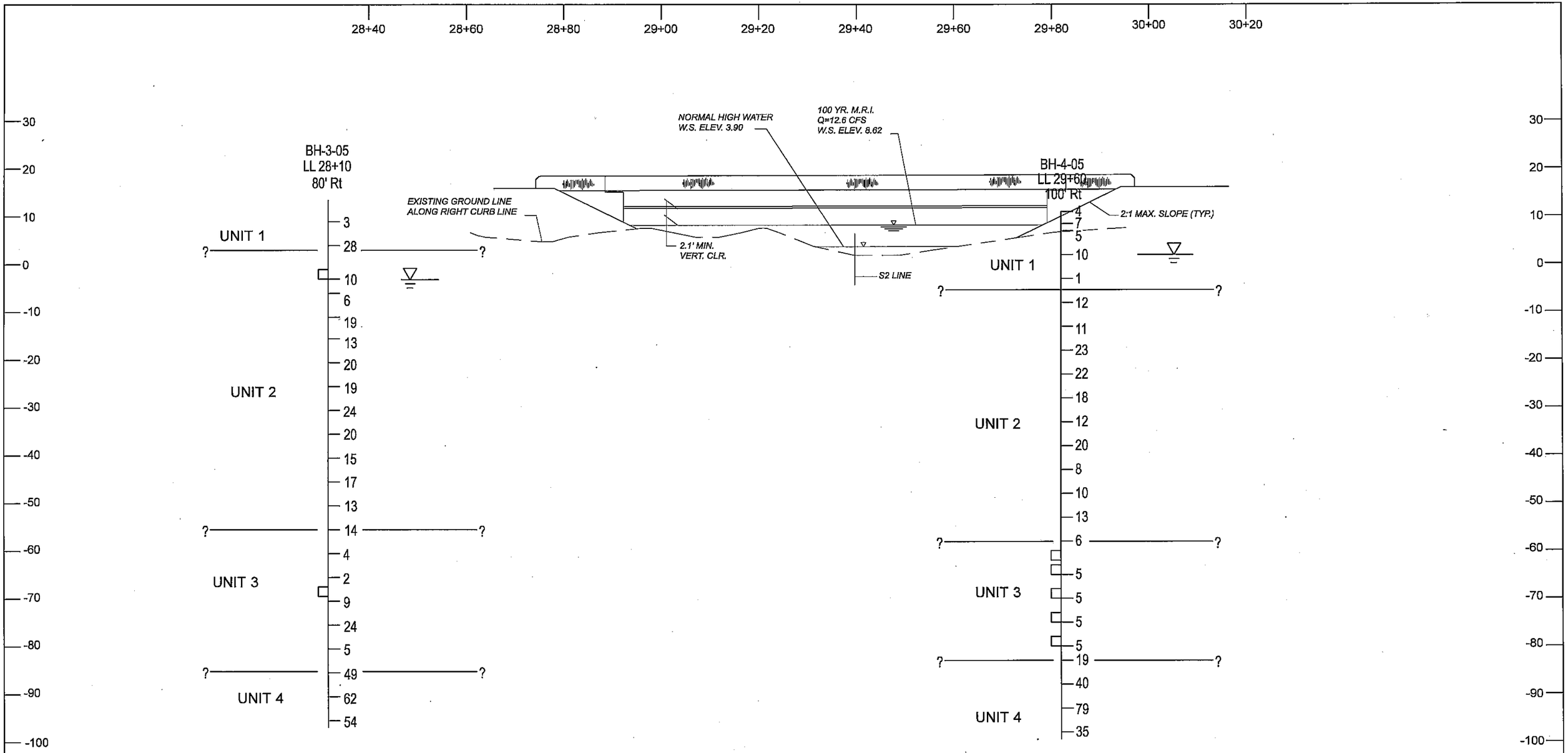


TEST HOLE LEGEND

H-1-98 TEST HOLE NUMBER
110+55 TEST HOLE STATION
26 ft.Rt. TEST HOLE OFFSET

23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)

UNDISTURBED SAMPLE

W.L. 8-6-86 WATER LEVEL & DATE

? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS

INDICATES INTACT ROCK

86% INDICATES CORE SAMPLE TAKEN

ROCK QUALITY DESIGNATION

DATUM
NAVD 1988

UNIT 1: Very loose to loose SILT

UNIT 2: Medium dense silty SAND to poorly graded SAND with layers of well graded SAND and very loose to loose silty SAND.

UNIT 3: Soft to very stiff lean to fat CLAY with lenses of well graded SAND.

UNIT 4: Dense silty SAND with gravel.

Figure 6: Profile

JOB OL-3485 S.R. 20 C.S.

SR 20 Fredonia to I-5
Over Higgins Slough
Bridge #20/214S

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 9/2005
SCALE 1=20' VERT.
1=20' HORIZ.
SHEET ___ OF ___
DRAWN BY WM

SEC. 9, T.34N., R.3E., W.M.
SKAGIT COUNTY
SR 20

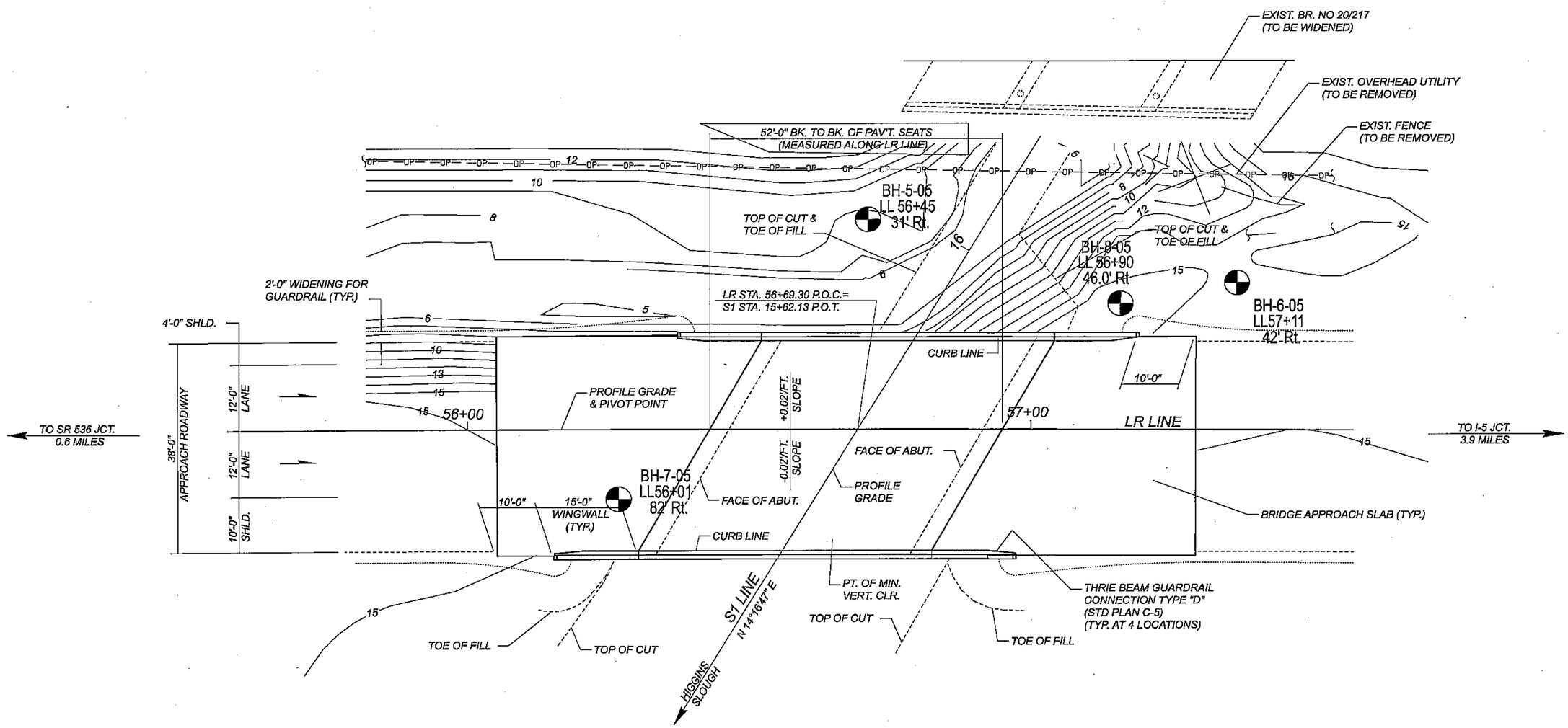


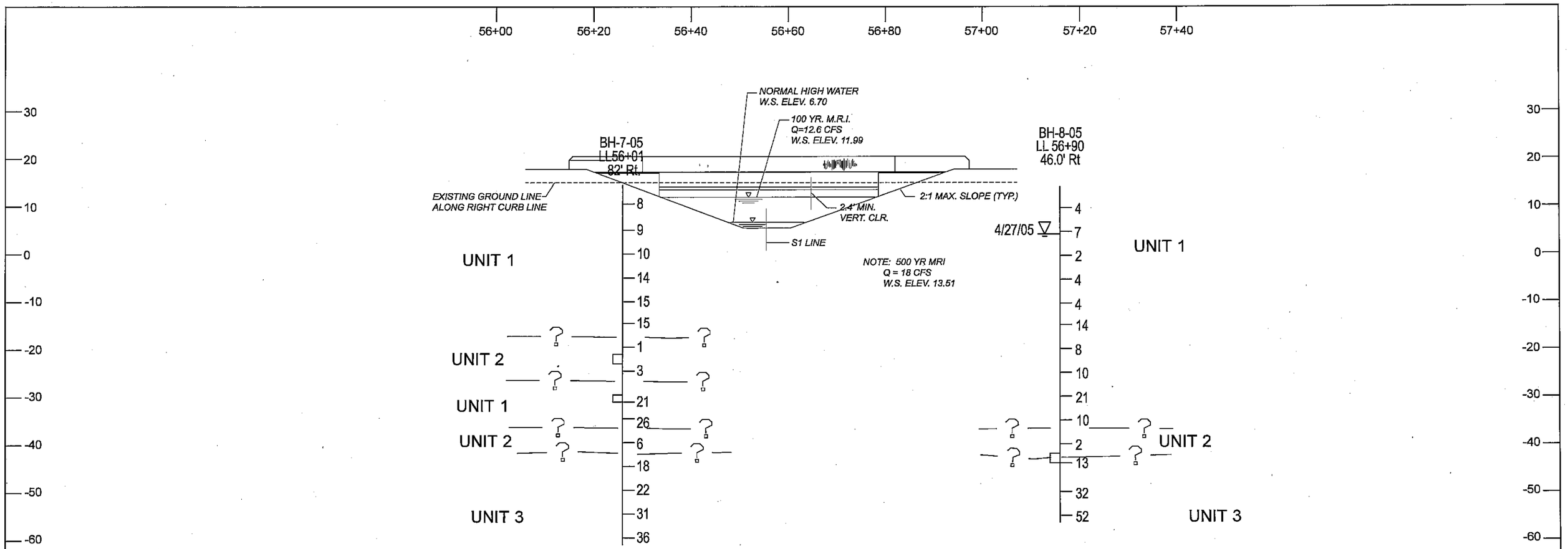
Figure 7: Plan

JOB OL-3485 S.R. 20 C.S. _____

SR 20 Fredonia to I-5
SR 20 Over Higgins Slough
Bridge #20/217S

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 9/2005
SCALE 1=20' VERT.
1=20' HORIZ.
SHEET ___ OF ___
DRAWN BY WM



UNIT 1 Loose to dense silty SAND and poorly graded SAND.

UNIT 2 Very soft to stiff, lean to fat SILTS and CLAYS.

UNIT 3 Medium dense to dense silty SAND and poorly graded SAND. Some sandy SILT.

TEST HOLE LEGEND

H-I-98 TEST HOLE NUMBER
110+55 TEST HOLE STATION
26 ft.Rt. TEST HOLE OFFSET

23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)
UNDISTURBED SAMPLE
W.L. 8-6-86 WATER LEVEL & DATE
? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
INDICATES INTACT ROCK
86% INDICATES CORE SAMPLE TAKEN
ROCK QUALITY DESIGNATION

DATUM
NAVD 1988

Figure 8: Profile

JOB OL-3485 S.R. 20 C.S.

SR 20 Fredonia to I-5
SR 20 Over Higgins Slough
Bridge #20/217S

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 9/2005
SCALE 1=20' VERT.
1=20' HORIZ.
SHEET ___ OF ___
DRAWN BY WM

SEC. 6, T.34N., R.4E., W.M.
SKAGIT COUNTY
SR 20

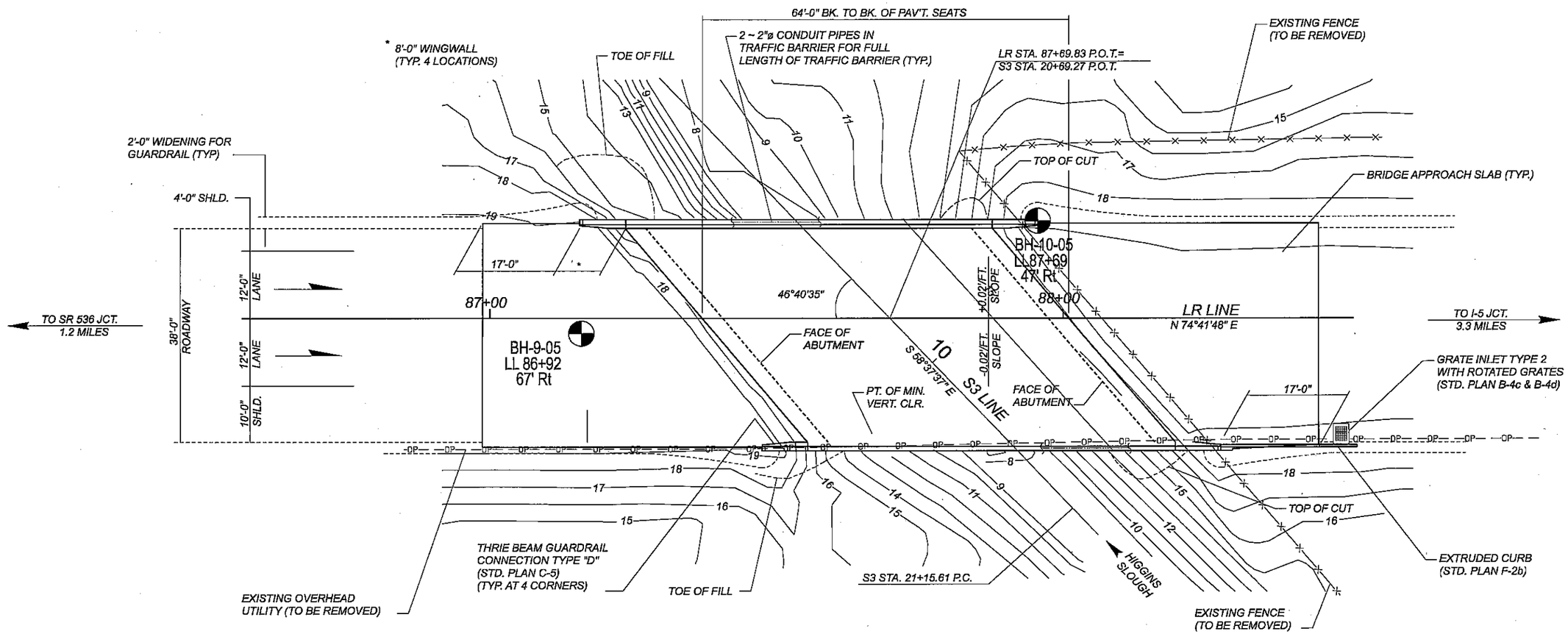


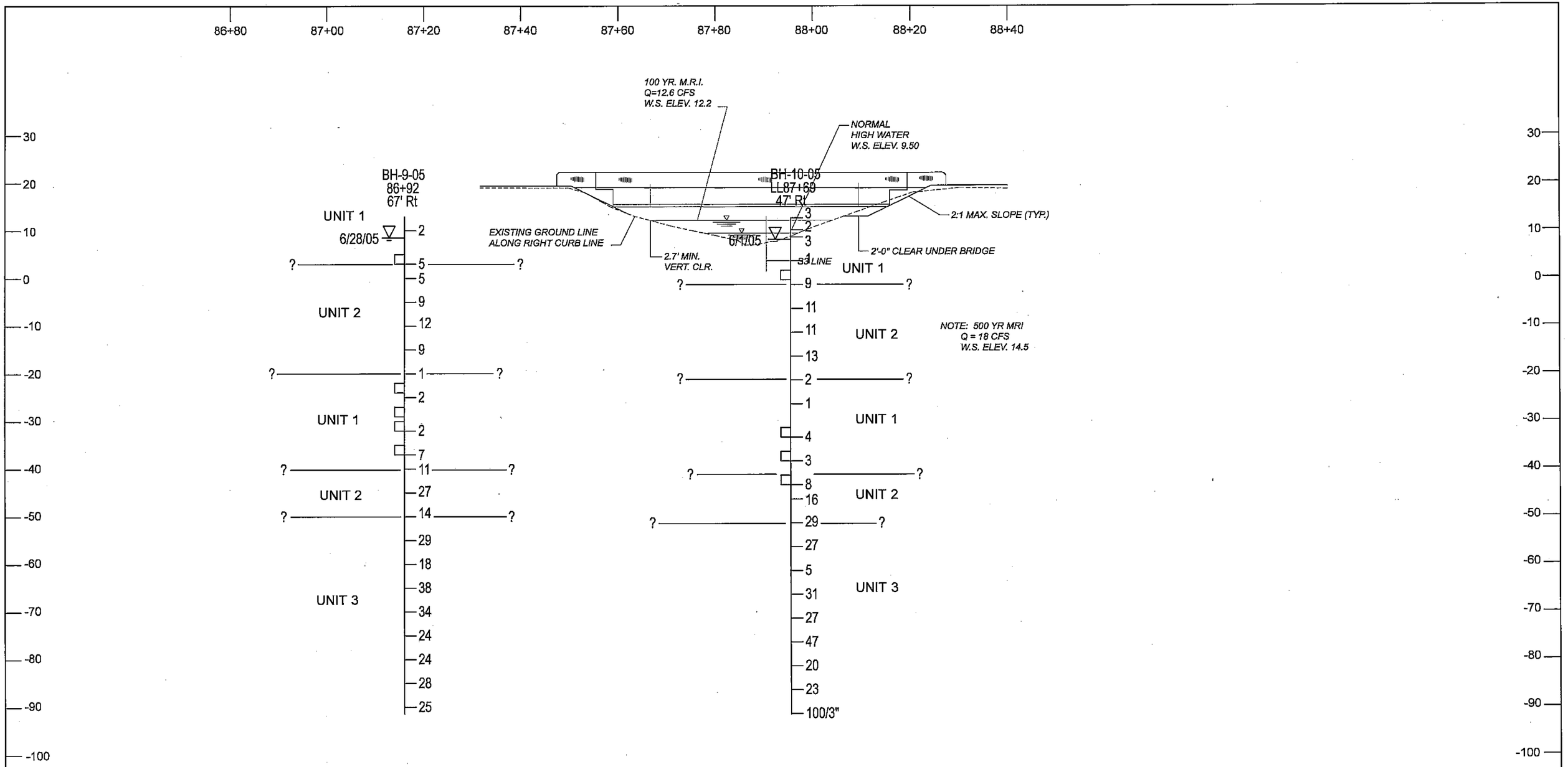
Figure 9: Plan

JOB OL-3485 S.R. 20 C.S. _____

SR 20 Fredonia to I-5
SR 20 Over Higgins Slough
Bridge #20/220S

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

DATE 9/2005
SCALE 1=20' VERT.
1=20' HORIZ.
SHEET ____ OF ____
DRAWN BY WM



TEST HOLE LEGEND

H-1-98 TEST HOLE NUMBER
110+55 TEST HOLE STATION
26 ft.Rt. TEST HOLE OFFSET

23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)
UNDISTURBED SAMPLE
8-6-86 WATER LEVEL & DATE
? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
INDICATES INTACT ROCK
86% INDICATES CORE SAMPLE TAKEN
ROCK QUALITY DESIGNATION

DATUM
NAVD 1988

UNIT 1: Very loose, SILT to sandy SILT.

UNIT 2: Loose to medium dense, poorly graded SAND with gravel to silty SAND

UNIT 3: Dense to very dense, poorly graded SAND with gravel and silt to well graded GRAVEL with sand.

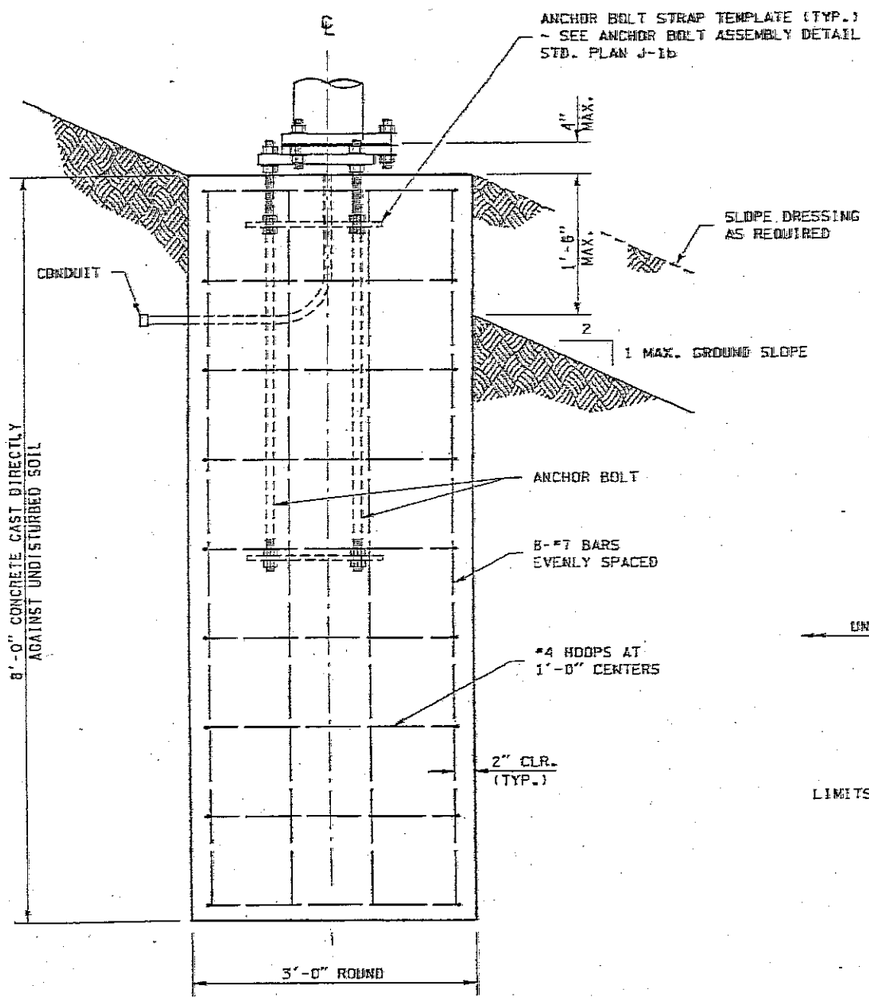
Figure 10: Profile

JOB OL-3485 S.R. 20 C.S. _____

SR 20 Fredonia to I-5
SR 20 Over Higgins Slough
Bridge #20/220S

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY
T. E. BAKER STATE MATERIALS ENGINEER

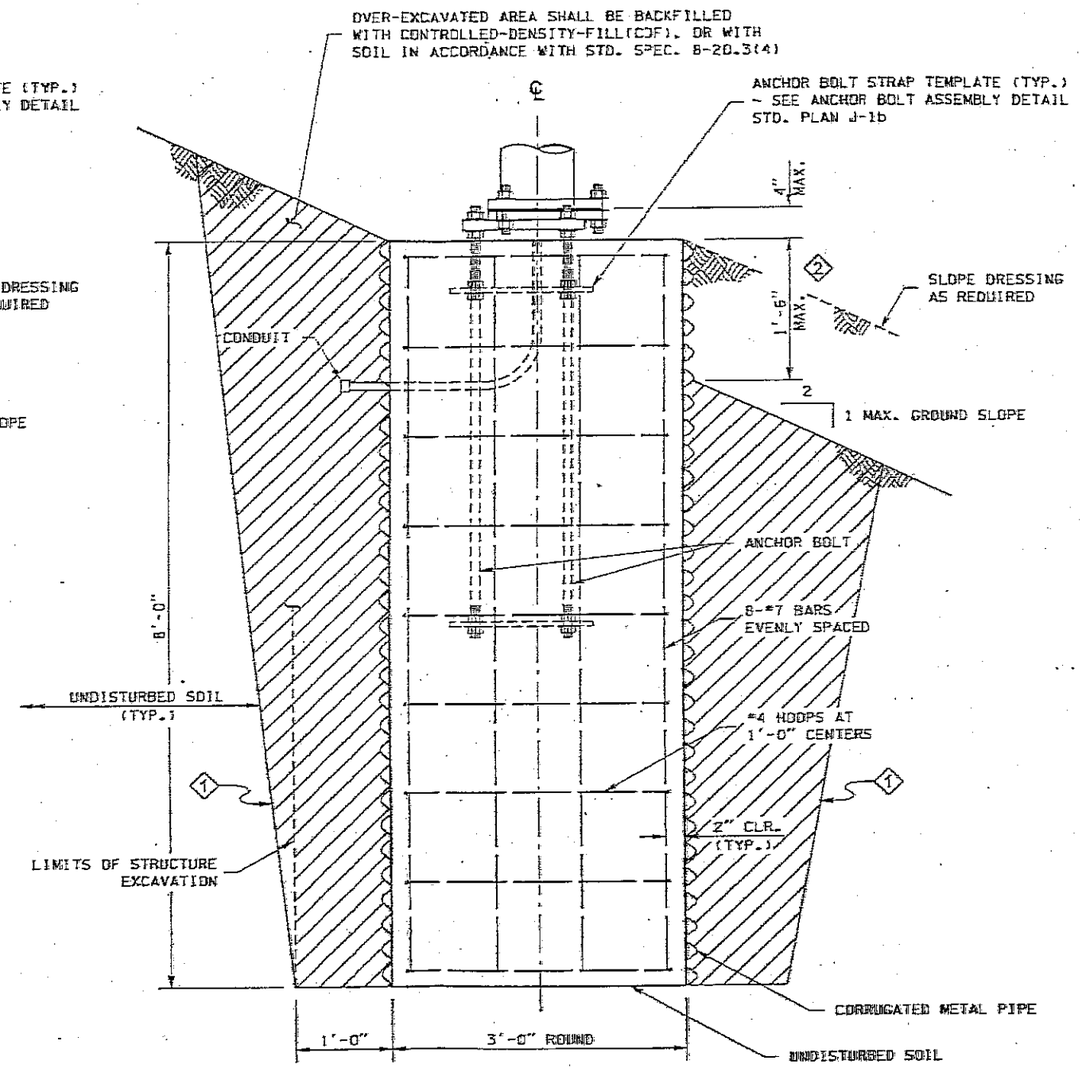
DATE 9/2005
SCALE 1=20' VERT.
1=20' HORIZ.
SHEET ___ OF ___
DRAWN BY WM



FOUNDATION REINFORCEMENT DETAIL

CONCRETE CAST DIRECTLY AGAINST UNDISTURBED SOIL

ALTERNATE # 1



FOUNDATION REINFORCEMENT AND BACKFILL DETAIL

CONCRETE CAST INSIDE CORRUGATED METAL PIPE STAY-IN-PLACE FORM.
PAPER OR CARDBOARD FORM SHALL NOT BE USED BENEATH THE GROUND SURFACE. 2

ALTERNATE # 2

1 TEMPORARY SLOPE OR SHORE AS REQUIRED

2 ANY EXPOSED TOP PORTION (1'-6" MAX.) OF THE FOUNDATION SHALL BE FORMED TO CREATE A SMOOTH CONCRETE SURFACE. ALL FORMING SHALL BE REMOVED UPON COMPLETION OF FOUNDATION CONSTRUCTION.

NOTES

1. See Standard Plan J-1b for anchor bolt, slip base, fixed base, and anchor bolt orientation details not shown.
2. Strap templates shall be held in place by nuts and a 4"x 3/8" square washer, 6" from the top of the foundation and 3" from the bottom of the anchor bolts. The square washer shall be placed between the bottom nut and the strap template. 12 nuts and 6 washers required per fdn.
3. These foundations are designed for a minimum of 1,500 PSF allowable lateral bearing pressure for the soil. A special foundation shall be required for soil with lower allowable lateral bearing pressure than 1,500 PSF.
4. These foundations are designed for installation on level ground, or on sloping ground not to exceed 2:1. Slopes steeper than 2:1 require a special design.
5. Slip bases are not required on poles outside of the Design Clear Zone, nor on poles installed behind traffic barrier at an offset which exceeds the deflection distance of the barrier system.
6. Light standard pole height shall not exceed 50'.
7. Installation of 50' pole with double mast arms on a slip base is not allowed.
8. For installation of a 50' pole with 12'-0" max. double mast arms on a fixed base, the foundation shall be 8'-0" deep; for anchor bolts see Standard Plan J-1b.
9. For foundations within the Design Clear Zone, the slip base shall be within 4" above the ground surface.
10. See Std. Plan C-8b for base plate and foundation requirements when light standards are mounted on conc. barrier.
11. Foundation constructed within Ecology Embankments shall be increased in depth by the depth of the Ecology Embankment.

Figure 11: Standard Plan Luminaire Foundation

FILE NAME	LightStandardFoundationPlan				REGION NO.	STATE	FED.AID PROJ.NO.			PLOT1
TIME	$TIME$				10	WASH				
DATE	$$$$DATE$$$				JOB NUMBER					
PLOTTED BY	$$USERNAME$$									
DESIGNED BY					CONTRACT NO.		LOCATION NO.			SHEET OF SHEETS
ENTERED BY										
CHECKED BY										
PROJ. ENGR.										
REGIONAL ADM.		REVISION	DATE	BY						

GURU KUMAR S. BEDI, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER, EXPIRES AUGUST 08, 2007 — 2/1/06 DATE

RICHARD P. ZELDENBERG, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER, EXPIRES NOVEMBER 14, 2006 — 2/1/06 DATE

Washington State Department of Transportation

APPENDIX B - FIELD EXPLORATIONS

FIELD EXPLORATIONS

Geotechnical drilling for the exploratory borings was performed using CME 45 skid-mounted, CME 55 truck mounted and CME 850 track mounted drill rigs. Test holes were advanced to a maximum depth of 115 feet below the ground surface using mud rotary drilling methods. At each location, soil samples were obtained using a SPT (Standard Penetration Test) sampler, in general accordance with ASTM D-1586. SPTs are obtained by driving a 2-inch OD, 1.4-inch ID split-spoon sampler 18-inches into the soil with a 140-pound hammer. The number of blows required to achieve each 6 inches of penetration is recorded and the soil's SPT resistance, or N-value, is calculated as the number of blows required to achieve the final 12 inches of penetration. Each drill rig is equipped with an automatic trip hammer to drive the split-spoon sampler.

In addition to the SPT samples, relatively undisturbed samples were taken by pushing Washington undisturbed liners or Shelby tubes where appropriate.

Select soil samples were then submitted to the OSC Materials Laboratory for laboratory testing.

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Washington State
Department of Transportation

Test Boring Legend

Sampler Symbols

	Standard Penetration Test
	Oversized Penetration Test (Dames & Moore, California)
	Shelby Tube
P	Piston Sample
	Washington Undisturbed
	Vane Shear Test
	Core
	Becker Hammer
B	Bag Sample

Well Symbols

	Cement Surface Seal
	Piezometer Pipe in Granular Bentonite Seal
	Piezometer Pipe in Sand
	Well Screen in Sand
	Granular Bentonite Bottom Seal
	Inclinometer Casing in Concrete Bentonite Grout

Laboratory Testing Codes

UU	Unconsolidated Undrained Triaxial
CU	Consolidated Undrained Triaxial
CD	Consolidated Drained Triaxial
UC	Unconfined Compression Test
DS	Direct Shear Test
CN	Consolidation Test
GS	Grain Size Distribution
MC	Moisture Content
SG	Specific Gravity
OR	Organic Content
DN	Density
AL	Atterberg Limits
PT	Point Load Compressive Test
SL	Slake Test
DG	Degradation
LA	LA Abrasion
HT	Hydrometer Test

Soil Density Modifiers

Gravel, Sand & Non-plastic Silt		Elastic Silts and Clay	
SPT Blows/ft	Density	SPT Blows/ft	Consistency
0-4	Very Loose	0-1	Very Soft
5-10	Loose	2-4	Soft
11-24	Medium Dense	5-8	Medium Stiff
25-50	Dense	9-15	Stiff
>50	Very Dense	16-30	Very Stiff
		31-60	Hard
		>60	Very Hard

Angularity of Gravel & Cobbles

Angular	Coarse particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Coarse grained particles are similar to angular but have rounded edges.
Subrounded	Coarse grained particles have nearly plane sides but have well rounded corners and edges.
Rounded	Coarse grained particles have smoothly curved sides and no edges.

Soil Moisture Modifiers

Dry	Absence of moisture; dusty, dry to touch
Moist	Damp but no visible water
Wet	Visible free water

Soil Structure

Stratified	Alternating layers of varying material or color at least 6mm thick; note thickness and inclination.
Laminated	Alternating layers of varying material or color less than 6mm thick; note thickness and inclination.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, somtimes striated.
Blocky	Cohesive soil that can be broken down into smaller angular lumps which resist further breakdown.
Disrupted	Soil structure is broken and mixed. Infers that material has moved substantially - landslide debris.
Homogeneous	Same color and appearance throughout.

HCL Reaction

No HCL Reaction	No visible reaction.
Weak HCL Reaction	Some reaction with bubbles forming slowly.
Strong HCL Reaction	Violent reaction with bubbles forming imediately.

Degree of Vesicularity of Pyroclastic Rocks

Slightly Vesicular	5 to 10 percent of total
Moderately Vesicular	10 to 25 percent of total
Highly Vesicular	25 to 50 percent of total
Scoriaceous	Greater than 50 percent of total

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Washington State
Department of Transportation

Test Boring Legend

Grain Size

Fine Grained	< 1mm	Few crystal boundaries/grains are distinguishable in the field or with hand lens.
Medium Grained	1mm to 5mm	Most crystal boundaries/grains are distinguishable with the aid of a hand lens.
Coarse Grained	> 5mm	Most crystal boundaries/grains are distinguishable with the naked eye.

