



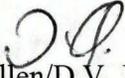
Washington State
Department of Transportation

FILE

Memorandum

October 25, 2004

TO: K. Grant/R. Meloy
SCR

FROM:  T.M. Allen/D.V. Jenkins
EEP Geotechnical Division, 47365

SUBJECT: SR24, OL3549
I-82 to Keys Road
Geotechnical Report

Attached with this memorandum is the *Geotechnical Report* for the design and construction of the proposed highway alignment of SR24 between I-82 and Keys Road. The report addresses the following:

- Project Location and Description
- Site Conditions
- Geologic Hazards
- Geotechnical Recommendations
 - SR24/1 Bridge Replacement
 - SR24/5 Bridge Replacement
 - Embankments
 - Retaining Walls 1 and 2
 - Pipe Arch – Blue Slough
 - Construction Considerations

If you have questions or require further information, please contact David Jenkins at (360) 709-5455 or Jim Cuthbertson at (360) 709-5452.

TMA
DVJ:dvj
Enclosure

cc: G. Hillsinger, SCR

K. Grant/R. Meloy
October 25, 2004
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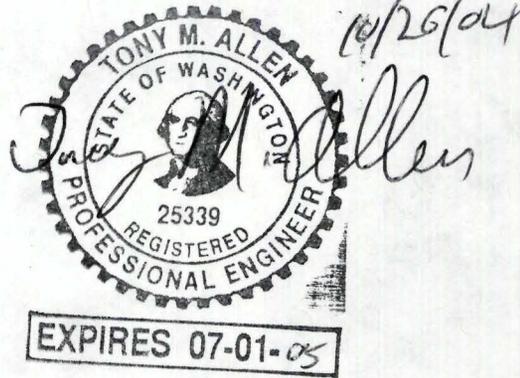
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GEOTECHNICAL REPORT

**SR24
I82 to Keys Road**

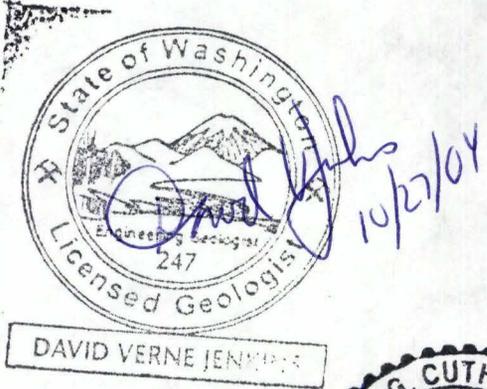
OL3549

Tony M. Allen
Tony M. Allen, P.E.
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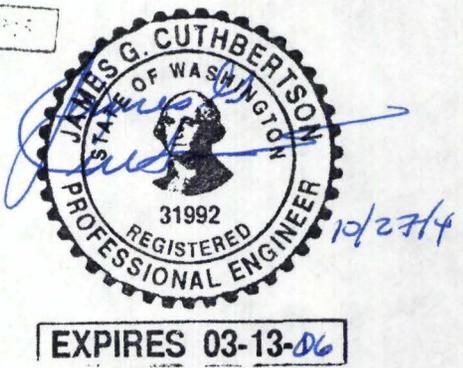
Prepared by:

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October 15, 2004



**Washington State
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1. Introduction

Our office was requested to prepare a geotechnical report for the project. The scope of work included evaluating the proposed embankments, bridges, retaining walls, and pipe arch for the project, based on both readily available geotechnical and geologic data, and site-specific test borings. In addition to the structure and earthwork investigation, test borings were drilled to determine groundwater levels and water infiltration rates at proposed pond sites.

1.1. Project Location and Description

A vicinity map labeled as *Figure 1* is attached in Appendix A. The purpose of the project is to improve mobility of traffic along SR-24 from the intersection of S. 18th Street in Yakima to the intersection of SR-24 and S. 33rd Street (formally Riverside Road). When finished, SR-24 will be a four-lane highway from I-82 to S. 33rd Street. The interchange of I-82 and SR-24 will be reconstructed and a wider bridge will be built over I-82 (Bridge 24/1). Intersections with SR-24 will be improved, including a county road, a city road, and two ramp-terminals. A pedestrian/bicycle path will cross I-82 (Bridge 24/1) and on the new Yakima River Bridge (Bridge 24/5), provide connections to the Greenway, and continue as a 12-foot wide pathway to South 33rd Street. These improvements will increase capacity at the Nob Hill interchange, accommodate future traffic growth, and remedy existing safety hazards.

1.1.1. Bridge No. 24/1 Replacement

The existing Bridge (24/1) over-crossing I-82 will be replaced in two stages resulting in the construction of a three pier, 157' – 8" long, 2-span, prestressed concrete tub girder bridge providing 6 – 12 ft wide lanes (3 lanes each direction), a single 12 ft wide center left-turn lane, 2 - 8 ft shoulders and a 12 ft wide bike/pedestrian pathway. The general location and detailed plan view of the bridge is shown on *Figures 1* and *2* respectively in Appendix A.

1.1.2. Yakima River Bridge Replacement 24/5

A new 1565 ft long bridge will be built across the Yakima River to replace the existing 600 ft long bridge (24/5). The existing bridge has critical scouring on 2 of its 5 piers. The new 10 pier, 9 span bridge will use high strength, pre-cast concrete super girders with lengths that vary from 150 ft to 181 ft. The new bridge will provide for 4 – 12 ft wide lanes, 2 – 8 ft wide shoulders and a 10 ft wide bike/pedestrian pathway. The general location and detailed plan view of the bridge is shown on *Figures 1* and *3A/3B* respectively in Appendix A.

1.1.3. Retaining Wall #1

Wall #1 is required along the FC line to keep embankment widening from encroaching onto the Yakima County humane society parking lot. The proposed wall is 350 ft long with a maximum exposed height of approximately 10 ft. The wall will be designed to support a traffic surcharge and will have a F-Shaped cast-in-place barrier and pedestrian rail on top of the retaining wall. The general location and detailed plan view of the wall is shown in *Figures 1* and *4* respectively in Appendix A.

1.1.4. Retaining Wall #2

Wall #2 is required to prevent fill widening of SR-24 from encroaching off right-of-way and onto the property of a propane distributor. The proposed wall is 200 ft long with a maximum exposed height of 12 feet. The wall will be designed to support a 2:1 fill slope. The general location and detailed plan view of Wall #2 is shown in *Figures 1* and *5* respectively in Appendix A.

1.1.5. Pipe Arch

A 12 ft wide by 8 ft high steel pipe arch is proposed to carry water in Blue Slough under SR-24 vicinity of Station L114+81. The general location and detailed plan view if the pipe arch is shown in *Figures 1* and *6* respectively in Appendix A. The pipe arch is approximately 180 ft long. The thickness of the embankment and pavement section over the crown of the pipe arch will vary from 4 to 9 ft.

1.2. Previous Studies

Several internal WSDOT soil reports have been prepared for this project since its initial development beginning in the early 1990's. The first soils report was a foundation report prepared for the widening of the existing 24/1 bridge over I-82. This report was titled "Geotechnical Recommendations for SR-82 Overcrossing Bridge 24/1E" dated September 21, 1994.

A second foundation report titled "Geotechnical Report, SR24, I-82 to Keys Road, C.S. 3934, OL-0702" was submitted on June 28, 1995. This report provide foundation recommendations for the replacement of the Yakima River Bridge 24/5, a pedestrian bridge over the Yakima River, cut and fill slope recommendations and retaining wall recommendations.

Several consultant reports were also prepared for this project during the same time period. The first consultant report was prepared by Shannon and Wilson. This report was titled: "Preliminary Geotechnical Report Proposed Improvements to SR-24 (Yakima to Moxee City), Yakima County, Washington" dated March 1993.

The second consultant report was prepared by HWA GoeSciences Inc. This report was titled "Geotechnical Report, SR-24, I-82 to Keys Road, Yakima, Washington" and was submitted on September 22, 2000. This report provided general foundation recommendations for the replacement of the Yakima River Bridge 24/5, cut and fill slope recommendations and retaining wall recommendations.

Since the preparation of these earlier soils reports, a significant change in the scope of the project has resulted in the need for additional geotechnical studies and analyses. The preparation of this report will address all structural elements of this project based on the current alignments being proposed by the Region.

2. Site Conditions

2.1. Surface Conditions

The project is located east of the city of Yakima, Washington, as shown on the Vicinity Map, *Figure 1*. Topography along the project alignment is relatively flat, with the exception of the Yakima River channel, which is incised approximately 15 to 20 feet below the surrounding ground surface. From the I-82 interchange, the project alignment runs southeast across the Yakima River floodplain and crosses the existing channel prior to reaching Keys Road. Surficial soils along the alignment consist of a varying assortment of sand, gravel, cobbles and boulders. Vegetation along the alignment consists of sparse grasses, which grow primarily on portions of the existing embankments, and bushes and small to medium size deciduous trees, which grow primarily along the banks of the Yakima River. Evidence of old gravel pit mining operations is present on the easterly end of the project. A larger inactive gravel pit (PS-E-187) is located south of the alignment. These pits are currently filled with water with a static level that often reflects the perched groundwater level in the floodplain.

The project corridor serves commercial, recreational, residential and agricultural areas. Commercial establishments along the alignment include K-Mart, Woodpecker Truck, a propane gas distributor, and an auto-wrecking yard. Recreational facilities include the Yakima County Arboretum, and Robertson Landing Park on the north side of SR-24, Sportsman's Park on the east side, and the Yakima River Greenway, which parallels the river on the west side. Homes and several agricultural fields are located along the corridor as well. The Yakima County regional wastewater treatment plant is located near the west end of the alignment, and effluent application fields border much of the south side of the corridor.

2.2. Regional Geology

The project site is located in the Yakima Fold Belt in south central Washington. The Yakima Fold Belt is a series of anticlinal ridges and synclinal valleys that cover about 14,000 km² of the western Columbia Plateau. Soil and rock units were folded and faulted under the north-south directed compression. The deformation continued into the late Miocene and Pliocene (10 m.y.a. and 1.6 m.y.a.). The new bridge over the Yakima River is located on the Yakima River floodplain, which is located in the synclinal Moxee Basin and Yakima Ridge and Ahtanum anticline ridges. The Naches and Ahtanum Valleys converge on the site from the northwest and west-southwest, respectively.

Silt, sand, gravel and cobbles were deposited in the valley bottoms. The oldest exposed deposit is the Thorp Gravel. Thorp Gravel consists of coarse sands and gravels which were deposited during the early Pliocene (1.6 m.y.a. and 5 m.y.a.). Stream terrace deposits formed during the late Pleistocene (13,000 y.a. and 1.6 m.y.a.) The Yakima River is currently reworking the terrace deposits. The stream deposits are thought to be as thick as 100 ft in the middle of the valley. The origin of the gravel deposits could be from two possible sources; catastrophic Spokane flood deposits from ancient Lake Missoula or glacial outwash deposits from the Cascade Range.

There are localized deposits of lacustrine (lake) and eolian (loess) silt and fine sand on the surface of the gravel deposits. The deposits appear to be localized in depressions in the vicinity of the project site.

2.3. Regional Seismicity

The seismicity and subsurface geologic structure is not completely understood in the vicinity of Yakima. The area is thought to be inactive seismically until recently. 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 caused by a 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 shallow events.

Several thrust fault systems associated with the Yakima Fold Belt are located within approximately 4 miles of the site. Regionally, the closest major fault zone is the White River-Naches Fault, which extends NW-SW some 100 km from North Bend to Naches. At its closest, the fault is about 17 miles northwest of the project alignment. Typically, the structural elements within the White River-Naches Fault zone do not extend into the overlying basalt bedrock. In addition, the White River-Naches Fault zone does not show evidence of Quaternary or Holocene (3 m.y.a. to present) and is considered inactive.

2.4. Site Soil Conditions

To characterize the surface and subsurface conditions, we performed a site reconnaissance and drilled a total of 17 test borings for the 24/1 and 24/5 Bridge replacements, walls 1 and 2, and pipe arch structure and 9 borings to investigate potential infiltration pond sites. In addition to these test holes drilled in 2004, 9 test borings drilled by the WSDOT in 1994 were also reviewed and 6 borings completed in 1999 by HWA Geosciences Inc. In addition to the recent test drilling, 3 borings conducted in 1958 for the investigation of the 24/1 bridge and 4 borings drilled in 1956 for the investigation of the 24/5 bridge were also reviewed. The Headquarters Materials Lab drilled all recent test borings except for the borings identified as B-H-#. These borings were drilled by HWA in 1999. The locations of all test borings are shown on plan sheets labeled as *Figures 2, 3A, 3B, 4, 5, and 6* included in Appendix A. The subsurface profiles for the 24/1 and 24/5 Bridge are shown in *Figure 7* and *8A/8B* respectively. The subsurface conditions along the wall profiles are shown in *Figures 9* and *10* for walls 1 and 2 respectively. A subsurface conditions along the pipe arch structure is shown in *Figure 11*. A description of the drilling and sampling techniques used as well as the boring logs and a legend of the terms and symbols used or shown on the boring logs are included in Appendix B. Subsurface conditions observed in the test borings performed at the project site were generally consistent with the geologic mapping. These units are described as follows.

- **Unit 1** – Fill material generally comprised of medium dense to very dense well graded GRAVELS with sand.
- **Unit 2** – Medium dense to very dense, well graded GRAVEL with sand, cobbles and boulders, and silty GRAVEL with sand and poorly graded GRAVEL with silt and sand with cobbles. This is the dominant soil type within the project limits.
- **Unit 3** – Loose to very dense silty SAND with gravel, poorly graded SAND with silt. This soil unit generally overlies Unit 2 soils.

- **Unit 4** – Dense to very dense well graded SAND with gravel and cobbles. This Unit is interbedded within Unit 2 soils and is very similar to Unit 2 soils but contains slightly more sand than gravel.

2.5. Groundwater

We anticipate the static water level is dependent upon seasonal variation in precipitation and the water elevations that vary in the Yakima River. Stand pipe piezometers were installed in H-7-04 (24/5 Bridge- Pier 8), H-11-04 (24/1 Bridge - Pier 2), H-14-04 (Wall 2) and in all TH-04 borings drilled for the design of the infiltration ponds. The groundwater observations are summarized in Table B-2 of Appendix B.

3. Geologic Hazards

3.1. Soil Liquefaction Hazard

Soil liquefaction is a phenomenon whereby saturated soil deposits temporarily lose strength and behave as a viscous fluid in response to cyclic loading. The liquefaction potential of saturated soils is evaluated mainly on soil gradation, density, and the depth of the deposit. The potential for liquefaction is highest for loose, fine to medium grained sands and silty sands. Increasing fines content (i.e., silt and clay) decreases the potential for liquefaction. Conversely, clean coarse-grained granular soils are less susceptible to liquefaction due to their high permeability. The potential for liquefaction also decreases with increasing density and depth.

We have evaluated the potential for liquefaction of the project soils based on the SPT data obtained from the field explorations and laboratory tests. Specifically, we focused our analyses on the bridge site.

Based on low seismicity, and the dense nature of site soils we expect the risk of liquefaction at the bridge site within the project limits to be very low.

3.2. Liquefaction Induced Lateral Spreading and Strain

The risk of liquefaction within the project limits is small. Therefore, the risk for lateral spreading is expected to be very low.

4. Geotechnical Recommendations

4.1. Embankments

The new grade established by the realignment of SR-24 and re-location of the new Yakima River Bridge (24/5) will require new embankments up to 15 ft in height. We estimate settlement due to the embankment loading will be negligible and all settlement will occur as the fills are being placed. Post construction settlement is expected to be minimal.

All final slopes on the embankments should be 2H:1V or flatter. Select or Gravel Borrow should be used for the embankments at the bridge approaches and these embankments should be

compacted using compaction Method C per the Standard Specifications. At a minimum, fill material meeting common borrow specification and compacted using Method B must be used for the remaining embankments on the project.

4.2. Bridge Approach Slabs

The Design Manual Section 1120.03(6) requires all bridges to have approach slabs unless approval for their deletion has been given. Since long term creep settlement of the approach embankments are not expected to occur, approach slabs may be deleted at both abutments. Although the approach slabs are not required from a geotechnical standpoint, they may be required for other reasons such as design speed, and ADT.

4.3. 24/1 Bridge Replacement - Foundation Recommendations

We understand structure and substructure design will be performed using Load and Resistance Factored Design (LRFD) methodology. The proposed 24/1 Bridge is a 2-span, pre-stressed concrete tub girder bridge. Settlement of the piers for this bridge has been designed assuming a maximum of 1 inch of total settlement with differential settlement anticipated being less than 0.5 inches.

4.3.1. Bridge Abutment Foundation Recommendations

We are recommending spread footing support at both abutments due to the presence of medium dense to very dense granular soils present at the bridge site. The spread footing for Pier 1 and 3 should be founded at an elevation based on minimum embedment criteria. This may place the footing at an elevation slightly lower than the elevation of the existing Bridge abutment piers (1010.8 - pier 1 and 1011.8 - pier 3 (NAVD 88)).

The construction of the spread footings at piers 1 and 3 will require the design and construction of shoring walls up to 25 ft in height. The shoring walls are necessary to maintain the integrity of the existing approach embankment to the existing bridge. The details of the shoring walls are described in section 4.3.6.

Nominal bearing capacity charts for strength, service and extreme event limit states are presented in Appendix D-1, *Figures 1*, and *3* for piers 1, and 3 respectively. The capacities shown on the plots are based on the effective foundation widths. A constant ultimate bearing capacity of 45 tsf must be used for all effective footing widths for strength and extreme event limit states.

For the service limit state, the figures present the ultimate bearing capacity at a given settlement as a function of effective foundation width. The service limit chart is based on 1 inch of settlement. Due to the presence of granular soils, settlement should occur as the loads are being applied. The estimated differential settlement between the abutment piers and the interior piers will be less than 0.5 inches. Post construction settlement following the closure pour between the 2-stage bridges should be negligible.

