Foundation Copy

Washington State
Department of Transportation
Sid Morrison
Secretary of Transportation

Materials Laboratory
P.O. Box 47365
Olympia, WA 98504-7365

July 2, 1999

Mr. J. A. Weigel
Department of Transportation
Bridge and Structures
P.O. Box 47340
Olympia, WA 98504-47340

Re: SR-6, C.S. 2105, OL-0911
South Fork Chehalis River Bridge
Bridge No. 6/115 Replacement
Geotechnical Recommendations

Dear Mr. Weigel:

This letter presents the geotechnical recommendations for the replacement of Bridge No. 6/115 between M. P. 42.60 and M.P. 42.75 on SR-6. The bridge carries traffic over the South Fork of the Chehalis River approximately 8.7 miles west of SR 5. The new bridge will be a seven span pre-stressed concrete girder structure approximately 765 ft in length with 8 ft wing walls. The new alignment is between 35 ft and 55 ft northwest of the existing alignment. The completed bridge will have a roadway width of 36 ft to provide for two 12 ft lanes and 6 ft shoulders. The bridge approaches will require new fills. The western approach will require new fills up to 10 ft in height. The eastern approach will require sliver fills up to 30 ft in height or an approximately 75 ft long retaining wall.

The analyses, conclusions, and recommendations presented in this letter are based on the project description and site conditions that existed at the time of the field exploration. We assume the exploratory borings represent the subsurface conditions throughout the project area. If different subsurface conditions are encountered or appear to be present, we should be contacted so that we can reevaluate our recommendations and assist you.

PROJECT SITE SUBSURFACE CONDITIONS

Regional Geology And Seismicity

The project site is located in the Willapa Hills region in the southwest corner of the state between Chehalis and Raymond on SR-6. The bridge is located near the junction of the Chehalis River and the South Fork of the Chehalis River. The topography and geology of the site are a direct result of north-south compression of the bedrock, ancient landslides, and stream deposits. The oldest bedrock consist of the Lincoln Creek Formation which is a marine sedimentary rock. The rock consists of tuffaceous siltstone and sandstone formed in

a marine environment during the Upper Eocene to Oligocene between 25 to 40 million years ago (m.y.a.). The tops of the hills have a cap of Grand Ronde basalt which was formed during the Miocene between 14 to 16.5 m.y.a. On the eastern approach, a layer of conglomerate was found during drilling. The conglomerate could be a Miocene unit in the marine sedimentary Astoria Formation (5 to 25 m.y.a.) or the continental sedimentary Wilkes Formation (8 to 12 m.y.a.).

Landslide deposits have been mapped along the Chehalis River. One known landslide area is located at the eastern approach of the new structure. The deposit consists of elastic silt and clay with sand and gravel.

The surface geology also includes glacial deposits and recent stream deposits. Deposits of Logan Hill Formation (1.0 to 1.6 m.y.a.) have been mapped east of the project site. Logan Hill Formation consists of late Wisconsin (Pleistocene) aged reddish to yellowish brown, out-wash sands and gravels with interbeded silt and clay. The existing stream flood plain consists of stream deposited silt, sand and gravels.

Seismicity

The seismicity and subsurface geologic structure is complex in the vicinity of the bridge site. The seismicity of this area is associated primarily with the interaction of the Juan de Fuca and North American crustal plates. The Juan de Fuca plate is being subducted beneath the North American plate off the coast of Washington. Seismicity can generally be characterized by shallow and deep focus earthquakes. The shallow earthquakes (less than 22 miles in depth) occur within the North American plate and are believed to be due to north-south compression and possibly crustal rebound resulting from the removal of the glacial ice. The deep focus earthquakes (greater than 25 miles in depth) are associated with crustal movement of the subducting Juan de Fuca plate beneath western Washington. In general, the deeper subcrustal seismic events have greater magnitude and less frequency than the shallower events.

The geologic map of the area shows a series of geologic structures. A series of 3 east-west trending faults are located between 3.5 miles and 6.5 miles north of the site. A northeast-southwest trending fault is located approximately 0.5 miles south of the bridge. A series of northwest-southeast trending faults appear to locate at the east end of the bridge, 4 miles west and 6 miles west of the bridge, respectively. The movement likely occurred between the uplift of the Cascade Mountains and the Holocene (1 m.y.a.). It is uncertain if movement has occurred since the Holocene.

Field Investigation

The field investigation consisted of a review of historical records, site review, and drilling 16 new test borings. The test borings were drilled to provide subsurface information for the replacement of existing Bridge No. 6/115. The existing structure was constructed between July, 1925 and March, 1926 under Contract 969. The final records show a soil profile along the bridge alignment. In 1997 the proposed realignment was southeast of the existing

structure. Seven test borings were drilled for this alignment, and three test holes were drilled for a proposed cut east of the new bridge. In 1998, the proposed alignment was shifted to the northwest side of the existing bridge. The alignment shift was due to potential problems with slope stability of the cut section. Six additional test borings were drilled for the current alignment. The test hole locations are shown on the attached site plans in Appendix A, and Table 1 below.

Table 1 *Test Boring and Ground Surface elevations.*

Test Hole No.	SR-6 Station	Offset (ft)	Ground Elevation (ft)	Top of Rock Elevation (ft)
H-1-97	19+10	47 Rt.	223.7	192.2
H-2-97	20+18	80 Rt.	214.7	193.2
H-3-97	21+28	93 Rt.	214.7	193.2
H-4-97	22+37	101 Rt.	213.2	193.2
H-5-97	23+45	99 Rt.	214.6	190.1
H-6-97	24+46	78 Rt.	215.2	197.7
H-7-97	25+22	86.5 Rt.	236.9	212.4
H-1-98	27+96	151 Rt.	273.5	251.0
H-2-98	29+38.4	120.5 Rt.	264.2	250.2
H-2A-98	29+49	124 Rt.	263.7	249.7
H-1-99	19+90	12 Lt.	211.1	193.1
H-2-99	23+59	14 Lt.	214.3	192.3
H-3-99	24+75	2 Rt.	210.3	197.8
H-4-99	25+70	3 Rt.	231.9	218.9
H-5-99	26+55	CL	238.2	218.2
H-6-99	26+20	53 Lt.	217.4	202.4

Soil sampling was performed at all of the test hole locations. Standard penetration tests (SPT), in general, were taken at approximate 5 ft intervals in the soils and 10 ft intervals in siltstone bedrock. The test holes varied in depth between 40 ft and 110 ft below the ground surface. In addition, 8 undisturbed samples were taken (three shelby tubes and five

Washington State undisturbed samples) in the surficial soils. To better define the soil/rock quality, approximately 710 ft of rock core was drilled. The disturbed soil samples and rock core samples were visually identified in the field and then submitted to the Materials Laboratory for a more detailed classification.

Copies of all the test hole logs are included in Appendix B.

Selected test holes were instrumented with inclinometers and piezometers. Inclinometers were installed in test holes H-1-98, H-2-98, H-5-99, and H-6-99. Piezometers were installed in test holes H-1-97, H-1A-98, H-2A-98, and H-5A-99. The results of the piezometric data is presented on the boring logs and in the Ground Water section below. The results of the inclinometer data is presented below in the Landslide Section.

Description of Soil Units

The field investigation indicated the presence of five major soil/rock units at this site. The five units are:

Unit 1 Fill - silty sand with gravel.

Unit 2 Very loose to loose, silt with sand to silty sand.

Unit 3 Fat clay to elastic silt with sand and gravel, yellowish red.

Unit 4 Medium dense to dense, sand with silt and gravel, cobbles and boulders to well graded gravel with silt and sand.

Unit 5 Siltstone bedrock [Lincoln Creek Formation].

In test holes H-1-98, H-2-98, and H-5-99, a layer between 1.5 ft to 2.5 ft thick of conglomerate was encountered during drilling. The conglomerate is a weakly cemented subrounded gravels which are water bearing. The conglomerate is on top of Unit 5 siltstone.

The top of the bedrock elevation is given in Table 1. Bedrock is defined as either the top of the conglomerate or siltstone. The final records for C-0969 show hard blue clay (Unit 5) being encountered at approximate elevation 198.0 ft on the eastern bank and at elevation 190.5 ft on the western bank of the river channel.

The area between Piers 1and 5 are located in the river flood plain. Unit 2 soils are underlain by Unit 4 soils. The top of the Unit 4 soils vary between elevations 199 ft and 205 ft along the alignment. The final records for C-0969 shows a layer of very dense gravel with boulders between elevation 190.5 ft and 197 ft in the vicinity of Pier 5. Test holes H-5-97 and H-2-99 confirms a very dense gravel layer in the vicinity of Pier 5.

The area between Piers 6 and 8 are likely located in landslide debris. The landslide debris consist of Unit 3 soils mixed with angular basaltic gravels and siltstone boulders. Unit 3 is between 13 ft and 20 ft thick along the proposed alignment.

Test hole plan view and subsurface profiles depicting generalized foundation conditions are presented in Appendix A. A cross-section of the eastern embankment is included in Appendix A.

Laboratory Testing

Laboratory testing was performed on selected samples from the field exploration program. All disturbed soil samples were visually examined and then grouped together based on particle size distribution, consistency, and color. Once groups of samples were established that had similar characteristics, a minimum of one sample per group was tested. The testing consisted of performing particle size analyses, determining the liquid limit if applicable, and determining the plastic limit and plasticity index if applicable. The tests were done in accordance with AASHTO T-88, T-89, and T-90 guide specifications respectively. After the testing is complete, the samples were classified using the Unified Soil Classification System (USCS).

Specialized testing was performed on selected samples to determined the soil/rock strength and the rate of settlement for the Unit 3 soils and the Unit 5 bedrock. From test hole H-6-99, two consolidation test were performed to determine the rate of settlement of the proposed sliver fill on clayey soil. Three unconsolidated-undrained triaxial compression tests were performed in the Unit 3 soils to determine the short term soil strength. Three direct shear tests were performed in a suspected failure plain in test hole H-2A-99. The tests were used to estimate the residual shear strength of the landslide debris. Fifteen uniaxial compressive tests were performed on selected rock cores to determine the approximate rock strength and Young's Modulus for Unit 5 bedrock.

The rock descriptions included the following: rock strength, color, structure, weathered state, and rock type. The rock cores were measured to find the amount of recovery, fractures per foot (FPF) and Rock Quality Designation (RQD).

RQD is a method to describe the rock mass qualitatively. The RQD classification index is the ratio of the total cumulative length of rock fragments that are 4 inches or longer in length divided by the total length of rock core.

The results of laboratory testing are attached in Appendix C.

Ground Water

The river level of the south fork of the Chehalis River has a direct effect on the ground water encountered in test holes located in the flood plain. The flood plain varies in height between approximate elevations 210 ft and 215 ft. Seepage zones were observed in the cut located east of existing structure between approximate Stations 27+50 and 30+50 Right. On March 19, 1998, ground water was observed up to elevation 260 ft between Stations 28+80 and 29+20 on the cut face. The measured ground water information is included on the logs of test borings in Appendix B.

Piezometers were established at four locations, H-1-97, H-1-98, H-2A-98, and H-5-99. Ground water was measured periodically. A summary of ground water elevation is as follows:

Test Hole	Location	Water Elevation (ft)		Date
H-1-97	STA 19+10 (47 ft Rt)	High	212.9	February 25, 1999
	(Vicinity Pier 1)	Low	200.0	October 30, 1998
H-1A-98	STA 28+02 (147 ft Rt)	High	263.1	December 29, 1999
	(Zone -7 ft to -25 ft)	Low	255.5	October 30, 1998
H-2A-98	STA 29+49 (124 ft Rt)	High	263.7	December 29, 1999
	(Zone -15 ft to -22 ft)	Low	253.1	October 30, 1998
	(Zone -28 ft to -35 ft)	High	253.5	February 25, 1999
		Low	249.3	October 30, 1999
H-5-99	STA 26+47 (4 ft Rt)	High	232.7	January 18, 1999
	(Vicinity Pier 8)	Low	218.2	April 26, 1999

Ancient Landslide Area

The roadway to the eastern approach of the bridge is built through the toe of an ancient landslide. Based on the air photographs, the limits of the slide are approximately 3,000 ft wide and extends up slope approximately 2,000 ft from SR-6. During 1997, the cut between Stations 26+50 and 30+50 Right was regraded to an approximate 1.5 H: 1V slope. This minor regrading apparently reactivated the old landslide debris above SR-6 during the winter of 1997-1998. Tension cracks were observed in the slope between 50 ft and 70 ft from the existing SR-6 alignment. Tension cracks were observed between approximate Stations 31+00 and 33+50, 180 ft and 70 ft respectively from the existing SR-6 alignment. Two test holes, H-1-98 and H-2-98, were drilled adjacent to the right-of-way to evaluate the subsurface conditions. Slope inclinometers were installed and have been monitored since March, 1998. Two additional inclinometers were installed in January, 1999, H-5-99 and H-6-99, which are located down slope from the existing SR-6 alignment.

Landslide debris (Unit 3 soils) is between 14 ft to 22.5 ft thick and is on top of 1.5 ft to 2.5 ft thick layer of conglomerate. The conglomerate is underlain by siltstone bedrock (Unit 5). The conglomerate is water bearing with between 12.5 ft to 15 ft of excess artesian pressure. Slickensided surfaces were seen at various depths in the test borings. Slickensided surfaces occur in old slide plane zones. One zone is within 5 ft of the bottom of the conglomerate layer. See cross-section A-A' in Appendix A. In test hole H-2-98, a second water bearing zone was encountered between elevation 230 ft and elevation 234 ft. This zone had between 15 ft and 20 ft of artesian pressure. In addition, drill water was lost at approximate elevation 181 ft in the same hole.

The inclinometer data showed movement on top of the conglomerate layer in test holes H-1-98 and H-2-98 at elevations 250.5 ft and 249 ft, respectively. The approximate locations of the test holes in plan view is shown in Figure D-1 in Appendix D. In H-2-98, up to 0. 6 inches of movement was seen in a N80°W direction. The movement occurred between December, 1998 and February, 1999. In H-1-98, up to 0.1 inches of movement was seen in a westerly direction. See Section A - A' in Appendix A. The majority of the movement in H-1-98 occurred in January. The inclinometers installed down slope of SR-6 in H-5-99 and H-6-99 did not show any significant movement.

Proposed Hillside Stabilization

The hillside above SR-6 is marginally stable with periodic movements during periods of saturated ground and heavy rainfall. The movement is currently at/or above a conglomerate layer which is between approximate elevation 249 ft and elevation 250 ft in test holes H-2-98 and H-1-98, respectively. To improve the hillside stability, we recommend dewatering by using an interceptor trench drain and a 2(H):1(V) soil berm. The soil berm can be constructed from Common Borrow or Select Borrow material between Stations 26+00 and 30+50. The Common Borrow should be compacted using Method C as outlined in Section 2-03.3(14) of the Standard Specification. Select Borrow can be compacted using Method B as outlined in Section 2-03.3(14) of the Standard Specification.

We do not recommend cutting into the hillside, since this could lead to further instability of the slope. If no soil berm is constructed, the hillside will continue to periodically move causing a long term maintenance problem in this cut section.

We looked at using horizontal drains as an alternate option to mitigate potential instability of the hillside. Horizontal drains were not considered as a permanent fix due to the potential for long-term clogging and continual maintenance. Therefore, we are not recommending horizontal drains at this site.

Interceptor Trench Drain

Based on stability analyses, lowering the level of the ground water will increase the stability of the slope at the eastern approach of the new bridge. To reduce the water table level, we recommend construction of a 4 ft wide, 15 ft deep interceptor trench in the existing ditch south of the existing SR-6 alignment. The trench should extend for an approximate length of 700 ft, as shown in Figures D-1 and D-2 in Appendix D. An outfall (cross drain) culvert is required to direct the ground water away from the hillside area. A positive trench slope needs to be constructed and maintained to adequately direct the water along the trench to the cross drain.

A geotextile lining of the trench walls will be required to avoid silting of the drain rock. See Figure D-3 for typical cross-section. Quarry spalls should be placed in the geotextile draped trench to a minimum thickness of 3 to 5 ft. The remainder of the trench should be filled with washed aggregate, such as Shoulder Ballast, Concrete Aggregate Grading No. 5 or No. 6, or equivalent. The installation of an underdrain pipe is not considered feasible because of the

depth of this trench drain. Special care should be taken around the cross drain to achieve a five foot thickness of quarry spalls to ensure that the washed aggregate gravel will not pipe out the cross drain.

A cross drain with a minimum diameter of 24 inches is needed in order to direct the water from the interceptor trench at its lowest elevation and carry it down slope. One or more cross drains should be constructed as shown in Figure D-1.

The geotextile lining should meet the requirements for Underground Drainage, Moderate Survivability, Class C under Section 9-33 in the Standard Specifications.

We recommend that the outfall pipe and trench be constructed first to dewater the site. A trench box should be required to shape the excavation and minimize the risk of wall collapse. The excavation and construction of the interceptor drain should be staged with no more than 40 ft of open trench at any one time. Backfilling and removal of the shoring needs to be done with care to ensure that the geotextile is not torn.

A similar trench was constructed under Contract 5344, SR-101 MP 78.9 Vicinity Slide, which has been recently completed. The bid items for C-5344 can be used to estimate the cost for this option.

GEOTECHNICAL RECOMMENDATIONS for STRUCTURES

Design Earthquake Parameters

An acceleration coefficient of 0.21 g is recommended for seismic design of the structures on this project in accordance with the 1996 USGS National Seismic Hazard Map for 10% probability of exceedance in a 50 year period.

Design response spectra presented in the AASHTO Guide Specifications for Seismic Design of Highway Bridges are considered appropriate for seismic design of the structures on this project. A Type I soil profile and a site coefficient of 1.0 is recommended at all Piers.

Liquefaction

Liquefaction should not occur at this site. Unit 2 soils, in general, have a high silt content which limits their potential to liquefy. Unit 3 soils are plastic silts and clay which are considered to be non-liquefiable. Unit 4 is confined by Unit 2 soils and the combination of density and gradation provides adequate factor of safety against liquefation for a magnitude 7.5 earthquake.

Bridge Approach Embankment Design Recommendations

The approach embankments will require new fills of variable thickness at the bridge approach site. We divided the fills into the northeast embankment (Pier 8) and the southwest embankment (Pier 1). In general, all bridge fills should be constructed according to Section 2-03.3(14) in the Standard Specifications. Select borrow or gravel borrow can be used.

New fill will be placed northwest of the existing alignment on loose Unit 2 soils. The fill will be constructed up to 10 ft in height. At Pier 1, the embankment will be stable with 2H:1V or flatter slopes.

We estimate up to 3 inches of settlement may occur in the vicinity of Pier 1. Fill settlement should occur as it is placed. Post-construction settlement will be negligible. Geotechnically, we view placing the new fill on loose soil with a high ground water table as a potential construction problem. The native undisturbed soil has enough soil strength for the fill foundation. However, the movement of heavy construction equipment over the site can degrade the foundation subgrade. To minimize foundation construction problems and provide a platform to compact the new fill, we recommend either placing a layer of shot rock or quarry spalls under the foot print of the new fill or limiting the use of vibrating compaction equipment in the bottom 3 ft of the new fill. Vibratory compaction equipment could create pumping soils at the base of the fill. At Pier 8, the minor fill will be built on clayey soils. The clayey soils should reach compaction provided moisture is controlled using Method C moisture requirements.

At Pier 8, we expect the site will require sliver fills up to 30 ft in height on old landslide debris, Unit 3 soils. The proposed 1.75H:1V fill located at Pier 8 will be unstable during periods of high ground water and marginally stable during periods of low ground water. We looked at various options to mitigate the new approach fill. A fill option will require additional right-of-way. A 2H:1V slope will be stable provided that the dewatering of the hillside occurs. A 2.5H:1V slope will be stable, if the dewatering of the hillside is not constructed.

Fill settlement should be 2.0 inches or less. The settlement will take approximately 3 months to occur after the fill is placed.

Retaining Wall - Stations 26+50 and 27+25 (Lt.)

It is our understanding that right-of-way and wet land issues may limit the fill options. This will require a wall. Both a standard reinforced concrete wall and a pre-approved proprietary MSE wall are unstable in the existing slope. We estimate that the new wall will have up to 9 ft of exposed wall face. The length of the wall will likely be 75 ft.

Please note that our wall design does not account for any lateral stresses due to the uphill instability. The uphill stability was previously discussed in the hillside stabilization section. The slope below SR-6 appears stable. No signs of instability were seen in the existing roadway surface. We assumed standard soil conditions for the wall design. If requested, we will provide recommendation for lateral stresses due to a potential landslide under a separate memorandum.

We recommend that a soldier pile wall be used. The soldier pile wall should extend a minimum of 4 ft into the bedrock to ensure overall stability. As with the fill options, high ground water will affect the design. High ground water will create marginal over-all stability in the slope if minimum pile embedment is used. We estimate the pile tip will need

to be at or below elevation 210 ft to insure overall stability. We are providing a typical earth pressure diagram to further evaluate this option in Appendix E, Figure E-8.

If required, a single row of tiebacks can be used. The tiebacks should be limited to 150 kips at the design load provided that the bond zone is in bedrock.

Our office considered other wall types such as H-Pile supported concrete wall, and a MSE wall back filled with polystyrene. These options are considered to be too costly or too difficult to construct at this site.

Bridge Foundation Design Recommendations

The existing bridge will be replaced with a new structure northwest of the existing alignment. The new bridge will be a 7 span pre-stressed concrete girder structure approximately 765 ft in length with 8 ft wing walls. The new alignment is between 35 ft and 55 ft northwest of the existing alignment. The completed bridge will have a roadway width of 36 ft to provide for two 12 ft lanes and 6 ft shoulders. We recommend drilled shafts for all Piers.

Drilled Shafts

The attached Figures E-1 through E-6 in Appendix E provide the geotechnical information needed to evaluate the shaft capacity. Figures 1, 3, and 5 provide ultimate vertical (downward) shaft capacity. Figures 2, 4, and 6 provide the design figures for ultimate uplift capacity. We discounted the top two diameters (2 B) of the shaft in the capacity calculations to account for construction disturbance. We recommend a minimum shaft tip at Piers 7 and 8 due to sloping bedrock. For design, we assumed an average minimum shaft tips of 211 ft and 213 ft, respectively at Piers 7 and 8. Bedrock may vary as much as 8 ft across the width of the roadway. In test hole H-5-99, a potential failure zone was encountered above elevation 213 ft.

Please note, the vertical shaft capacity is a function of skin friction and shaft end bearing. The design figures assume that the shafts are founded in Unit 5 Siltstone Bedrock. The shafts should be predominately end bearing. We estimate between 40 % to 70% of the load will be carried in end bearing.

For design, the total settlement of the new shaft foundation will be equal to or less than one inch. The differential settlement between piers or bents will be less than 0.5 inches.

Shaft Spacing and Design Factors of Safety

It is our understanding that the interior piers will require two shafts approximately spaced 1.8 shaft diameters apart. The design figures assume the shafts will be placed in siltstone bedrock. For shafts placed in rock, we recommend that no group reduction factors be used.

At Piers 7 and 8, the top of the shaft may be in soil. We recommend the following group reduction factors be used for evaluating lateral loads in soil:

Shaft Spacing	Transverse Loading Reduction Factor	Longitudinal Loading Reduction Factor
3D	0.5	0.7
2.5D	0.45	0.62
2D	0.4	0.55
1.8D	0.35	0.52

The capacity provided in the figures in Appendix E are ultimate capacities based on both skin friction and end bearing. We recommend that the following safety factors be applied to the ultimate capacities when evaluating the loads. The factored loads should be less than or equal to the ultimate capacity divided by the following safety factors ($\Sigma L \leq Q_{ult} / SF$).

Load Group	Minimum Factor of Safety (SF) Shafts	Piles
Unfactored DL+LL(1)	2.5	2.5
Group I-IV	1.67 (2)	1.67
Groups V, VI, VIII, and IX	1.43	1.25
Group VII + DD_{EQ}(3)	1.3	1.00

(1) To account for downdrag load due to static settlement, calculate the ultimate capacity required for this load case and add the downdrag load presented below to determine the ultimate capacity required for the shaft or pile ($2.5\Sigma(DL+LL)$ + downdrag $\leq Q_{ult}$). No factor of safety should be applied to the estimated downdrag load.

(2) Use SF= 2.0 if any group exceeds 1.25 x Q_{ult} for uplift. This requirement will ensure that non-transient (working) loads are resisted entirely by skin friction and will therefore limit settlement under non-transient loads.

(3) DD_{EQ} = ultimate downdrag load due to liquefaction.

P-y curve soil data in included in Appendix E as Figure E-7. This data should be used to evaluate the lateral deflection of the shafts.

Approach Slabs

The Design Manual Section 1120.03(7) requires all bridges to have approach slabs unless approval for their deletion has been given. It is our understanding that the existing structures does not have approach slabs. We recommend that approach slabs be constructed at the abutments. The approach slabs are needed due to the presence of soft or loose soils below the fill. At Pier 1, there will be marginal compaction near the abutment which could

lead to potential long-term settlement. At Pier 8, there is potential for long-term settlement due to fill placed on clayey soils.

CONSTRUCTION CONSIDERATIONS

Construction considerations that will require attention during design and construction of this project are as follows:

1. Temporary shoring may be needed to preserve the existing adjacent roadway at Piers 1 and 7. Cobbles and boulders may be present in Unit 4 soils and siltstone bedrock. Sheet pile shoring may be difficult to install due to either very dense soil or cobbles and boulders. This may require additional time and effort to install temporary shoring. Soldier piles and lagging may be required.

   Please note that the determination of the actual slope used for the temporary excavation is the responsibility of the contractor. The contractor will have control over factors which affect the stability of the excavation slope, such as length of exposed slope, length of time the excavation is left open, the amount and type of dewatering utilized, and response to inclement weather.

2. The movement of heavy construction equipment over the site can degrade the foundation subgrade leading to the approaches of Piers 1through 8. To minimize foundation construction problems and provide a platform to compact new fill, we recommend either placing a layer of shot rock or quarry spalls under the foot print of the new fill or limit the use of vibrating compaction equipment in the bottom 3 ft of the new fill. Vibratory compaction equipment could create pumping soils at the base of the fill. The access road to construct the shaft foundations at Piers 1 though 8 could degrade during periods of high ground water. The river level of the South Fork of the Chehalis River can rise rapidly after a major rain, flooding the low lying areas.

3. We expect unstable ground during shaft construction. Caving ground could occur in the Unit 1, Unit 2 and Unit 4 soils. The shaft sides could squeeze in Unit 3 clayey soils. We recommend permanent casing be required to the top of Unit 5 bedrock due to the high likelihood of caving or squeezing. Other means covered by the Bridge Special Provision (BSP) for shafts such as slurry may be used below the casing, if needed, to prevent caving. The following table summarizes the casing requirements:

South Fork Chehalis River Bridge No. 6/115

Bridge Pier No.	Casing Type	Elevation of Bottom of Required Casing (ft)
Piers 1 though 5	Permanent	191
Pier 6	Permanent	196
Pier 7 Lt.	Permanent	211
Pier 7 Rt.	Permanent	217
Pier 8 Lt.	Permanent	212
Pier 8 Rt.	Permanent	217

4. Ground water will be encountered during the shaft excavations. Ground water will be affected by the level of water in the Chehalis or South Fork of the Chehalis Rivers at the time of excavation. Ground water was encountered in the northeast hillside at one or more perched water zones. See the test hole logs [H-1-98, H-2-98, and H-5-99] for more details. We expect that the shafts will likely be constructed under wet conditions.

5. We recommend that a Summary of Geotechnical Conditions be included in the contract documents to identify potential construction difficulties. The Summary of Geotechnical Conditions will be written during the PS&E review after the structural design work has been completed.

CLOSURE

The proposed bridge widening foundation recommendations are summarized in the attached appendices. The site plan, test hole locations and subsurface profile sheets are in Appendix A. Logs of Test Borings and laboratory test data are included in Appendix B and C, respectively. Hillside drainage plans are included in Appendix D. The attached Drilled Shaft Design Figures, typical wall sheets, and p-y curve soil data are included in Appendix E.

If you have questions or require further information, please contact Donald A. Williams at (360)709-5457.

Sincerely,

for

TONY M. ALLEN
State Geotechnical Engineer

TMA
DAW
Attachments

cc: R. A. Lewis, Construction, 47354
J. A. Vanlund, Bridge and Structures, 47340
Eric J. Sniezak, Bridge and Structures, 47340
Alex Young, Bridge and Structures, 47340
Doug P. Ficco, SWR Construction, Southwest Region, S15
R. L. Laing, Materials Engineer, Southwest Region, S15
Jack R. Foulke, Project Engineer, Southwest Region, S15
Ali Momeni-Farahani, Project Office, Southwest Region, S15

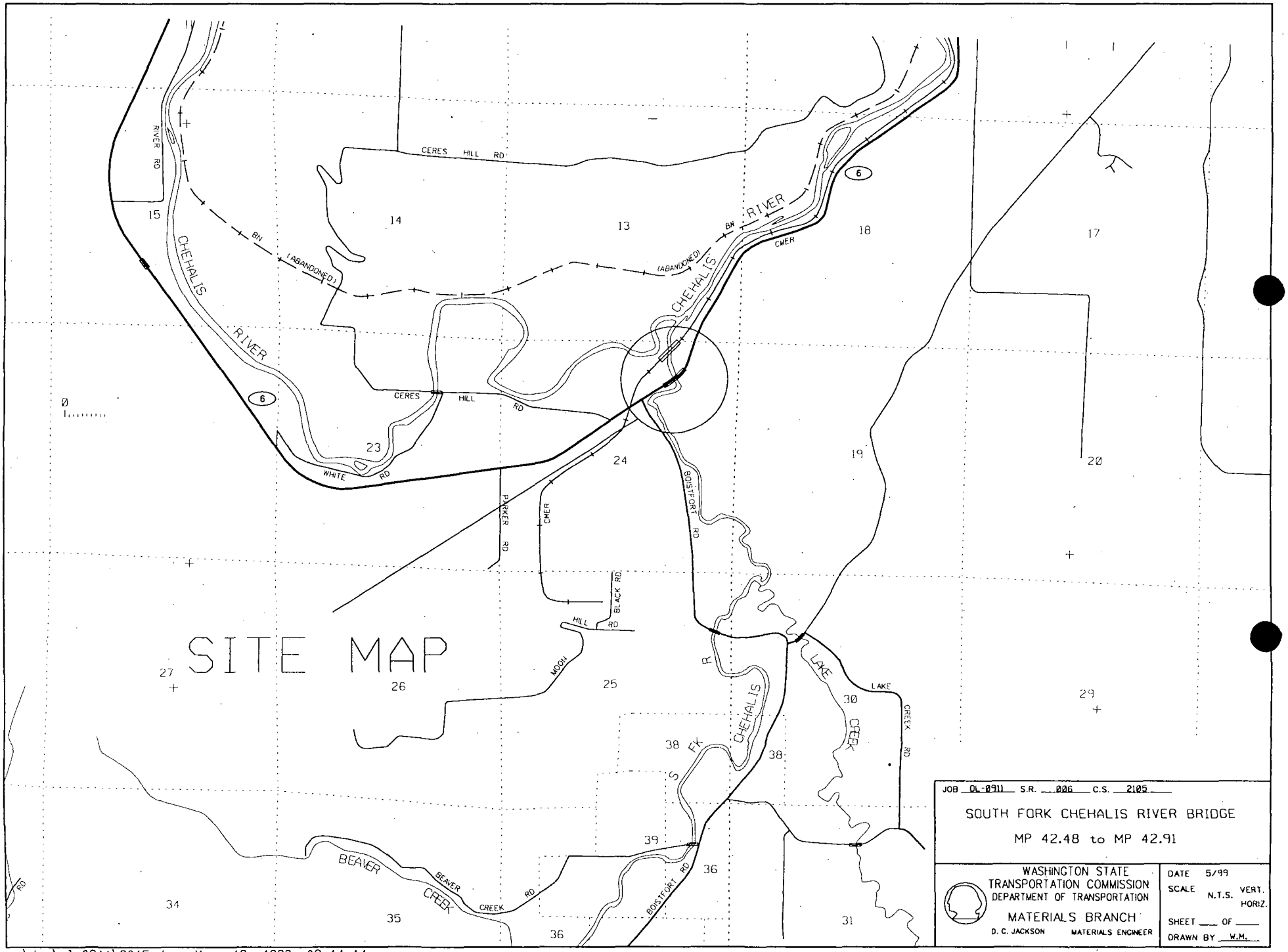
APPENDIX - A

Site Map

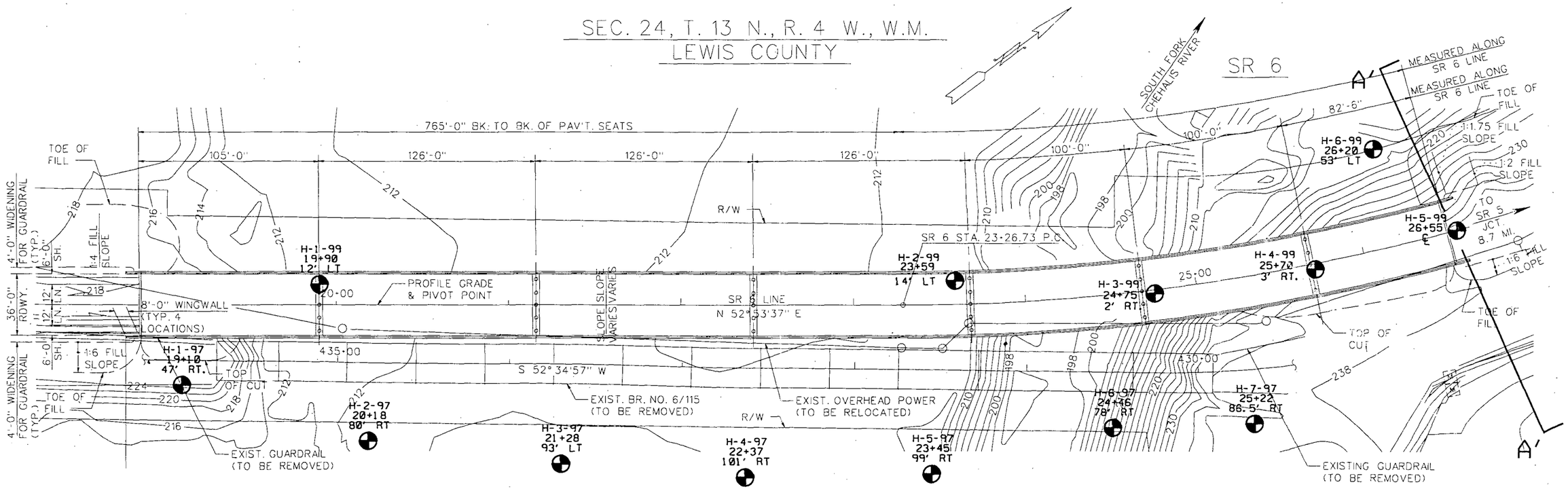
Test Hole Plan Sheet

Subsurface Profile Sheets

Cross-Section A - A'



c:\dgn\ol-0911\2015.dgn May. 18, 1999 09:14:14



TEST HOLE PLAN SHEET

JOB OL-0911 S.R. 006 C.S. 2105

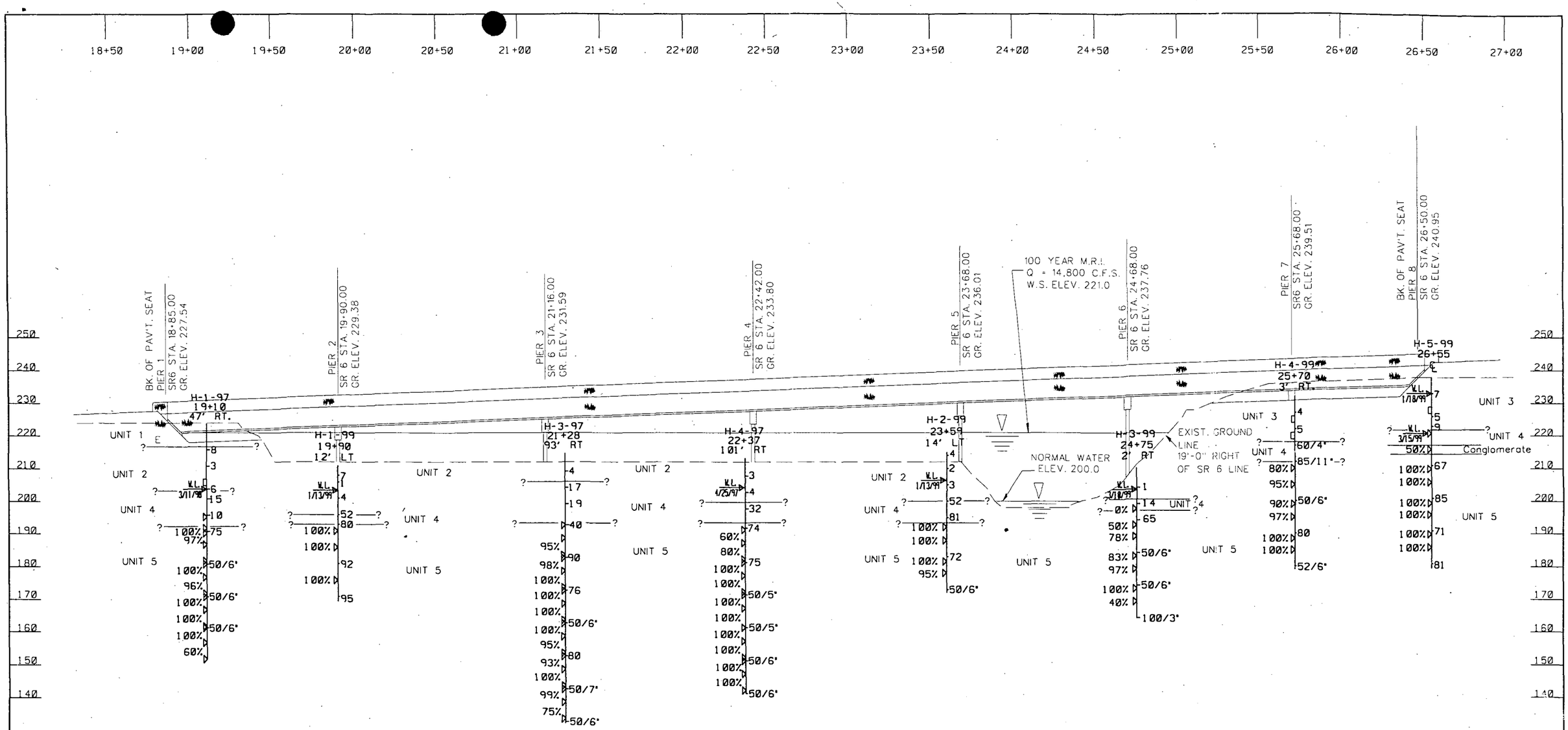
SOUTH FORK CHEHALIS RIVER BRIDGE

MP 42.48 to MP 42.91

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
D. C. JACKSON MATERIALS ENGINEER

DATE 2/99
SCALE 1" = 60' VERT.
1" = 60' HORIZ.
SHEET ___ OF ___
DRAWN BY W. M.

c:\dgn\ol-0911\sr6_bsd.dgn Mar. 19, 1999 10:05:25



UNIT 1: FILL-Silty sand with gravel

UNIT 2: Very loose to loose, silt with sand to silty sand

UNIT 3: Fat clay to elastic silt with sand and gravel, yellowish red.

UNIT 4: Medium dense to dense sand with silt and gravel to well graded gravel with silt and sand.

UNIT 5: SILTSTONE

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

N.A.V.D. 1988

SUBSURFACE PROFILE

JOB OL-0911 S.R. 006 C.S. 2105

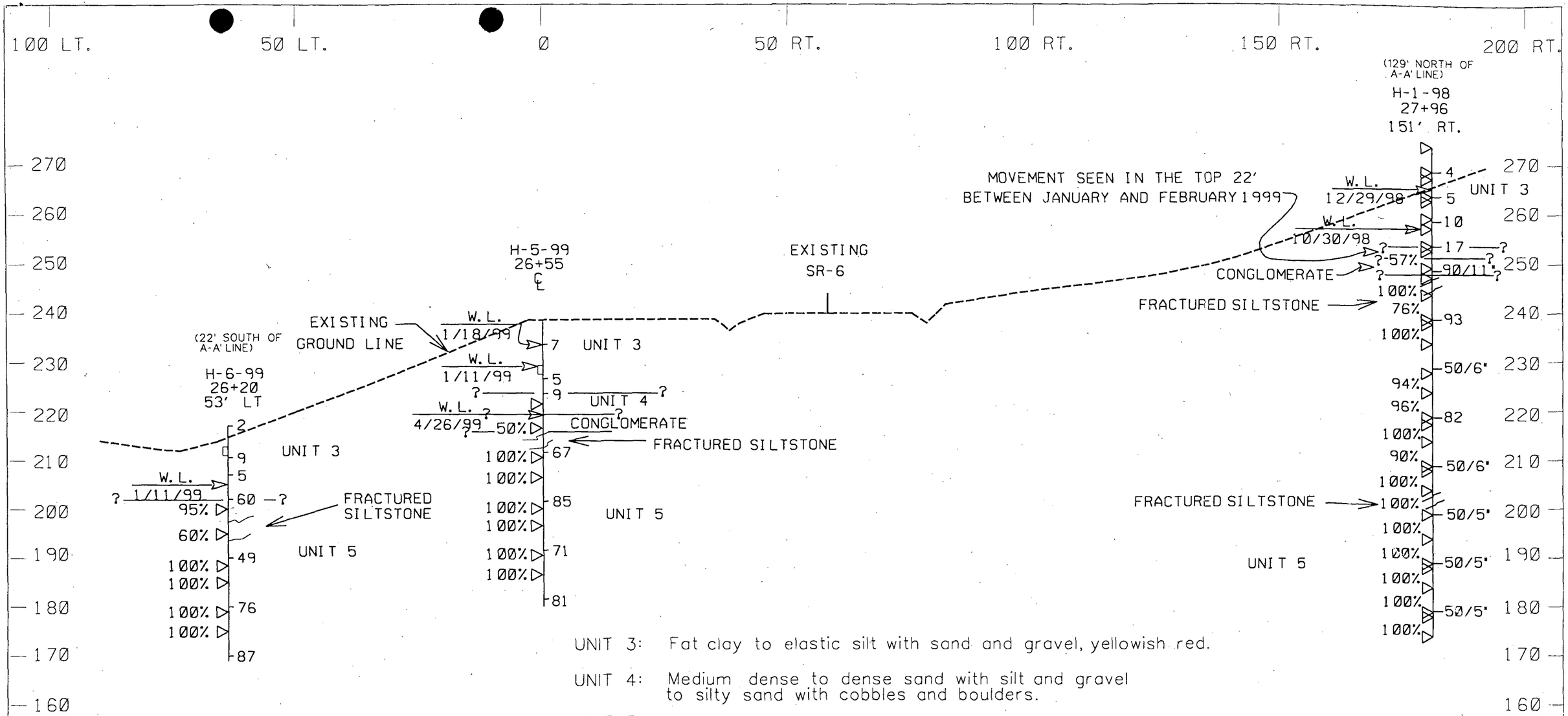
SOUTH FORK CHEHALIS RIVER BRIDGE

MP 42.48 to MP 42.91

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
D. C. JACKSON MATERIALS ENGINEER

DATE 2/99
SCALE 1" = 30' VERT.
1" = 60' HORIZ.
SHEET ___ OF ___
DRAWN BY W. M.

c:\dgn\ol-0911\sr6_bsd.dgn Mar. 23, 1999 11:09:07



UNIT 3: Fat clay to elastic silt with sand and gravel, yellowish red.

UNIT 4: Medium dense to dense sand with silt and gravel to silty sand with cobbles and boulders.

UNIT 5: SILTSTONE

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

CROSS-SECTION A-A'

SKEW TO SR-6

USE SAME SOIL UNITS ON SOIL PROFILE SHEET

JOB OL-0911 S.R. 006 C.S. 2105 LAYOUT

SOUTH FORK CHEHALIS RIVER BRIDGE

MP 42.48 to MP 42.91

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
D. C. JACKSON MATERIALS ENGINEER

DATE 3/99
SCALE 1"=20' VERT.
1"=20' HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

c:\dgn\ol-0911\sr6_bsd.dgn May. 13, 1999 16:03:40

APPENDIX - B

Logs of Test Borings

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1-97

PROJECT South Fork Chehalis River Bridge 6/115 Replacement

Job No. OL-0911

S.R. 6

Station 19+10

Offset 47' Rt.