Weathered State

Term	Description	Grade
Fresh	No visible sign of rock material weathering; perhaps slight discoloration in major discontinuity surfaces.	I
Slightly Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than its fresh condition.	II
Moderately Weathered	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as core stones.	III
Highly Weathered	More than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as discontinuous framework or as core stone.	IV
Completely Weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.	V
Residual Soil	All rock material is converted to soil. The mass structure and material fabric is destroyed. There is a large change in volume, but the soil has not been significantly transported.	VI

Relative Rock Strength

Grade	Description	Field Identification	Uniaxial Compressive Strength approx
R1	Very Weak	Specimen crumbles under sharp blow from point of geological hammer, and can be cut with a pocket knife.	150-3500 psi
R2	Moderately Weak	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	3500-7500 psi
R3	Moderately Strong	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer.	7500-15000 psi
R4	Strong	Specimen breaks with one firm blow from the hammer end of a geological hammer.	15000-30000 psi
R5	Very Strong	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 30000 psi

Discontinuities

Spacing	
Very Widely	Greater than 3 m
Widely	1 m to 3 m
Moderately	0.3 m to 1 m
Closely	50 mm to 300 mm
Very Closely	Less than 50 mm

RQD (%)

$$\frac{100(\text{length of core in pieces} > 100\text{mm})}{\text{Length of core run}}$$

Condition	
Excellent	Very rough surfaces, no separation, hard discontinuity wall
Good	Slightly rough surfaces, separation less than 1 mm, hard discontinuity wall.
Fair	Slightly rough surfaces, separation greater than 1 mm, soft discontinuity wall.
Poor	Slickensided surfaces, or soft gouge less than 5 mm thick, or open discontinuities 1 to 5 mm.
Very Poor	Soft gouge greater than 5 mm thick, or open discontinuities greater than 5 mm.

Fracture Frequency (FF) is the average number of fractures per 300 mm of core.
Does not include mechanical breaks caused by drilling or handling.

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22725

HOLE No. BH-01-05

Job No. OL-3485 SR 20 Elevation 13.5 ft

Sheet 1 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Robert Shepard Lic# 2710 T

Site Address Vic. SR 20 & SR 536

Inspector James Fetterly

Start May 19, 2005 Completion May 20, 2005 Well ID# Equipment CME 55 w/ autohammer

Station LL 27+53 Offset 26' Lt Hole Dia (inches) 4" Method Wet Rotary

Northing Easting Latitude Longitude

County Skagit Subsection SW/SE Section 19 Range 3 EWM Township 34 N

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	13.0							
	12.0							
	11.0							
	10.0							
	9.0	2 1 2 (3)		D-1	GS MC	ML, MC=33% SILT, contains organics and FeO stains, very loose, grey, moist, Laminated, HCl reaction not tested Length Recovered 1.2 ft, Length Retained 1.2 ft		
5	8.0						▽ 05/20/2005	
	7.0							
	6.0							
	5.0							
	4.0	6 7 9 (16)		D-2	GS MC	SM, MC=24% Silty SAND, medium dense, grey, moist, Homogeneous, HCl reaction not tested, trace FeO stains Length Recovered 1.2 ft, Length Retained 1.2 ft		
10	3.0							
	2.0							
	1.0							
	0.0							
	-1.0	7 4 2 (6)		D-3		Silty SAND, loose, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.2 ft, Length Retained 1.2 ft		
15	-2.0							
	-3.0							
	-4.0							
	-5.0							
	-6.0	2 12		D-4		Silty SAND, dense, grey, moist, Homogeneous, HCl reaction not reported, gravel is subrounded.		
20								

SOILA 01-3485 SR 20 FREDONIA TO I-5 WIDENING.GPJ SOIL.GDT 6/14/06 8:08:07 A6

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22725

HOLE No. BH-01-05

Job No. OL-3485 SR 20 Elevation 13.5 ft (4.1 m)

Sheet 2 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Robert Shepard Lic# 2710 T

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		15 (27)				Length Recovered 1.2 ft, Length Retained 1.2 ft		
25	-10	10 13 13 (26)		D-5		Silty SAND, dense, grey, moist, Homogeneous, HCl reaction not tested, gravel is subrounded Length Recovered 1.2 ft, Length Retained 1.2 ft		
30	-15	4 9 11 (20)		D-6	GS MC	SW, MC=13% Well graded SAND with gravel, medium dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
35	-20	7 12 14 (26)		D-7	GS MC	(34-34.3')SP-SM, MC=82% Poorly graded SAND with silt (34.3')SP-SM, MC=19% Poorly graded SAND with silt, dense, grey, wet, Stratified, HCl reaction not tested, gravel is subrounded. Length Recovered 1.5 ft, Length Retained 1.5 ft		
40	-25	7 10 14 (24)		D-8		Poorly graded SAND with silt, medium dense, grey, moist, Homogeneous, HCl reaction not tested, gravel is subrounded Length Recovered 1.5 ft, Length Retained 1.5 ft		
45	-30	9 10 13 (23)		D-9	GS MC	SP-SM, MC=20% Poorly graded SAND with silt, medium dense, grey, moist, Homogeneous, HCl reaction not tested, gravel is subrounded		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22725

HOLE No. BH-01-05

Job No. OL-3485 SR 20 Elevation 13.5 ft (4.1 m)

Sheet 3 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Robert Shepard Lic# 2710 T

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
						Length Recovered 1.2 ft, Length Retained 1.2 ft		
	-35	3 8 11 (19)		D-10	GS MC	SM, MC=26% Silty SAND, medium dense, grey, wet, Stratified, HCl reaction not tested, top 0.7' silty sand. bottom 0.8' poorly graded sand. Length Recovered 1.5 ft, Length Retained 1.5 ft		
50								
	-40	3 3 2 (5)		D-11	GS MC	SM, MC=27% Silty SAND, loose, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.5 ft		
55								
						ML, MC=48%, LL=42, PI=NP SILT, contains organic material, medium dense, grey, moist, Laminated, HCl reaction not tested, silt boundary at 57'. Moisture tin retained.		
	-45	3 3 3 (6)		D-12	GS MC AL	Length Recovered 1.5 ft, Length Retained 1.5 ft		
60				S-13		SILT, loose, grey, moist, Stratified, HCl reaction not tested, pushed easy to 1.0', refusal. silt with organics on top, sand on bottom. Length Recovered 1.0 ft, Length Retained 1.0 ft		
		3 4 9 (13)		D-14	GS MC	SM, MC=27% Silty SAND, medium dense, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.2 ft, Length Retained 1.2 ft		
	-50	4 4 4 (8)		D-15	GS MC AL	CL, MC=15%, PI=13 Sandy lean CLAY, medium stiff, greenish grey, moist, Stratified, HCl reaction not tested, Top 0.2' Silty sand/grey; next 0.4' silt/dk. brown; next 0.3' well graded gravel with sand/grey; next 0.7' silt/greenish grey. Length Recovered 1.5 ft, Length Retained 1.5 ft		
65								
	-55	4 4 5 (9)		D-16	GS MC AL	CL, MC=33%, PI=22 Lean CLAY, contains organics, stiff, greenish grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.5 ft		
70								

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22725

HOLE No. BH-01-05

Job No. OL-3485 SR 20 Elevation 13.5 ft (4.1 m)

Sheet 4 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Robert Shepard Lic# 2710 T

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	-60	0 2 1 (3)		U-17 A D-18 B		Elastic SILT, contains organics, stiff, grey, moist, Homogeneous, HCl reaction not tested, small layer of gravel caused refusal. Length Recovered 0.5 ft, Length Retained 0.5 ft		
75						Lean CLAY, soft, greenish grey, moist, Laminated, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.5 ft		
				S-19		Elastic SILT, soft, greenish grey, moist, Homogeneous, HCl reaction not tested, pushed easy Length Recovered 2.0 ft, Length Retained 2.0 ft		
	-65	1 1 1 (2)		D-20	GS MC AL	CL, MC=36%, PI=18 Lean CLAY, soft, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.5 ft		
80				S-21		No Recovery		
		1 1 1 (2)		D-22	GS MC	SW-SM, MC=24% Well graded SAND with silt, very loose, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.3 ft, Length Retained 0.3 ft		
	-70	9 10 9 (19)		D-23	GS MC AL	CL, MC=24%, PI=10 Lean CLAY with gravel, very stiff, grey, wet, Homogeneous, HCl reaction not tested, gravel is subangular. gravel contact (small layer) at 83.0' Length Recovered 1.5 ft, Length Retained 1.5 ft		
85								
	-75	1 1 3 (4)		D-24	GS MC AL	CL, MC=31%, PI=15 Lean CLAY, soft, grey, moist, Homogeneous, HCl reaction not tested, Moisture tin retained Length Recovered 1.5 ft, Length Retained 1.5 ft		
90				U-25 A thru F		SILT, very loose, grey, moist, Homogeneous, HCl reaction not tested, soft push Length Recovered 2.0 ft, Length Retained 2.0 ft		
	-80	32 36 18 (54)		D-26	GS MC	ML, MC=19% Sandy SILT, very dense, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.5 ft		
95								

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22725

HOLE No. BH-01-05

Job No. OL-3485 SR 20 Elevation 13.5 ft (4.1 m)

Sheet 5 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Robert Shepard Lic# 2710 T

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	-85			6 4 4 (8)		D-27	GS MC	SM, MC=15% Silty SAND, loose, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft, Length Retained 0.4 ft		
100										
	-90			6 6 5 (11)		D-28	GS MC	SM, MC=11% Silty SAND with gravel, medium dense, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.5 ft		
105										
	-95			21 18 13 (31)		D-29		Silty SAND with gravel, dense, grey, moist, Homogeneous, HCl reaction not tested, gravel is subrounded Length Recovered 1.2 ft, Length Retained 1.2 ft		
110										
	-100			16 16 25 (41)		D-30		Silty SAND with gravel, dense, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.2 ft, Length Retained 1.2 ft		
115								End of test hole boring at 115 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	-105									
120										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65972

HOLE No. BH-02-05

Job No. OL-3485 SR 20 Elevation 14.1 ft

Sheet 1 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Robert Shepard Lic# 2710 T

Site Address Vic. SR 20 & SR 536

Inspector James Fetterly

Start May 23, 2005 Completion May 24, 2005 Well ID# AHN-955

Equipment CME 55 w/ autohammer

Station LL 28+28 Offset 30' Lt Hole Dia (inches) 4"

Method Wet Rotary

Northing Easting Latitude Longitude

County Skagit Subsection SW/SE Section 9 Range 3 EWM Township 34 N

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	13.0									
	12.0									
	11.0									
	10.0									
5	9.0			2 2 2 (4)		D-1	GS MC	ML, M.C. = 43% SILT, very loose, brownish grey, wet, Homogeneous, HCl reaction not tested, FeO stains throughout Length Recovered 0.3 ft, Length Retained 0.3 ft		
	8.0									
	7.0									
	6.0									
	5.0									
10	4.0			4 5 6 (11)		D-2	GS MC	SM, M.C. = 29% Silty SAND, medium dense, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft 05/24/2005		
	3.0									
	2.0									
	1.0									
	0.0									
15	-1.0			7 5 3 (8)		D-3	GS MC	SM, M.C. = 25% Silty SAND, contains trace organics, loose, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.8 ft, Length Retained 0.8 ft		
	-2.0									
	-3.0									
	-4.0									
	-5.0			3		D-4		Silty SAND, medium dense, grey, moist, Stratified, HCl		
20										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65972

HOLE No. BH-02-05

Job No. OL-3485 SR 20 Elevation 14.1 ft (4.3 m)

Sheet 2 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Robert Shepard Lic# 2710 T

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				7 9 (16)				reaction not tested, stratified with sandy SILT Length Recovered 1.0 ft, Length Retained 1.0 ft		
	-10			1 4 9 (13)		D-5	GS MC	SM, M.C. = 30% Silty SAND, medium dense, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
25										
	-15			6 9 13 (22)		D-6	GS MC	SM, M.C. = 19% Silty SAND, medium dense, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.1 ft, Length Retained 1.1 ft		
30										
	-20			9 12 11 (23)		D-7		Silty SAND, medium dense, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.3 ft, Length Retained 1.3 ft		
35										
	-25			6 11 9 (20)		D-8	GS MC	SP-SM, M.C. = 20% Poorly graded SAND with silt, medium dense, grey, moist, Stratified, HCl reaction not tested, one 3" stratum of subangular gravel interbedded in sand. The rest of the sample contains sparse subangular gravel throughout. Length Recovered 1.0 ft, Length Retained 1.0 ft		
40										
	-30			10 12		D-9		Poorly graded SAND with silt, dense, grey, moist, Stratified, HCl reaction not tested, gravel is subangular.		
45										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65972

HOLE No. BH-02-05

Job No. OL-3485 SR 20 Elevation 14.1 ft (4.3 m)

Sheet 3 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Robert Shepard Lic# 2710 T

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		15 (27)				Length Recovered 1.0 ft, Length Retained 1.0 ft		
50	-35	8 6 5 (11)		D-10	GS MC	SM, M.C. = 26% Silty SAND, medium dense, grey, moist, Stratified, HCl reaction not tested, bottom 0.5' is non-elastic silt and clay. Length Recovered 0.9 ft, Length Retained 0.9 ft		
55	-40	4 1 1 (2)		D-11	GS MC	SM, M.C. = 30% Silty SAND, very loose, grey, moist, Stratified, HCl reaction not tested. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	-45			S-12		No Recovery		
60		3 3 6 (9)		D-13		Silty SAND, contains organics, loose, grey, moist, Stratified, HCl reaction not tested, interbedded with 2" strata of non-elastic clay. Bottom 2" contained brown-grey silt with organic material. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	-50							
65		3 5 7 (12)		D-14	GS MC AL	CL, M.C. = 23%, PI = 12 Lean CLAY with sand, stiff, grey, moist, Homogeneous, HCl reaction not tested, gravel is angualr to sub-angular. Moisture tin retained. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	-55							
70								

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65972

HOLE No. BH-02-05

Job No. OL-3485 SR 20 Elevation 14.1 ft (4.3 m)

Sheet 4 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Robert Shepard Lic# 2710 T

Field SPT (N) / Moisture Content / RQD — 20 40 60 80

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		2 3 4 (7)		D-15	GS MC AL	CH, M.C. = 39%, PI = 25 Fat CLAY, medium stiff, brown to greenish grey, moist, Homogeneous, HCl reaction not tested, grain size = clay. non-elastic. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	-60							
75		0 0 3 (3)		D-16	GS MC AL	CL, M.C. =31%, PI = 18 Lean CLAY, soft, greenish grey, moist, Homogeneous, HCl reaction not tested, Length Recovered 1.5 ft, Length Retained 1.5 ft		
				S-17		No Recovery		
	-65							
80		0 0 0 (0)		D-18	GS MC AL	CL, M.C. =31%, PI = 20 Lean CLAY, very soft, greenish grey, moist, Homogeneous, HCl reaction not tested, moisture tin retained. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	-70	0 1 5 (6)		D-19		Lean CLAY, medium stiff, greenish grey, moist, Homogeneous, HCl reaction not tested, moisture tin retained. high plasticity. Length Recovered 1.5 ft, Length Retained 1.5 ft		
85								
	-75	1 2 1 (3)		D-20	GS MC AL	ML, M.C. = 41%, LL = 27, PI = NP SILT, very loose, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.5 ft		
90								
	-80	7 6 11 (17)		D-21	GS MC AL	CL-ML, M.C. = 19%, PI = 7 Sandy Silty CLAY, very stiff, grey, moist, Stratified, HCl reaction not tested, top 0.4' = silt with sand bottom 0.5' = fine sand with subrounded gravel		
95								

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65972

HOLE No. BH-02-05

Job No. OL-3485 SR 20 Elevation 14.1 ft (4.3 m)

Sheet 5 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Robert Shepard Lic# 2710 T

◆ Field SPT (N)
✚ Moisture Content
▨ RQD

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								Length Recovered 0.9 ft, Length Retained 0.9 ft		
	-85		✚ ◆	6 28 22 (50)		D-22	GS MC	SM, M.C. = 19% Silty SAND with gravel, dense, grey, moist, Homogeneous, HCl reaction not tested, gravel is subrounded Length Recovered 0.9 ft, Length Retained 0.9 ft		
100										
	-90		✚ ◆	14 20 28 (48)		D-23	GS MC	ML, M.C. = 17% Sandy SILT, dense, grey, moist, Homogeneous, HCl reaction not tested, gravel is subrounded. contains 5% gravel. Length Recovered 1.2 ft, Length Retained 1.2 ft		
105								End of test hole boring at 105 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	-95									
110										
	-100									
115										
	-105									
120										

SOILA OL-3485 SR 20 FREDONIA TO I-5 WIDENING.GPJ SOIL.GDT 6/14/06 8:08:10 A6

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65972

HOLE No. BH-03-05

Job No. OL-3485 SR 20 Elevation 13.0 ft

Sheet 1 of 5

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

Site Address Vic. SR 20 & SR 536

Inspector Don Nebgen

Start May 4, 2005 Completion May 4, 2005 Well ID# AHN-957

Equipment CME 45 w/ autohammer

Station LL 28+10 Offset 80' Rt Hole Dia (inches) 4"

Method Wet Rotary

Northing Easting Latitude Longitude

County Skagit Subsection SW/SE Section 9 Range 3 EWM Township 34 N

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								From the ground surface to 2.0 feet silty SAND		
	12.0									
	11.0							2.0 to12.5 feet appears to be debris- loose gravel, cobbles, logs etc. drilled through one log from 8.5 feet to 12 feet.		
	10.0									
	9.0									
5	8.0		◆	2 1 2 (3)		D-1		No Recovery		
	7.0									
	6.0									
	5.0								▽ 05/05/2005	
	4.0		◆	7 13 15 (28)		D-2		Wood, very stiff, brown, moist, Disrupted, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
10	3.0									
	2.0									
	1.0									
	0.0									
	-1.0		✚			U-3	GS MC AL	ML, MC=58%, PI=NA SILT with sand and wood chunks, fine grained		
15	-2.0									
	-3.0		◆✚	3 5 5 (10)		D-4	GS MC	SM, MC=17% Silty SAND with gravel, loose, grey, wet, Homogeneous, no HCl reaction Length Recovered 1.1 ft, Length Retained 1.1 ft		
	-4.0									
	-5.0									
	-6.0		◆	1		D-5		Well graded SAND with gravel, loose, grey, wet,		
20	-7.0									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65972

HOLE No. BH-03-05

Job No. OL-3485 SR 20 Elevation 13.0 ft (4.0 m)

Sheet 2 of 5

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				2 4 (6)				Homogeneous, no HCl reaction Length Recovered 0.5 ft, Length Retained 0.5 ft		
	-10									
25				4 9 10 (19)		D-6	GS MC	SW-SM, MC=10% Well graded SAND with silt, medium dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 0.7 ft, Length Retained 0.7 ft		
	-15									
30				3 6 7 (13)		D-7		Poorly graded SAND, medium dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
	-20									
35				8 9 11 (20)		D-8	GS MC	SW-SM, MC=23% Well graded SAND with silt, medium dense, grey, moist, Laminated, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
	-25									
40				5 9 10 (19)		D-9		Well graded SAND, medium dense, grey, moist, Laminated, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
	-30									
45				5 11		D-10	GS MC	SP-SM, MC=24% Poorly graded SAND with silt, medium dense, grey,		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65972

HOLE No. BH-03-05

Job No. OL-3485 SR 20 Elevation 13.0 ft (4.0 m)

Sheet 3 of 5

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		13 (24)				moist, Homogeneous, no HCl reaction Length Recovered 1.4 ft, Length Retained 1.2 ft		
	-35							
50		9 10 10 (20)		D-11	GS MC	SP-SM, MC=28% Poorly graded SAND with silt, medium dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.1 ft, Length Retained 1.1 ft		
	-40							
55		5 7 8 (15)		D-12		Poorly graded SAND, medium dense, grey, moist, Stratified, no HCl reaction Length Recovered 1.4 ft, Length Retained 1.3 ft		
	-45							
60		5 8 9 (17)		D-13	GS MC	SM, MC=32% Silty SAND, medium dense, grey, moist, Stratified, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.3 ft		
	-50							
65		4 6 7 (13)		D-14		Poorly graded SAND with silt lamina, medium dense, grey, moist, Stratified, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.4 ft		
	-55							
70		4 6		D-15	GS MC	CH, MC=63%, PI=28 Fat CLAY, stiff, brownish grey, moist, Laminated, no HCl		

SOILA OL-3485 SR 20 FREDONIA TO I-5 WIDENING.GPJ SOIL.GDT 6/14/06,8:08:11 A6

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65972

HOLE No. BH-03-05

Job No. OL-3485 SR 20 Elevation 13.0 ft (4.0 m)

Sheet 4 of 5

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		8 (14)			AL	reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
	-60							
75		2 2 2 (4)		D-16	GS MC AL	CH, MC=40%, PI=31 Fat CLAY, soft, brownish grey, moist, Stratified, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
	-65							
80		1 1 1 (2)		D-17	GS MC AL	CL, MC=29%, PI=18 Lean CLAY, soft, grey, moist, Laminated, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
				U-18 A thru F	GS MC AL CN UU	CH, MC=37%, PI=27 at 81.8' for U-18/c CL, MC=33%, PI=15 at 82.5' for U-18/e Lean CLAY, soft, grey, moist, Laminated, no HCl reaction Length Recovered 2.0 ft, Length Retained 1.8 ft		
	-70							
85		1 5 4 (9)		D-19	GS MC AL	CL-ML, MC=26%, PI=7% Silty CLAY, stiff, grey, moist, Laminated, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.4 ft		
	-75							
90		8 12 12 15 (24)		D-20	GS MC AL	ML, MC=24%, PI=NA SILT, medium dense, grey, moist, Stratified, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
	-80							
95		1 3		D-21	GS MC	CL, MC=22%, PI=12 Lean CLAY with sand, medium stiff, grey, moist,		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65972

HOLE No. BH-03-05

Job No. OL-3485 SR 20 Elevation 13.0 ft (4.0 m)

Sheet 5 of 5

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

◆ Field SPT (N)
✚ Moisture Content
▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		2 (5)			AL	Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.2 ft		
	-85	28 24 25 (49)		D-22		Sandy SILT with gravel, dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.4 ft, Length Retained 1.4 ft		
100	-90	20 28 34 (62)		D-23		Well graded SAND with gravel, very dense, grey, moist, Stratified, no HCl reaction Length Recovered 1.4 ft, Length Retained 1.4 ft		
105	-95	13 24 30 (54)		D-24		Poorly graded SAND with laminae sandy silt., very dense, grey, moist, Stratified, no HCl reaction Length Recovered 1.4 ft, Length Retained 1.4 ft		
110	-100					End of test hole boring at 110.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. Piezo installed water level 1st. reading 9:15 am 5-5-05, 8.6' ground surface		
115	-105							
120								

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-22725

HOLE No. BH-04-05

Sheet 1 of 5

Job No. OL-3485 SR 20 Elevation 10.0 ft

Project SR-20 Fredonia to I-5 Widening

Driller Brian Hilts Lic# 2249

Site Address Vic of SR 20 & Airport Rd.

Inspector Dave Nelson

Start June 14, 2005 Completion June 15, 2005 Well ID# Equipment CME 850 w/ autohammer

Station LL 29+60 Offset 100' Rt Hole Dia (inches) HQ x 109&HWT x 62 Method Wet Rotary

Northing Easting Latitude Longitude

County Skagit Subsection SW 1/4 of Se 1/4 Section 9 Range 3 EWM Township 34 N

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				2 2 2 (4)		D-1		Silty SAND with gravel, very loose, light brown, dry, Homogeneous, no HCl reaction Length Recovered 0.6 ft		
	9.0									
	8.0									
				3 3 4 (7)		D-2		Silty SAND, loose, grayish brown, dry, Homogeneous, no HCl reaction Length Recovered 0.8 ft		
	7.0									
	6.0			2 2 3 (5)		D-3	GS MC	SM, MC=29% Silty SAND, mottled, loose, grayish brown, moist, Homogeneous, no HCl reaction Length Recovered 0.8 ft		
5	5.0									
	4.0									
	3.0									
	2.0									
	1.0			3 5 5 (10)		D-4	GS MC	SP, MC=23% Poorly graded SAND, loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
10	0.0									
	-1.0									
	-2.0									
	-3.0									
	-4.0			1 0 1 (1)		D-5	GS MC	ML, MC=37%, PI=NA Sandy SILT with organics, very loose, dark grey, wet, Stratified, no HCl reaction Length Recovered 1.0 ft		
15	-5.0									
	-6.0									
	-7.0									
	-8.0									
	-9.0			4 6		D-6		Silty SAND with organics, medium dense, dark grey, wet, Homogeneous, no HCl reaction		
20	-10.0									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22725

HOLE No. BH-04-05

Job No. OL-3485 SR 20 Elevation 10.0 ft (3.0 m)

Sheet 2 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Brian Hilts Lic# 2249

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				6 (12)				Length Recovered 1.0 ft		
25	-15			2 3 8 (11)		D-7	GS MC AL	SP-SM, MC=19% Poorly graded SAND with silt, medium dense, dark grey, wet, Stratified, no HCl reaction Length Recovered 1.0 ft		
30	-20			7 10 13 (23)		D-8		Silty SAND, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
35	-25			5 10 12 (22)		D-9	GS MC	Well graded SAND, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
40	-30			3 6 12 (18)		D-10		Well graded SAND with gravel, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
45	-35			4 6		D-11	GS MC	SP-SM, MC=21% Poorly graded SAND with silt, medium dense, dark grey,		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22725

HOLE No. BH-04-05

Job No. OL-3485 SR 20 Elevation 10.0 ft (3.0 m)

Sheet 3 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Brian Hilts Lic# 2249

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				6 (12)				wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
50	-40			9 10 10 (20)		D-12		Poorly graded SAND, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
55	-45			2 4 4 (8)		D-13	GS MC AL	ML, MC=55%, LL=38 SILT, loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
60	-50			4 5 5 (10)		D-14		Silty SAND, loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
65	-55			6 6 7 (13)		D-15	GS MC AL	CL, MC=22%, PI=19 Lean CLAY with gravel, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 0.9 ft		
70	-60			2 3		D-16	GS MC	CH, MC=36%, PI=32 Fat CLAY, mottled, medium stiff, dark grey, wet,		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22725

HOLE No. BH-04-05

Job No. OL-3485 SR 20 Elevation 10.0 ft (3.0 m)

Sheet 4 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Brian Hilts Lic# 2249

◆ Field SPT (N) ✚ Moisture Content ▨ RQD (20 40 60 80)

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		3 (6)			AL	Homogeneous, no HCl reaction Length Recovered 1.0 ft		
				U-17 A B		Elastic SILT, mottled, medium stiff, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 0.8 ft		
75	-65			U-18 A B C D		Elastic SILT, medium stiff, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.4 ft		
		2 2 3 (5)		D-19	GS MC AL	CH, MC=13%, PI=26 Fat CLAY, medium stiff, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
80	-70			U-20 A B C		Elastic SILT, medium stiff, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
		2 2 3 (5)		D-21		Elastic SILT, medium stiff, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
85	-75			U-22 A B C D		Elastic SILT, medium stiff, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.4 ft		
		2 2 3 (5)		D-23		Elastic SILT, medium stiff, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
90	-80			U-24 A B C D		Elastic SILT, medium stiff, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.4 ft		
		2 2 3 (5)		D-25	GS MC AL	ML, MC=24%, LL=24 SILT, loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
95	-85	4 6		D-26	GS MC	ML, MC=21%, LL=19 SILT with sand, medium dense, dark grey, wet,		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22725

HOLE No. BH-04-05

Job No. OL-3485 SR 20 Elevation 10.0 ft (3.0 m)

Sheet 5 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Brian Hilts Lic# 2249

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				13 (19)			AL	Homogeneous, no HCl reaction Length Recovered 1.0 ft		
100	-90			9 12 28 (40)		D-27		Silty SAND with gravel, dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 0.9 ft		
105	-95			17 48 31 (79)		D-28		Silty SAND with gravel, very dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
110	-100			16 16 19 (35)		D-29		Silty SAND with gravel, dense, dark grey, wet, Homogeneous, no HCl reaction, no bail test performed, using bentonite to drill hole. Wall cake on walls will not let the water in to give a correct water reading for recharge. Length Recovered 1.0 ft		
115	-105							End of test hole boring at 110.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
120	-110									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-05-05

Job No. OL-3485 SR 20 Elevation 8.0 ft

Sheet 1 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

Site Address Vic of SR 20 & Airport Rd.

Inspector Dave Nelson

Start May 24, 2005 Completion May 25, 2005 Well ID# Equipment CME 850 w/ autohammer

Station 56+45 Offset 31' Rt. Hole Dia (inches) HQ x 109&HWT x 50 Method Wet Rotary

Northing Easting Latitude Longitude

County Skagit Subsection NW 1/4 of Sw 1/4 Section 10 Range 3 EWM Township 34 N

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	7.0			2 2 2 (4)		D-1		Silty SAND with organics and roots, very loose, dark reddish brown, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	6.0									
	5.0			2 2 2 (4)		D-2	GS MC AL	SM, MC=61%, PI=NA Silty SAND with organics, very loose, dark grey, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft	▽ 05/25/2005	
	4.0			1 1 1 (2)		D-3	GS MC	SM, MC=39% Silty SAND, very loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
5	3.0									
	2.0									
	1.0									
	0.0									
	-1.0			2 2 3 (5)		D-4	GS MC	SP, MC=23% Poorly graded SAND, loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
10	-2.0									
	-3.0									
	-4.0									
	-5.0									
	-6.0			3 4 7 (11)		D-5		Poorly graded SAND, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
15	-7.0									
	-8.0									
	-9.0									
	-10.0									
	-11.0			2 6		D-6	GS MC	SP, MC=18% Poorly graded SAND, medium dense, dark grey, wet,		
20	-12.0									

SOIL A OL-3485 SR 20 FREDONIA TO I-5 WIDENING.GPJ SOIL.GDT 6/14/06,8:08:15 A6

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-05-05

Job No. OL-3485 SR 20 Elevation 8.0 ft (2.4 m)

Sheet 2 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		8 (14)				Homogeneous, no HCl reaction Length Recovered 1.0 ft		
25	-15	4 6 9 (15)		D-7		Well graded SAND, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
30	-20	3 4 4 (8)		D-8	GS MC	SP, MC=25% Poorly graded SAND, loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
35	-25	4 4 4 (8)		D-9		Well graded SAND with gravel, loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
40	-30	4 4 5 (9)		D-10	GS MC	SP, MC=19% Poorly graded SAND, loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
45	-35	5 9		D-11		Silty SAND, medium dense, dark grey, wet, Homogeneous, no HCl reaction		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-05-05

Job No. OL-3485 SR 20 Elevation 8.0 ft (2.4 m)

Sheet 3 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		14 (23)				Length Recovered 1.0 ft		
	-40							
50		2 3 4 (7)		D-12	GS MC AL	ML, MC=48%, LL=41 SILT with organics, loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	-45							
55		4 4 7 (11)		D-13		Silty SAND with organics, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	-50							
60		4 6 8 (14)		D-14		Silty SAND, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	-55							
65		18 23 15 (38)		D-15	GS MC	GP-GM, MC=5% Poorly graded GRAVEL with silt and sand, dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 0.6 ft		
	-60							
70		9 8		D-16		Silty SAND with gravel, medium dense, dark grey, wet, Homogeneous, no HCl reaction		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-05-05

Job No. OL-3485 SR 20 Elevation 8.0 ft (2.4 m)

Sheet 4 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Profile	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			4 (13)				Length Recovered 1.0 ft		
	-65								
75			5 4 7 (11)		D-17	GS MC	SP, MC=18% Poorly graded SAND with gravel, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 0.7 ft		
	-70								
80			14 21 23 (44)		D-18		Well graded SAND with gravel, dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 0.9 ft		
	-75								
85			11 8 26 (34)		D-19		Silty SAND with gravel, dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 0.8 ft		
	-80								
90			14 16 22 (38)		D-20		Well graded SAND with gravel, dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	-85								
95									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-05-05

Job No. OL-3485 SR 20 Elevation 8.0 ft (2.4 m)

Sheet 5 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	-90									
100				10 15 20 (35)		D-21		Poorly graded SAND with gravel, dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	-95									
105				21 18 13 (31)		D-22		Silty SAND, dense, dark grey, wet, Stratified, no HCl reaction, Length Recovered 1.0 ft		
	-100									
110				20 31 40 (71)		D-23		Sandy SILT, very dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	-105							End of test hole boring at 110.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
115										
	-110									
120										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-06-05

Job No. OL-3485 SR 20 Elevation 14.2 ft

Sheet 1 of 4

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

Site Address Near junction SR-20 & Airport road.

Inspector Don Nebgen

Start May 2, 2005 Completion May 3, 2005 Well ID# Equipment CME 55 w/ autohammer

Station LL 57+11 Offset 42', Rt Hole Dia (inches) 4" Method Wet Rotary

Northing Easting Latitude Longitude

County Skaget Subsection NW/SW Section 10 Range 3 EWM Township 34 N

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14.0									
	13.0									
	12.0									
	11.0									
	10.0		◆ ✚	2 2 2 (4)		D-1	GS MC	ML, MC=28% Sandy SILT, very loose, brown, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.2 ft		
5	9.0									
	8.0									
	7.0									
	6.0									
	5.0		◆ ✚	1 4 4 (8)		D-2	GS MC	SP, MC=21% Poorly graded SAND, loose, brown - grey, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
10	4.0									
	3.0									
	2.0									
	1.0									
	0.0		◆	3 3 5 (8)		D-3		Poorly graded SAND, loose, brown-grey, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
15	-1.0									
	-2.0									
	-3.0									
	-4.0									
	-5.0		◆ ✚	3 4		D-4	GS MC	SP, MC=16% Poorly graded SAND, loose, grey, moist, Homogeneous,		
20										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-06-05

Job No. OL-3485 SR 20 Elevation 14.2 ft (4.3 m)

Sheet 2 of 4

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

Depth (ft)	Elevation (ft)	Profile	◆ Field SPT (N) ✚ Moisture Content ▨ RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				5 (9)				no HCl reaction Length Recovered 1.4 ft, Length Retained 1.2 ft		
25	-10		◆	3 6 7 (13)		D-5		Poorly graded SAND, medium dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.2 ft		
30	-15		✚	3 6 7 (13)		D-6	GS MC	SP, MC=12% Poorly graded SAND, medium dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.4 ft, Length Retained 1.2 ft		
35	-20		◆	4 5 5 (10)		D-7		Poorly graded SAND, loose, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
40	-25		◆ ✚	3 4 7 (11)		D-8	GS MC	SP, MC=27% Poorly graded SAND, medium dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
45	-30		◆ ✚	3 5		D-9	GS MC	SP, MC=25% Poorly graded SAND, medium dense, grey, moist,		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-06-05

Job No. OL-3485 SR 20 Elevation 14.2 ft (4.3 m)

Sheet 3 of 4

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		8 (13)				Stratified, no HCl reaction, stratified with poorly graded fine sand. Length Recovered 1.2 ft, Length Retained 1.2 ft		
50	-35	5 6 7 (13)		D-10		No Recovery		
55	-40	4 3 4 (7)		D-11	GS MC	ML, MC=35% SILT, very loose, grey, moist, Stratified, no HCl reaction, Volcanic Ash Length Recovered 1.4 ft, Length Retained 1.3 ft		
60	-45	7 7 14 (21)		D-12	GS MC AL	MC=89%, LL=50 Poorly graded SAND with silt strata., medium dense, grey, moist, Stratified, no HCl reaction, two sample bags sent sand, silt. Length Recovered 1.5 ft, Length Retained 1.5 ft SM, MC=10% Silty SAND with gravel		
65	-50	7 11 13 (24)		D-13	GS MC	SM, MC=20% Silty SAND, medium dense, grey, moist, Stratified, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.2 ft		
70	-55	11 12		D-14	GS MC	GP-GM, MC=5% Poorly graded GRAVEL with silt and sand, medium		

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-06-05

Job No. OL-3485 SR 20 Elevation 14.2 ft (4.3 m)

Sheet 4 of 4

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

Depth (ft)	Elevation (ft)	Profile	◆ Field SPT (N) ✚ Moisture Content ▨ RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				12 (24)				dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
	-60		◆	12 13 17 (31)		D-15		Poorly graded GRAVEL with silt and sand, dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.1 ft, Length Retained 1.1 ft		
75								End of test hole boring at 75.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	-65									
80										
	-70									
85										
	-75									
90										
	-80									
95										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card R-65971

HOLE No. BH-07-05

Job No. OL-3485 SR 20 Elevation 14.6 ft

Sheet 1 of 4

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

Site Address Near junction SR-20 & Airport road.