Per the *Bridge Design Manual*, the lateral earth pressure due to traffic surcharge loading should be calculated using a uniformly distributed load at the ground surface of 250 psf, multiplied by K_a ($K_a \times 250$ psf), or an equivalent fluid weight of 60 psf.

For passive pressure resistance at the foundation toe and active pressure acting on the abutments, the following soil properties shown in Table 1 should be used to estimate the forces. If the retaining wall is not allowed to move during bridge construction, we are recommending the wall be designed using K_o (at rest).

For calculating seismic earth pressures, K_{ae} is multiplied by the soil unit weight and wall height. A uniform pressure distribution is recommended when using K_{ae} . For reference, please refer to *figure 13* in Appendix A.

Table 1

Parameter	Value
Unit Weight γ (soil above footing)	125 pcf
Soil Friction ϕ_f (soil above footing)	36°
Active Earth Pressure (k_a)	0.24
At Rest Pressure (k_o)	0.43
Passive Earth Pressure (k_p)	3.8
Seismic Coefficient (K_{ae})	0.27
Coefficient of Sliding, $\tan \delta$	0.65

4.3.2. Bridge Interior Pier Foundation Recommendations

We are recommending support of the interior pier using spread footings due to the presence of dense Unit 2 soils. The spread footing elevation at pier 2 should be located based on minimum embedment as specified in the Bridge Design Manual. The excavation for the construction of Pier 2 may require temporary shoring walls up to 5 ft in height located parallel to the east and west bound lanes of I-82. The shoring walls may be required to maintain the integrity of the interstate highway. The excavation for the construction of the Pier 2 footing may also be performed using temporary cut slopes. The design of the shoring walls or temporary slopes is the responsibility of the contractor.

Nominal bearing capacity charts for strength, service and extreme event limit states are presented in Appendix D-1, *Figure 2*. The capacities shown on the plots are based on the effective foundation widths. A nominal bearing capacity of 45 tsf must be used for all effective footing widths for strength and extreme states.

For the service limit state, the figures present the nominal bearing capacity at a given settlement as a function of effective foundation width. The service limit chart is based on 1 inch of settlement. Due to the presence of granular soils, settlement should occur as the loads are being applied. The estimated differential settlement between the abutment piers and the interior piers will be less than 0.5 inches. Post construction settlement should be negligible.

4.3.3. Seismic Design

For Seismic Design, a bedrock acceleration coefficient of 0.11g is recommended in accordance with the *WSDOT Bridge Design Manual*.

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 II soil profile response spectrum, with a site coefficient of 1.2 is recommended for seismic design of the 24/1 Bridge.

4.3.4. Resistance Factors for Spread Footing Design

We recommend that the following resistance factors, shown in Table 3, be used when evaluating different limit states;

Table 3

Limit State	Resistance Factor ϕ		
	Bearing	Shear Resistance to Sliding	Passive Pressure Resistance to Sliding
Strength	0.45	0.80	0.50
Service	1.00	n/a	n/a
Extreme	1.00	1.00	1.00

4.3.5. Soil Spring Constants for Spread Footing Design

We recommended that equivalent spring constants for the spread footing foundations be determined by the method outlined in section 7.2.4 of FHWA Report No. FHWA-IP-87-6 entitled: Seismic Design And Retrofit For Highway Bridges. The shear modulus and Poisson's ratio of the foundation soil must be estimated to calculate the equivalent spring constant using this method.

Based on the results of our analysis, we have developed a range of shear modulus values for the soil units under the spread footing foundation. The most critical spring constant for the pier support depends on the rigidity of the superstructure which is determined by the structural engineer. We are providing a range of shear modulus values so that you may decide which is more critical, a weak or stiff spring. Our recommended soil parameters for spring constant determination are presented in Table 4.

Table 4

Pier location	Shear Modulus*	Poisson's ratio μ
Pier 1	260 to 780 tsf	0.3
Pier 2	300 to 900 tsf	0.3
Pier 3	460 to 1380 tsf	0.3

*Shear modulus is for strain magnitudes expected for strong motion earthquakes between 0.2 to 0.02 percent strains, respectively.

4.3.6. Temporary Shoring Walls

The replacement bridge will be constructed in 2 stages and as a result, spread footing construction for the abutments of the replacement bridge will require temporary shoring. At piers 1 and 3 we anticipate the shoring walls would approach 25 ft in maximum height.

The construction of the stage 1 bridge will require the removal of the side slope of the existing approach embankments. The first shoring wall would likely consist of a sheet pile wall or soldier pile wall. The construction of this wall is necessary to maintain integrity of the embankment (and allow traffic to use the existing bridge over I-82) while providing the necessary space to allow construction of the stage 1 bridge. Temporary soil nail walls are not recommended because of anticipated very poor stand-up time required for soil nail wall construction. We noted generally less than 7% fines present in the approach fills. It has been our experience the presence of fines tends to improve stand-up performance. The contractor will ultimately be responsible for the design of all temporary shoring.

During stage 1 construction, the contractor may elect to construct either a sheet pile wall or a soldier pile wall. Because of the wall height and to provide lateral support, tiebacks will be required for both the sheet pile or soldier pile wall options. The vibrating of sheet piles for a shoring wall would be difficult due to the dense nature and composition of these granular soils.

A second shoring wall would be built during the construction of the new embankment to the stage 1 bridge. The face of the 2nd shoring wall would abut the face of the 1st shoring wall. The construction of this wall would allow the removal of the remaining section of the “old” approach fills while allowing traffic to be shifted to the new stage 1 bridge.

The second shoring wall would likely consist of an MSE wall. A concrete facing is not required. The face of the first shoring wall could be used as the bracing for the face of the MSE wall. Following the completion of stage 2 bridge this wall would be buried within the approach embankments.

4.4. 24/5 Bridge Replacement – Foundation Recommendations

We understand structure and substructure design will be performed using Load and Resistance Factored Design (LRFD) methodology. The proposed Yakima River Bridge is a multiple span structure supported on ten piers. The existing ground elevation under the shadow of the bridge varies from 980 ft (NAVD 88) in the vicinity of the Yakima River and at the easterly end of the structure to a high of 1002 ft at the westerly end of the bridge.

Headquarters Hydraulics office performed a scour analyses of the river channel and has determined the scour elevation at all bridge Piers. The scour analyses assume that 5 ft diameter columns would be exposed above the thalweg. The thalweg elevation is the estimated stream bottom elevation of the river which was estimated to be approximately 981 ft. The scour elevation of Piers 2 - 6 is approximately 967 ft, Piers 7-9 is 981 ft and the abutments at 986 ft. Because of their analyses and estimates of deep scour, the new bridge interior piers must be supported on deep, drilled shaft foundations. The abutments may be supported on spread footings.

Figures 3A and 3B in Appendix A shows a detailed subsurface soil profile at the Yakima River Bridge replacement. In general the foundation soils consist of 0 to 10 ft of loose to medium dense silty sand with gravel, poorly graded sand with silt and gravel (**Unit 3**) underlain by medium dense to very dense well to poorly graded gravel with sand, cobbles and boulders and

silty gravel with sand (Unit 2) and medium dense to very dense well graded sand with gravel and cobbles (Unit 4).

4.4.1. Seismic Design

For Seismic Design, a bedrock acceleration coefficient of 0.11g is recommended in accordance with the *WSDOT Bridge Design Manual*.

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 II soil profile response spectrum, with a site coefficient of 1.2 is recommended for seismic design of the Yakima River Bridge.

4.4.1.1. Drilled Shafts

Drilled shafts capacities for strength, service and extreme limit states are provided in Appendix D for 8-foot diameter shafts at each pier location. The Bridge and Structures office has requested we provide shaft capacity charts for 8 ft diameter shafts only. *Figure 4* contains capacities for Piers 2-6 and *Figure 5* for Piers 7-9. The charts include nominal resistance for end bearing and skin friction resistance for each limit state. For the service limit case, the un-factored bearing resistance is based on 1 inch of settlement. The resistance charts do not account for the net weight of the shafts, and it should be added as a separate load when sizing the shafts. It should be noted that we have neglected skin resistance for that portion of the shaft that extends above the scour elevation.

Resistance factors for bearing capacity and uplift for service, strength, and extreme limit states for shafts are shown in the table below:

Table 5 - Drilled Shaft Resistance Factors

Limit State	Resistance Factor ϕ		
	Skin Friction	End Bearing	Uplift
Strength	0.65	0.50	0.55
Service	1.00	1.00	N/A
Extreme	1.00	1.00	1.00

4.4.1.2. Lateral Analysis of Deep Foundations

We understand lateral analyses of deep foundations will be evaluated using the LPILE computer program (Reese and Wang, 1989). We are recommending the bridge designer perform two case studies to perform a lateral analyses and test the sensitivity of the structural design. The design should proceed by way of the following analyses using identical shaft input parameters:

- **CASE 1** - Perform a P-y analyses assuming total loss of soil material within the scour zone and estimate the lateral deflections using live lateral loads only.

- **CASE 2** - Perform a P-y analyses assuming no loss of soil material within the scour zone and estimate the lateral deflections using earthquake loads.

P-y curve soil parameters used for the LPILE input are presented in Appendix E.

Group reduction factors for lateral load analysis should be used where drilled shafts and piles are spaced closer than 5D, where D is the drilled shaft/pile diameter and spacing is center to center. These reduction factors should be applied to the cohesion and modulus of subgrade reaction values shown on the P-y curve input parameter tables. Figure 4.4.3-1 from the *Bridge Design Manual* should be used to adjust the friction angle for group effects.

Table 6 - Reduction Factors for Group Effects

Pile Spacing	Reduction Factor (Longitudinal Direction)	Reduction Factor (Transverse Direction)
6D	1.0	1.0
5D	0.8	1.0
4D	0.65	0.9
3D	0.5	0.9
2D	0.4	0.6

For the purposes here, the longitudinal direction applies to piers that are configured in the direction of the applied lateral load (in a row parallel to the direction of load). The transverse direction applies to piles configured in a direction perpendicular to the applied load.

4.4.2. *Deep Foundation Settlement*

4.4.2.1. Drilled Shafts

The shaft capacity charts for service loads shown in *Figures 4 and 5* of Appendix D-2 were developed for 1 inch of settlement. Differential settlement between piers is estimated to be less than 0.5 inches. The settlement is for a single shaft. Shafts spaced closer than 3D where D equals the shaft diameter, will require our office to assess group settlement.

4.4.3. *Abutment Lateral Load Analyses*

The following soil properties should be used to estimate the passive pressure resistance and active pressures acting on the abutments, in accordance with the design methodology presented in the *Bridge Design Manual*. If the retaining wall is not allowed to move during bridge construction, we are recommending the wall be designed using K_o (at rest).

Table 7 - Abutment Soil Properties

Parameter	Value
Unit Weight (γ)	125 pcf
Soil Friction (ϕ_f)	36°
Active Earth Pressure (K_a)	0.24
At Rest Pressure (k_o)	0.43
Passive Earth Pressure (K_p)	3.8
Seismic Coefficient (K_{ae})	0.27

Per the *Bridge Design Manual*, the lateral earth pressure due to traffic surcharge loading could be calculated using a uniformly distributed load at the ground surface of 250 psf, multiplied by K_a ($K_a \times 250$ psf), or an equivalent fluid weight of 60 psf.

For calculating seismic earth pressure, K_{ae} is multiplied by the soil unit weight and wall height. The uniform distribution is assumed for the extreme case with the resultant force located at 0.5H. Please refer to *figure 13* in Appendix A. The seismic force is added to the traffic surcharge.

4.4.4. Spread footings

We are recommending support of the abutments using spread footings due to the presence of dense Unit 2 soils. The spread footing may be located at the thalweg elevation (986 ft) or above provided proper armoring of the embankment is designed to protect against scour. If the footing at Pier 1 were to be located at or above elevation 995 ft the top 5 ft of soil would require removal and re-compaction using Method C. The upper 5 ft at Pier 1 was loose. If the footing were to be located above thalweg elevation, you would need to coordinate the design of the scour protection with the Headquarters Hydraulic division. Placing the footing at elevation 986 ft would result in an excavation approximately 15ft below the existing ground surface at Pier 1 and 0 to 15 ft below the ground surface at Pier 10. The excavation for the construction of abutments may require temporary shoring up to 15 ft in height. Temporary slopes may also be feasible. The design of the shoring walls and temporary slopes are the responsibility of the contractor.

Nominal bearing capacity charts for strength, service and extreme event limit states for Pier 1 and 10 are presented in Appendix D-2, *Figure 6*. The capacities shown on the plots are based on the effective foundation widths. A constant ultimate bearing capacity of 45 tsf must be used for all effective footing widths for strength and extreme.

For the service limit state, the figures present the ultimate bearing capacity at a given settlement as a function of effective foundation width. The service limit chart is based on 1 inch of settlement. Due to the presence of granular soils, settlement should occur as the loads are being applied. The estimated differential settlement between the abutment piers and the interior piers will be less than 0.5 inches. Post construction settlement should be negligible.

We recommend using the resistance values in Table 3 for design of the spread footings. The following table may be used to determine the spring constants.

Table 8

Pier location	Shear Modulus*	Poisson's ratio μ
Pier 1 and 10	220 to 650 tsf	0.3

*Shear modulus is for strain magnitudes expected for strong motion earthquakes between 0.2 to 0.02 percent strains, respectively.

4.5. Retaining Walls

4.5.1. Wall No. 1

Wall #1 is required along the FC line to keep embankment widening from encroaching onto the Yakima County humane society parking lot. The proposed wall is 350 ft long with a maximum exposed height of approximately 10 ft. The wall will be designed to support a traffic surcharge. A traffic barrier and pedestrian rail will be located at the top of the wall. The general location and detailed plan view of the wall is shown in *Figures 4 and 9* respectively in Appendix A. The foundation soils generally consist of 2 to 20 ft of loose to very dense silty sand with gravel and poorly graded sand with silt (**Unit 3**) underlain by medium dense to very dense well graded gravels with sand (**Unit 2**).

4.5.2. Wall No. 2

Wall #2 is required to prevent fill widening of SR-24 from encroaching off right-of-way and onto the storage yard of an existing propane distributor. The wall will be designed to support a 2:1 fill slope. As depicted in *Figures 5 and 10* in Appendix A, the wall will be 200 ft long with a maximum exposed height of 12 ft. The foundation soils generally consist of 2 ft of loose to medium dense silty sand with gravel and poorly graded sand with silt (**Unit 3**) underlain by medium dense to very dense well and poorly graded gravels with sand and cobbles (**Unit 2**).

4.5.3. MSE Walls

We recommend using either one of the seven WSDOT pre-approved MSE proprietary wall suppliers, which include *Ares, Mesa, Keysystem I, MSE Plus, Reinforced Earth, Retained Earth, Eureka Reinforced Soil* or a *WSDOT Standard Plan geosynthetic wall* with a cast-in-place concrete face.

Standard plan concrete cantilever walls are feasible, but the cost of these systems is generally much higher than MSE walls. Standard walls with traffic barrier are generally cost competitive with MSE walls if the MSE walls require a moment slab barrier and are less than 10 ft in total height.

Tensar Earth Technology manufactures the *Ares* and *Mesa* walls. This wall system uses geogrid internal reinforcement with modular concrete blocks for facing. The *Keysystem I* wall, manufactured by *Keystone*, utilizes modular concrete facing blocks and wire ladder bar

reinforcement. The *MSE Plus* system utilizes a wire ladder bar internal reinforcement with pre-cast concrete panels for the finished face. The *Reinforced Earth Company* uses pre-cast concrete panels with steel strip reinforcement. The *Retained Earth* system supplied by Foster Geotechnical utilizes a pre-cast concrete panel face with bar mat internal reinforcement. Hilfiker Retaining Walls is the designer and supplier of the *Eureka Reinforced Soil* wall and the *Welded Wire Wall*. These systems use welded wire mat reinforcement with either pre-cast panels or wire face, respectively. Final wall selection will depend on the aesthetic needs for the project.

As per the Design Manual, the Region should take the responsibility to coordinate the design effort and contact the suppliers of the selected pre-approved systems to confirm in writing the adequacy and availability of their systems for the proposed use. The recommended MSE walls are pre-approved to a maximum height of 33 ft. Detailed wall plans and designs for the proprietary wall options will not be developed until after the contract is awarded. Therefore, a general wall plan, a profile showing neat line top and bottom of wall, a final ground line in front of and in back of the wall, typical cross section, and the generic details for the desired appurtenances and drainage requirements are to be included in the contract PS&E.

It is best to locate catch basins, grate inlets, signal foundations, etc. outside the reinforced backfill zone of MSE walls to avoid interference with the soil reinforcement. However, in some cases it may not be possible to do this. In those cases where conflict with these reinforcement obstructions cannot be avoided, the location(s) and dimensions of the reinforcement obstructions(s) relative to the wall must be clearly indicated in the plans. The region should contact Bridge and Structures Office to find out the limits on size and location of obstructions for which pre-approved wall details and designs are available, and regarding what generic details should be provided in the plans. The standard specifications and general special provisions for the Structural Earth Walls should be used.

4.5.4. Standard Plan Geosynthetic Walls

We recommend you include in the contract plans for walls 1 and 2 the option of constructing a Standard Plan geosynthetic reinforced wall with a cast-in-place concrete face. The Bridge and Structures office is currently preparing standard plans for a moment slab traffic barrier. You would need to contact that office regarding their time schedule for completion. We are recommending a standard plan Type 4 wall with horizontal backslope and 2 ft traffic surcharge for wall 1 and a Type 5 or 6 for Wall 2. Type 4, 5 and 6 walls are recommended in low seismic areas of Washington State. The Type 5 wall retains a fill slope of 2:1 and a Type 6 retains a fill slope of 1.75:1. Standard plan geosynthetic walls have been designed to a maximum height of 35 ft. The contractor would select internal reinforcement based on wall height and reinforcement spacing. The geosynthetic reinforcement would be selected from the tables in Appendix D of WSDOT Qualified Products List.