C.S. 2105

Equipment CME-45/Auto Hammer

Casing HW X 35', HQ X 72'

Ground El 223.7 (68.18 m)

Method of Boring Wet Rotary

Start Date March 14, 1997

Completion Date March 19, 1997

Sheet 1 of 4

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m 0.0 ft to 7.0 ft Sandy SILT with gravel, fill.		
	1									
5										
	2			2 4 4 (8)		D-1	MC GS	ML, M.C. = 34% SILT with sand, gravel, organics and roots, loose, reddish brown, wet, homogeneous. Retained 0.5 ft.		
10	3									
				2 2 1 (3)		D-2		Sandy SILT with gravel, organics and roots, very loose, reddish brown, moist, homogeneous. Retained 0.8 ft.		
	4									
15										
	5					U-3		Poorly graded SAND with silt and gravel. Recovered 2.0 ft.	▽	
	6			2 3		D-4	MC GS	SM, M.C. = 27% Silty SAND with gravel, loose, reddish brown, wet,		
20										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1-97**

Sheet 2 of 4

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				3 (6)				homogeneous.		
	7			4 4 11 (15)		D-5	MC GS	SP-SM, M.C. = 17% Poorly graded SAND with silt and gravel, medium dense, reddish brown, wet, homogeneous. Retained 1.0 ft.		
25										
	8			4 3 7 (10)		D-6	MC GS	GP, M.C. = 12% Poorly graded GRAVEL with sand, loose, reddish brown, wet, homogeneous. Retained 1.0 ft.		
						C-7		No recovery.		
30	9									
	10		> >	23 42 33 (75) RQD 100% FF 0		D-8		SILTSTONE, very dense, bluish-gray, moist, homogeneous. Retained 1.0 ft.		
						C-9		SILTSTONE, bluish-gray, fine grained, fresh. Recovered 100%		
35	11			RQD 97% FF 0		C-10		SILTSTONE, bluish-gray, fine grained, fresh. Recovered 100%		
40	12									
	13			25 50 (50/6") RQD 100% FF 0		D-11		SILTSTONE, very dense, bluish-gray, moist, homogeneous. Retained 1.0 ft.		
						C-12		SILTSTONE, bluish-gray, fine grained, fresh. Recovered 100%		
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1-97

Sheet 3 of 4

PROJECT South Fork Chehalis River Bridge 6/115 Replacement

Job No. OL-0911

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			RQD 96% FF 0		C-13		SILTSTONE, bluish-gray, fine grained, fresh. Recovered 100%		
	15									
50										
	16			30 50 (50/6") RQD 100% FF 0		D-14 C-15		SILTSTONE, very dense, bluish-gray, moist, homogeneous. Retained 1.0 ft. SILTSTONE, bluish-gray, fine grained, fresh. Retained 100%		
55										
	17			RQD 100% FF 0		C-16		SILTSTONE, bluish gray, fine grained, fresh. Recovered 100%		
	18									
60										
	19			50 (50/6") RQD 100% FF 0		D-17 C-18		SILTSTONE, very dense, bluish-gray, moist, homogeneous. Retained 0.5 ft. SILTSTONE, bluish-gray, fine grained, fresh. Recovered 100%		
65										
	20			RQD 60% FF 2		C-19		SILTSTONE, bluish-gray, fine grained, fresh, moderately fractured.' Recovered 100%		
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1-97**

Sheet **4** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	22							End of test hole boring at 72.0 ft below ground elevation. Bail test 3/17/97 HQ X 33.5 ft Bailed to 29.5 ft 1 min. 28.5 ft 2 min. 20.5 ft 3 min. 18.5 ft 4 min. 17.8 ft 5 min. to 20 min 17.8 ft Bail test 3/18/97 Unable to bail hole below 20.0 ft with HW casing drilled into the siltstone 4.0 ft. Not able to seal contact between rock and soil. WATER TABLE DATE DEPTH ELEV. 3-19-97 -17.8 205.9FT. 3-11-98 -20.0 203.7FT. 3-31-98 -20.2 203.5FT. 6-8-98 -22.7 201.0FT. 10-30-98 -23.7 200.0FT. 12-21-98 -18.7 205.0FT. 12-29-98 -12.8 210.9FT. 1-20-99 -14.2 209.5FT. 2-25-99 -10.8 212.9FT. 3-15-99 -14.0 209.7FT. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
75	23									
	24									
80										
	25									
85	26									
	27									
90										
	28									
95										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2-97**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement** Job No. **OL-0911**

S.R. **6**

Station **20+18** Offset **80' Rt.** C.S. **2105**

Equipment **CME 850** Casing **HQ X 71.5'** Ground El **214.7 (65.44 m)**

Method of Boring **Wet Rotary**

Start Date **April 30, 1997** Completion Date **April 30, 1997** Sheet **1** of **4**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Depth 0 ft. to 1.5 ft. is Topsoil.		
5	1, 2			1 2 2 (4)		D-1		Silty SAND, rounded, very loose, dark yellowish brown, wet, homogeneous. Recovered 0.5 ft.		
10	3			1 0 1 (1)		D-2	MC GS	SM, M.C. = 49% Silty SAND, rounded, very loose, dark reddish brown, wet, homogeneous. Recovered 1.5 ft.		
15	4, 5			10 14 15 (29)		D-3	MC GS	GW-GM, M.C. = 10% Well graded GRAVEL with silt and sand, subrounded, dense, dark greenish gray, wet, homogeneous. Recovered 1.5 ft.		
20	6			12 15		D-4		Well graded GRAVEL with silt and sand, subrounded, dense, dark greenish		

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2-97**

Sheet **2** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				19 (34)				gray and strong brown, wet, stratified. Recovered 1.0 ft.		
	7									
25				25 30 35 (65)		D-5		SILTSTONE, dark greenish gray, moist, homogeneous. Recovered 1.5 ft.		
	8			RQD 0% FF 0		C-6		SILTSTONE, dark greenish gray, fine grained, completely weathered, very weak rock, discontinuities are closely spaced and in poor condition. Core Recovery = 100% (4.5 ft.)		
	9									
30				RQD 100% FF 0		C-7	UC	SILTSTONE (R-1), dark greenish gray, fine grained, fresh, very weak rock, discontinuities are moderately spaced and in good condition. Core Recovery = 100% (5.0 ft.)		
	10									
35				32 34 50 (84)		D-8		SILTSTONE, dark greenish gray, moist, homogeneous. Recovered 1.5 ft.		
	11									
				RQD 100% FF 0		C-9		SILTSTONE, dark greenish gray, fine grained, fresh, very weak rock, no discontinuities are present. Core Recovery = 100% (2.5 ft.)		
	12									
40				RQD 100% FF 0		C-10		SILTSTONE, dark greenish gray, fine grained, fresh, very weak rock, discontinuities are moderately spaced and in good condition. Core Recovery = 100% (5.0 ft.)		
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-2-97

Sheet 3 of 4

PROJECT South Fork Chehalis River Bridge 6/115 Replacement

Job No. OL-0911

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			32 50/7 (50/7")		D-11		SILTSTONE, dark greenish gray, moist, homogeneous. Recovered 1.5 ft.		
	15			RQD 100% FF 0		C-12		SILTSTONE, dark greenish gray, fine grained, fresh, very weak rock, no discontinuities are present. Core Recovery = 100% (2.5 ft.)		
50				RQD 100% FF 0		C-13	UC	SILTSTONE (R-1), dark greenish gray, fine grained, fresh, very weak rock, no discontinuities are present. Core Recovery = 100% (5.0 ft.)		
	16									
55										
	17			32 50 (50/6")		D-14		SILTSTONE, dark greenish gray, moist, homogeneous. Recovered 1.5 ft.		
	18			RQD 98% FF 0		C-15		SILTSTONE, dark greenish gray, fine grained, fresh, very weak rock, discontinuities are moderately spaced and in fair condition. Core Recovery = 100% (2.5 ft.)		
60				RQD 80% FF 1		C-16	UC	SILTSTONE (R-1), dark greenish gray, fine grained, slightly weathered, very weak rock, discontinuities are moderately spaced and in fair to poor condition. Core Recovery = 100% (5.0 ft.)		
	19									
65										
	20			RQD 100% FF 0		C-17		SILTSTONE, dark greenish gray, fine grained, fresh, moderately weak rock, no discontinuities are present. Core Recovery = 100% (5.0 ft.)		
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2-97**

Sheet **4** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				32 50 (50/6")		D-18		SILTSTONE, dark greenish gray, dry, homogeneous. Recovered 1.5 ft.		
	22							End of the Test Hole Boring at 72.0 ft. below ground elevation.		
75	23							Note: Bail test was performed. Recharge of water was as fast as bailing. An adequate seal may not have been present due to fractured nature of C-6. No determination could be made as to whether the water was coming from within the siltstone or from above. Possible areas of water movement observed at depths 26.0 ft. to 30.5 ft. and 60.5 ft. to 65.5 ft. Note: No instrumentation installed.		
	24							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
80										
	25									
85	26									
	27									
90										
	28									
95										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-3-97

PROJECT South Fork Chehalis River Bridge 6/115 Replacement

Job No. OL-0911

S.R. 6

Station 21 + 28

Offset 93' Rt.

C.S. 2105

Equipment CME-850

Casing HQ X 82.5'

Ground El 214.7 (65.44 m)

Method of Boring Wet Rotary

Start Date April 28, 1997

Completion Date April 28, 1997

Sheet 1 of 4

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m		
5	1, 2			1 2 2 (4)		D-1		Silty SAND, very loose, dark reddish brown, wet, homogeneous. Retained 1.0 ft.		
10	3, 4			5 9 8 (17)		D-2	GS MC	SP-SM, M.C. = 16% Poorly graded SAND with silt and gravel, medium dense, dark yellowish brown, wet, homogeneous. Retained 1.0 ft.		
15	5			6 8 11 (19)		D-3		Well graded GRAVEL with silt and sand, subrounded, medium dense, dark brown, wet, homogeneous. Retained 1.5 ft.		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-3-97**

Sheet 2 of 4

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				10 18 22 (40)		D-4 C-5	GS MC	D-4A: Well graded GRAVEL with silt and sand, subrounded, dense, dark brown, wet, homogeneous. D-4B: ML, M.C. = 29% SILT, hard, dark greenish gray, moist and homogeneous. (SILTSTONE ?) Retained 1.0 ft. No recovery. Pushing something, acting as an advancer.		
25	7									
	8			RQD 95% FF 0		C-6		SILTSTONE, dark greenish gray, fine grained, moderately weathered, very weak rock, fossilized wood was present at 30.5 ft. to 30.7 ft, discontinuities are moderately spaced and in fair condition. Core Recovery = 100% (4.0 ft.)		
30	9									
			> >	25 40 50 (90)		D-7		SILTSTONE, very hard, dark greenish gray, moist, homogeneous. Retained 1.5 ft.		
	10			RQD 98% FF 0		C-8		SILTSTONE, dark greenish gray, fine grained, moderately weathered, very weak rock, three inch sandstone lense at 35.0 ft, discontinuities are moderately spaced and in fair condition. Core Recovery = 100% (4.0 ft.)		
35										
	11			RQD 100% FF 0		C-9	UC	SILTSTONE (R-1), dark greenish gray, fine grained, slightly weathered, very weak rock, discontinuities are widely spaced and in good condition. Core Recovery = 100% (5.0 ft.)		
	12									
40										
			> >	15 32 44 (76)		D-10		SILTSTONE, very hard, dark greenish gray, moist, homogeneous. Retained 1.5 ft.		
	13			RQD 100% FF 0		C-11		SILTSTONE, dark greenish gray, fine grained, slightly weathered, very weak rock, no discontinuities are present. Core Recovery = 100% (4.0 ft.)		
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-3-97**

Sheet **3** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			RQD 100% FF 0		C-12		SILTSTONE, dark greenish gray, fine grained, slightly weathered, moderately weak rock, no discontinuities are present. Core Recovery = 100% (5.0 ft.)		
	15									
50				32 50 (50/6")		D-13		Retained 1.5 ft.		
	16			RQD 100% FF 0		C-14		SILTSTONE, dark greenish gray, fine grained, slightly weathered, very weak rock, no discontinuities are present. Core Recovery = 100% (4.0 ft.)		
55										
	17			RQD 95% FF 0		C-15	UC	SILTSTONE (R-1), dark greenish gray, fine grained, slightly weathered, very weak rock, discontinuities are moderately spaced and in fair condition. Core Recovery = 100% (5.0 ft.)		
	18									
60			> >	19 40 40 (80)		D-16		SILTSTONE, very hard, dark greenish gray, dry, homogeneous. Retained 1.5 ft.		
	19			RQD 93% FF 0		C-17		SILTSTONE, dark greenish gray, fine grained, slightly weathered, very weak rock, discontinuities are moderately spaced and in fair condition. Core Recovery = 100% (4.0 ft.)		
65										
	20			RQD 100% FF 0		C-18		SILTSTONE, dark greenish gray, fine grained, slightly weathered, moderately weak rock, no discontinuities are present. Core Recovery = 100% (5.0 ft.)		
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-3-97**

Sheet **4** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				20 50/7 (50/7")		D-19		SILTSTONE, very hard, dark greenish gray, dry, homogeneous. Retained 1.5 ft.		
	22			RQD 99% FF 0		C-20		SILTSTONE, dark greenish gray, fine grained, slightly weathered, moderately weak rock, discontinuities are moderately spaced and in good condition. Core Recovery = 100% (4.0 ft.)		
75	23			RQD 75% FF 0		C-21		SILTSTONE, dark greenish gray, fine grained, slightly weathered, moderately weak rock, discontinuities are closely spaced and in fair condition. Core Recovery = 100% (5.0 ft.)		
	24									
80				11 50 (50/6")		D-22		SILTSTONE, very hard, dark greenish gray, dry, homogeneous. Retained 1.5 ft.		
	25									
								End of the Test Hole Boring at 82.5 ft. below ground elevation.		
85	26							Water Table Elevation: Not determined.		
								This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	27									
90										
	28									
95										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-4-97**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement** Job No. **OL-0911**

S.R. **6**

Station **22+37** Offset **101' Rt.** C.S. **2105**

Equipment Casing **HW X 21', HQWL X 71'** Ground El **213.2 (64.99 m)**

Method of Boring **Wet Rotary**

Start Date **April 25, 1997** Completion Date **April 25, 1997** Sheet **1** of **4**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Organic soil with sand, soft, dark brown, moist.		
5	1			1 1 2 (3)		D-1		Sample D-1A: SILT with sand, soft, dark reddish brown, moist.		
	2							Sample D-1B: Silty SAND, loose, dark reddish brown, moist. Retained 1.5 ft.		
10	3			2 2 2 (4)		D-2		Silty SAND with gravel, loose, dark reddish brown, wet. Retained 1.0 ft.		
	4									
15	5			10 16 16 (32)		D-3		Poorly graded SAND with silt and gravel, dense, dark brown, wet. Retained 1.2 ft.		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-4-97**

Sheet **2** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				23 36 38 (74) RQD 60% FF 3		D-4 C-5		SILTSTONE, dark gray, fine grained, fresh, very weak, massive. Retained 1.5 ft. SILTSTONE, dark gray, fine grained, fresh, weak rock, closely spaced, excellent condition. Recovered 3.1 ft.		
25	7									
	8			RQD 80% FF 2		C-6		SILTSTONE, dark gray, fine grained, fresh, weak rock, closely spaced, excellent condition. Recovered 5.0 ft.		
30	9									
				26 49 (49/6") RQD 100% FF 1		D-7 C-8		SILTSTONE, weak rock. Retained 1.0 ft. Recovered 4.0 ft.		
	10									
35										
	11			RQD 100% FF <1		C-9		Lense of volcanic ash in SILTSTONE 35.5 ft to 35.7 ft. Recovered 5.0 ft.		
	12									
40										
				22 50/5 (50/5") RQD 100% FF <1		D-10 C-11		Retained 0.9 ft. SILTSTONE, dark gray, fine grained, fresh, weak rock, closely spaced, excellent condition. Recovered 4.1 ft.		
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-4-97**

Sheet **3** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			RQD 100% FF<1		C-12		SILTSTONE, dark gray, fine grained, fresh, weak rock, closely spaced, excellent condition, massive. Recovered 5.0 ft.		
	15									
50										
				30 50/5 (50/5")		D-13		Retained 0.9 ft.		
	16							Recovered 4.1 ft.		
				RQD 100% FF <1		C-14				
55										
	17			RQD 100% FF 1		C-15		SILTSTONE, dark gray, fine grained, fresh, weak rock, closely spaced, excellent condition. Recovered 5.0 ft.		
	18									
60										
				30 50 (50/6")		D-16		Retained 1.0 ft.		
	19			RQD 100% FF <1		C-17		SILTSTONE, dark gray, fine grained, fresh, weak rock, closely spaced, excellent condition. Recovered 4.0 ft.		
65										
	20			RQD 100% FF <1		C-18		SILTSTONE, dark gray, fine grained, fresh, weak rock, closely spaced, excellent condition. Recovered 5.0 ft.		
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-4-97**

Sheet **4** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				30 50 (50/6")		D-19		Retained 1.0 ft.		
	22							End of the Test Hole Boring at 72.0 ft below ground elevation. There appears to be a perched water table between 7.0 ft and 20.0 ft. This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
75	23									
	24									
80										
	25									
85	26									
	27									
90										
	28									
95										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-5-97**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement** Job No. **OL-0911**

S.R. **6**

Station **23+45** Offset **99' Rt.** C.S. **2105**

Equipment Casing Ground El **214.6 (65.39 m)**

Method of Boring **Wet Rotary**

Start Date **April 24, 1997** Completion Date **April 24, 1997** Sheet **1** of **4**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m		
5	1, 2			0 1 1 (2)		D-1		Silty SAND, very loose, dark reddish brown, moist and homogeneous. Retained 1.0 ft.		
10	3			1 1 1 (2)		D-2		Silty SAND, very loose, dark reddish brown, wet and homogeneous. Retained 1.5 ft.		
15	4, 5			1 2 2 (4)		D-3	GS MC	SM, M.C. = 64% Silty SAND with organics, very loose, dark bluish gray, wet and homogeneous. Retained 0.5 ft.		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-5-97**

Sheet **2** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				6 50 (50/6")		D-4	GS MC	SP-SM, M.C. = 20% Poorly graded SAND with silt and gravel, very dense, black, wet and homogeneous. Retained 1.0 ft. Core caught in casing.		
	7									
25				50/7" (50/7")		D-5		SILTSTONE, dark greenish gray. Retained 1.0 ft.		
	8			RQD 90% FF 0		C-6		SILTSTONE, dark greenish gray, fine grained, fresh and moderately weak rock, discontinuities are moderately spaced and in good condition. Recovered 50%		
	9									
30				RQD 75% FF 0		C-7		SILTSTONE, dark greenish gray, fine grained, fresh and moderately weak rock, discontinuities are widely spaced and in fair condition. Recovered 80%.		
	10									
35				29 50 (50/6")		D-8		SILTSTONE, very hard, dark greenish gray, moist and homogeneous. Retained 1.5 ft.		
	11									
				RQD 100% FF 0		C-9		SILTSTONE, dark greenish gray, fine grained, fresh and very weak rock (R1), discontinuities are widely spaced and in good condition. Recovered 100%.		
	12									
40				RQD 100% FF 0		C-10	UC	SILTSTONE (R-1), dark greenish gray, fine grained, fresh and moderately weak rock, no discontinuities were present. Recovered 100%		
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-5-97**

Sheet **3** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			23 50 (50/6") RQD 100% FF 0		D-11 C-12		SILTSTONE, very hard, dark greenish gray, dry and homogeneous. Retained 1.0 ft. SILTSTONE, dark greenish gray, fine grained, fresh and moderately weak rock, discontinuities are widely spaced and in good condition. Recovered 100%		
	15									
50				RQD 100% FF 0		C-13		SILTSTONE, dark greenish gray,m fine grained, fresh and moderately weak rock, discontinuities are widely spaced and in good condition. Recovered 100%		
	16									
55								SILTSTONE, very hard, dark greenish gray, dry and homogeneous. Retained 1.0 ft.		
	17			50/7" (50/7")		D-14				
				RQD 87% FF 0		C-15		SILTSTONE, dark greenish gray, fine grained, fresh and moderately weak rock, discontinuities are moderately spaced and in good condition. Recovered 100%.		
	18									
60				RQD 85% FF 1		C-16		SILTSTONE, dark greenish gray, fine grained, fresh and moderately weak rock, discontinuities are moderately spaced and in fair condition. Recovered 100%		
	19									
65										
	20			50/6" (50/6")		D-17		SILTSTONE, very hard, dark greenish gray, dry and homogeneous. Retained 1.0 ft.		
				RQD 100% FF 0		C-18		SILTSTONE, dark greenish gray, fine grained, fresh and moderately weak rock, no discontinuities were present. Recovered 100%		
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-5-97

Sheet 4 of 4

PROJECT South Fork Chehalis River Bridge 6/115 Replacement

Job No. OL-0911

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 100% FF 0		C-19		SILTSTONE, dark greenish gray, fine grained, fresh and moderately weak rock, discontinuities are moderately spaced and in good condition. Recovered 100%		
	22									
75										
	23			50/7" (50/7")		D-20		SILTSTONE, very hard, dark greenish gray, dry and homogeneous. Retained 1.0 ft.		
				RQD 100% FF 0		C-21		SILTSTONE, dark greenish gray, fine grained, fresh and moderately weak rock, no discontinuities were present. Recovered 100%		
	24									
80										
				RQD 100% FF 0		C-22		SILTSTONE, dark greenish gray, fine grained, fresh and moderately weak rock, no discontinuities were present. Recovered 60%.		
	25									
85										
	26			50/7" (50/7")		D-23		SILTSTONE, very hard, dark greenish gray, dry and homogeneous. Retained 1.0 ft.		
								End of the Test Hole Boring at 86.2 ft. below ground elevation.		
								Water table elevation: Not determined.		
	27							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
90										
	28									
95										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-6-97**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement** Job No. **OL-0911**

S.R. **6**

Station **24+46** Offset **78' Rt.** C.S. **2105**

Equipment **CME-45** Casing Ground El **215.2 (65.59 m)**

Method of Boring **Wet Rotary**

Start Date **March 27, 1997** Completion Date **March 27, 1997** Sheet **1** of **4**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m		
5	1									
	2			2 1 4 (5)		D-1	GS MC PI	CH, M.C. = 36%, PI = 34 FAT CLAY with sand, highly plastic, medium stiff, strong brown, wet, homogeneous (Residual Soil). Retained 1.0 ft.		
10	3									
				3 3 7 (10)		D-2		FAT CLAY with sand, stiff, strong brown mottled with light yellowish brown, dry, homogeneous (Residual Soil). Retained 1.5 ft.		
15	4									
	5			12 17 24 (41)		D-3		SILT with sand, hard, dark greenish gray, dry, homogeneous. Retained 1.5 ft.		
				RQD 100% FF 0		C-4		SILTSTONE, dark greenish gray, medium grained, slightly weathered, moderately weak rock, discontinuities are widely spaced and in fair condition. Recovered 100%		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-6-97**

Sheet **2** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 98% FF 0		C-5	UC	SILTSTONE (R-1), dark greenish gray, medium dense, slightly weathered, very weak rock, discontinuities are widely spaced and in fair condition. Recovered 100%		
	7									
25										
	8			9 50 (50/6")		D-6		Retained 1.0 ft.		
				RQD 95% FF 0		C-7		SILTSTONE, dark greenish gray, medium grained, slightly weathered, moderately weak rock, discontinuities are widely spaced and in fair condition. Recovered 95%		
	9									
30										
				RQD 98% FF 0		C-8		SILTSTONE, dark greenish gray, medium grained, slightly weathered, moderately weak rock, discontinuities are widely spaced and in fair condition Recovered 100%		
	10									
35										
	11			29 50 (50/6")		D-9		Retained 1.0 ft.		
				RQD 100% FF 0		C-10		SILTSTONE, dark greenish gray, medium grained, slightly weathered, moderately weak rock, discontinuities are widely spaced and in fair condition. Recovered 100%		
	12									
40										
				RQD 100% FF 0		C-11		SILTSTONE, dark greenish gray, medium grained, slightly weathered, moderately weak rock, discontinuities are widely spaced and in fair condition. Recovered 100%		
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-6-97

Sheet 3 of 4

PROJECT South Fork Chehalis River Bridge 6/115 Replacement

Job No. OL-0911

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			23 50 (50/6")		D-12		Retained 1.0 ft.		
				RQD 100% FF 0		C-13		SILTSTONE, dark greenish gray, medium grained, slightly weathered 47.5 ft to 47.8 ft very soft otherwise the rest of core is moderately weak rock, discontinuities are widely spaced and in fair condition. Recovered 100%		
	15									
50										
				RQD 98% FF 0		C-14		SILTSTONE, dark greenish gray, medium grained, slightly weathered, moderately weak rock, discontinuities are widely spaced and in fair condition. Recovered 80%		
	16									
55										
	17			50/6" (50/6")		D-15		Retained 1.0 ft.		
				RQD 100% FF 0		C-16		SILTSTONE, dark greenish gray, medium grained, slightly weathered, moderately weak rock,discontinuities are widely spaced and in fair condition. Recovered 100%		
	18									
60										
				RQD 90% FF 0		C-17		SILTSTONE, dark greenish gray, medium grained, slightly weathered, moderately weak rock, discontinuities are widely spaced and in fair condition. Dropped core and broke it. Recovered 100%		
	19									
65										
	20			27 50 (50/6")		D-18		SILTSTONE, dark greenish gray, medium grained, slightly weathered, moderately weak rock, discontinuities are widely spaced and in fair condition. Retained 1.0 ft.		
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-7-97

PROJECT South Fork Chehalis River Bridge 6/115 Replacement

Job No. OL-0911

S.R. 6

Station 25+22

Offset 86.5' Rt.

C.S. 2105

Equipment CME-45

Casing

Ground El 236.9 (72.21 m)

Method of Boring Wet Rotary

Start Date March 12, 1997

Completion Date March 12, 1997

Sheet 1 of 4

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m		
5	1									
10	2			2 4 5 (9)		D-1	GS MC PI	CH, M.C. = 37%, PI = 38 FAT CLAY, stiff, yellowish red, wet, homogeneous. Retained 1.1 ft.		
15	3			8 6 8 (14)		D-2		Elastic SILT with gravel, angular, stiff, strong brown, wet, homogeneous. Retained 0.4 ft.		
20	4									
	5			2 3 6 (9)		D-3	GS MC PI	CH, M.C. = 50%, PI = 48 FAT CLAY with sand, stiff, yellowish red, wet, homogeneous. Retained 1.1 ft.		
	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-7-97**

Sheet **2** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				50/4" (50/4")		D-4	GS MC	SM, M.C. = 25% Silty SAND with gravel, very dense, strong brown, moist, homogeneous. Retained 0.4 ft. Silty SAND with gravel and cobbles, angular, very dense, black mottled with dark yellowish brown, moist and disrupted.		
				RQD 90% FF 1		C-5				
	7									
25								SILTSTONE, dark greenish gray, medium grained, very weak rock, discontinuities are moderately spaced and in fair condition. Recovered 100%		
	8		> >	17 25 50 (75)		D-6				
				RQD 100 FF 0		C-7		SILTSTONE, dark greenish gray, medium grained, very weak rock, discontinuities are moderately spaced and in fair condition. Recovered 80%		
	9									
30										
				16 50 (50/6")		D-8				
	10			RQD 100% FF 0		C-9		SILTSTONE, dark greenish gray, medium grained, very weak rock, discontinuities are moderately spaced and in fair condition. Recovered 95%		
35										
	11		> >	10 30 54 (84)		D-10				
				RQD 90% FF 0		C-11		SILTSTONE, dark greenish gray, medium grained, moderately weak rock, discontinuities are moderately spaced and in fair condition. Recovered 80%		
	12									
40										
				15 50/7 (50/7")		D-12				
	13			RQD 100% FF 0		C-13		SILTSTONE, dark greenish gray, medium grained, moderately weak rock, discontinuities are moderately spaced and in fair condition. Recovered 100%		
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-7-97**

Sheet 3 of 4

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			30 50 (50/6")		D-14				
				RQD 100% FF 0		C-15		SILTSTONE, dark greenish gray, medium grained, moderately weak rock, discontinuities are moderately spaced and in fair condition. Recovered 100%		
	15									
50										
				20 28 39 (67)		D-16				
	16			RQD 100% FF 0		C-17		SILTSTONE, dark greenish gray, medium grained, moderately weak, discontinuities are moderately spaced and in fair condition. Recovered 80%		
55										
	17			15 40 42 (82)		D-18				
				RQD 60% FF 2		C-19		SILTSTONE, dark greenish gray, medium grained, moderately weak, highly weathered, discontinuities are moderately spaced and in poor condition. Recovered 75%		
	18									
60										
				19 50 (50/6")		D-20				
	19			RQD 60% FF 2		C-21		SILTSTONE, dark greenish gray, medium grained, moderately weathered, moderately weak, discontinuities moderately spaced and in fair condition. Recovered 100%		
65										
	20			30 50 (50/6")		D-22				
				RQD 95% FF 0		C-23		SILTSTONE, dark greenish gray, medium grained, no weathering, moderately weak, discontinuities are moderately spaced and in fair condition. Recovered 90%		
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-7-97**

Sheet **4** of **4**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	22							End of the Test Hole Boring at 71.0 ft below ground elevation.		
								Water Table Elevation: Not determined.		
75	23							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	24									
80										
	25									
85	26									
	27									
90										
	28									
95										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1-98**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement** Job No. **OL-0911**

S.R. **6**

Station **27+96** Offset **151' Rt.** C.S. **2105**

Equipment **CME 850** Casing Ground El **273.5 (83.36 m)**

Method of Boring **Auto Hammer**

Start Date **March 4, 1998** Completion Date **March 11, 1998** Sheet **1** of **5**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
						C-1		1 ft. = 0.3048m Silty sand with clayey silt Recovered: 0.6 ft.		
5	1			2 1 3 (4)		D-2	GS MC PI	MH, MC=60%, PI=37 Elastic SILT, very loose, yellowish-red, wet, homogeneous. Recovered: 1.0 ft.		
	2					C-3		SILTY sand with clayey silt and basalt chunks, dark yellowish-brown, wet, blocky. Recovered: 2.0 ft.		
10	3			1 2 3 (5)		D-4		SILTY sand with clayey silt, loose, dark yellowish-brown, wet, blocky. Recovered: 1.5 ft.		
						C-5		SILTY sand with clayey silt and basalt cobble and boulder Recovered: 2.0 ft.		
	4									
15	5			2 4 6 (10)		D-6	GS MC PI	MH, MC=47%, PI=21 Sandy elastic SILT, loose, dark yellowish-brown, wet, stratified. Recovered: 1.5 ft.		
						C-7		SILTY sand, dark yellowish-brown, wet, stratified. Recovered: 1.5 ft.		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1-98**

Sheet **2** of **5**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				3 7 10 (17)		D-8	GS MC PI	MH, MC=57%, PI=28 Elastic SILT, medium dense, gray, wet, homogeneous. Recovered: 1.5 ft.		
				RQD 57% FF 0		C-9	UC	SILTSTONE (R-0), bluishgray, medium grained, fresh, extremely weak rock. CR=80%		
	7							CONGLOMERATE		
25			> >	17 40 50/5"		D-10		SILTSTONE, bluishgray, wet, disrupted Recovered: 1.4 ft.		
	8			RQD 100% FF 0		C-11	UC	SILTSTONE (R-1), bluishgray, fine grained, fresh CR=100%		
	9									
30				RQD 76% FF 0		C-12		SILTSTONE, gray, fine grained, fresh. CR=100%		
	10									
35			> >	21 43 50 (93)		D-13		SILTSTONE, gray, moist, homogeneous. Recovered: 1.5 ft.		
	11			RQD 100% FF 0		C-14		SILTSTONE, gray, fine grained, fresh. CR=100%		
	12									
40				RQD 94% FF 0		C-15		SILTSTONE, gray, fine grained, fresh. CR=100%		
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1-98**

Sheet **3** of **5**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				26 50 (50/6")		D-16		SILTSTONE, gray, moist, homogeneous. Recovered: 1.0 ft.		
	14			RQD 94% FF 0		C-17		SILTSTONE, gray, fine grained, fresh. CR=100%		
	15									
50				RQD 96% FF 0		C-18	UC	SILTSTONE (R-2), gray, fine grained, fresh. CR=100%		
	16									
55			> >	38 32 50 (82)		D-19		SILTSTONE, gray, moist, blocky. Recovered: 1.5 ft.		
	17			RQD 85% FF 0		C-20		SILTSTONE, gray, fine grained, fresh. CR=100%		
	18									
60				RQD 90% FF 0		C-21		SILTSTONE, gray, fine grained, fresh. CR=100%		
	19									
65				29 50 (50/6")		D-22		SILTSTONE, gray, moist, homogeneous. Recovered: 1.0 ft.		
	20			RQD 100% FF <1		C-23		SILTSTONE, very dark gray, medium grained, fresh, moderately weak rock, discontinuities widely spaced, open and closed, separates easily, good condition, 0-10 potential for slaking. CR=100%		
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1-98**

Sheet **4** of **5**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 100% FF 1		C-24		SILTSTONE, very dark gray, medium grained, fresh, moderately weak rock, discontinuities widely spaced, open and closed, separates easily, good condition, 0-10 potential for slaking. CR=100%, (@ 72' fracture at 50 slickensided).		
	22									
75				40 50/5 (50/5") RQD 100% FF 1		D-25 C-26	GS MC PI UC	MH, MC=47%, PI=13 Volcanic ash, light gray, (75.5' to 75.6'). Recovered and Retained: 1.0 ft. SILTSTONE, very dark gray, medium grained, fresh, moderately strong rock(R3), discontinuities closely spaced, open, shinny, slickensided, poor condition, 45 CR=100%		
	23									
	24									
80				RQD 100% FF <1		C-27		SILTSTONE (R-2), very dark gray, medium grained, fresh, moderately weak rock, discontinuities widely spaced, open, good condition, 2 fractures @ 10 CR=100%		
	25									
85				40 50/5 (50/5") RQD 100% FF 0		D-28 C-29		SILTSTONE, very dark gray, medium grained, moist, fissured, blocky, chunks of sandstone. Recovered: 1.0 ft. SILTSTONE, very dark gray, medium grained, fresh, moderately weak rock, discontinuities widely spaced, 4' stick, no fractures. CR=100%		
	26									
	27									
90				RQD 100% FF 0		C-30		SILTSTONE, very dark gray, medium grained, fresh, moderately weak rock, discontinuities widely spaced, 4' stick, 1 fractures in 5 ft. CR=100%		
	28									
95										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1-98**

Sheet **5** of **5**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	29			42 50/5 (50/5") RQD 100% FF 0		D-31 C-32		Recovered and Retained: 0.9 ft. SILTSTONE, very dark gray, medium grained, fresh, moderately weak rock, 1 fracture in 4'. CR=100%		
	30									
100										
	31							End of Test Hole Boring at 100 feet below ground elevation. Installed Slope Inclinometer casing to 100' and grout. 3-10-98 A piezometer was installed at station 28+02 (147ft Rt.),25 feet below ground elevation. Ground elevation 273.1ft. DATE DEPTH ELEVATION 3-11-98 -14.2' 258.9' 3-12-98 -12.6' 260.5' 3-31-98 -13.4' 259.7' 6-11-98 -15.1' 258.0' 10-30-98 -17.6' 255.5' 12-21-98 -14.7' 258.4' 12-29-98 -10.0' 263.1' 1-20-99 -11.5' 261.6' 2-25-99 -10.2' 262.9' 3-15-99 -14.8' 258.3' This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
105	32									
	33									
110										
	34									
115	35									
	36									
120										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2-98**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement** Job No. **OL-0911**

S.R. **6**

Station **29+38.4** Offset **120.5' Rt.** C.S. **2105**

Equipment **CME 850/Auto Hammer** Casing Ground El **264.2 (80.53 m)**

Method of Boring **Wet Rotary**

Start Date **March 11, 1998** Completion Date **March 12, 1998** Sheet **1** of **5**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
						C-1		1 ft. = 0.3048m Clayey SILT, reddish brown, moist to wet, scattered basalt and sandstone gravel and cobbles. Recovered 1.0 ft.		
5	1			2 4 3 (7)		D-2 C-3		Sandy LEAN CLAY, medium stiff, moist, mottled with brown, rust, and yellowish brown, lensed, scattered sandstone gravel, weathered rock appearance. Recovered 1.3 ft. and Retained 1.0 ft. Sandy clayey SILT, yellowish, reddish brown, moist to wet, scattered sandstone.	3/19/98	
10	2 3			2 3 3 (6)		D-4		Sandy LEAN CLAY, medium stiff, mottled reddish brown and orange, moist, blocky to mottled gray, highly weathered, disrupted at depth of 11.0 ft. Recovered and Retained 1.0 ft.		
	4					C-5		SILTSTONE, greenish, bluish gray, fine grained, soft, weak rock, scattered basalt cobbles and gravel at depth of 14.0 ft. to 15.0 ft. Core recovery = 100% (3.5) Note: Core is in mylar tube.		
15	5			10 27 31 (58) RQD 100% FF <1		D-6 C-7	GS MC	ML, MC=51% SILT with sand, dark olive, moist to dry, laminated, fissured, blocky. Recovered 1.5 ft. and Retained 1.0 ft. SILTSTONE, very dark olive gray, fine grained, fresh, moderately weak rock, discontinuities are open, closed and in good condition (one discontinuities at 45 degrees at depth of 17.7 ft.). Core recovery = 100% (3.5 ft.) Note: Core is in mylar tube.		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2-98**

Sheet **2** of **5**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				13 34 44 (78)		D-8		SILTSTONE, dark olive gray, moist, laminated, fissured, blocky. Recovered 1.5 ft. and Retained 1.0 ft.		
	7			RQD 95% FF 1		C-9		SILTSTONE, very dark olive gray, fine grained, fresh, moderately weak rock, discontinuities are open, closed and in good condition. discontinuities at 10 degrees. Core recovery = 100% (3.5 ft.) Note: Core is in mylar tube.		
25	8			RQD 90% FF 1		C-10	UC	SILTSTONE (R-1), dark greenish gray, fine grained, fresh, very weak rock, discontinuities are closely spaced, open and in fair condition. Discontinuities are 0 to 10 degrees. Core recovery = 100% (5.0 ft.)	3/23/98	
30	9			RQD 18% FF 5		C-11		SILTSTONE, dark greenish gray, fine grained, fresh, very weak rock, discontinuities are very closely spaced, healed with clayey infilling and in fair condition. Discontinuities are 0 to 10 degrees. Core recovery = 100% (5.0 ft.)		
35	10			28 45 (45/6")		D-12		SILTSTONE, dark greenish gray. Recovered and Retained 1.0 ft.		
	11			RQD 100% FF 0		C-13	UC	SILTSTONE (R-1), fine grained, dark greenish gray, fresh, very strong rock, discontinuities are widely spaced (one fracture in 4.0 ft.). Core recovery = 100% (4.0 ft.)		
40	12			RQD 100% FF 0		C-14		SILTSTONE, fine grained, dark greenish gray, fresh, moderately strong rock, discontinuities are widely spaced (two fractures in 5.0 ft.) and in good condition. Core recovery = 100% (5.0 ft.)		
45	13									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2-98**

Sheet **3** of **5**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				20 48 (48/6")		D-15		SILTSTONE, dark greenish gray. Recovered and Retained: 1.0 ft.		
	14			RQD 100% FF 0		C-16		SILTSTONE, fine grained, dark greenish gray, fresh, moderately strong rock, discontinuities are widely spaced (two fractures in 4.0 ft.) and in good condition. Core recovery = 100% (4.0 ft.)		
	15									
50				RQD 100% FPF 0		C-17		SILTSTONE, fine grained, dark greenish gray, fresh, moderately strong rock, discontinuities are widely spaced (three fractures in 5.0 ft.) and in good condition. Core recovery = 100% (5.0 ft.) Note: Core barrel broke.		
	16									
55				40 38 50/5"		D-18		SILTSTONE, greenish gray. Recovered 1.5 ft. and Retained 1.0 ft.		
	17			RQD 100% FF 0		C-19		SILTSTONE, medium grained, dark greenish gray, fresh, moderately weak rock, one fracture in 3.5 ft. Core recovery = 100% (3.5 ft.)		
	18									
60				RQD 100% FF 0		C-20		SILTSTONE, medium grained, dark greenish gray, fresh, moderately weak rock, one fracture in 5.0 ft. Core recovery = 100% (5.0 ft.)		
	19									
65				RQD 100% FF 0		C-21		SILTSTONE, medium grained, dark greenish gray, fresh, moderately weak rock, one fracture in 5.0 ft. Core recovery = 100% (5.0 ft.)		
	20									
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2-98**

Sheet **4** of **5**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 100% FF 0		C-22		SILTSTONE, medium grained, dark greenish gray, fresh, moderately weak rock, one fracture in 5.0 ft., 3" layer of volcanic ash at depth of 71.5 ft. Core recovery = 100% (5.0 ft.)		
	22									
75	23			RQD 100% FF 0		C-23		SILTSTONE, medium grained, dark greenish gray, fresh, moderately weak rock, one fracture in 5.0 ft. Core recovery = 100% (5.0 ft.)		
	24									
80				RQD 83% FF 1		C-24		SILTSTONE, medium grained, dark greenish gray, fresh, moderately weak rock, discontinuities are widely spaced, open and closed and in poor condition. Discontinuities are 30 to 50 degrees. Discontinuities have sand infilling at depth of 83.3 ft. Note: 40% water loss. Core recovery = 100% (5.0 ft.)		
	25									
85	26			RQD 100% FF <1		C-25		SILTSTONE, medium grained, dark greenish gray, fresh, moderately weak rock, discontinuities are widely spaced, open, and in fair condition. Discontinuities are 30 to 45 degrees. Core recovery = 100% (5.0 ft.)		
	27									
90				RQD 100% FF 0		C-26		SILTSTONE, medium grained, dark greenish gray, fresh, moderately weak rock, discontinuities are widely spaced (one fracture in 5.0 ft.), open, and in fair condition. Discontinuities are 40 degrees. Core recovery = 100% (5.0 ft.)		
	28									
95										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2-98**

Sheet **5** of **5**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	29			RQD 100% FF 0		C-27		SILTSTONE, medium grained, dark greenish gray, fresh, moderately weak rock, discontinuities are widely spaced (one joint at depth of 99.5 ft. at 45 degrees-slickensided), open, and in fair condition. Core recovery = 100% (5.0 ft.)		
	30									
100				RQD 97% FF 0		C-28	CU	SILTSTONE (R-2), greenish gray, medium grained, fresh, moderately weak rock, discontinuities are closed. Core recovery = 100% (5.0 ft.)		
	31									
105	32			RQD 97% FF 0		C-29		SILTSTONE, greenish gray, medium grained, fresh, discontinuities are closed. Core recovery = 100% (5.0 ft.)		
	33									
110								End of the Test Hole Boring at 110.0 ft. below ground elevation. Water Table Elevations: See Test Boring H-2A-98		
	34							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
115	35									
	36									
120										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2A-98**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement** Job No. **OL-0911**

S.R. **6**

Station **29+49** Offset **124' Rt.** C.S. **2105**

Equipment **CME-850/AUTO HAMMER** Casing **HW X 22'/HQ X 35'** Ground El **263.7 (80.38 m)**

Method of Boring **WET ROTARY**

Start Date **March 25, 1998** Completion Date **March 25, 1998** Sheet **1** of **2**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
						S-1		1 ft. = 0.3048m LEAN CLAY, dark brown, wet. Recovered 1.0 ft.		
5	1, 2					S-2		Silty SAND with basalt chunks, reddish-brown, wet. Recovered and Retained: 1.3 ft. Note: Basalt chunk followed the drill stem to depth of 12.0 ft. before being able to move to side to take sample.		
10	3, 4					S-3	GS MC PI DS	MH, MC=43%, PI=43 Elastic SILT, reddish-brown, wet. Recovered 1.7 ft.		
15	5, 6							WATER TABLE #1 DATE DEPTH ELEVATION 3-31-98 -5.8' 257.9' 6-11-98 -9.0' 254.7' 10-30-98 -10.6' 253.1' 12-21-98 -7.9' 255.8' 12-29-98 0 263.7' 1-20-99 -0.8' 262.9' 2-25-99 0 263.7' 3-15-99 -7.7' 256.0'		
20										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2A-98**

Sheet **2** of **2**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
25	7, 8							WATER TABLE #2 DATE DEPTH ELEVATION 3-25-98 -28.0' 235.7' 3-31-98 -7.2' 256.5' 6-11-98 -13.6' 250.1' 10-30-98 -14.4' 249.3' 12-21-98 -11.4' 252.3' 12-29-98 -10.6' 253.1' 1-20-99 -11.4' 252.3' 2-25-99 -10.2' 253.5' 3-15-99 -11.2' 252.5'	3/25/98	
30	9					C-4		SILTSTONE, greenish-gray, fine to medium grained, fresh.		
35	10									
	11							End of the Test Hole Boring at 35.0 ft. (10.7m) below ground elevation. Installed two piezometers at depths of 22.0 ft. (6.7m) and 35.0 ft. (10.7m).		
40	12							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
45	13									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1-99

PROJECT South Fork Chehalis River Bridge 6/115 Replacement — Job No. OL-0911

SR-6 MP 42.48 to 42.91 — S.R. 6

Station 19+90 — Offset 12' Left — C.S. 2105

Equipment CME 850 w/autohammer — Casing HW/HQ — Ground El 211.1 (64.34 m)

Method of Boring wet rotary

Start Date January 12, 1999 — Completion Date January 13, 1999 — Sheet 1 of 2

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
	1			4 4 3 (7)		D-1		Silty SAND, loose, brown, moist, homogeneous. Recovered and Retained: 0.6 ft.		
5				0 0 1 (1)		D-2		Silty SAND, very loose, brown, wet, homogeneous. Recovered and Retained: 1.5 ft.		
	2							1-13-99	▽	
10	3			0 0 4 (4)		D-3		Silty SAND, very loose, dark gray, wet, homogeneous. Recovered and Retained: 1.5 ft.		
								Note-(Changed to GRAVEL at 11')		
	4									
15	5		>>	10 22 30 (52)		D-4		Poorly graded GRAVEL with sand, very dense, gray, wet, homogeneous. Recovered and Retained: 0.6 ft.		
			>>	14 30 50 (80)		D-5		SILTSTONE, gray, homogeneous. Recovered and Retained: 1.5 ft.		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-1-99**

Sheet **2** of **2**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 100% FF-2		C-7		SILTSTONE, medium dark gray, very fine grained, fresh, very weak rock, discontinuities are widely spaced and in good condition. Core recovery = 100 %		
	8									
	9									
30				11 42 50 (92)		D-8		SILTSTONE, very dense, gray, moist, homogeneous. Recovered and Retained: 1.5 ft.		
				RQD 100% FF-2		C-9		SILTSTONE, medium dark gray, very fine grained, fresh, very weak rock, discontinuities are widely spaced and in good condition. Core recovery = 100 %		
	10									
35				RQD 100% FF-0		C-10		SILTSTONE, medium dark gray, very fine grained, fresh, very weak rock, discontinuities are widely spaced and in good condition. Core recovery = 100 %		
	11									
	12									
40				20 25 70 (95)		D-11		SILTSTONE, very dense, gray, moist, homogeneous. Recovered and Retained: 1.5 ft.		
	13							End of Test Hole Boring at 41.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
45										
	14									
	15									
50										
	16									
55										
	17									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2-99**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement** Job No. **OL-0911**

SR-6 MP 42.48 to 42.91 S.R. **6**

Station **23+59** Offset **14' Left** C.S. **2105**

Equipment **CME 850 w/autohammer** Casing **HW/HQ** Ground El **214.3 (65.32 m)**

Method of Boring **wet rotary**

Start Date **January 13, 1999** Completion Date **January 13, 1999** Sheet **1** of **2**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
				0 2 2 (4)		D-1		Silty SAND, very loose, brown, moist, homogeneous. Recovered and Retained: 1.5 ft.		
	1									
5				0 1 1 (2)		D-2	GS MC	SM, MC=42% Silty SAND, very loose, brown, moist, homogeneous. Recovered and Retained: 0.6 ft.		
	2								▽ 1-13-99	
10	3			1 1 2 (3)		D-3		Silty SAND with organics, very loose, brown, moist, homogeneous. Recovered and Retained: 1.0 ft.		
	4							Note-(changed to GRAVEL at 13')		
15			>>	10 22 30 (52)		D-4	GS MC	GW-GM, MC=8% Well graded GRAVEL with silt and sand, dense, gray, wet, homogeneous. Recovered and Retained: 0.9 ft.		
	5									
	6									
20			>>							