Inspector Don Nebgen

Start May 3, 2005 Completion May 3, 2005 Well ID# AHN-959

Equipment CME 55 w/ autohammer

Station LL 56+01 Offset 82' Rt Hole Dia (inches) 4"

Method Wet Rotary

Northing Easting Latitude Longitude

County Skaget Subsection NW/SW Section 10 Range 3 EWM Township 34 N

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14.0									
	13.0									
	12.0									
	11.0									
	10.0			3 4 4 (8)		D-1	GS MC	SM, MC=21% Silty SAND, loose, brown, moist, Stratified, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
5	9.0									
	8.0									
	7.0									
	6.0									
	5.0			1 4 5 (9)		D-2	GS MC	SP-SM, MC=27% Poorly graded SAND with silt, wood chunks, loose, brown to grey, moist, Stratified, no HCl reaction Length Recovered 1.1 ft, Length Retained 1.1 ft 05/05/05	▽	
10	4.0									
	3.0									
	2.0									
	1.0									
	0.0			2 4 6 (10)		D-3		Poorly graded SAND with silt, loose, brown and grey, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
15	-1.0									
	-2.0									
	-3.0									
	-4.0									
	-5.0			3		D-4	GS	SP, MC=23%		
20										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65971

HOLE No. BH-07-05

Job No. OL-3485 SR 20 Elevation 14.6 ft (4.5 m)

Sheet 2 of 4

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		6 8 (14)			MC	Poorly graded SAND, medium dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
25	-10	4 7 8 (15)		D-5		Poorly graded SAND with silt, medium dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
30	-15	5 6 9 (15)		D-6	GS MC	SP, MC=23% Poorly graded SAND, medium dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.3 ft, Length Retained 1.2 ft		
35	-20	0 0 1 (1)		D-7	GS MC AL	ML, MC=76%, LL=69 SILT, grass roots, very soft, grey, moist, Stratified, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft		
				U-8 A B C D E F	GS MC UU CN	ML, MC=66% SILT with wood fibers, very soft, grey, moist, Stratified, no HCl reaction Length Recovered 2.0 ft, Length Retained 1.4 ft ML, MC=50%, LL=40 SILT with wood fibres		
40	-25	0 0 3 (3)		D-9	GS MC AL	ML, MC=92%, LL=49 SILT, very loose, grey, moist, Laminated,Fissured, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.2 ft		
45	-30			U-10		No Recovery		

SOILA OL-3485 SR 20 FREDONIA TO I-5 WIDENING.GPJ SOIL.GDT 6/14/06,8:08:18 A6

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65971

HOLE No. BH-07-05

Job No. OL-3485 SR 20 Elevation 14.6 ft (4.5 m)

Sheet 3 of 4

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				6 10 11 (21)		D-11		Poorly graded SAND with silt, medium dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.2 ft		
50	-35			10 13 13 (26)		D-12	GS MC	SP-SM, MC=25% Poorly graded SAND with silt, dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
55	-40			1 3 3 (6)		D-13	GS MC AL	ML, MC=47%, LL=38 SILT, loose, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.4 ft, Length Retained 0.9 ft		
60	-45			3 8 10 (18)		D-14	GS MC	ML, MC=27% Sandy SILT, medium dense, grey, moist, Stratified, no HCl reaction, sandy silt to 60 feet fine sand below 60 feet. Length Recovered 1.0 ft, Length Retained 1.0 ft		
65	-50			6 10 12 (22)		D-15	GS MC	SM, MC=24% Silty SAND, medium dense, grey, moist, Stratified, no HCl reaction Length Recovered 1.4 ft, Length Retained 1.3 ft		
70	-55			5 14		D-16	GS MC	SP-SM, MC=11% Poorly graded SAND with silt and gravel, dense, grey,		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65971

HOLE No. BH-07-05

Job No. OL-3485 SR 20 Elevation 14.6 ft (4.5 m)

Sheet 4 of 4

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

Depth (ft)	Elevation (ft)	Profile	◆ Field SPT (N) ✚ Moisture Content ▨ RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				17 (31)				moist, Stratified, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.2 ft		
	-60		◆	11 17 19 (36)		D-17		Poorly graded SAND with silt and gravel, dense, grey, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
75								End of test hole boring at 75.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. Piezo installed water level 1st. reading 9:00 am 5-5-05, 9.9' ground surface		
80	-65									
85	-70									
90	-75									
95	-80									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-08-05

Job No. OL-3485 SR 20 Elevation 14.2 ft

Sheet 1 of 4

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

Site Address Vicinity SR-20 and Airport RD.

Inspector James Fetterly

Start April 27, 2005 Completion April 27, 2005 Well ID# Equipment CME 55 w/ autohammer

Station 56+90 Offset 46' Rt Hole Dia (inches) 4" Method Wet Rotary

Northing Easting Latitude Longitude

County Skagit Subsection NW/SW Section 10 Range 3 EWM Township 34 N

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14.0							
	13.0							
	12.0							
	11.0							
	10.0							
5	9.0	1 2 2 (4)		D-1		Silty SAND with trace organics and FEO stains throughout, very loose, brownish grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
	8.0							
	7.0							
	6.0							
	5.0							
10	4.0	1 2 5 (7)		D-2	GS MC	SM, M.C. = 26% Silty SAND, with gravel, loose, grey, wet, Stratified, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft 04/27/2005	▽	
	3.0							
	2.0							
	1.0							
	0.0							
15	-1.0	1 1 1 (2)		D-3		Well graded GRAVEL with sand, subrounded, very loose, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.8 ft, Length Retained 0.8 ft		
	-2.0							
	-3.0							
	-4.0							
	-5.0	2		D-4	GS	SP, M.C. = 25%		
20								

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-08-05

Job No. OL-3485 SR 20 Elevation 14.2 ft (4.3 m)

Sheet 2 of 4

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				1 3 (4)			MC	Poorly graded SAND, very loose, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.5 ft		
25	-10		◆	1 1 3 (4)		D-5		Poorly graded SAND, very loose, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.2 ft, Length Retained 1.2 ft		
30	-15		◆ ✚	5 7 7 (14)		D-6	GS MC	SP, M.C. = 22% Poorly graded SAND, medium dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.1 ft, Length Retained 1.1 ft		
35	-20		◆	3 3 5 (8)		D-7		Poorly graded SAND, loose, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.2 ft, Length Retained 1.2 ft		
40	-25		◆	3 4 6 (10)		D-8		Poorly graded SAND, loose, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.9 ft, Length Retained 0.9 ft		
45	-30		◆	6 10		D-9		Poorly graded SAND with sea shell fragments throughout, medium dense, grey, wet, Homogeneous, HCl reaction		

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-08-05

Job No. OL-3485 SR 20 Elevation 14.2 ft (4.3 m) Sheet 3 of 4

Project SR-20 Fredonia to I-5 Widening Driller James Fetterly Lic# 2708

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		11 (21)				not tested Length Recovered 1.5 ft, Length Retained 1.5 ft		
	-35	4 6 4 (10)		D-10		Poorly graded SAND, loose, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 0.7 ft		
50								
	-40	1 1 1 (2)		D-11		SILT with Organics and wood debris, very loose, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.5 ft		
55				U-12 A to F		SILT with organics and wood debris, very loose, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 2.0 ft, Length Retained 2.0 ft		
	-45	1 5 8 (13)		D-13		Sandy SILT, medium dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.5 ft		
60								
	-50	7 15 17 (32)		D-14		Poorly graded SAND with gravel, dense, grey, wet, Homogeneous, HCl reaction not tested, Gravel contacted at 65.0' Length Recovered 1.2 ft, Length Retained 1.2 ft		
65								
	-55	7 22		D-15		Poorly graded SAND with gravel, very dense, grey, moist, Homogeneous, HCl reaction not tested		
70								

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S-22722

HOLE No. BH-08-05

Job No. OL-3485 SR 20 Elevation 14.2 ft (4.3 m)

Sheet 4 of 4

Project SR-20 Fredonia to I-5 Widening

Driller James Fetterly Lic# 2708

Depth (ft)	Elevation (ft)	Profile	◆ Field SPT (N) ✚ Moisture Content ▨ RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				30 (52)				Length Recovered 1.5 ft, Length Retained 1.5 ft		
								End of test hole boring at 70.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
								Bailed the hole to 22.0' and after ten minutes hole stabilized at 10.0'		
	-60									
75										
	-65									
80										
	-70									
85										
	-75									
90										
	-80									
95										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22723

HOLE No. BH-09-05

Job No. OL-3485 SR 20 Elevation 13.1 ft

Sheet 1 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

Site Address Vic. SR 20 & Airport Rd.

Inspector Dave Nelson

Start June 20, 2005 Completion June 28, 2005 Well ID# Equipment CME 850 w/ autohammer

Station LL86+92 Offset 67' Rt Hole Dia (inches) 4"x107.0' Method Wet Rotary

Northing Easting Latitude Longitude

County Skagit Subsection SW/SE Section 10 Range 3 EWM Township 34 N

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	12.0									
	11.0									
	10.0			2 1 1 (2)		D-1	GS MC AL	ML, MC=35%, PI=NA SILT, very loose, Dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft	▽ 06/28/2005	
	9.0									
5	8.0									
	7.0									
	6.0									
	5.0					U-2 A B C D	GS MC AL UU CN	ML, MC=36%, PI=NA Sandy SILT, very loose, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.4 ft, Length Retained 1.4 ft ML, MC=50%, PI=NA SILT		
	4.0									
10	3.0			2 2 3 (5)		D-3	GS MC	SP, MC=18% Poorly graded SAND, loose, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft, Length Retained 0.4 ft		
	2.0									
	1.0									
	0.0			1 2 3 (5)		D-4	GS MC	SP, MC=5% Poorly graded SAND, loose, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
	-1.0									
15	-2.0									
	-3.0									
	-4.0									
	-5.0			3 4 5 (9)		D-5		Poorly graded SAND, loose, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
	-6.0									
20										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22723

HOLE No. BH-09-05

Job No. OL-3485 SR 20 Elevation 13.1 ft (4.0 m)

Sheet 2 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	-10			4 6 6 (12)		D-6		Poorly graded SAND, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
25										
	-15			4 5 4 (9)		D-7		Poorly graded SAND, loose, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
30										
	-20			0 0 1 (1)		D-8	GS MC AL	ML, MC=69%, LL=38 SILT with sand, very loose, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
35						U-9 A B C D		SILT with organics, very loose, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.4 ft, Length Retained 1.4 ft		
	-25			1 0 2 (2)		D-10		SILT with sand, very loose, dark grey, wet, Stratified, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
40						U-11 A B C D		SILT with organics, loose, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.4 ft, Length Retained 1.4 ft		
	-30					U-12 A B C D		SILT with organics, loose, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.4 ft, Length Retained 1.4 ft		
45										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22723

HOLE No. BH-09-05

Job No. OL-3485 SR 20 Elevation 13.1 ft (4.0 m)

Sheet 3 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Profile	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			1 1 1 (2)		D-13		SILT with organics, very loose, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
	-35				U-14 A B C D		SILT with organics, loose, dark grey, wet, Stratified, HCl reaction not tested Length Recovered 1.4 ft, Length Retained 1.4 ft		
50			2 2 5 (7)		D-15	GS MC	ML, MC=31% Sandy SILT, loose, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
	-40		2 4 7 (11)		D-16	GS MC	SM, MC=18% Silty SAND with wood chunks, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
55									
	-45		5 9 18 (27)		D-17		Silty SAND, dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
60									
	-50		8 5 9 (14)		D-18	GS MC	GW, MC=2% Well graded GRAVEL with sand, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
65									
	-55		16 17 12 (29)		D-19		Well graded GRAVEL with sand, dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
70									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22723

HOLE No. BH-09-05

Job No. OL-3485 SR 20 Elevation 13.1 ft (4.0 m)

Sheet 4 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	-60			10 9 9 (18)		D-20		Well graded GRAVEL with sand, rounded, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.9 ft, Length Retained 0.9 ft		
75										
	-65			30 24 14 (38)		D-21		Well graded GRAVEL with sand, rounded, dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
80										
	-70			14 19 15 (34)		D-22		Well graded GRAVEL with sand, subrounded, dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.8 ft, Length Retained 0.8 ft		
85										
	-75			13 14 10 (24)		D-23		Well graded GRAVEL with sand, rounded, medium dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.6 ft, Length Retained 0.6 ft		
90										
	-80			3 10 14 (24)		D-24	GS MC	SP-SM, MC=23% Poorly graded SAND with silt, seashell fragments, medium dense, grey, moist, Homogeneous, HCl reaction not tested Length Recovered 1.3 ft, Length Retained 1.3 ft		
95										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-22723

HOLE No. BH-09-05

Job No. OL-3485 SR 20 Elevation 13.1 ft (4.0 m)

Sheet 5 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	-85		◆	13 15 13 (28)		D-25		Well graded GRAVEL with sand, rounded, dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.6 ft, Length Retained 0.6 ft		
100										
	-90		◆	6 11 14 (25)		D-26		Well graded GRAVEL with sand, rounded, dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft, Length Retained 0.4 ft		
105								End of test hole boring at 104.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. Bailed hole to 18.0' , recharged to 4.5' after ten mins.		
	-95									
110										
	-100									
115										
	-105									
120										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65970

HOLE No. BH-10-05

Job No. OL-3485 SR 20 Elevation 12.7 ft

Sheet 1 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

Site Address Vic SR 20 & Airport Rd.

Inspector Dave Nelson

Start May 26, 2005 Completion June 1, 2005 Well ID# AHN-958

Equipment CME 850 w/ autohammer

Station LL 87+69 Offset 47' Rt Hole Dia (inches) HQx10400 & HWTx84

Method Wet Rotary

Northing Easting Latitude Longitude

County Skagit Subsection SW 1/4 of SE 1/4 Section 10 Range 3 EWM Township 34 N

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	12.0			1 1 2 (3)		D-1	GS MC	ML, MC=8% Sandy SILT with wood chunks and root fibers, very loose, reddish brown, moist, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	11.0									
	10.0			1 1 1 (2)		D-2	GS MC	ML, MC=25% Sandy SILT with organics, very loose, reddish brown, wet, Homogeneous, no HCl reaction Length Recovered 0.4 ft		
	9.0									
	8.0			1 1 1 (3)		D-3	GS MC AL	MH, MC=86%, LL=66(Sample to small for legal test) Sandy SILT with organics and mottled, very loose, reddish brown, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft	▽ 06/01/2005	
5	7.0									
	6.0									
	5.0									
	4.0			0 0 1 (1)		D-4	GS MC	ML, MC=36% Sandy SILT, very loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
10	3.0									
	2.0					U-5 A B C D		Sandy SILT, very loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.3 ft		
	1.0									
	0.0									
	-1.0			3 4 5 (9)		D-6	GS MC	SP, MC=14% Poorly graded SAND with gravel, loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
15	-2.0									
	-3.0									
	-4.0									
	-5.0									
	-6.0			5 5		D-7		Poorly graded SAND with gravel, medium dense, dark grey, wet, Homogeneous, no HCl reaction		
20	-7.0									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65970

HOLE No. BH-10-05

Job No. OL-3485 SR 20 Elevation 12.7 ft (3.9 m)

Sheet 2 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material
		6 (11)				Length Recovered 1.0 ft
	-10					
25		5 5 6 (11)		D-8	GS MC	SP, MC=21% Poorly graded SAND, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft
	-15					
30		6 6 7 (13)		D-9		Poorly graded SAND with gravel, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft
	-20					
35		1 1 1 (2)		D-10	GS MC AL	ML, MC=48%, LL=38 SILT, very loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft
	-25					
40		1 1 0 (1)		D-11	GS MC AL	MH, MC=51%, LL=54 SILT, very loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft
	-30					
45				U-12		No Recovery

Groundwater

Instrument

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65970

HOLE No. BH-10-05

Job No. OL-3485 SR 20 Elevation 12.7 ft (3.9 m)

Sheet 3 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

◆ Field SPT (N) ✚ Moisture Content ▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material
		0 2 2 (4)		D-13	GS MC AL	ML, MC=60%, LL=42 SILT, very loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft
	-35					
				U-14		No Recovery
50						
		1 1 2 (3)		D-15	GS MC AL	ML, MC=54%, LL=49 SILT, very loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft
	-40					
				U-16 A B C	GS MC	SM, MC=18% Silty SAND, very loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft
55						
		2 4 4 (8)		D-17	GS MC	SM, MC=21% Silty SAND, loose, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft
	-45					
		8 8 8 (16)		D-18		Silty SAND, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft
60						
	-50					
		14 14 15 (29)		D-19	GS MC	SP-SM, MC=5% Poorly graded SAND with silt and gravel, dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft
65						
	-55					
		27 24		D-20		Poorly graded SAND with silt and gravel, dense, dark grey, wet, Homogeneous, no HCl reaction
70						

Groundwater

Instrument

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-65970

HOLE No. BH-10-05

Job No. OL-3485 SR 20 Elevation 12.7 ft (3.9 m)

Sheet 4 of 5

Project SR-20 Fredonia to I-5 Widening

Driller Joe Judd Lic# 2454

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				13 (37)				Length Recovered 0.8 ft		
	-60									
75			◆	5 3 2 (5)		D-21		Poorly graded SAND with silt and gravel, loose, dark grey, wet, Homogeneous, no HCl reaction, driveing on large gravel Length Recovered 0.2 ft		
	-65									
80			◆	29 25 16 (31)		D-22		Poorly graded SAND with silt and gravel, dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft		
	-70									
85			◆	19 13 14 (27)		D-23		Poorly graded SAND with silt and gravel, dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 0.8 ft		
	-75									
90			◆	18 19 28 (47)		D-24		Poorly graded SAND with silt and gravel, dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 0.9 ft		
	-80									
95			◆	14 11		D-25		Poorly graded SAND with silt and gravel, medium dense, dark grey, wet, Homogeneous, no HCl reaction		

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card R-65970

HOLE No. BH-10-05

Job No. OL-3485 SR 20 Elevation 12.7 ft (3.9 m)

Sheet 5 of 5

Project SR-20 Fredonia to I-5 Widening

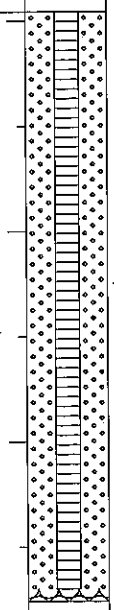
Driller Joe Judd Lic# 2454

◆ Field SPT (N)
✚ Moisture Content
▨ RQD

Depth (ft)	Elevation (ft)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material
		9 (20)				Length Recovered 0.9 ft
	-85					
100		9 11 12 (23)		D-26		Poorly graded SAND with silt and gravel, medium dense, dark grey, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft
	-90					
105		100/3 (100/3")		D-27		Poorly graded SAND with silt and gravel, very dense, dark grey, wet, Homogeneous, no HCl reaction, heaving sand Length Recovered 0.1 ft
	-95					End of test hole boring at 104.2 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. No bail test perform
110						
	-100					
115						
	-105					
120						

Groundwater

Instrument



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Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-26356

HOLE No. BH-18-06

Job No. OL-3485 SR 20 Elevation ft

Sheet 1 of 3

Project SR-20 Fredonia to I-5 Widening

Driller Thomas Harvey Lic# 2599

Site Address Vic. SR-536 and SR-20

Inspector James Fetterly

Start April 18, 2006 Completion April 18, 2006 Well ID# Equipment CME 45 w/ autohammer

Station Offset Hole Dia (inches) 4" X 53' Method Wet Rotary

Northing Easting Latitude Longitude

County Skagit Subsection SW/SE Section 9 Range 3 EWM Township 34 N

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								04/18/2006	▽	
5				0 0 0 (0)		D-1	GS MC AL	ML, MC=96%, PI=NA SILT with trace organics, very loose, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.7 ft, Length Retained 0.7 ft		
						S-2	GS MC	SM, MC=32% SILT with trace organics, very loose, dark grey, moist, Homogeneous, HCl reaction not tested, Very easy push Length Recovered 2.0 ft, Length Retained 2.0 ft		
10				3 7 9 (16)		D-3		Well graded SAND with gravel, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
				5 6 6 (12)		D-4		Well graded SAND with gravel, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.1 ft, Length Retained 1.1 ft		
15				6 9 10 (19)		D-5		Well graded SAND, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.3 ft, Length Retained 1.3 ft		
20				5 8		D-6		Well graded SAND with gravel, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-26356

HOLE No. BH-18-06

Job No. OL-3485 SR 20 Elevation ft (m)

Sheet 2 of 3

Project SR-20 Fredonia to I-5 Widening

Driller Thomas Harvey Lic# 2599

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				7 (15)				Length Recovered 1.1 ft, Length Retained 1.1 ft		
25				8 11 12 (23)		D-7		Poorly graded SAND with trace gravel, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.2 ft, Length Retained 1.2 ft		
30				6 9 12 (21)		D-8		Poorly graded SAND, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.4 ft, Length Retained 1.4 ft		
35				8 10 11 (21)		D-9		Poorly graded SAND, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.3 ft, Length Retained 1.3 ft		
40				2 3 9 (12)		D-10		Poorly graded SAND, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.4 ft, Length Retained 1.4 ft		
45				6 11		D-11		Poorly graded SAND, medium dense, dark grey, wet, Homogeneous, HCl reaction not tested		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-26356

HOLE No. BH-18-06

Job No. OL-3485 SR 20 Elevation ft (m)

Sheet 3 of 3

Project SR-20 Fredonia to I-5 Widening

Driller Thomas Harvey Lic# 2599

Depth (ft)	Elevation (ft)	Profile	◆ Field SPT (N) ✚ Moisture Content ▨ RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				13 (24)				Length Recovered 1.3 ft, Length Retained 1.3 ft		
			◆	11 13 14 (27)		D-12		Poorly graded SAND, dense, dark grey, wet, Homogeneous, HCl reaction not tested Length Recovered 1.3 ft, Length Retained 1.3 ft		
50								End of test hole boring at 50.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. Bail test = start = 2.5' bail to 13.0' Ten min. recharge = 3.0'		
55										
60										
65										
70										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-26357

HOLE No. BH-19-06

Job No. OL-3485 SR 20 Elevation ft

Sheet 1 of 2

Project SR-20 Fredonia to I-5 Widening

Driller Vince Johnson Lic# 2532

Site Address Vic. SR-20 and Higgins Airport Way

Inspector Brian Hilts

Start March 8, 2006 Completion March 8, 2006 Well ID#

Equipment CME 850 w/ autohammer

Station Offset Hole Dia (inches) 4"x27'

Method Wet Rotary

Northing Easting Latitude Longitude

County Skagit Subsection SE/NW Section 10 Range 3 EWM Township 34 N

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				1 2 3 3 (5)		D-1		Silty SAND, loose, grayish brown, moist, Stratified, no HCl reaction, The top .4' was silty sand with hair roots, and the bottom .9' was (SP) sand. Length Recovered 1.3 ft, Length Retained 1.3 ft		
5				3 5 5 6 (10)		D-2		Silty SAND, loose, grayish brown, wet, Homogeneous, no HCl reaction Length Recovered 1.2 ft, Length Retained 1.2 ft		
				4 3 4 3 (7)		D-3		Silty SAND, loose, grayish brown, wet, Stratified, no HCl reaction, The top .6' was brown silty sand, and the bottom .5' was dark gray (SP) sand. Length Recovered 1.1 ft, Length Retained 1.1 ft		
10				3 5 5 (10)		D-4		Poorly graded SAND, loose, dark gray, wet, Homogeneous, no HCl reaction Length Recovered 0.9 ft, Length Retained 0.9 ft		
15				3 5 6 (11)		D-5		Poorly graded SAND, medium dense, dark gray, wet, Homogeneous, no HCl reaction Length Recovered 0.8 ft, Length Retained 0.8 ft		
20				5 5		D-6		Poorly graded SAND, medium dense, dark gray, wet, Homogeneous, no HCl reaction		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-26357

HOLE No. BH-19-06

Job No. OL-3485 SR 20 Elevation ft (m)

Sheet 2 of 2

Project SR-20 Fredonia to I-5 Widening

Driller Vince Johnson Lic# 2532

Depth (ft)	Elevation (ft)	Profile	◆ Field SPT (N) ✚ Moisture Content ▨ RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				6 (11)				Length Recovered 0.9 ft, Length Retained 0.9 ft		
			◆	5 6 6 (12)		D-7		Poorly graded SAND, medium dense, dark gray, wet, Homogeneous, no HCl reaction Length Recovered 0.8 ft, Length Retained 0.8 ft		
25								End of test hole boring at 25.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
30										
35										
40										
45										

LABORATORY TESTING

Laboratory testing was performed on selected samples from the field exploration program. Testing included performing moisture content, grain size analyses, and Atterberg Limits tests. The tests were done in general accordance with AASHTO T-88, T-89, and T-90 guide specifications. After the testing was complete, the samples were classified in general accordance with the Unified Soil Classification System (USCS).

In addition, consolidation testing and unconsolidated undrained shear strength testing were performed on select samples. pH and resistivity testing was performed at the proposed culvert location.

APPENDIX C - LABORATORY TESTING

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-01-05** Sheet **1** of **4**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

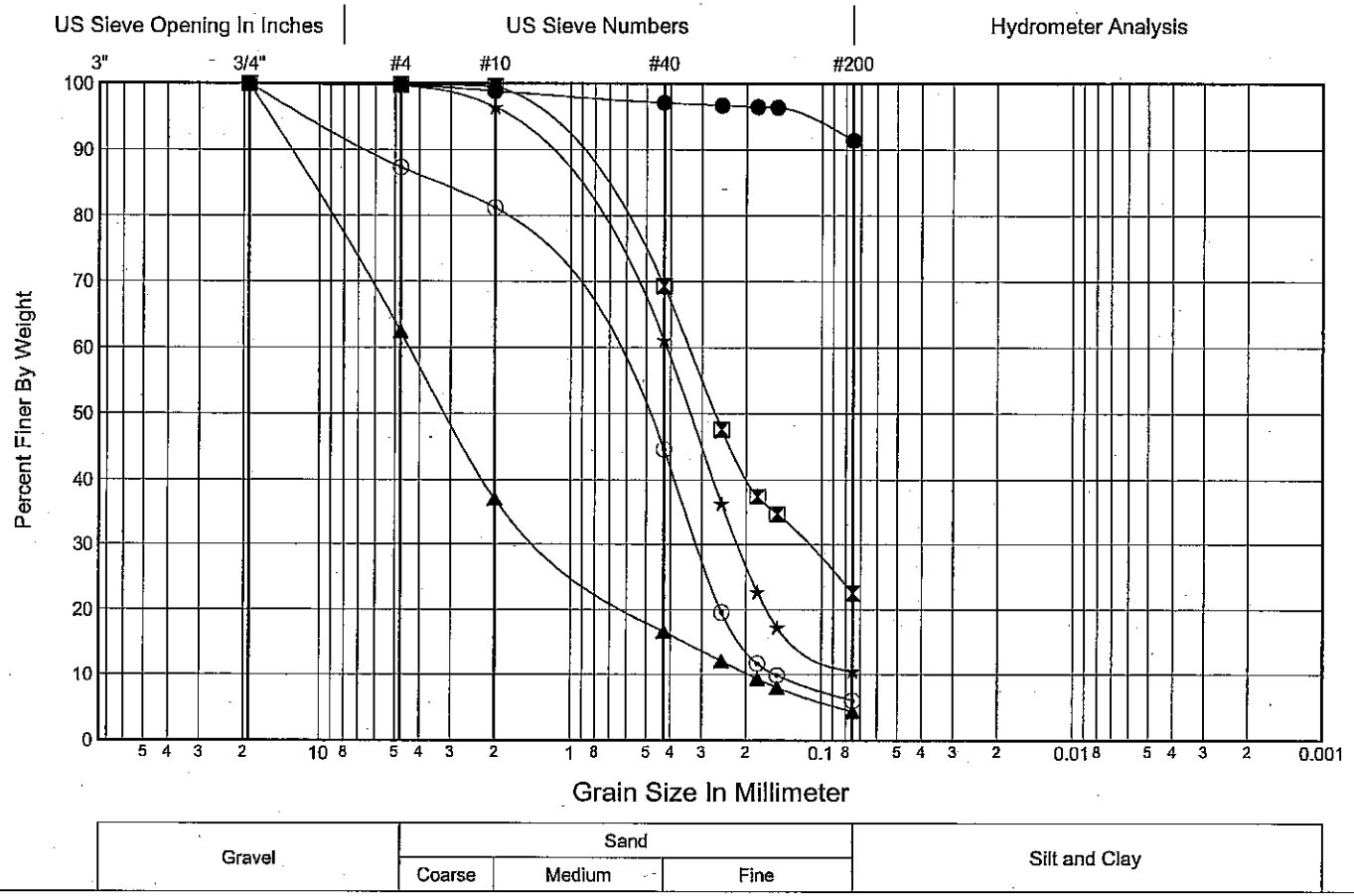
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	4.0	1.22	D-1	ML	See Boring Log	SILT	33			
⊠	9.0	2.74	D-2	SM	See Boring Log	SILTY SAND	24			
▲	29.0	8.84	D-6	SW	See Boring Log	WELL-GRADED SAND with GRAVEL	13			
★	34.0	10.36	D-7A	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	82			
⊙	34.3	10.45	D-7	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	19			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.2	8.4	91.4		
⊠	0.2	77.3	22.5		
▲	37.6	58.0	4.4	1.6	22.5
★	0.3	89.2	10.5	1.6	5.8
⊙	12.7	81.3	6.0	0.8	5.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠	0.339	0.27	0.11		
▲	4.379	3.12	1.18	0.55	0.195
★	0.415	0.34	0.21	0.16	
⊙	0.816	0.53	0.31	0.25	0.152



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-01-05** Sheet **2** of **4**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

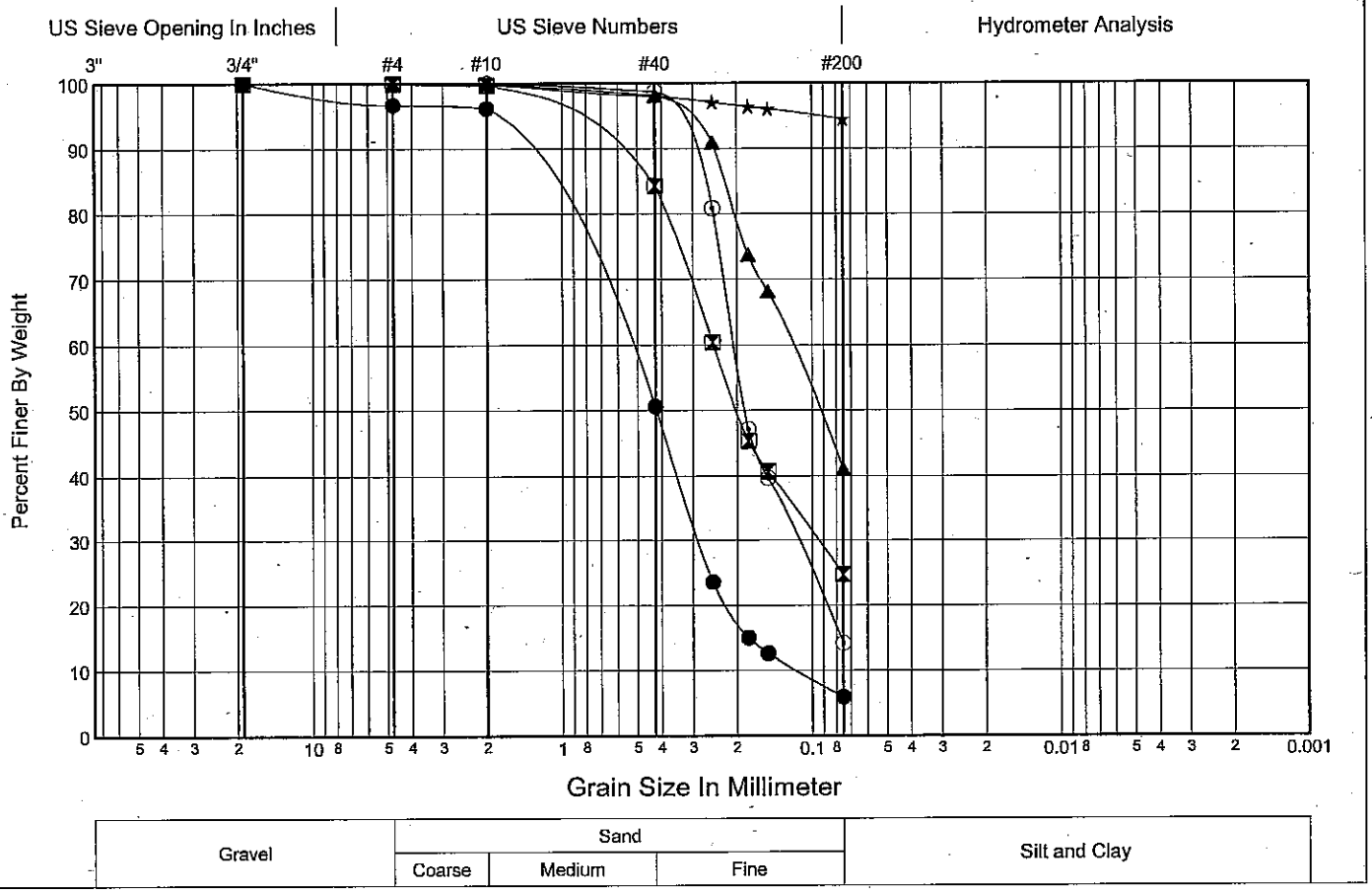
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	43.5	13.26	D-9	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	20			
⊠	48.5	14.78	D-10	SM	See Boring Log	SILTY SAND	26			
▲	53.5	16.31	D-11	SM	See Boring Log	SILTY SAND	27			
★	58.0	17.68	D-12	ML	See Boring Log	SILT	48	42	NP	NA
⊙	61.5	18.75	D-14	SM	See Boring Log	SILTY SAND	27			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	3.3	90.8	5.9	1.2	5.1
⊠	0.1	75.2	24.7		
▲	0.0	59.0	41.0		
★	0.1	5.4	94.5		
⊙	0.0	85.9	14.1		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.586	0.42	0.28	0.22	0.115
⊠	0.248	0.20	0.09		
▲	0.122	0.09			
★					
⊙	0.204	0.19	0.12	0.09	