4.5.5. MSE Wall Design Criteria

The construction and design of the MSE wall should meet the following criteria:

- The maximum allowable bearing pressure is 3 tsf. The estimated total and differential settlement of a wall designed at this capacity will be less than 1 inch per 100 ft of wall length.

- MSE walls (and geosynthetic reinforced walls) should have a minimum embedment at the wall face not less than 10 percent of the wall height or 2 ft, whichever is greatest.
- Gravel borrow compacted using Method C should be used within the reinforced wall prism.
- The following soil properties should be used for the internal MSE wall design:

Soil Properties	Wall Backfill	Retained Soil	Foundation Soil
Unit Weight (pcf)	130	130	125
Friction Angle (deg)	38	38	36
Cohesion (psf)	0	0	0
	AASHTO Load Group I		AASHTO Load Group VII
Allowable Bearing Capacity (tsf)		3	6
Acceleration Coefficient (g)		N/A	0.11

These parameters must be included in the Structural Earth Wall general special provisions. Using the criteria above, you will need to prepare wall profiles showing minimum footing elevation, grade line at top of wall, final grade line at bottom of wall, and a typical cross section similar to the cross section shown in *Figure 12* in Appendix A. In addition, please show all desired appurtenances, and locations and size of any reinforced backfill obstructions such as utilities, drainage structures, and sign bridges.

4.6. Pipe Arch

4.6.1. Blue Slough Pipe Arch

Two test borings were drilled for the foundation investigation of the structural pipe arch. As shown in *Figure 11* of Appendix A, medium dense to very dense well graded gravel with sand and cobbles (**Unit 2**) is underlain by loose to very dense silty sand and poorly graded sand with silt (**Unit 3**). These soils will provide excellent support for the new pipe arch structure.

We have had discussion with the Region, and they have indicated a scour analysis has not been performed for this structure. We also understand this creek normally flows year round but a majority of the high flow is related to demands of local irrigation. We recommend staff from the Headquarters Hydraulics division evaluate the stream and structure for scour. Based on their recommendations, the bearing elevation of the pipe arch must be located at or below the estimated scour elevation. Appropriate protection of the pipe arch inlet to prevent side scour should be used. The hydraulics office should be able to provide you assistance in this design.

The design of the structure must meet the requirements outlined in Section 9-05-6 of the Standard Specifications (current edition). Proper pipe bedding material as specified in the Standard Specifications and compacted in accordance with the recommendations of the structural pipe arch manufacturer will result in adequate support of the structure. Using allowable stress design, we recommend the structure be designed for a maximum allowable bearing pressure of 3 tsf. Based on structure weight and amount of embankment placed on the pipe arch, the actual

stresses will be less than the recommended maximum allowable bearing pressure. We have estimated settlement of the pipe arch will be less than 1 inch and differential settlement along the full length of the structure will be less than 0.5 inches.

4.7. Construction Considerations

- The excavations for the construction of the abutment foundations for bridge 24/5 will encounter a perched groundwater table. The contractor will be required to maintain a dry excavation to allow footing construction. Dewatering using pumps appears feasible although the contractor should expect significant in-flows into the excavation.

The contract plans could be developed with a concrete seal poured at the footing elevation. The seal may be deleted if the groundwater is lower than the footing elevation or if the contractor is successful in dewatering the excavation using pumps.

- The construction of the splice between the shaft foundation and pier column will require the contractor to place either a large diameter temporary casing or construct an internally braced sheet pile wall. The contractor should expect difficult conditions when attempting to vibrate large diameter casing through Unit 1 and 3 and into 2 soils. The presence of cobbles and boulders may affect temporary casing penetration using vibratory equipment.
- Temporary casing with slurries may be required to maintain sidewall stability of the shaft excavation for shaft construction at bridge 24/5. The driving of the temporary shaft casing will be difficult due to the very dense nature of the foundation soils. Due to the very clean nature of the soils at this site, slurries may not be totally effective to prevent caving. The use of the rotator or oscillator shaft drilling equipment is recommended at this site. The Association of Drill Shaft Contractors will have an opportunity to review this report and will make recommendations to WSDOT for drill shaft construction.
- Embankment widening will require hillside terrace construction per the Standard Specifications section 2-03.3(14).
- We recommend an inspection of the in-situ soils be conducted by the Region Materials Engineer (or his representative) immediately following the excavation for the foundations (spread footings/walls/pipe arch) of all structures. Any loose material found to be present within the footing perimeter must be properly compacted prior to footing construction.
- The construction of stage 1 shoring wall for Piers 1 and 3 at bridge 24/1 will require either an anchor supported sheet pile wall or soldier pile wall. The existing fills and embankment foundation soils through which the shoring would be installed contain layers of dense sands and gravels. Although not encountered in the test drilling, cobbles are present on the surface of the embankment. Vibrating sheet piles through these soils could be difficult. The drilling of shafts for a soldier pile tieback wall may require temporary casing. The contractor must be made aware of these conditions.

5. Conclusions

Attached with this report are: *Figures 1-13* in Appendix A; logs of test borings and laboratory test data in Appendices B and C, capacity charts for foundations of the 24/1 and 24/5 bridge are contained in Appendix D and P-y data is contained in Appendix E. Copies of the logs of test

borings should be included with the contract special provisions. We will provide a "Summary of Geotechnical Conditions" when the final PS&E set is being prepared. A copy of this report should be made available to all prospective bidders.

If you have questions or require further information, please contact David Jenkins at (360) 709-5455.



TA,JC,:dj

Attachments: *Appendix A – Figures*
Appendix B – Field Explorations
Appendix C – Laboratory Testing
Appendix D – Shaft and Footing Capacity Graphs
Appendix E – P-y Curve Data

APPENDIX A - FIGURES

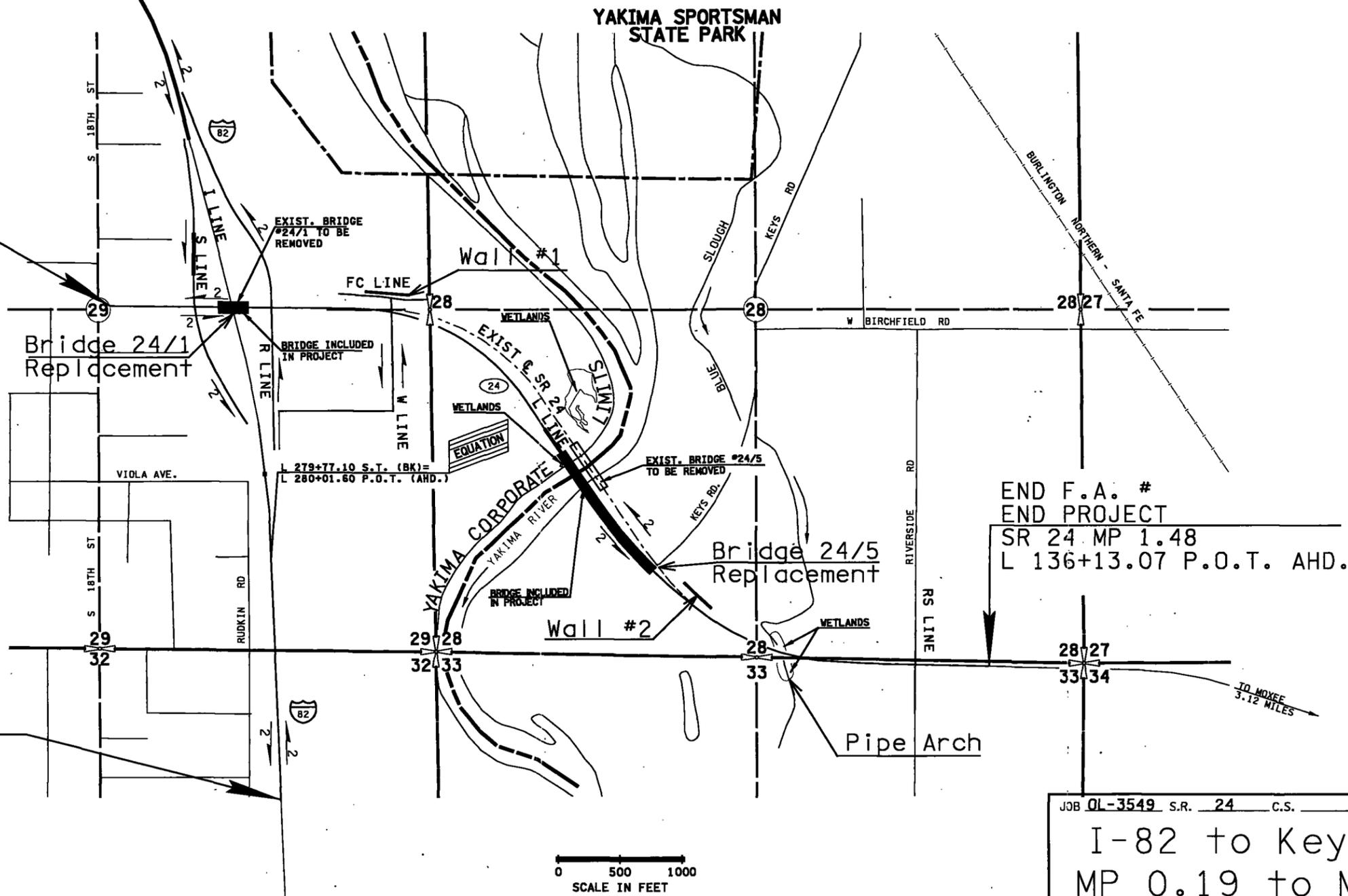
T.13N. R.19E. W.M.

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STA. I 220+74.37
MP 34.03

BEGIN F.A. #
BEGIN PROJECT
SR 24 MP -0.15
L 49+70.00 P.O.T.

CITY OF
YAKIMA

END CONSTRUCTION
STA. I 299+22.73
MP 35.52



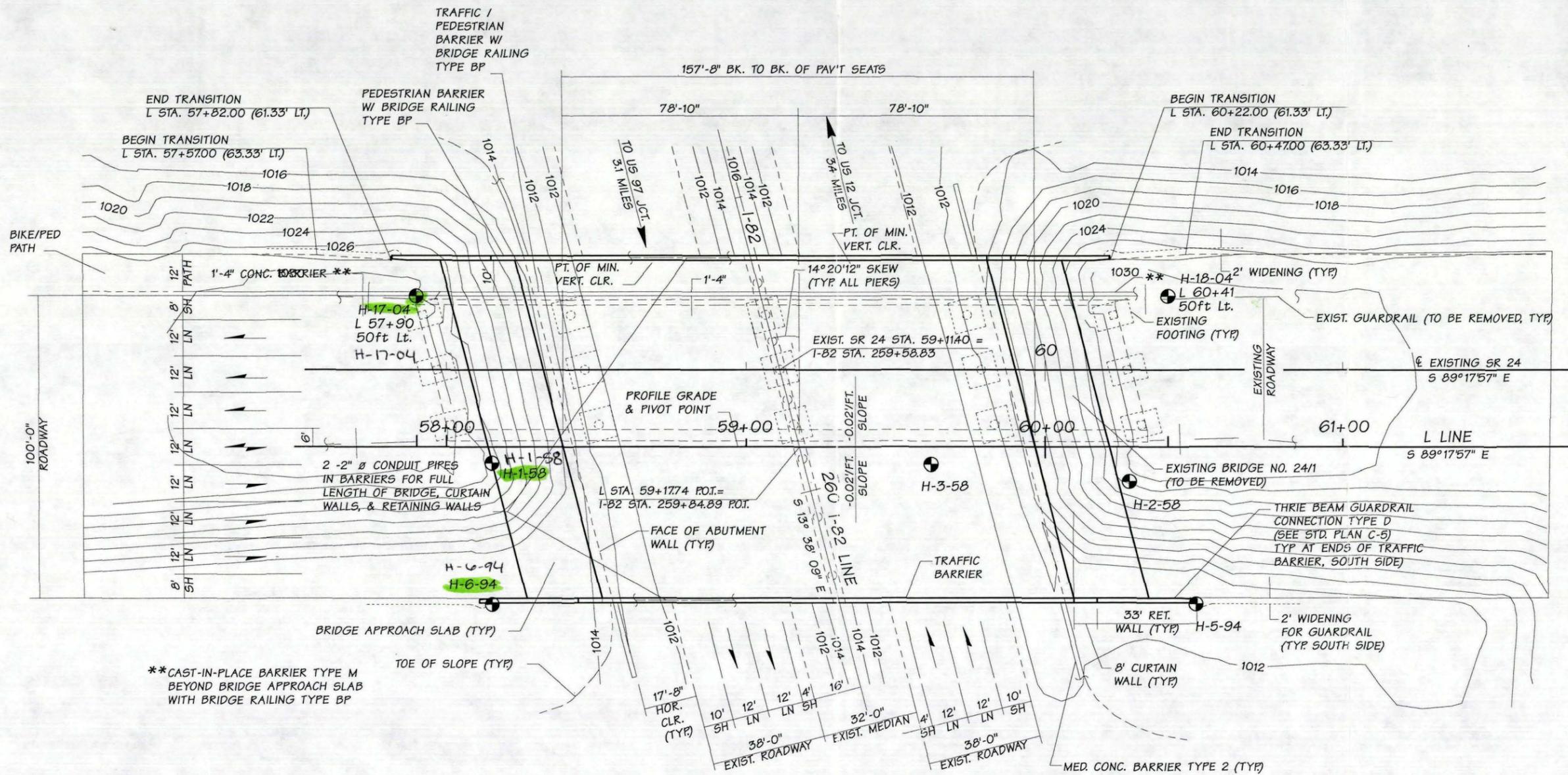
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JOB 01-3549 S.R. 24 C.S. _____
I-82 to Keys Road
MP 0.19 to MP 1.29

WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION MATERIALS BRANCH T. E. BAKER MATERIALS ENGINEER	DATE 6/2004
	SCALE N.T.S. VERT. HORIZ.
	SHEET ___ OF ___ DRAWN BY W.M.

Figure 1: Vicinity Map

SEC. 29, T.13N., R.19E., W.M.
CITY OF YAKIMA
SR 24



**CAST-IN-PLACE BARRIER TYPE M BEYOND BRIDGE APPROACH SLAB WITH BRIDGE RAILING TYPE BP

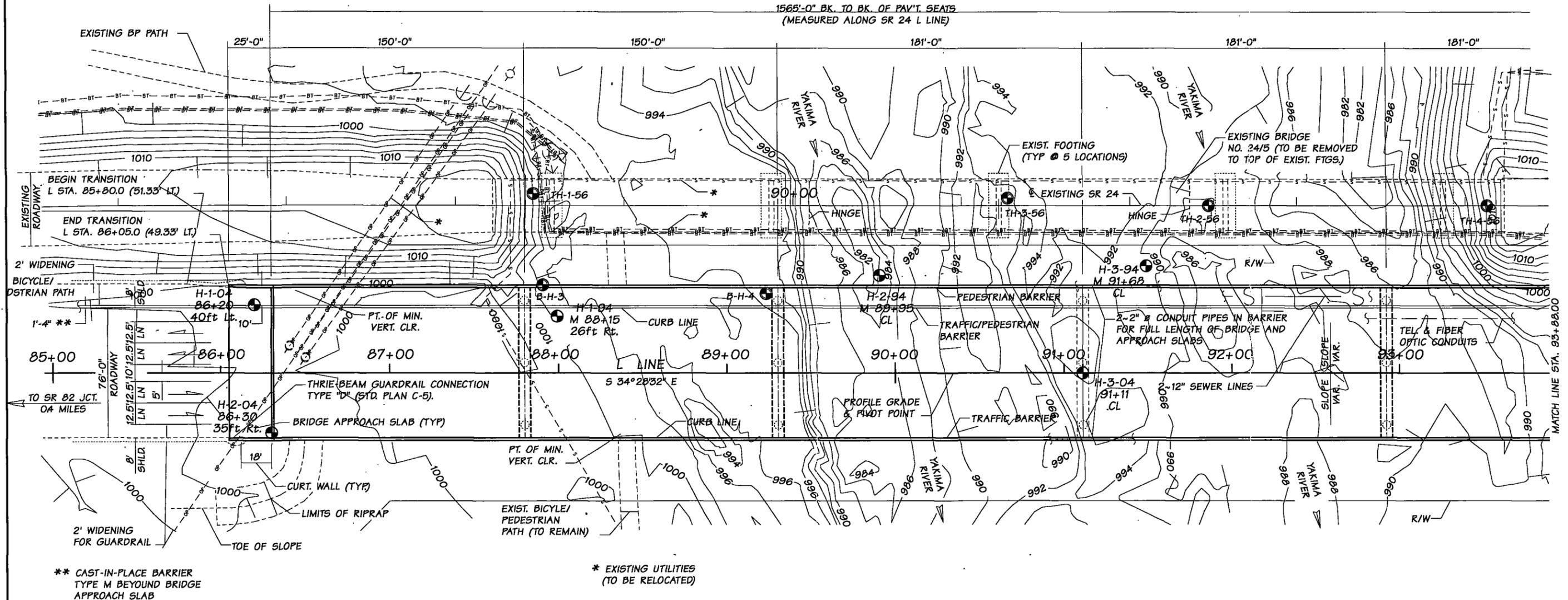
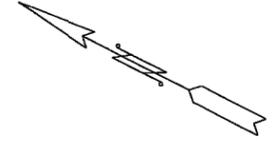
H-11-04
L 59+65.02
159ft Rt.