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-2-99**

Sheet **2** of **2**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				19 31 50 (81)		D-5		Poorly graded SAND with silt and gravel, very dense, gray, wet, homogeneous. Recovered and Retained: 0.6 ft.		
	7			RQD 100% FF-0		C-6		SILTSTONE, medium dark gray, very fine grained, fresh, very weak rock, discontinuities are widely spaced and in good condition. Core recovery = 100 %		
25	8			RQD 100% FF-3		C-7		SILTSTONE, medium dark gray, very fined grained, fresh, very weak rock, discontinuities are widely spaced and in good condition. Core recovery = 100 %		
30	9			12 22 50 (72)		D-8		SILTSTONE, gray, moist, homogeneous. Recovered and Retained: 1.5 ft.		
	10			RQD 100% FF-1		C-9		SILTSTONE, medium dark gray, very fined grained, fresh, very weak rock, discontinuities are widely spaced and in good condition. Core recovery = 100 %		
35	11			RQD 95% FF-2		C-10		SILTSTONE, medium dark gray, very fined grained, fresh, very weak rock, discontinuities are widely spaced and in good condition. Core recovery = 100 %		
40	12			31 50/6" (50/6")		D-11		SILTSTONE, gray, moist, homogeneous.		
	13							End of Test Hole Boring at 43 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-3-99

PROJECT South Fork Chehalis River Bridge 6/115 Replacement — Job No. OL-0911

SR-6 MP 42.48 to 42.91 — S.R. 6

Station 24+75 — Offset 2 RT — C.S. 2105

Equipment CME 45 w/ autohammer — Casing HQ — Ground El 210.3 (64.10 m)

Method of Boring wet rotary

Start Date March 9, 1999 — Completion Date March 10, 1999 — Sheet 1 of 3

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
	1							Sandy CLAY to organic silt, reddish brown		
5										
	2			0 0 1 (1)		D-1		No recovery	03/10/1999	
10	3							Change in soil at 9.5'		
				5 6 8 (14)		D-2		SILT with sand and gravel, stiff, Dark Greenish Gray, moist, Homogeneous, no HCl reaction, Encountered cobbles, gravels, and silt at 9.5'. Length Recovered 0.6 ft, Length Retained 0.5 ft		
	4			RQD 0 FF 20		C-3		SILTSTONE, fine grained, fresh, moderately weak rock, no HCl reaction, very closely spaced, fair condition, Bottom 1' of sample is highly fractured(15'-16')., Percent Recovered 100.0%		
15										
	5		>>	10 22 43 (65)		D-4		SILTSTONE Length Recovered 1.5 ft, Length Retained 1.0 ft		
				RQD 50 FF 2		C-5		SILTSTONE, fine grained, fresh, very weak rock, no HCl reaction, moderately spaced, fair condition, Percent Recovered 100.0%		
20	6									

SOIL OL0911-2.GPJ SOIL.GDT 3/31/99 09:12:00 A3

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-3-99**

Sheet **2** of **3**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 78 FF 1		C-6		SILTSTONE, fine grained, fresh, very weak rock, no HCl reaction, moderately spaced, fair condition, Percent Recovered 100.0%		
	7									
25										
	8			12 50 (50/6")		D-7		SILTSTONE Length Recovered 1.0 ft, Length Retained 1.0 ft		
				RQD 83 FF .5		C-8		SILTSTONE, fine grained, fresh, very weak rock, no HCl reaction, widely spaced, execellent condition, Percent Recovered 100.0%		
	9									
30										
				RQD 97 FF .25		C-9		SILTSTONE, fine grained, fresh, very weak rock, no HCl reaction, widely spaced, execellent condition, Percent Recovered 100.0%		
	10									
35										
	11			21 50 (50/6")		D-10		SILTSTONE Length Recovered 1.0 ft, Length Retained 1.0 ft		
				RQD 100 FF 0		C-11		SILTSTONE, fine grained, fresh, moderately weak rock, no HCl reaction, widely spaced, execellent condition, Percent Recovered 100.0%		
	12									
40										
				RQD 40 FF 20		C-12		SILTSTONE, fine grained, fresh, moderately weak rock, no HCl reaction, very closely spaced, good condition, Stratified with 6" of a light gray ASH at 43'. Sample may have been fractured during drilling due to core tube being stuck., Percent Recovered 100.0%		
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-3-99**

Sheet **3** of **3**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14		>>	100/3 (100/3")		D-13		SILT with sand, very dense, Dark Greenish Gray, dry, Homogeneous, no HCl reaction Length Recovered 0.3 ft, Length Retained 0.3 ft		
								End of test hole boring at 46.2 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.		
	15									
50										
	16									
55										
	17									
	18									
60										
	19									
65										
	20									
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-4-99**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement** Job No. **OL-0911**

SR-6 MP 42.48 to 42.91 S.R. **6**

Station **25+70** Offset **3' Rt.** C.S. **2105**

Equipment **CME 45 w/ autohammer** Casing **HQ-52** Ground El **231.9 (70.68 m)**

Method of Boring **wet rotary**

Start Date **January 9, 1999** Completion Date **January 10, 1999** Sheet **1** of **3**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
5	1			2 2 2 (4)		D-1		Fat CLAY, sandy, soft, strong brown, moist, Disrupted, no HCl reaction, scattered twigs. Length Recovered 0.8 ft, Length Retained 0.8 ft		
	2					U-2 A B C D E	GS MC PI	SM, MC=50%, PI=25 Silty SAND, very loose, strong brown, moist, Disrupted, no HCl reaction, 8' silty SAND Length Recovered 1.8 ft, Length Retained 1.8 ft		
10	3			2 2 3 (5)		D-3		SILT with sand, loose, strong brown, moist, Blocky,Disrupted, no HCl reaction, mottled, chunks of siltstone. Length Recovered 1.4 ft, Length Retained 1.0 ft		
	4					U-4 A B C	GS MC PI	CH, MC=48%, PI=48 Fat CLAY, soft, strong brown, moist, Blocky,Disrupted, no HCl reaction, bedded layers, sand, silt ,clay, chunks of sandstone. Length Recovered 1.0 ft, Length Retained 1.0 ft		
15	5		>>	35 60/4 (60/4")		D-5	GS MC	SM, MC=20% Silty SAND with gravel, very dense, strong brown, moist, Disrupted, no HCl reaction, scattered basalt gravels, and cobbles. 13 - 16. Length Recovered 0.9 ft, Length Retained 0.9 ft		
20	6		>>	28 35 50/5 (85/11")		D-6		SILTSTONE, gray, very weak rock, moderately weathered. Length Recovered 1.4 ft, Length Retained 1.0 ft		
	7			RQD 80% FF-1		C-7		Siltstone, medium grained, moderately weathered, very weak rock, no HCl reaction, moderately spaced, good condition. Top 1.0ft. is moderately weak. Percent Recovered 100.0%		
25										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-4-99**

Sheet **2** of **3**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				28 35 50/5 (85/11")		D-6		SILTSTONE, gray, very weak rock, moderately weathered. Length Recovered 1.4 ft, Length Retained 1.0 ft		
	7			RQD 80% FF-1		C-7		Siltstone, medium grained, moderately weathered, very weak rock, no HCl reaction, moderately spaced, good condition. Top 1.0ft. is moderately weak. Percent Recovered 100.0%		
25	8			RQD 95% FF-1		C-8		Siltstone, medium grained, fresh, very weak rock, no HCl reaction, moderately spaced, good condition, Percent Recovered 100.0%		
30	9			35 50 (50/6")		D-9		SILTSTONE, dark olive gray. Length Recovered 1.0 ft, Length Retained 1.0 ft		
	10			RQD 90% FF-1		C-10		Siltstone, medium grained, fresh, very weak rock, no HCl reaction, widely spaced, good condition. Percent Recovered 100.0%		
35	11			RQD 97% FF-0		C-11		Siltstone, fine grained, fresh, very weak rock, no HCl reaction, widely spaced, good condition, Percent Recovered 100.0%		
40	12									
	13			25 30 50 (80)		D-12		SILTSTONE, dark olive gray. Length Recovered 1.5 ft, Length Retained 1.0 ft		
45				RQD 100% FF-0		C-13		Siltstone, fine grained, fresh, very weak rock, no HCl reaction, widely spaced, excellent condition, Percent Recovered 100.0%		

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-4-99**

Sheet **3** of **3**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			RQD 100% FF-0		C-14		Siltstone, fine grained, fresh, very weak rock, no HCl reaction, widely spaced, excellent condition, Percent Recovered 100.0%		
50	15									
	16		>>	29 52 (52/6")		D-15		SILTSTONE, dark olive gray. Length Recovered 1.0 ft, Length Retained 1.0 ft		
55	17							End of test hole boring at 53 ft below ground elevation. Water table elevation not determined. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	18									
60	19									
65	20									
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-5-99

PROJECT South Fork Chehalis River Bridge 6/115 Replacement — Job No. OL-0911

SR-6 MP 42.48 to 42.91 — S.R. 6

Station 26+55 — Offset CL — C.S. 2105

Equipment CME 45 w/ autohammer — Casing HQ-57 — Ground El 238.2 (72.60 m)

Method of Boring wet rotary

Start Date January 12, 1999 — Completion Date January 13, 1999 — Sheet 1 of 3

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft.=0.3048 m.		
5	1			4 3 4 (7)		D-1		Lean CLAY, sand and gravel, medium stiff, dark reddish gray, moist, Homogeneous, no HCl reaction Length Recovered 0.7 ft, Length Retained 0.7 ft 01/13/1999	▽	
10	2 3					U-2 A B C D	GS MC PI UU	Fat CLAY with sand, soft, yellowish brown, moist, Disrupted, no HCl reaction, chunks of siltstone. Length Recovered 1.4 ft, Length Retained 1.4 ft CH, MC=44%, PI=53 Fat CLAY with sand		
	4			1 4 25 (5)		D-3		Fat CLAY, soft, yellowish brown, moist, Disrupted, no HCl reaction, 13.2 basalt cobbles. Length Recovered 1.3 ft, Length Retained 1.0 ft		
15	5			4 3 6 (9)		D-4		Elastic SILT, stiff, dark greenish gray, moist, Disrupted, no HCl reaction, mottled, 13.2 - 15, cobbles, 15 - silt, grey. Length Recovered 1.5 ft, Length Retained 1.0 ft		
20	6					C-5		SILTY sand with gravel and cobbles, rounded, very dense, greenish gray, moist, Homogeneous, no HCl reaction, 3' silty gravel, 2' conglomerate, well cemented. Length Recovered 4.5 ft, Length Retained 4.5 ft 3-15-99	▼	

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-5-99**

Sheet **2** of **3**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								Conglomerate, subrounded to rounded gravel in a weakly cemented - very weak rock.		
				RQD 50% FF-3		C-6		Siltstone, medium grained, moderately weathered, very weak rock, no HCl reaction, very closely spaced, very poor condition, 23' to 25' The siltstone is fissured and highly fractured with slicken sides and moistured, (slide plain) Percent Recovered 95.0%		
25	7									
	8									
			>>	25 42 (67)		D-7		SILTSTONE, dark gray, moist, Laminated,Fissured, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
				RQD 100% FF-0		C-8		Siltstone, medium grained, fresh, very weak rock, no HCl reaction, very widely spaced, excellent condition, Percent Recovered 100.0%		
30	9									
				RQD 100% FF-0		C-9		SILTSTONE, medium grained, fresh, very weak rock, no HCl reaction, very widely spaced, excellent condition, sampler over full, broke core., Percent Recovered 100.0%		
	10									
35	11									
			>>	15 35 50 (85)		D-10		SILTSTONE, dark greenish gray. Length Recovered 1.5 ft, Length Retained 1.0 ft		
				RQD 100% FF-0		C-11		Siltstone, medium grained, fresh, very weak rock, no HCl reaction, very widely spaced, excellent condition, Percent Recovered 100.0%		
40	12									
	13			RQD 100% FF-0		C-12		Siltstone, medium grained, fresh, very weak rock, no HCl reaction, very widely spaced, excellent condition, Percent Recovered 100.0%		
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-5-99**

Sheet **3** of **3**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14									
			>>	29 42 (71) RQD 100% FF-0		D-13 C-14		SILTSTONE, dark greenish gray. Length Recovered 1.0 ft, Length Retained 1.0 ft Siltstone, medium grained, fresh, moderately weak rock, no HCl reaction, very closely spaced, excellent condition, Percent Recovered 100.0%		
	15									
50										
	16			RQD 100% FF-0		C-15		Siltstone, medium grained, fresh, very weak rock, no HCl reaction, very widely spaced, excellent condition, Percent Recovered 100.0%		
55										
	17									
			>>	27 32 49 (81)		D-16		SILTSTONE, dark greenish gray, moist. Length Recovered 1.5 ft, Length Retained 1.0 ft		
	18									
60								End of test hole boring at 58.5 ft below ground elevation.		
	19							Installed 57' of slope Inclinemeter Piezometer installed 28.6' below ground elevation at Sta. 26+47 (3' Rt.) Ground Elevation= 237.7'		
65								DATE DEPTH ELEVATION 1-14-99 -11' 226.7' 1-15-99 -6' 231.7' 1-18-99 -5' 232.7' 1-20-99 -16.3' 221.4' 2-25-99 -16' 221.7' 3-15-99 -18.6' 219.1' This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	20									
	21									
70										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-6-99**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement** Job No. **OL-0911**

SR-6 MP 42.48 to 42.91 S.R. **6**

Station **26+20** Offset **53 Lt.** C.S. **2105**

Equipment **CME 45 w/ autohammer** Casing **HQ-47** Ground El **217.4 (66.26 m)**

Method of Boring **wet rotary**

Start Date **January 10, 1999** Completion Date **January 11, 1999** Sheet **1** of **3**

Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		0 1 1 (2)		D-1		Lean CLAY, silt, soft, dark brown, moist, Homogeneous, no HCl reaction Length Recovered 0.5 ft, Length Retained 0.5 ft		
5	1			U-2 A B C	GS MC PI	A: CH, MC=41%, PI=38 Fat CLAY with sand B: MH, MC=47%, PI=41 Elastic SILT with sand, soft, dark brown, moist,		
	2	4 3 6 (9)		D-3		Homogeneous, no HCl reaction, same as above, but with basalt gravel. Refusal @ 6.5 Length Recovered 1.0 ft, Length Retained 1.0 ft Lean CLAY, silt, stiff, strong brown, moist, Laminated,Fissured, no HCl reaction, horizontal bedding, mottled. Scattered basalt gravel/ Length Recovered 1.2 ft, Length Retained 1.0 ft		
10	3	1 2 3 (5)		D-4	GS MC PI	CH, MC=50%, PI=27 Sandy FAT CLAY with gravel, medium stiff, strong brown, moist, Disrupted, no HCl reaction, mottled. Length Recovered 0.7 ft, Length Retained 0.7 ft		
	4						01/11/1999	
15	5	15 30 30 (60)		D-5		SILTSTONE, dark greenish gray, 9" to 10" gravels, and cobbles. 10" to 12.5" clay, 12.5" to 15.2" sandstone, brown, 15.2" siltstone, gray. Length Recovered 1.5 ft, Length Retained 1.0 ft		
		RQD 95% FF-0		C-6		Siltstone, medium grained, fresh, very weak rock, no HCl reaction, moderately spaced, good condition, Percent Recovered 95.0%		
20	6							

Standard Penetration Blows/ft: 10, 20, 30, 40

SOIL OL0911~1.GPJ SOIL.GDT 4/21/99□10:09:44 A4

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-6-99**

Sheet **2** of **3**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				RQD 60% FF-3		C-7		Siltstone, medium grained, slightly weathered, very weak rock, no HCl reaction, closely spaced, poor condition, @ 40 and 80 degrees, highly fractured between 23.8ft and 24.2ft Percent Recovered 90.0%		
25	7									
	8			10 15 34 (49)		D-8		SILTSTONE, dark greenish gray, moist, Laminated,Fissured, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.0 ft		
				RQD 100% FF-0		C-9		Siltstone, fine grained, fresh, very weak rock, no HCl reaction, widely spaced, poor condition, one fracture @ 45 degrees shinny, slickensided., Percent Recovered 100.0%		
30	9									
	10			RQD 100% FF-0		C-10		Siltstone, fine grained, fresh, very weak rock, no HCl reaction, widely spaced, excellent condition, no fractures, one solid piece., Percent Recovered 100.0%		
35	11			26 50 26 (76)		D-11		SILTSTONE, dark greenish gray. Length Recovered 1.0 ft, Length Retained 1.0 ft		
				RQD 100% FF-0		C-12		Siltstone, fine grained, fresh, moderately weak rock, no HCl reaction, widely spaced, excellent condition, no fractures., Percent Recovered 100.0%		
40	12									
	13			RQD 100% FF-0		C-13		Siltstone, fine grained, fresh, very weak rock, no HCl reaction, widely spaced, excellent condition, no fractures., Percent Recovered 100.0%		
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. **H-6-99**

Sheet **3** of **3**

PROJECT **South Fork Chehalis River Bridge 6/115 Replacement**

Job No. **OL-0911**

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
	14			36 51 (87)		D-14		SILTSTONE, dark greenish gray. no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
50	15							End of test hole boring at 48 ft below ground elevation. Installed 47' of Slope Inclinemeter This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
55	16									
60	17									
65	18									
70	19									
	20									
	21									

APPENDIX - C

Laboratory Test Data

LABORTATORY SUMMARY

Test Hole Number	Sample No.	Laboratory Number	Sample Depth (feet)	USCS	Unit Weight γ_w (pcf)	Moisture Content (%)	Gradation Fraction Gravel (%)	Sand (%)	Fines (%)	Atterberg Limits LL (%)	PL (%)	PI (%)	SPECIALIZED TESTING Test Type Rock Unconfined Compression					Remarks
South Fork Chahalis River Bridge No. 6/115 Replacement														Su (psi)				
Original Investigation																		
H-1-97	D-1	F-2022	7.0-8.5	ML		34	0	19.2	80.8	NP	NP	NP						
	D-4	F-2022	19.0-20.5	SM		27	0	50.5	49.5									
	D-5	F-2022	22.0-23.5	SP/SM		17	26.3	64.1	9.6									
	D-6	F-2022	27.0-28.5	GP		12	76.1	20.6	3.3									
H-2-97	D-2	F-2093	9.0-10.5	SM		49	0	54.8	45.2									
	D-3	F-2093	14.0-15.5	GW/GP		10	50.0	43.5	6.5									
	C-7	F-2093	30.6-31.2	R-1	110.4	30								252	Es =	2.6 x 10^4 psi		Very Weak
	C-13	F-2093	50.5-55.5	R-1	115.2									211				Siltstone
	C-16	F-2093	61.2-62.0	R-1	117.3	26.7								205	Es =	1.8 x 10^4 psi		
H-3-97	D-2	F-2084	9.0-10.5	SP/SM		16	41.8	48.3	9.9									
	D-5	F-2084	21.5-22.0	ML		29	4.2	21.7	74.1	NP	NP	NP						
	C-9	F-2084	40.2-40.8	R-1	114.4									352				Very Weak
	C-14	F-2084	55.5-56.0	R-1	115.3									268	Es =	4.0 x 10^4 psi		Siltstone
H-5-97	D-3	F-2083	15.5-16.0	SM		64	8.1	71.3	20.6									
	D-4	F-2083	20.5-21.5	SP/SM		20	16.8	75.6	7.6									
	C-9	F-2083	39.4-40.0	R-1	114.4									710	Es =	2.1 x 10^4 psi		Very Weak
																		Siltstone
H-6-97	D-3	F-2031	6.5-8.0	CH		36	0	15.0	85.0	58	24	34						
	C-5	F-2031	21.6-22.2	R-0	106.5	33								111	Es =	0.96 x 10^4 psi		Ext. Weak
																		Siltstone
H-7-97	D-1	F-2004	6.5-7.5	CH		37	0	12.7	87.3	62	24	38						
	D-3	F-2004	16.0-17.5	CH		50	0	17.0	83.0	77	29	48						
	D-4	F-2004	21.0-21.4	SM		25	35.6	41.3	23.1									

Test Hole Number	Sample No.	Laboratory Number	Sample Depth (feet)	USCS	Unit Weight (pcf)	Moisture Content (%)	Gradation Fraction Gravel (%)	Sand (%)	Fines (%)	Atterberg Limits LL (%)	PL (%)	PI (%)	SPECIALIZED TESTING Test Type					Remarks
													Rock Unconfined Compression					
H-1-98	D-2	F-2443	5.0-6.5	MH		60	0	10.6	89.4	79	42	37		Su				
	D-6	F-2443	15.0-16.5	MH		47	0.1	46.6	53.3	54	33	21		(psi)				
	D-8	F-2443	20.0-21.5	MH	128.3	57	0	9.0	91.0	71	43	28						
	C-9	F-2443	22.0-22.5	R-0	105.2									127	Es =	1.2×10^4 psi		
	C-11	F-2443	26.4-26.9	R-1	111.5									484	Es =	7.6×10^4 psi		
	C-18	F-2443	52.0-52.5	R-2	114.1									951	Es =	7.2×10^4 psi		
	D-25	F-2443	75.0-76.0	MH		47	0	10.1	89.9	53	40	13						Ash Layer
	C-26	F-2443	78.0-78.7	R-2	114.1									1059	Es =	7.0×10^4 psi		
H-2-98	C-3	F-2451	6.5-10.0	ML	115.8									7.0	Es =	0.02×10^4 psi		
	D-6	F-2451	15.0-16.5	ML		51	0	14.9	85.1	NP	NP	NP						
	C-10	F-2451	25.4-25.9	R-1	111.1									690	Es =	7.5×10^4 psi		
	C-13	F-2451	36.0-36.5	R-1	111.1									632	Es =	8.7×10^4 psi		
	C-28	F-2451	100-105	R-2	114.1									847				
H-2A-98	S-3	F-2460	12.0-14.0	MH	102	43	2.5	5.5	92.0	85	42	43	Direct Shear			c = 402 psf		Peak Values
																$\phi = 38°$		
																c = 220 psf		Residual Values
1999 Investigation																$\phi = 17°$		
H-2-99	D-2	F-2791	5.0-6.5	SM		42	0	54.0	45.9									
	D-4	F-2791	15.0-16.5	GW/GM		8	42.3	39.2	6.5									
H-4-99	U-2B	F-2785	7.3-7.7	SM	103.0	50	0	56.9	43.1	60	35	25	UU	c = 240 psf		Es = 92 psi		
	U-4B	F-2785	12.3-12.7	CH	104.1	48	0	14.9	85.1	84	36	48	UU	c = 465 psf		Es = 275 psi		
	D-5	F-2785	15.0-15.9	SM		20	37.6	40.2	22.2									
H-5-99	U-2B	F-2786	10.3-10.7	CH	104.8	36	0	15.0	85.0	58	24	34	UU	c = 640 psf		Es = 260 psi		
													Consolidation Data					
													P_o	C_r	C_c	C_v	C_∞	
H-6-99	U-2 A	F-2787	5.0-5.3	CH	108.9	41	0	24.0	76.0	69	31	38	2 ksf	0.015	0.097	5×10^{-4}	.0010	
	U-2 B	F-2787	5.3-5.7	MH	106.6	47	0	22.7	77.3	80	39	41	2 ksf	0.012	0.089	8×10^{-4}	.0007	
	D-4	F-2787	15.0-15.9	CH		50	15.8	34.0	50.2	57	30	27				in^2/ sec		

Job No. **OL-0911** Date **May 22, 1997**

Hole No. **H-1-97** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

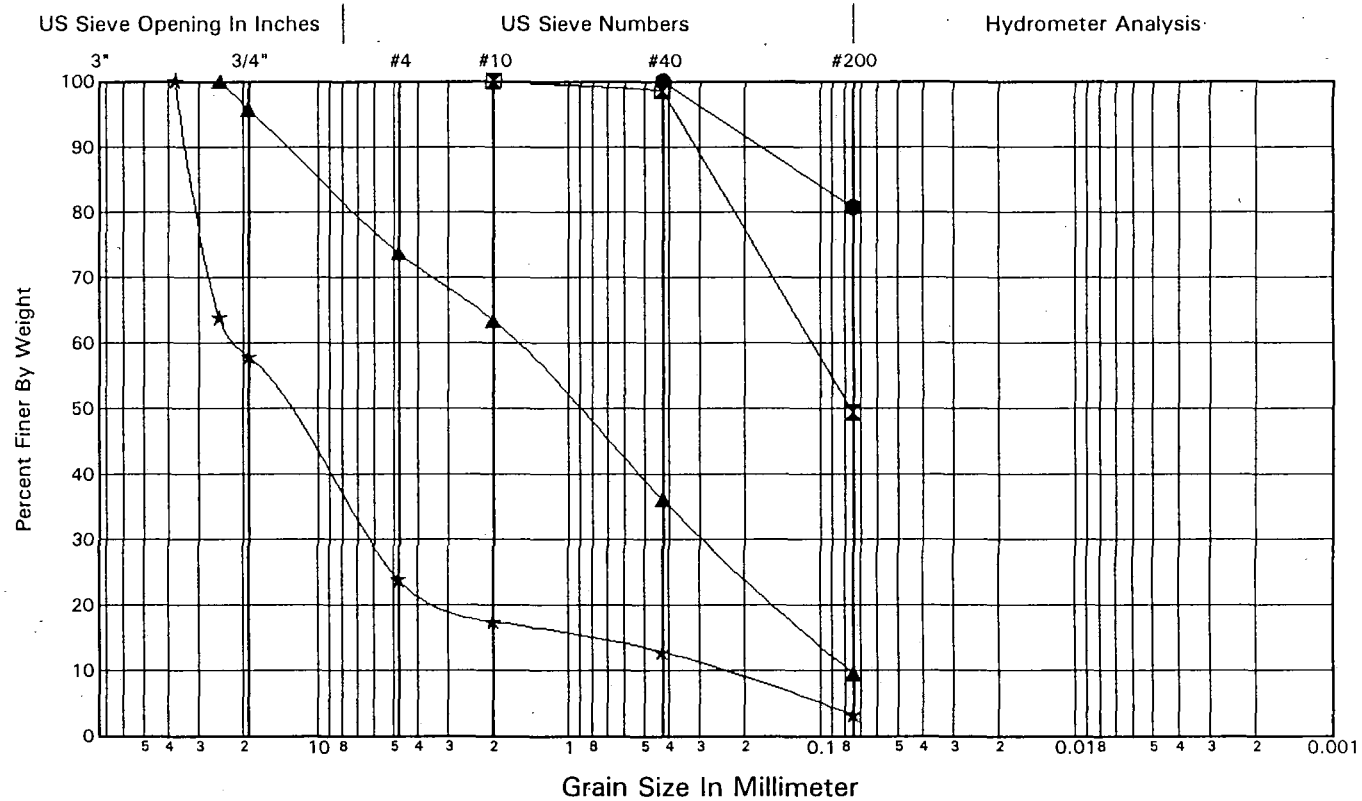
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	7.0	2.13	D-1	ML	Refer to Boring Log	SILT with SAND	34	NP	NP	NP
⊠	19.0	5.79	D-4	SM	Refer to Boring Log	SILTY SAND	27	NP	NP	NP
▲	22.0	6.71	D-5	SP-SM	Refer to Boring Log	POORLY GRADED SAND with SILT and GRAVEL	17	NP	NP	NP
★	27.0	8.23	D-6	GP	Refer to Boring Log	POORLY GRADED GRAVEL with SAND	12	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	19.2	80.8		
⊠	0.0	50.5	49.5		
▲	26.3	64.1	9.6	0.6	21.4
★	76.1	20.6	3.3	7.0	83.1

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠	0.11	0.08			
▲	1.65	0.93	0.28	0.15	0.08
★	20.92	13.77	6.09	2.80	0.25



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-0911** Date **May 22, 1997**

Hole No. **H-2-97** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

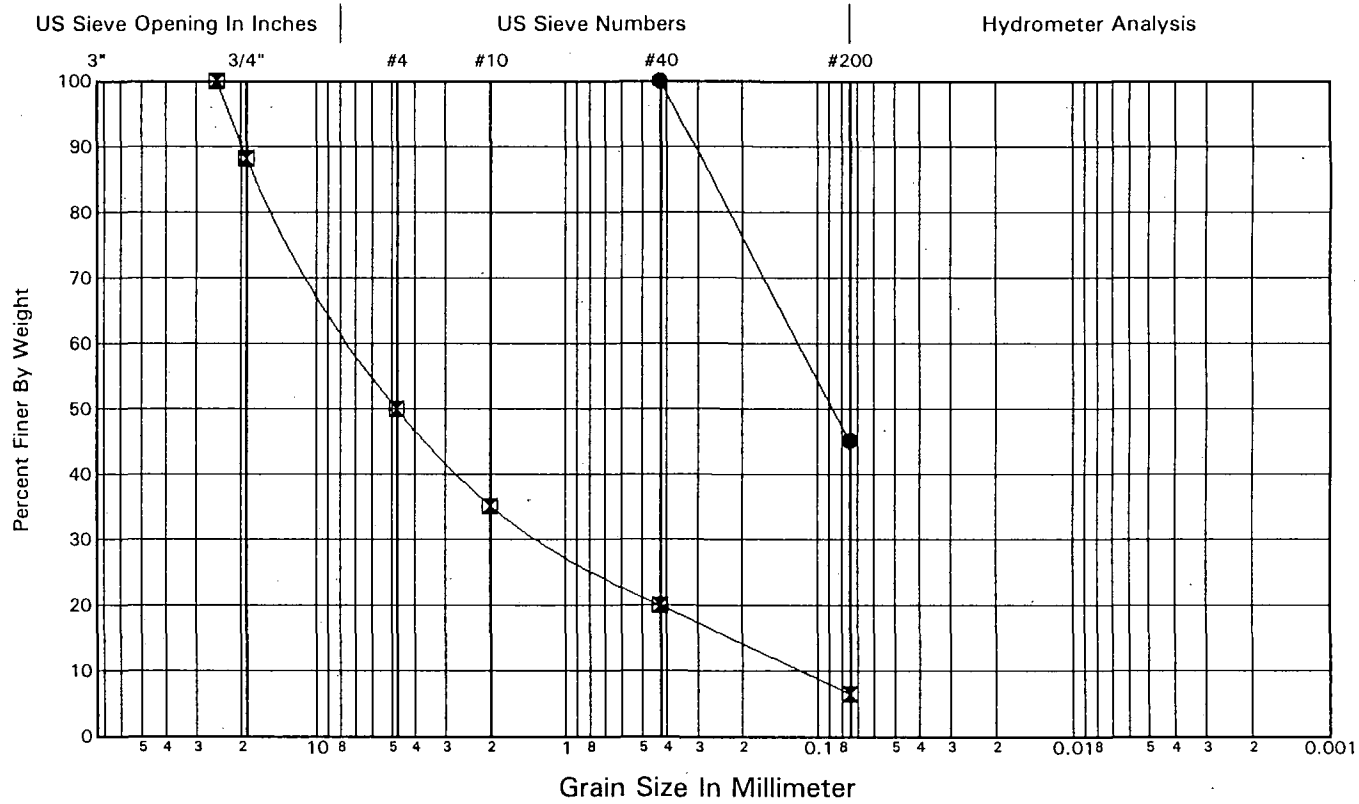
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	9.0	2.74	D-2	SM	Refer to Boring Log	SILTY SAND	49	NP	NP	NP
⊠	14.0	4.27	D-3	GW-GM	Refer to Boring Log	WELL GRADED GRAVEL with SILT and SAND	10	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	54.8	45.2		
⊠	50.0	43.5	6.5	1.7	58.0

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.12	0.09			
⊠	6.82	4.75	1.18	0.43	0.12



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-0911** Date **May 22, 1997**

Hole No. **H-3-97** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

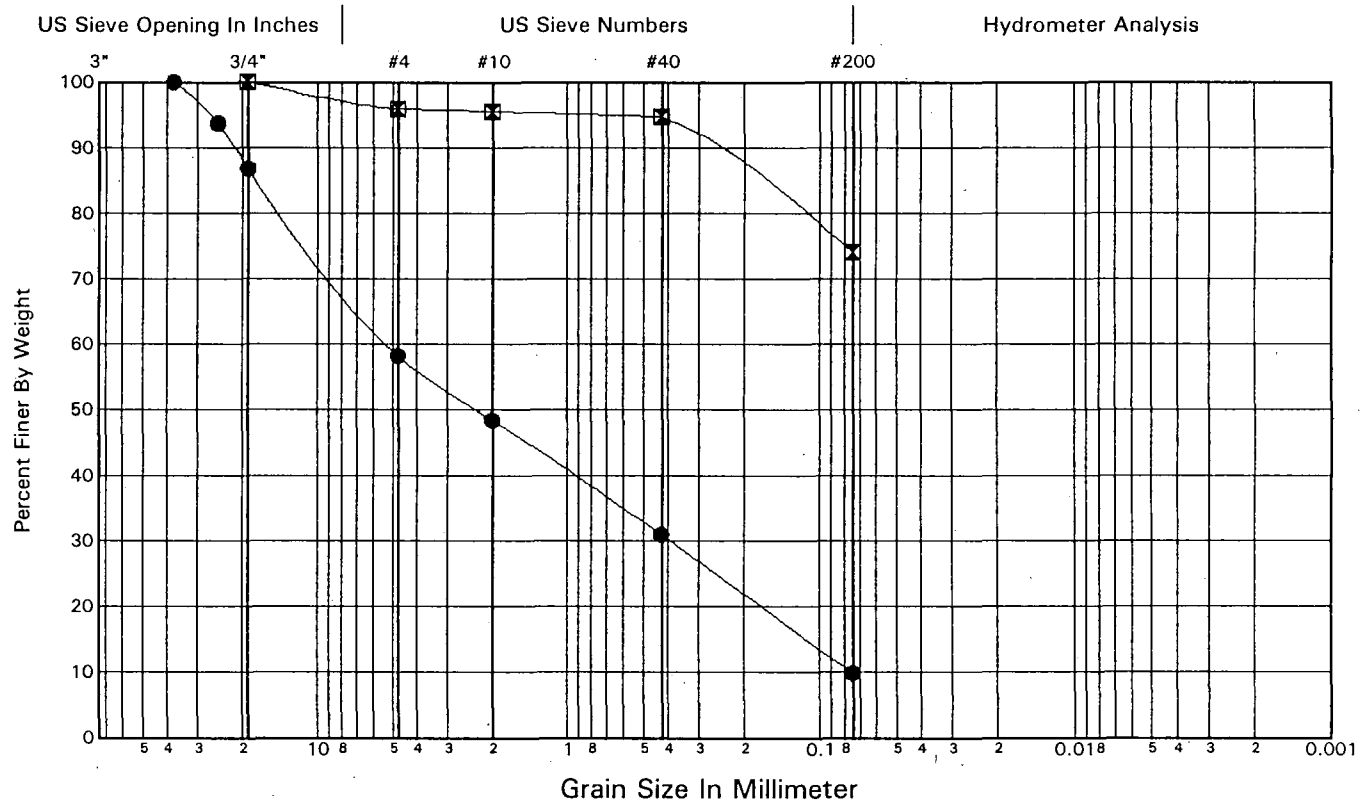
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	9.5	2.90	D-2	SP-SM	Refer to Boring Logs	POORLY GRADED SAND with SILT and GRAVEL	16	NP	NP	NP
⊠	21.5	6.55	D-4B	ML	Refer to Boring Log	SILT with SAND	29	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	41.8	48.3	9.9	0.4	68.5
⊠	4.2	21.7	74.1		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	5.18	2.30	0.39	0.17	0.08
⊠					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-0911** Date **May 22, 1997**

Hole No. **H-5-97** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

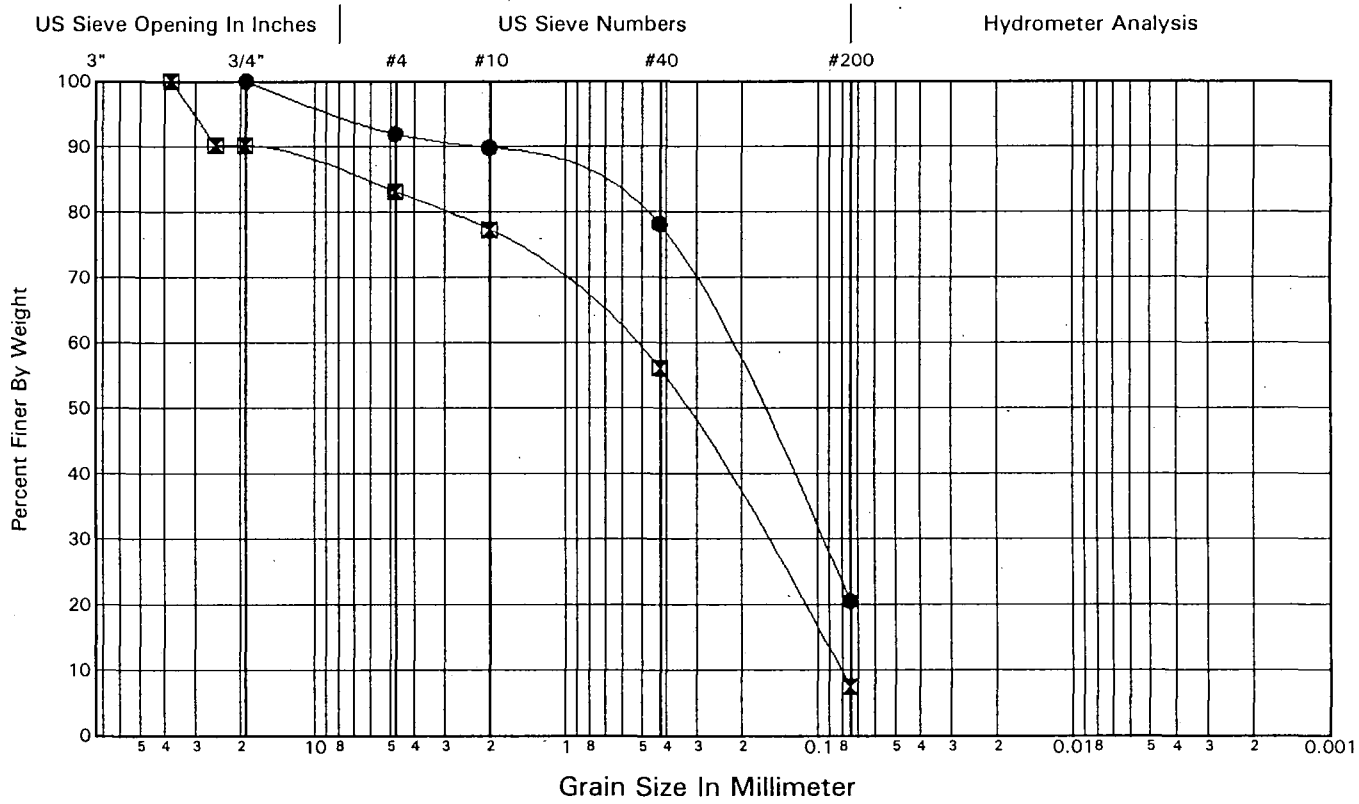
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	15.5	4.72	D-3	SM	Refer to Boring Log	SILTY SAND	64	NP	NP	NP
⊠	20.5	6.25	D-4	SP-SM	Refer to Boring Log	POORLY GRADED SAND with SILT and GRAVEL	20	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	8.1	71.3	20.6		
⊠	16.8	75.6	7.6	0.6	6.9

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.25	0.18	0.10		
⊠	0.57	0.34	0.17	0.12	0.08



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-0911** Date **June 10, 1997**

Hole No. **H-6-97** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

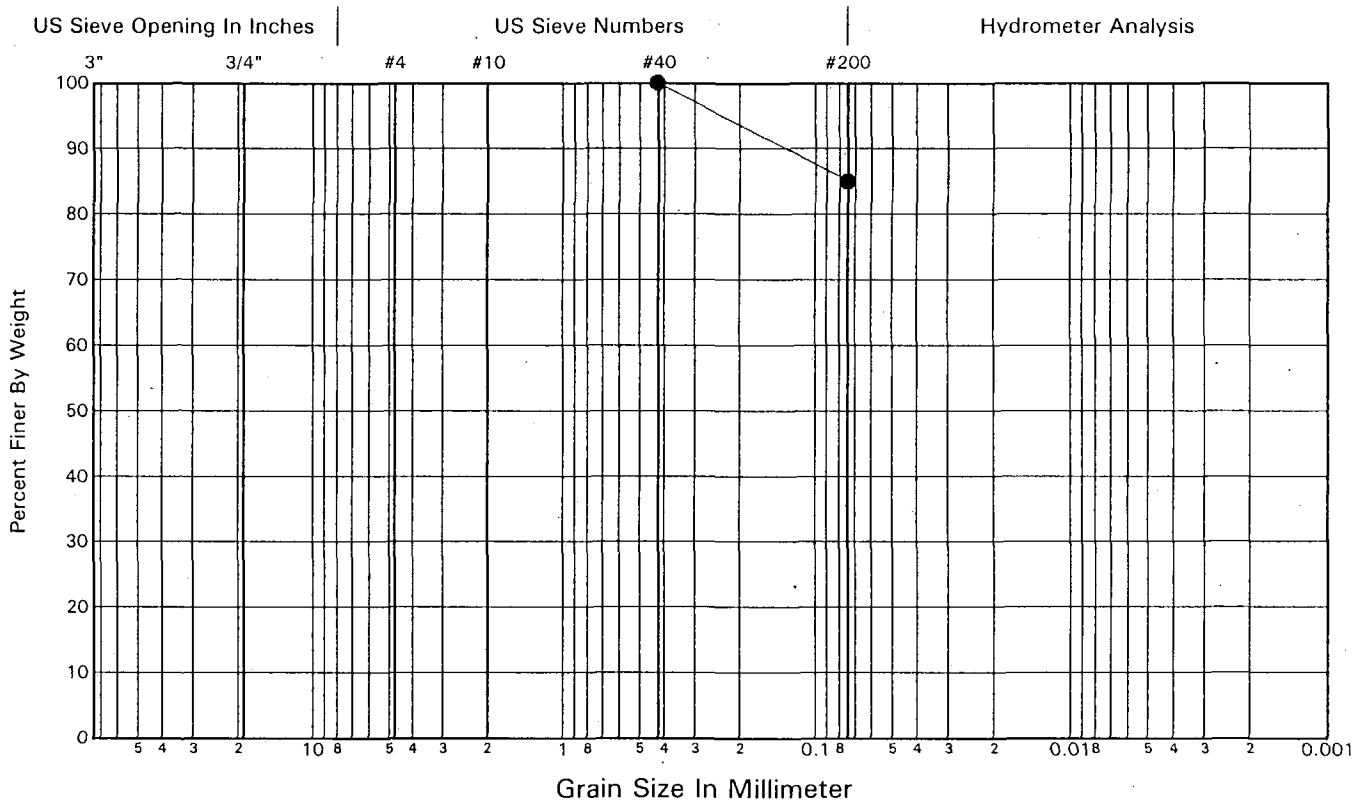
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	6.5	1.98	D-1	CH	Refer to Boring Log	FAT CLAY with SAND	36	58	24	34

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	15.0	85.0		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-0911** Date **June 10, 1997**

Hole No. **H-7-97** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

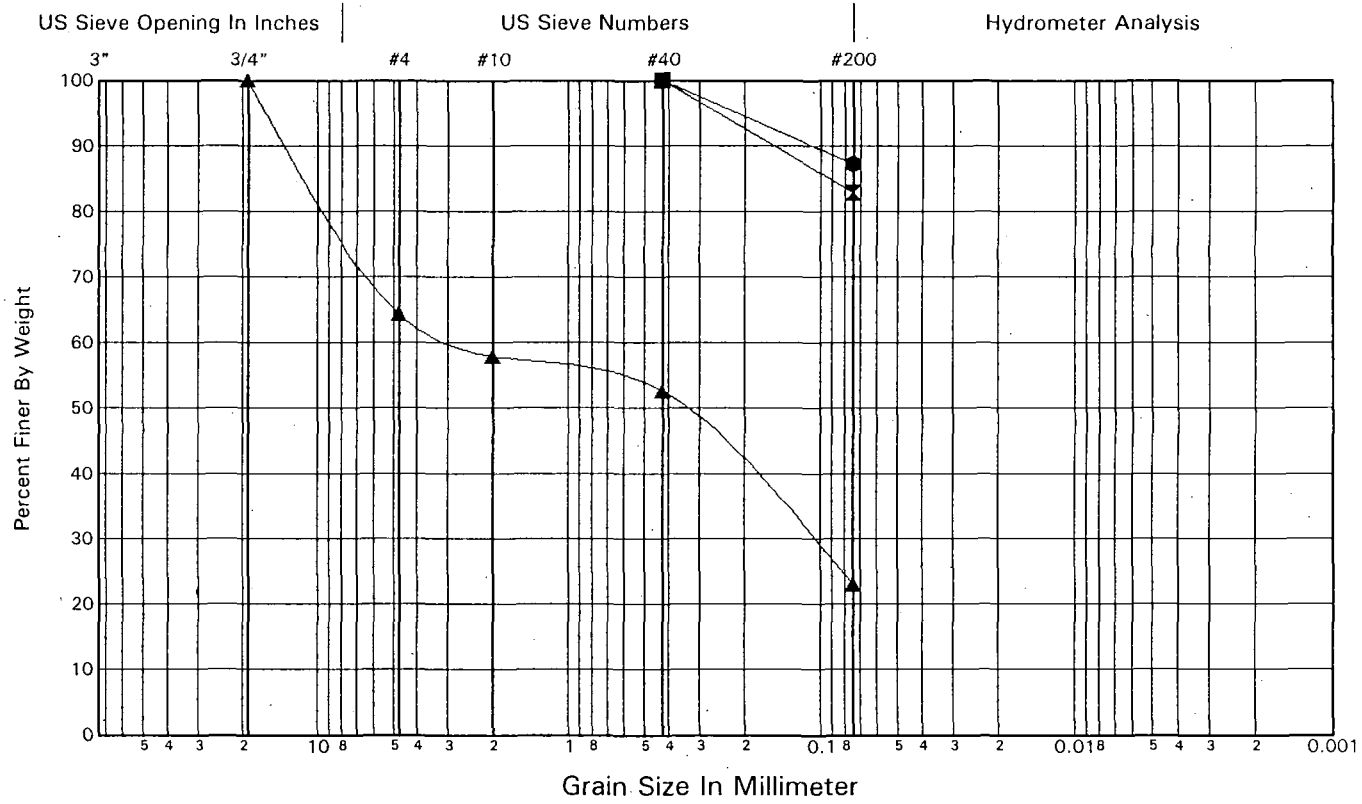
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	6.0	1.83	D-1	CH	Refer to Boring Log	FAT CLAY	37	62	24	38
⊠	16.0	4.88	D-3	CH	Refer to Boring Log	FAT CLAY with SAND	50	77	29	48
▲	21.0	6.40	D-4	SM	Refer to Boring Log	SILTY SAND with GRAVEL	25	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	12.7	87.3		
⊠	0.0	17.0	83.0		
▲	35.6	41.3	23.1		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠					
▲	2.65	0.36	0.11		