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-01-05** Sheet **3** of **4**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

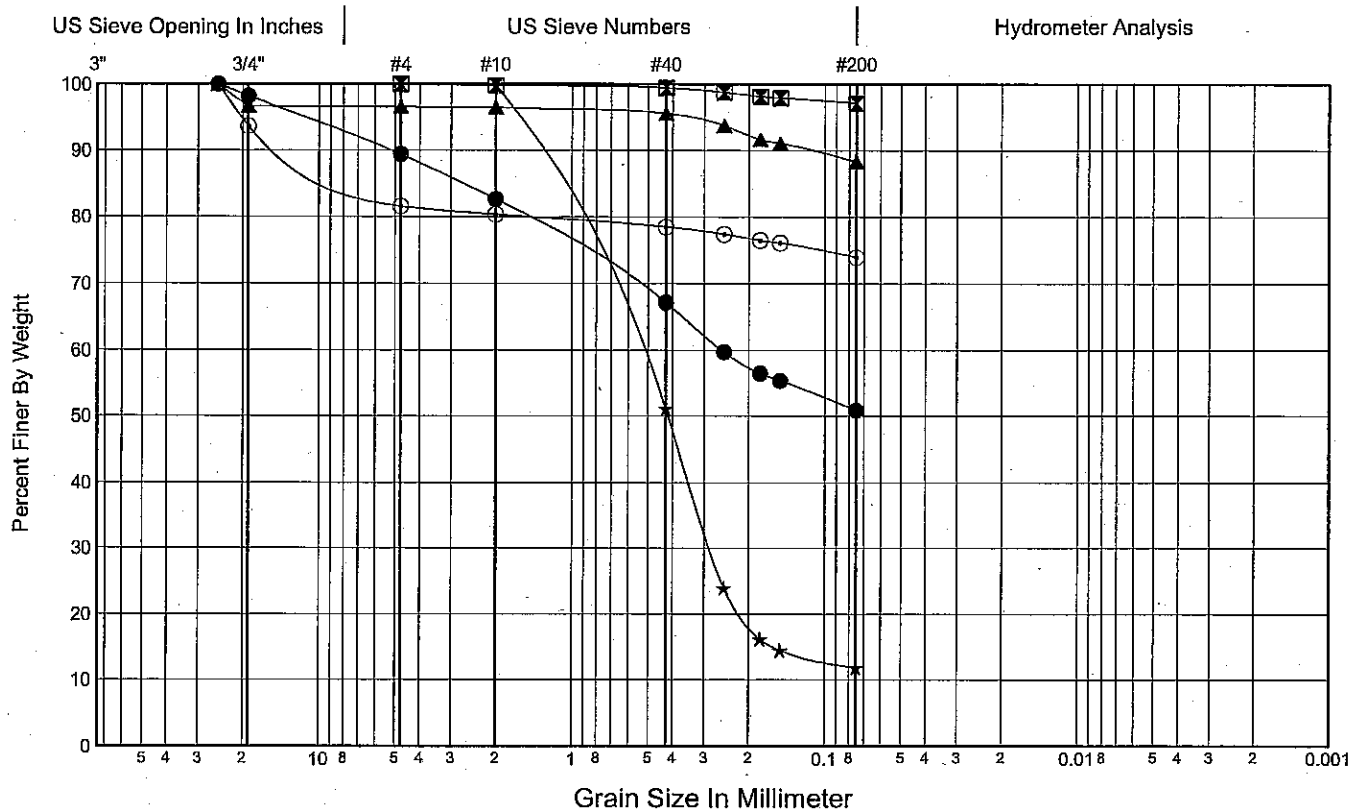
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	63.5	19.35	D-15	CL	See Boring Log	SANDY LEAN CLAY	15	31	18	13
⊠	68.5	20.88	D-16	CL	See Boring Log	LEAN CLAY	33	46	24	22
▲	78.0	23.77	D-20	CL	See Boring Log	LEAN CLAY	36	38	20	18
★	81.5	24.84	D-22	SW-SM	See Boring Log	WELL-GRADED SAND with SILT	24			
⊙	83.5	25.45	D-23	CL	See Boring Log	LEAN CLAY with GRAVEL	24	27	17	10

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	10.6	38.6	50.8		
⊠	0.0	2.9	97.1		
▲	3.5	8.2	88.3		
★	0.0	88.2	11.8	3.0	12.0
⊙	18.5	7.6	73.9		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.255				
⊠					
▲					
★	0.564	0.42	0.28	0.21	
⊙					



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-01-05** Sheet **4** of **4**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

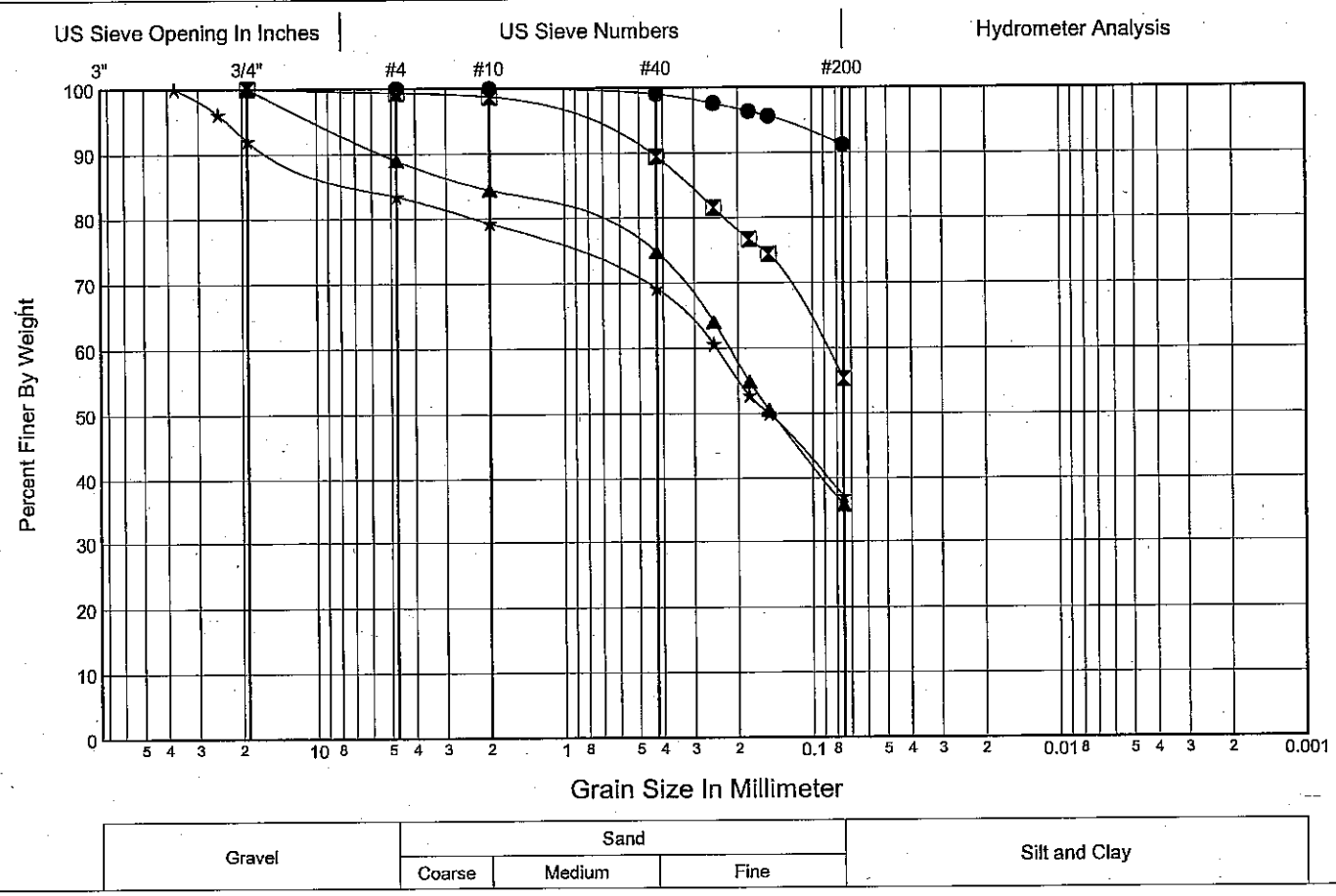
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	88.5	26.97	D-24	CL	See Boring Log	LEAN CLAY	31	37	22	15
⊠	93.5	28.50	D-26	ML	See Boring Log	SANDY SILT	19			
▲	98.5	30.02	D-27	SM	See Boring Log	SILTY SAND	15			
★	103.5	31.55	D-28	SM	See Boring Log	SILTY SAND with GRAVEL	11			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	8.8	91.2		
⊠	0.7	43.9	55.4		
▲	11.0	53.4	35.6		
★	16.7	46.3	37.0		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠	0.089				
▲	0.216	0.15			
★	0.243	0.15			



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-02-05** Sheet **1** of **4**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

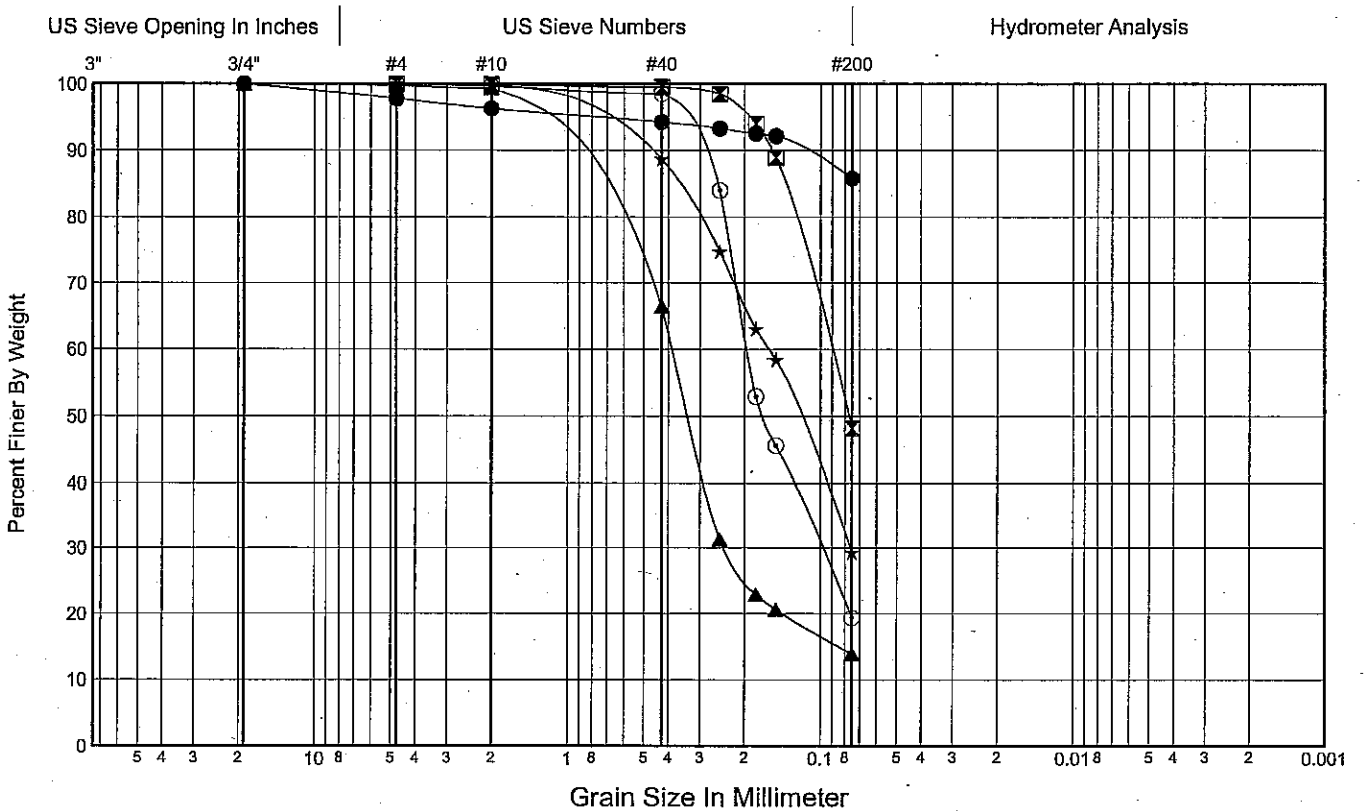
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	4.5	1.37	D-1	ML	See Boring Log	SILT	43			
⊠	9.5	2.90	D-2	SM	See Boring Log	SILTY SAND	29			
▲	14.5	4.42	D-3	SM	See Boring Log	SILTY SAND	25			
★	24.5	7.47	D-5	SM	See Boring Log	SILTY SAND	30			
⊙	29.5	8.99	D-6	SM	See Boring Log	SILTY SAND	19			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	2.2	12.0	85.8		
⊠	0.0	51.8	48.2		
▲	0.2	85.9	13.9		
★	0.0	70.7	29.3		
⊙	0.0	80.7	19.3		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠	0.092	0.08			
▲	0.386	0.33	0.24	0.14	
★	0.160	0.12	0.08		
⊙	0.194	0.17	0.10	0.08	



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-02-05** Sheet **2** of **4**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

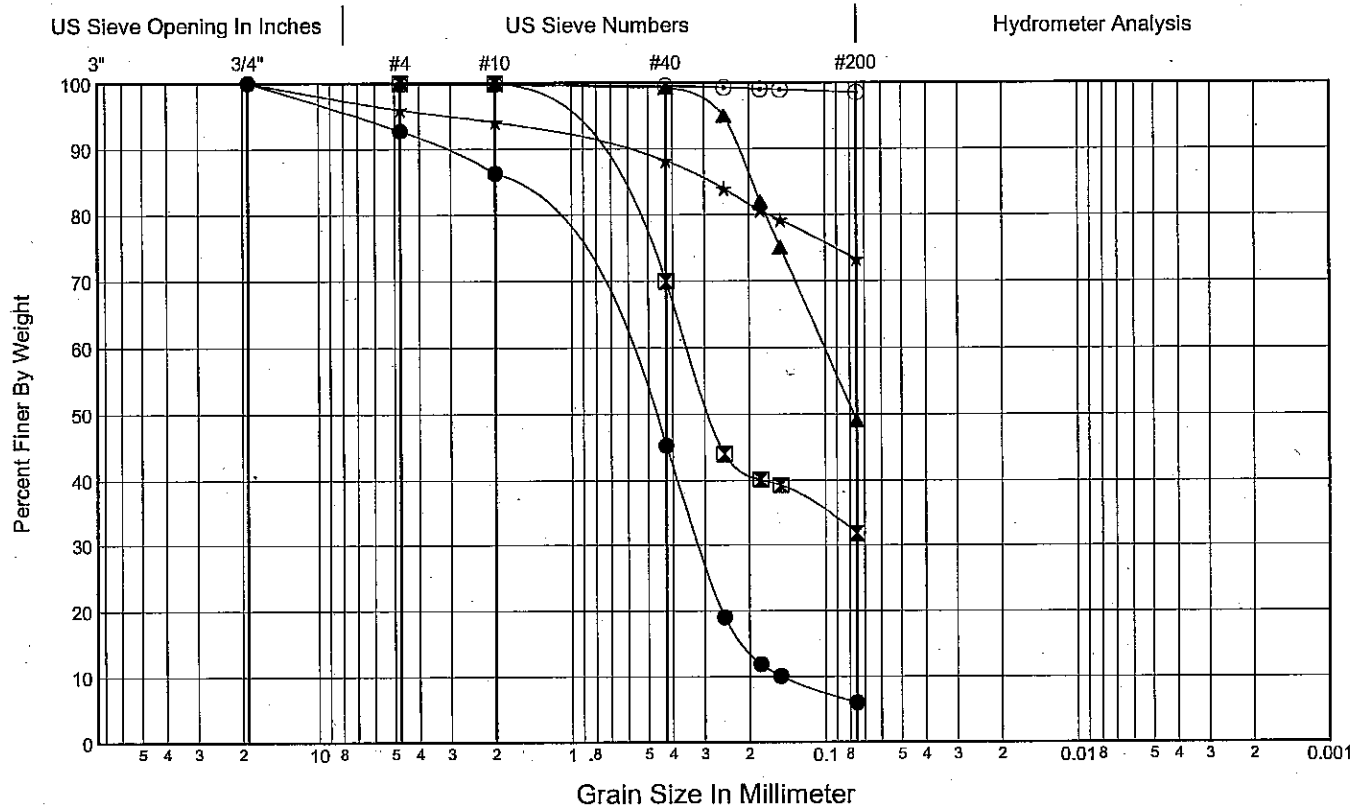
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	39.5	12.04	D-8	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	20			
⊠	49.0	14.94	D-10	SM	See Boring Log	SILTY SAND	26			
▲	54.0	16.46	D-11	SM	See Boring Log	SILTY SAND	30			
★	65.5	19.96	D-14	CL	See Boring Log	LEAN CLAY with SAND	23	31	19	12
⊙	70.5	21.49	D-15	CH	See Boring Log	FAT CLAY	39	52	27	25

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	7.2	86.7	6.0	0.9	5.0
⊠	0.0	68.2	31.8		
▲	0.0	51.0	49.0		
★	4.0	22.8	73.2		
⊙	0.2	1.3	98.5		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.743	0.51	0.31	0.26	0.148
⊠	0.347	0.28			
▲	0.100	0.08			
★					
⊙					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-02-05** Sheet **3** of **4**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

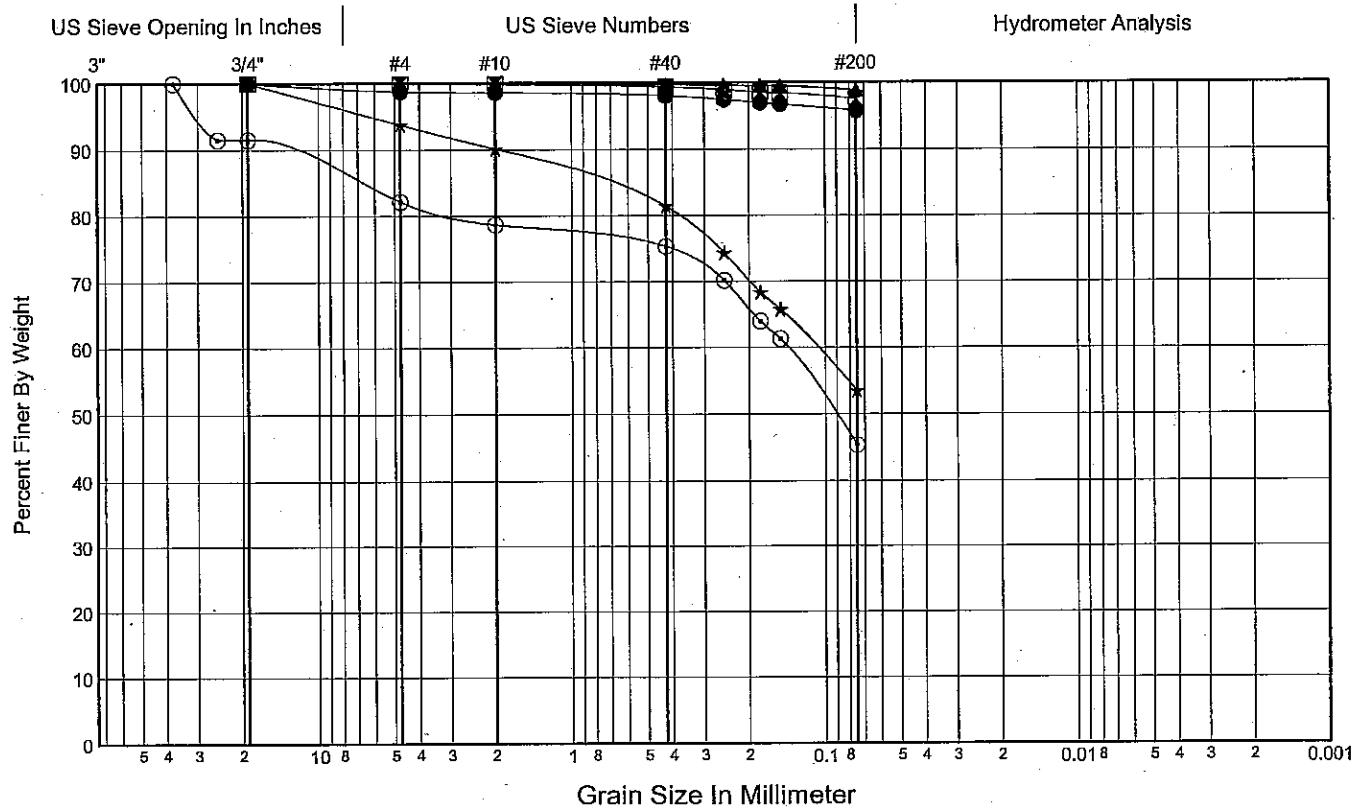
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	75.5	23.01	D-16	CL	See Boring Log	LEAN CLAY	31	38	20	18
⊠	79.0	24.08	D-18	CL	See Boring Log	LEAN CLAY	31	40	20	20
▲	88.5	26.97	D-20	ML	See Boring Log	SILT	41	27	NP	NA
★	93.5	28.50	D-21	CL-ML	See Boring Log	SANDY SILTY CLAY	19	22	15	7
⊙	98.5	30.02	D-22	SM	See Boring Log	SILTY SAND with GRAVEL	19			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	1.3	3.0	95.7		
⊠	0.1	2.4	97.5		
▲	0.0	1.2	98.8		
★	6.2	40.3	53.5		
⊙	17.9	36.8	45.3		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠					
▲					
★	0.108				
⊙	0.142	0.09			



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-02-05** Sheet **4** of **4**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

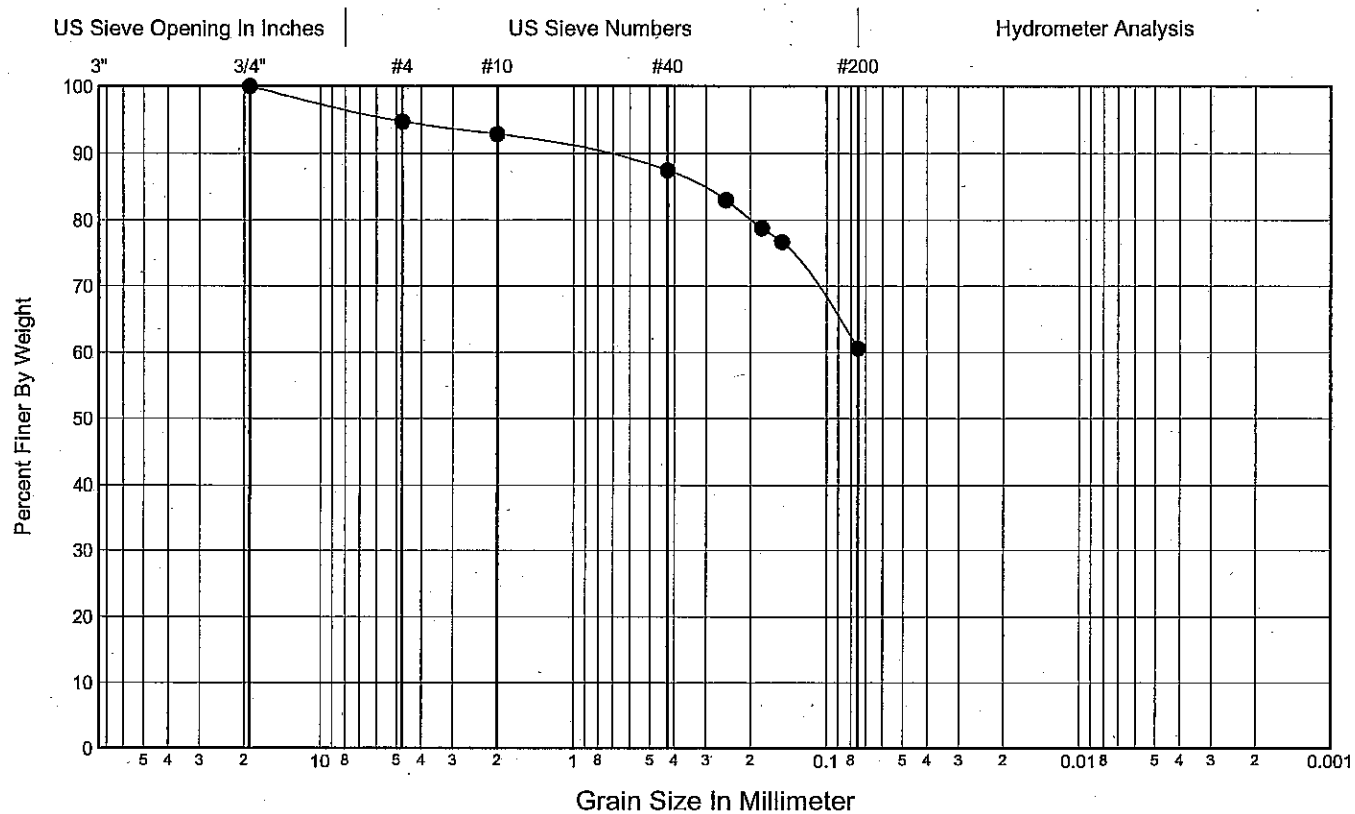
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	**103.5**	**31.55**	**D-23**	**ML**	**See Boring Log**	**SANDY SILT**	**17**			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	**5.3**	**34.1**	**60.6**		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-03-05** Sheet **1** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

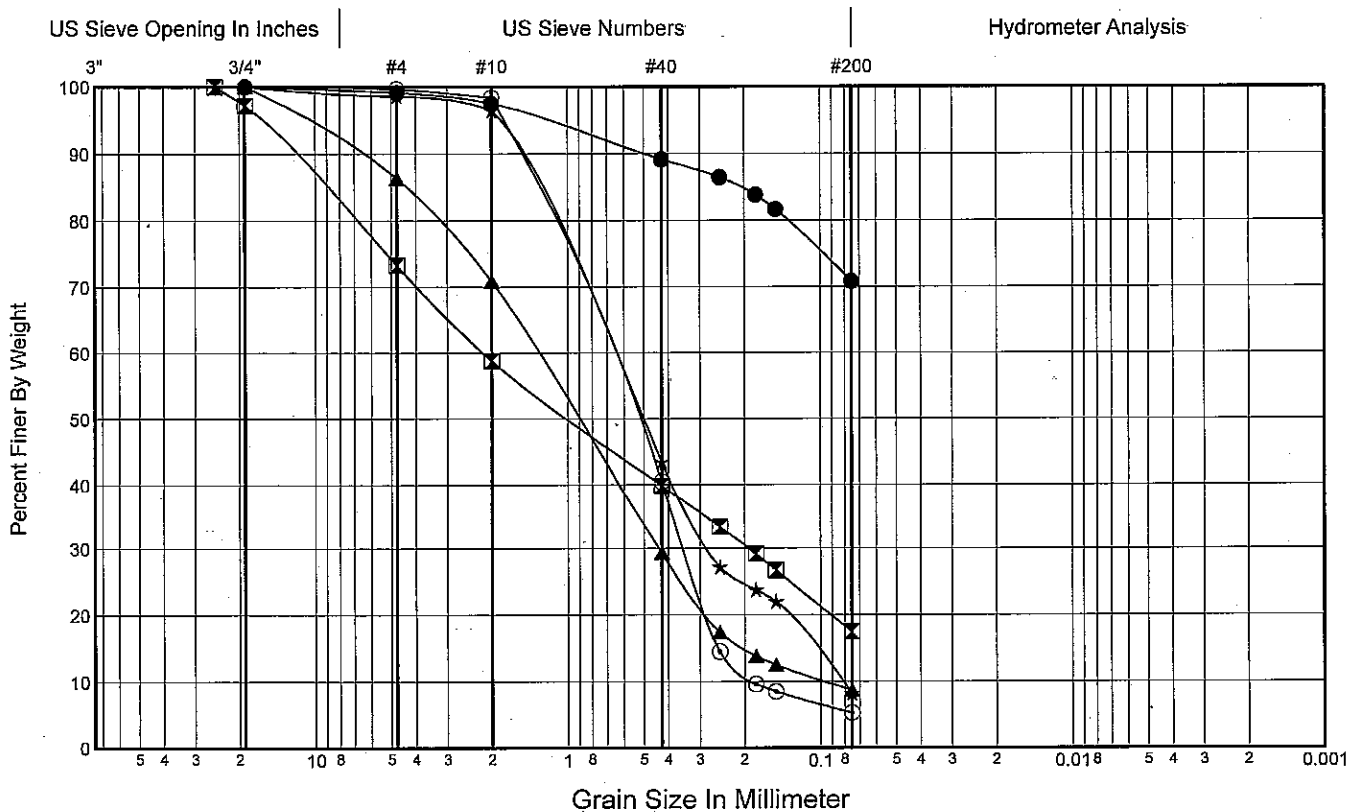
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	14.5	4.42	U-3	ML	See Boring Log	SILT with SAND with wood chunks	58			
⊠	16.5	5.03	D-4	SM	See Boring Log	SILTY SAND with GRAVEL	17			
▲	24.5	7.47	D-6	SW-SM	See Boring Log	WELL-GRADED SAND with SILT	10			
★	34.0	10.36	D-8	SW-SM	See Boring Log	WELL-GRADED SAND with SILT	23			
⊙	44.0	13.41	D-10	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	24			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.9	28.3	70.8		
⊠	26.7	55.8	17.5		
▲	13.6	77.7	8.7	1.5	14.1
★	1.4	90.4	8.2	1.3	8.4
⊙	0.4	94.4	5.3	0.9	3.9

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠	2.150	0.97	0.19	0.09	
▲	1.334	0.92	0.44	0.28	0.095
★	0.689	0.51	0.27	0.14	0.082
⊙	0.717	0.55	0.34	0.28	0.185



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-03-05** Sheet **2** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

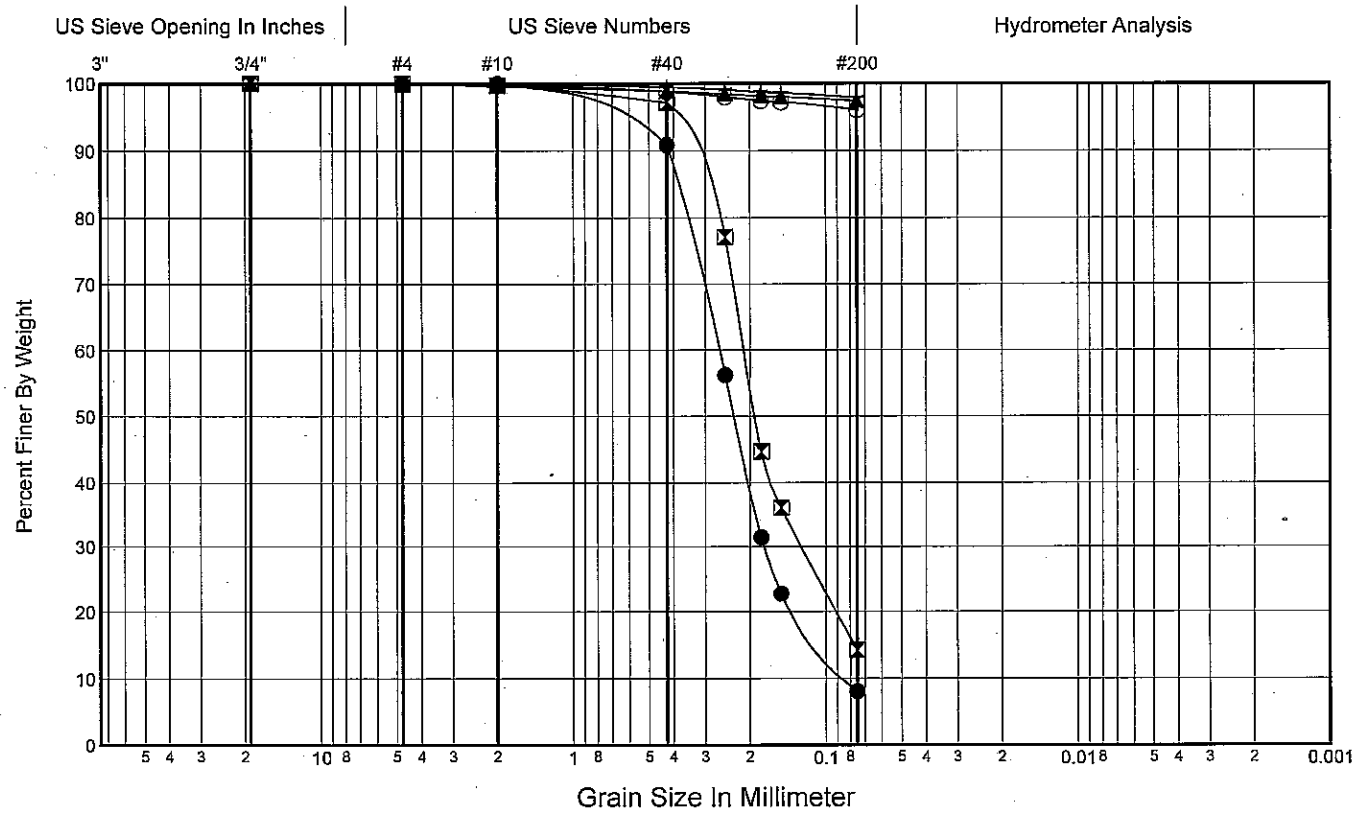
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	49.0	14.94	D-11	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	28			
⊠	59.0	17.98	D-13	SM	See Boring Log	SILTY SAND	32			
▲	69.0	21.03	D-15	CH	See Boring Log	FAT CLAY	63	52	24	28
★	74.0	22.56	D-16	CH	See Boring Log	FAT CLAY	40	55	24	31
⊙	79.0	24.08	D-17	CL	See Boring Log	LEAN CLAY	29	36	18	18