Figure 2: Bridge 24/1 Replacement Plan

JOB <u>OL-3549</u> S.R. <u>24</u> C.S. _____	
I-82 to Keys Road O.C. Bridge #24/1 Replacement	
 WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION MATERIALS BRANCH T. E. BAKER MATERIALS ENGINEER	DATE <u>6/2004</u> SCALE <u>1=40'</u> VERT. HORIZ. SHEET _____ OF _____ DRAWN BY <u>W.M.</u>

I-82 OC BSD.dgn 09/08/2004 03:40:35 PM

SEC. 28, T.13N., R.19E., W.M.
YAKIMA COUNTY
SR 24



** CAST-IN-PLACE BARRIER
TYPE M BEYOND BRIDGE
APPROACH SLAB

* EXISTING UTILITIES
(TO BE RELOCATED)

JOB <u>01-3549</u> S.R. <u>24</u> C.S. _____	
I-82 to Keys Road	
Yakima Bridge #24/5 Replacement	
MP 0.19 to MP 1.29	
 WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION MATERIALS BRANCH T. E. BAKER MATERIALS ENGINEER	DATE <u>6/2004</u>
	SCALE <u>1=60'</u> VERT. HORIZ.
	SHEET _____ OF _____
DRAWN BY <u>W.M.</u>	

Figure 3A: Bridge 24/5 Replacement Plan

SEC. 28, T.13N., R.19E., W.M.
YAKIMA COUNTY
SR 24

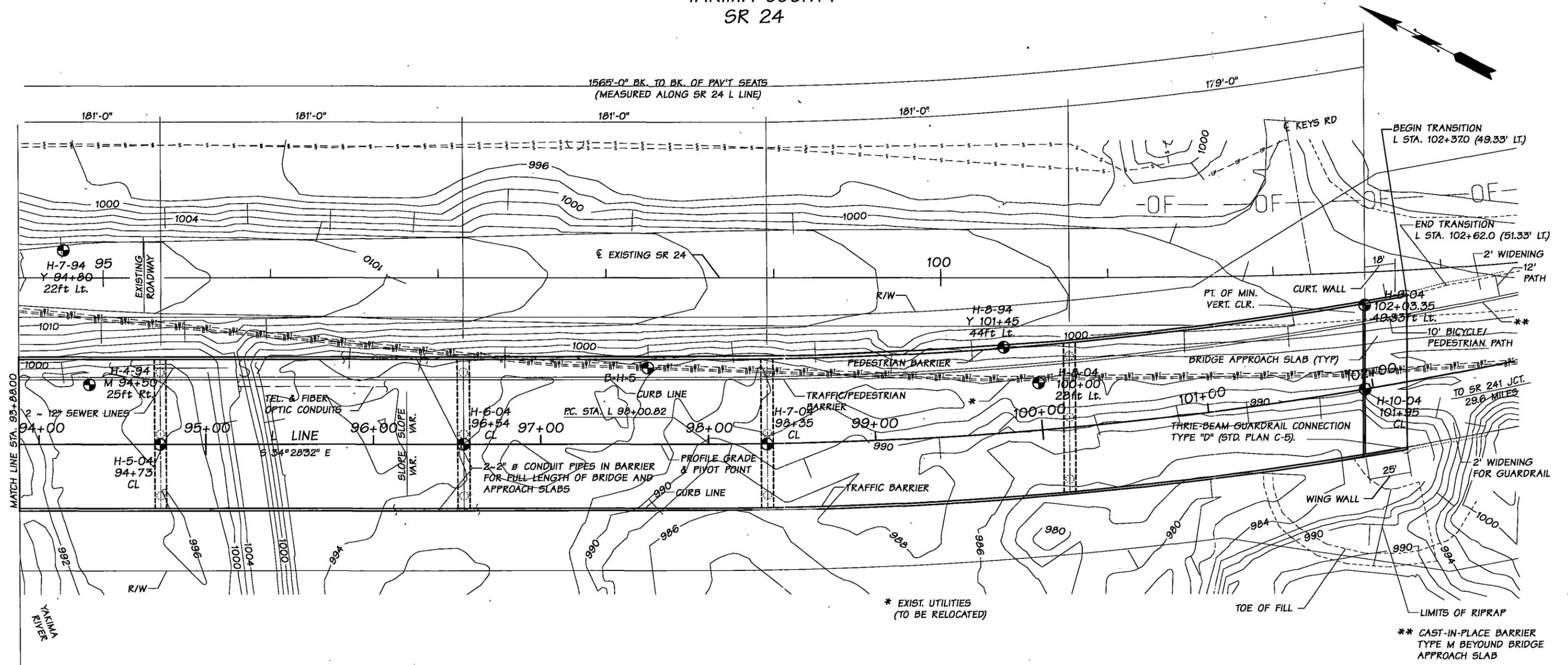


Figure 3B: Bridge 24/5 Replacement Plan

JOB <u>01-3549</u> S.R. <u>24</u> C.S. _____	
I-82 to Keys Road	
Yakima Bridge #24/5 Replacement	
MP 0.19 to MP 1.29	
 WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION MATERIALS BRANCH T. E. BAKER MATERIALS ENGINEER	DATE 6/2004 SCALE 1=60' VERT. HORIZ.
	SHEET _____ OF _____
	DRAWN BY <u>W.M.</u>

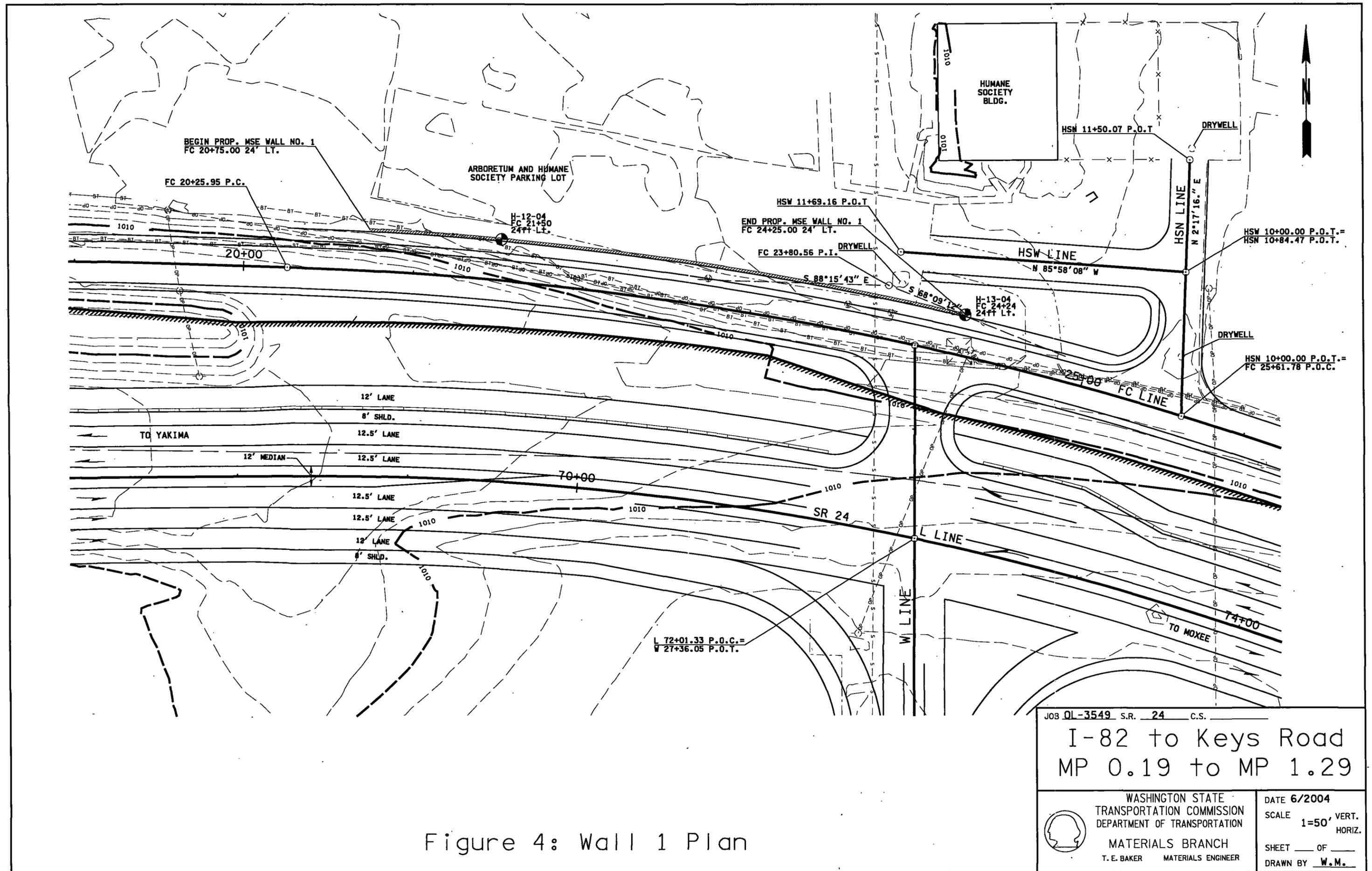


Figure 4: Wall 1 Plan

JOB <u>01-3549</u> S.R. <u>24</u> C.S. _____	
I-82 to Keys Road MP 0.19 to MP 1.29	
 WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION MATERIALS BRANCH T. E. BAKER MATERIALS ENGINEER	DATE 6/2004
	SCALE 1=50' VERT. HORIZ.
	SHEET _____ OF _____ DRAWN BY <u>W.M.</u>

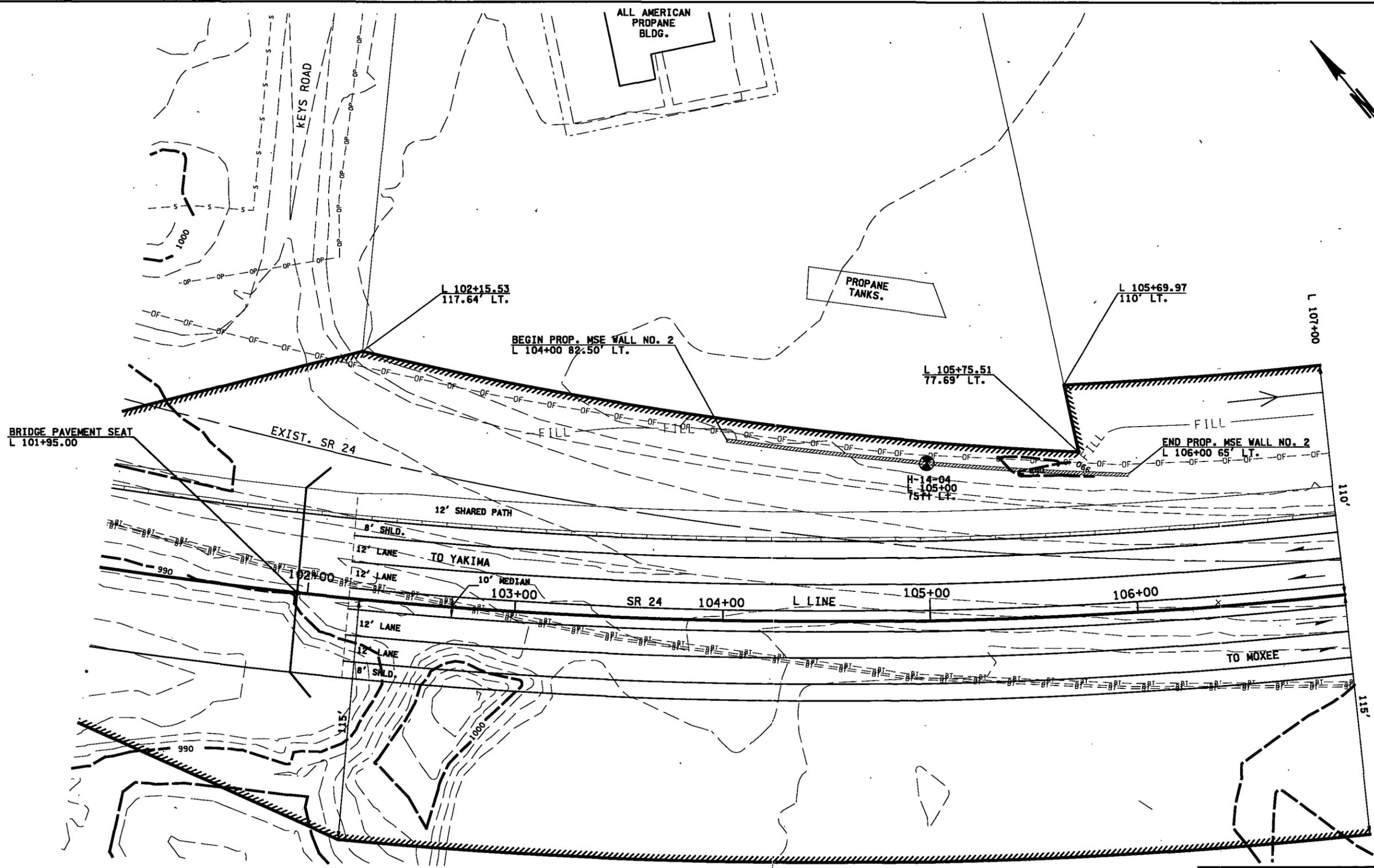
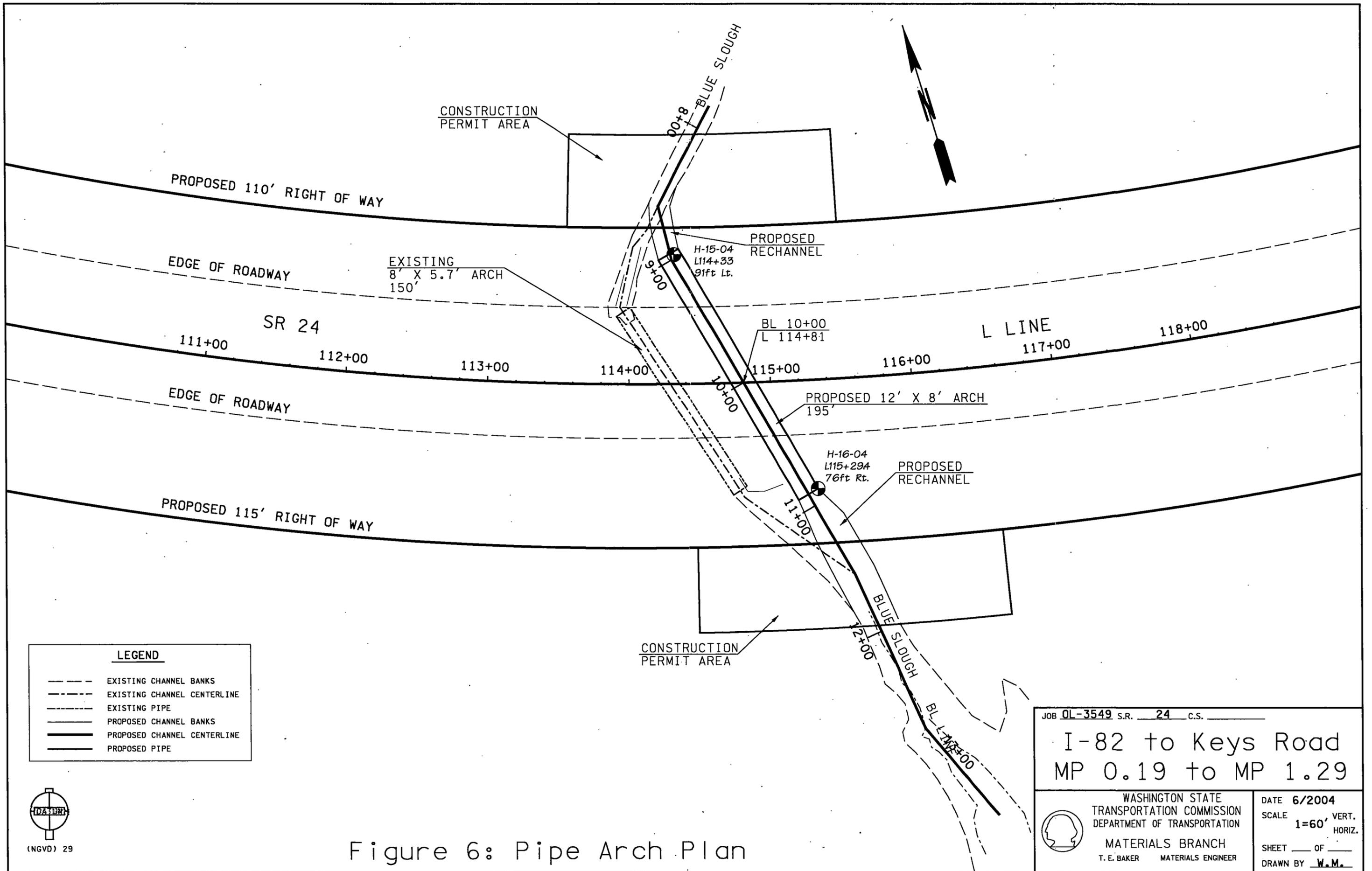


Figure 5: Wall 2 Plan

JOB <u>01-3549</u> S.R. <u>24</u> C.S. _____	
I-82 to Keys Road MP 0.19 to MP 1.29	
 WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION	DATE 6/2004
	SCALE 1=50' VERT. HORIZ.
MATERIALS BRANCH	
T. E. BAKER MATERIALS ENGINEER	
SHEET _____ OF _____	DRAWN BY <u>W.M.</u>



LEGEND	
---	EXISTING CHANNEL BANKS
- - - -	EXISTING CHANNEL CENTERLINE
---	EXISTING PIPE
---	PROPOSED CHANNEL BANKS
---	PROPOSED CHANNEL CENTERLINE
---	PROPOSED PIPE