Job No. **OL-0911** Date **June 26, 1998**

Hole No. **H-1-98** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

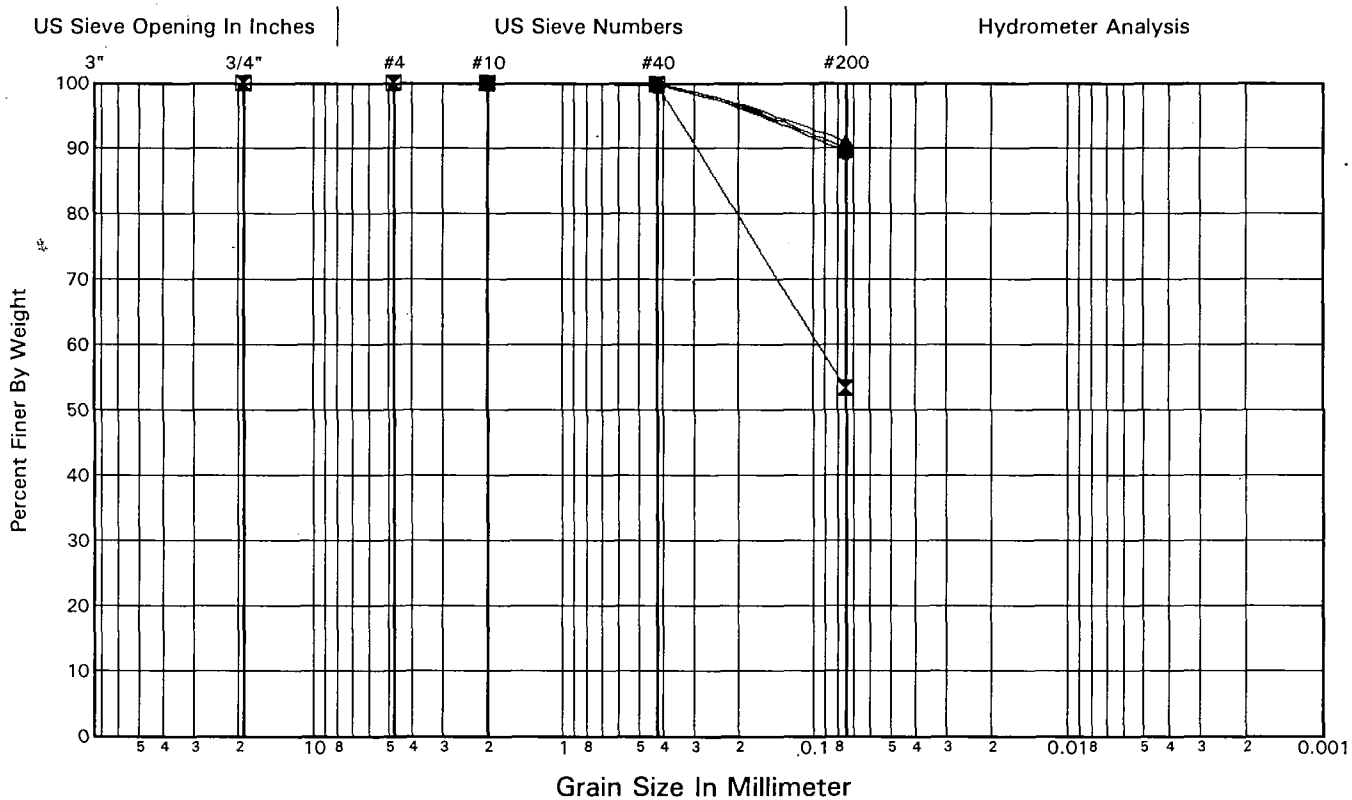
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-2	MH	SEE BORING LOG	ELASTIC SILT	60	79	42	37
⊠	15.0	4.57	D-6	MH	SEE BORING LOG	SANDY ELASTIC SILT	47	54	33	21
▲	20.0	6.10	D-8	MH	SEE BORING LOG	ELASTIC SILT	57	71	43	28
★	75.0	22.86	D-24	MH	SEE BORING LOG	ELASTIC SILT	47	53	40	13

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	10.6	89.4		
⊠	0.1	46.6	53.3		
▲	0.0	9.0	91.0		
★	0.0	10.1	89.9		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠	0.10				
▲					
★					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-0911** Date **June 26, 1998**

Hole No. **H-2-98** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

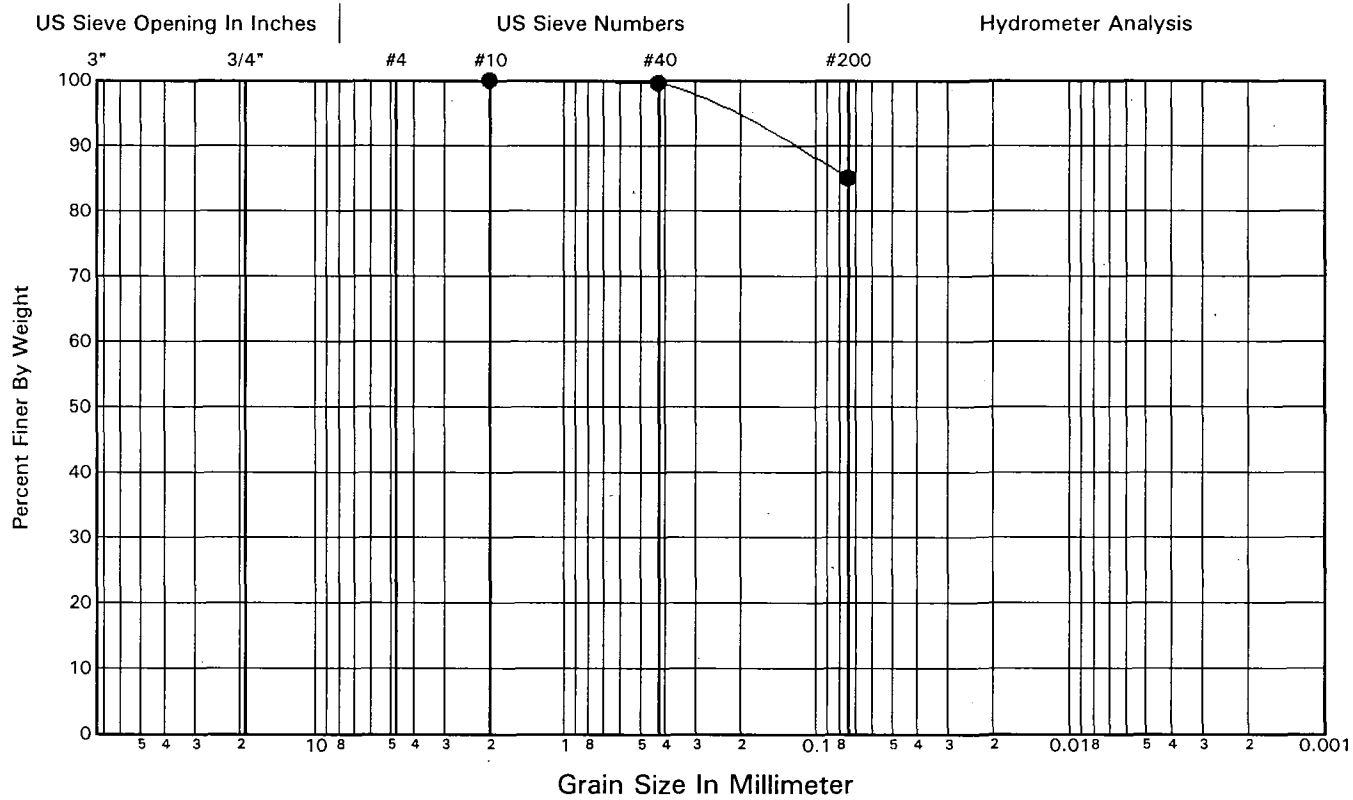
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	**15.0**	**4.57**	**D-6**	**ML**	**SEE BORING LOG**	**SILT with SAND**	**51**	**NP**	**NP**	**NP**

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	**0.0**	**14.9**	**85.1**		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. OL-0911 Date June 26, 1998

Hole No. H-2A-98 Sheet 1 of 1

Project South Fork Chehalis River Bridge 6/115 Replacement

Laboratory Summary

Washington State Department of Transportation

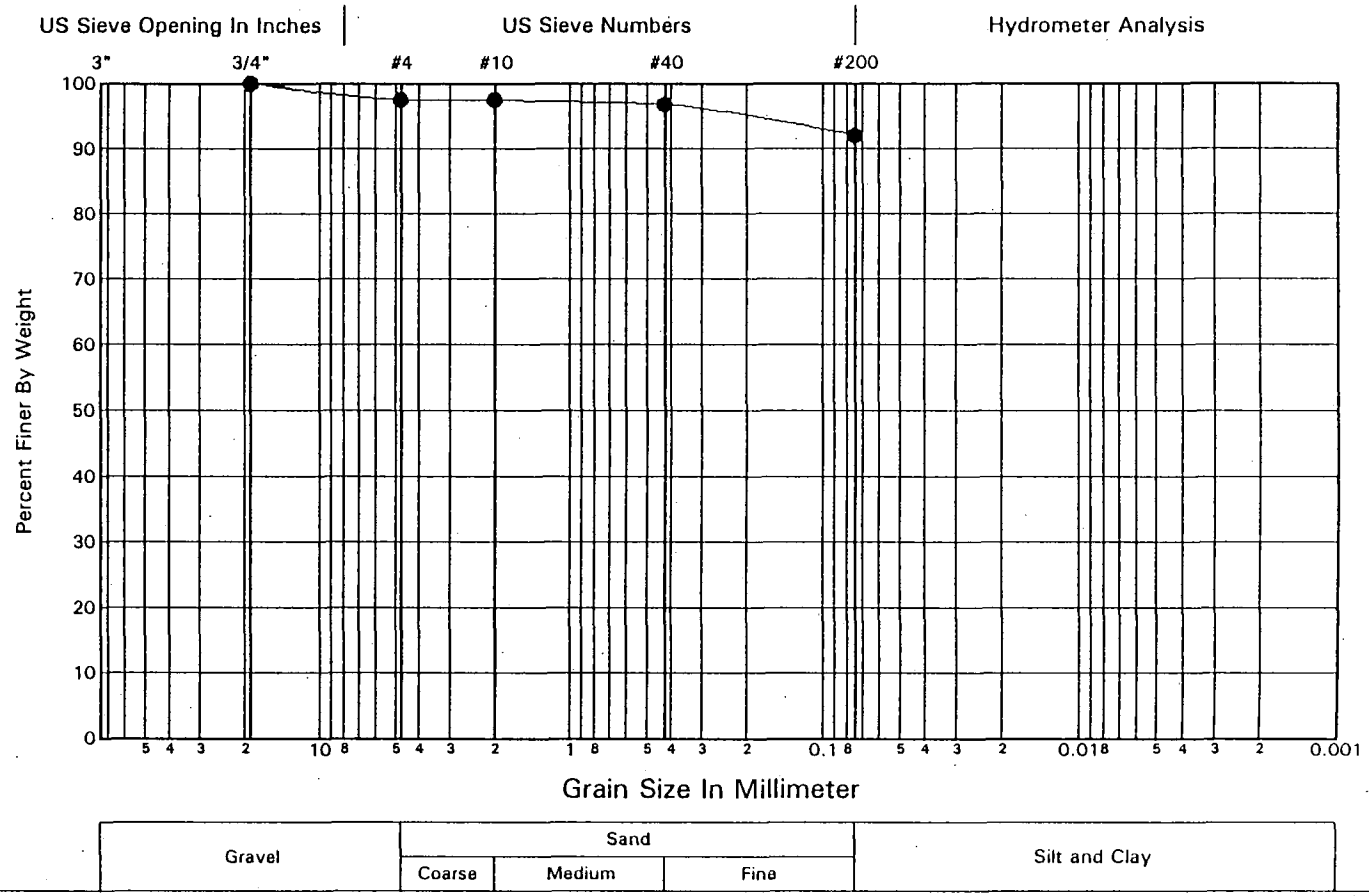
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	12.0	3.66	S-3	MH	SEE BORING LOG	ELASTIC SILT	43	85	42	43

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	2.5	5.5	92.0		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					



Job No. **OL-0911** Date **February 5, 1999**

Hole No. **H-2-99** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

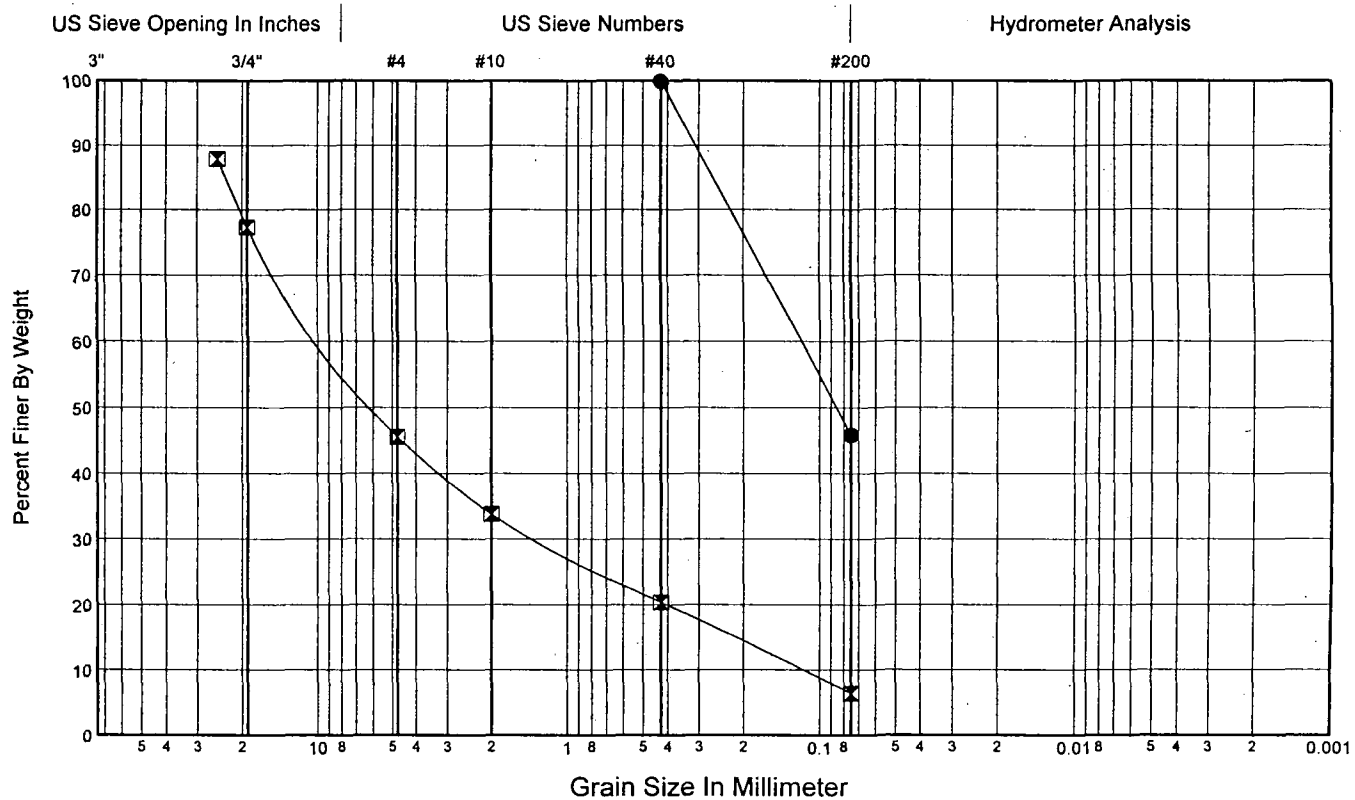
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-2	SM	see boring log	SILTY SAND	42	NP	NP	NP
⊠	15.0	4.57	D-4	GW-GM	see boring log	WELL-GRADED GRAVEL with SILT and SAND	8	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	54.0	45.9		
⊠	42.3	39.2	6.5	1.6	76.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.12	0.09			
⊠	8.91	5.76	1.29	0.40	0.12



Job No. **OL-0911** Date **March 9, 1999**

Hole No. **H-4-99** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

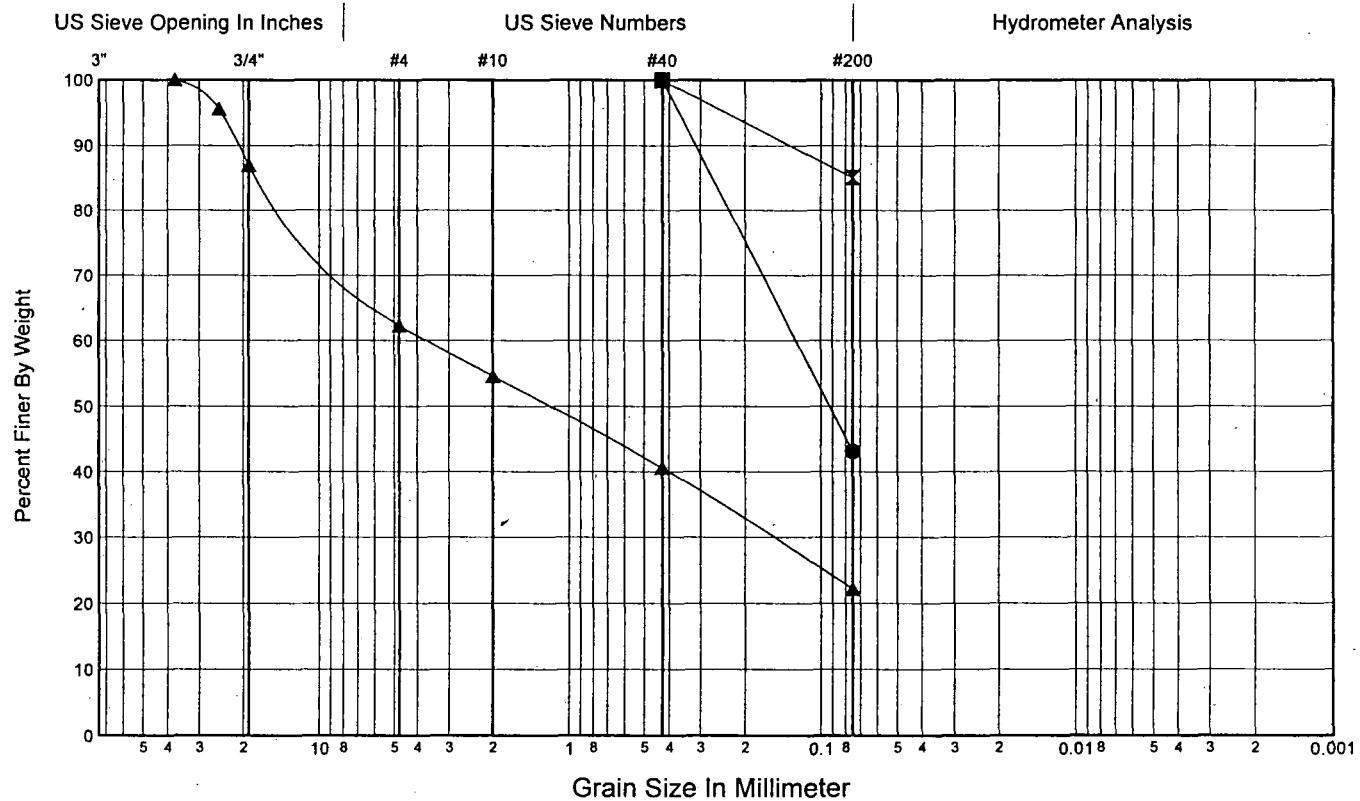
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	7.5	2.29	U-2B	SM	see boring log	SILTY SAND	50	60	35	25
⊠	12.5	3.81	U-4B	CH	see boring log	FAT CLAY	48	84	36	48
▲	15.0	4.57	D-5	SM	see boring log	SILTY SAND with GRAVEL	20	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	56.9	43.1		
⊠	0.0	14.9	85.1		
▲	37.6	40.2	22.2		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.13	0.09			
⊠					
▲	3.65	1.20	0.16		



Job No. **OL-0911** Date **March 5, 1999**

Hole No. **H-5-99** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

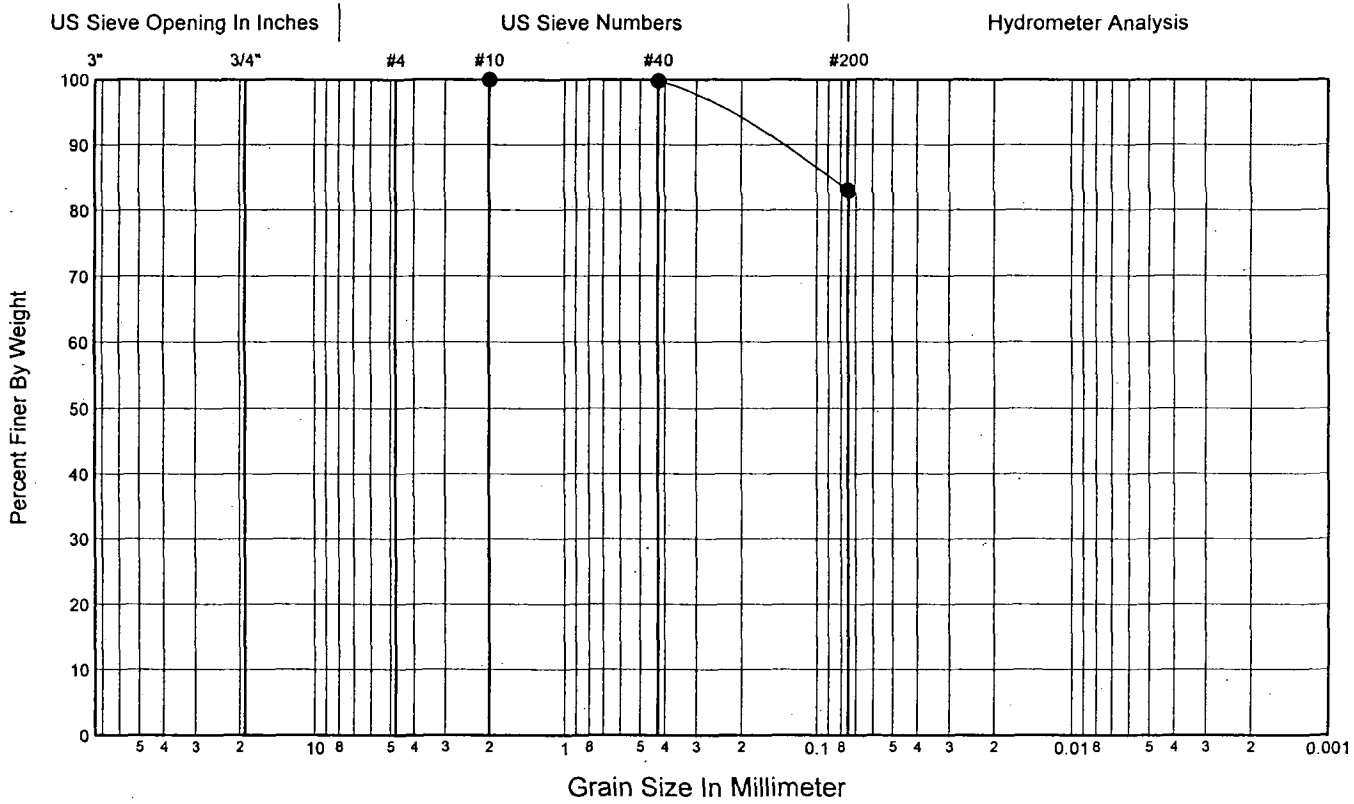
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	10.3	3.14	U-2B	CH	see boring log	FAT CLAY with SAND	44	82	29	53

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	16.9	83.1		

GRADATION VALUES

	D60	D50	D30	D20	D10
●					



Job No. **OL-0911** Date **April 21, 1999**

Hole No. **H-6-99** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

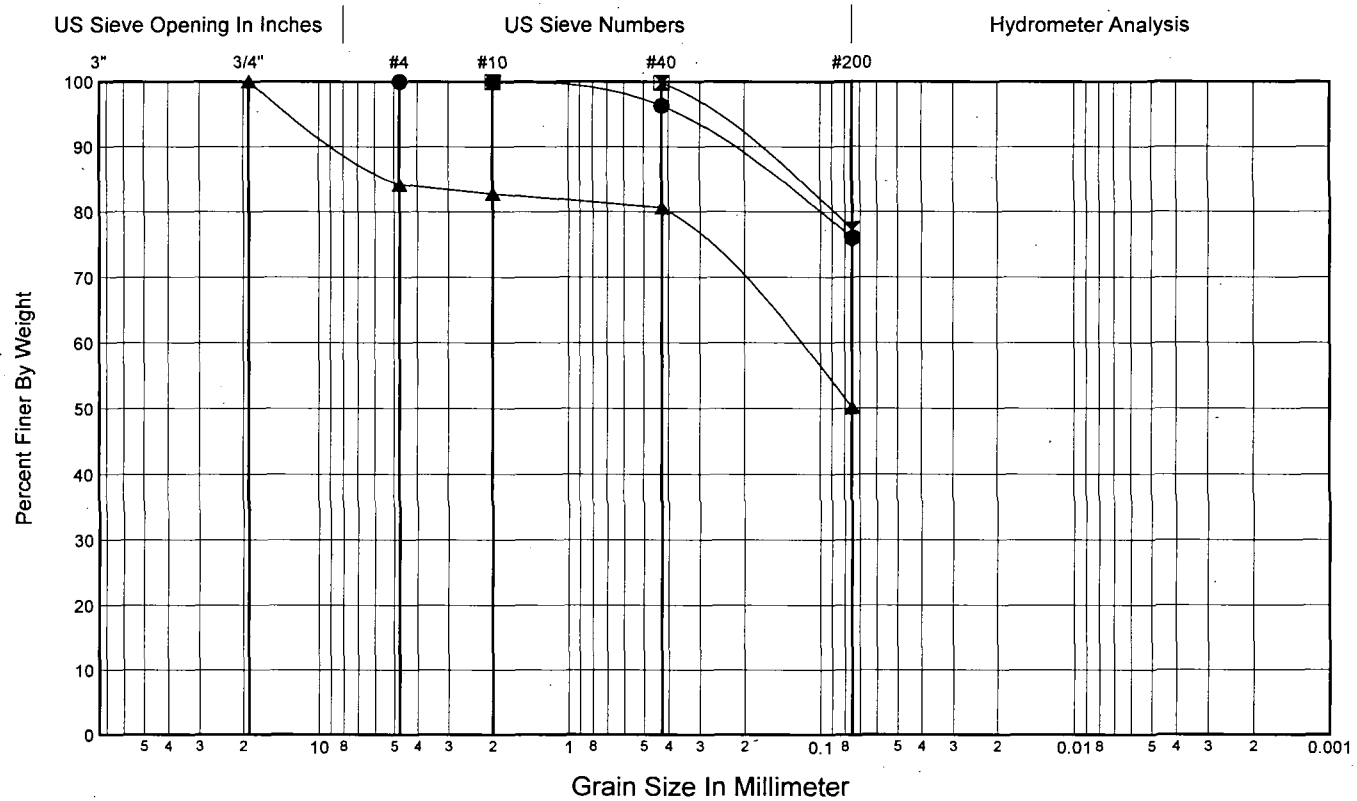
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	U-2A	CH	see boring log	FAT CLAY with SAND	41	69	31	38
⊠	5.3	1.62	U-2B	MH	see boring log	ELASTIC SILT with SAND	47	80	39	41
▲	10.0	3.05	D-4	CH	see boring log	SANDY FAT CLAY with GRAVEL	50	57	30	27

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	24.0	76.0		
⊠	0.0	22.7	77.3		
▲	15.8	34.0	50.2		

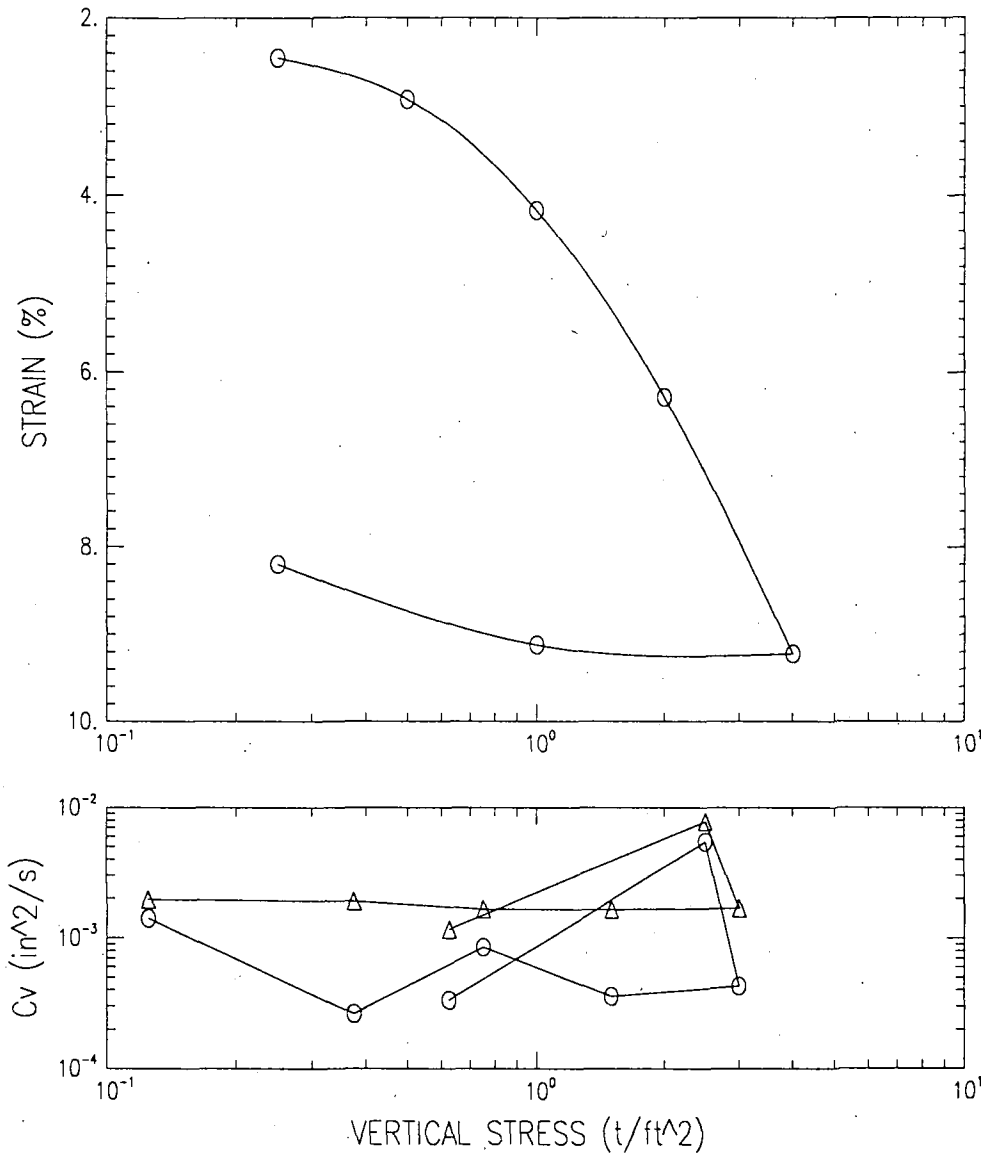
GRADATION VALUES

	D60	D50	D30	D20	D10
●					
⊠					
▲	0.13				



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

CONSOLIDATION TEST
SUMMARY REPORT



Washington State D.O.T.
Project Name : S FK CHEHALIS R BR 6/115
Project No : OL-0911 Boring No : H-6-99 Sample No : U-2/A
Test Date : 3/18/99 Test No : 2787-2A Depth : 5-5.3 FEET
Description : WET DK YELLOWISH BROWN ELASTIC SILT WITH CLAY
Remarks :

CONSOLIDATION TEST DATA

Project : S FK CHEHALIS R BR 6/115
Location : SR-6
Project No.: OL-0911
Boring No.: H-6-99
Tested by : LHB
Checked by : DW
Sample No.: U-2/A
Test Date : 3/18/99
Depth : 5-5.3 FEET
Test No. : 2787-2A
Sample Type: WADOT UNDI

Soil Description : WET DK YELLOWISH BROWN ELASTIC SILT WITH CLAY
Remarks :

	APPLIED PRESSURE (t/ft^2)	FINAL DISPLACEMENT (in)	VOID RATIO	STRAIN AT END (%)	FITTING T50 TIME (min) SQ.RT.	LOG	COEFFICIENT OF CONSOLIDATION (in^2/s) SQ.RT.	LOG	AVE
1)	0.25	0.015	1.023	2.45	0.2	0.2	1.41E-003	1.96E-003	1.68E-003
2)	0.50	0.018	1.013	2.92	1.2	0.2	2.63E-004	1.90E-003	1.08E-003
3)	1.00	0.026	0.987	4.17	0.4	0.2	8.49E-004	1.66E-003	1.25E-003
4)	2.00	0.039	0.943	6.29	0.8	0.2	3.56E-004	1.65E-003	1.00E-003
5)	4.00	0.058	0.883	9.22	0.6	0.2	4.28E-004	1.68E-003	1.06E-003
6)	1.00	0.057	0.885	9.12	0.0	0.0	5.43E-003	7.78E-003	6.60E-003
7)	0.25	0.051	0.904	8.20	0.8	0.2	3.34E-004	1.16E-003	7.49E-004

CONSOLIDATION TEST DATA

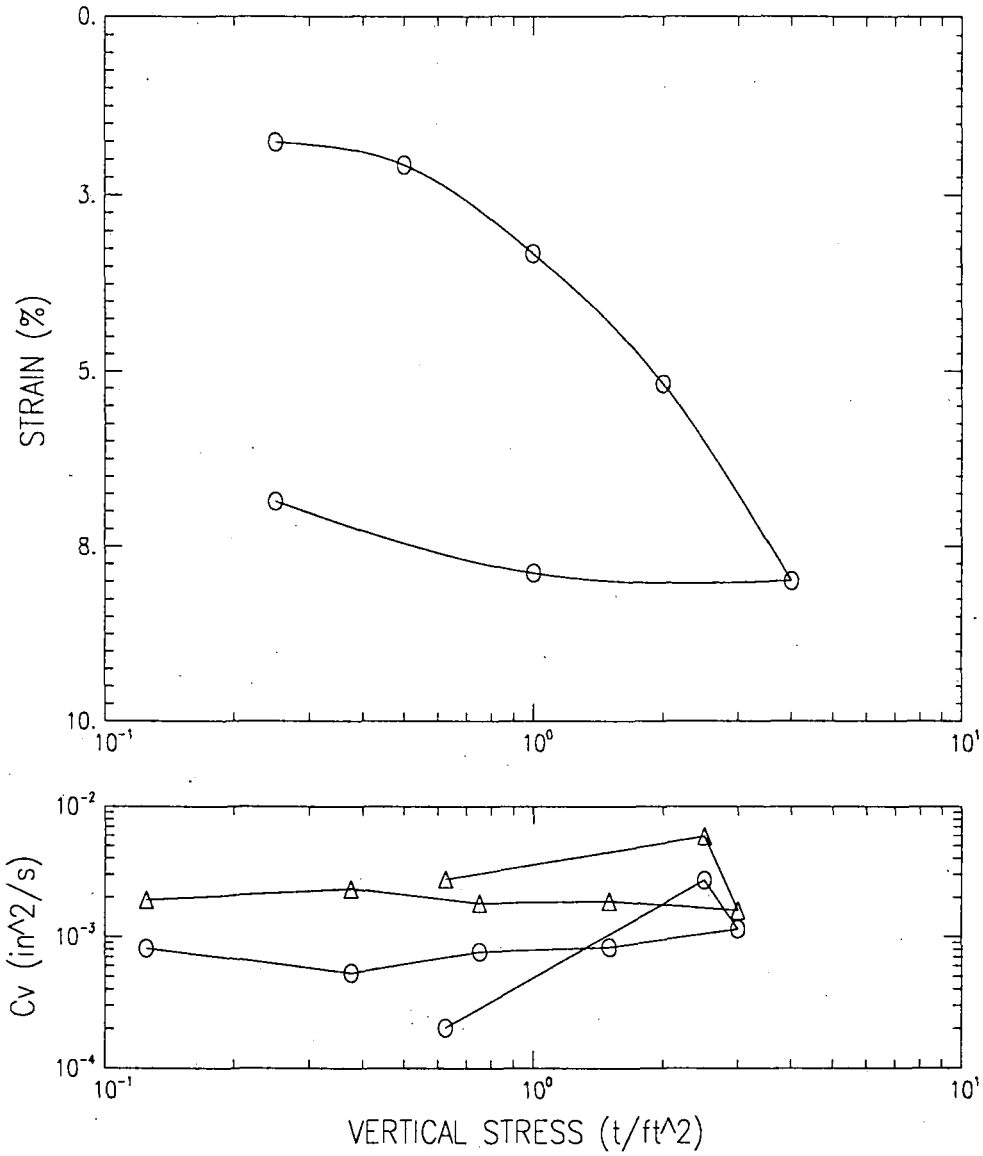
Project : S FK CHEHALIS R BR 6/115
Location : SR-6
Project No.: OL-0911
Boring No.: H-6-99
Tested by : LHB
Checked by : DW
Sample No.: U-2/A
Test Date : 3/18/99
Depth : 5-5.3 FEET
Test No. : 2787-2A
Sample Type: WADOT UNDI

Soil Description : WET DK YELLOWISH BROWN ELASTIC SILT WITH CLAY
Remarks :

Specific Gravity : 2.65
Liquid Limit : 69
Initial Height : 0.63 (in)
Initial Void Ratio : 1.07
Plastic Limit : 31
Sample Diameter : 1.91 (in)
Final Void Ratio : 0.90
Plasticity Index : 38

	BEFORE CONSOLIDATION		AFTER CONSOLIDATION	
	TRIMMINGS	SPECIMEN + RING	SPECIMEN + RING	TRIMMINGS
CONTAINER NO.		RING	RING	
WT CONTAINER + WET SOIL (gm)	356.10	460.60	459.90	87.20
WT CONTAINER + DRY SOIL (gm)	276.20	446.90	446.90	74.20
WT CONTAINER (gm)	82.20	409.40	409.40	36.70
WT DRY SOIL (gm)	194.00	37.50	37.50	37.50
WATER CONTENT (%)	41.19	36.53	34.67	34.67
VOID RATIO	------	1.07	0.91	------
DEGREE OF SATURATION (%)	------	90.17	101.45	------
DRY DENSITY (lb/ft^3)	------	79.78	86.82	------

CONSOLIDATION TEST
SUMMARY REPORT



Washington State D.O.T.
Project Name : S FK CHEHALIS R BR 6/115
Project No : OL-0911 Boring No : H-6-99 Sample No : U-2/B
Test Date : 2/3/99 Test No : 2787-2B Depth : 5.3-5.6 FT
Description : WET DK YELLOWISH BROWN ELASTIC SILT WITH CLAY
Remarks :

CONSOLIDATION TEST DATA

Project : S FK CHEHALIS R BR 6/115
Location : SR-6
Project No.: OL-0911
Boring No.: H-6-99
Tested by : LHB
Checked by : DAW
Sample No.: U-2/B
Test Date : 2/3/99
Depth : 5.3-5.6 FT
Test No. : 2787-2B
Sample Type: WSDOT TUBE

Soil Description : WET DK YELLOWISH BROWN ELASTIC SILT WITH CLAY
Remarks :

	APPLIED PRESSURE (t/ft^2)	FINAL DISPLACEMENT (in)	VOID RATIO	STRAIN AT END (%)	FITTING T50 TIME (min) SQ.RT.	LOG	COEFFICIENT OF CONSOLIDATION (in^2/s) SQ.RT.	LOG	AVE
1)	0.25	0.011	1.254	1.76	0.4	0.2	8.14E-004	1.91E-003	1.36E-003
2)	0.50	0.013	1.246	2.08	0.6	0.1	5.30E-004	2.32E-003	1.42E-003
3)	1.00	0.021	1.218	3.32	0.4	0.2	7.66E-004	1.81E-003	1.29E-003
4)	2.00	0.032	1.175	5.19	0.4	0.2	8.29E-004	1.87E-003	1.35E-003
5)	4.00	0.050	1.111	7.99	0.2	0.2	1.14E-003	1.59E-003	1.37E-003
6)	1.00	0.049	1.113	7.88	0.1	0.0	2.69E-003	5.91E-003	4.30E-003
7)	0.25	0.043	1.137	6.86	1.4	0.1	2.03E-004	2.75E-003	1.48E-003

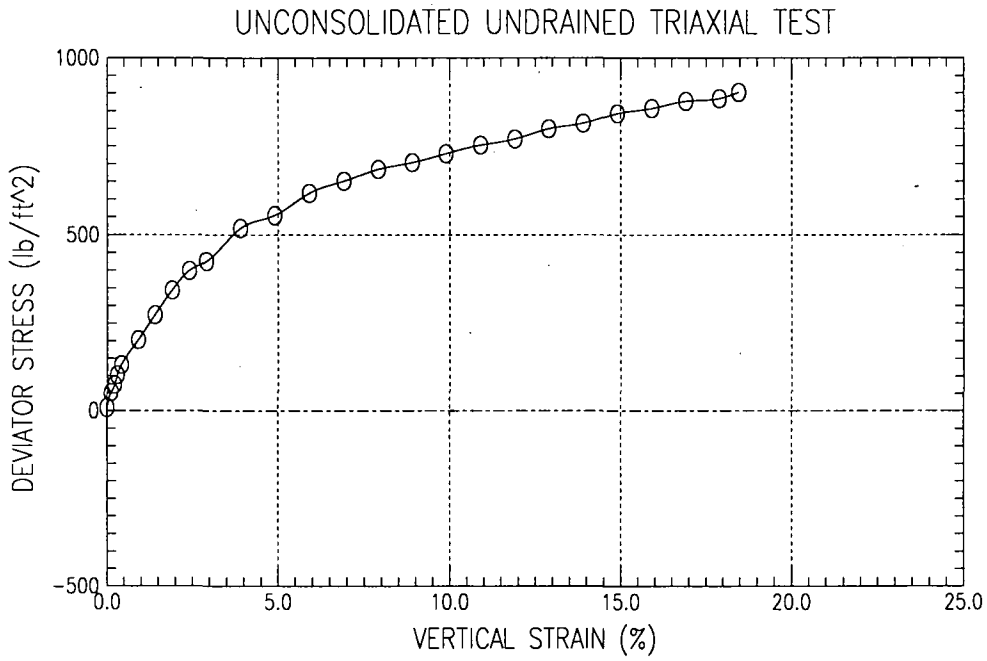
CONSOLIDATION TEST DATA

Project : S FK CHEHALIS R BR 6/115	Location : SR-6	Project No.: OL-0911
Boring No.: H-6-99	Tested by : LHB	Checked by : DAW
Sample No.: U-2/B	Test Date : 2/3/99	Depth : 5.3-5.6 FT
Test No. : 2787-2B	Sample Type: WSDOT TUBE	

Soil Description : WET DK YELLOWISH BROWN ELASTIC SILT WITH CLAY
Remarks :

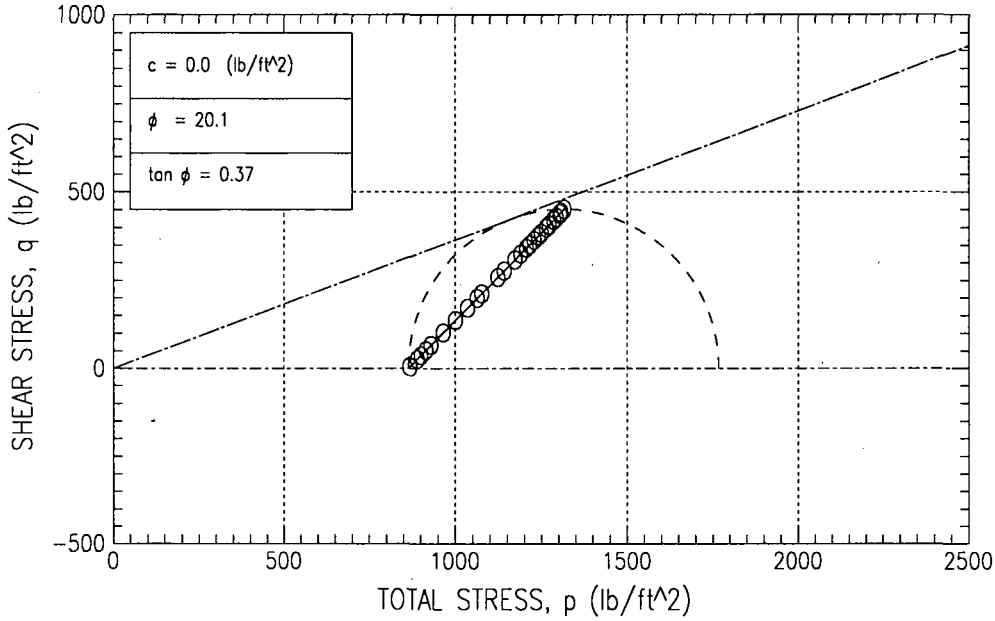
Specific Gravity : 2.65	Liquid Limit : 80	Initial Height : 0.63 (in)
Initial Void Ratio : 1.29	Plastic Limit : 39	Sample Diameter : 1.91 (in)
Final Void Ratio : 1.14	Plasticity Index : 41	