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	91.9	8.1	1.4	3.2
⊠	0.0	85.7	14.3		
▲	0.1	2.5	97.4		
★	0.0	2.2	97.8		
⊙	0.1	3.9	96.1		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.265	0.23	0.17	0.13	0.082
⊠	0.210	0.19	0.12	0.09	
▲					
★					
⊙					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-03-05** Sheet **3** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

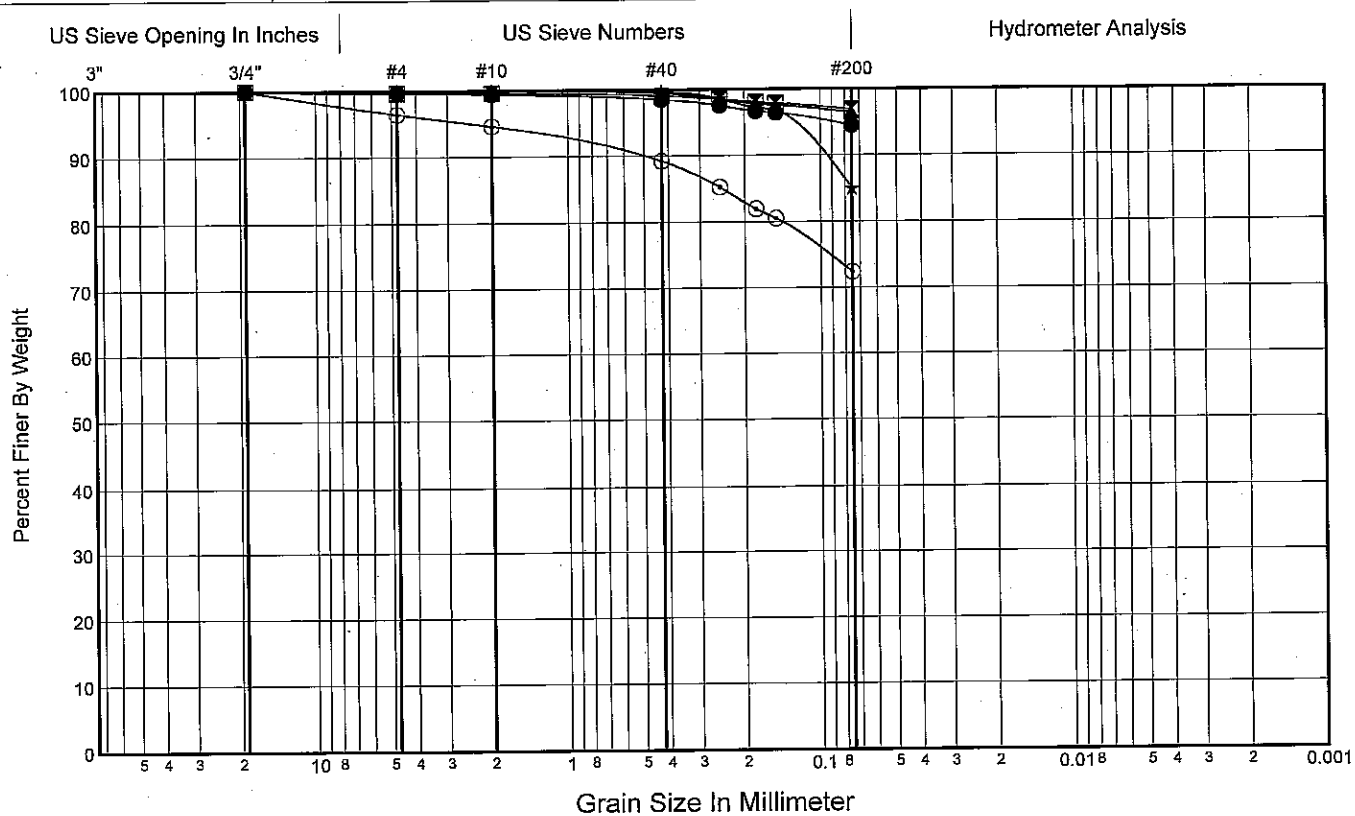
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	81.8	24.93	U-18/C	CH	See Boring Log	FAT CLAY	37	51	24	27
⊠	82.5	25.15	U-18/E	CL	See Boring Log	LEAN CLAY	33	34	19	15
▲	84.0	25.60	D-19	CL-ML	See Boring Log	SILTY CLAY	26	26	19	7
★	89.0	27.13	D-20	ML	See Boring Log	SILT	24			
⊙	94.0	28.65	D-21	CL	See Boring Log	LEAN CLAY with SAND	22	28	16	12

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.3	5.3	94.4		
⊠	0.3	2.8	96.8		
▲	0.0	3.6	96.4		
★	0.0	14.9	85.1		
⊙	3.6	24.0	72.4		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠					
▲					
★					
⊙					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-04-05** Sheet **1** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

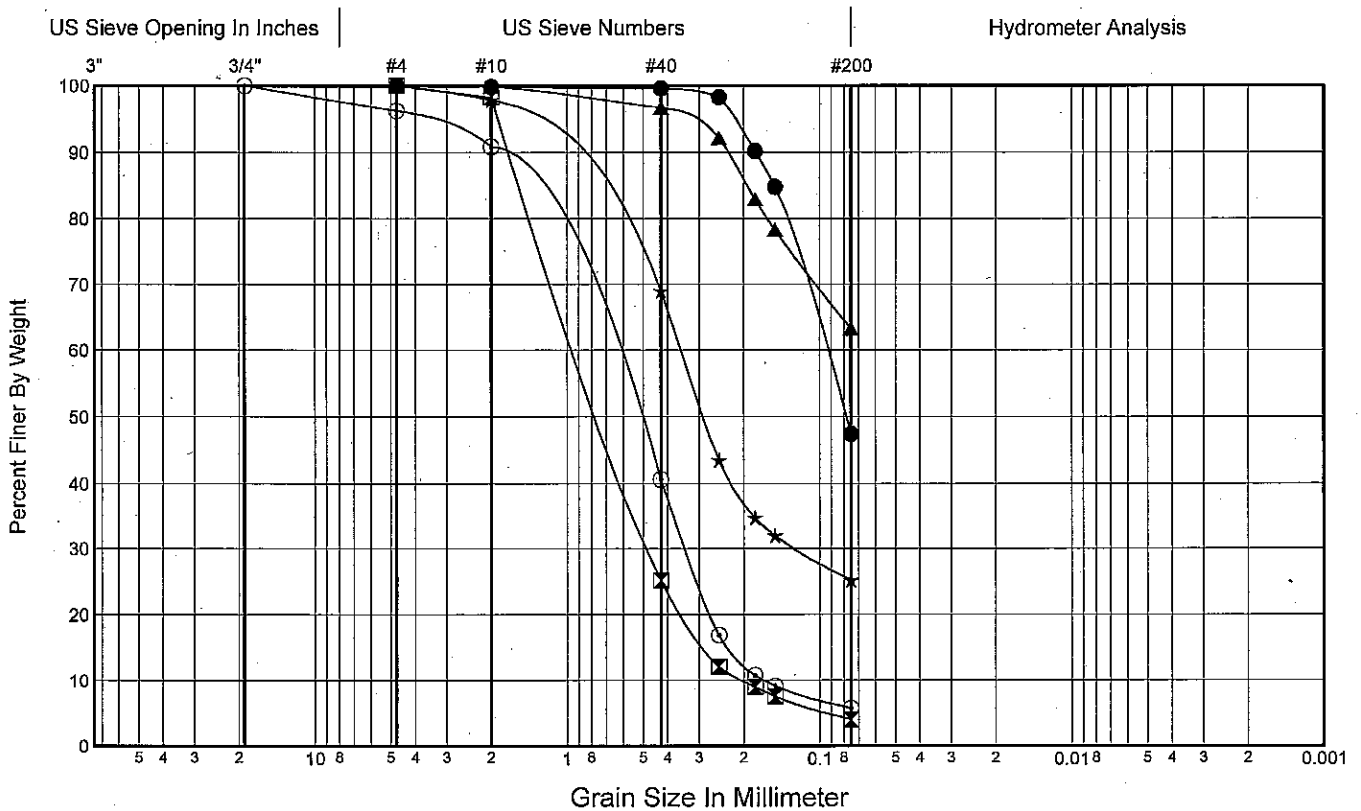
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	4.0	1.22	D-3	SM	See Boring Log	SILTY SAND	29			
⊠	9.0	2.74	D-4	SP	See Boring Log	POORLY GRADED SAND	23			
▲	14.0	4.27	D-5	ML	See Boring Log	SANDY SILT	37			
★	24.0	7.32	D-7	SM	See Boring Log	SILTY SAND	33	NA	NP	NA
⊙	34.0	10.36	D-9	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	19			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	52.6	47.4		
⊠	0.0	96.0	4.0	1.2	4.4
▲	0.0	36.8	63.2		
★	0.0	74.8	25.2		
⊙	3.8	90.5	5.7	0.9	4.7

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.095	0.08			
⊠	0.889	0.72	0.47	0.34	0.201
▲					
★	0.352	0.29	0.12		
⊙	0.772	0.57	0.34	0.27	0.165



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-04-05** Sheet **2** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

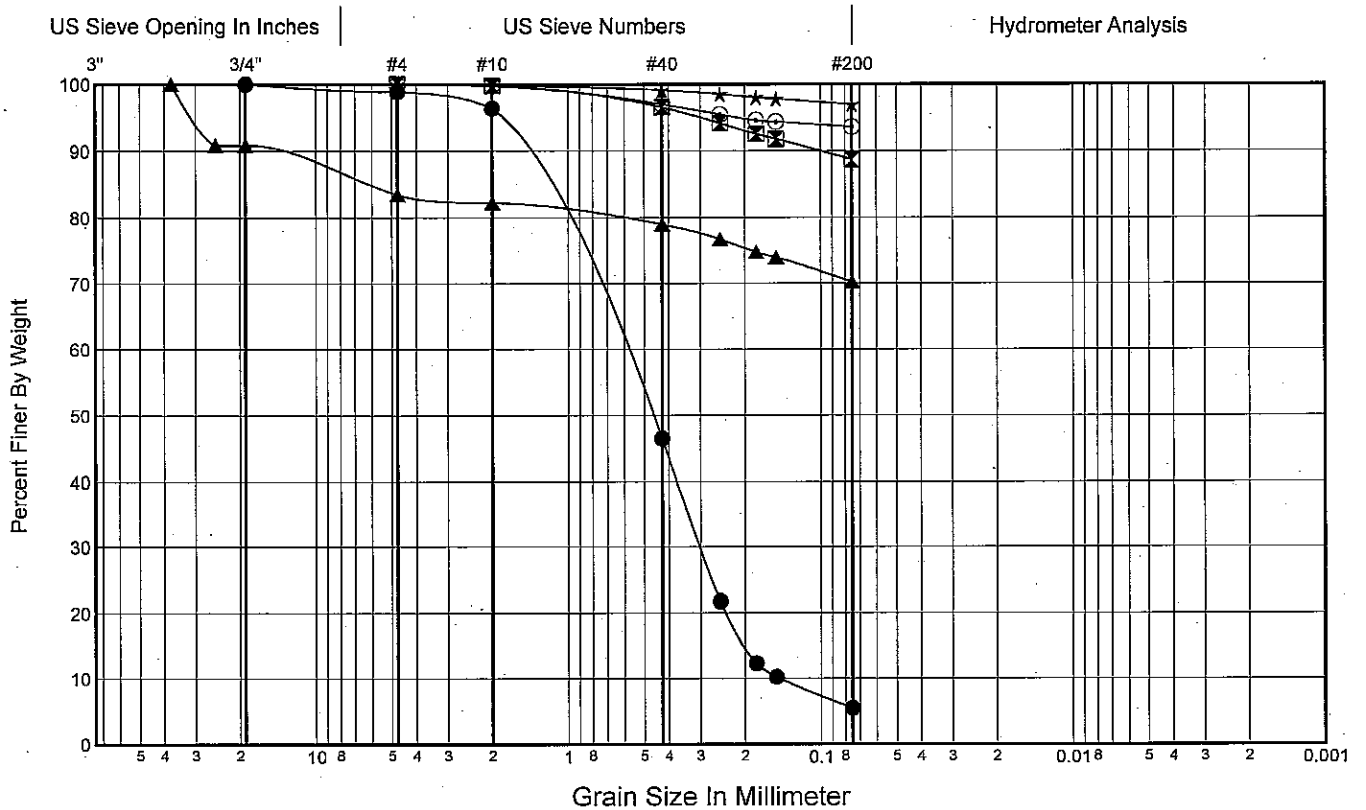
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	44.0	13.41	D-11	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	21			
⊠	54.0	16.46	D-13	ML	See Boring Log	SILT	55	38	NP	NA
▲	64.0	19.51	D-15	CL	See Boring Log	LEAN CLAY with GRAVEL	22	37	18	19
★	69.0	21.03	D-16	CH	See Boring Log	FAT CLAY	36	59	27	32
⊙	76.0	23.16	D-19	CH	See Boring Log	FAT CLAY	13	51	25	26

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	1.1	93.4	5.5	1.0	4.5
⊠	0.0	11.3	88.7		
▲	16.5	13.3	70.2		
★	0.0	3.1	96.9		
⊙	0.0	6.4	93.6		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.646	0.47	0.30	0.24	0.144
⊠					
▲					
★					
⊙					



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-04-05** Sheet **3** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

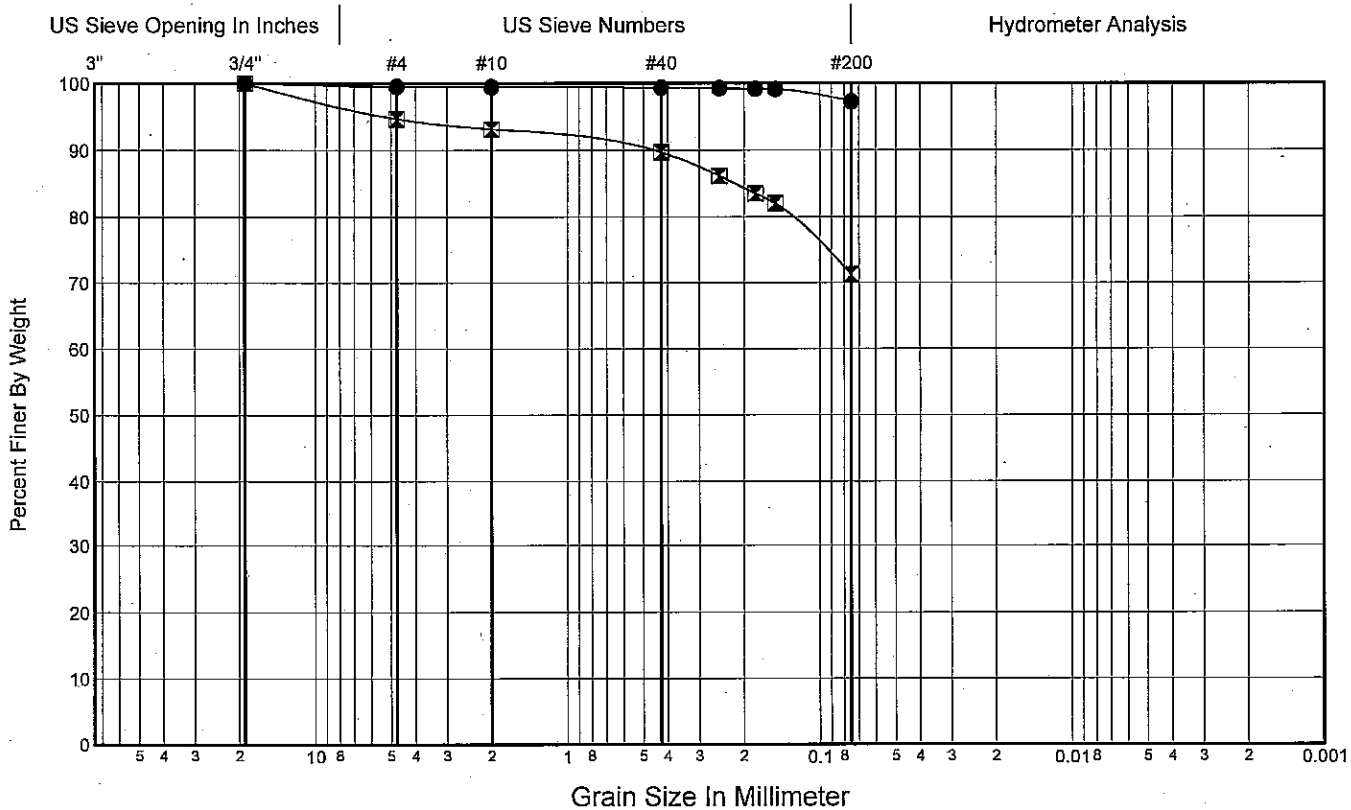
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	91.0	27.74	D-25	ML	See Boring Log	SILT	24	24	NP	NA
⊠	94.0	28.65	D-26	ML	See Boring Log	SILT with SAND	21	19	NP	NA

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.5	2.3	97.3		
⊠	5.3	23.4	71.3		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-05-05** Sheet **1** of **2**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

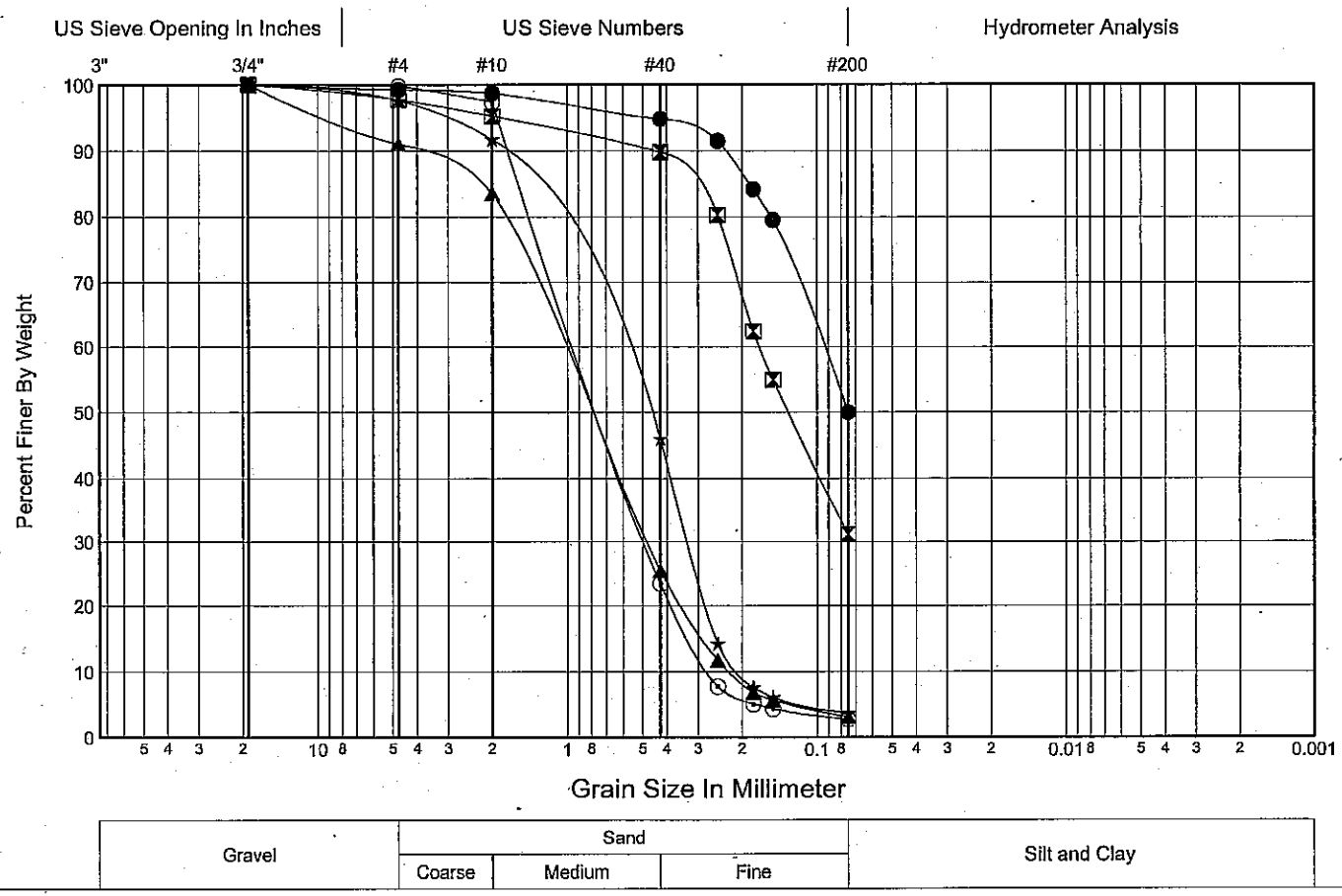
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	2.5	0.76	D-2	SM	See Boring Log	SILTY SAND	61	NA	NP	NA
⊠	4.0	1.22	D-3	SM	See Boring Log	SILTY SAND	39			
▲	9.0	2.74	D-4	SP	See Boring Log	POORLY GRADED SAND	23			
★	19.0	5.79	D-6	SP	See Boring Log	POORLY GRADED SAND	18			
⊙	29.0	8.84	D-8	SP	See Boring Log	POORLY GRADED SAND	25			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.7	49.3	49.9		
⊠	2.2	66.6	31.2		
▲	9.0	87.9	3.1	1.0	4.8
★	2.4	93.9	3.7	0.8	3.4
⊙	0.3	97.0	2.7	1.0	3.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.095	0.08			
⊠	0.170	0.13			
▲	1.069	0.82	0.48	0.34	0.223
★	0.684	0.49	0.33	0.28	0.203
⊙	0.915	0.74	0.49	0.38	0.270



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-05-05** Sheet **2** of **2**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

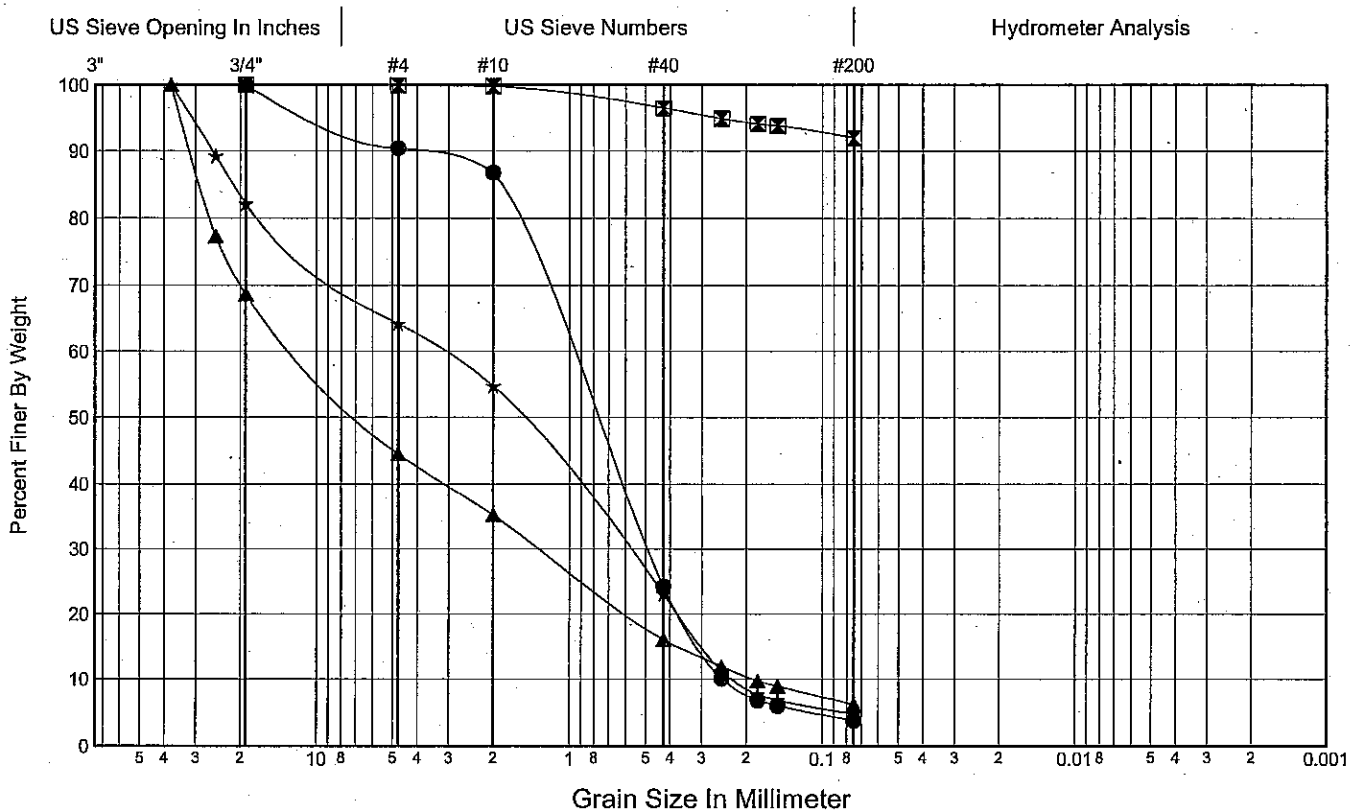
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	39.0	11.89	D-10	SP	See Boring Log	POORLY GRADED SAND	19			
⊠	49.0	14.94	D-12	ML	See Boring Log	SILT	48	41	NP	NA
▲	64.0	19.51	D-15	GP-GM	See Boring Log	POORLY GRADED GRAVEL with SILT and SAND	5			
★	74.0	22.56	D-17	SP	See Boring Log	POORLY GRADED SAND with GRAVEL	18			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	9.6	86.6	3.8	0.9	4.2
⊠	0.1	8.0	92.0		
▲	55.6	38.3	6.2	0.8	61.8
★	35.8	59.3	4.8	0.5	14.6

GRADATION VALUES

	D60	D50	D30	D20	D10
●	1.030	0.80	0.49	0.36	0.247
⊠					
▲	11.599	6.53	1.31	0.58	0.188
★	3.238	1.59	0.60	0.37	0.222



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-06-05** Sheet **1** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

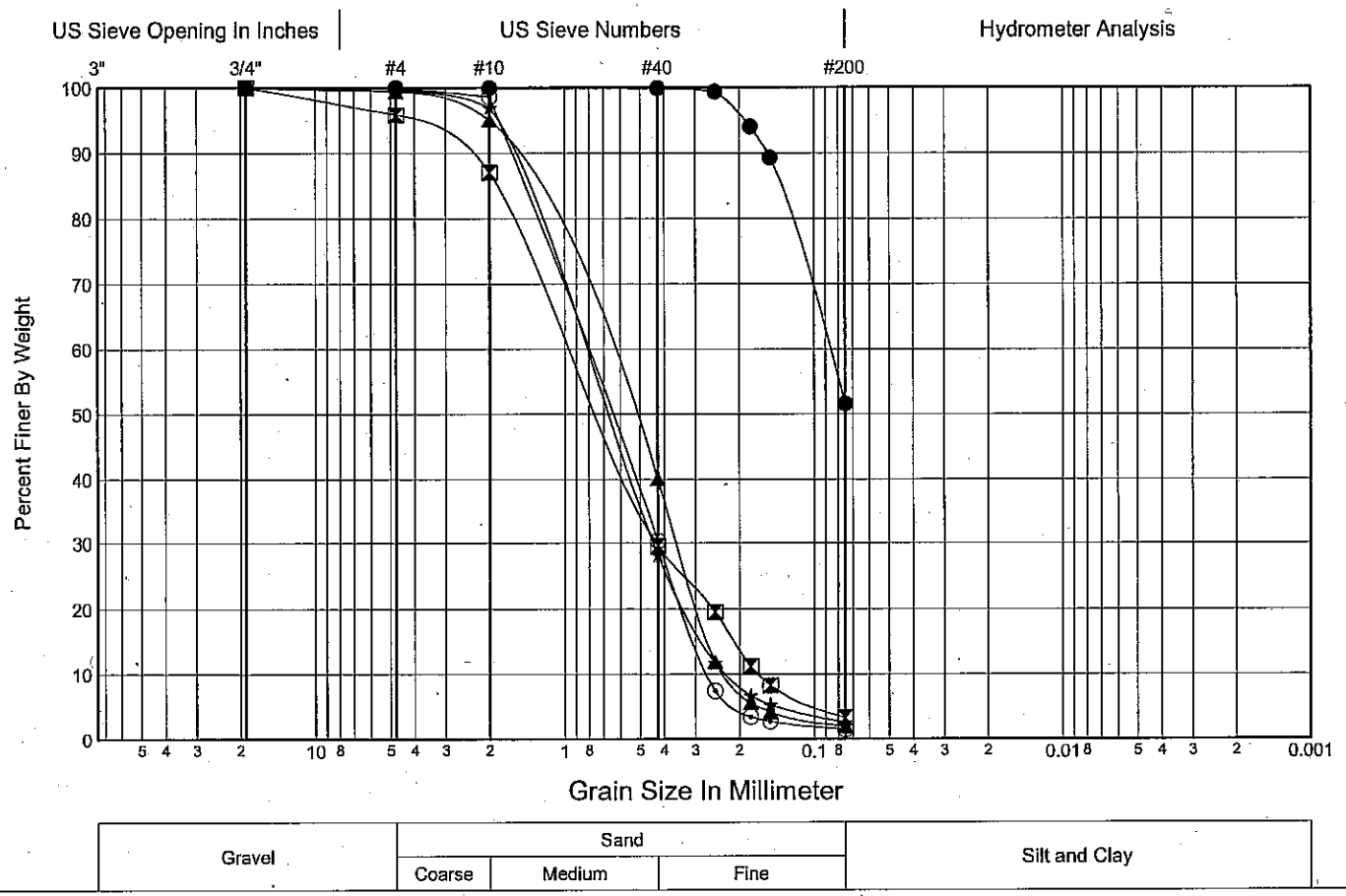
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	4.0	1.22	D-1	ML	See Boring Log	SANDY SILT	28			
⊠	9.0	2.74	D-2	SP	See Boring Log	POORLY GRADED SAND	21			
▲	19.0	5.79	D-4	SP	See Boring Log	POORLY GRADED SAND	16			
★	29.0	8.84	D-6	SP	See Boring Log	POORLY GRADED SAND	12			
⊙	39.0	11.89	D-8	SP	See Boring Log	POORLY GRADED SAND	27			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	48.4	51.6		
⊠	4.1	92.6	3.3	1.1	5.8
▲	0.6	97.4	1.9	0.7	3.3
★	0.4	97.0	2.5	1.0	3.9
⊙	0.2	98.4	1.4	0.8	3.1

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.088				
⊠	0.965	0.74	0.43	0.26	0.167
▲	0.746	0.56	0.35	0.29	0.227
★	0.869	0.69	0.44	0.33	0.224
⊙	0.833	0.66	0.42	0.33	0.266



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-06-05** Sheet **2** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

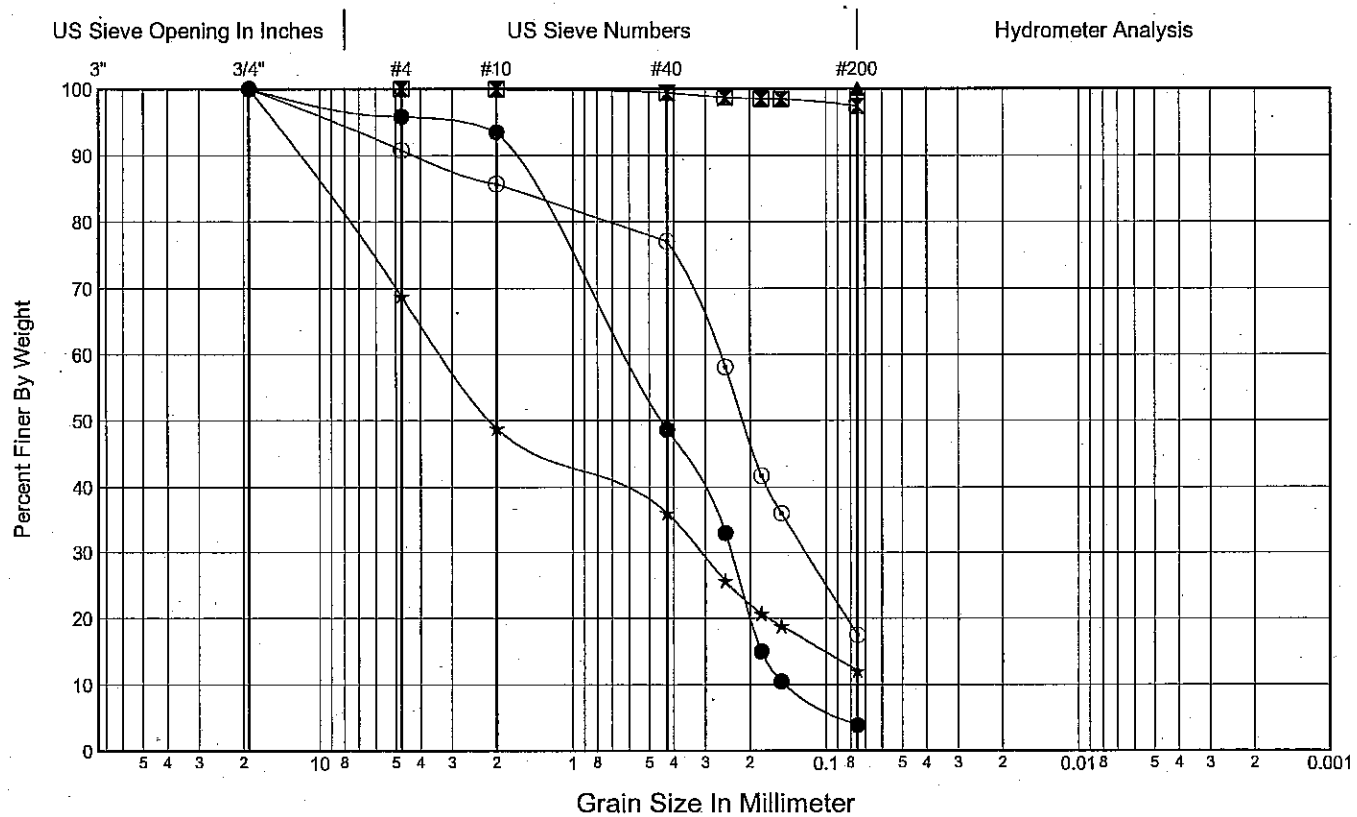
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	44.0	13.41	D-9	SP	See Boring Log	POORLY GRADED SAND	25			
⊠	54.0	16.46	D-11	ML	See Boring Log	SILT	35			
▲	59.0	17.98	D-12A	MH	See Boring Log	ELASTIC SILT Moisture Content Only	89	50	NP	NA
★	60.0	18.29	D-12B	SM	See Boring Log	SILTY SAND with GRAVEL	10			
⊙	64.0	19.51	D-13	SM	See Boring Log	SILTY SAND	20			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	4.2	92.0	3.8	0.6	4.4
⊠	0.0	2.6	97.4		
▲	0.0	0.0	100.0		
★	31.2	56.7	12.1	0.5	53.5
⊙	9.2	73.3	17.5		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.630	0.45	0.24	0.20	0.143
⊠					
▲					
★	3.246	2.10	0.31	0.17	
⊙	0.263	0.21	0.12	0.08	