JOB 01-3549 S.R. 24 C.S. _____

I-82 to Keys Road
MP 0.19 to MP 1.29

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION

MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

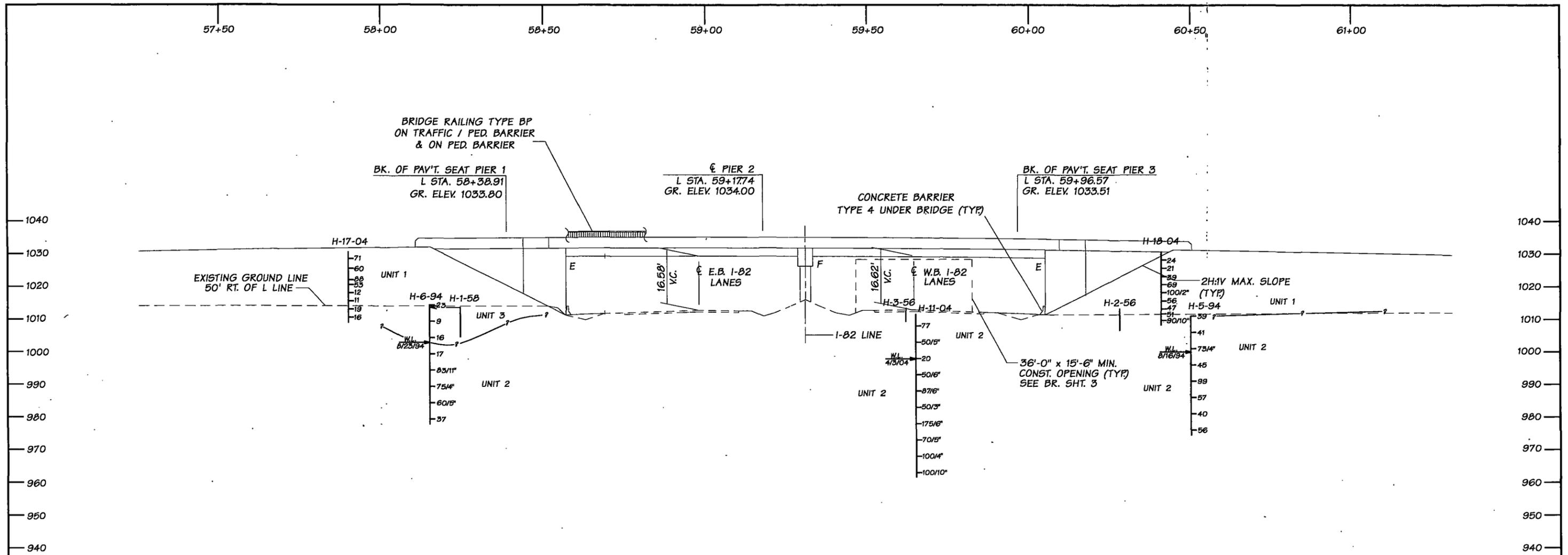
DATE 6/2004
SCALE 1=60' VERT.
HORIZ.

SHEET _____ OF _____
DRAWN BY W.M.

Figure 6: Pipe Arch Plan



(NGVD) 29



TEST HOLE LEGEND

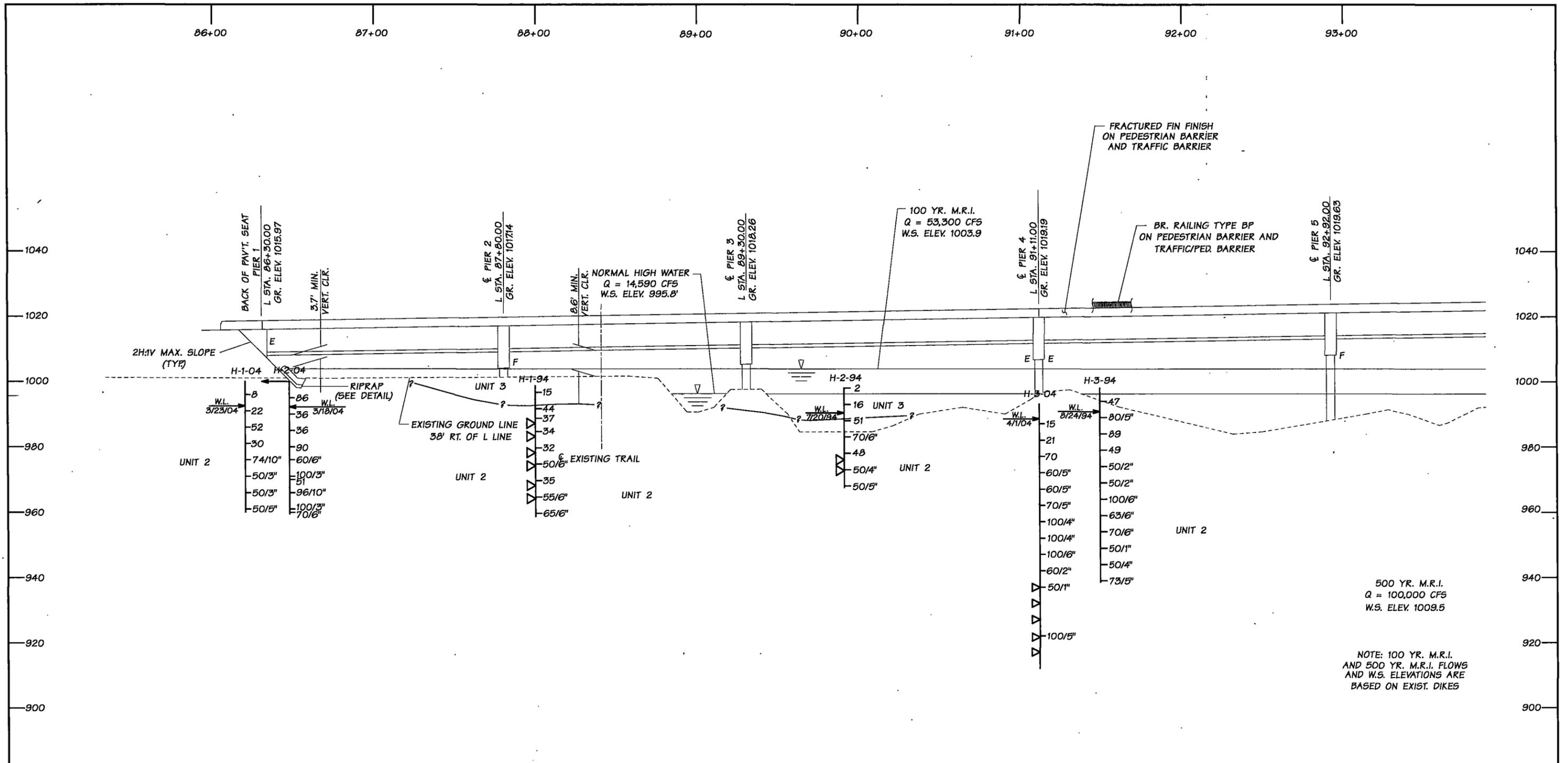
- H-1-98 TEST HOLE NUMBER
- 110+55 TEST HOLE STATION
- 26 ft. Rt. TEST HOLE OFFSET
- 23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)
- UNDISTURBED SAMPLE
- WL 8-6-86 WATER LEVEL & DATE
- ? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
- INDICATES INTACT ROCK
- INDICATES CORE SAMPLE TAKEN
- ROCK QUALITY DESIGNATION

- UNIT 1 - Fill material generally comprised of medium dense to very dense well graded GRAVELS with and without sand.
- UNIT 2 - Medium dense to very dense, well graded GRAVEL with sand, cobbles and boulders, and silty GRAVEL with sand and poorly graded GRAVEL with silt and sand.
- UNIT 3 - Loose to medium dense silty SAND with gravel, poorly graded SAND with silt.
- UNIT 4 - Dense to very dense well graded SAND with gravel and cobbles. This Unit is interbedded with Unit 2 soils.

DATUM
NGVD 1929

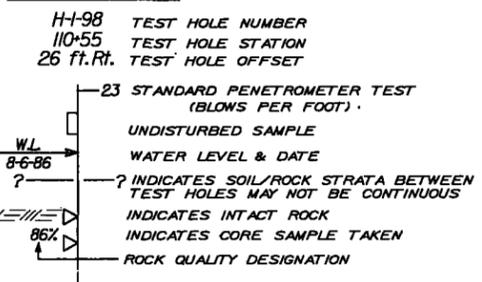
Figure 7: Bridge 24/1 Replacement Profile

JOB <u>OL-3549</u> S.R. <u>24</u> C.S. _____	
I-82 to Keys Road	
O.C. Bridge #24/1 Replacement	
WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION	DATE 6/2004
MATERIALS BRANCH T. E. BAKER MATERIALS ENGINEER	SCALE 1=30' VERT. HORIZ.
DRAWN BY <u>W.M.</u>	SHEET _____ OF _____



NOTE: 100 YR. M.R.I. AND 500 YR. M.R.I. FLOWS AND W.S. ELEVATIONS ARE BASED ON EXIST. DIKES

TEST HOLE LEGEND



- UNIT 1 - Fill material generally comprised of medium dense to very dense well graded GRAVELS with and without sand.
- UNIT 2 - Medium dense to very dense, well graded GRAVEL with sand, cobbles and boulders, and silty GRAVEL with sand and poorly graded GRAVEL with silt and sand.
- UNIT 3 - Loose to medium dense silty SAND with gravel, poorly graded SAND with silt.
- UNIT 4 - Dense to very dense well graded SAND with gravel and cobbles. This Unit is interbedded with Unit 2 soils.

Figure 8A: Bridge 24/5 Replacement Profile

JOB 01-3549 S.R. 24 C.S. _____

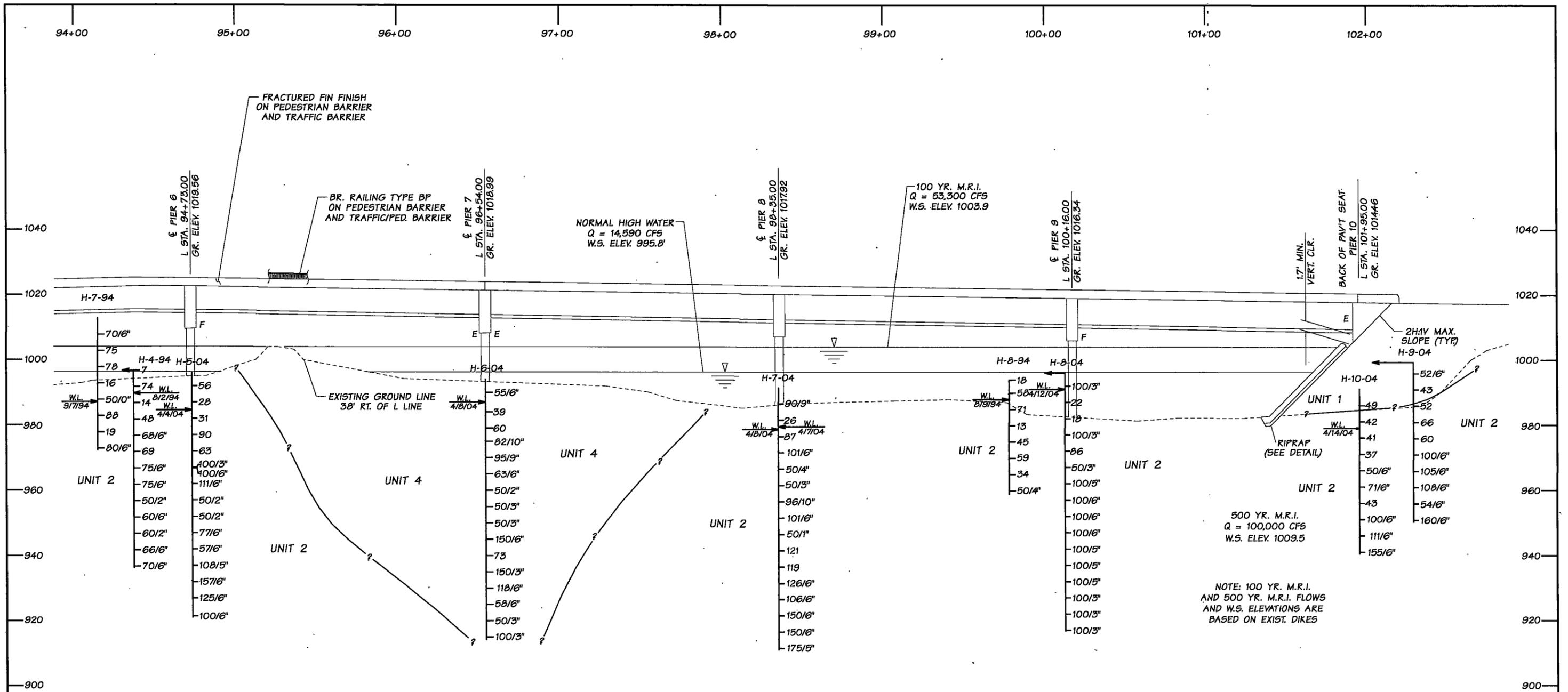
I-82 to Keys Road
Yakima Bridge #24/5 Replacement
MP 0.19 to MP 1.29

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION

MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 6/2004
SCALE 1=30' VERT.
1=60' HORIZ.

SHEET _____ OF _____
DRAWN BY W.M.



NORMAL HIGH WATER
 Q = 14,590 CFS
 W.S. ELEV. 995.8'

100 YR. M.R.I.
 Q = 53,300 CFS
 W.S. ELEV. 1003.9

500 YR. M.R.I.
 Q = 100,000 CFS
 W.S. ELEV. 1009.5

NOTE: 100 YR. M.R.I.
 AND 500 YR. M.R.I. FLOWS
 AND W.S. ELEVATIONS ARE
 BASED ON EXIST. DIKES

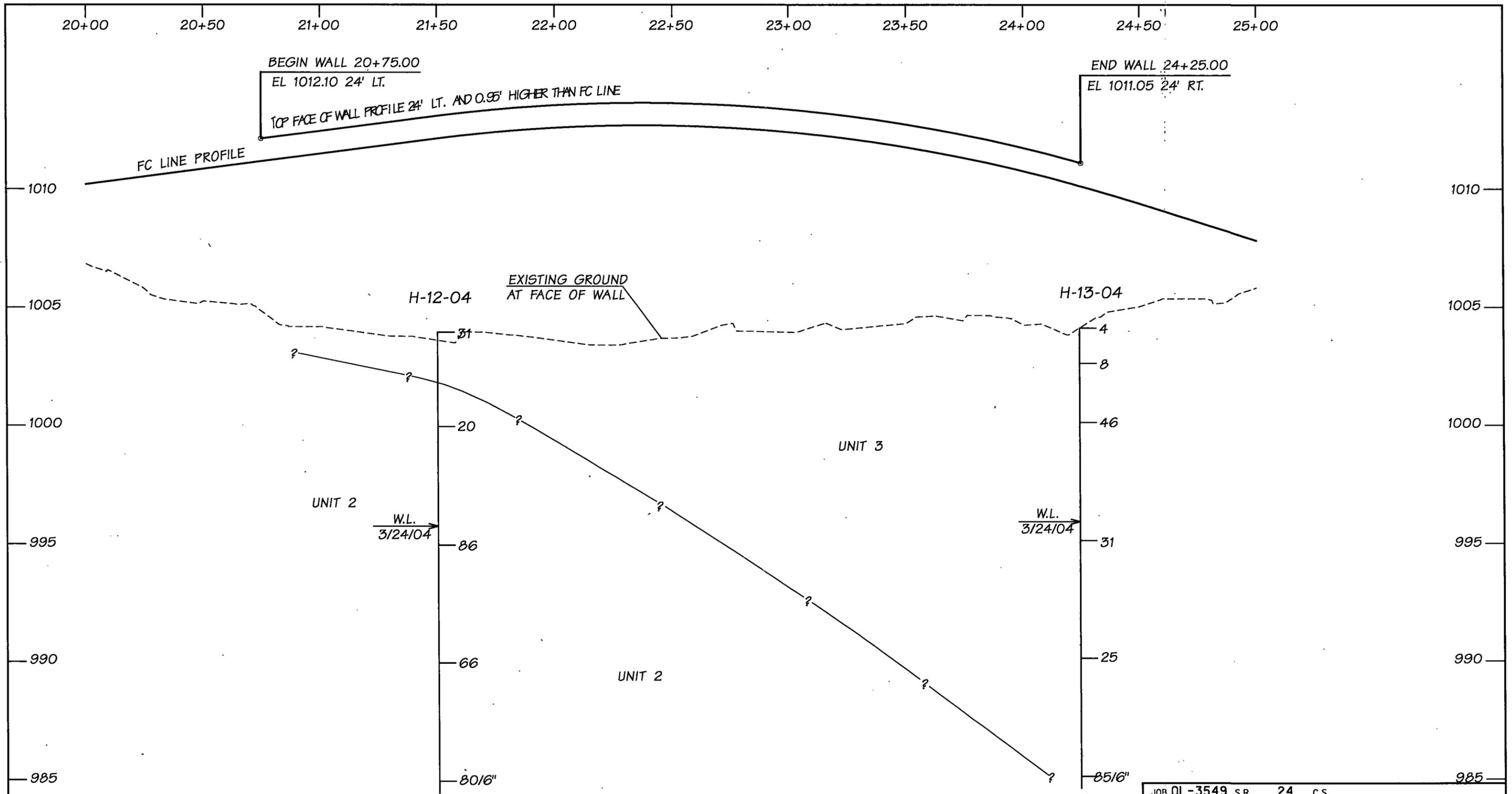
TEST HOLE LEGEND

- 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
- 85% INDICATES CORE SAMPLE TAKEN
- ROCK QUALITY DESIGNATION

- UNIT 1 - Fill material generally comprised of medium dense to very dense well graded GRAVELS with and without sand.
- UNIT 2 - Medium dense to very dense, well graded GRAVEL with sand, cobbles and boulders, and silty GRAVEL with sand and poorly graded GRAVEL with silt and sand.
- UNIT 3 - Loose to medium dense silty SAND with gravel, poorly graded SAND with silt.
- UNIT 4 - Dense to very dense well graded SAND with gravel and cobbles. This Unit is interbedded with Unit 2 soils.