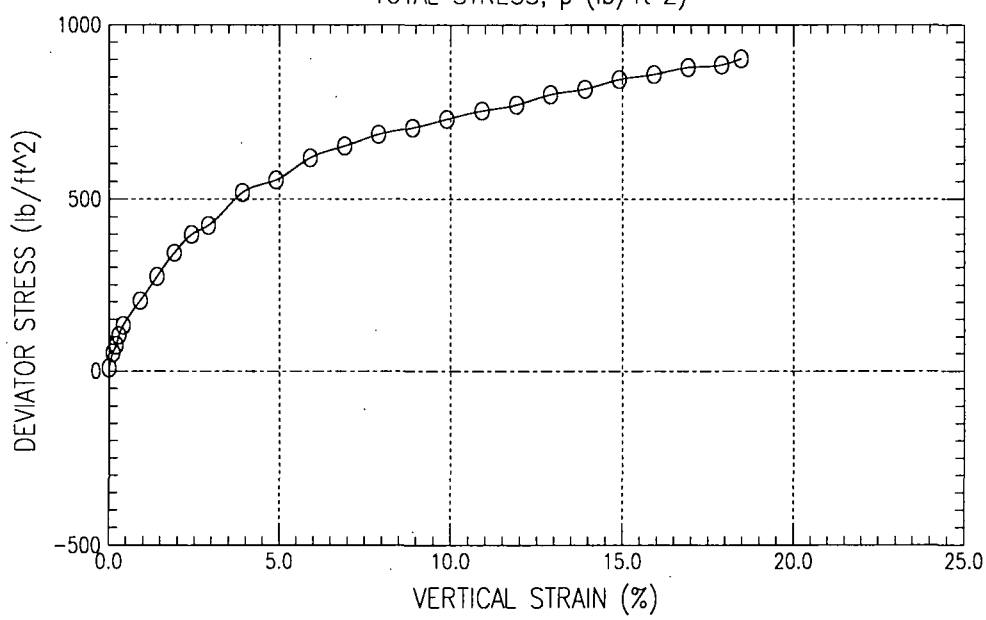
	BEFORE CONSOLIDATION		AFTER CONSOLIDATION	
	TRIMMINGS	SPECIMEN + RING	SPECIMEN + RING	TRIMMINGS
CONTAINER NO.		RING	RING	
WT CONTAINER + WET SOIL (gm)	348.10	458.50	458.10	85.60
WT CONTAINER + DRY SOIL (gm)	263.00	443.40	443.40	70.90
WT CONTAINER (gm)	81.10	409.50	409.50	37.00
WT DRY SOIL (gm)	181.90	33.90	33.90	33.90
WATER CONTENT (%)	46.78	44.54	43.36	43.36
VOID RATIO	------	1.29	1.15	------
DEGREE OF SATURATION (%)	------	91.22	99.59	------
DRY DENSITY (lb/ft^3)	------	72.12	76.81	------



Washington State D.O.T.
Project Name : S FK CHEHALIS R BR 6/115
Project No : OL-0911 Boring No : H-4-99 Sample No : U-2/B
Test Date : 2/4/99 Test No : 2785-2B Depth : 7.5 FT
Description : WET OLIVE BROWN SILTY SAND
Remarks :

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST





Washington State D.O.T.
Project Name : S FK CHEHALIS R BR 6/115
Project No : OL-0911 Boring No : H-4-99 Sample No : U-2/B
Test Date : 2/4/99 Test No : 2785-2B Depth : 7.5 FT
Description : WET OLIVE BROWN SILTY SAND
Remarks :

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

Project : S FK CHEHALIS R BR 6/115 Location : SR-6
Project No. : OL-0911 Test No. : 2785-2B
Boring No. : H-4-99 Test Date : 2/4/99 Tested by : LHB
Sample No. : U-2/B Depth : 7.5 FT Checked by : DW
Sample Type : WSDOT TUBE Elevation :
Soil Description : WET OLIVE BROWN SILTY SAND
Remarks :

Height : 4.000 (in) Piston Diameter : 0.625 (in) Filter Correction : 0.00 (lb/ft^2)
Diameter : 1.910 (in) Piston Friction : 0.00 (lb) Membrane Correction : 3.20 (lb/in)
Volume : 11.46 (in^3) Piston Weight : 914.90 (gm) Area Correction : Uniform

	TIME (min.)	VERTICAL STRAIN (%)	TOTAL VERTICAL STRESS (lb/ft^2)	TOTAL HORIZONTAL STRESS (lb/ft^2)	TOTAL p (lb/ft^2)	q (lb/ft^2)
1)	0	0.00	872.79	864.00	868.40	4.40
2)	0.116667	0.12	916.36	864.00	890.18	26.18
3)	0.216667	0.21	938.08	864.00	901.04	37.04
4)	0.3	0.29	967.02	864.00	915.51	51.51
5)	0.416667	0.42	995.85	864.00	929.93	65.93
6)	0.9	0.91	1067.24	864.00	965.62	101.62
7)	1.43333	1.40	1137.93	864.00	1000.96	136.96
8)	1.93333	1.91	1207.85	864.00	1035.93	171.93
9)	2.41667	2.41	1262.86	864.00	1063.43	199.43
10)	2.88333	2.91	1289.07	864.00	1076.53	212.53
11)	3.86667	3.90	1382.55	864.00	1123.27	259.27
12)	4.83333	4.90	1418.64	864.00	1141.32	277.32
13)	5.81667	5.91	1481.18	864.00	1172.59	308.59
14)	6.78333	6.91	1515.18	864.00	1189.59	325.59
15)	7.75	7.91	1548.41	864.00	1206.21	342.21
16)	8.71667	8.90	1567.53	864.00	1215.77	351.77
17)	9.66667	9.89	1592.62	864.00	1228.31	364.31
18)	10.6333	10.91	1616.81	864.00	1240.41	376.41
19)	11.5833	11.91	1633.98	864.00	1248.99	384.99
20)	12.55	12.89	1663.37	864.00	1263.68	399.68
21)	13.55	13.91	1679.10	864.00	1271.55	407.55
22)	14.5167	14.91	1706.75	864.00	1285.38	421.38
23)	15.5	15.91	1721.23	864.00	1292.62	428.62
24)	16.4667	16.91	1741.32	864.00	1302.66	438.66
25)	17.4167	17.89	1748.82	864.00	1306.41	442.41
26)	17.9667	18.46	1766.40	864.00	1315.20	451.20

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

Project : S FK CHEHALIS R BR 6/115 Location : SR-6
Project No. : OL-0911 Test No. : 2785-2B
Boring No. : H-4-99 Test Date : 2/4/99 Tested by : LHB
Sample No. : U-2/B Depth : 7.5 FT Checked by : DW
Sample Type : WSDOT TUBE Elevation :
Soil Description : WET OLIVE BROWN SILTY SAND
Remarks :

Height : 4.000 (in) Piston Diameter : 0.625 (in) Filter Correction : 0.00 (lb/ft^2)
Diameter : 1.910 (in) Piston Friction : 0.00 (lb) Membrane Correction : 3.20 (lb/in)
Volume : 11.46 (in^3) Piston Weight : 914.90 (gm) Area Correction : Uniform

	TIME (min.)	CHANGE IN LENGTH (in)	VERTICAL STRAIN (%)	CORR. AREA (in^2)	DEV. LOAD (lb)	CORR. DEV. LOAD (lb)	DEV. STRESS (lb/ft^2)	VERTICAL STRESS (lb/ft^2)
1)	0	0.000	0.00	2.87	0.00	0.17	8.79	872.79
2)	0.116667	0.005	0.12	2.87	0.87	1.04	52.36	916.36
3)	0.216667	0.008	0.21	2.87	1.30	1.48	74.08	938.08
4)	0.3	0.012	0.29	2.87	1.88	2.06	103.02	967.02
5)	0.416667	0.017	0.42	2.88	2.46	2.63	131.85	995.85
6)	0.9	0.037	0.91	2.89	3.91	4.08	203.24	1067.24
7)	1.43333	0.056	1.40	2.91	5.35	5.53	273.93	1137.93
8)	1.93333	0.076	1.91	2.92	6.80	6.97	343.85	1207.85
9)	2.41667	0.096	2.41	2.94	7.96	8.13	398.86	1262.86
10)	2.88333	0.116	2.91	2.95	8.54	8.71	425.07	1289.07
11)	3.86667	0.156	3.90	2.98	10.56	10.74	518.55	1382.55
12)	4.83333	0.196	4.90	3.01	11.43	11.60	554.64	1418.64
13)	5.81667	0.236	5.91	3.05	12.88	13.05	617.18	1481.18
14)	6.78333	0.277	6.91	3.08	13.74	13.92	651.18	1515.18
15)	7.75	0.316	7.91	3.11	14.61	14.79	684.41	1548.41
16)	8.71667	0.356	8.90	3.15	15.19	15.37	703.53	1567.53
17)	9.66667	0.396	9.89	3.18	15.91	16.09	728.62	1592.62
18)	10.6333	0.436	10.91	3.22	16.64	16.81	752.81	1616.81
19)	11.5833	0.476	11.91	3.25	17.22	17.39	769.98	1633.98
20)	12.55	0.516	12.89	3.29	18.08	18.26	799.37	1663.37
21)	13.55	0.556	13.91	3.33	18.66	18.84	815.10	1679.10
22)	14.5167	0.596	14.91	3.37	19.53	19.71	842.75	1706.75
23)	15.5	0.637	15.91	3.41	20.11	20.28	857.23	1721.23
24)	16.4667	0.676	16.91	3.45	20.83	21.01	877.32	1741.32
25)	17.4167	0.716	17.89	3.49	21.27	21.44	884.82	1748.82
26)	17.9667	0.738	18.46	3.51	21.85	22.02	902.40	1766.40

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

Project : S FK CHEHALIS R BR 6/115 Location : SR-6
Project No. : OL-0911 Test No. : 2785-2B
Boring No. : H-4-99 Test Date : 2/4/99 Tested by : LHB
Sample No. : U-2/B Depth : 7.5 FT Checked by : DW
Sample Type : WSDOT TUBE Elevation :
Soil Description : WET OLIVE BROWN SILTY SAND
Remarks :

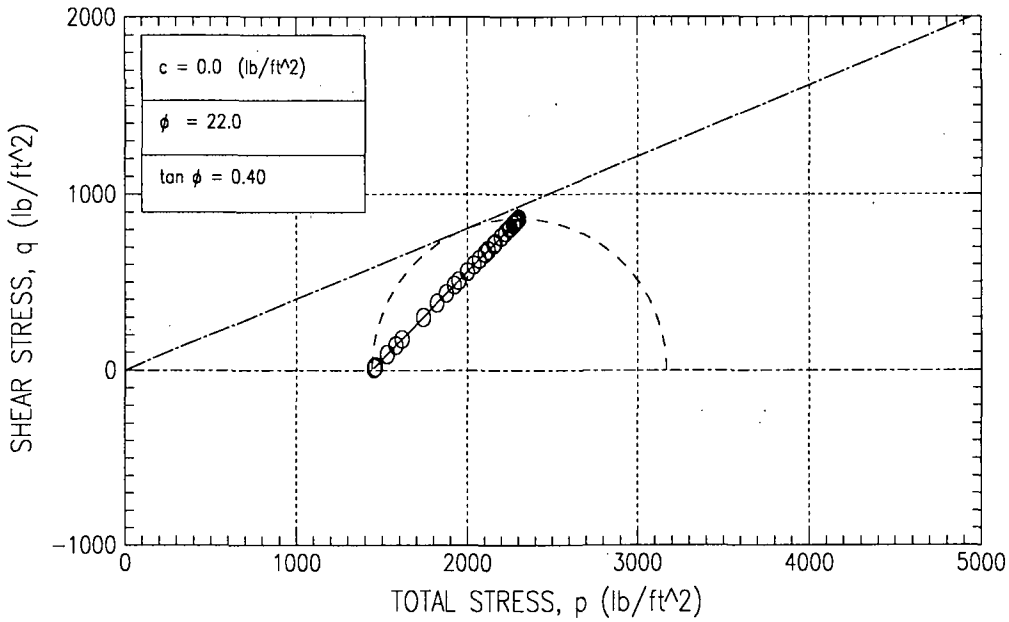
Liquid Limit : 60 Plastic Limit : 35 Specific Gravity : 2.65

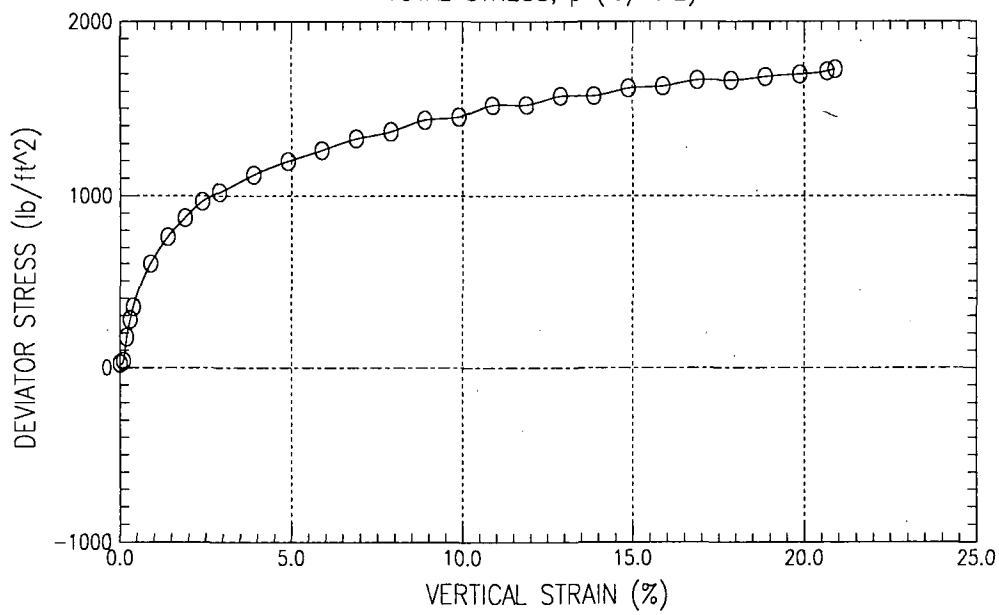
	WATER CONTENT BEFORE TEST	AFTER TEST
CONTAINER NO.		
WT CONTAINER + WET SOIL (gm)	388.80	388.80
WT CONTAINER + DRY SOIL (gm)	286.20	286.20
WT WATER (gm)	102.60	102.60
WT CONTAINER (gm)	82.00	82.00
WT DRY SOIL (gm)	204.20	204.20
WATER CONTENT (%)	50.24	50.24

	INITIAL	AT CONSOLIDATION
WATER CONTENT (%)	50.24	50.24
VOID RATIO	1.41	1.41
WET DENSITY (lb/ft^3)	102.98	102.98
DRY DENSITY (lb/ft^3)	68.54	68.54
DEGREE OF SATURATION (%)	94.26	94.26

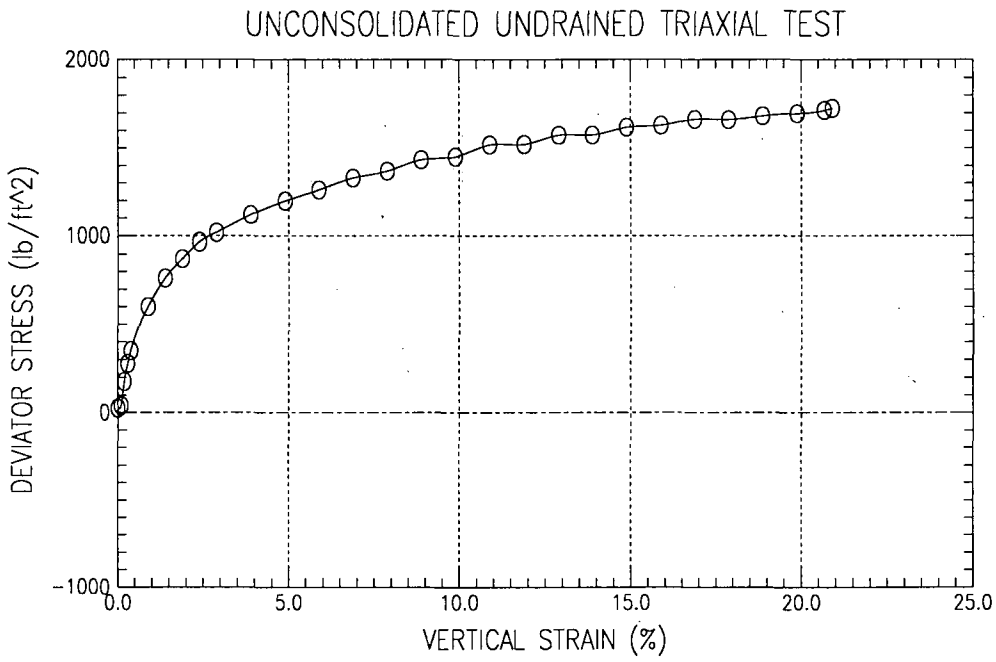
Maximum Shear Stress = 451.20 (lb/ft^2) at a Vertical Strain of 18.46 %

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST





Washington State D.O.T.
Project Name : S FK CHEHALIS R BR REPL
Project No : OL-0911 Boring No : H-4-99 Sample No : U-4/B
Test Date : 2/6/99 Test No : 2785-4B Depth : 12.5'
Description : WET DARK YELLOWISH BROWN FAT CLAY
Remarks :



Washington State D.O.T.
Project Name : S FK CHEHALIS R BR REPL
Project No : OL-0911 Boring No : H-4-99 Sample No : U-4/B
Test Date : 2/6/99 Test No : 2785-4B Depth : 12.5'
Description : WET DARK YELLOWISH BROWN FAT CLAY
Remarks :

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

Project : S FK CHEHALIS R BR REPL
Location : SR-6
Project No. : OL-0911
Test No. : 2785-4B
Boring No. : H-4-99
Test Date : 2/6/99
Tested by : LHB
Sample No. : U-4/B
Depth : 12.5'
Checked by : DAW
Sample Type : WSDOT TUBE
Elevation :
Soil Description : WET DARK YELLOWISH BROWN FAT CLAY
Remarks :

Height : 4.000 (in)
Piston Diameter : 0.625 (in)
Filter Correction : 0.00 (lb/ft^2)
Diameter : 1.910 (in)
Piston Friction : 0.00 (lb)
Membrane Correction : 3.20 (lb/in)
Volume : 11.46 (in^3)
Piston Weight : 914.90 (gm)
Area Correction : Uniform

	TIME (min.)	VERTICAL STRAIN (%)	TOTAL VERTICAL STRESS (lb/ft^2)	TOTAL HORIZONTAL STRESS (lb/ft^2)	TOTAL p (lb/ft^2)	q (lb/ft^2)
1)	0	0.00	1464.27	1440.00	1452.14	12.14
2)	0.1	0.09	1478.78	1440.00	1459.39	19.39
3)	0.216667	0.19	1616.63	1440.00	1528.31	88.31
4)	0.333333	0.29	1717.94	1440.00	1578.97	138.97
5)	0.433333	0.39	1790.11	1440.00	1615.05	175.05
6)	0.916667	0.88	2040.60	1440.00	1740.30	300.30
7)	1.41667	1.39	2202.46	1440.00	1821.23	381.23
8)	1.95	1.89	2312.71	1440.00	1876.35	436.35
9)	2.45	2.39	2407.58	1440.00	1923.79	483.79
10)	2.91667	2.89	2459.15	1440.00	1949.57	509.57
11)	3.9	3.89	2560.46	1440.00	2000.23	560.23
12)	4.88333	4.90	2638.61	1440.00	2039.31	599.31
13)	5.86667	5.88	2701.47	1440.00	2070.73	630.73
14)	6.83333	6.88	2769.31	1440.00	2104.65	664.65
15)	7.8	7.89	2808.50	1440.00	2124.25	684.25
16)	8.78333	8.88	2873.26	1440.00	2156.63	716.63
17)	9.73333	9.89	2890.17	1440.00	2165.08	725.08
18)	10.7	10.89	2958.30	1440.00	2199.15	759.15
19)	11.6667	11.89	2960.48	1440.00	2200.24	760.24
20)	12.65	12.90	3012.76	1440.00	2226.38	786.38
21)	13.6	13.88	3013.75	1440.00	2226.87	786.87
22)	14.6	14.88	3057.36	1440.00	2248.68	808.68
23)	15.5667	15.89	3068.80	1440.00	2254.40	814.40
24)	16.55	16.88	3103.96	1440.00	2271.98	831.98
25)	17.5	17.88	3102.00	1440.00	2271.00	831.00
26)	18.5	18.88	3123.05	1440.00	2281.52	841.52
27)	19.4667	19.89	3137.10	1440.00	2288.55	848.55
28)	20.2333	20.67	3155.00	1440.00	2297.50	857.50
29)	20.4667	20.91	3167.20	1440.00	2303.60	863.60

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

Project : S FK CHEHALIS R BR REPL
Location : SR-6
Project No. : OL-0911
Test No. : 2785-4B
Boring No. : H-4-99
Test Date : 2/6/99
Tested by : LHB
Sample No. : U-4/B
Depth : 12.5'
Checked by : DAW
Sample Type : WSDOT TUBE
Elevation :
Soil Description : WET DARK YELLOWISH BROWN FAT CLAY
Remarks :

Height : 4.000 (in)
Piston Diameter : 0.625 (in)
Filter Correction : 0.00 (lb/ft^2)
Diameter : 1.910 (in)
Piston Friction : 0.00 (lb)
Membrane Correction : 3.20 (lb/in)
Volume : 11.46 (in^3)
Piston Weight : 914.90 (gm)
Area Correction : Uniform

	TIME (min.)	CHANGE IN LENGTH (in)	VERTICAL STRAIN (%)	CORR. AREA (in^2)	DEV. LOAD (lb)	CORR. DEV. LOAD (lb)	DEV. STRESS (lb/ft^2)	VERTICAL STRESS (lb/ft^2)
1)	0	0.000	0.00	2.87	1.54	0.48	24.27	1464.27
2)	0.1	0.004	0.09	2.87	1.83	0.77	38.78	1478.78
3)	0.216667	0.008	0.19	2.87	4.57	3.52	176.63	1616.63
4)	0.333333	0.012	0.29	2.87	6.60	5.55	277.94	1717.94
5)	0.433333	0.015	0.39	2.88	8.05	6.99	350.11	1790.11
6)	0.916667	0.035	0.88	2.89	13.11	12.06	600.60	2040.60
7)	1.41667	0.055	1.39	2.91	16.44	15.38	762.46	2202.46
8)	1.95	0.076	1.89	2.92	18.75	17.70	872.71	2312.71
9)	2.45	0.096	2.39	2.94	20.78	19.72	967.58	2407.58
10)	2.91667	0.116	2.89	2.95	21.93	20.88	1019.15	2459.15
11)	3.9	0.156	3.89	2.98	24.25	23.20	1120.46	2560.46
12)	4.88333	0.196	4.90	3.01	26.13	25.08	1198.61	2638.61
13)	5.86667	0.235	5.88	3.04	27.72	26.67	1261.47	2701.47
14)	6.83333	0.275	6.88	3.08	29.46	28.41	1329.31	2769.31
15)	7.8	0.316	7.89	3.11	30.62	29.56	1368.50	2808.50
16)	8.78333	0.355	8.88	3.14	32.35	31.30	1433.26	2873.26
17)	9.73333	0.396	9.89	3.18	33.07	32.02	1450.17	2890.17
18)	10.7	0.436	10.89	3.22	34.96	33.90	1518.30	2958.30
19)	11.6667	0.476	11.89	3.25	35.39	34.34	1520.48	2960.48
20)	12.65	0.516	12.90	3.29	36.98	35.93	1572.76	3012.76
21)	13.6	0.555	13.88	3.33	37.42	36.36	1573.75	3013.75
22)	14.6	0.595	14.88	3.37	38.86	37.81	1617.36	3057.36
23)	15.5667	0.636	15.89	3.41	39.59	38.53	1628.80	3068.80
24)	16.55	0.675	16.88	3.45	40.89	39.83	1663.96	3103.96
25)	17.5	0.715	17.88	3.49	41.32	40.27	1662.00	3102.00
26)	18.5	0.755	18.88	3.53	42.33	41.28	1683.05	3123.05
27)	19.4667	0.795	19.89	3.58	43.20	42.15	1697.10	3137.10
28)	20.2333	0.827	20.67	3.61	44.07	43.02	1715.00	3155.00
29)	20.4667	0.836	20.91	3.62	44.50	43.45	1727.20	3167.20

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

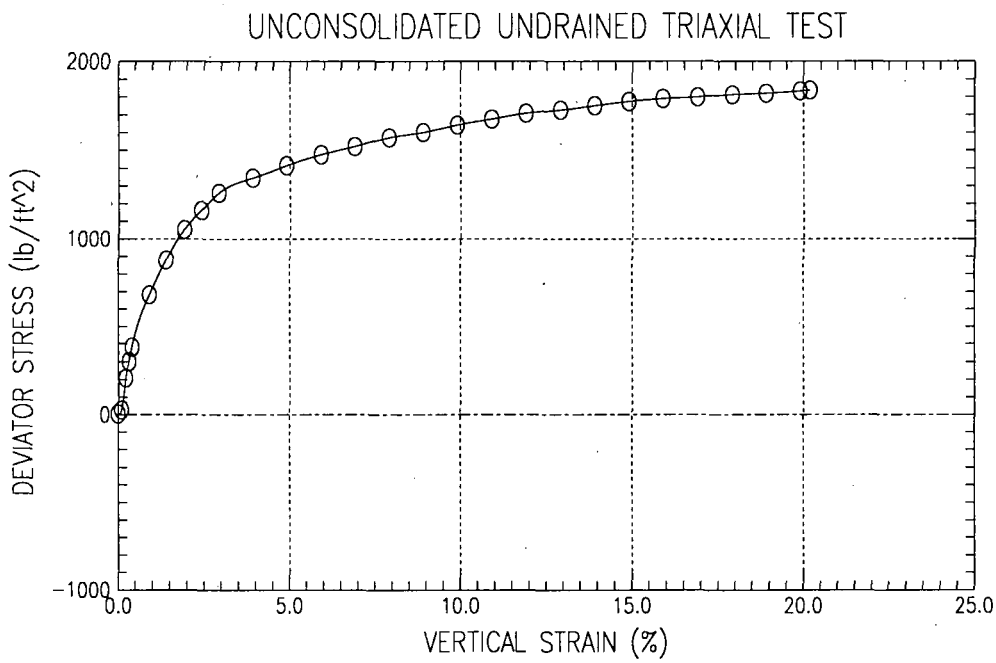
Project : S FK CHEHALIS R BR REPL
Location : SR-6
Project No. : OL-0911
Test No. : 2785-4B
Boring No. : H-4-99
Test Date : 2/6/99
Tested by : LHB
Sample No. : U-4/B
Depth : 12.5'
Checked by : DAW
Sample Type : WSDOT TUBE
Elevation :
Soil Description : WET DARK YELLOWISH BROWN FAT CLAY
Remarks :

Liquid Limit : 84
Plastic Limit : 36
Specific Gravity : 2.65

	WATER CONTENT BEFORE TEST	AFTER TEST
CONTAINER NO.		
WT CONTAINER + WET SOIL (gm)	391.60	391.60
WT CONTAINER + DRY SOIL (gm)	291.20	291.20
WT WATER (gm)	100.40	100.40
WT CONTAINER (gm)	81.60	81.60
WT DRY SOIL (gm)	209.60	209.60
WATER CONTENT (%)	47.90	47.90

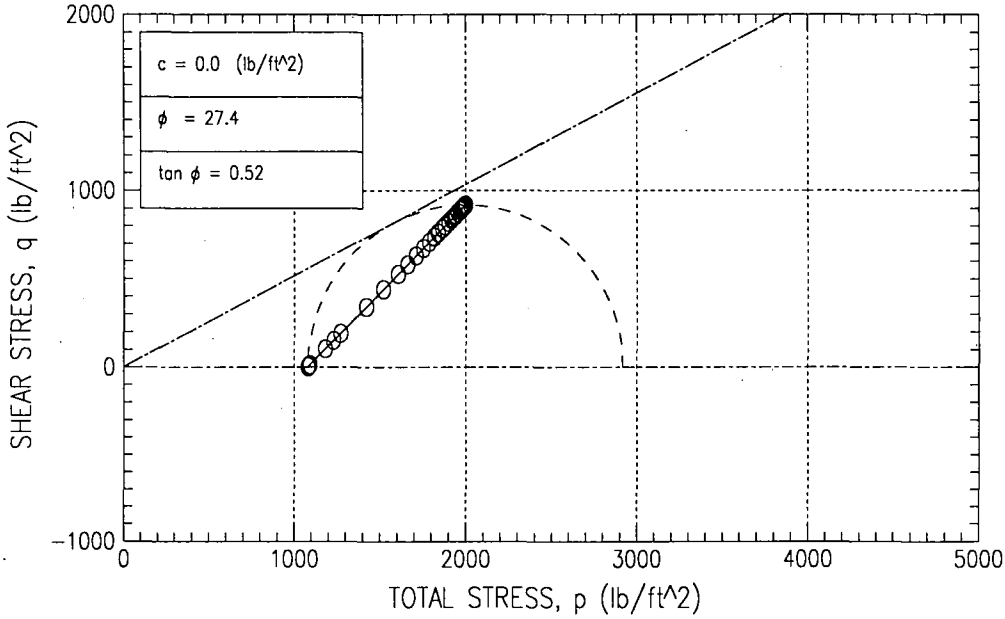
	INITIAL	AT CONSOLIDATION
WATER CONTENT (%)	47.90	47.90
VOID RATIO	1.35	1.35
WET DENSITY (lb/ft^3)	104.07	104.07
DRY DENSITY (lb/ft^3)	70.37	70.37
DEGREE OF SATURATION (%)	94.03	94.03

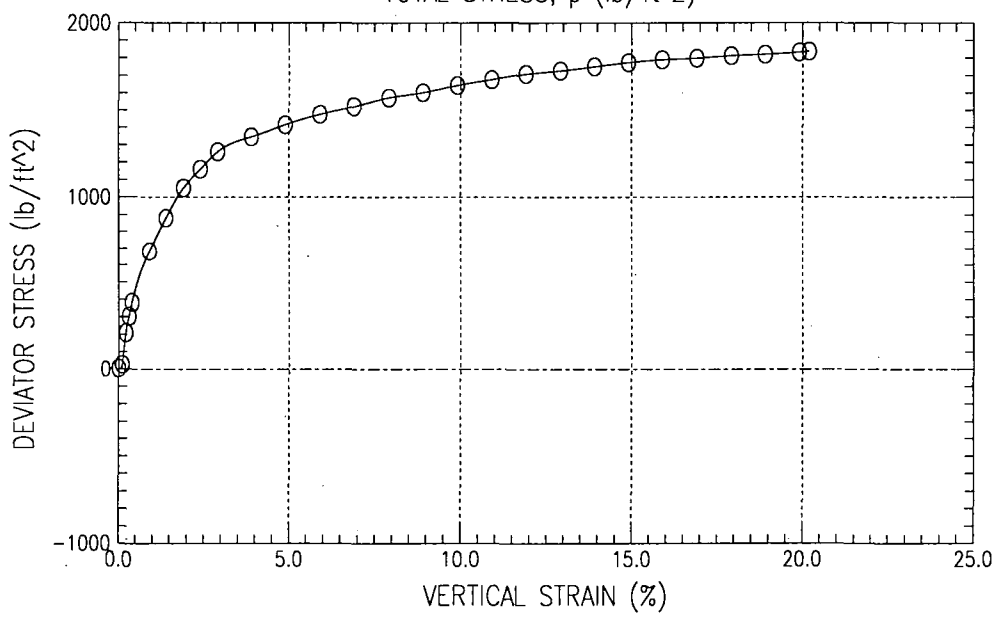
Maximum Shear Stress = 863.60 (lb/ft^2) at a Vertical Strain of 20.91 %



Washington State D.O.T.
Project Name : S FK CHEHALIS R BR REPL
Project No : OL-0911 Boring No : H-5-99 Sample No : U-2/B
Test Date : 2/6/99 Test No : 2786-2B Depth : 10.3'
Description : WET YELLOWISH BROWN FAT CLAY WITH SAND
Remarks :

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST





Washington State D.O.T.
Project Name : S FK CHEHALIS R BR REPL
Project No : OL-0911 Boring No : H-5-99 Sample No : U-2/B
Test Date : 2/6/99 Test No : 2786-2B Depth : 10.3'
Description : WET YELLOWISH BROWN FAT CLAY WITH SAND
Remarks :

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

Project : S FK CHEHALIS R BR REPL
Location : SR-6
Project No. : OL-0911
Test No. : 2786-2B
Boring No. : H-5-99
Test Date : 2/6/99
Tested by : LHB
Sample No. : U-2/B
Depth : 10.3'
Checked by : DAW
Sample Type : WSDOT TUBE
Elevation :
Soil Description : WET YELLOWISH BROWN FAT CLAY WITH SAND
Remarks :

Height : 3.965 (in)
Piston Diameter : 0.625 (in)
Filter Correction : 0.00 (lb/ft^2)
Diameter : 1.910 (in)
Piston Friction : 0.00 (lb)
Membrane Correction : 3.20 (lb/in)
Volume : 11.36 (in^3)
Piston Weight : 916.60 (gm)
Area Correction : Uniform

	TIME (min.)	VERTICAL STRAIN (%)	TOTAL VERTICAL STRESS (lb/ft^2)	TOTAL HORIZONTAL STRESS (lb/ft^2)	TOTAL p (lb/ft^2)	q (lb/ft^2)
1)	0	0.00	1084.86	1080.00	1082.43	2.43
2)	0.1	0.10	1106.65	1080.00	1093.33	13.33
3)	0.216667	0.21	1288.01	1080.00	1184.00	104.00
4)	0.316667	0.31	1382.04	1080.00	1231.02	151.02
5)	0.416667	0.40	1461.44	1080.00	1270.72	190.72
6)	0.95	0.91	1762.06	1080.00	1421.03	341.03
7)	1.46667	1.40	1959.45	1080.00	1519.73	439.73
8)	1.96667	1.91	2133.15	1080.00	1606.57	526.57
9)	2.45	2.41	2241.39	1080.00	1660.69	580.69
10)	2.95	2.92	2341.22	1080.00	1710.61	630.61
11)	3.91667	3.90	2426.22	1080.00	1753.11	673.11
12)	4.9	4.90	2495.28	1080.00	1787.64	707.64
13)	5.88333	5.91	2555.40	1080.00	1817.70	737.70
14)	6.85	6.90	2600.85	1080.00	1840.43	760.43
15)	7.85	7.91	2651.33	1080.00	1865.67	785.67
16)	8.8	8.90	2680.73	1080.00	1880.37	800.37
17)	9.76667	9.91	2722.09	1080.00	1901.04	821.04
18)	10.7167	10.91	2755.66	1080.00	1917.83	837.83
19)	11.7	11.90	2788.21	1080.00	1934.10	854.10
20)	12.6667	12.91	2806.64	1080.00	1943.32	863.32
21)	13.65	13.91	2830.60	1080.00	1955.30	875.30
22)	14.6	14.91	2853.69	1080.00	1966.85	886.85
23)	15.6	15.89	2869.81	1080.00	1974.91	894.91
24)	16.5667	16.90	2878.56	1080.00	1979.28	899.28
25)	17.5667	17.92	2892.37	1080.00	1986.18	906.18
26)	18.5333	18.90	2900.06	1080.00	1990.03	910.03
27)	19.5167	19.91	2912.53	1080.00	1996.26	916.26
28)	19.8	20.19	2917.56	1080.00	1998.78	918.78

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

Project : S FK CHEHALIS R BR REPL
Location : SR-6
Project No. : OL-0911
Test No. : 2786-2B
Boring No. : H-5-99
Test Date : 2/6/99
Tested by : LHB
Sample No. : U-2/B
Depth : 10.3'
Checked by : DAW
Sample Type : WSDOT TUBE
Elevation :
Soil Description : WET YELLOWISH BROWN FAT CLAY WITH SAND
Remarks :

Height : 3.965 (in)
Piston Diameter : 0.625 (in)
Filter Correction : 0.00 (lb/ft^2)
Diameter : 1.910 (in)
Piston Friction : 0.00 (lb)
Membrane Correction : 3.20 (lb/in)
Volume : 11.36 (in^3)
Piston Weight : 916.60 (gm)
Area Correction : Uniform

	TIME (min.)	CHANGE IN LENGTH (in)	VERTICAL STRAIN (%)	CORR. AREA (in^2)	DEV. LOAD (lb)	CORR. DEV. LOAD (lb)	DEV. STRESS (lb/ft^2)	VERTICAL STRESS (lb/ft^2)
1)	0	0.000	0.00	2.87	0.38	0.10	4.86	1084.86
2)	0.1	0.004	0.10	2.87	0.81	0.53	26.65	1106.65
3)	0.216667	0.008	0.21	2.87	4.43	4.15	208.01	1288.01
4)	0.316667	0.012	0.31	2.87	6.31	6.03	302.04	1382.04
5)	0.416667	0.016	0.40	2.88	7.90	7.62	381.44	1461.44
6)	0.95	0.036	0.91	2.89	13.98	13.70	682.06	1762.06
7)	1.46667	0.055	1.40	2.91	18.03	17.75	879.45	1959.45
8)	1.96667	0.076	1.91	2.92	21.65	21.36	1053.15	2133.15
9)	2.45	0.095	2.41	2.94	23.96	23.68	1161.39	2241.39
10)	2.95	0.116	2.92	2.95	26.13	25.85	1261.22	2341.22
11)	3.91667	0.155	3.90	2.98	28.16	27.87	1346.22	2426.22
12)	4.9	0.194	4.90	3.01	29.89	29.61	1415.28	2495.28
13)	5.88333	0.234	5.91	3.05	31.48	31.20	1475.40	2555.40
14)	6.85	0.274	6.90	3.08	32.79	32.50	1520.85	2600.85
15)	7.85	0.314	7.91	3.11	34.23	33.95	1571.33	2651.33
16)	8.8	0.353	8.90	3.15	35.25	34.96	1600.73	2680.73
17)	9.76667	0.393	9.91	3.18	36.55	36.27	1642.09	2722.09
18)	10.7167	0.432	10.91	3.22	37.70	37.42	1675.66	2755.66
19)	11.7	0.472	11.90	3.25	38.86	38.58	1708.21	2788.21
20)	12.6667	0.512	12.91	3.29	39.73	39.45	1726.64	2806.64
21)	13.65	0.552	13.91	3.33	40.74	40.46	1750.60	2830.60
22)	14.6	0.591	14.91	3.37	41.76	41.47	1773.69	2853.69
23)	15.6	0.630	15.89	3.41	42.62	42.34	1789.81	2869.81
24)	16.5667	0.670	16.90	3.45	43.35	43.06	1798.56	2878.56
25)	17.5667	0.710	17.92	3.49	44.21	43.93	1812.37	2892.37
26)	18.5333	0.750	18.90	3.53	44.94	44.66	1820.06	2900.06
27)	19.5167	0.789	19.91	3.58	45.81	45.52	1832.53	2912.53
28)	19.8	0.801	20.19	3.59	46.10	45.81	1837.56	2917.56

UNCONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST

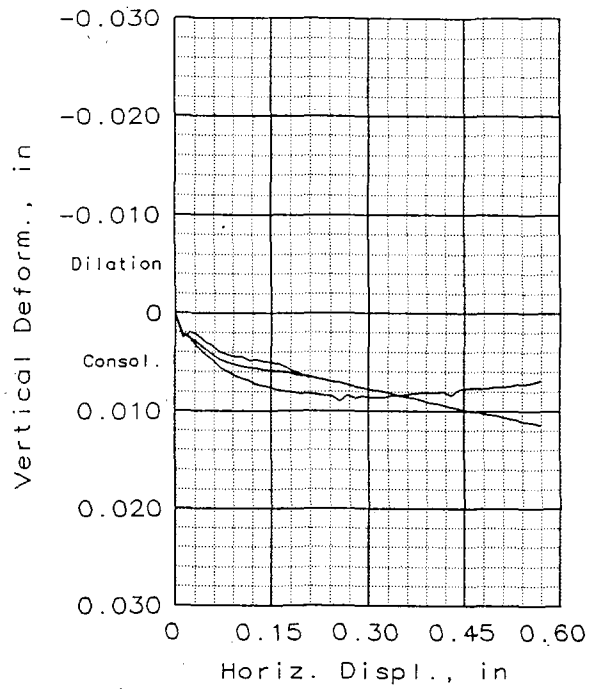
Project : S FK CHEHALIS R BR REPL
Location : SR-6
Project No. : OL-0911
Test No. : 2786-2B
Boring No. : H-5-99
Test Date : 2/6/99
Tested by : LHB
Sample No. : U-2/B
Depth : 10.3'
Checked by : DAW
Sample Type : WSDOT TUBE
Elevation :
Soil Description : WET YELLOWISH BROWN FAT CLAY WITH SAND
Remarks :

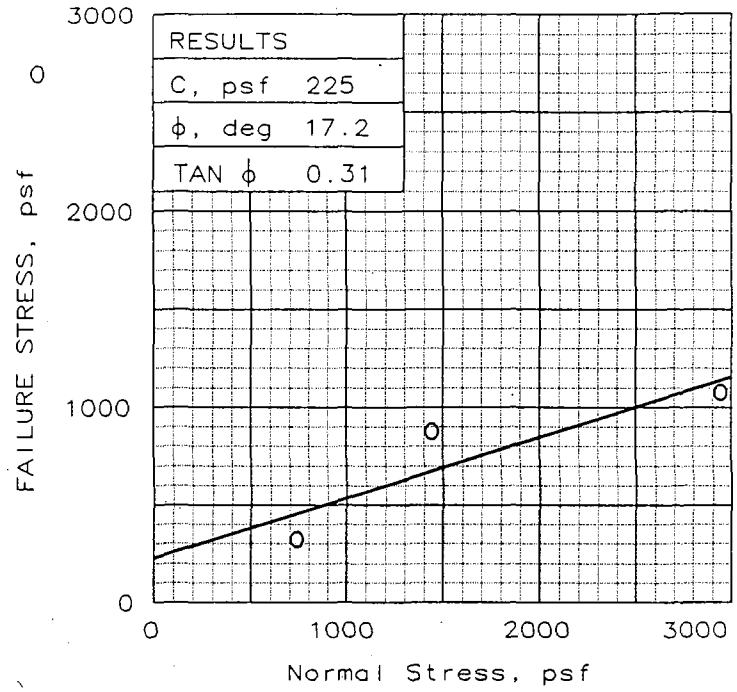
Liquid Limit : 82
Plastic Limit : 29
Specific Gravity : 2.65

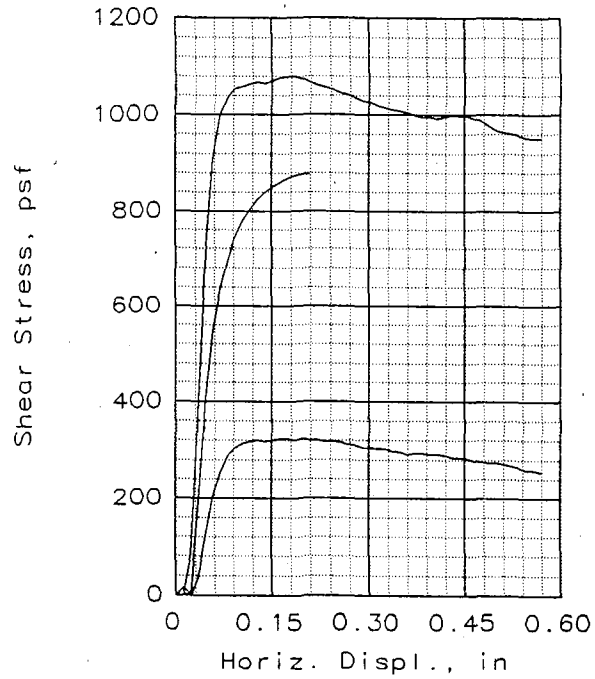
	WATER CONTENT BEFORE TEST	AFTER TEST
CONTAINER NO.		
WT CONTAINER + WET SOIL (gm)	393.10	393.10
WT CONTAINER + DRY SOIL (gm)	298.50	298.50
WT WATER (gm)	94.60	94.60
WT CONTAINER (gm)	83.60	83.60
WT DRY SOIL (gm)	214.90	214.90
WATER CONTENT (%)	44.02	44.02

	INITIAL	AT CONSOLIDATION
WATER CONTENT (%)	44.02	44.02
VOID RATIO	1.27	1.27
WET DENSITY (lb/ft^3)	104.86	104.86
DRY DENSITY (lb/ft^3)	72.81	72.81
DEGREE OF SATURATION (%)	91.77	91.77

Maximum Shear Stress = 918.78 (lb/ft^2) at a Vertical Strain of 20.19 %







SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	43.2	43.2	43.2
	DRY DENSITY, pcf	71.0	70.9	69.6
	SATURATION, %	86.0	85.8	83.1
	VOID RATIO	1.331	1.334	1.376
	DIAMETER, in	2.88	2.88	2.88
	HEIGHT, in	0.74	0.74	0.73
AT TEST	WATER CONTENT, %	62.8	67.9	62.7
	DRY DENSITY, pcf	71.0	70.4	68.8
	SATURATION, %	124.9	133.2	118.1
	VOID RATIO	1.331	1.350	1.405
	DIAMETER, in	2.88	2.88	2.88
	HEIGHT, in	0.74	0.75	0.74
NORMAL STRESS, psf		754	1459	2960
FAILURE STRESS, psf		323	878	1079
DISPLACEMENT, in		0.16	0.20	0.18
ULTIMATE STRESS, psf		321	878	1068
DISPLACEMENT, in		0.13	0.21	0.13
Strain rate, %/min		0.00	0.00	0.00

SAMPLE TYPE: SHELBY
DESCRIPTION: WET ELASTIC SILT

LL= 85 PL= 42 PI= 43
SPECIFIC GRAVITY= 2.65
REMARKS:

Fig. No.: 1

CLIENT: DON WILLIAMS

PROJECT: SOUTH FORK CHEHALIS RIVER BRIDGE

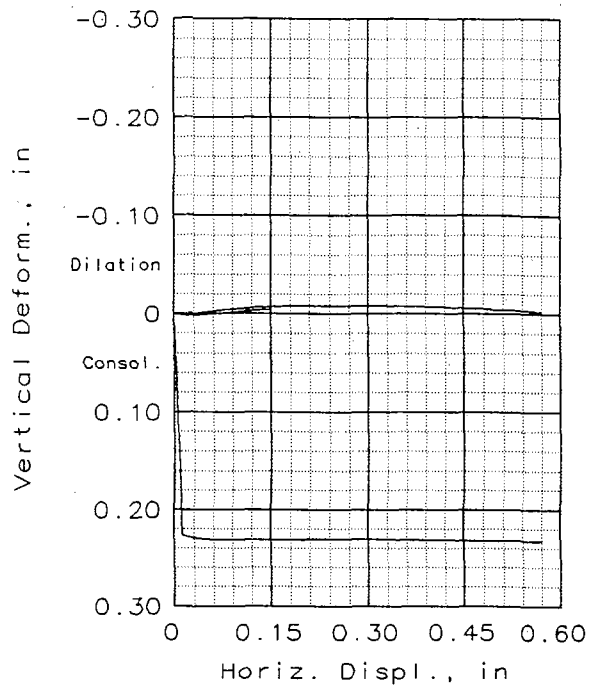
SAMPLE LOCATION: SR-6

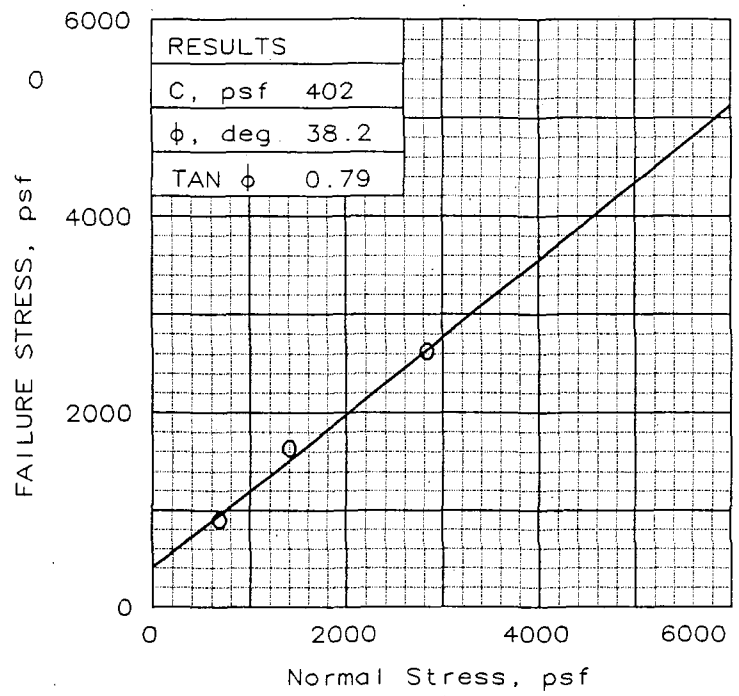
PROJ. NO.: OL-0911 DATE: 6/30/98

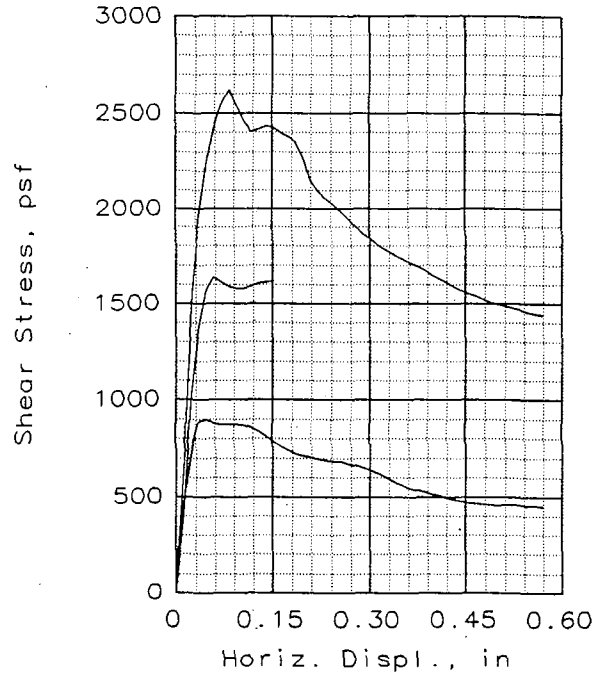
DIRECT SHEAR TEST REPORT

WASHINGTON STATE DOT

Data File F246053B







SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	43.2	43.2	43.2
	DRY DENSITY, pcf	71.0	70.9	69.6
	SATURATION, %	86.0	85.8	83.1
	VOID RATIO	1.331	1.334	1.376
	DIAMETER, in	2.88	2.88	2.88
	HEIGHT, in	0.74	0.74	0.73
AT TEST	WATER CONTENT, %	62.8	67.9	62.7
	DRY DENSITY, pcf	71.0	70.4	68.8
	SATURATION, %	124.9	133.2	118.1
	VOID RATIO	1.331	1.350	1.405
	DIAMETER, in	2.88	2.88	2.88
	HEIGHT, in	0.74	0.75	0.74
NORMAL STRESS, psf		725	1435	2865
FAILURE STRESS, psf		902	1638	2622
DISPLACEMENT, in		0.05	0.06	0.08
ULTIMATE STRESS, psf		871	1638	2416
DISPLACEMENT, in		0.11	0.06	0.13
Strain rate, %/min		0.00	0.00	0.00

SAMPLE TYPE: SHELBY TUBE
DESCRIPTION: WET ELASTIC SILT

LL= 85 PL= 42 PI= 43
SPECIFIC GRAVITY= 2.65
REMARKS:

Fig. No.: 1

CLIENT: DON WILLIAMS

PROJECT: SOUTH FORK CHEHALIS RIVER BRIDGE

SAMPLE LOCATION: SR-6

PROJ. NO.: OL-0911 DATE: 6/30/98

DIRECT SHEAR TEST REPORT

WASHINGTON STATE DOT

Data File F246053

Job No. **OL-0911** Date **June 26, 1998**

Hole No. **H-2A-98** Sheet **1** of **1**

Project **South Fork Chehalis River Bridge 6/115 Replacement**

Laboratory Summary

Washington State Department of Transportation

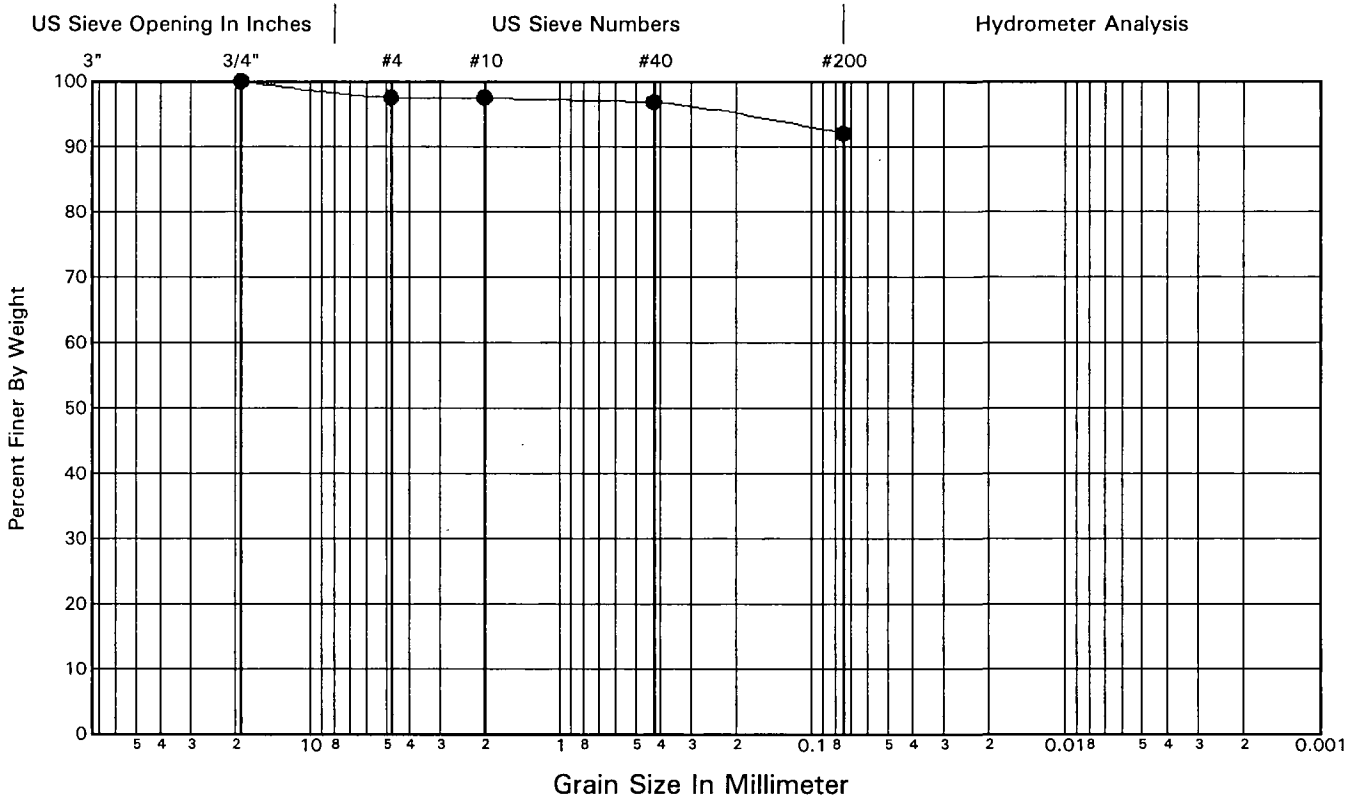
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	12.0	3.66	S-3	MH	SEE BORING LOG	ELASTIC SILT	43	85	42	43

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	2.5	5.5	92.0		

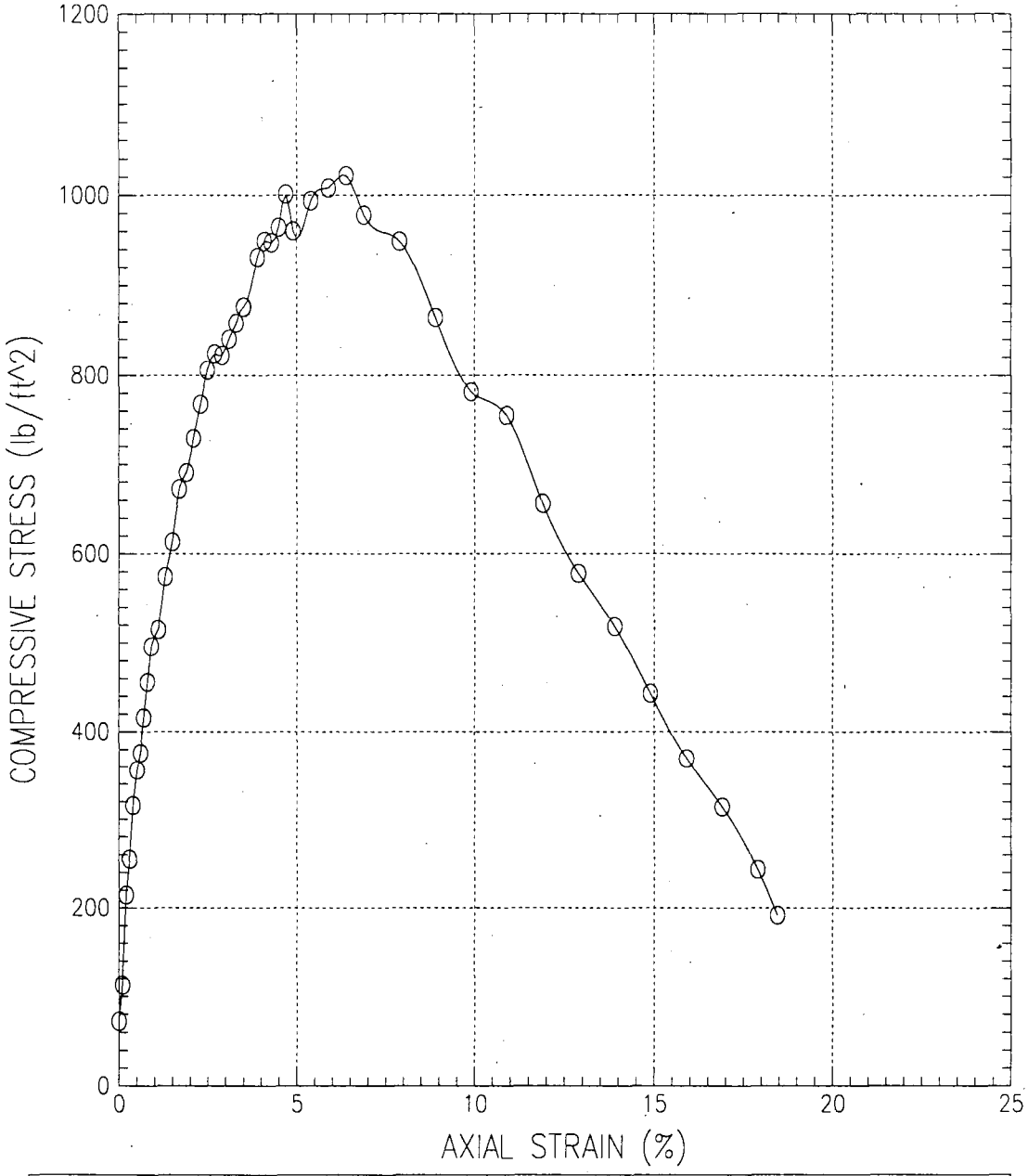
GRADATION VALUES

	D60	D50	D30	D20	D10
●					



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

UNCONFINED COMPRESSION TEST



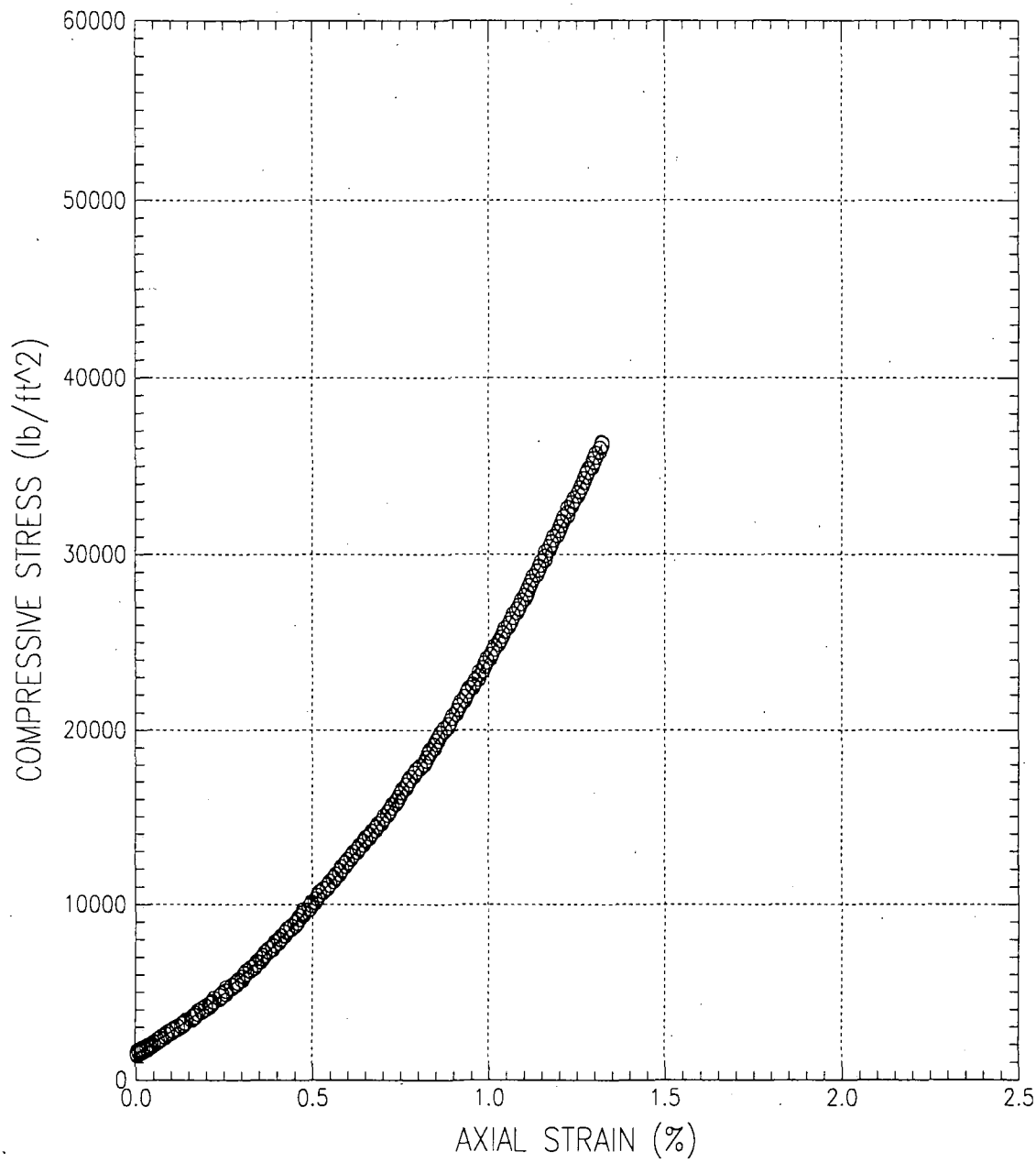
Project Name : S FK CHEHALIS R BR 6/115

Project No : OL-0911 Boring No : H-2-98 Sample No : C-3

Test Date : 4/10/98 Test No : 2451-3 Depth : 6.5'-10'

Description :

UNCONFINED COMPRESSION TEST



Project Name : S FK CHEALIS R BR

Project No : OL-0911 Boring No : H-2-97 Sample No : C-7

Test Date : 12/31/97 Test No : 2093-7 Depth : 30.65-31.2

Description : MOIST BRITTLE ROCK CORE

Washington State Department of Transportation
Materials Laboratory - Olympia Service Center
1655 South 2nd Ave, Tumwater, WA 98502, P O Box 7365, Olympia, WA 98504-7365

PCC Compressive Strength Test Report

Date Received: 01/02/1998
State Route No: 6
County: LEWIS
Project Title: CHEHALIS RIVER BRIDGE 6/115
Contractor:
Local Agency No:

Contract No: 0L0911
Lab Id No: 0000201205
Transmittal No: 162604
Bid Item No:
Org. Code: 442503
Federal Aid No: BR-00PE(91)
Lab No: J-05378

Material: *Cylinders*
Material Desc: ROCK CORES
Brand: ?
Date Made: 01/02/1997 **Hour Made:**
Sample Location: H-2-97 50.5' TO 55.5'
Station: **Ending Station:** **Offset:**
Sampled By: ?

AASHTO Test method T22

Cement: ? **Type:** ? **Cement Ship Cert. No:**
Mixing Plant: ? **Cement Wt:**
Place: ? **Water Gal / 100 Wt. of Cement:**
Gravel: ? **Air Ent. Admixture / 100 Wt:**
Sand: ? **Water Reducer Admixture / 100 Wt:**
Mix ID No: **High Range Admixture / 100 Wt:**
Date Tested: 01/02/1998 * **% Air:**
Scheduled Test Age: 28 days * **Approx Slump:** 0,00
Actual Test Age: 365 days **Class:** ?

Cylinder No:	C-13
Average Diameter (in):	2.39
Cross Section (sq. in):	4.49
Original Height (in):	5.02
Original Weight (lbs):	1.50
Mass (lbs/c.f.):	115.00
Maximum Load (lbs):	960
Comp. Strength (psi):	210
Fracture Type:	Shear

Average Comp. Strength (psi): 210

* tested by field personnel using test methods published in WSDOT Materials Manual.

Distribution:
X Materials File

Project Engineer:
X (2) OSC Mat Lab Geotech - Don Williams

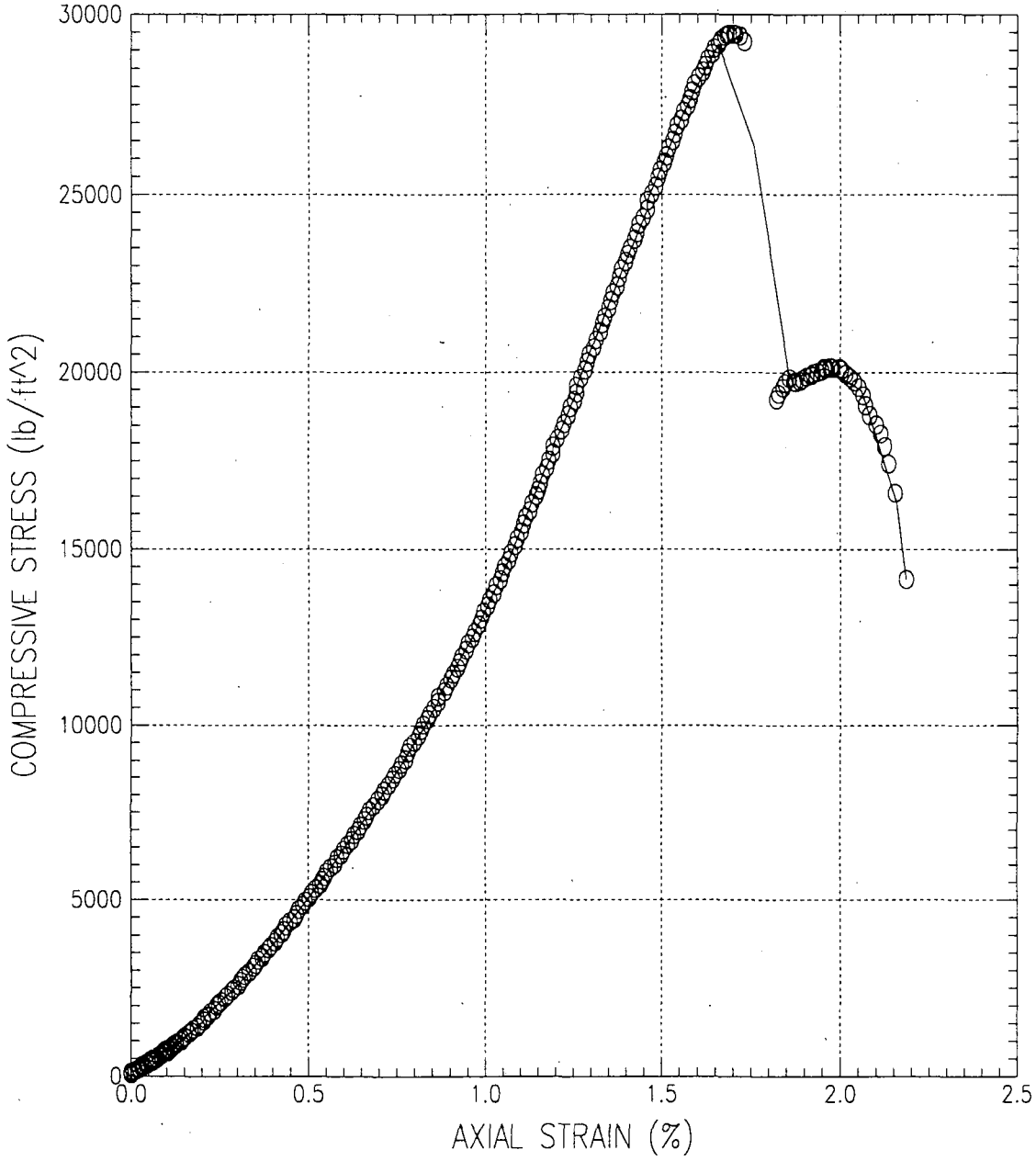
Results: Informational

Test Codes
T46E - 1

Dennis C. Jackson, P.E.
State Materials Engineer
David M. Jones, P.E.
Phone: (360) 709-5446

By:
Date: 01/05/1998

UNCONFINED COMPRESSION TEST



Project Name : S FK CHEHALIS R BRIDGE

Project No : OL-0911 Boring No : H-2-97 Sample No : C-16

Test Date : 1/2/98 Test No : 2093-16 Depth : 61.2-62'

Description :

Washington State Department of Transportation
Materials Laboratory - Olympia Service Center
1655 South 2nd Ave, Tumwater, WA 98502, P O Box 7365, Olympia, WA 98504-7365

PCC Compressive Strength Test Report

Date Received: 01/02/1998
State Route No: 6
County: LEWIS
Project Title: CHEHALIS RIVER BRIDGE 6/115
Contractor:
Local Agency No:

Contract No: 0L0911
Lab Id No: 0000201206
Transmittal No: 162604
Bid Item No:
Org. Code: 442503
Federal Aid No: BR-00PE(91)
Lab No: J-05379

Material: *Cylinders*
Material Desc: ROCK CORES
Brand: ?
Date Made: 01/02/1997 **Hour Made:**
Sample Location: H-3-97 40.2' TO 40.8'
Station: **Ending Station:** **Offset:**
Sampled By: ?

AASHTO Test method T22

Cement: ? **Type:** ? **Cement Ship Cert. No:**
Mixing Plant: ? **Cement Wt:**
Place: ? **Water Gal / 100 Wt. of Cement:**
Gravel: ? **Air Ent. Admixture / 100 Wt:**
Sand: ? **Water Reducer Admixture / 100 Wt:**
Mix ID No: **High Range Admixture / 100 Wt:**
Date Tested: 01/02/1998 * **% Air:**
Scheduled Test Age: 28 days * **Approx Slump:** 0.00
Actual Test Age: 365 days **Class:** ?

Cylinder No:	C-9
Average Diameter (in):	2.39
Cross Section (sq. in):	4.49
Original Height (in):	5.01
Original Weight (lbs):	1.51
Mass (lbs/c.f.):	115.99
Maximum Load (lbs):	1580
Comp. Strength (psi):	350
Fracture Type:	Columnar

Average Comp. Strength (psi): 350

* tested by field personnel using test methods published in WSDOT Materials Manual.

Distribution:
X Materials File

Project Engineer:
X (2) OSC Mat Lab Geotech - Don Williams

Results: Informational

Test Codes
T46E - 1

Dennis C. Jackson, P.E.
State Materials Engineer
David M. Jones, P.E.
Phone: (360) 709-5446

By:
Date: 01/05/1998

Washington State Department of Transportation
Materials Laboratory - Olympia Service Center
1655 South 2nd Ave, Tumwater, WA 98502, P O Box 7365, Olympia, WA 98504-7365

PCC Compressive Strength Test Report

Date Received: 01/06/1998
State Route No: 6
County: LEWIS
Project Title: CHEHALIS RIVER BRIDGE 6/115
Contractor:
Local Agency No:

Contract No: 0L0911
Lab Id No: 0000201215
Transmittal No: 162605
Bid Item No:
Org. Code: 442503
Federal Aid No: BR-00PE(91)
Lab No: J-05382

Material: *Cylinders*
Material Desc: ROCK CORE
Brand: ?
Date Made: 01/05/1997 **Hour Made:**
Sample Location: H-3-97, 55.5' - 56'
Station: **Ending Station:** **Offset:**
Sampled By: ?

AASHTO Test method T22

Cement: ? **Type:** ? **Cement Ship Cert. No:**
Mixing Plant: ? **Cement Wt:**
Place: ? **Water Gal / 100 Wt. of Cement:**
Gravel: ? **Air Ent. Admixture / 100 Wt:**
Sand: ? **Water Reducer Admixture / 100 Wt:**
Mix ID No: **High Range Admixture / 100 Wt:**
Date Tested: 01/06/1998 * **% Air:**
Scheduled Test Age: 0 days * **Approx Slump:**
Actual Test Age: 366 days **Class:** ?

Cylinder No:	**2084-14**
Average Diameter (in):	2.38
Cross Section (sq. in):	4.45
Original Height (in):	5.00
Original Weight (lbs):	1.50
Mass (lbs/c.f.):	116.49
Maximum Load (lbs):	1889
Comp. Strength (psi):	420
Fracture Type:	Columnar

Average Comp. Strength (psi): **420**

* tested by field personnel using test methods published in WSDOT Materials Manual.

Distribution:
X Materials File

Results: Informational

Project Engineer:
X (2) OSC Mat Lab Geotech - Don Williams

Test Codes
T46E - 1

Dennis C. Jackson, P.E.
State Materials Engineer

David M. Jones, P.E.
Phone: (360) 709-5446

By:
Date: 01/09/1998

Washington State Department of Transportation
Materials Laboratory - Olympia Service Center
1655 South 2nd Ave, Tumwater, WA 98502, P O Box 7365, Olympia, WA 98504-7365

PCC Compressive Strength Test Report

Date Received: 01/06/1998
State Route No: 6
County: LEWIS
Project Title: CHEHALIS RIVER BRIDGE 6/115
Contractor:
Local Agency No:

Contract No: 0L0911
Lab Id No: 0000201214
Transmittal No: 162605
Bid Item No:
Org. Code: 442503
Federal Aid No: BR-00PE(91)
Lab No: J-05381

Material: *Cylinders*
Material Desc: ROCK CORE
Brand: ?
Date Made: 01/05/1997 **Hour Made:**
Sample Location: H-5-97, 39.4' - 40'
Station: **Ending Station:** **Offset:**
Sampled By: ?

AASHTO Test method T22

Cement: ? **Type:** ? **Cement Ship Cert. No:**
Mixing Plant: ? **Cement Wt:**
Place: ? **Water Gal / 100 Wt. of Cement:**
Gravel: ? **Air Ent. Admixture / 100 Wt:**
Sand: ? **Water Reducer Admixture / 100 Wt:**
Mix ID No: **High Range Admixture / 100 Wt:**
Date Tested: 01/06/1998 * **% Air:**
Scheduled Test Age: 0 days * **Approx Slump:**
Actual Test Age: 366 days **Class:** ?

Cylinder No:	**2083-9**
Average Diameter (in):	2.38
Cross Section (sq. in):	4.45
Original Height (in):	5.00
Original Weight (lbs):	1.48
Mass (lbs/c.f.):	114.94
Maximum Load (lbs):	3141
Comp. Strength (psi):	710
Fracture Type:	Columnar

Average Comp. Strength (psi): **710**

* tested by field personnel using test methods published in WSDOT Materials Manual.

Distribution:
X Materials File

Results: Informational

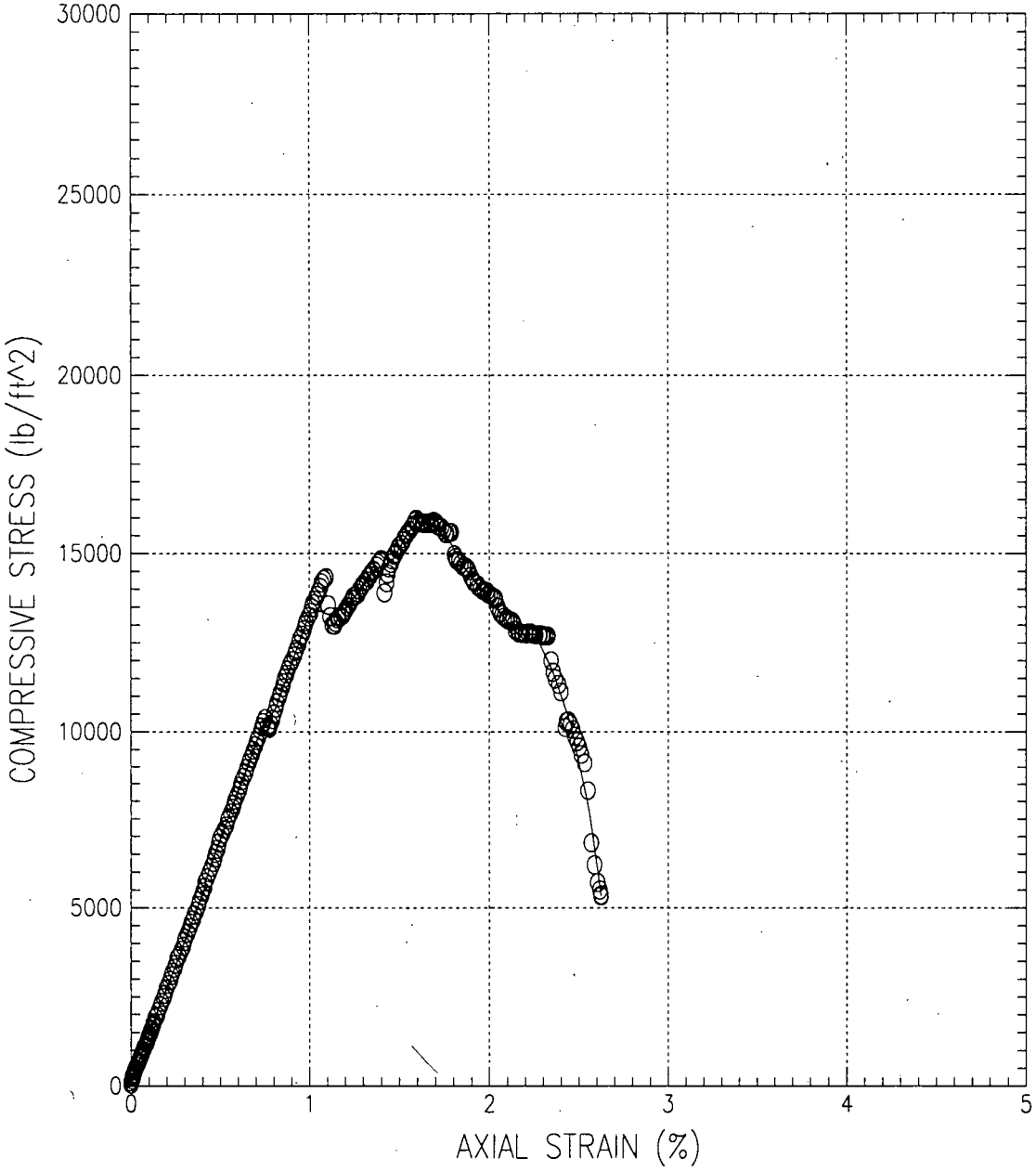
Project Engineer:
X (2) OSC Mat Lab Geotech - Don Williams

Test Codes
T46E - 1

Dennis C. Jackson, P.E.
State Materials Engineer
David M. Jones, P.E.
Phone: (360) 709-5446

By:
Date: 01/09/1998

UNCONFINED COMPRESSION TEST



Project Name : S FK CHEHALIS R BRIDGE

Project No : OL-0911 Boring No : H-6-97 Sample No : C-5

Test Date : 1/2/98 Test No : 2031-5 Depth : 21.6-22.2'

Description :

Washington State Department of Transportation
Materials Laboratory - Olympia Service Center
1655 South 2nd Ave, Tumwater, WA 98502, P O Box 7365, Olympia, WA 98504-7365

PCC Compressive Strength Test Report

Date Received: 04/14/1998
State Route No: 6
County: LEWIS
Project Title: CHEHALIS RIVER BRIDGE 6/115
Contractor:
Local Agency No:

Contract No: 0L0911
Lab Id No: 0000201791
Transmittal No: 162608
Bid Item No:
Org. Code: 442503
Federal Aid No: BR-00PE(91)
Lab No: J-05414

Material: *ROCK CORES*
Material Desc: ROCK CORES
Brand:
Date Made: 04/10/1998 **Hour Made:**
Sample Location: C-11, H-1-98
Station: **Ending Station:** **Offset:**
Sampled By: ?

AASHTO Test method T22

Cement: **Type:** **Cement Ship Cert. No:**
Mixing Plant: **Cement Wt:**
Place: **Water Gal / 100 Wt. of Cement:**
Gravel: **Air Ent. Admixture / 100 Wt:**
Sand: **Water Reducer Admixture / 100 Wt:**
Mix ID No: **High Range Admixture / 100 Wt:**
Date Tested: 04/14/1998 *** % Air:**
Scheduled Test Age: 28 days *** Approx Slump:**
Actual Test Age: 4 days **Class:**

Cylinder No:	C-11
Average Diameter (in):	2.28
Cross Section (sq. in):	4.08
Original Height (in):	4.94
Original Weight (lbs):	1.33
Mass (lbs/c.f.):	114.03
Maximum Load (lbs):	1993
Comp. Strength (psi):	490
Fracture Type:	Columnar

Average Comp. Strength (psi): 490

* Results reported by field testing personnel using test methods published in WSDOT Materials Manual.

Distribution:
X Materials File

Results: Informational

Project Engineer:
X (2) OSC Mat Lab Geotech - Don Williams

Test Codes
T46E - 1

Dennis C. Jackson, P.E.
State Materials Engineer
David M. Jones, P.E.
Phone: (360) 709-5446

By: DMJ
Date: 04/15/1998

Washington State Department of Transportation
Materials Laboratory - Olympia Service Center
1655 South 2nd Ave, Tumwater, WA 98502, P O Box 7365, Olympia, WA 98504-7365

PCC Compressive Strength Test Report

Date Received: 04/14/1998
State Route No: 6
County: LEWIS
Project Title: CHEHALIS RIVER BRIDGE 6/115
Contractor:
Local Agency No:

Contract No: 0L0911
Lab Id No: 0000201792
Transmittal No: 162608
Bid Item No:
Org. Code: 442503
Federal Aid No: BR-00PE(91)
Lab No: J-05415

Material: *ROCK CORES*
Material Desc: ROCK CORES
Brand:
Date Made: 04/10/1998 **Hour Made:**
Sample Location: C-18, H-1-98
Station: **Ending Station:** **Offset:**
Sampled By: ?

AASHTO Test method T22

Cement: **Type:** **Cement Ship Cert. No:**
Mixing Plant: **Cement Wt:**
Place: **Water Gal / 100 Wt. of Cement:**
Gravel: **Air Ent. Admixture / 100 Wt:**
Sand: **Water Reducer Admixture / 100 Wt:**
Mix ID No: **High Range Admixture / 100 Wt:**
Date Tested: 04/14/1998 *** % Air:**
Scheduled Test Age: 28 days *** Approx Slump:**
Actual Test Age: 4 days **Class:**

Cylinder No:	C-18
Average Diameter (in):	2.35
Cross Section (sq. in):	4.34
Original Height (in):	5.14
Original Weight (lbs):	1.54
Mass (lbs/c.f.):	119.29
Maximum Load (lbs):	4213
Comp. Strength (psi):	970
Fracture Type:	Columnar

Average Comp. Strength (psi): 970

* Results reported by field testing personnel using test methods published in WSDOT Materials Manual.

Distribution:
X Materials File

Results: Informational

Project Engineer:
X (2) OSC Mat Lab Geotech - Don Williams

Test Codes
T46E - 1

Dennis C. Jackson, P.E.
State Materials Engineer
David M. Jones, P.E.
Phone: (360) 709-5446

By: [signature]
Date: 04/15/1998

Washington State Department of Transportation
Materials Laboratory - Olympia Service Center
1655 South 2nd Ave, Tumwater, WA 98502, P O Box 7365, Olympia, WA 98504-7365

PCC Compressive Strength Test Report

Date Received: 04/14/1998
State Route No: 6
County: LEWIS
Project Title: CHEHALIS RIVER BRIDGE 6/115
Contractor:
Local Agency No:

Contract No: 0L0911
Lab Id No: 0000201793
Transmittal No: 162608
Bid Item No:
Org. Code: 442503
Federal Aid No: BR-00PE(91)
Lab No: J-05416

Material: *ROCK CORES*
Material Desc: ROCK CORES
Brand:
Date Made: 04/10/1998 **Hour Made:**
Sample Location: C-29, H-1-98
Station: **Ending Station:** **Offset:**
Sampled By: ?

AASHTO Test method T22

Cement: **Type:** **Cement Ship Cert. No:**
Mixing Plant: **Cement Wt:**
Place: **Water Gal / 100 Wt. of Cement:**
Gravel: **Air Ent. Admixture / 100 Wt:**
Sand: **Water Reducer Admixture / 100 Wt:**
Mix ID No: **High Range Admixture / 100 Wt:**
Date Tested: 04/14/1998 * **% Air:**
Scheduled Test Age: 28 days * **Approx Slump:**
Actual Test Age: 4 days **Class:**

Cylinder No:	C-29
Average Diameter (in):	2.35
Cross Section (sq. in):	4.34
Original Height (in):	5.04
Original Weight (lbs):	1.50
Mass (lbs/c.f.):	118.50
Maximum Load (lbs):	4738
Comp. Strength (psi):	1090
Fracture Type:	Columnar

Average Comp. Strength (psi): **1090**

* Results reported by field testing personnel using test methods published in WSDOT Materials Manual.

Distribution:
X Materials File

Results: Informational

Project Engineer:
X (2) OSC Mat Lab Geotech - Don Williams

Test Codes
T46E - 1

Dennis C. Jackson, P.E.
State Materials Engineer
David M. Jones, P.E.
Phone: (360) 709-5446

By:
Date: 04/15/1998

Washington State Department of Transportation
Materials Laboratory - Olympia Service Center
1655 South 2nd Ave, Tumwater, WA 98502, P O Box 7365, Olympia, WA 98504-7365

PCC Compressive Strength Test Report

Date Received: 04/14/1998
State Route No: 6
County: LEWIS
Project Title: CHEHALIS RIVER BRIDGE 6/115
Contractor:
Local Agency No:

Contract No: 0L0911
Lab Id No: 0000201795
Transmittal No: 162609
Bid Item No:
Org. Code: 442503
Federal Aid No: BR-00PE(91)
Lab No: J-05418

Material: *ROCK CORES*
Material Desc: ROCK CORES
Brand:
Date Made: 04/10/1998 **Hour Made:**
Sample Location: C-10, H-2-98
Station: **Ending Station:** **Offset:**
Sampled By: ?

AASHTO Test method T22

Cement: **Type:** **Cement Ship Cert. No:**
Mixing Plant: **Cement Wt:**
Place: **Water Gal / 100 Wt. of Cement:**
Gravel: **Air Ent. Admixture / 100 Wt:**
Sand: **Water Reducer Admixture / 100 Wt:**
Mix ID No: **High Range Admixture / 100 Wt:**
Date Tested: 04/14/1998 *** % Air:**
Scheduled Test Age: 28 days *** Approx Slump:**
Actual Test Age: 4 days **Class:**

Cylinder No:	C-10
Average Diameter (in):	2.38
Cross Section (sq. in):	4.45
Original Height (in):	5.08
Original Weight (lbs):	1.46
Mass (lbs/c.f.):	111.60
Maximum Load (lbs):	2995
Comp. Strength (psi):	670
Fracture Type:	Columnar

Average Comp. Strength (psi): 670

* Results reported by field testing personnel using test methods published in WSDOT Materials Manual.

Distribution:
X Materials File

Results: Informational

Project Engineer:
X (2) OSC Mat Lab Geotech - Don Williams

Test Codes
T46E - 1

Dennis C. Jackson, P.E.
State Materials Engineer
David M. Jones, P.E.
Phone: (360) 709-5446

By: [signature]
Date: 04/15/1998

Washington State Department of Transportation
Materials Laboratory - Olympia Service Center
1655 South 2nd Ave, Tumwater, WA 98502, P O Box 7365, Olympia, WA 98504-7365

PCC Compressive Strength Test Report

Date Received: 04/14/1998
State Route No: 6
County: LEWIS
Project Title: CHEHALIS RIVER BRIDGE 6/115
Contractor:
Local Agency No:

Contract No: 0L0911
Lab Id No: 0000201796
Transmittal No: 162609
Bid Item No:
Org. Code: 442503
Federal Aid No: BR-00PE(91)
Lab No: J-05419

Material: *ROCK CORES*
Material Desc: ROCK CORES
Brand:
Date Made: 04/10/1998 **Hour Made:**
Sample Location: C-13, H-2-98
Station: **Ending Station:** **Offset:**
Sampled By: ?

AASHTO Test method T22

Cement: **Type:** **Cement Ship Cert. No:**
Mixing Plant: **Cement Wt:**
Place: **Water Gal / 100 Wt. of Cement:**
Gravel: **Air Ent. Admixture / 100 Wt:**
Sand: **Water Reducer Admixture / 100 Wt:**
Mix ID No: **High Range Admixture / 100 Wt:**
Date Tested: 04/14/1998 *** % Air:**
Scheduled Test Age: 28 days *** Approx Slump:**
Actual Test Age: 4 days **Class:**

Cylinder No:	C-13
Average Diameter (in):	2.28
Cross Section (sq. in):	4.08
Original Height (in):	5.04
Original Weight (lbs):	1.34
Mass (lbs/c.f.):	112.61
Maximum Load (lbs):	2563
Comp. Strength (psi):	630
Fracture Type:	Columnar

Average Comp. Strength (psi): 630

* Results reported by field testing personnel using test methods published in WSDOT Materials Manual.

Distribution:
X Materials File

Results: Informational

Project Engineer:
X (2) OSC Mat Lab Geotech - Don Williams

Test Codes
T46E - 1

Dennis C. Jackson, P.E.
State Materials Engineer
David M. Jones, P.E.
Phone: (360) 709-5446

By: [signature]
Date: 04/15/1998

Washington State Department of Transportation
Materials Laboratory - Olympia Service Center
1655 South 2nd Ave, Tumwater, WA 98502, P O Box 7365, Olympia, WA 98504-7365

PCC Compressive Strength Test Report

Date Received: 04/14/1998
State Route No: 6
County: LEWIS
Project Title: CHEHALIS RIVER BRIDGE 6/115
Contractor:
Local Agency No:

Contract No: 0L0911
Lab Id No: 0000201794
Transmittal No: 162607
Bid Item No:
Org. Code: 442503
Federal Aid No: BR-00PE(91)
Lab No: J-05417

Material: *ROCK CORES*
Material Desc: ROCK CORES
Brand:
Date Made: 04/09/1998 **Hour Made:**
Sample Location: C-28, H-2-98
Station: **Ending Station:** **Offset:**
Sampled By: ?

AASHTO Test method T22

Cement: **Type:** **Cement Ship Cert. No:**
Mixing Plant: **Cement Wt:**
Place: **Water Gal / 100 Wt. of Cement:**
Gravel: **Air Ent. Admixture / 100 Wt:**
Sand: **Water Reducer Admixture / 100 Wt:**
Mix ID No: **High Range Admixture / 100 Wt:**
Date Tested: 04/14/1998 *** % Air:**
Scheduled Test Age: 28 days *** Approx Slump:**
Actual Test Age: 5 days **Class:**

Cylinder No:	C-28
Average Diameter (in):	2.39
Cross Section (sq. in):	4.49
Original Height (in):	4.90
Original Weight (lbs):	1.52
Mass (lbs/c.f.):	119.38
Maximum Load (lbs):	3784
Comp. Strength (psi):	840
Fracture Type:	Shear

Average Comp. Strength (psi): 840

* Results reported by field testing personnel using test methods published in WSDOT Materials Manual.