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-06-05** Sheet **3** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

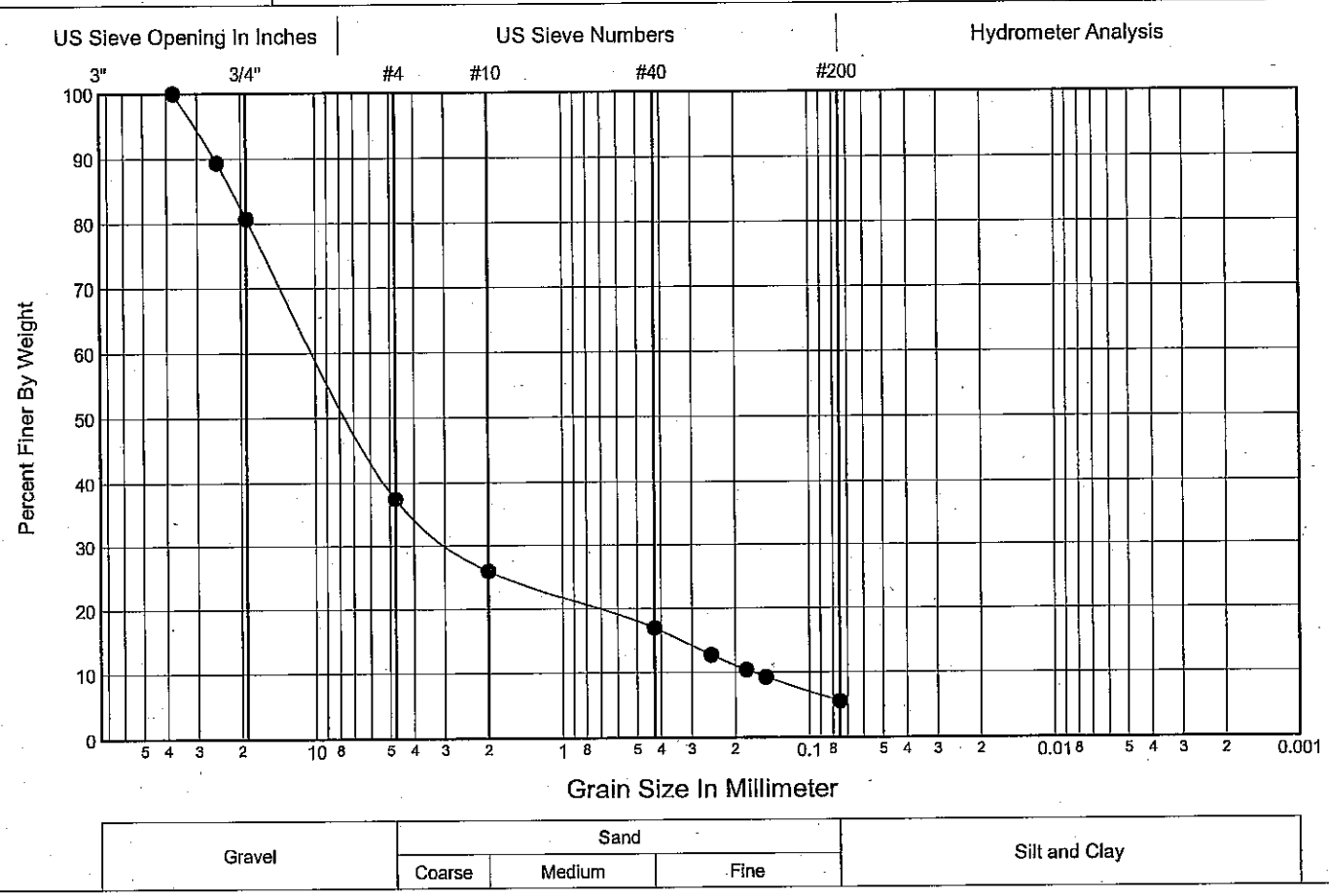
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	69.0	21.03	D-14	GP-GM	See Boring Log	POORLY GRADED GRAVEL with SILT and SAND	5			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	62.6	31.8	5.5	4.5	58.1

GRADATION VALUES

	D60	D50	D30	D20	D10
●	9.807	7.12	2.73	0.72	0.169



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-07-05** Sheet **1** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

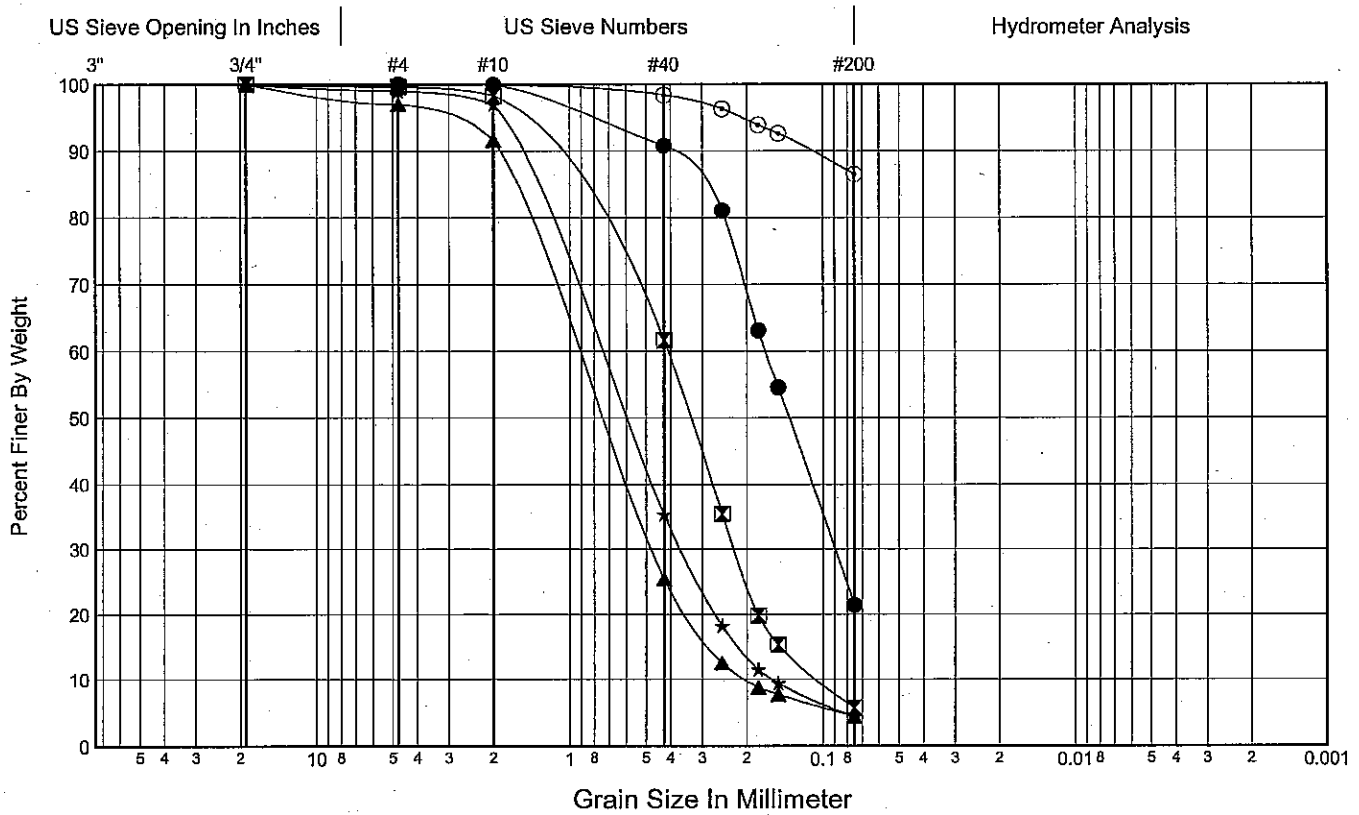
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	4.0	1.22	D-1	SM	See Boring Log	SILTY SAND	21			
⊠	9.5	2.90	D-2	SP-SM	See Boring Log	POORLY GRADED SAND with SILT and wood chunks	27			
▲	19.5	5.94	D-4	SP	See Boring Log	POORLY GRADED SAND	23			
★	29.0	8.84	D-6	SP	See Boring Log	POORLY GRADED SAND	23			
⊙	34.0	10.36	D-7	MH	See Boring Log	ELASTIC SILT	76	69	NP	NA

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	78.5	21.5		
⊠	0.3	93.9	5.7	1.2	4.0
▲	3.0	92.7	4.4	1.2	4.8
★	1.0	94.6	4.4	1.0	5.0
⊙	0.0	13.5	86.5		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.168	0.14	0.09		
⊠	0.411	0.34	0.22	0.18	0.102
▲	0.955	0.76	0.47	0.34	0.201
★	0.790	0.61	0.36	0.26	0.158
⊙					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-07-05** Sheet **2** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

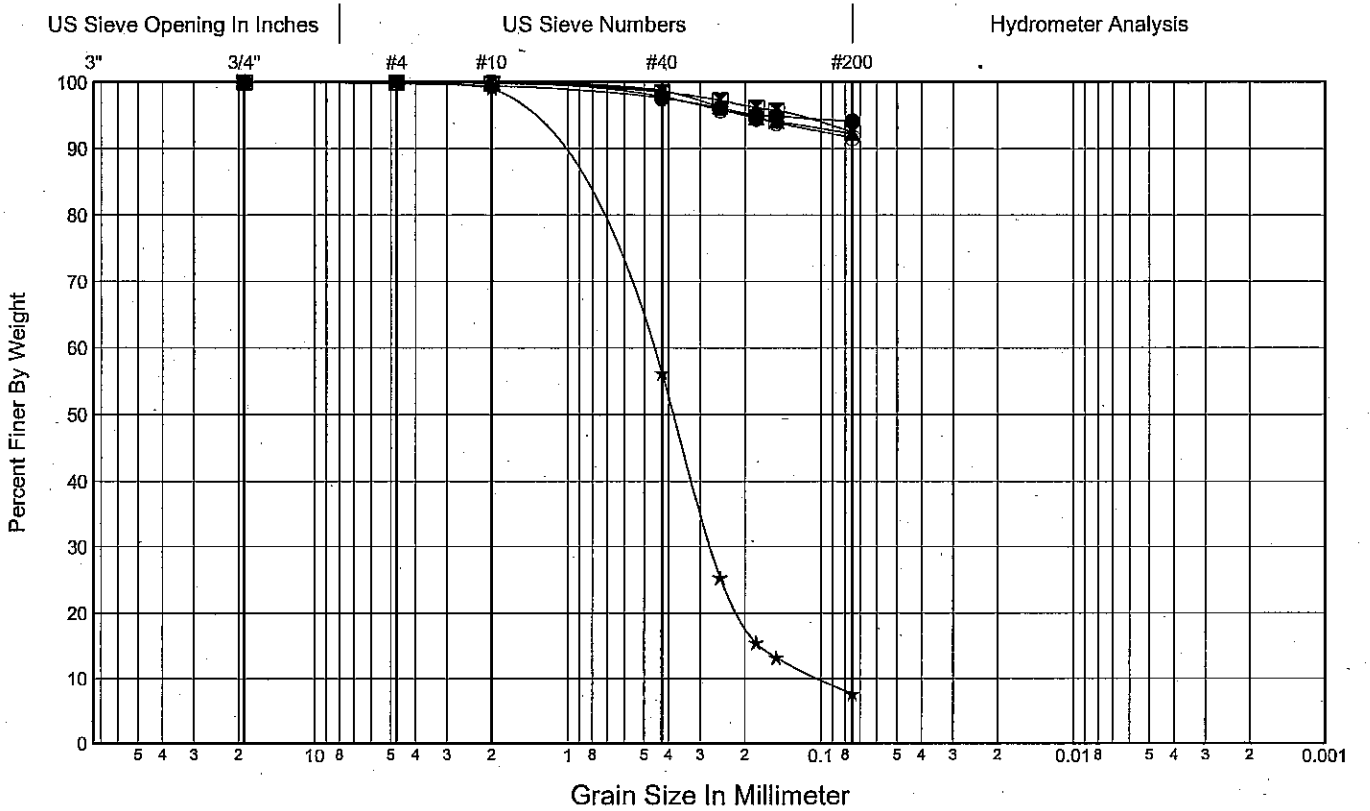
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	36.3	11.06	U-8/C	ML	See Boring Log	SILT and wood fibres	66			
⊠	37.0	11.28	U-8/E	ML	See Boring Log	SILT and wood fibres	50	40	NP	NA
▲	39.0	11.89	D-9	ML	See Boring Log	SILT	92	49	NP	NA
★	49.0	14.94	D-12	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	25			
⊙	54.0	16.46	D-13	ML	See Boring Log	SILT	47	38	NP	NA

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.2	5.7	94.0		
⊠	0.0	7.5	92.4		
▲	0.0	7.8	92.2		
★	0.0	92.4	7.6	1.5	4.8
⊙	0.0	8.4	91.6		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠					
▲					
★	0.487	0.38	0.27	0.21	0.101
⊙					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-07-05** Sheet **3** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

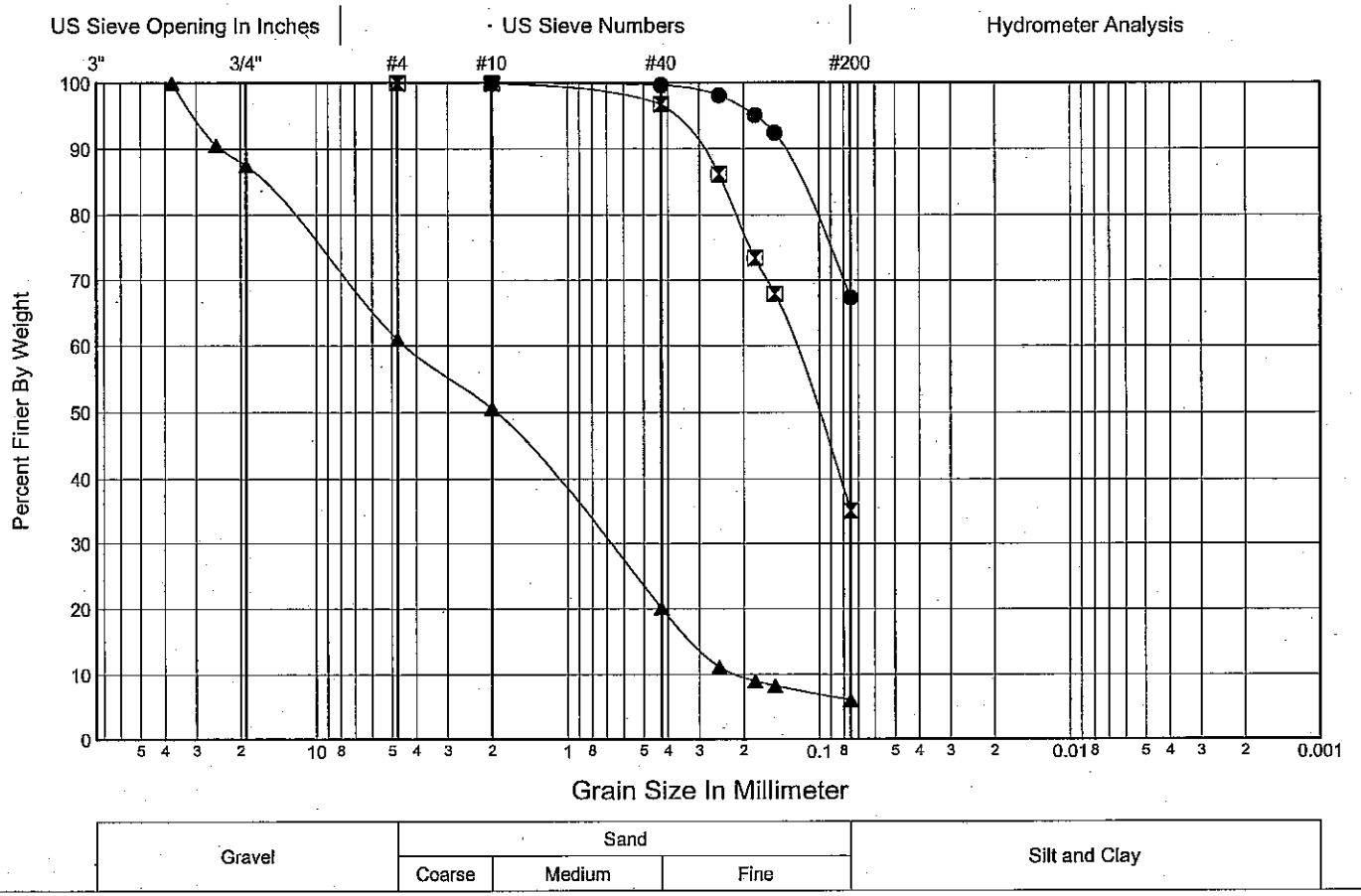
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	59.0	17.98	D-14	ML	See Boring Log	SANDY SILT	27			
⊠	64.0	19.51	D-15	SM	See Boring Log	SILTY SAND	24			
▲	69.0	21.03	D-16	SP-SM	See Boring Log	POORLY GRADED SAND with SILT and GRAVEL	11			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	32.7	67.3		
⊠	0.0	65.0	35.0		
▲	39.1	54.9	6.0	0.5	20.9

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠	0.127	0.10			
▲	4.397	1.94	0.70	0.42	0.210



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-08-05** Sheet **1** of **1**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

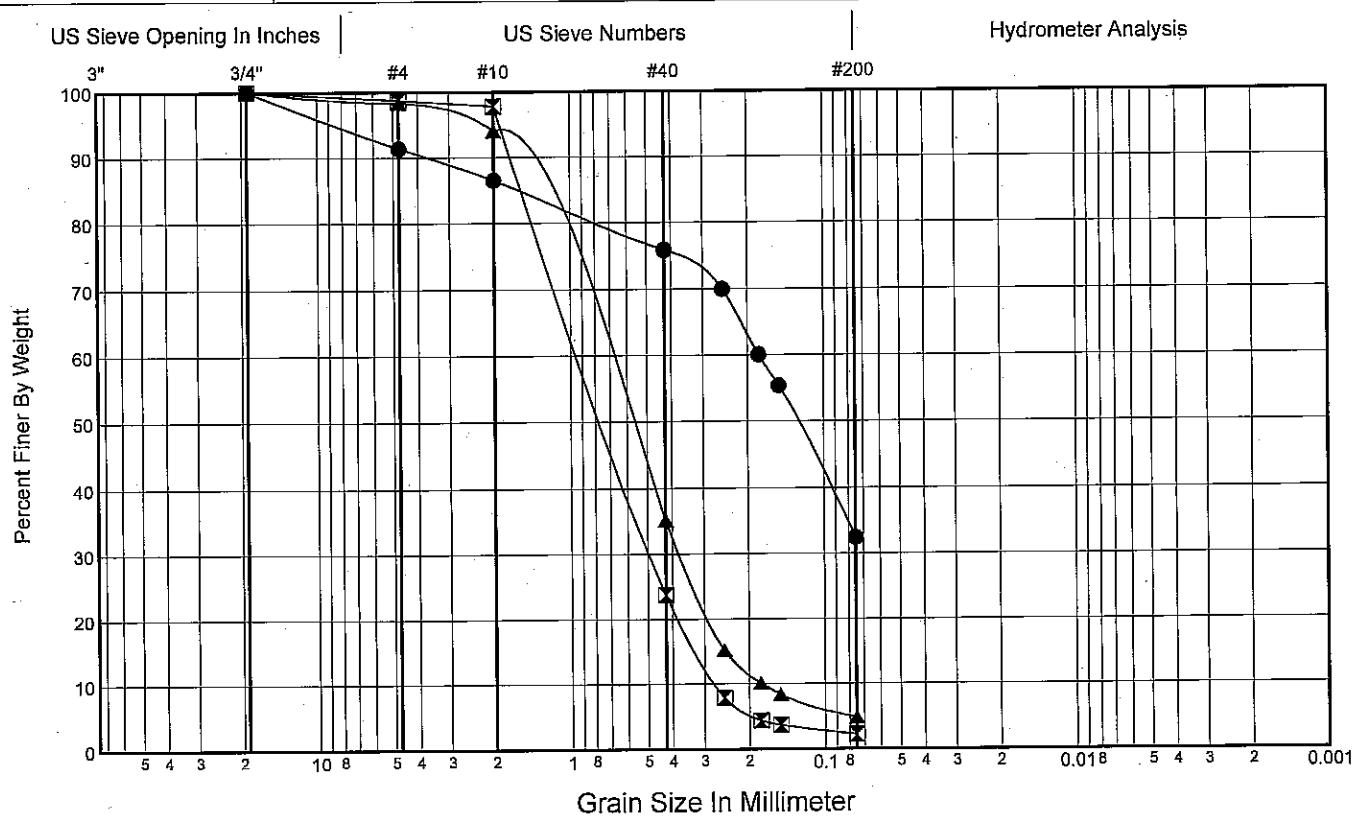
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	9.5	2.90	D-2	SM	See Boring Log	SILTY SAND	26			
⊠	19.5	5.94	D-4	SP	See Boring Log	POORLY GRADED SAND	25			
▲	29.0	8.84	D-6	SP	See Boring Log	POORLY GRADED SAND	22			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	8.6	59.1	32.4		
⊠	1.3	96.5	2.2	1.0	3.4
▲	1.7	93.5	4.8	0.9	4.6

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.180	0.13			
⊠	0.907	0.74	0.48	0.37	0.268
▲	0.818	0.63	0.37	0.28	0.178



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-09-05** Sheet **1** of **2**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

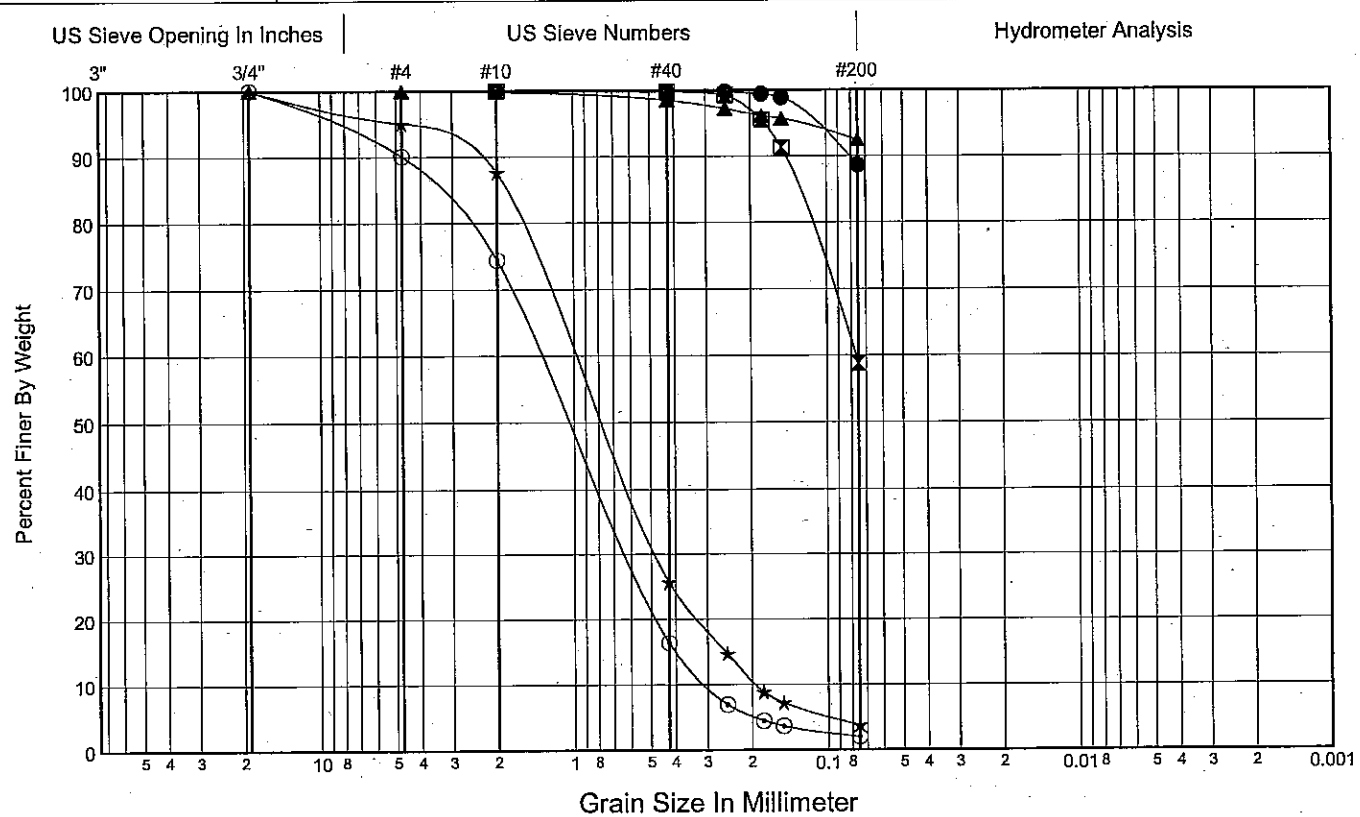
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	3.0	0.91	D-1	ML	See Boring Log	SILT	35	NA	NP	NA
⊠	8.2	2.50	U-2/A	ML	See Boring Log	SANDY SILT	36	NA	NP	NA
▲	8.5	2.59	U-2/B	ML	See Boring Log	SILT	50	NA	NP	NA
★	10.0	3.05	D-3	SP	See Boring Log	POORLY GRADED SAND	18			
⊙	13.0	3.96	D-4	SP	See Boring Log	POORLY GRADED SAND	5			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	11.4	88.6		
⊠	0.0	41.2	58.8		
▲	0.0	7.5	92.4		
★	5.0	91.3	3.7	1.2	5.2
⊙	9.9	88.1	2.0	0.9	4.6

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠	0.077				
▲					
★	1.003	0.78	0.47	0.32	0.192
⊙	1.361	1.04	0.61	0.47	0.297



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-09-05** Sheet **2** of **2**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

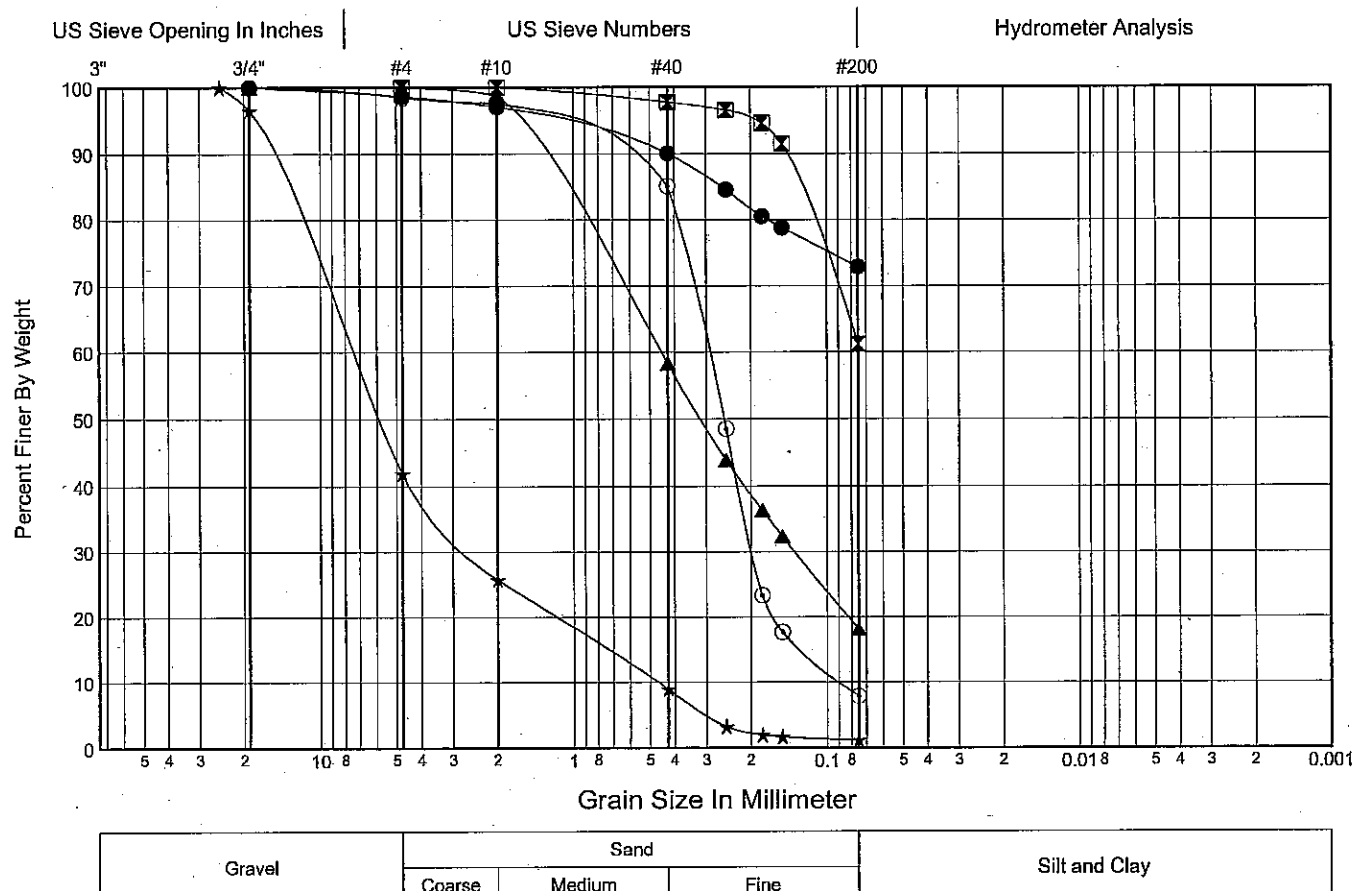
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	33.0	10.06	D-8	ML	See Boring Log	SILT with SAND	69	38	NP	NA
⊠	50.0	15.24	D-15	ML	See Boring Log	SANDY SILT	31			
▲	53.0	16.15	D-16	SM	See Boring Log	SILTY SAND and wood chunks	18			
★	63.0	19.20	D-18	GW	See Boring Log	WELL-GRADED GRAVEL with SAND	2			
⊙	93.0	28.35	D-24	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	23			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	1.4	25.8	72.9		
⊠	0.0	38.8	61.2		
▲	0.1	81.8	18.1		
★	58.1	40.7	1.2	1.8	16.0
⊙	1.6	90.6	7.8	1.5	3.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠					
▲	0.454	0.31	0.13	0.08	
★	7.525	5.84	2.52	1.18	0.471
⊙	0.295	0.26	0.20	0.16	0.087



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-10-05** Sheet **1** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

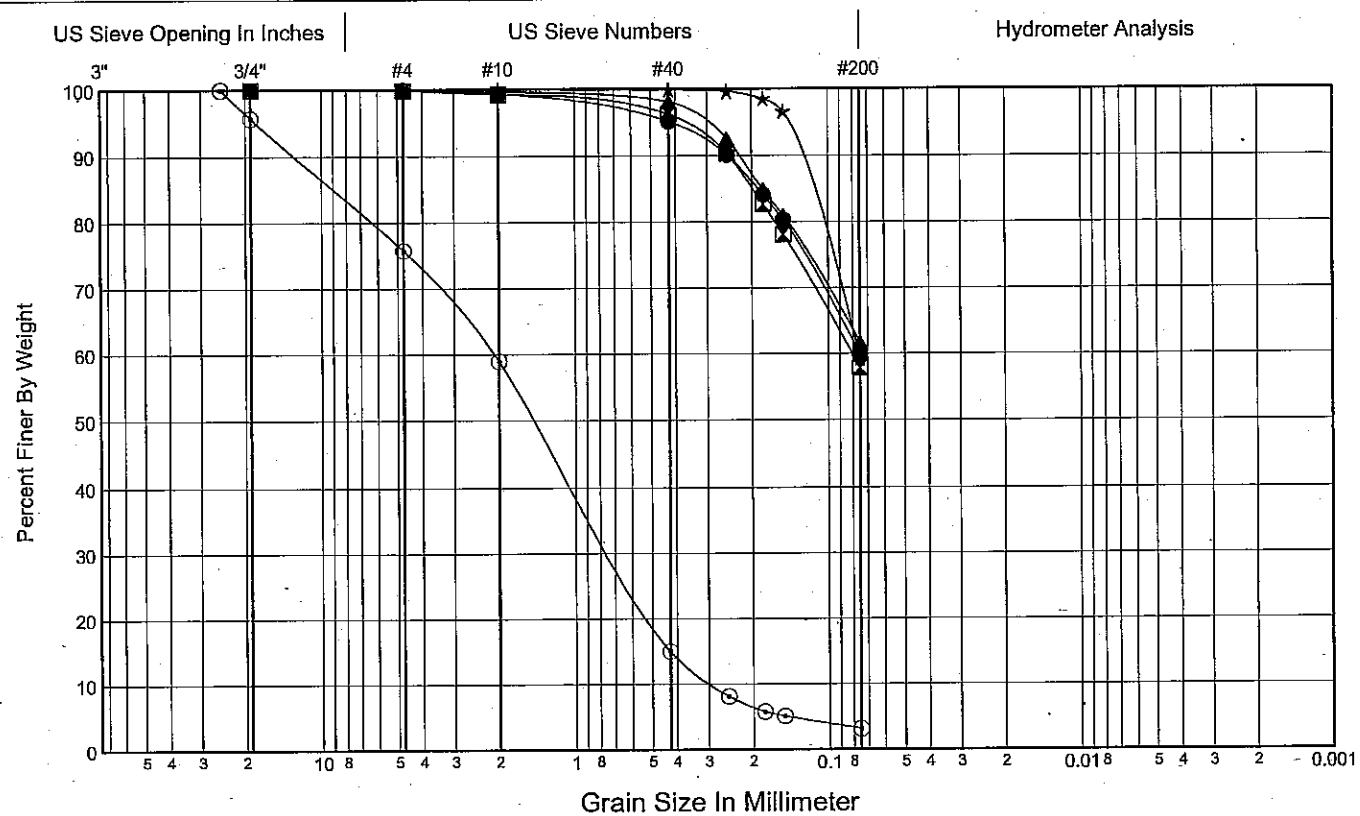
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	0.0	0.00	D-1	ML	See Boring Log	SANDY SILT and wood chunks,root fibers	8			
⊠	2.5	0.76	D-2	ML	See Boring Log	SANDY SILT and organics	25			
▲	4.0	1.22	D-3	MH	See Boring Log	SANDY ELASTIC SILT (sample too small)	86	66	NP	NA
★	9.0	2.74	D-4	ML	See Boring Log	SANDY SILT	36			
⊙	14.0	4.27	D-6	SP	See Boring Log	POORLY GRADED SAND with GRAVEL	14			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.1	40.1	59.9		
⊠	0.1	42.0	57.8		
▲	0.2	38.1	61.7		
★	0.0	40.8	59.2		
⊙	24.2	72.6	3.1	0.9	7.3