JOB <u>OL-3549</u> S.R. <u>24</u> C.S. _____	
I-82 to Keys Road	
Yakima Bridge #24/5 Replacement	
MP 0.19 to MP 1.29	
WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION	DATE 6/2004
MATERIALS BRANCH	SCALE 1=30' VERT. 1=60' HORIZ.
T. E. BAKER MATERIALS ENGINEER	SHEET _____ OF _____
	DRAWN BY <u>W.M.</u>

Figure 8B: Bridge 24/5 Replacement Profile



TEST HOLE LEGEND

- H-12-04 TEST HOLE NUMBER
- 10+55 TEST HOLE STATION
- 26 ft. RT. TEST HOLE OFFSET
- 23 STANDARD PENETROMETER TEST (BLOWS PER FOOT)
- UNDISTURBED SAMPLE
- W.L. WATER LEVEL & DATE
- 86/86 ? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
- INDICATES INTACT ROCK
- 85X INDICATES CORE SAMPLE TAKEN
- ROCK QUALITY DESIGNATION



(NGVD) 29

- UNIT 1 - Fill material generally comprised of medium dense to very dense well graded GRAVELS with and without sand.
- UNIT 2 - Medium dense to very dense, well graded GRAVEL with sand, cobbles and boulders, and silty GRAVEL with sand and poorly graded GRAVEL with silt and sand.
- UNIT 3 - Loose to medium dense silty SAND with gravel, poorly graded SAND with silt.
- UNIT 4 - Dense to very dense well graded SAND with gravel and cobbles. This Unit is interbedded with Unit 2 soils.

Figure 9: Wall 1 Profile

JOB 01-3549 S.R. 24 C.S. _____

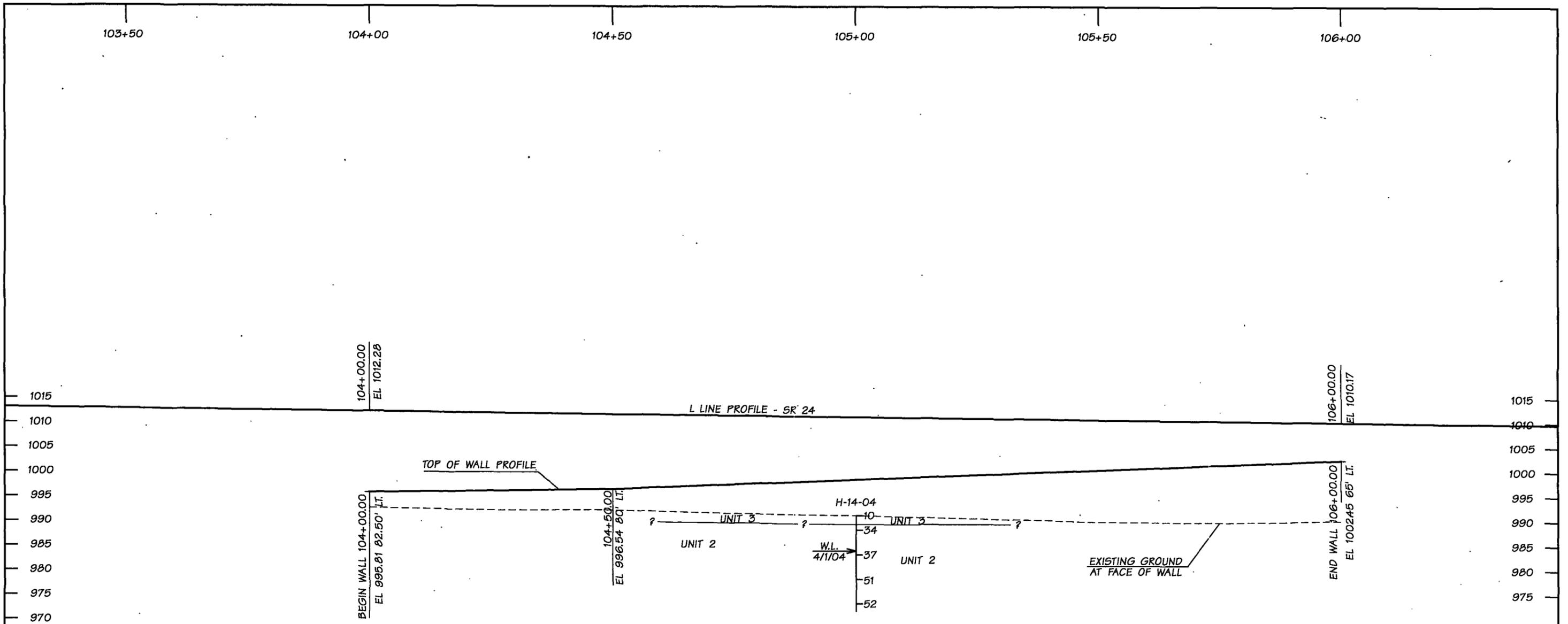
I-82 to Keys Road
MP 0.19 to MP 1.29

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION

MATERIALS BRANCH
T. E. BAKER MATERIALS ENGINEER

DATE 6/2004
SCALE 1"=4' VERT.
1"=40' HORIZ.

SHEET _____ OF _____
DRAWN BY W.M.



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. WATER LEVEL & DATE
- ? ? INDICATES SOIL/ROCK STRATA BETWEEN TEST HOLES MAY NOT BE CONTINUOUS
- INDICATES INTACT ROCK
- INDICATES CORE SAMPLE TAKEN
- ROCK QUALITY DESIGNATION

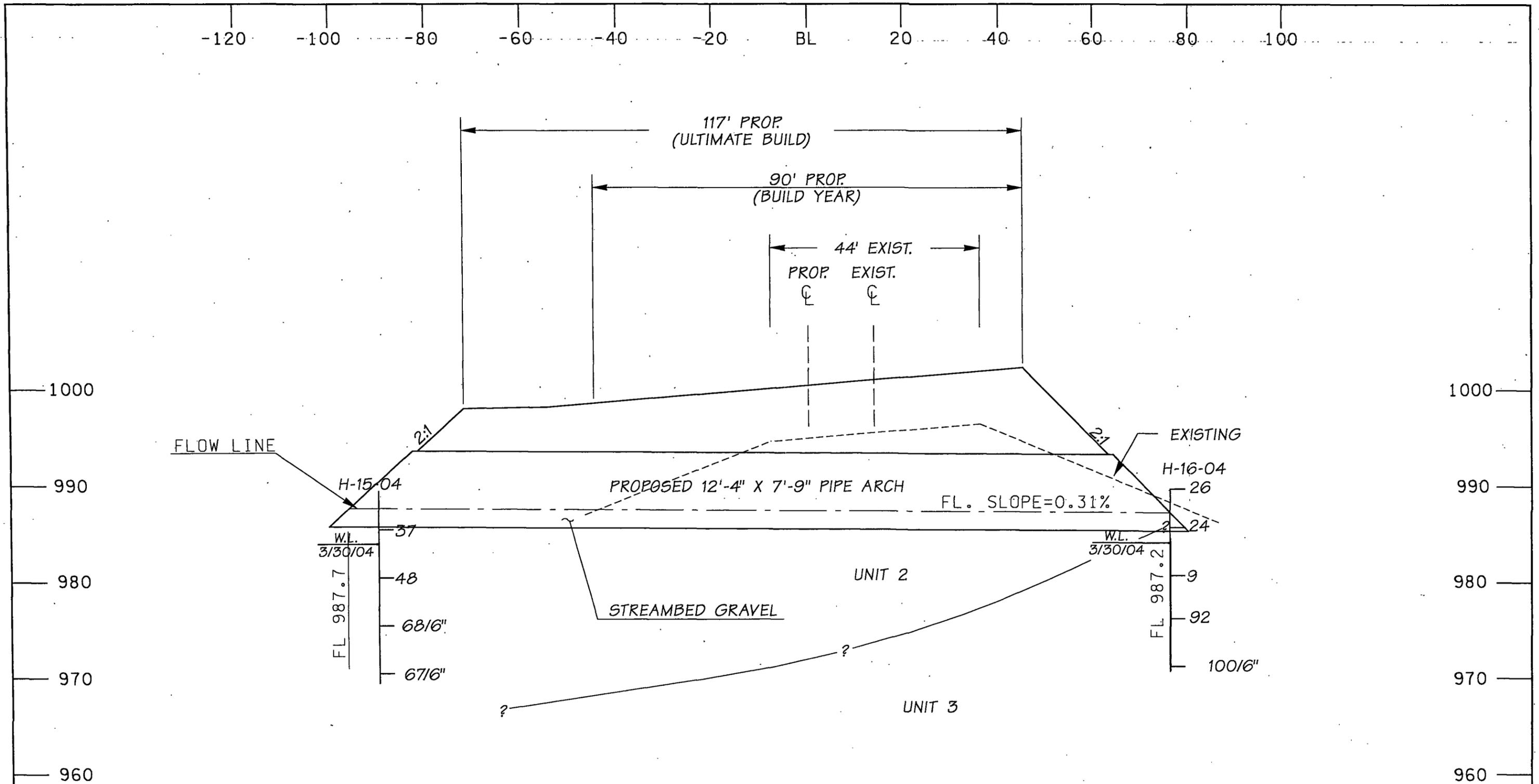
- UNIT 1 - Fill material generally comprised of medium dense to very dense well graded GRAVELS with and without sand.
- UNIT 2 - Medium dense to very dense, well graded GRAVEL with sand, cobbles and boulders, and silty GRAVEL with sand and poorly graded GRAVEL with silt and sand.
- UNIT 3 - Loose to medium dense silty SAND with gravel, poorly graded SAND with silt.
- UNIT 4 - Dense to very dense well graded SAND with gravel and cobbles. This Unit is interbedded with Unit 2 soils.

JOB <u>01-3549</u> S.R. <u>24</u> C.S. _____	
I-82 to Keys Road MP 0.19 to MP 1.29	
 WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION MATERIALS BRANCH T. E. BAKER MATERIALS ENGINEER	DATE 6/2004 SCALE 1=20' VERT. HORIZ. SHEET _____ OF _____ DRAWN BY W.M.

Figure 10: Wall 2 Profile



(NGVD) 29



- UNIT 1 - Fill material generally comprised of medium dense to very dense well graded GRAVELS with and without sand.
- UNIT 2 - Medium dense to very dense, well graded GRAVEL with sand, cobbles and boulders, and silty GRAVEL with sand and poorly graded GRAVEL with silt and sand.
- UNIT 3 - Loose to medium dense silty SAND with gravel, poorly graded SAND with silt.
- UNIT 4 - Dense to very dense well graded SAND with gravel and cobbles. This Unit is interbedded with Unit 2 soils.

TEST HOLE LEGEND

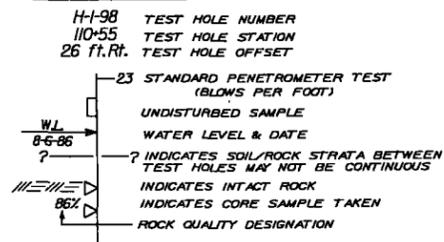


Figure 11: Pipe Arch Profile

JOB 01-3549 S.R. 24 C.S. _____

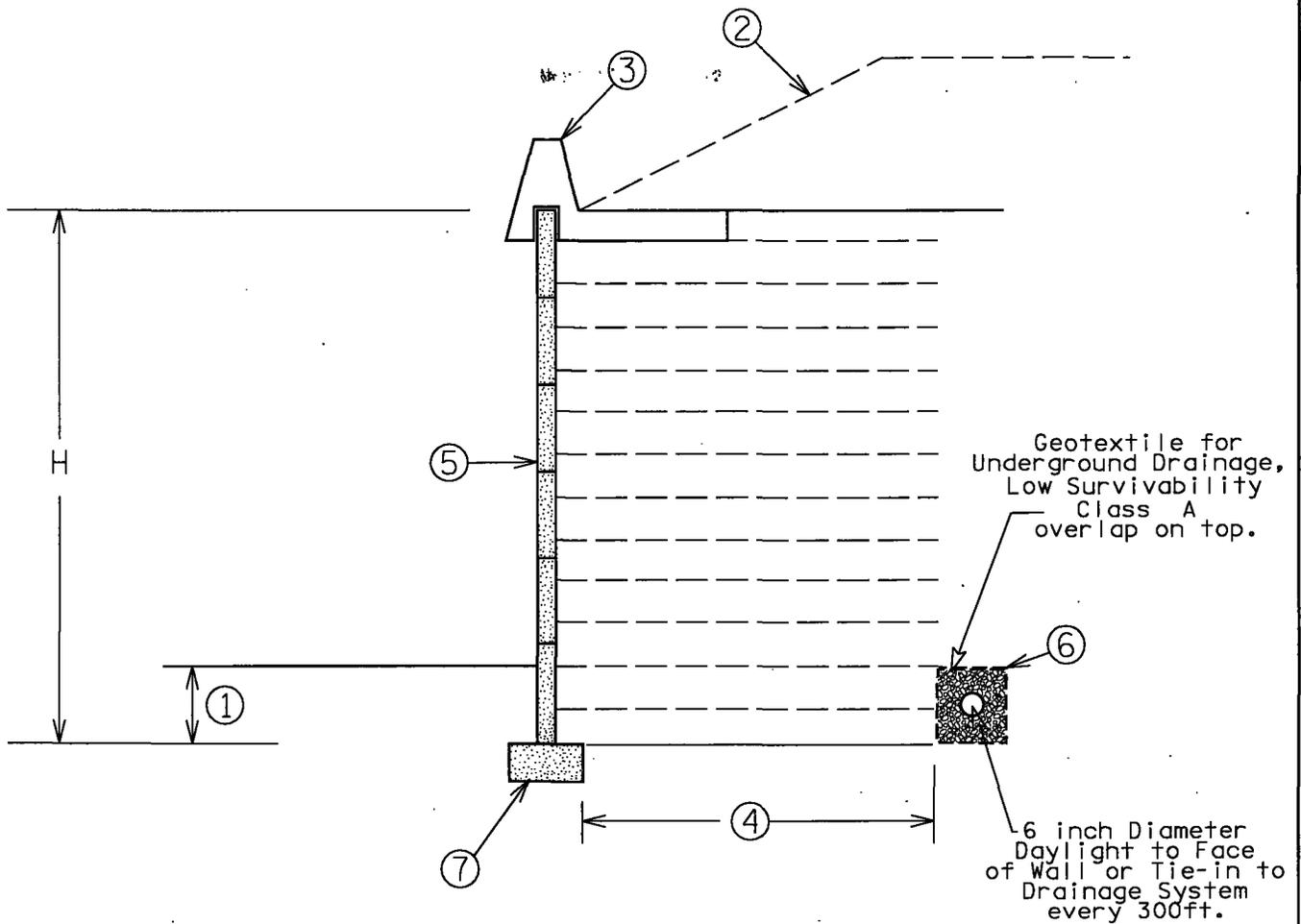
I-82 to Keys Road
 MP 0.19 to MP 1.29

WASHINGTON STATE
 TRANSPORTATION COMMISSION
 DEPARTMENT OF TRANSPORTATION

MATERIALS BRANCH
 T. E. BAKER MATERIALS ENGINEER

DATE 6/2004
 SCALE 1=10' VERT.
 1=20' HORIZ.

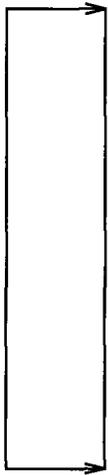
SHEET ___ OF ___
 DRAWN BY W.M.



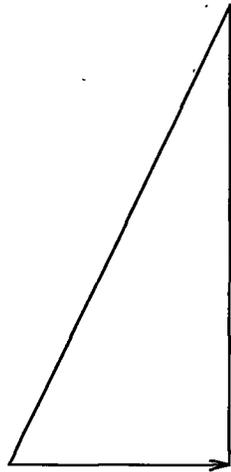
- ① Minimum embedment of 2ft or 10% of H which ever is greatest
- ② 2:1 slope surcharge (Wall 2)
- ③ Cost-in-place moment slab barrier (if required per manufacture design) Wall 1
- ④ Reinforcement length typically not less than 70% of H
- ⑤ Wall facing either pre-cast concrete panel or modular block
- ⑥ Heel drain
- ⑦ Concrete leveling pad (per manufacture design)

FIGURE 12: Wall 1 and 2 Typical Wall-Section

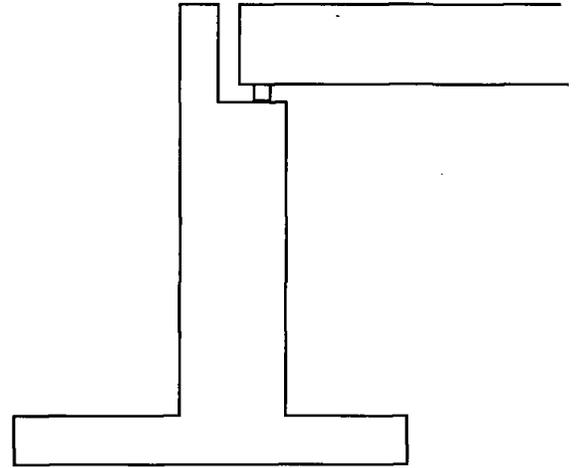
JOB DL-3549 S.P. 24 C.S. LAYOUT	
I-82 to Keys Road MP 0.19 to MP 1.29	
 WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION MATERIALS BRANCH T. E. BAKER MATERIALS ENGINEER	DATE 6/2004
	SCALE N.T.S. VERT. HORIZ.
	SHEET ___ OF ___ DRAWN BY W.M.