Distribution:
X Materials File

Results: Informational

Project Engineer:
X (2) OSC Mat Lab Geotech - Don Williams

Test Codes
T46E - 1

Dennis C. Jackson, P.E.
State Materials Engineer
David M. Jones, P.E.
Phone: (360) 709-5446

By:
Date: 04/15/1998

APPENDIX - D

Hillside Drainage

Figure D-1: Approximate Limits of Hillside Drainage

Figure D-2: Typical Cross Section for Interceptor Trench Option

Figure D-3: Typical Interceptor Trench Section

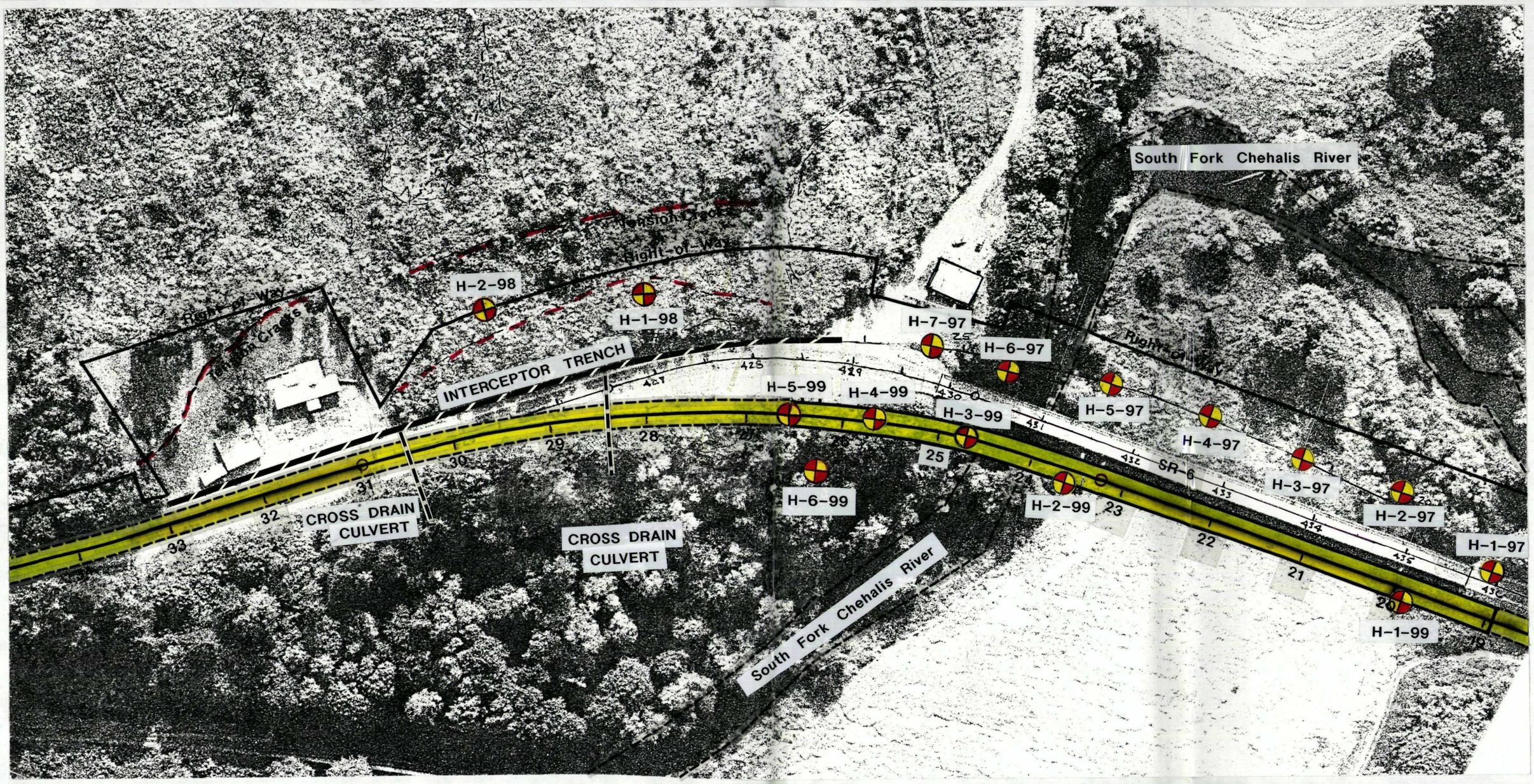


FIGURE D-1: APPROXIMATE LIMITS OF HILLSIDE DRAINAGE

JOB OL-0911 S.R. 006 C.S. 2105 LAYOUT

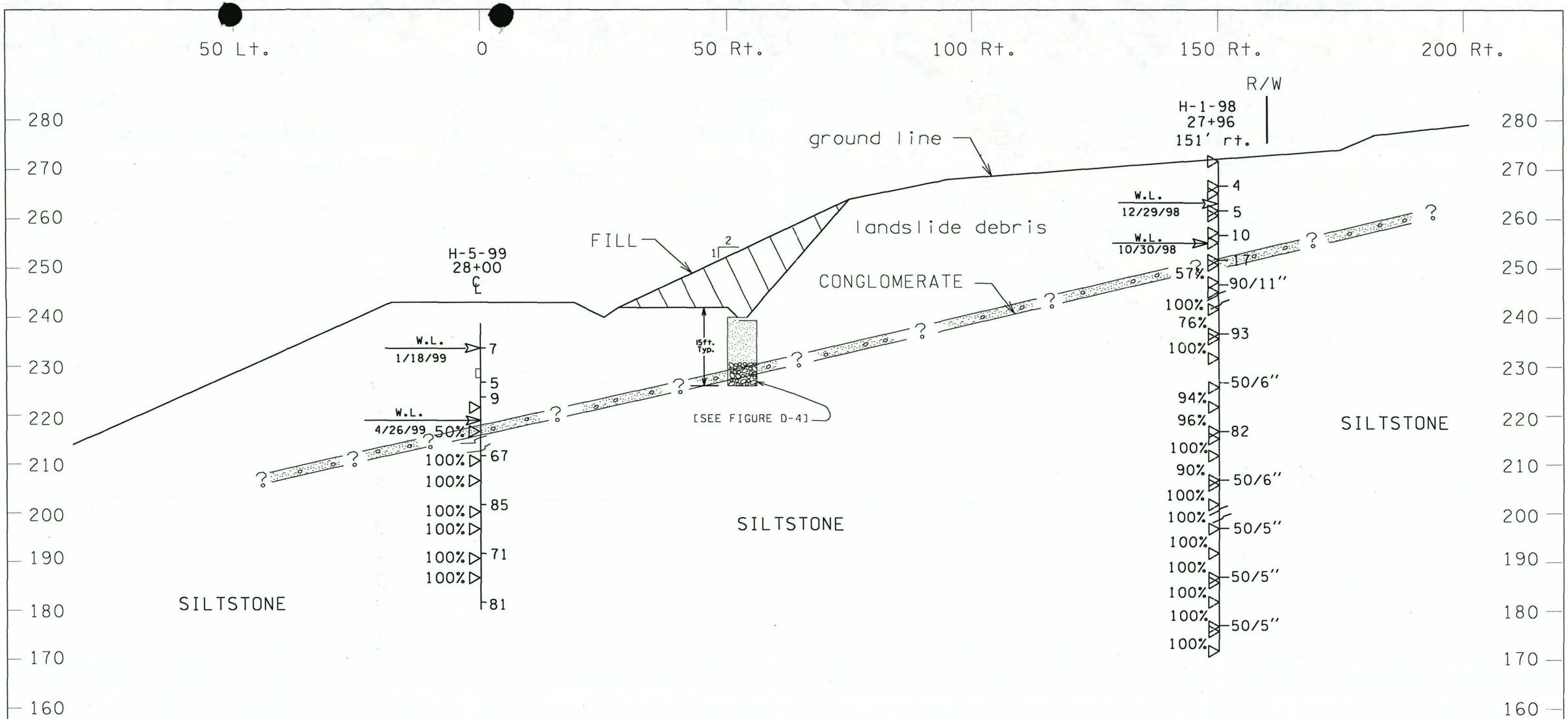
SOUTH FORK CHEHALIS RIVER BRIDGE

MP 42.48 to MP 42.91

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
D. C. JACKSON MATERIALS ENGINEER

DATE 5/99
SCALE 1" = 100' VERT.
1" = 100' HORIZ.
SHEET ___ OF ___
DRAWN BY W. M.

c:\dgn\ol-0911\sr6_bsd.dgn May. 13, 1999 14:41:32



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

FIGURE D-2: TYPICAL CROSS SECTION FOR INTERCEPTOR TRENCH STATION 26+00 TO STATION 33+00

JOB OL-0911 S.R. 006 C.S. 2105 LAYOUT

SOUTH FORK CHEHALIS RIVER BRIDGE

MP 42.48 to MP 42.91

WASHINGTON STATE TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
D. C. JACKSON MATERIALS ENGINEER

DATE 5/99
SCALE 1"=20' VERT. 1"=20' HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

e:\ol-0911\sr6_bsd.dgn Jul. 01, 1999 09:47:22

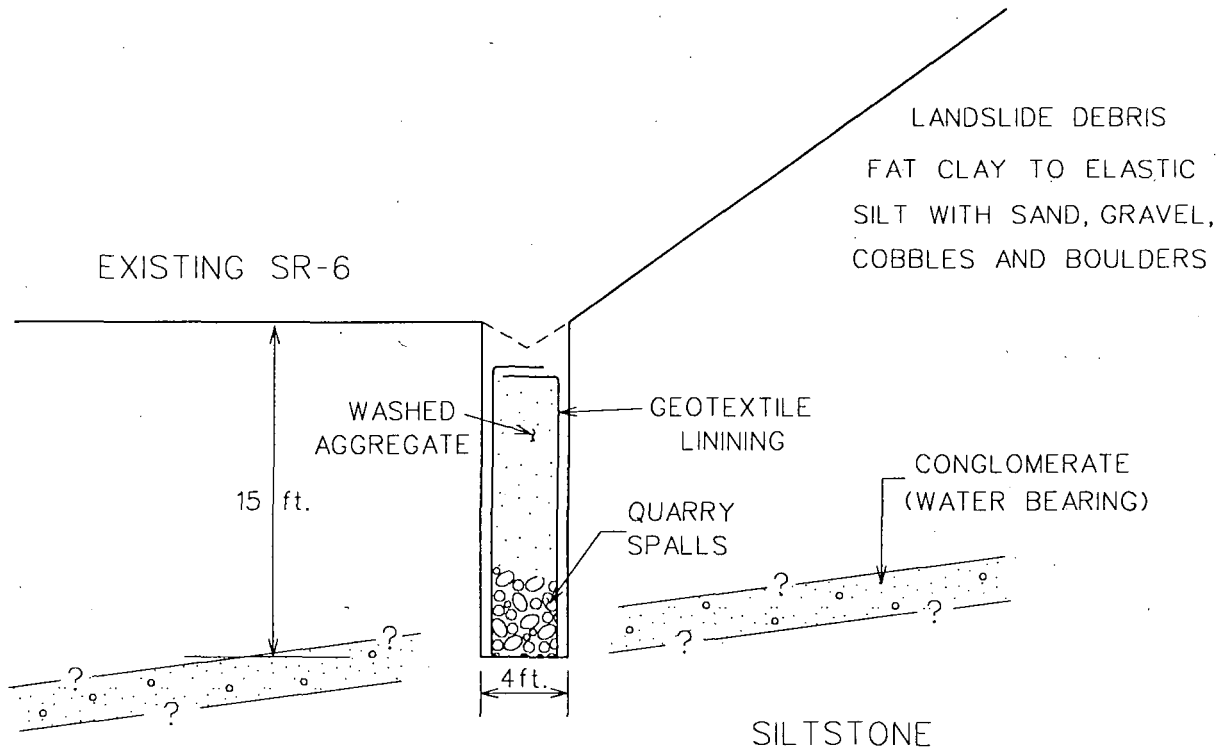


FIGURE D-3: TYPICAL INTERCEPTOR TRENCH SECTION

JOB OL-0911 S.R. 006 C.S. 2105

SOUTH FORK CHEHALIS RIVER BRIDGE

MP 42.48 to MP 42.91

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
D. C. JACKSON MATERIALS ENGINEER

DATE 5/99
SCALE 1" = 10' VERT.
1" = 10' HORIZ.
SHEET ___ OF ___
DRAWN BY W.M.

e:\ol-0911\sr6_bsd.dgn Jul. 01, 1999 09:30:43

APPENDIX - E

Drilled Shaft Design Curves

Figure E-1: Piers 1 to 6 - Ultimate Vertical Capacity

Figure E-2: Piers 1 to 6 - Ultimate Uplift Capacity

Figure E-3: Pier 7 - Ultimate Vertical Capacity

Figure E-4: Pier 7 - Ultimate Uplift Capacity

Figure E-5: Pier 8 - Ultimate Vertical Capacity

Figure E-6: Pier 8 - Ultimate Uplift Capacity

Figure E-7: P-Y Curve Soil Data

Figure E-8: Typical Earth Pressure for Soldier Pile Wall Station 26+50 to Station 27+25

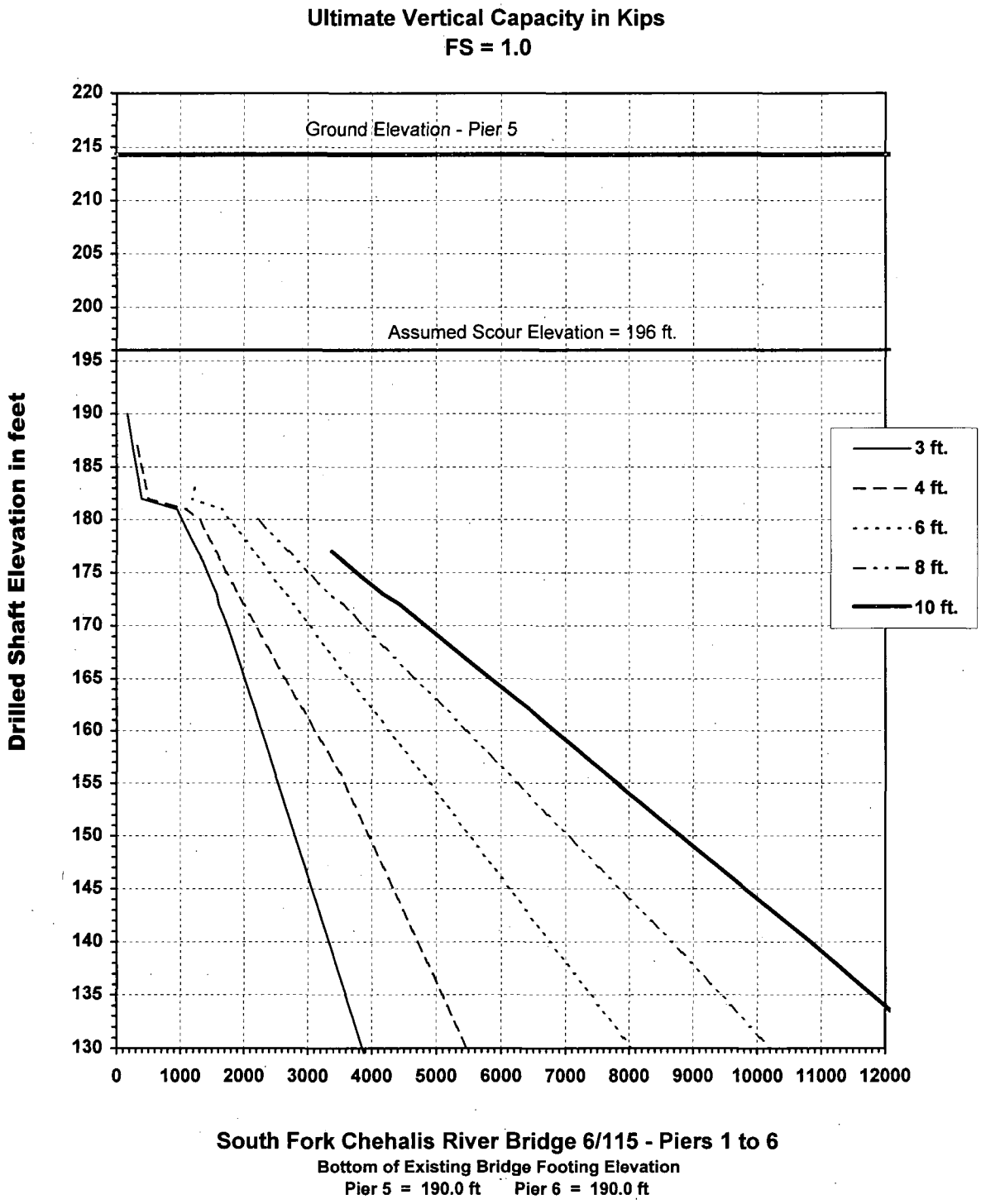
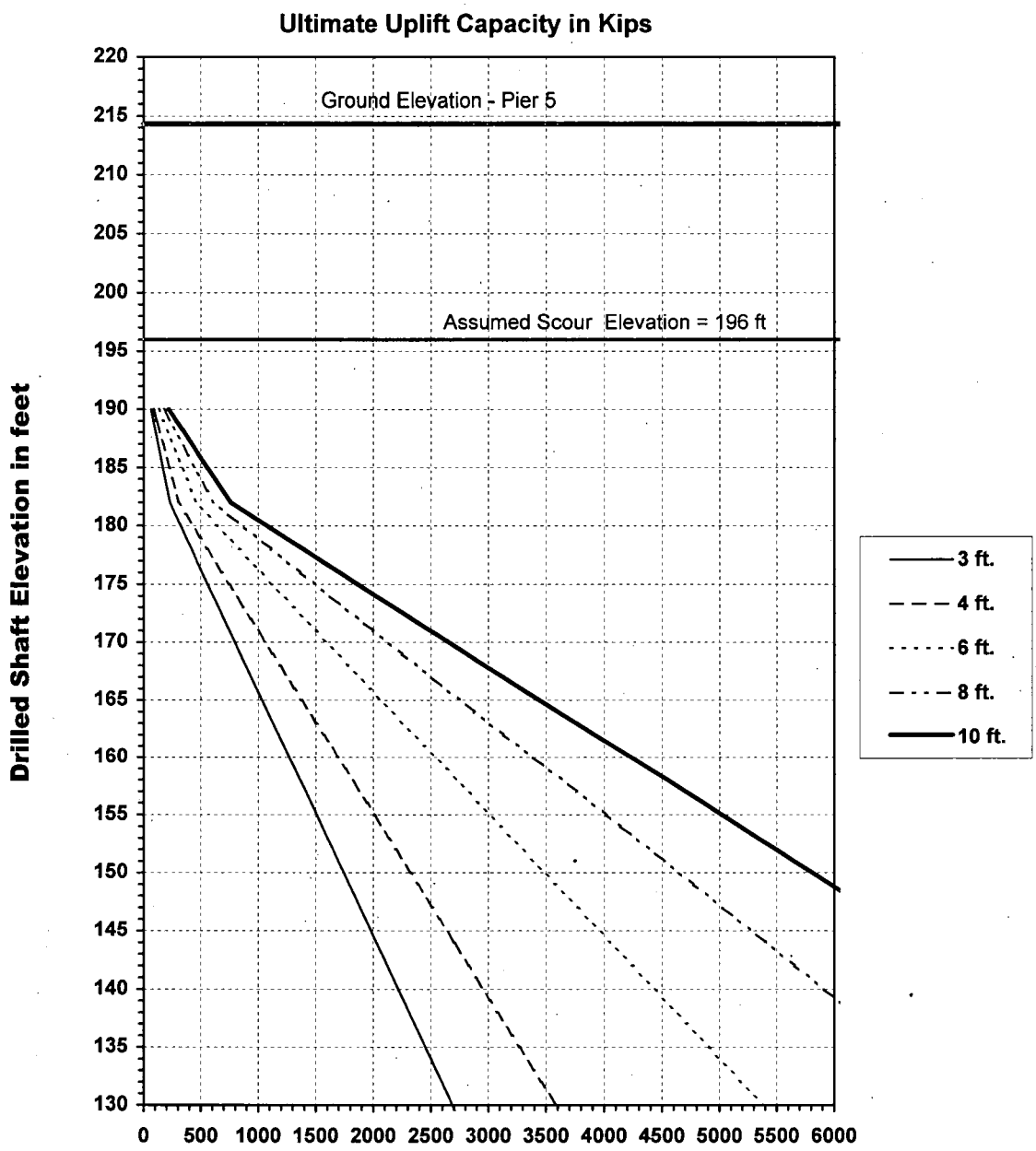


FIGURE E-1: Drilled Shaft Design Curves



South Fork Cehalis River Bridge 6/115 - Piers 1 to 6

Bottom of Existing Bridge Footing Elevation

Pier 5 = 190.0 ft Pier 6 = 190.0 ft

FIGURE E-2: Drilled Shaft Design Curves

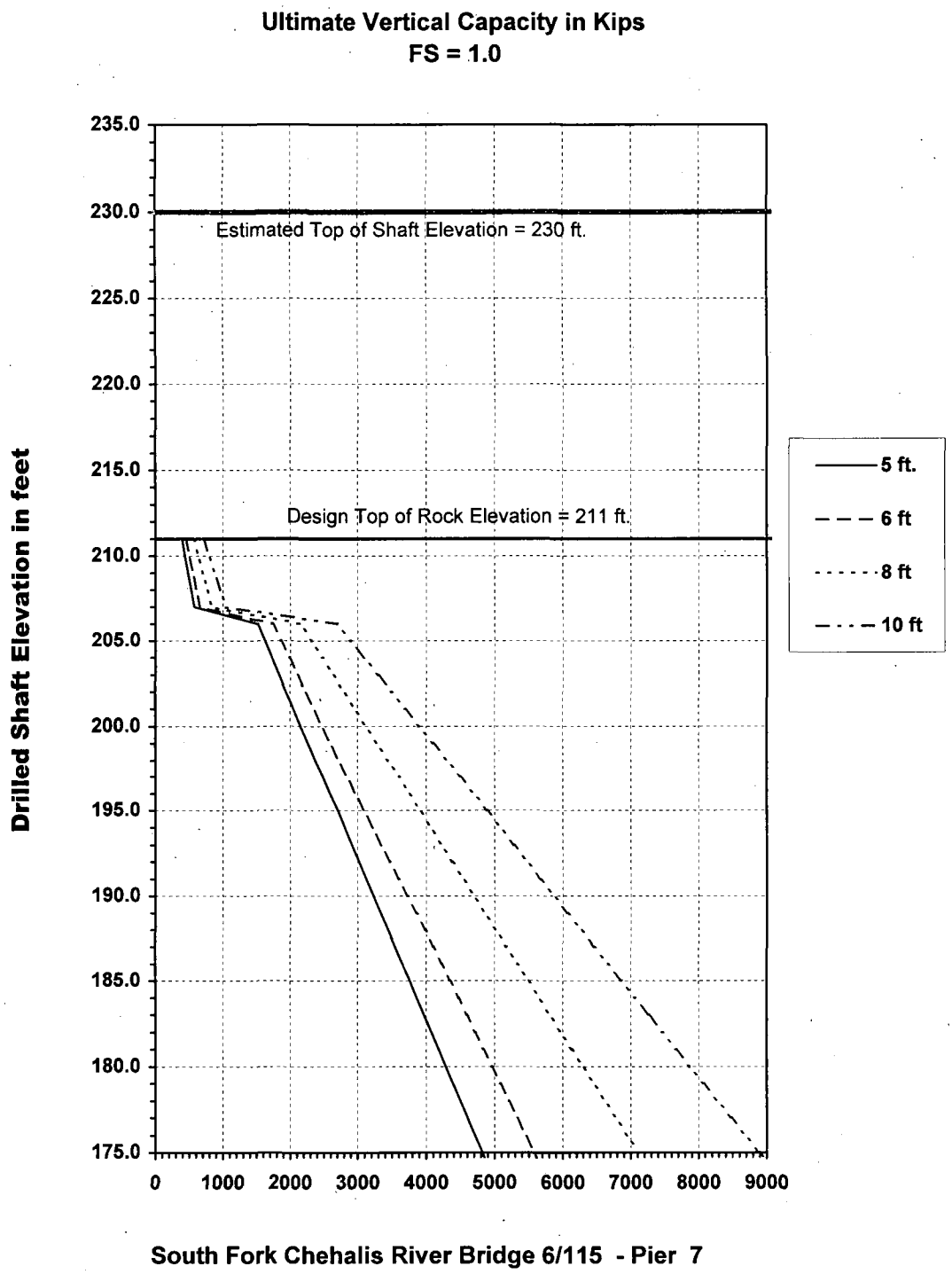
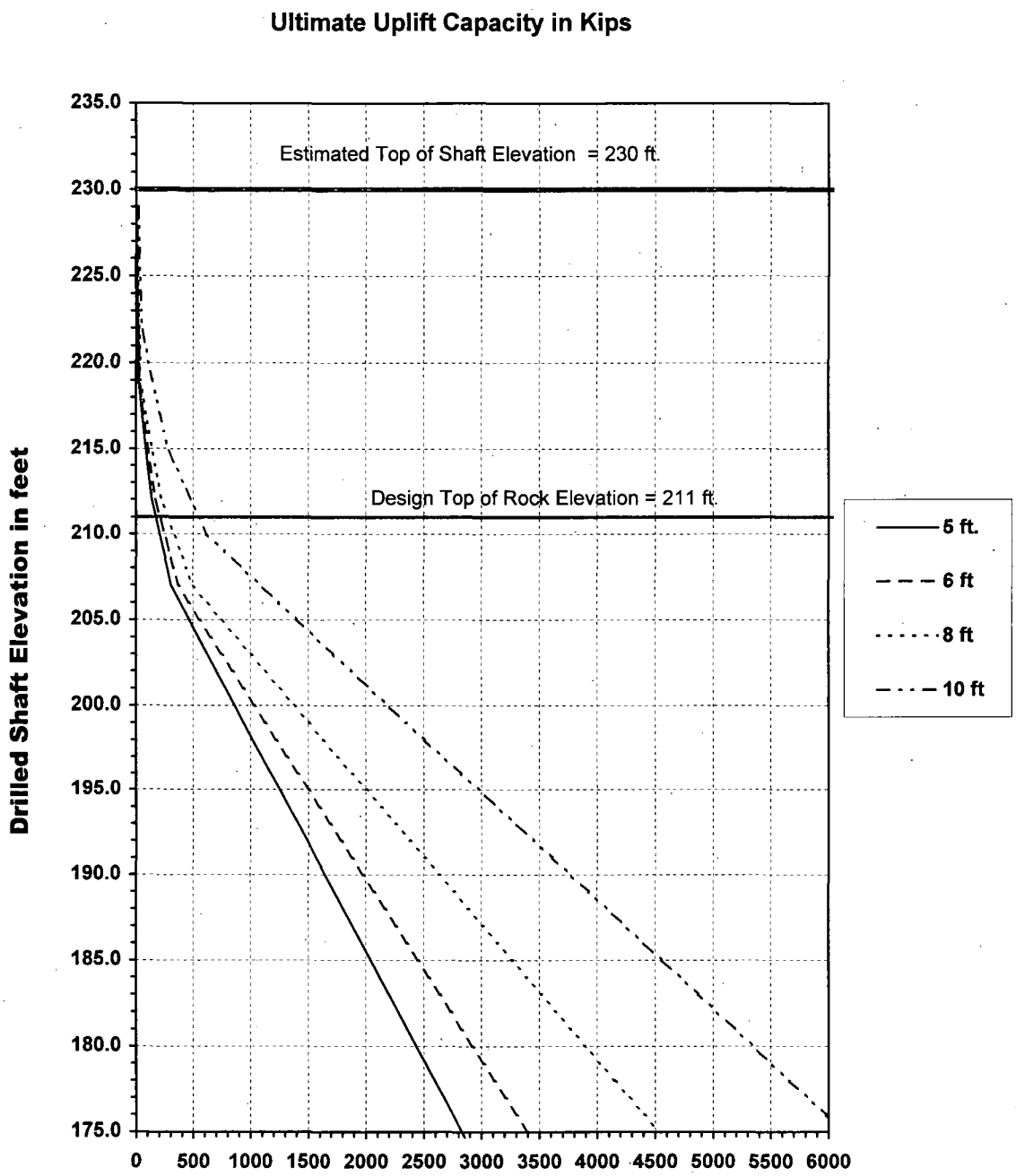


FIGURE E-3: Drilled Shaft Design Curves



South Fork Chehalis River Bridge 6/115 - Pier 7

FIGURE E-4: Drilled Shaft Design Curves

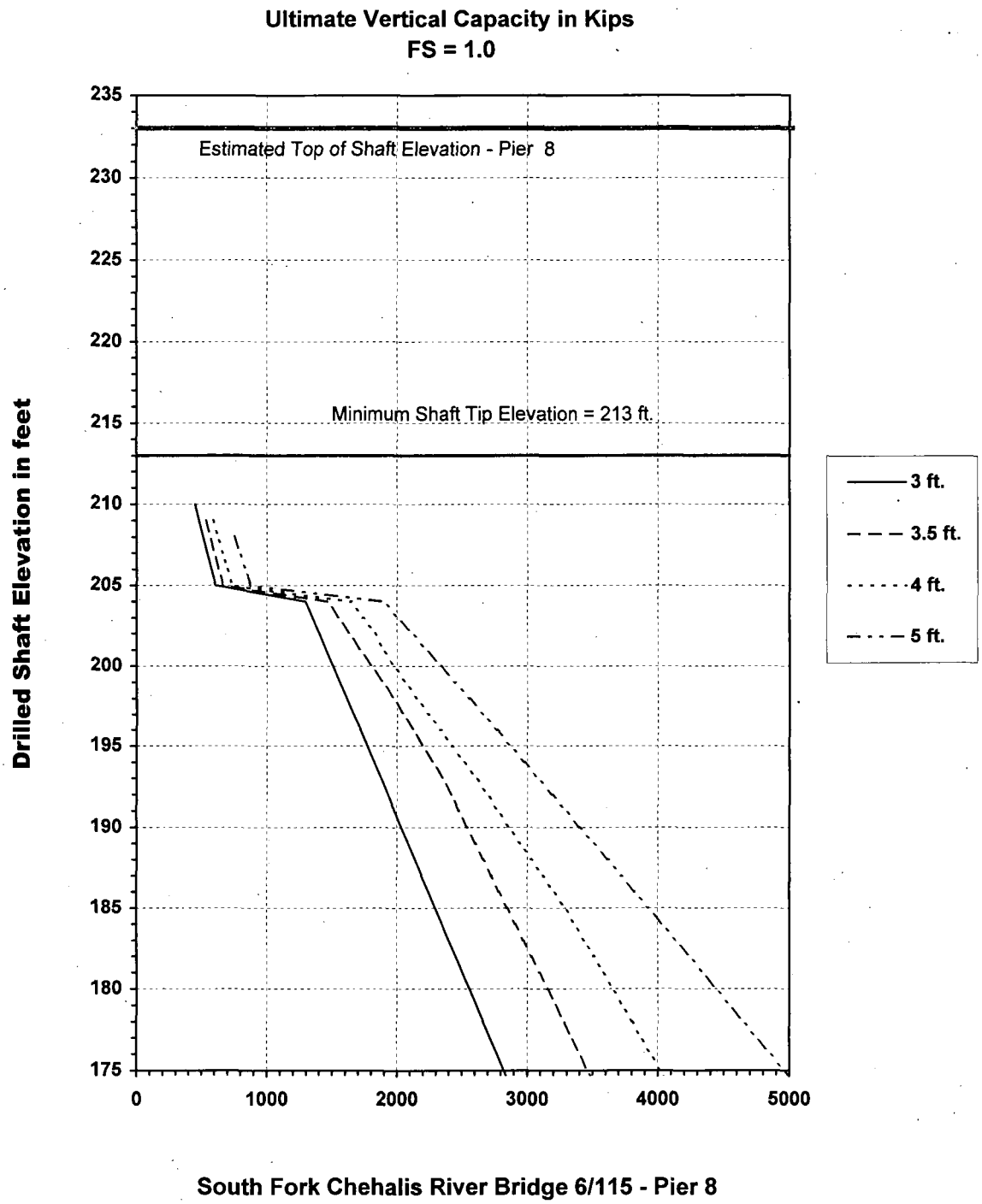
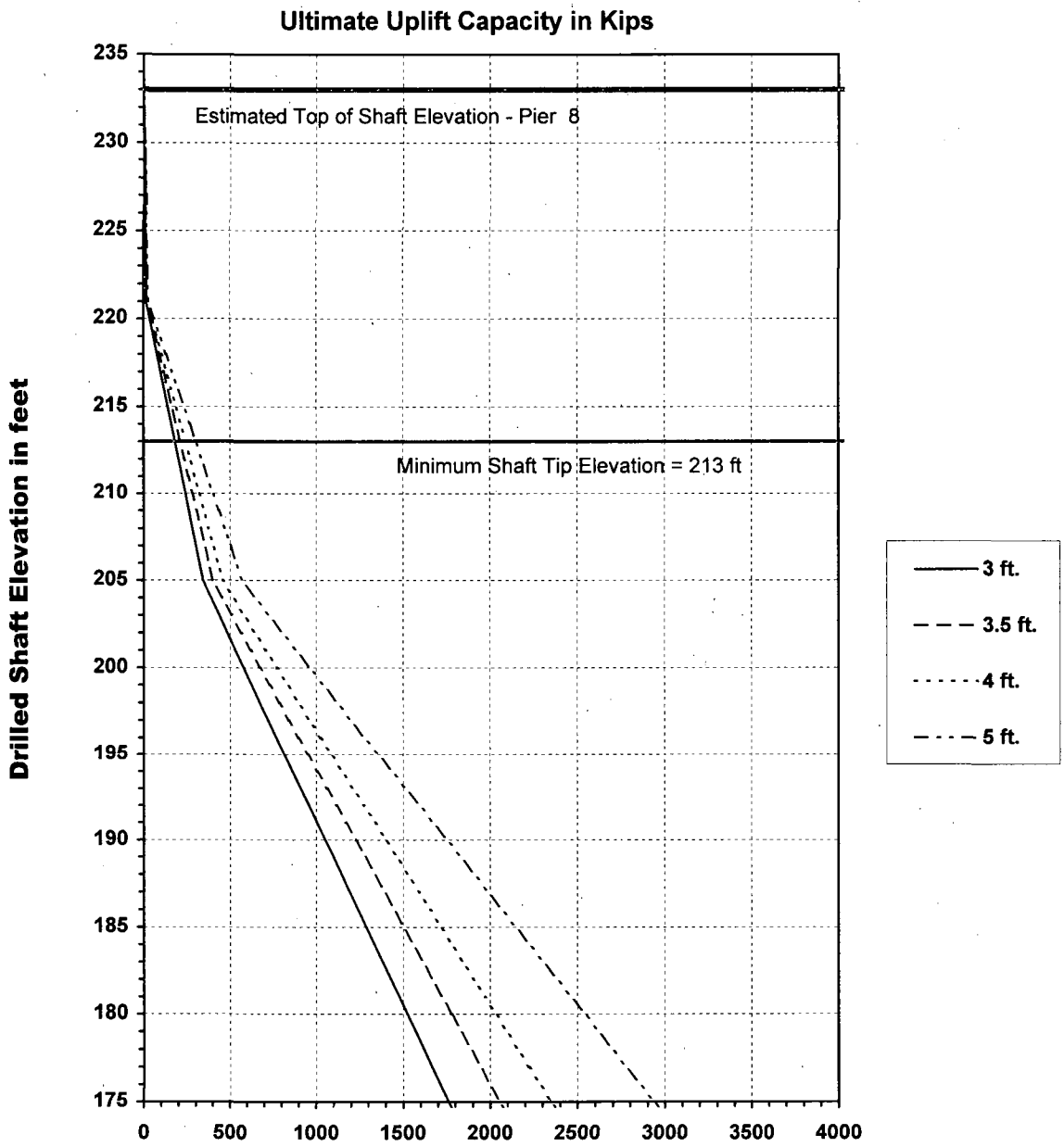


FIGURE E-5: Drilled Shaft Design Curves



South Fork Cehalis River Bridge 6/115 - Pier 8

FIGURE E-6: Drilled Shaft Design Curves

SR-6 MP 42.48 to MP 42.91

South Fork Chehalis River Bridge 6/115 Replacement

P-Y Curve Data

Static and Dynamic Conditions

Pier No.	Gound Elevation (ft.)	Soil/Rock Layer	Soil/Rock Type (KSOIL #)	Depth to Bottom of layer (ft.)	Depth to Bottom of layer (in.)	Effective Unit Wt. (pcf)	Cohesion (psf)	Axial Strain ε_{50}	Friction Angle (Φ) (deg.)	Shear Strength S_u (psi)	Young's Modulus E_s (ksi)	Modulus of Subgrade Reaction (k) (lb/in^3)
1	218.1	1	Sand (# 4)	14.3	172	105.0			30			45
		2	Sand (# 4)	15.0	180	42.6			30			33
		3	Sand (# 4)	25.0	300	62.6			35			80
		4	Elastic *	35.0	420	110.0	8,000			111	10	
		5	Elastic *	86.0	1032	114.5	18,500			258	40	
2	211.1	1	Sand (# 4)	7.3	88	100.0			28			20
3	213.1	2	Sand (# 4)	13.0	156	37.6			28			10
4	211.8	3	Sand (# 4)	22.0	264	72.6			38			105
		4	Elastic *	26.0	312	110.0	8,000			111	10	
		5	Elastic *	86.0	1032	114.5	18,500			258	40	
5	214.3	1	Sand (# 4)	7.3	88	100.0			28			20
		2	Sand (# 4)	13.0	156	37.6			28			10
		3	Sand (# 4)	22.0	264	72.6			38			105
		4	Elastic *	26.0	312	110.0	8,000			111	10	
		5	Elastic *	86.0	1032	114.5	18,500			258	40	
6	210.3	1	Soft Clay (# 1)	3.0	36	104.0	470	0.014				
		2	Soft Clay (# 1)	11.0	132	41.6	470	0.014				
		4	Elastic *	21.0	252	110.0	8,000			111	10	
		5	Elastic *	86.0	1032	114.5	18,500			258	40	
7	231.9	1	Soft Clay (# 1)	5.0	60	104.0	470	0.014				
		2	Soft Clay (# 1)	13.0	156	41.6	470	0.014				
		3	Sand (# 4)	21.0	252	72.6			38			105
		4	Elastic *	25.0	300	110.0	8,000			111	10	
		5	Elastic *	86.0	1032	114.5	18,500			258	40	
8	238.2	1	Soft Clay (# 1)	16.0	192	104.8	640	0.007				30
		2	Soft Clay (# 1)	17.0	204	42.4	640	0.007				30
		3	Sand (# 4)	21.0	252	72.6			38			105
		4	Elastic *	33.0	396	110.0	8,000			111	10	
		5	Elastic *	86.0	1032	114.5	18,500			258	40	

* User defined Model

Elastic P-Y Curve used for Siltstone Bedrock

Su = Unconfined Compressive Strength (equals twice the cohesion)

Es = Young's Modulus = σ/ε

Maximum Allowed Lateral Deflection (Y) = 0.01 B

B = Shaft Diameter (in inches)

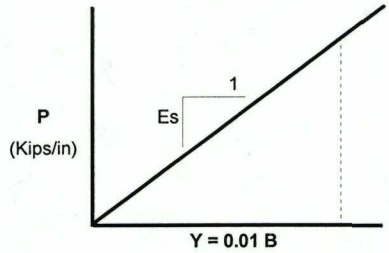
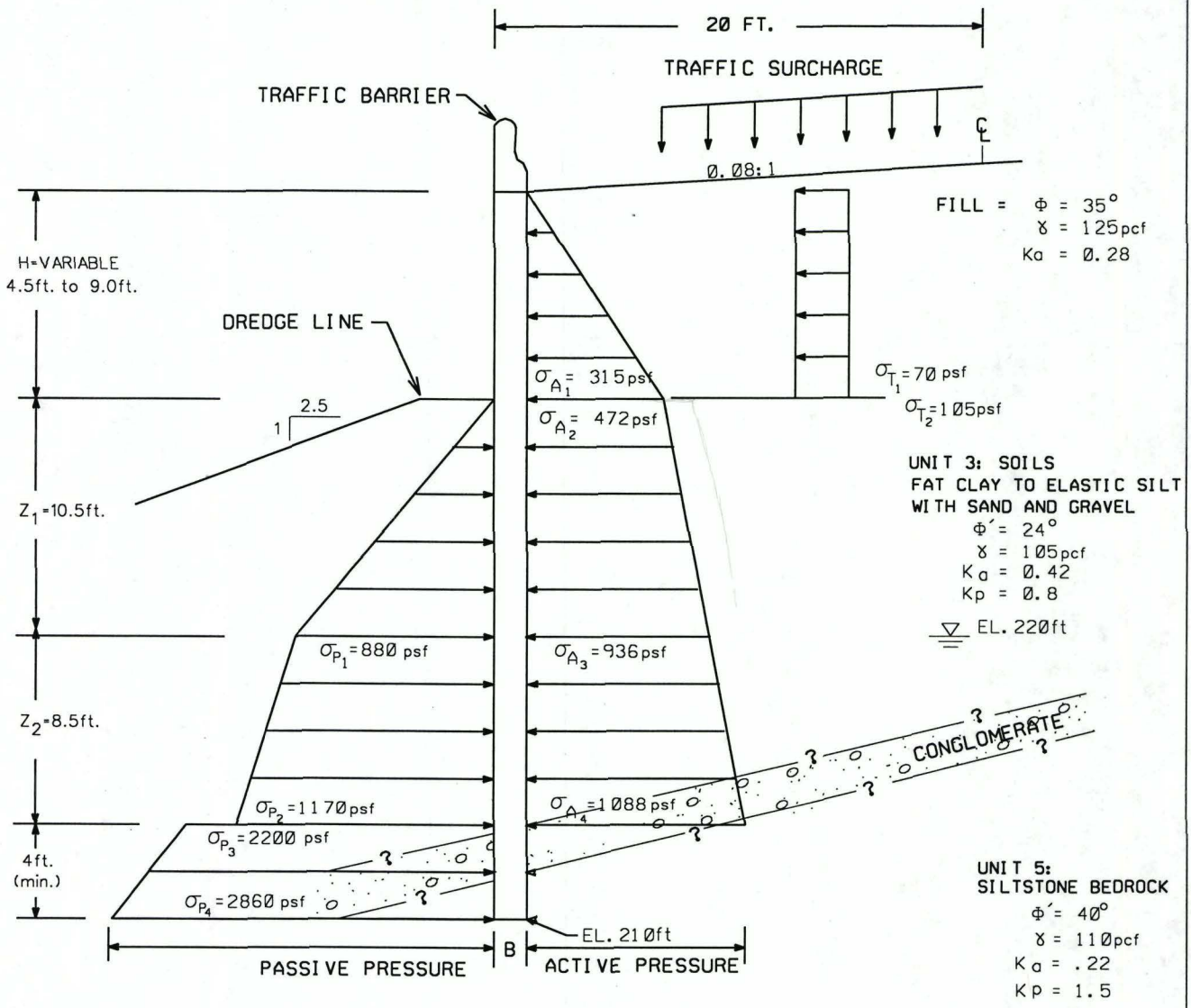


FIGURE E- 7: P-Y Curve Data Input



NOTES: (1) ACTIVE PRESSURE IS GIVEN AS $\sigma_a = K_a \gamma H$ BELOW THE DREDGE LINE, ACTIVE PRESSURE ACTS OVER ONE SOLDIER PILE DIAMETER.

(2) PASSIVE PRESSURE IS GIVEN AS $\sigma_p = K_p \gamma H$ KP INCLUDES A FACTOR OF SAFETY OF 1.5(Kp/1.5). PASSIVE PRESSURE MAY BE TAKEN TO ACT OVER THREE SOLDIER PILE DIAMETERS WHERE PILES ARE SPACED GREATER THAN 3D

FIGURE E-8: TYPICAL EARTH PRESSURE DIAGRAM
STATION 26+50 TO STATION 27+25

JOB OL-0911 S.R. 006 C.S. 2105 LAYOUT

SOUTH FORK CHEHALIS RIVER BRIDGE

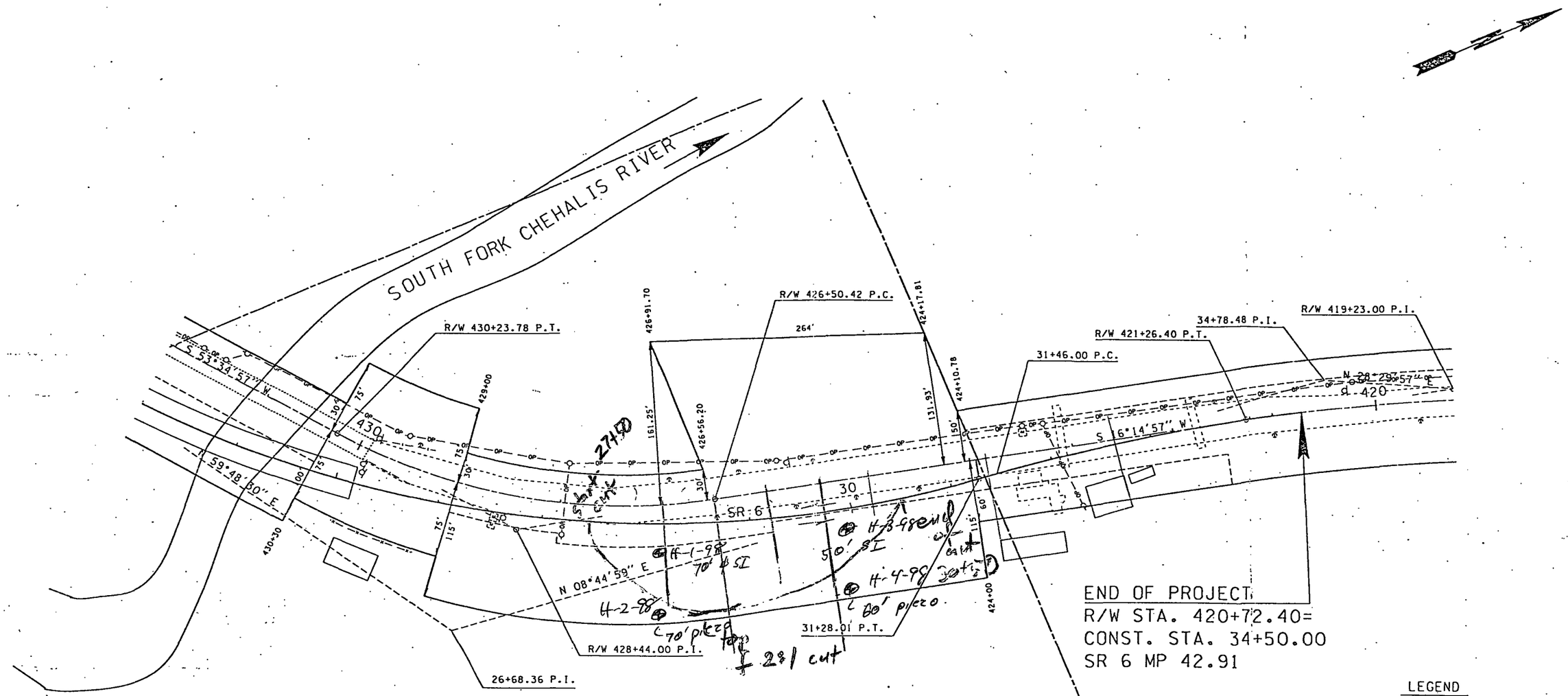
MP 42.48 to MP 42.91

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION
MATERIALS BRANCH
R. MOORE MATERIALS ENGINEER

DATE 5/99
SCALE N. T. S. VERT. HORIZ.
SHEET ___ OF ___
DRAWN BY W. M.

e:\ol-0911\sr6_bsd.dgn Jul. 02, 1999 10:39:51

T.13N., R.4W. W.M.