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.075				
⊠	0.081				
▲					
★	0.076				
⊙	2.114	1.46	0.72	0.51	0.289



Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-10-05** Sheet **2** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

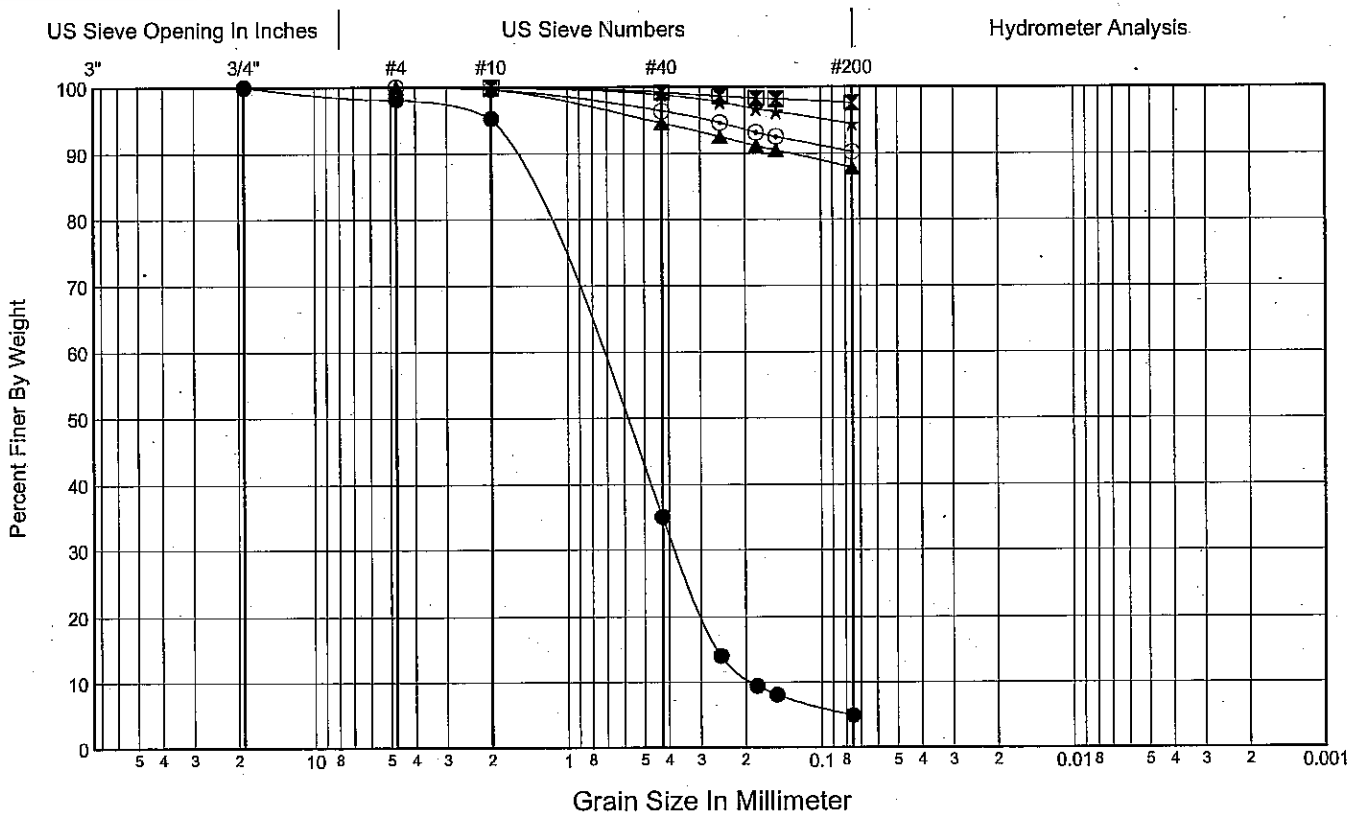
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	24.0	7.32	D-8	SP	See Boring Log	POORLY GRADED SAND	21			
⊠	34.0	10.36	D-10	ML	See Boring Log	SILT	48	38	NP	NA
▲	39.0	11.89	D-11	MH	See Boring Log	ELASTIC SILT	51	54	NP	NA
★	46.0	14.02	D-13	ML	See Boring Log	SILT	60	42	NP	NA
⊙	51.0	15.54	D-15	ML	See Boring Log	SILT	54	49	NP	NA

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	1.9	93.3	4.9	0.9	4.3
⊠	0.0	2.4	97.6		
▲	0.0	12.2	87.8		
★	0.0	5.6	94.4		
⊙	0.0	9.8	90.2		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.808	0.63	0.37	0.29	0.188
⊠					
▲					
★					
⊙					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-10-05** Sheet **3** of **3**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

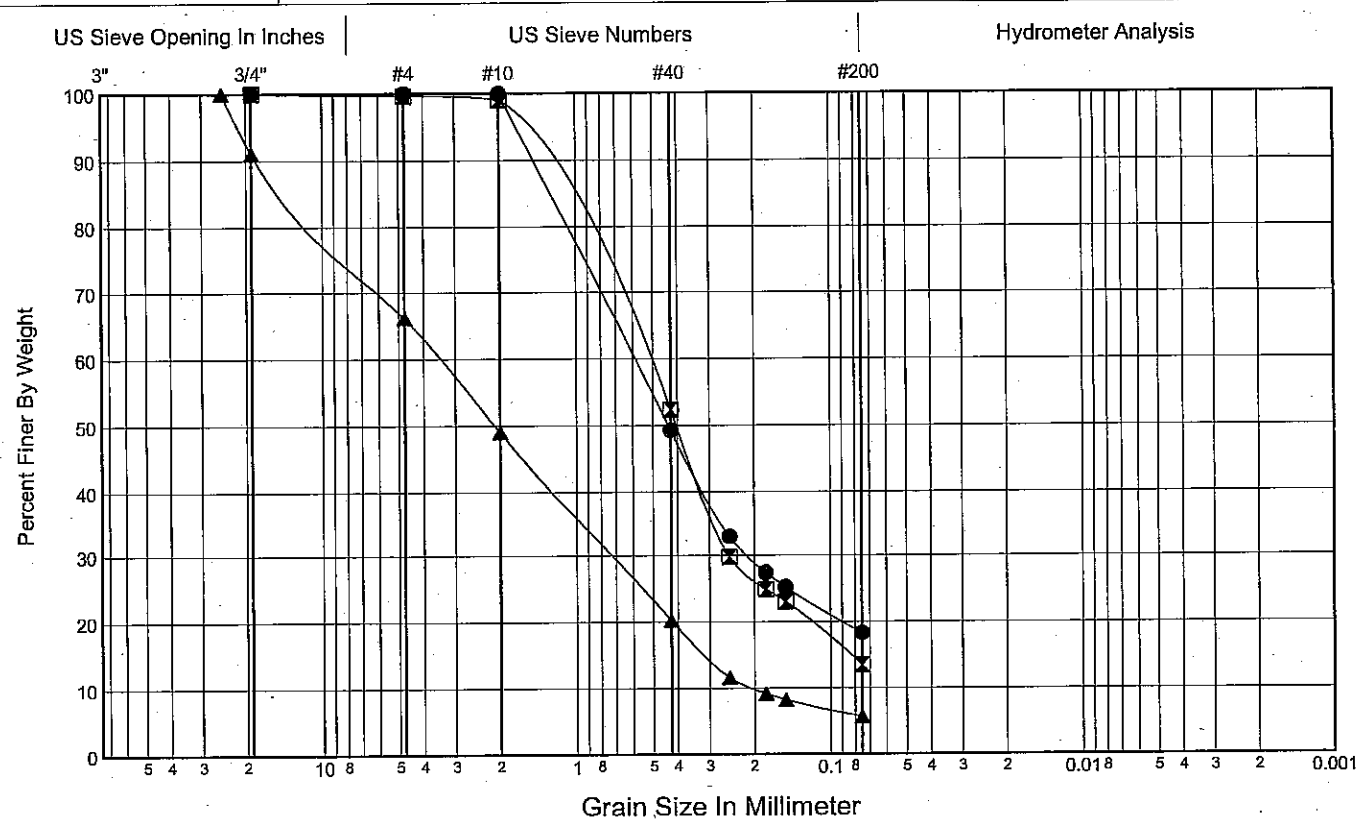
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	54.0	16.46	D-16	SM	See Boring Log	SILTY SAND	18			
⊠	56.0	17.07	D-17	SM	See Boring Log	SILTY SAND	21			
▲	64.0	19.51	D-19	SP-SM	See Boring Log	POORLY GRADED SAND with SILT and GRAVEL	5			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	81.7	18.3		
⊠	0.3	86.1	13.5		
▲	33.9	60.4	5.7	0.7	17.3

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.590	0.44	0.21	0.09	
⊠	0.548	0.40	0.25	0.12	
▲	3.488	2.10	0.72	0.42	0.202



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3485** Date **July 14, 2006**

Hole No. **BH-18-06** Sheet **1** of **1**

Project **SR-20 Fredonia to I-5 Widening**

Laboratory Summary

Washington State Department of Transportation

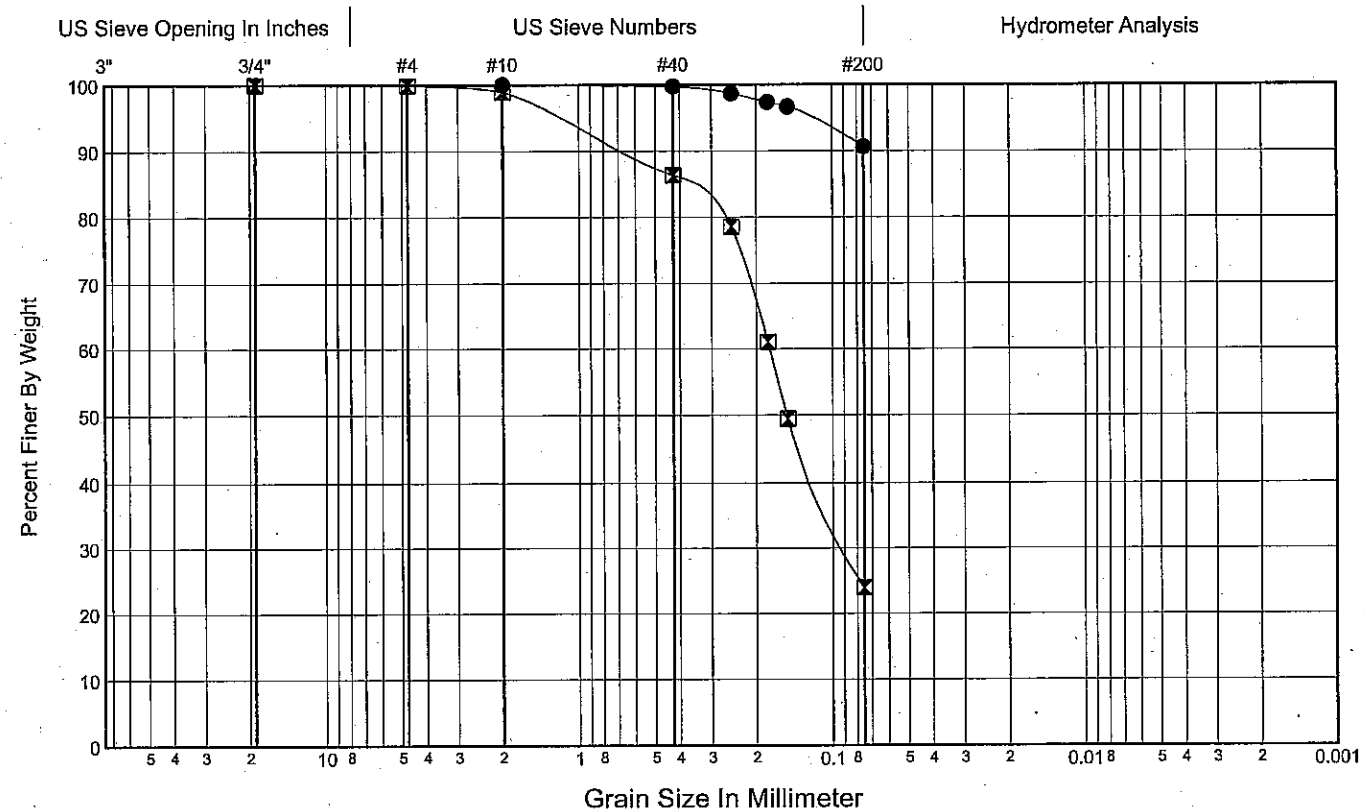
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	4.0	1.22	D-1	ML	See Boring Log	SILT	96	NA	NP	NA
⊠	6.5	1.98	S-2	SM	See Boring Log	SILTY SAND with organics	32			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	9.4	90.6		
⊠	0.1	76.0	23.9		

GRADATION VALUES

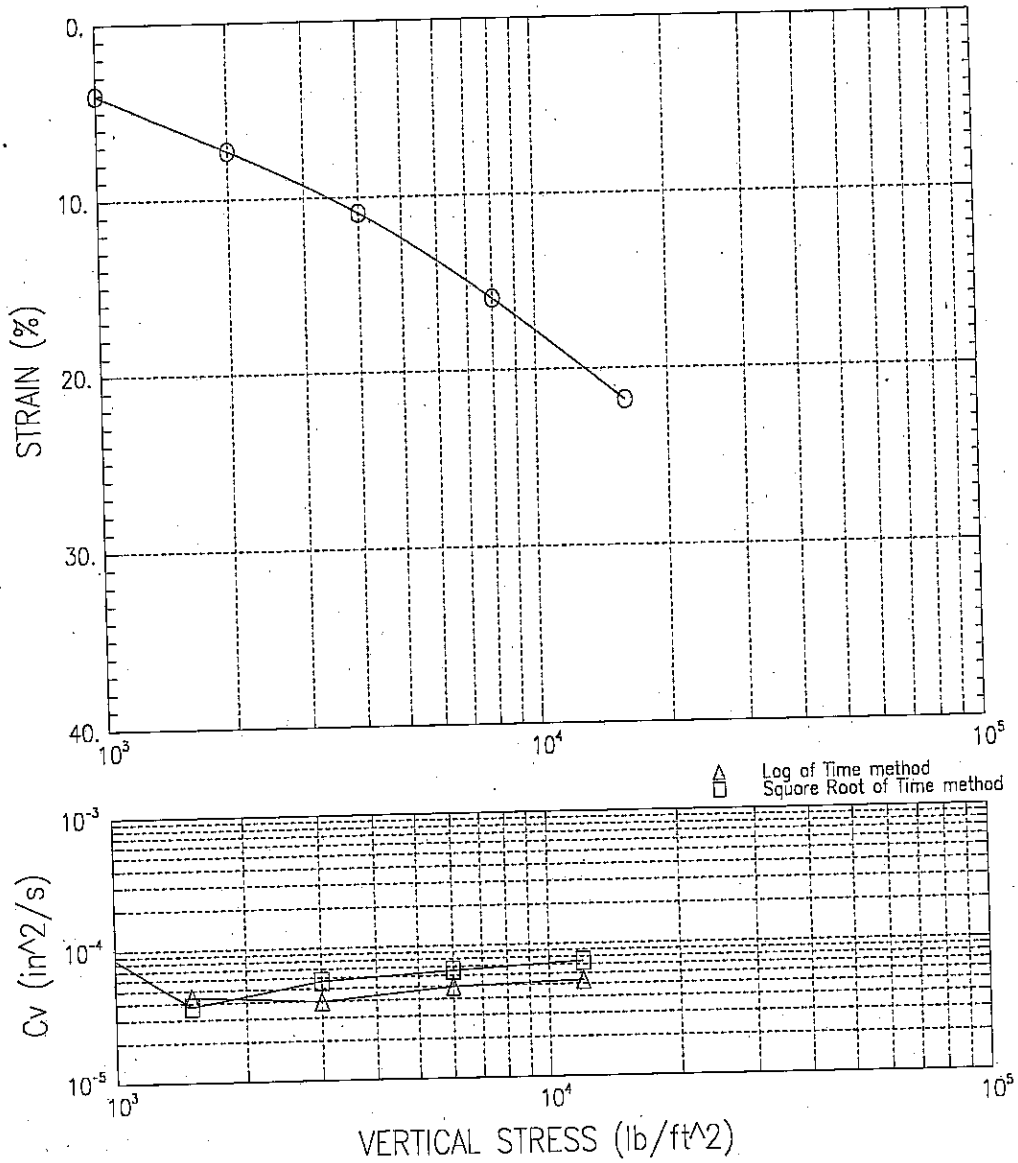
	D60	D50	D30	D20	D10
●					
⊠	0.177	0.15	0.09		



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

CONSOLIDATION TEST

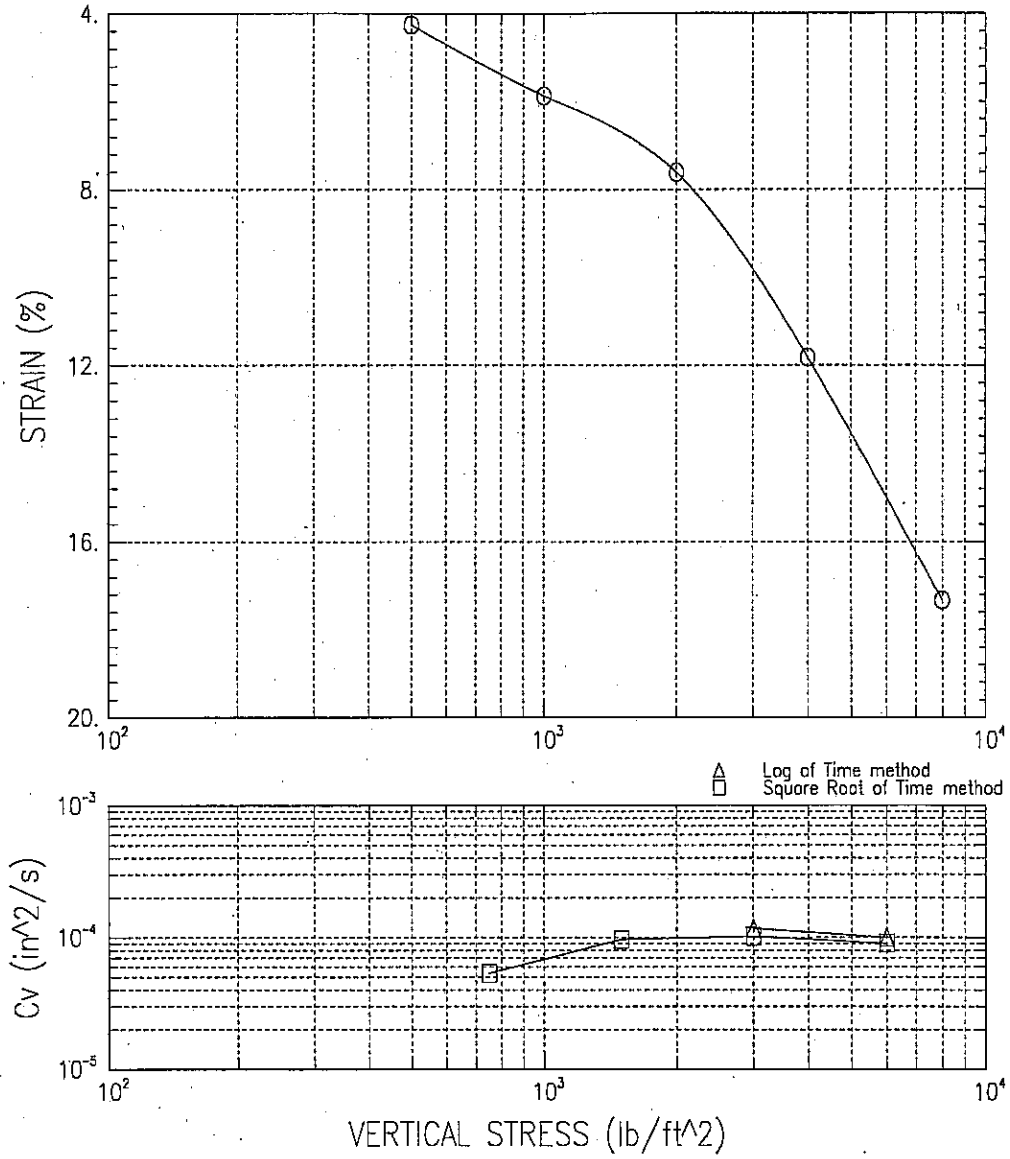
SUMMARY REPORT



Washington State D.O.T.
Project Name : FREDONIA TO I-5
Project No : OL-3485 Boring No : BH-3-05 Sample No : U-18/C
Test Date : 2/6/06 Test No : 603418C Depth : 81.8 FT
Description : MOIST GRAY CLAY
Remarks :

CONSOLIDATION TEST

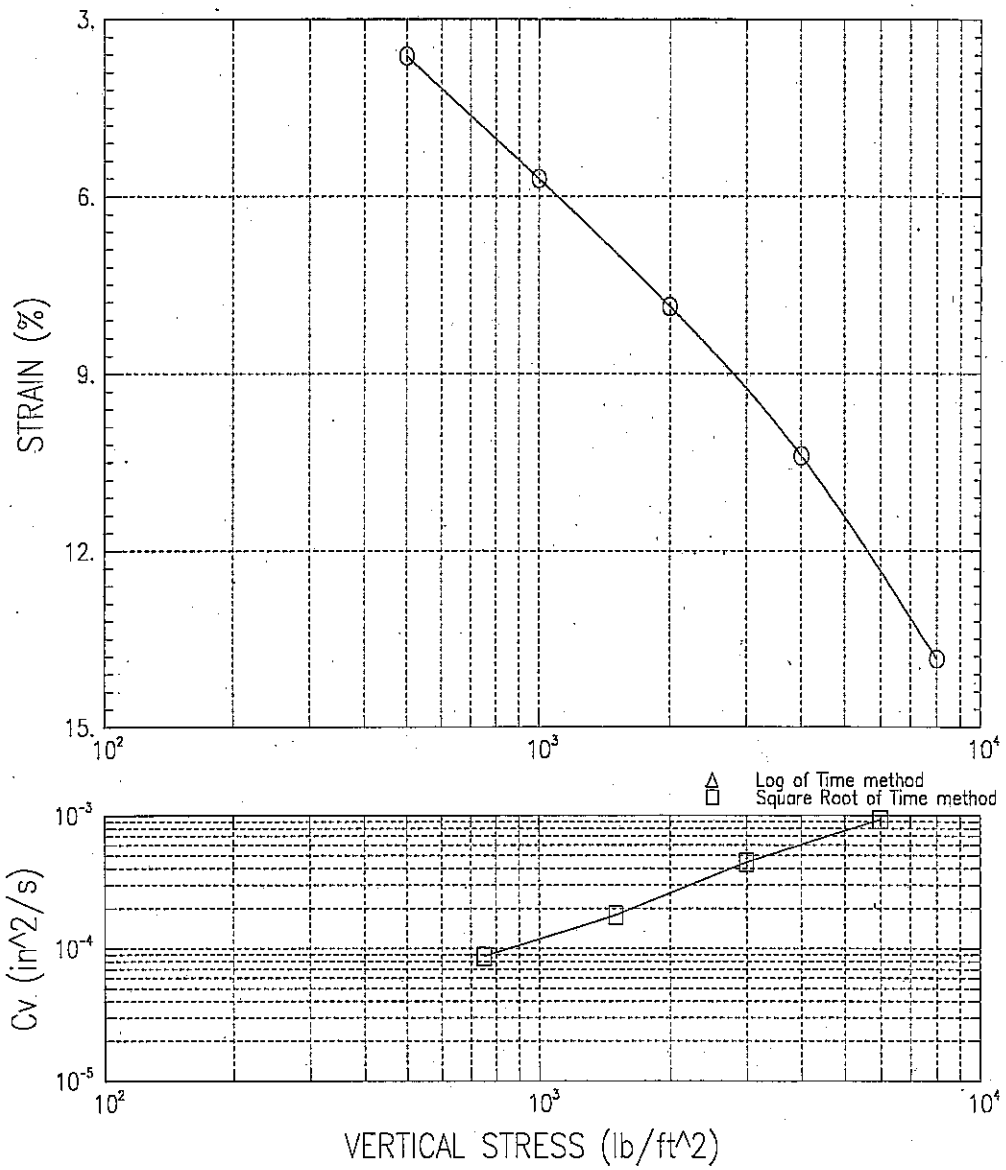
SUMMARY REPORT



Washington State D.O.T.
Project Name : FREDONIA TO I-5
Project No : OL-3485 Boring No : BH-7-05 Sample No : U-8/C
Test Date : 1/30/06 Test No : 6036UBC Depth : 36.3 FT
Description : GRAY MOIST SILT WITH ORGANICS
Remarks :

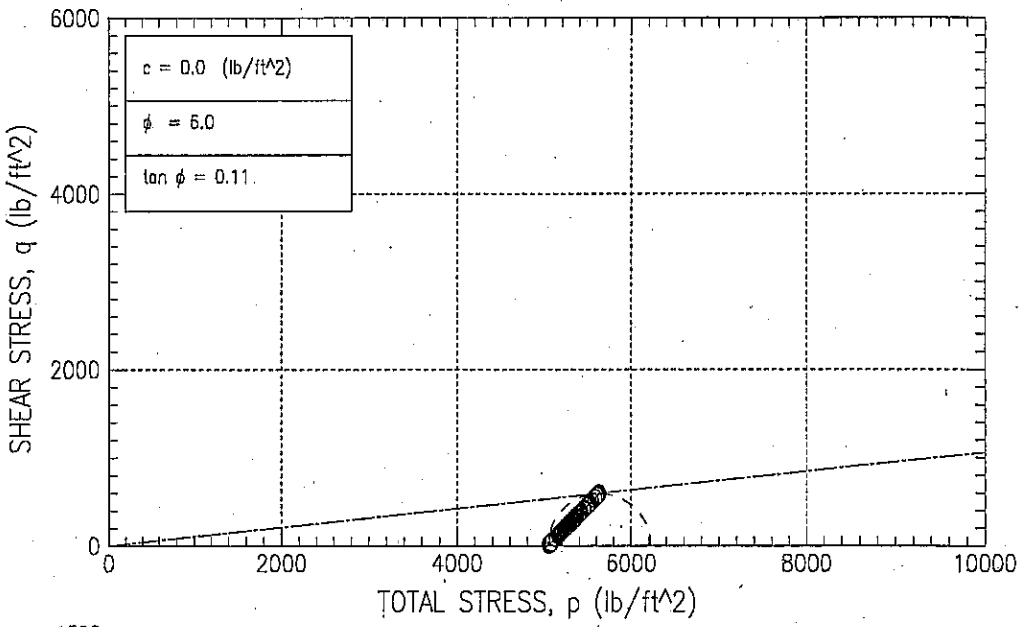
CONSOLIDATION TEST

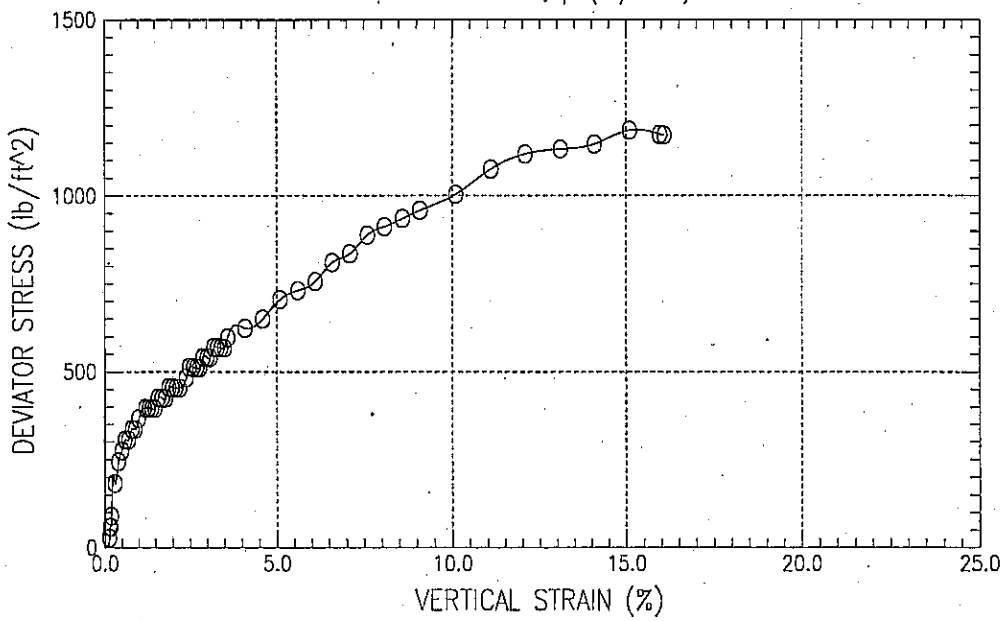
SUMMARY REPORT



Washington State D.O.T.
Project Name : FREDONIA TO I-5
Project No : OL-3485 Boring No : BH-9-05 Sample No : U-2/B
Test Date : 2/1/06 Test No : 6203U2B Depth : 8.5 FT
Description : WET DARK GRAY SILT
Remarks :

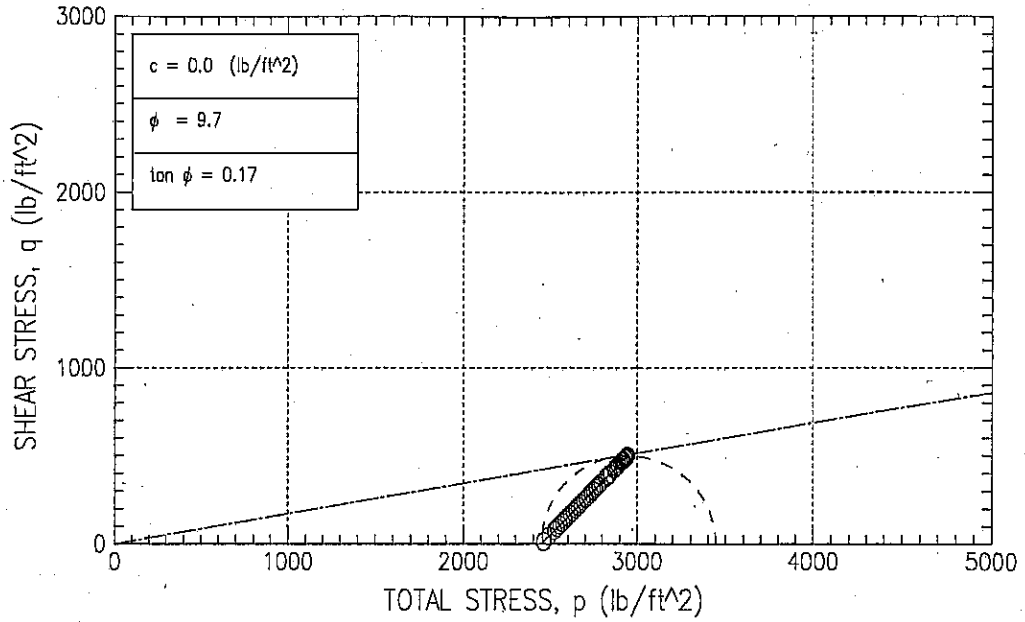
UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

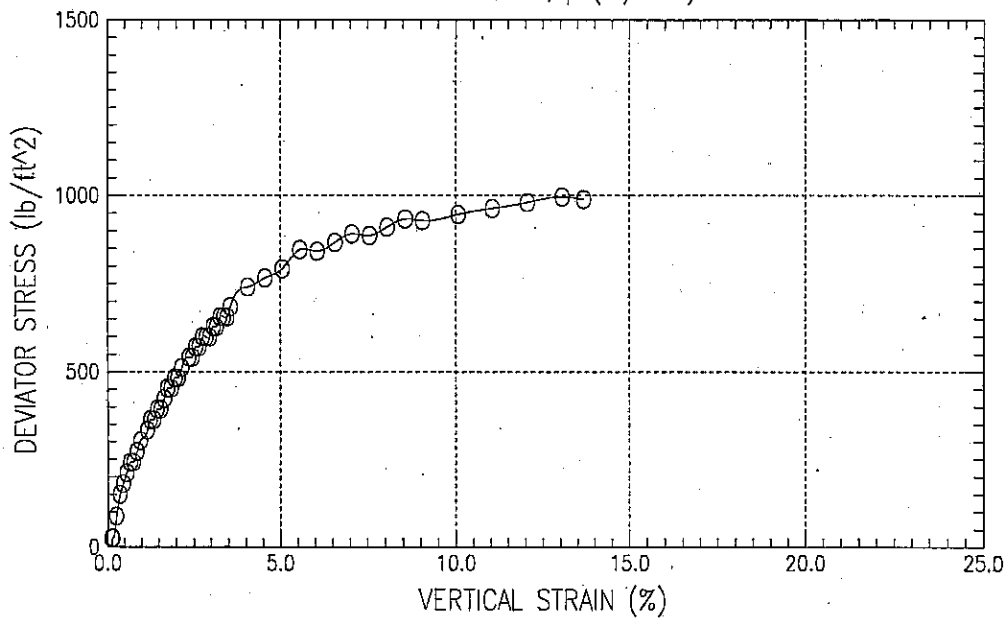




Washington State D.O.T.
Project Name : FREDONIA TO I-5
Project No : OL-3485 Boring No : BH-3-05 Sample No : U-18/E
Test Date : 1/31/06 Test No : 603418E Depth : 82.5 FT
Description : GRAY MOIST SILT
Remarks :

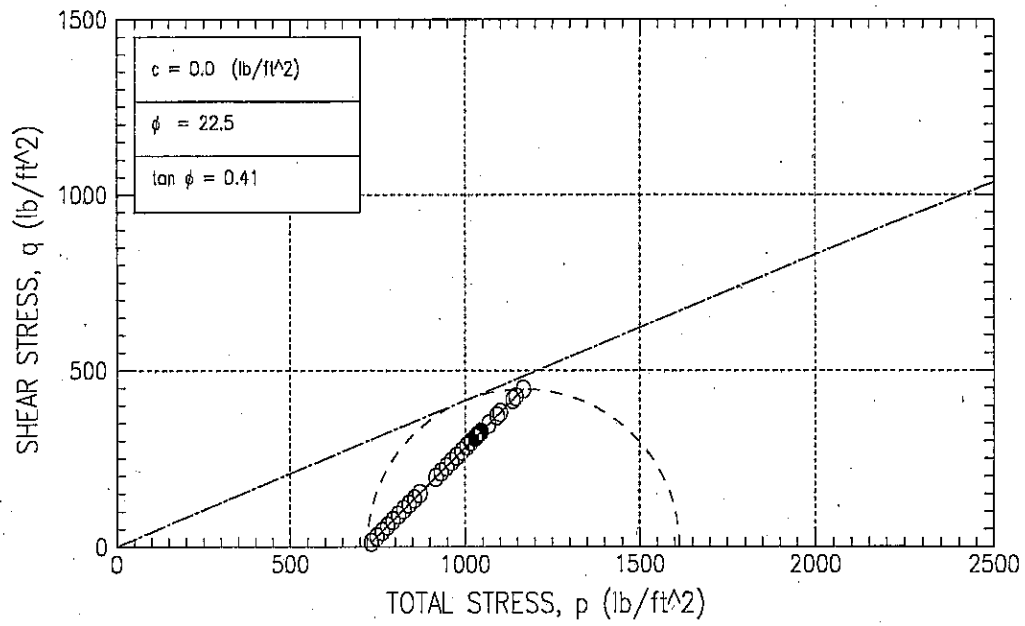
UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

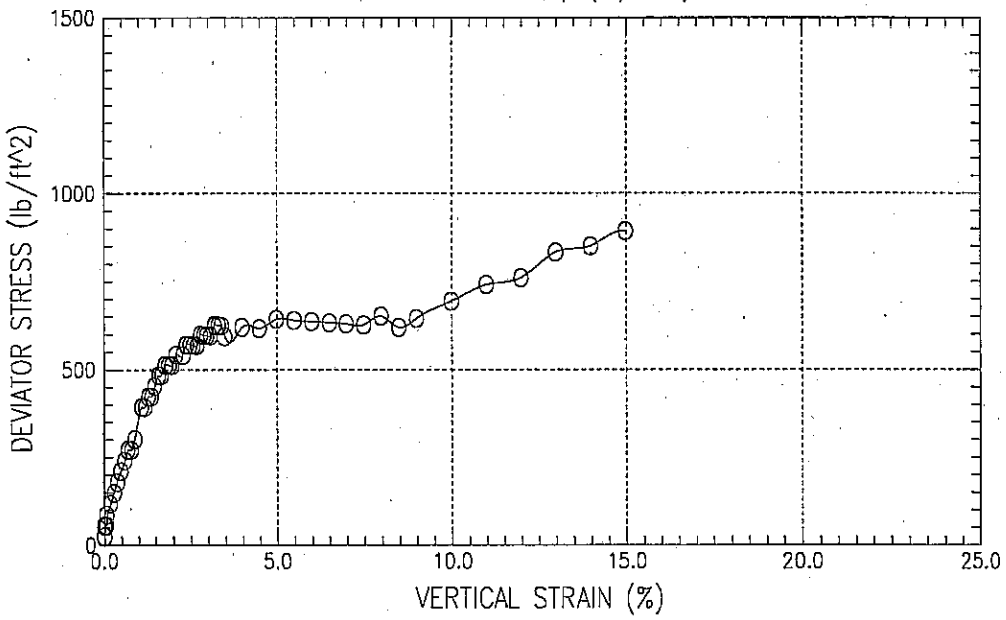




Washington State D.O.T.
Project Name : FREDONIA TO I-5
Project No : OL-3485 Boring No : BH-7-05 Sample No : U-8/E
Test Date : 1/31/06 Test No : 6036U8E Depth : 37 FT
Description : GRAY MOIST SILT WITH ORGANICS
Remarks :

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST





Washington State D.O.T.
Project Name : FREDONIA TO I-5
Project No : OL-3485 Boring No : BH-9-05 Sample No : U-2/A
Test Date : 2/1/06 Test No : 6203U2A Depth : 8.2 FT
Description : DARK GRAY WET SILT
Remarks :

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION - STATE MATERIALS LABORATORY
PO BOX 47365 OLYMPIA WA 98504-7365 / 1655 SOUTH 2ND AVE TUMWATER WA 98512

Physical Testing Section
Soils Test Report

Date Sampled:
Sampled By:
Date Received: 06/06/2006
S.R. No.: 20
Section: **FREDONIA TO I-5 WIDENING**
Contractor:

Work Order No. **0L3485**
Lab ID No. **0000226144**
Lab Number **PS-226144**
Trans. No. **479207**
Bid Item No.
Org. No. **306310**
F.A. No.