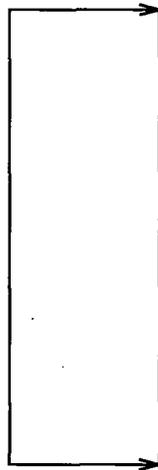
*Ka(Traffic)



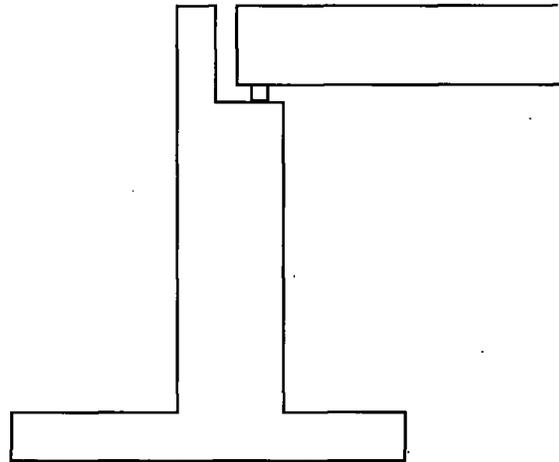
*KaγH



Strength Limit State



*KaεγH



Extreme Event I Limit State

* Refer to Tables 1 & 7 for Appropriate Values.

FIGURE 13: Earth Pressure Diagrams for Strength and Extreme Limit State for Bridge L Abutments.

JOB DL-3549 S.R. 24 C.S. LAYOUT	
I-82 to Keys Road MP 0.19 to MP 1.29	
 WASHINGTON STATE TRANSPORTATION COMMISSION DEPARTMENT OF TRANSPORTATION MATERIALS BRANCH T. E. BAKER MATERIALS ENGINEER	DATE 6/2004 SCALE N.T.S. VERT. HORIZ.
	SHEET ___ OF ___ DRAWN BY W.M.

APPENDIX B –FIELD EXPLORATION

FIELD EXPLORATION PROGRAM

To characterize the surface and subsurface conditions, we performed a site reconnaissance and drilled a total of 6 test borings. Five test borings drilled in 1980 for the G-Line Bridge were also used for the design. The Headquarters Materials Laboratory drilled all borings. The locations of the test borings are shown on the detailed site plan (*Figures 2, XX and XX*) in Appendix A.

The Headquarters Materials Lab borings were performed using three types of drill rigs. Ten borings were completed using a track mounted CME 850. Four of the borings were complete using a CME 45 skid-mounted drill rig, eleven using a CME-55 truck-mounted drill rig, and nine using a truck-mounted Longyear drill rig. HWA Geosciences used Layne Christenson Company of Tacoma, Washington and this drilling company employed a Becker drill rig to advance the test borings.

Borings drilled in 1994 and 2004 were advanced using either mud rotary drilling methods or augers. All test borings drilled by HWA were advanced using Becker drill rig. The Becker drill rig is a dual-wall drill casing advanced using an AP 1000 single-cylinder diesel percussion hammer. Forced air is forced down the annulus between the inner and outer drive pipe walls and returned via the center of the inner pipe, lifting the displaced soil cuttings to the top of the drive pipe where they are collected. At each location, soil samples were obtained using a SPT (Standard Penetration Test) sampler, in general accordance with ASTM T 206-87. SPTs are obtained by driving a 2-inch outside diameter split-spoon sampler 18-inches into the soil with a 140-pound hammer. The number of blows required to achieve each 6 inches of penetration is recorded and the soil's SPT resistance, or N-value, is calculated as the number of blows required to achieve the final 12 inches of penetration. Each drill rig is equipped with an automatic trip hammer to drive the split-spoon sampler. The automatic hammers on the drill rigs are rated at approximately 80 percent efficiency, as compared to approximately 60 percent for manual hammers.

Following completion of the drilling program, select soil samples were then submitted to the Headquarters Materials Laboratory for laboratory testing. The soil samples from the SPT were visually classified in the field then submitted to the Headquarters Materials Laboratory for more detailed classification and testing. Boring logs and a legend of the terms and symbols used or shown on the boring logs are included in this appendix and should be included in the contract documents.

The locations and elevations of the borings were determined by survey. The dates, driller, drilling equipment type and depths of each boring are shown on the following table. In addition, the table also shows the purpose for the boring.

Table B-1 Boring Dates, Depths and Purposes

Boring	Date Drilled	Driller	Drilling Equipment	Depth (ft)	Purpose
TH-1-04	3/16/04	Headquarters Materials Lab	CME 850	15.5	Pond
TH-2-04	3/16/04	"	"	16.5	"
TH-3-04	4/3/04	"	CME 45	14.5	"
TH-4-04	3/17/04	"	CME 850	16	"
TH-5-04	3/16/04	"	"	18	"
TH-6-04	3/15/04	"	"	12	"
TH-7-04	3/25/04	"	CME 55	11	"
TH-8-04	3/25/04	"	"	12.5	"
H-1-04	3/24/04	"	CME 850	40	Bridge 24/5
H-2-04	3/17/04	"	"	40.5	"
H-3-04	3/30/04	"	CME 45	81	"
H-5-04	3/25/04	"	CME 850	75	"
H-6-04	4/8/04	"	"	79.7	"
H-7-04	4/8/04	"	CME 55	80.4	"
H-8-04	4/14/04	"	CME 850	79.2	"
H-9-04	4/1/04	"	CME 55	49	"
H-10-04	4/14/04	"	"	50.5	"
H-11-04	4/3/04	"	"	49.8	Bridge 24/1
H-12-04	3/23/04	"	"	19.5	Wall 1
H-13-04	3/24/04	"	"	19.5	"
H-14-04	4/1/04	"	"	19.5	Wall 2
H-15-04	3/30/04	"	"	20	Pipe Arch
H-16-04	3/30/04	"	"	19	"
H-17-04	4/13/04	"	CME 45	21.5	Bridge 24/1
H-18-04	4/13/04	"	"	22.4	"
H-1-94	7/26/94	"	BK 81	40	Bridge 24/5
H-2-94	7/20/94	"	"	30.4	"
H-3-94	8/24/94	"	"	59.4	"
H-4-94	8/2/94	"	"	60.5	"
H-5-94	8/16/94	"	"	36.5	Bridge 24/1
H-6-94	8/23/94	"	"	36.5	"
H-7-94	9/7/94	"	"	40.5	Ped. Bridge
H-8-94	8/9/94	"	"	35	Wall
H-9-94	8/11/94	"	"	36	Slope
BH-1	11/12/99	HWA	Becker	20.5	Slope
BH-2	11/13/99	"	"	20.5	Slope
BH-3	11/11/99	"	"	69.8	Bridge 24/5
BH-4	11/12/99	"	"	80.5	"
BH-5	11/13/99	"	"	20.5	"
BH-6	11/13/99	"	"	19.4	Slope

The exploratory borings are assumed to be representative of the subsurface conditions at the proposed bridge abutment, pier, and slope locations. If during construction, subsurface conditions different from those encountered in the field explorations are observed, we should be advised immediately so that we may reevaluate our recommendations and provide assistance.

The groundwater levels in the borings were measured at various times following completion of the borings. A complete record of these measurements is shown in the table below:

Table B-2 - Groundwater Level Measurements

Boring Number	Boring Elevation (feet, NAVD 88 Datum)	Date	Depth to Ground Water (ft)	Ground Water Elevation, feet (NAVD 88 Datum)
TH-1-04	1018.3	3/16/04	dry	N/A
TH-2-04	1010.2	3/17/04	12.2	998
TH-3-04	1010.0	4/03/04	7.4	1002.6
TH-4-04	1007.5	3/17/04	11.9	995.6
TH-5-04	1009.3	3/16/04	dry	N/A
TH-6-04	999.5	3/15/04	7.3	992.2
TH-7-04	989.5	3/25/04	5.7	983.8
TH-8-04	991.0	3/25/04	dry	N/A
H-7-04	991.5	4/8/04	12.8	978.7
H-11-04	1011.4	4/3/04	13.5	997.9

**Appendix B-1
Logs of Test Borings
1994/2004 WSDOT**

Test Boring Legend

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

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

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

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

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

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

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

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

Degree of Vesicularity of Pyroclastic Rocks	
Slightly Vesicular	5 to 10 percent of total
Moderately Vesicular	10 to 25 percent of total
Highly Vesicular	25 to 50 percent of total
Scoriaceous	Greater than 50 percent of total



Test Boring Legend

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

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

Relative Rock Strength			
Grade	Description	Field Identification	Uniaxial Compressive Strength approx
R1	Very Weak	Specimen crumbles under sharp blow from point of geological hammer, and can be cut with a pocket knife.	150-3500 psi
R2	Moderately Weak	Shallow cuts or scrapes can be made in a specimen with a pocket knife. Geological hammer point indents deeply with firm blow.	3500-7500 psi
R3	Moderately Strong	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer.	7500-15000 psi
R4	Strong	Specimen breaks with one firm blow from the hammer end of a geological hammer.	15000-350000 psi
R5	Very Strong	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 30000 psi

Discontinuities			
Spacing		Condition	
Very Widely	Greater than 3 m	Excellent	Very rough surfaces, no separation, hard discontinuity wall
Widely	1 m to 3 m	Good	Slightly rough surfaces, separation less than 1 mm, hard discontinuity wall.
Moderately	0.3 m to 1 m	Fair	Slightly rough surfaces, separation greater than 1 mm, soft discontinuity wall.
Closely	50 mm to 300 mm	Poor	Slickensided surfaces, or soft gouge less than 5 mm thick, or open discontinuities 1 to 5 mm.
Very Closely	Less than 50 mm	Very Poor	Soft gouge greater than 5 mm thick, or open discontinuities greater than 5 mm.
RQD (%) $\frac{100(\text{length of core in pieces} > 100\text{mm})}{\text{Length of core run}}$			

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



Start Card _____

Job No. OL-3549 SR 24

Elevation 998.7 ft (304.4 m)

HOLE No. H-1-94

Sheet 1 of 2

Project SR-24 / I-82 to Keys Road

Driller _____ Lic# _____

Site Address _____

Inspector _____

Start July 26, 1994 Completion July 28, 1994 Well ID# _____ Equipment _____

Station M 88+15 Offset 26' Rt. Casing HW X 17', HQ X 40' Method Wet Rotary

Northing _____ Easting _____ Latitude _____ Longitude _____

County _____ Subsection _____ Section _____ Range _____ Township _____

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
0	0	X											
1	0.3	X						2 7 18 (15)	D-1		Top surface cobbles and boulders. Rip Rap. 0.0 ft. to 2.0 ft. Silty SAND with cobbles and boulders. Fill material.		
5	1.5	X											
2	0.6							26 21 23 (44)	D-2	MC GS	Silty SAND with gravel, angular, medium dense, brown, moist. Some cobbles and boulders as indicated by drilling. Fill. (100% water loss). Retained 0.5 ft.		
10	3.0							44 24 13 (37)	D-3	MC GS	GW-GM, M.C. = 7% Well graded GRAVEL with silt and sand, angular, dense, dark brown, moist. Some cobbles and boulders as indicated by drilling. (50% water loss). Fill. Retained 1.0 ft.		
4	1.2							8 13 21 (34)	D-5		GW, M.C. = 5% 7/26/94 Well graded GRAVEL with sand, cobbles and boulders, angular, dense, brown, wet. (50% water loss). Retained 0.6 ft.		
4	1.2								C-4		Well graded GRAVEL, subrounded, with cobbles and boulders. Fines washed away. Recovered 2.5 ft.		
15	4.5								D-6		Well graded GRAVEL with silt and sand, subrounded, dense, brown, wet. (98% water loss). Retained 1.0 ft.		
5	1.5								C-6		Well graded GRAVEL with cobbles and boulders, rounded to subrounded. Fines washed away. Recovered 2.7 ft.		
20	6.0							8 15	D-7		Well graded GRAVEL with silt and sand, subrounded to angular, very dense, brown, wet. (100% water loss). Retained 0.7 ft.		

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04.9:32:19 A6



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7							17 (32)	C-8		Well graded GRAVEL with cobbles and boulders, fines washed away. Gravel is rounded, subrounded to angular, 100% water loss down hole. 94% recovery.			
25							50/6"	D-9 C-10		Well graded GRAVEL with silt and sand, rounded, subrounded to angular, very dense, brown, wet. Retained 0.3 ft.			
8										Well graded GRAVEL with cobbles and boulders, subrounded to angular, most of fine washed away. Some cobble and boulder sized pieces of Basalt. 100% water loss down hole. 67% recovery.			
9							12 20 15 (35)	D-11 C-12	MC GS	GP-GM, M.C. = 14% Poorly graded GRAVEL with silt and sand, angular, dense, brown, wet. Retained 0.8 ft.			
10										GRAVEL with cobbles and boulders, fines washed away. 100% water loss down hole. 67% recovery.			
35							55/6"	D-13 C-14		Poorly graded GRAVEL with silt and sand, subrounded to angular, very dense, brown, wet. Retained 0.5 ft.			
11										Well graded GRAVEL with cobbles and boulders, fines washed away. 100% water loss down hole. 67% recovery.			
12							40 65/6"	D-15	MC GS	GW-GM, M.C. = 12% Well graded GRAVEL with silt and sand, angular, very dense, brown, wet. Cobble and boulder sized material as indicated by drilling. 100% water loss. Retained 0.5 ft. End of test hole boring at 40.0 ft. below ground elevation.			
13										This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.			
45													

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04 9:32:20 A6



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7							22 24 24 (48)	D-5 C-6		Well graded GRAVEL with cobbles, rounded to subrounded, dark brown, wet, 100% recovery.			
25							50/4"	D-7 C-8		Well graded GRAVEL with silt and sand, very dense, dark brown, wet. Retained 0.3 ft.			
30							50/5"	D-9		Well graded GRAVEL with cobbles, rounded to subrounded, dark brown, wet. 64% recovery.			
30.4										Well graded GRAVEL with silt and sand, very dense, dark brown, wet, Retained 0.4 ft. End of test hole boring at 30.4 ft. below ground elevation.			
10										This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.			
35													
40													
45													

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04 9:32:20 A6



Start Card _____

Job No. 0L-3549 SR 24

Elevation 998.0 ft (304.2 m)

HOLE No. H-3-94

Sheet 1 of 3

Project SR-24 / I-82 to Keys Road

Driller _____ Lic# _____

Site Address _____

Inspector _____

Start August 24, 1994 Completion September 1, 1994 Well ID# _____ Equipment _____

Station M 91+68 Offset Centerline Casing 4" OD X 25', HQ X 59.4' Method Dry to Wet Rotary

Northing _____ Easting _____ Latitude _____ Longitude _____

County _____ Subsection _____ Section _____ Range _____ Township _____

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
0.0	0.0									0.0 ft. to 4.0 ft. Silty SAND with gravel.			
1	0.3					6		D-1	MC	GP, M.C. = 4% Poorly graded GRAVEL with sand, subround to angular, dense, brown, moist. River channel material. Retained 1.0 ft. Extremely hard drilling from 5.5 ft. to 9.0 ft., cobbles and boulders.			
5	1.5					19			GS				
28	8.5					28							
47	14.0					(47)							
80/5"	13.7							D-2		Well graded GRAVEL with sand, cobbles and boulders, angular, very dense, dark brown, wet. River channel material. Retained 0.4 ft.	8/24/94		
25	7.6					25		D-3	MC	GW, M.C. = 9% Well graded silty GRAVEL with sand, cobbles and boulders, subrounded to angular, very dense, dark brown, wet. Extremely hard drilling. Retained 1.5 ft.			
43	13.1					43			GS				
46	13.7					46							
(89)	16.1					(89)							
22	6.7					22		D-4	MC	GW-GM, M.C. = 14% Well graded GRAVEL with silt and sand, cobbles and boulders, angular, very dense, dark brown, wet. Very			
27	8.1					27			GS				

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04.9:32:21 A6



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
0	0						22 (49)						hard drilling. Retained 1.2 ft.
7	2.4												
25	7.6						50	50/2"	D-5				Well graded GRAVEL with silt and sand, cobbles and boulders, angular, very dense, dark brown, wet. Retained 0.6 ft.
8	2.4												
30	9.1						33	37	50/2"	D-6			Extremely hard drilling. Auger refused at depth 29:0 ft. Changed to HQ core through barrel at 29.0 ft. Well graded GRAVEL with silt and sand, cobbles and boulders, angular, very dense, dark brown, wet. 10% to 20% water loss down hole. Retained 1.2 ft.
9	2.7												
35	10.7						100	6"	D-7				Well graded GRAVEL with sand, cobbles and boulders, subrounded to angular, very dense, dark brown, wet. 10% to 15% water loss down hole. Retained 0.5 ft.
10	3.0												
40	12.2						63	6"	D-8				Well graded GRAVEL with sand, cobbles and boulders, subrounded to angular, very dense, dark brown, wet. Retained 0.5 ft.
11	3.3												
45	13.7						70	6"	D-9				Well graded GRAVEL with sand, cobbles and boulders, subrounded to angular, very dense, dark brown, wet. 10% to 15% water loss down hole.
12	3.7												
13	4.0												

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04 9:32:21 A6



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
14											Retained 0.5 ft.		
15							50/1"	D-10			Sampler bouncing on rock. No recovery. 10% water loss down hole.		
50							50 50/4"	D-11			Well graded GRAVEL with sand, cobbles and boulders, subrounded to angular, very dense, dark brown, wet. 10% to 15% water loss down hole. Retained 0.8 ft.		
16													
55													
17													
18							>>	73/5"	D-11		Well graded GRAVEL with sand, cobbles and boulders, subrounded to angular, very dense, dark brown, wet. 10% water loss. Retained 0.4 ft. End of test hole boring at 59.4 ft. below ground elevation.		
60													
19													
65													
20													
21													
70													

SOIL_01-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04 9:32:21 AM

This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.