CURVE DATA				
P.I. STATION	DELTA	RADIUS	TANGENT	LENGTH
R/W 419+23.00	12°15'00" LT.	1910.00	204.96	408.36
R/W 428+44.00	37°20'00" RT.	573.00	193.58	373.36
26+68.36	51°03'31" LT.	1111.51	530.86	990.51
34+78.48	19°44'58" RT.	1910.00	332.48	658.36

LEGEND

- EXISTING GUARDRAIL
- EXISTING OVERHEAD POWER
- EXISTING CULVERT
- EXISTING RAILROAD SIGNAL
- EXISTING GUIDEPOST
- EXISTING SIGN
- EXISTING MAILBOX
- EXISTING BURIED TELEPHONE
- EXISTING LUMINAIRE
- EXISTING CONTROL CABINET
- EXISTING TELEPHONE JUNCTION BOX
- EXISTING POWER POLE
- EXISTING FENCE

REGION NO.	STATE	FED. AID PROJ. NO.
10	WASH	

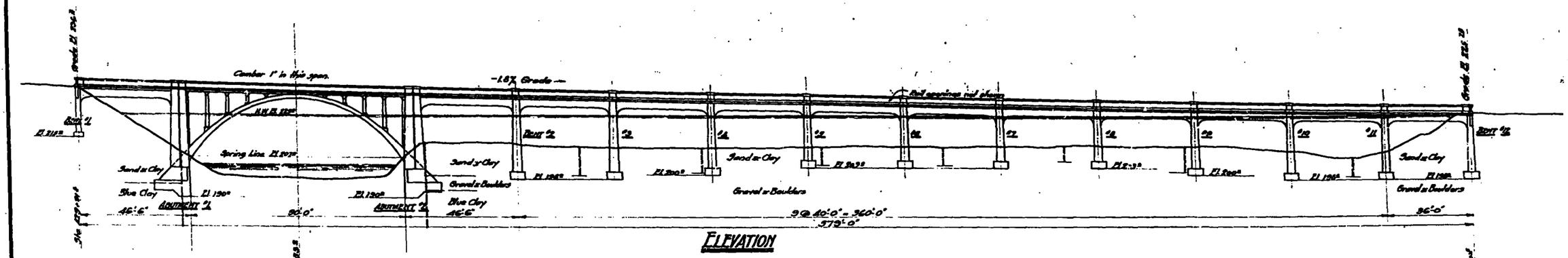
PROGRAM DEVELOPMENT DIVISION

Washington State

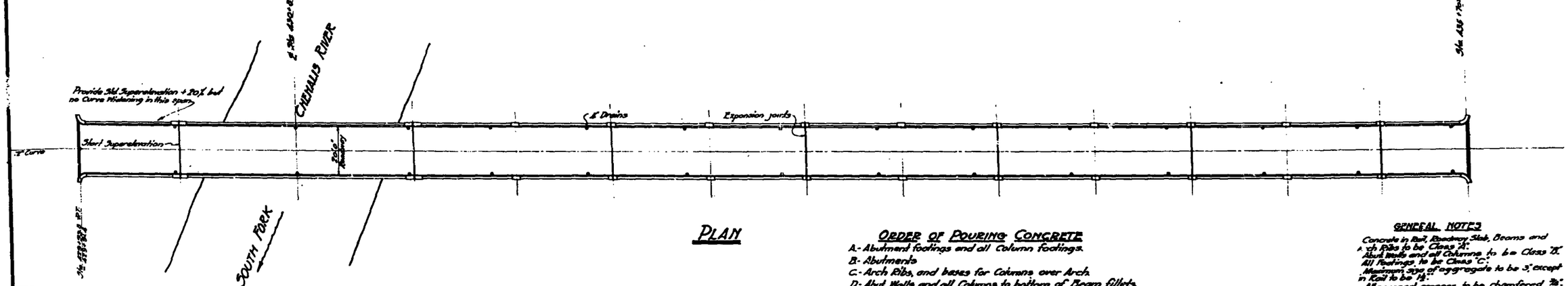
REFERENCE SHEET NUMBER

DESIGNED BY J. WAIR

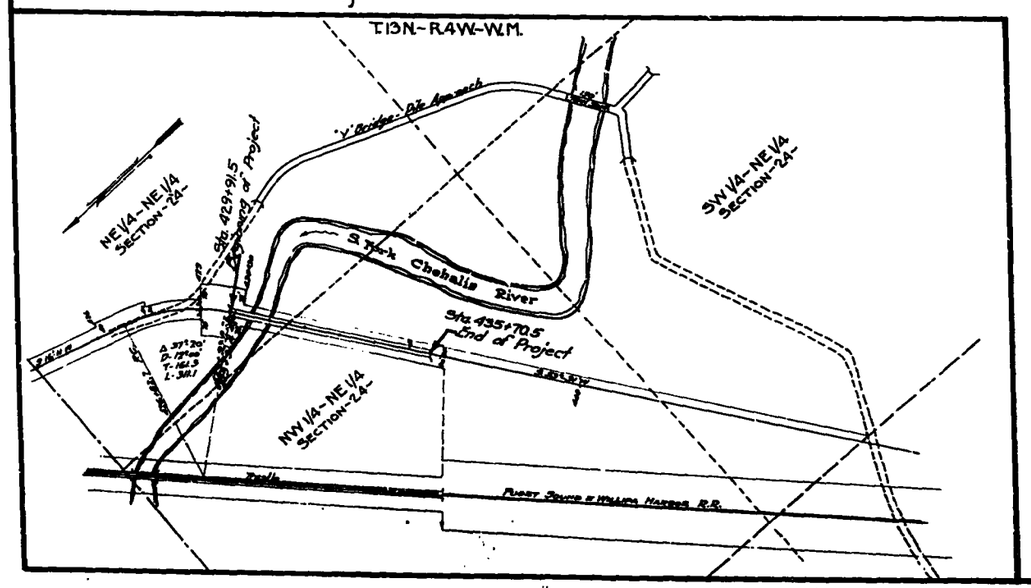
40



ELEVATION



PLAN



ORDER OF POURING CONCRETE

A- Abutment footings and all Column footings.
B- Abutments
C- Arch Ribs, and bases for Columns over Arch.
D- Abut. Walls, and all Columns to bottom of Beam fillets.
E- Beams and Slabs except over Arch.
F- Beams and Slab over Arch, after falsework is released.
G- Railing, after falsework is released.

QUANTITIES — APPROXIMATE		
Struc. Excavation	1900	Cu. Yds.
Concrete - Class A.	980	"
" " B.	365	"
" " C.	335	"
Reinforcing Steel	185,000	Lbs.
Expansion Bearings	960	"

GENERAL NOTES

Concrete in Rail, Roadway Slab, Beams and Arch Ribs to be Class "A".
Abut. Walls and all Columns to be Class "B".
All Footings to be Class "C".
Maximum size of aggregate to be 3" except in Rail to be 1½".
All exposed corners to be chamfered ¾".
All surfaces exposed to view to have class "B" finish except Rail to have Class "A" finish.
All Reinforcing Steel to be deformed.
In forming hooks on the ends of bars use radius equal to at least 3 diam. of bar and extend for 6 diam. beyond bend.
Bars to be spaced not less than 3 diam. c-c. and not less than 2 diam. center of steel to surface of concrete, with a minimum of 1½".
Rail to be cast in place after falsework has been released.
Use standard superelevation + 20%, but no curve widening.

Designed by J.H.G. Date April 1925
Drawn by " Date "
Traced by E.W.E. Date
Checked by Date

Approved:
Chief Engineer
Bridge Engineer

STATE OF WASHINGTON
STATE HIGHWAY COMMISSION
OLYMPIA, WASHINGTON

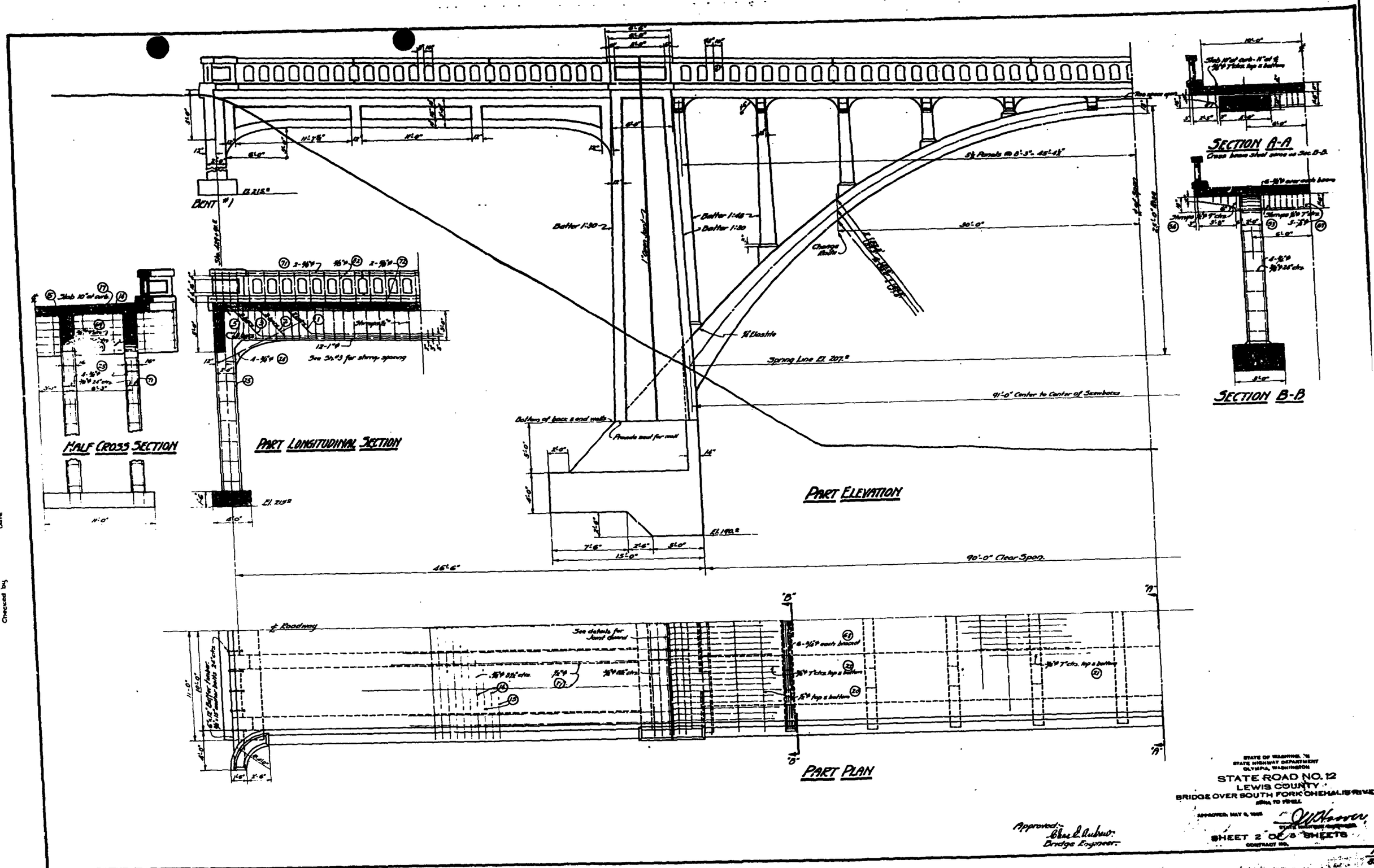
STATE ROAD NO. 12
LEWIS COUNTY
BRIDGE OVER SOUTH FORK CHEHALIS RIVER

SHEET 1 OF 5 SHEETS

6/115

40

Designed by J.W.G. Date Apr. 1935
Drawn by " Date "
Traced by J.S.M. Date
Checked by Date

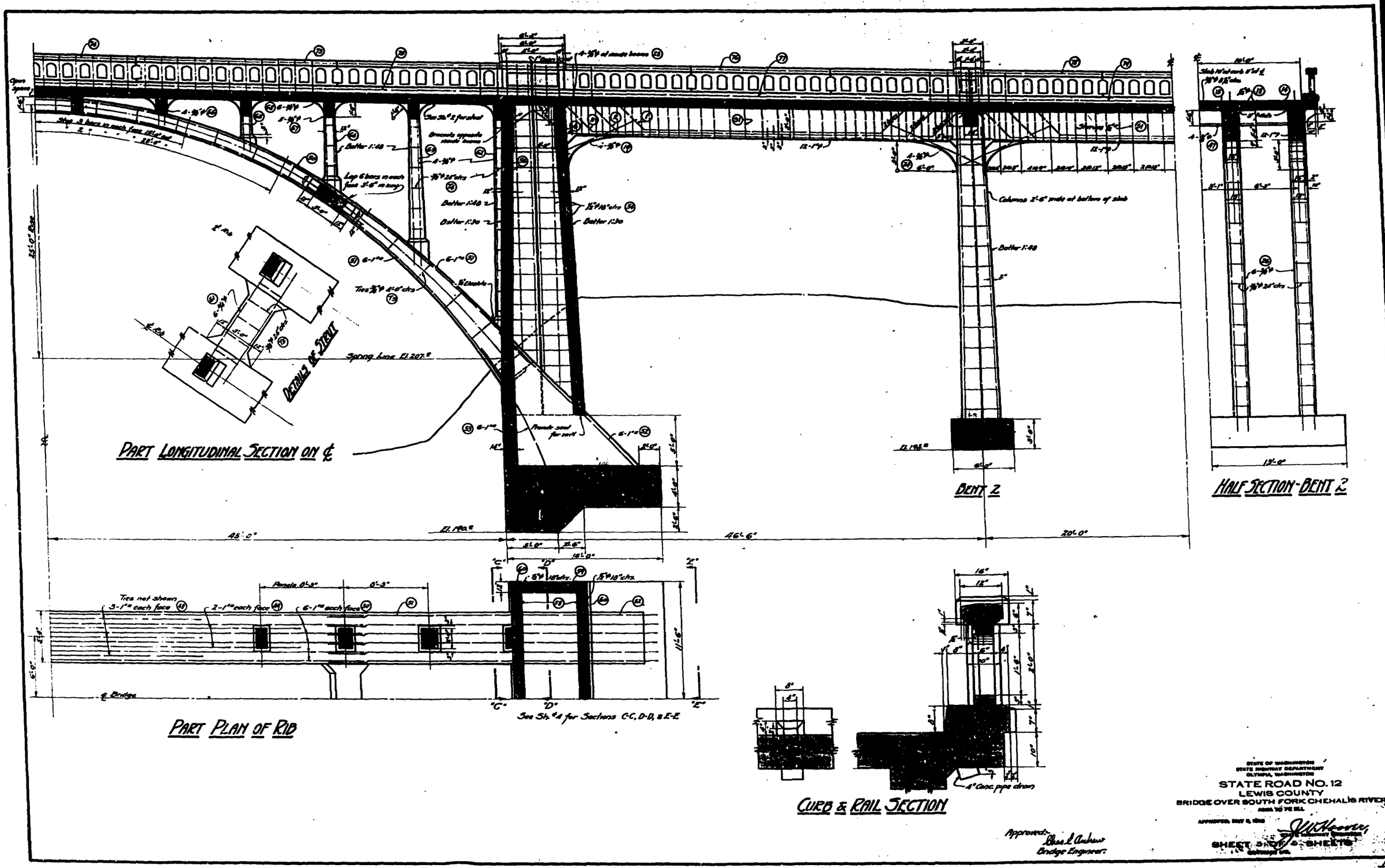


STATE OF WASHINGTON, 19
STATE HIGHWAY DEPARTMENT
OLYMPIA, WASHINGTON

STATE ROAD NO. 12
LEWIS COUNTY
BRIDGE OVER SOUTH FORK CHEHALIS RIVER
BRIDGE TO PIERS

APPROVED MAY 6, 1935
State Highway Engineer

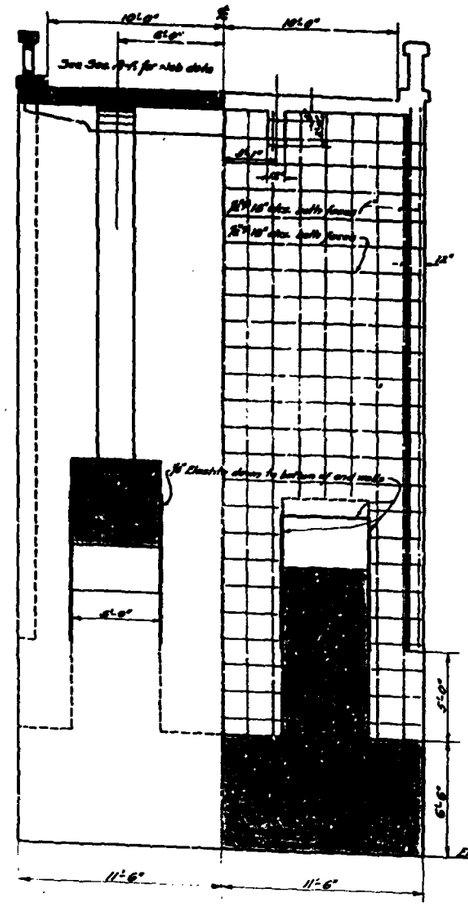
SHEET 2 OF 3 SHEETS
CONTRACT NO.



Designed by J.W.G. Date Apr. 1925
Drawn by Date
Traced by J.F.M. Date
Checked by Date.

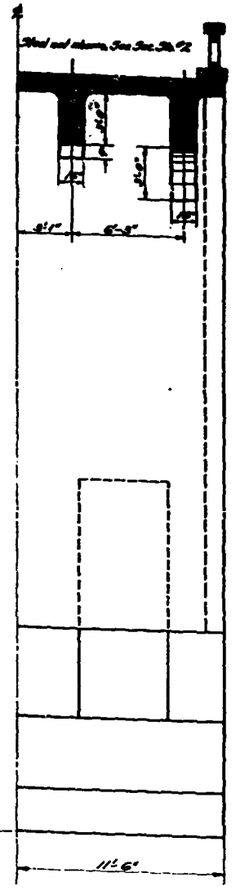
15
86

Designed by J.H.G. Date Apr. 1925
Drawn by " Date "
Traced by J.F.H. Date
Checked by Date

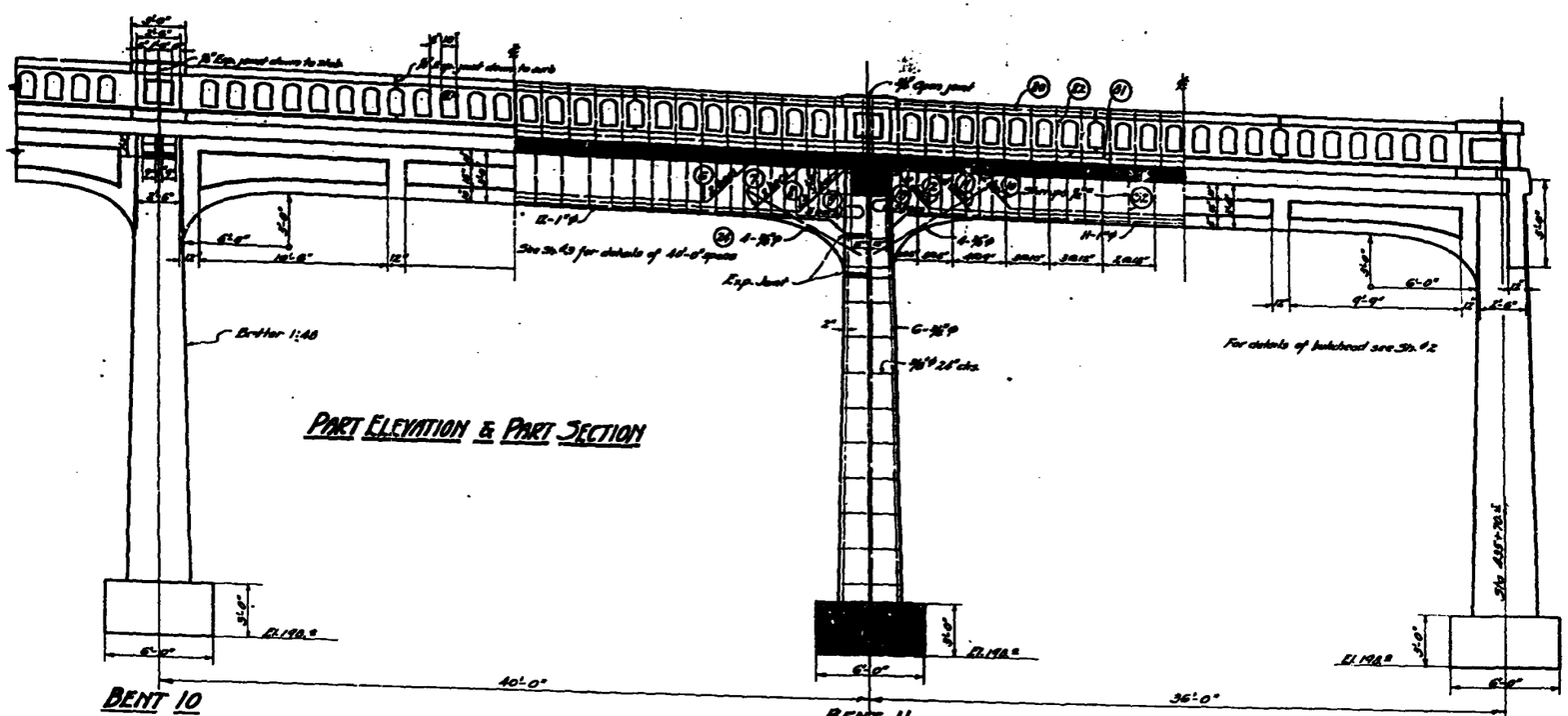


SECTION C-C

SECTION D-D



SECTION E-E

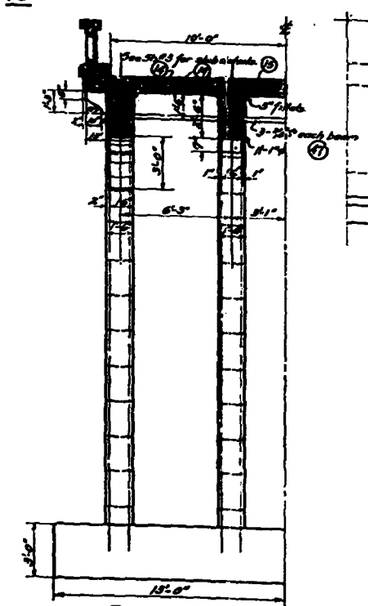


PART ELEVATION & PART SECTION

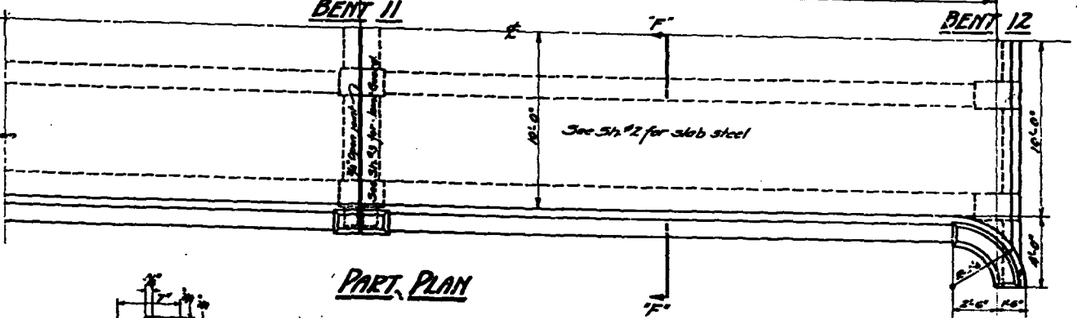
BENT 10

BENT 11

BENT 12

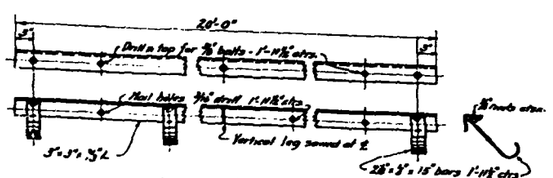


SECTION F-F

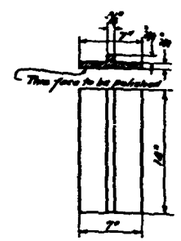


PART PLAN

Note:-
Guard angles to be set as follows: One angle to be nailed to form of slab first poured. Second angle then to be attached to first by means of clip angles and top bolts until remainder of slab is poured.



JOINT GUARD
To be included as Reinforcing Steel
7 Pcs. Rqd.



EXPANSION PLATES
20 Pcs. Rqd. - Phosphor Bronze.

Approved:
Bridge Engineer.

STATE OF WASHINGTON
STATE HIGHWAY DEPARTMENT
OLYMPIA, WASHINGTON

STATE ROAD NO. 12
LEWIS COUNTY
BRIDGE OVER SOUTH FORK CHEHALIS RIVER
AREA TO FS 11.1

SHEET 4 OF 4 SHEETS

OL-0911 SR 6 South Fork Chehalis River Bridge

Standpipe Piezometer Data

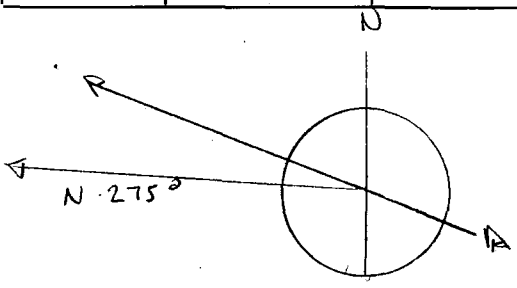
DATE	HOLE #	W.T. BELOW GROUND ELE. (ft.)	Δ ELE. (ft.)	COMMENTS
	H-1-97			
3/11/1998	Depth 30'	20.0		
3/31/1998		20.2	-0.2	
6/8/1998		22.7	-2.5	
10/30/1998		23.7	-1.0	
12/21/1998		18.7	5.0	
12/29/1998		12.8	5.9	
1/20/1999		14.2	-1.4	
2/25/1999		10.8	3.4	
3/15/1999		14	-3.2	
4/26/1999		17.5	-3.5	
6/16/1999		21.6	-4.1	
3/11/1998	Depth 65'	20.5		
3/31/1998		20.5	0.0	
6/11/1998		22.8	-2.3	
10/30/1998		23.6	-0.8	
12/29/1998		12.9	10.7	
1/20/1999		14.2	-1.3	
2/25/1999		10.8	3.4	
3/15/1999		14.1	-3.3	
4/26/1999		17.6	-3.5	
6/16/1999		21.7	-4.1	
	H-1A-98			
3/11/1998	Depth 23'	14.2		
3/31/1998		13.4	0.8	
6/11/1998		15.1	-1.7	
10/30/1998		17.6	-2.5	
12/21/1998		14.7	2.9	
12/29/1998		10.0	4.7	
1/20/1999		11.5	-1.5	
2/25/1999		10.2	1.3	
3/15/1999		14.8	-4.6	
4/26/1999		15.0	-0.2	
6/16/1999		15.8	-0.8	
	H-2A-98			
3/31/1998	Depth 20'	5.8		
6/11/1998		9.0	-3.2	
10/30/1998		10.6	-1.6	
12/21/1998		7.9	2.7	
12/29/1998		0.0	7.9	
1/20/1999		0.8	-0.8	
2/25/1999		0.0	0.8	
3/15/1999		7.7	-7.7	
4/26/1999		8.2	-0.5	
6/16/1999		9.1	-0.9	
3/31/1998	Depth 35'	7.2		
6/11/1998		13.6	-6.4	
10/30/1998		14.4	-0.8	
12/21/1998		11.4	3.0	
12/29/1998		10.6	0.8	
12/20/1999		11.4	-0.8	
2/25/1999		10.2	1.2	
3/15/1999		11.3	-1.1	
4/26/1999		12.6	-1.3	
6/16/1999		13.5	-0.9	
	H-5-99			
1/20/1999	DEPTH 28.6'	16.3		
2/25/1999		16	0.3	
3/15/1999		18.6	-2.6	
4/26/1999		19.5	-0.9	
6/16/1999		19.6	-0.1	

OL-0911 SR 6 South Fork Chehalis River Bridge

Standpipe Piezometer Data

DATE	HOLE #	W.T. BELOW GROUND ELE. (ft.)	Δ ELE. (ft.)	COMMENTS	Δ
	H-1-97	EL - 223.7			
3/11/1998	Depth 30'	20.0		203.7	
3/31/1998		20.2	-0.2	203.5	
6/8/1998		22.7	-2.5	201.0	
10/30/1998		23.7	-1.0	200.0 LOW	
12/21/1998		18.7	5.0	205.0	
12/29/1998		12.8	5.9	210.9	12.9 ft
1/20/1999		14.2	-1.4	209.5	
2/25/1999		10.8	3.4	212.9 HI	
3/15/1999		14	-3.2	209.7	
4/26/1999		17.5	-3.5	206.2	
	Poor seal.				
3/11/1998	Depth 65'	20.5			
3/31/1998		20.5	0.0		
6/11/1998		22.8	-2.3		
10/30/1998		23.6	-0.8		
12/29/1998		12.9	10.7		
1/20/1999		14.2	-1.3		
2/25/1999		10.8	3.4		
3/15/1999		14.1	-3.3		
4/26/1999		17.6	-3.5		
					movement -22 ft
	H-1A-98	EL - 273.11			
3/11/1998	Depth 23'	14.2		258.9	
3/31/1998		13.4	0.8	259.7	
6/11/1998		15.1	-1.7	258.0	
10/30/1998		17.6	-2.5	255.5 LOW	
12/21/1998		14.7	2.9	258.4	> 7.6 ft
12/29/1998		10.0	4.7	263.1 HI	
1/20/1999		11.5	-1.5	261.6	
2/25/1999		10.2	1.3	262.9 HI	
3/15/1999		14.8	-4.6	258.3	
4/26/1999		15.0	-0.2	258.1	

-17 ft



A 0.070
B - 0.0230 > 0.074

DATE	HOLE #	W.T. BELOW GROUND ELE. (ft.)	Δ ELE. (ft.)	COMMENTS
	H-2A-98	EL - 263.66		
3/31/1998	Depth 20'	5.8		257.9
6/11/1998		9.0	-3.2	254.7
10/30/1998		10.6	-1.6	253.1 LOW
12/21/1998		7.9	2.7	255.8
12/29/1998		0.0	7.9	263.7 (HT)
1/20/1999		0.8	-0.8	262.9
2/25/1999		0.0	0.8	263.7 (HII)
3/15/1999		7.7	-7.7	256.0
4/26/1999		8.2	-0.5	255.5
3/31/1998	Depth 35'	7.2		256.5 (HI)
6/11/1998		13.6	-6.4	250.1
10/30/1998		14.4	-0.8	249.3 LOW
12/21/1998		11.4	3.0	252.3
12/29/1998		10.6	0.8	253.1
12/20/1999		11.4	-0.8	252.3
2/25/1999		10.2	1.2	253.5 *
3/15/1999		11.3	-1.1	252.4
4/26/1999		12.6	-1.3	251.1
	H-5-99	EL - 237.72		
1/20/1999	DEPTH 28.6'	16.3		221.4
2/25/1999		16	0.3	221.7 HII
3/15/1999		18.6	-2.6	219.1
4/26/1999		19.5	-0.9	218.2

Oct – Dec

MOVEMENT
-1.5'
EL. 247.7 ft

Δ 10.6 ft

22 ω

28 ft
35 ft

7.2 ft

4.2 ft

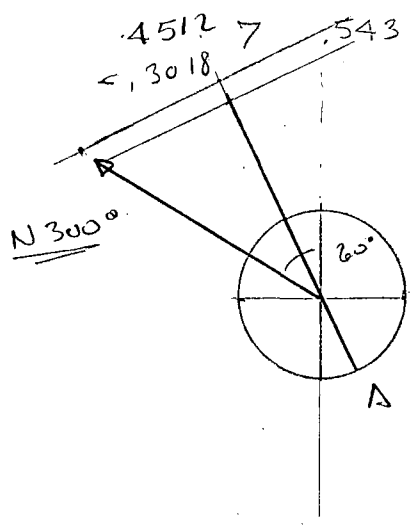
3.5 ft

WATER LEVEL
(83.25')
EL 180.75

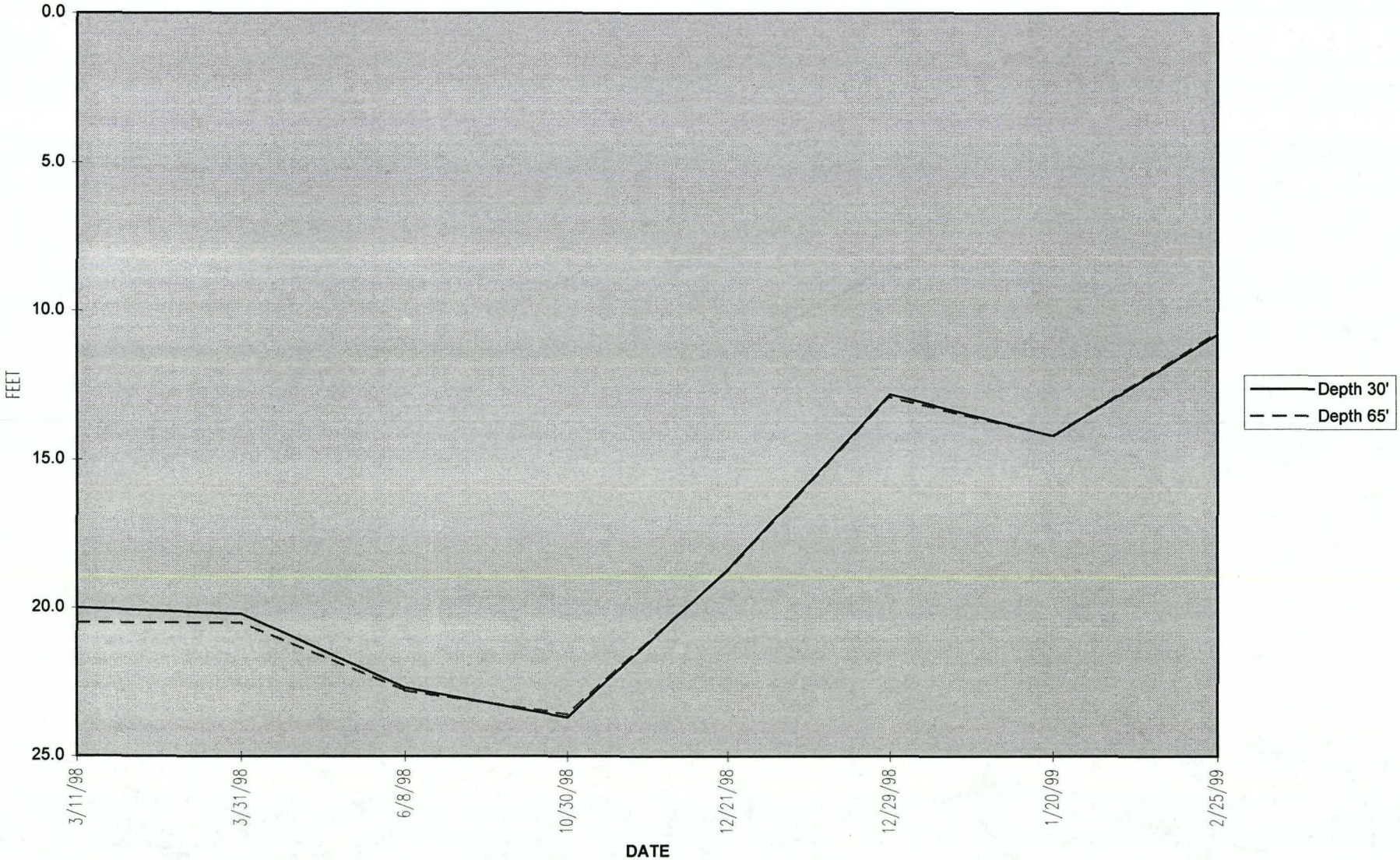
OCT -30 —

(Dec - = 21,178) 0.2064 > 0.257"
.1520

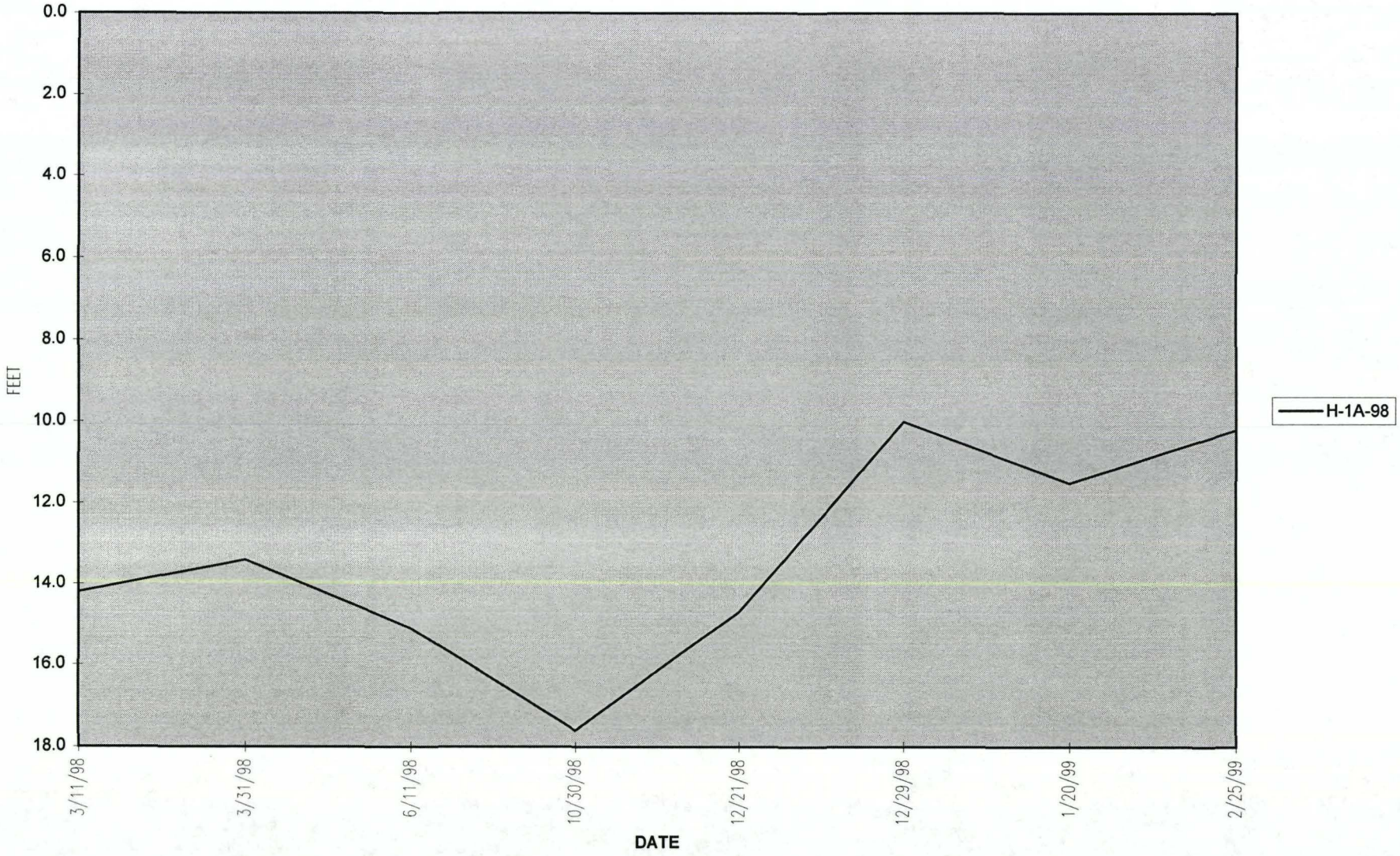
.5022 > 0.598"
.3252



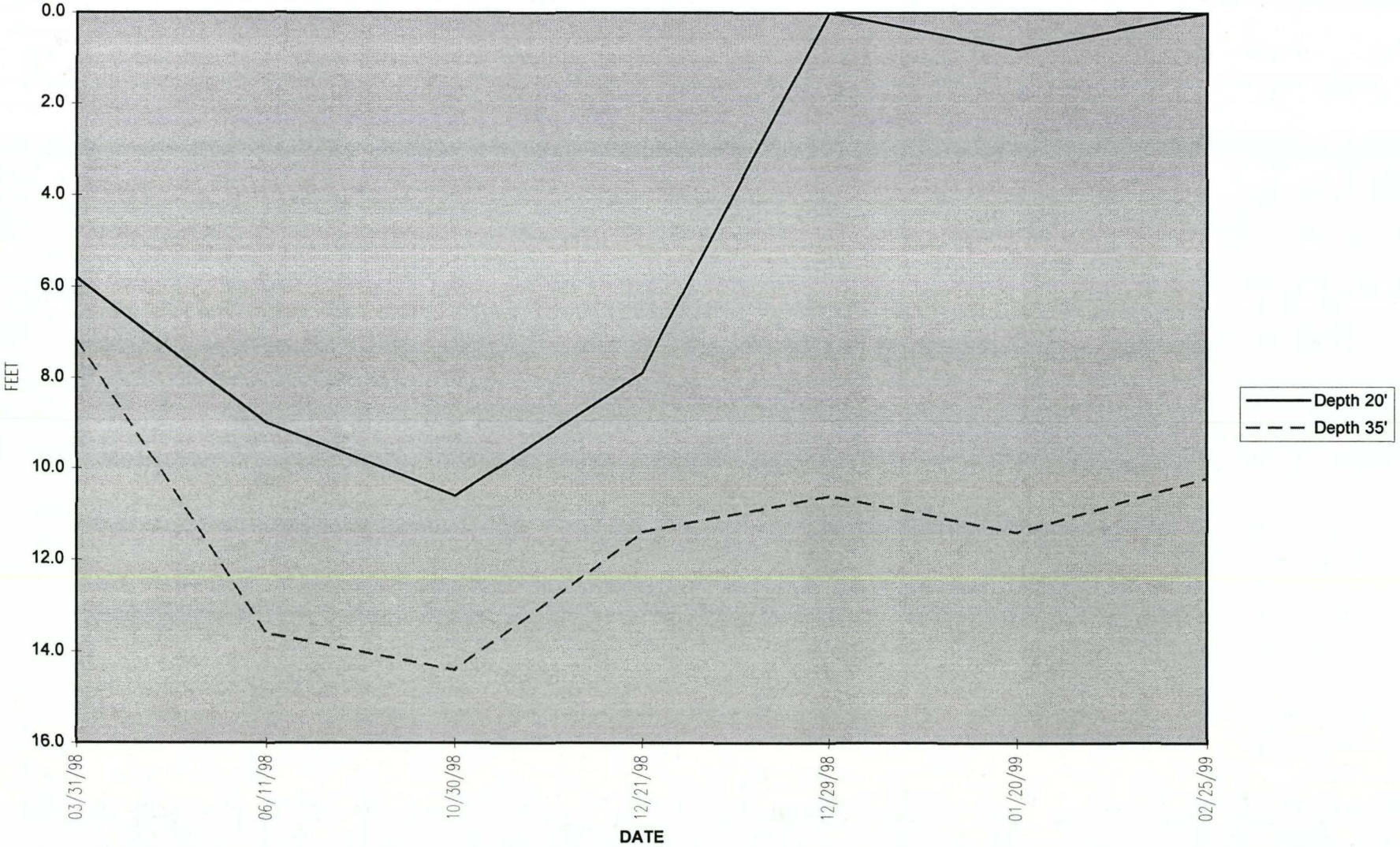
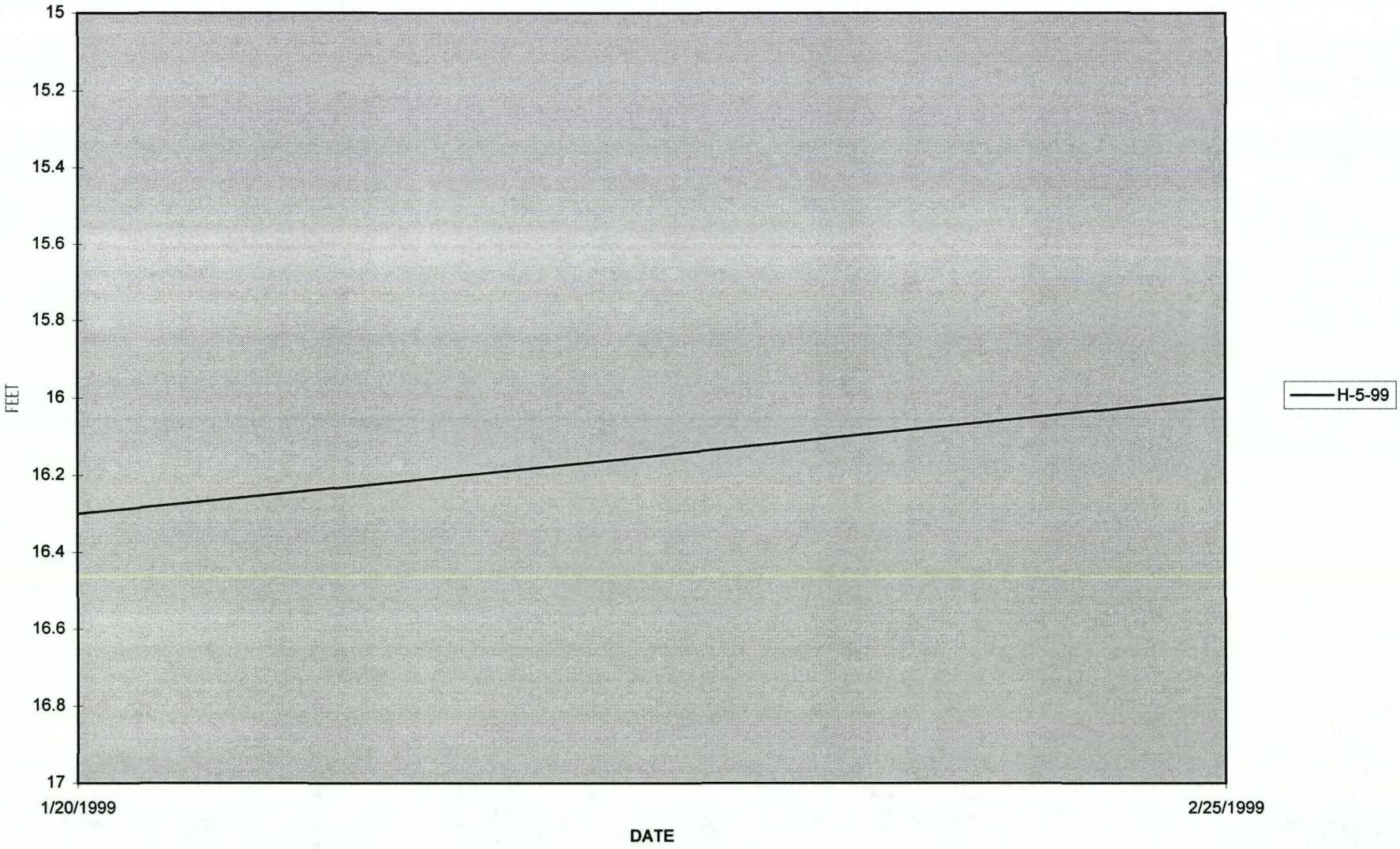
WATER TABLE B.G.E. - H-1-97



WATER TABLE B.G.E - H-1A-97



WATER TABLE B.G.E. - H-2A-97



SR 6 CHEHALIS R. BRIDGE