==========

Material **SOIL**

Pit No.:

Quantity Represented:

Sample No:

Sample Loc.: **D-4**

GRADATION (AASHTO T-88):

SIZE	% PASSING	SPECIFICATIONS

ORGANIC MATTER (AASHTO T-267): %

PH VALUE (AASHTO T-289): 4.1

RESISTIVITY (AASHTO T-288): (OHMS) 2,200

HYDROMETER RESULTS (WSDOT TM 124):

SAND %	50 MAXIMUM
CLAY %	20 MAXIMUM
SILT %	---

SOIL TEXTURE CLASSIFICATION

==========

Distribution:
Materials File X
Region Construction
Project Engineer:
PETE PALMERSON X(2)

Result: **INFORMATIONAL**
Remarks:

THOMAS E. BAKER, P.E.
MATERIALS ENGINEER

Donald Brouillard
Date: 06/13/2006
Phone: (360)709-5446

By: Copy

T42G-	T44J-	T44T-	
T43B-	T44K-	T44U-	
T43H-	T44N-	T44V-	1.0
T44A-	T44P-	1.0	T2D1-
T44G-			T2L0-

soils.dfr 3/03

WASHINGTON STATE DEPARTMENT OF TRANSPORTATION - STATE MATERIALS LABORATORY
PO BOX 47365 OLYMPIA WA 98504-7365 / 1655 SOUTH 2ND AVE TUMWATER WA 98512

Physical Testing Section
Soils Test Report

Work Order No. 0L3485
Lab ID No. 0000226143
Lab Number PS-226143
Trans. No. 479206
Bid Item No.
Org. No. 306310
F.A. No.

Date Sampled:
Sampled By:
Date Received: 06/06/2006
S.R. No.: 20
Section: FREDONIA TO I-5 WIDENING
Contractor:

==========

Material SOIL

Pit No.:

Quantity Represented:

Sample No:

Sample Loc.: D-3

GRADATION (AASHTO T-88):

SIZE	% PASSING	SPECIFICATIONS

ORGANIC MATTER (AASHTO T-267): %

PH VALUE (AASHTO T-289): 5.7

RESISTIVITY (AASHTO T-288): (OHMS) 3,400

HYDROMETER RESULTS (WSDOT TM 124):

SAND %		50 MAXIMUM
CLAY %		20 MAXIMUM
SILT %		---

SOIL TEXTURE CLASSIFICATION

==========

Distribution:
Materials File X
Region Construction
Project Engineer:
PETE PALMERSON X(2)

Result: INFORMATIONAL
Remarks:

THOMAS E. BAKER, P.E.
MATERIALS ENGINEER

T42G-	T44J-	T44T-	
T43B-	T44K-	T44U-	
T43H-	T44N-	T44V-	1.0
T44A-	T44P-	1.0	T2D1-
T44G-			T2L0-

Donald Brouillard
Date: 06/13/2006
Phone: (360)709-5446

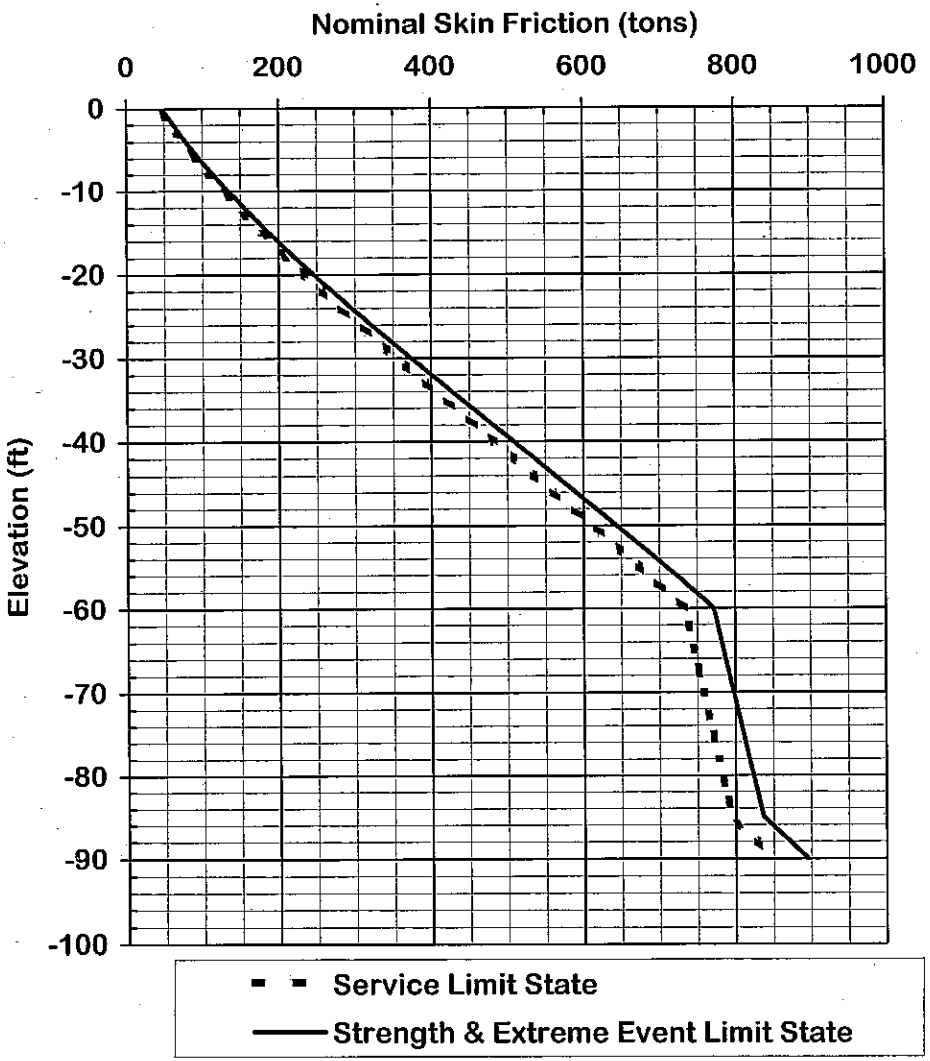
By:

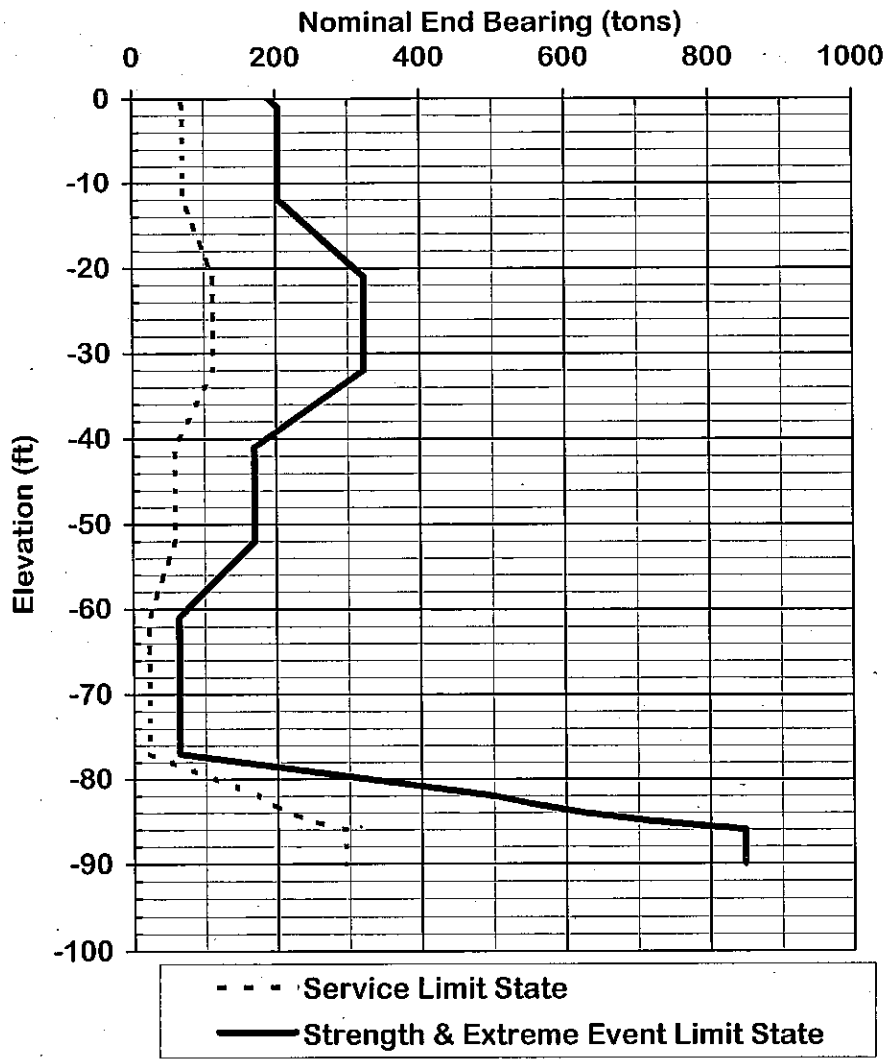
soils.dfr 3/03

APPENDIX D – DRILLED SHAFT AXIAL CAPACITIES

Bridge #20/214 N & S
Pier(s) 1 & 2
Diameter 6 (ft)

Drilled Shaft Axial Capacity



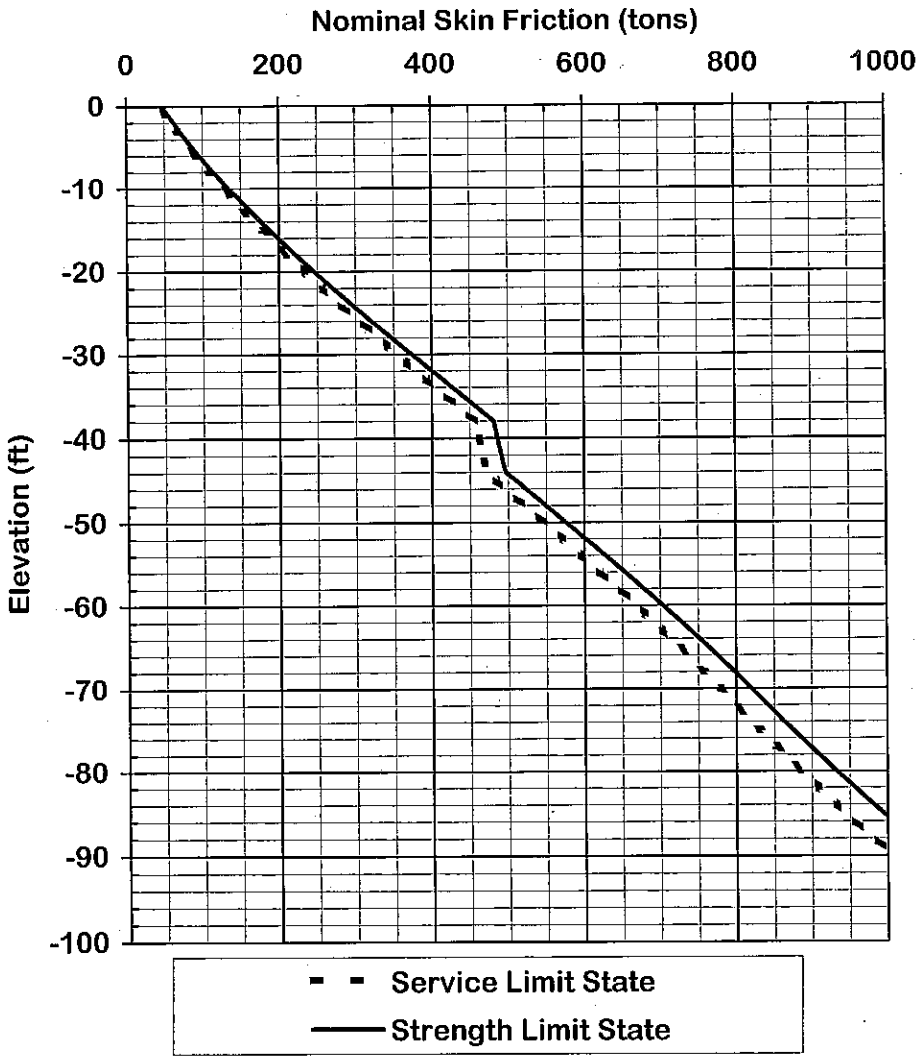


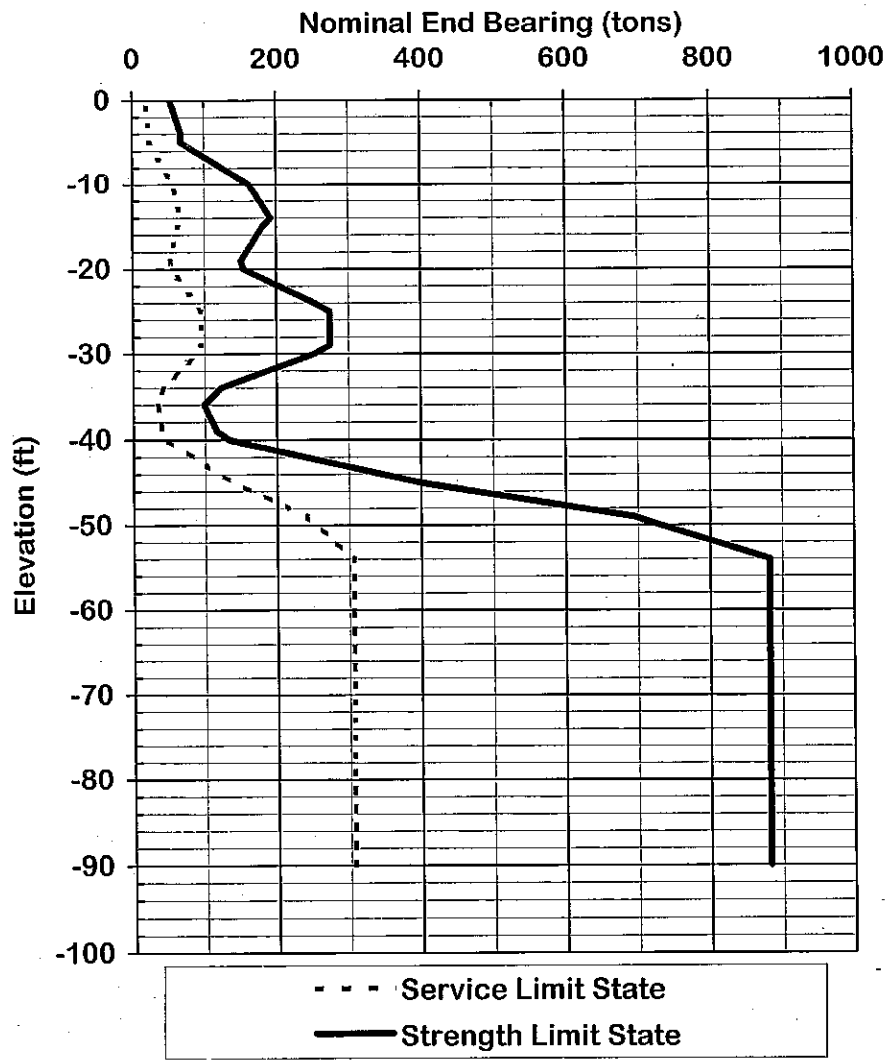
Unfactored Strength, Service Extreme Event Limit State Capacity for Drilled Shafts (English Units)

Figure 1

Bridge #20/217S
Pier(s) 1 & 2
Diameter 6 (ft)

Drilled Shaft Axial Capacity



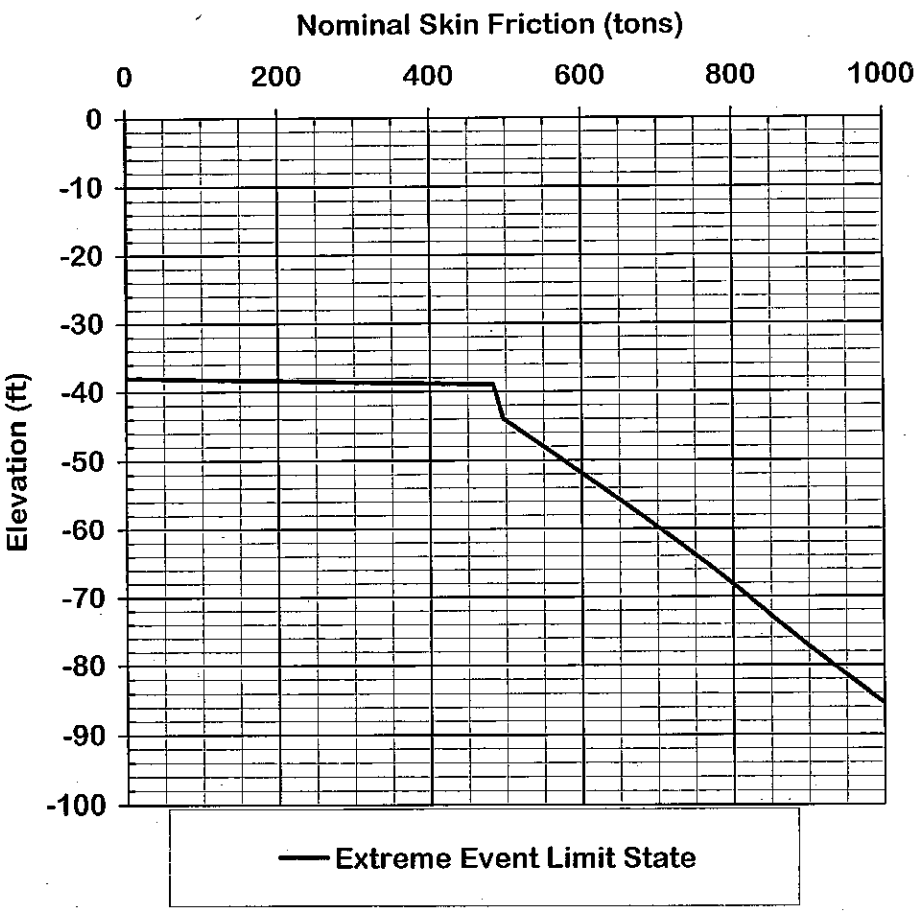


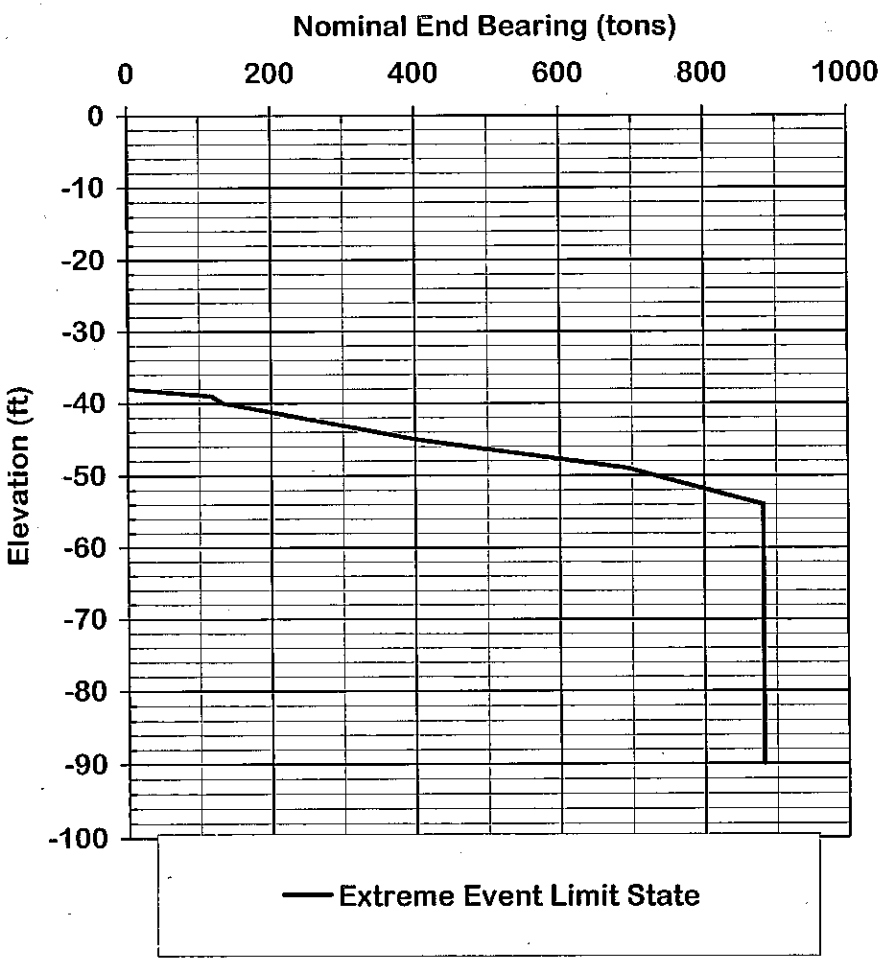
Unfactored Strength and Service Limit State Capacity for Drilled Shafts (English Units)

Figure 2

Bridge #20/217S
Pier(s) 1 & 2
Diameter 6 (ft)
Casing Permanent

Drilled Shaft Axial Capacity



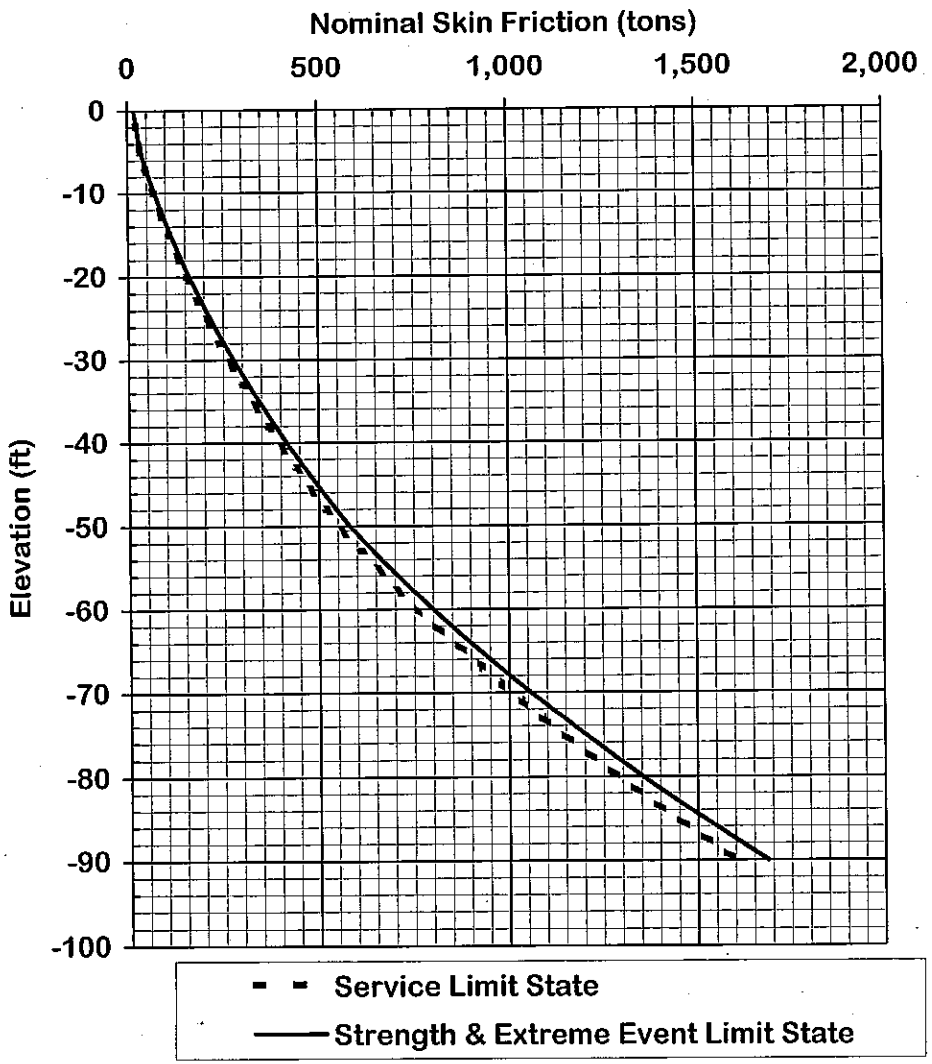


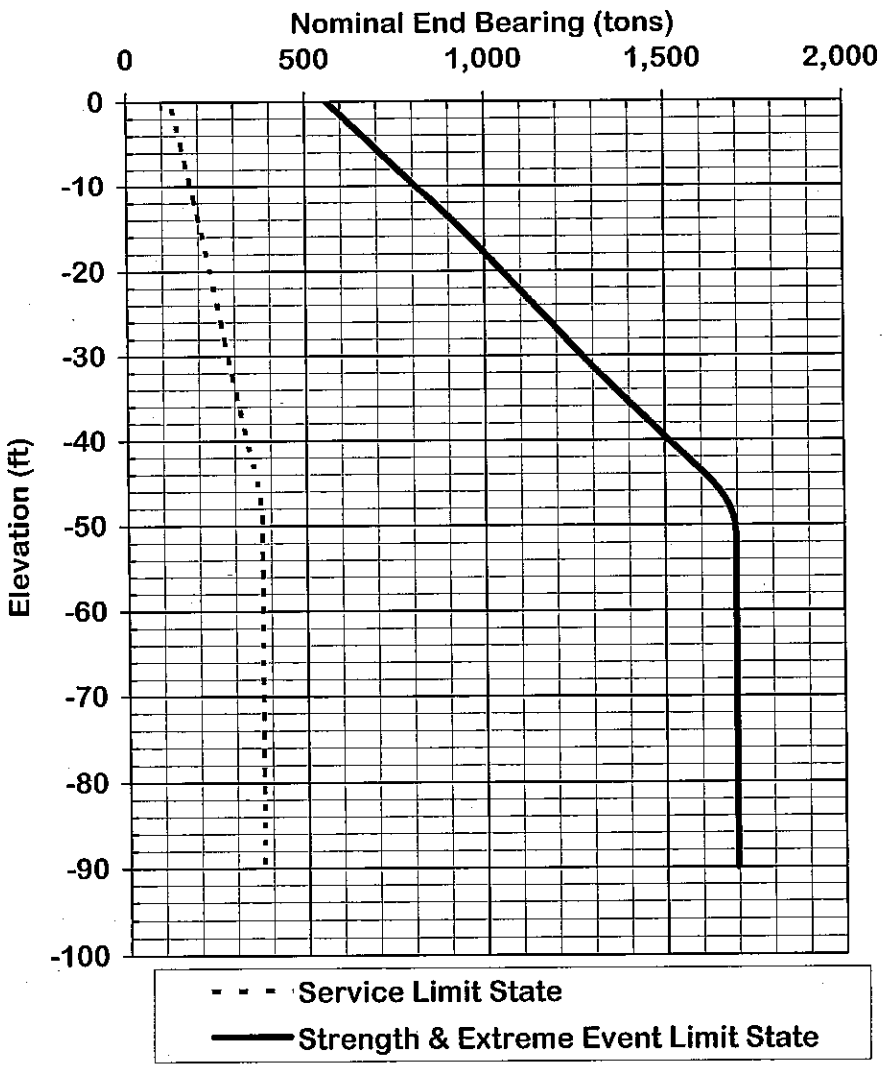
Unfactored Extreme Event Limit State Capacity for Drilled Shafts (English Units)

Figure 3

Bridge 20/220 S
Pier(s) 1 & 2
Diameter 6 (ft)

Drilled Shaft Axial Capacity





Unfactored Strength, Service Extreme Event Limit State Capacity for Drilled Shafts (English Units)

Figure 4

APPENDIX E-LATERAL CAPACITY PARAMETERS

DFSAP Input Data

Bridge No. or Name Fredonia to I-5 20/214N
Pier No(s). 1 & 2
Ground Surface Elevation 14.0 (ft)

Layer	Soil Type	Layer Thickness (ft)	Btm. Elev. (ft)	Effective Unit Weight (pcf)	Friction[1] 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 (bpf)	Fines Content (%)	Angularity
1	Sand	13	1	105	25	1.000	No							
2	Sand	8	-7	53	30	0.750	No							
3	Sand	34	-41	58	35	0.600	No							
4	Sand	13	-54	53	30	0.750	No							
5	Clay	35	-89	38		1.200			500	500				
6	Sand	20	-109	63	38	0.400	No							

[1] For Rock, this is the effective friction angle of the rock mass.

Bridge No. or Name Fredonia to I-5 20/214S
Pier No(s). 1 & 2
Ground Surface Elevation 13.0 (ft)

Layer	Soil Type	Layer Thickness (ft)	Btm. Elev. (ft)	Effective Unit Weight (pcf)	Friction[1] 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 (bpf)	Fines Content (%)	Angularity
1	Sand	15	-1	105	25	1.000	No							
2	Sand	17	-18	53	32	0.680	No							
3	Sand	18	-36	53	35	0.600	No							
4	Sand	18	-54	53	30	0.750	No							
5	Clay	33	-87	38		1.200			500	500				
6	Sand	20	-107	63	38	0.400	No							

[1] For Rock, this is the effective friction angle of the rock mass.

Figure 1

DFSAP Input Data

Bridge No. or Name Fredonia to I-5 20/217S
Pier No(s). 1 & 2
Ground Surface Elevation 14.0 (ft)

Layer	Soil Type	Layer Thickness (ft)	Btm. Elev. (ft)	Effective Unit Weight (pcf)	Friction[1] 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 (bpf)	Fines Content (%)	Angularity
1	Sand	52	-38	53	29	0.800	Yes					8	5	Rounded
2	Clay	10	-48	38		1.200	No		500	500				
3	Sand	42	-90	53	34	0.600	No							

[1] For Rock, this is the effective friction angle of the rock mass.

Bridge No. or Name Fredonia to I-5 Bridge 20/220
Pier No(s). 1 & 2
Ground Surface Elevation 12.7 (ft)

Layer	Soil Type	Layer Thickness (ft)	Btm. Elev. (ft)	Effective Unit Weight (pcf)	Friction[1] 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 (bpf)	Fines Content (%)	Angularity
1	Sand	5	10	100	30	0.750	No							
2	Sand	5	5	38	30	0.750	No							
3	Sand	42	-38	48	30	0.750	No							
4	Sand	11	-49	48	32	0.680	No							
5	Sand	55	-104	63	35	0.600	No							

[1] For Rock, this is the effective friction angle of the rock mass.