Start Card _____

Job No. OL-3549 SR 24

Elevation 996.7 ft (303.8 m)

HOLE No. H-4-94

Sheet 1 of 3

Project SR-24 / I-82 to Keys Road

Driller _____ Lic# _____

Site Address _____

Inspector _____

Start August 2, 1994 Completion August 4, 1994 Well ID# _____ Equipment _____

Station M 94+50 Offset 25' Rt. Casing HW,HQ Method HQ Coring

Northing _____ Easting _____ Latitude _____ Longitude _____

County _____ Subsection _____ Section _____ Range _____ Township _____

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10 20 30 40	1 2 5 (7)	▲	D-1		Top surface rip rap NW of hole, dike 30' SE of test hole. Silty SAND with root hairs, loose, brown, dry. 2.0 ft. of overburden. 100% water loss. Retained 1.0 ft.		
1				16 24 50 (74)	▲	D-2		Well graded GRAVEL with silt and sand, angular, very dense, brown, moist. Retained 1.0 ft. Cored from 5.0 ft. to 10.0 ft. Cobbles, boulders, some pieces of cobble sized basalt in core run. 100% water loss down hole. 60% recovery.	▽	
5				11 8 6 (14)	▲	D-3		Well graded GRAVEL with silt and sand, subround to angular, medium dense, brown, wet. Retained 1.1 ft. Cored from 10.0 ft. to 15.0 ft. Cobbles and boulders shown in core run. 70% recovery.		
10				18 18 30 (48)	▲	D-4		Well graded GRAVEL with silt and sand, angular, dense, brown, wet. Retained 1.1 ft. Note: Some boulders and cobbles as indicated in core run from 15.0 ft. to 20.0 ft. 100% water loss.		
15										
20										

SOIL OL-3549 SR-24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04 9:32:22 A6



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7							24 68/6"	D-5		Well graded GRAVEL with silt and sand, angular, very dense, brown, wet. 98% water loss down hole. Drilling with HQ advancer. Retained 1.0 ft.			
25	8						35 38 31 (69)	D-6		Well graded GRAVEL with silt and sand, subrounded to angular, very dense, dark brown, wet. 90% water loss. Retained 1.0 ft. 25.0 ft. to 30.0 ft. HQ core. 60% recovery.			
30	9						75/6"	D-7		Well graded GRAVEL with silt and sand, angular, very dense, dark brown, wet. 90% water loss down hole. Retained 0.5 ft. Cored 30.0 ft. to 35.0 ft. Cobbles, boulders and cobble sized Basalt. 50% recovery.			
35	11						75/6"	D-8		Well graded GRAVEL with silt and sand, very dense, dark brown, wet. Retained 0.5 ft. Cored from 35.0 ft. to 40.0 ft. Cobbles and boulders shown in core run. 40% recovery.			
40	12						50/2"	D-9		Sampler bouncing on gravel. No recovery. Cored from 40.0 ft. to 45.0 ft. Some pieces of Basalt, cobble sized. 15% water loss down hole. 22% recovery.			
45	13												

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04,9:32:22 A6



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
14							23	60/6"	D-10		Well graded GRAVEL with silt and sand, angular, very dense, dark brown, wet. Retained 0.8 ft. Cored from 45.0 ft. to 50.0 ft. Some pieces of fine grained Basalt, cobble sized. 5% water loss down hole. 22% recovery.		
50							60/2"	D-11		Well graded GRAVEL with silt and sand, angular, very dense, dark brown, wet. Retained 0.2 ft. Cored from 50.0 ft. to 55 ft. Some pieces of cobble sized Basalt. 40% recovery.			
55							70	66/6"	D-12		Well graded GRAVEL with silt and sand, angular, very dense, dark brown, wet. Retained 1.0 ft. Cored from 55.0 ft. to 60 ft. Same material. 15% water loss. 46% recovery.		
60							70/6"	D-13		Well graded GRAVEL with silt and sand, angular, very dense, dark brown, wet. Retained 0.5 ft. End of test hole boring at 60.5 ft. below ground elevation.			
19											This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
65													
20													
21													
70													

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04.9:32:22 A6



LOG OF TEST BORING

Start Card _____

Job No. 0L-3549 SR 24 Elevation 1011.0 ft (308.2 m)

HOLE No. H-5-94

Sheet 1 of 2

Project SR-24 / I-82 to Keys Road

Driller _____ Lic# _____

Site Address _____

Inspector _____

Start August 16, 1994 Completion August 16, 1994 Well ID# _____ Equipment _____

Station L 60+50 Offset 52' Rt. Casing 4" OD X 35' H. C. AUGERS Method DRY ROTARY

Northing _____ Easting _____ Latitude _____ Longitude _____

County _____ Subsection _____ Section _____ Range _____ Township _____

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
1													
5						14 15 24 (39)	D-1	MC GS		GM, M.C. = 1% Dense, brown, dry, silty GRAVEL with sand (FILL?). Recovered 0.8 ft., Retained 0.8 ft.			
2						15 21 20 (41)	D-2			Dense, brown, dry, well graded GRAVEL with silt and sand. Note: Cobbles and boulders were encountered as indicated by drilling. Recovered 0.9 ft., Retained 0.9 ft.			
10						9 23 73/4"	D-3			Very dense, brown, dry to wet, well graded GRAVEL with sand. Note: Cobbles and boulders were encountered as indicated by drilling. Recovered 0.7 ft., Retained 0.7 ft.			
4						22 24 21 (45)	D-4			Dense, brown, wet, well graded GRAVEL with silt and sand. Note: Cobbles and boulder were encountered as indicated by drilling. Recovered 1.3 ft., Retained 1.3 ft.			
15													
5													
20													

8-16-94

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ_SOIL.GDT 1/3/05,8:34:04 A1



LOG OF TEST BORING

Start Card _____

Job No. OL-3549

SR 24

Elevation 1011.0 ft (308.2 m)

HOLE No. H-5-94

Sheet 2 of 2

Project SR-24 / I-82 to Keys Road

Driller _____

Lic# _____

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7						>>	40 44 55 (99)	D-5	MC GS	GP-GM, M.C. = 13% Very dense, brown, wet, poorly graded GRAVEL with silt and sand. Note: Cobbles and boulders were encountered as indicated by drilling. Recovered 1.5 ft., Retained 1.5 ft.			
25						>>	50 32 25 (57)	D-6		Note: Very hard drilling. Very dense, brown, wet, well graded GRAVEL with silt and sand. Recovered 1.5 ft., Retained 1.5 ft.			
30							30 22 18 (40)	D-7		Note: Very hard drilling. Dense, dark brown, wet, poorly graded GRAVEL with silt and sand. Note: Cobbles and boulders were encountered as indicated by drilling. Recovered 1.5 ft., Retained 1.5 ft.			
35						>>	45 27 29 (56)	D-8		Note: Very hard drilling. Very dense, brown, wet, well graded GRAVEL with silt and sand. Note: Cobbles and boulders were encountered as indicated by drilling. Recovered 1.5 ft., Retained 1.5 ft.			
40										End of the Test Hole Boring at 36.5 ft. below ground elevation.			
45										This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.			

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 1/3/05,8:34:05 A1



LOG OF TEST BORING

Start Card _____

Job No. OL-3549

SR 24

Elevation 1014.3 ft (309.2 m)

HOLE No. H-6-94

Sheet 2 of 2

Project SR-24 / I-82 to Keys Road

Driller _____ Lic# _____

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7							31 33 50/5" (83/11")	D-5		Very dense, brown, wet, well graded GRAVEL with silt and sand. Recovered 1.0 ft., Retained 1.0 ft.			
25							75/4" (75/4")	D-6		Note: Hard drilling. Sampler bouncing on Rock material. Very dense, brown, wet, well graded GRAVEL with silt and sand. Recovered 0.3 ft., Retained 0.3 ft.			
30							16 60/5 (60/5")	D-7		Note: Extremely hard drilling from depth of 30 ft. to 35 ft. Very dense, brown, wet, poorly graded GRAVEL with silt and sand. Recovered 1.5 ft., Retained 0.9 ft.			
35							11 17 20 (37)	D-8		GP-GM, M.C. = 9% Dense, brown, wet, poorly graded GRAVEL with silt and sand. Recovered 1.5 ft., Retained 1.0 ft.			
40											End of the Test Hole Boring at 36.5 ft. below ground elevation.		
45											This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT 1/3/05, 8:34:07, A1



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7													
25	8					15 11 5 (16)		D-4	MC GS	SM, M.C. = 12% Silty SAND with gravel, decayed wood fiber and root hairs, subrounded to angular, medium dense, brown, moist. Retained 1.0 ft.			
25	8					50/0"		D-5		Very dense, sampler bouncing on rock. Gravel with cobbles and boulders as indicated by drilling from 22.0 ft. to 25.0 ft. No recovery.	▽		
30	9					25 28 60 (88)		D-6		Well graded GRAVEL with sand, cobbles and boulders, angular, very dense, brown, wet. Retained 1.5 ft.			
35	10									Possibly old river channel at 35.0 ft. as indicated by drilling..			
35	11					11 8 11 (19)		D-7		Well graded GRAVEL with silt and sand, subrounded to angular, medium dense, brown, wet. Retained 1.0 ft. Advanced rapidly from from 35.0 ft. to 37.0 ft., resumed hard drilling at 37.0 ft.			
40	12					80/6"		D-8		Well graded GRAVEL with silt and sand, cobbles and boulders, angular, very dense, dark brown, wet. Sampler bouncing on rock at 40.5 ft. below ground elevation. Auger head stopped cutting. Retained 0.5 ft. End of test hole boring at 40.5 ft. below ground elevation.			
45	13									This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.			

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04 9:32:24 A6



LOG OF TEST BORING

Start Card _____

Job No. 0L-3549 SR 24

Elevation 993.8 ft (302.9 m)

HOLE No. H-8-94

Sheet 1 of 2

Project SR-24 / I-82 to Keys Road

Driller _____ Lic# _____

Site Address _____

Inspector _____

Start August 9, 1994 Completion August 9, 1994 Well ID# _____ Equipment _____

Station Y 101+45 Offset 44' Rt. Casing 4" OD Hollow Core Augers Method Dry Rotary

Northing _____ Easting _____ Latitude _____ Longitude _____

County _____ Subsection _____ Section _____ Range _____ Township _____

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
0	0		10 20 30 40	4 6 12 (18)	▲	D-1	MC GS	SM, M.C. = 4% Top surface bladed cat road below toe of slope. Silty SAND with gravel, angular, medium dense, brown, dry. Cobbles and boulders encountered as indicated by drilling. Fill material. Retained 0.5 ft.		
5	1.5			20 25 33 (58)	▼	D-2	MC GS	GW-GM, M.C. = 2% Well graded GRAVEL with silt and sand, angular, very dense, brown, dry. Boulders and cobbles encountered. Fill material. Retained 1.0 ft.	▽	
10	3			33 51 20 (71)	▲	D-3		Well graded GRAVEL with silt, sand and cobbles of Basalt, subrounded to angular, very dense, brown, wet. Retained 1.0 ft.		
15	4.5			46 8 5 (13)	▲	D-4		Well graded GRAVEL with silt and sand, medium dense, brown, wet. Cobbles and boulders encountered, drill bouncing very hard augering. Retained 1.2 ft.		
20	6			13 20	▲	D-5		Well graded GRAVEL with silt and sand, subrounded to angular, dense, brown, wet. Cobbles, boulders and cobble sized pieces of basalt encountered.		

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04 9:32:24 A6



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7							25 (45)				Retained 1.1 ft.		
25	8						44 24 34 (59)	D-6			Poorly graded SAND with silt and gravel, subrounded to angular, very dense, brown, wet. Cobbles and boulders encountered. Very hard drilling, drill bouncing on cobbles and boulders. Retained 1.5 ft.		
30	9						26 16 18 (34)	D-7			Poorly graded GRAVEL with silt and sand, angular, dense, brown, wet. Cobbles and boulders as indicated by drilling. Note: Kelley bar twisted and bent, top bearing broke while drilling. Retained 1.5 ft.		
35	10						50/4"	D-8			Poorly graded GRAVEL with silt and sand, angular, very dense, brown, wet. Cobbles and boulders. Sampler bouncing on rock at 34.3 ft. Retained 0.3 ft.		
35	11										End of test hole boring at 34.3 ft. below ground elevation.		
40	12										This is a summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
45	13												

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04 9:32:24 A6



LOG OF TEST BORING

Start Card _____

Job No. 0L-3549 SR 24

Elevation 1008.3 ft (307.3 m)

HOLE No. H-9-94

Sheet 1 of 2

Project SR-24 / I-82 to Keys Road

Driller _____ Lic# _____

Site Address _____

Inspector _____

Start August 11, 1994 Completion August 17, 1994 Well ID# _____ Equipment _____

Station Y 76+30 Offset 50' Lt. Casing 4" OD Hollow Core Augers Method Dry Rotary

Northing _____ Easting _____ Latitude _____ Longitude _____

County _____ Subsection _____ Section _____ Range _____ Township _____

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10 20 30 40	7 9 11 (20)	▲	D-1	MC GS	Top surface toe of slope, silty sand and gravel (Fill). GP-GM, M.C. = 4% Poorly graded GRAVEL with silt and sand, angular, medium dense, brown, moist. Retained 1.0 ft.		
1										
5				1 1 3 (4)	▲	D-2	MC GS	SM, M.C. = 17% Silty SAND, very loose, brown, moist. Retained 1.0 ft.		
2				3 4 4 (8)	▲	D-3		Silty SAND, loose, brown, moist. Retained 1.5 ft.		
10				14 20 21 (41)	▲	D-4	MC GS	GW-GM, M.C. = 10% Well graded GRAVEL with silt and sand, angular, dense, dark brown, wet. Cobbles and boulders encountered as indicated by drilling. Retained 0.9 ft.		
4										
15				8 16 18 (34)	▲	D-5		Well graded GRAVEL with silt and sand, angular, dense, dark brown, wet. Retained 0.5 ft.		
5										
6										
20										

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/25/04 9:32:25 AG

8/11/94



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7							27 65/6"	D-6		Well graded GRAVEL with silt and sand, angular, very dense, dark brown, wet. Cobbles and boulders encountered as indicated by drilling. Retained 0.8 ft.			
25	8						60/4"	D-7		Well graded GRAVEL with silt and sand with cobbles and boulders, angular, dense, dark brown, wet. Retained 0.3 ft. Sampler bouncing on rock at depth 25.3'.			
30	9						25 45 50/2"	D-8		Well graded GRAVEL with silt and sand, angular, very dense, brown, wet. Cobbles and boulders as indicated by drilling. Retained 1.0 ft.			
35	11						16 61/6"	D-9		Poorly graded GRAVEL with silt and sand, angular, very dense, brown, wet. Cobbles and boulders as indicated by drilling. Retained 0.9 ft.			
										End of test hole boring at 36.0 ft. below ground elevation.			
40	12									This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.			
45	13												



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7													
25							13 (30)				wet, Homogeneous, no HCl reaction, Note drilling indicates cobbles. Recovery from oversized sampler. Length Recovered 1.0 ft, Length Retained 1.0 ft		
8							>>	18 24 50/4" (74/10")	D-5		Poorly graded SAND with silt, very dense, gray, wet, Homogeneous, no HCl reaction, Drilling indicates cobbles. Length Recovered 1.0 ft, Length Retained 1.0 ft		
9								50/3" (50/3")	D-6		Poorly graded SAND with silt, very dense, gray, wet, Homogeneous, no HCl reaction, Drilling indicates cobbles. Length Recovered 0.3 ft, Length Retained 0.3 ft		
10													
35								50/3" (50/3")	D-7		Poorly graded SAND with silt, very dense, gray, wet, Homogeneous, no HCl reaction, Drilling behavior indicates cobbles. Recovery from oversized sampler. Length Recovered 0.3 ft, Length Retained 0.3 ft		
11													
12								21 50/5" (50/5")	D-8		SP, MC=15% Poorly graded SAND with gravel, very dense, brown, wet, Homogeneous, no HCl reaction, Drilling indicates cobbles. Water reading after fresh water flush and 20 min. wait 7.5 ft. Length Recovered 0.8 ft, Length Retained 0.8 ft End of test hole boring at 39.9 ft below ground elevation.		
13													
45											This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT 6/8/04,10:15:22, A6



LOG OF TEST BORING

Start Card S23965

Job No. 0L-3549 SR 24 Elevation 1000.0 ft (304.8 m)

HOLE No. H-2-04

Sheet 1 of 2

Project SR-24 / I-82 to Keys Road

Driller Fetterly Lic# 2708

Site Address SR 24 MP .5 100 ft. South

Inspector Hanning

Start March 17, 2004 Completion March 18, 2004 Well ID# NA Equipment CME 850 w/ autohammer

Station 86+30 Approx. Offset 35ft Rt. Casing 3.5" Method Wet Rotary

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection NW/SW Section 28 Range 19 EWM Township 13N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
1													
5							20 34 52 (86)	D-1	Well graded GRAVEL with sand, subrounded, very dense, brown, dry, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft				
2													
10	3						39 22 14 (36)	D-2	Well graded GRAVEL with sand, subrounded, dense, gray, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		03/18/2004		
4													
15	5						11 13 23 (36)	D-3	Well graded GRAVEL with sand, subrounded, dense, brown, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft				
5													
20	6												

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 7/2/04,7:40:22 AZ



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7							32 38 52 (90)	D-4			Well graded GRAVEL with sand, subrounded, very dense, brown, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft		
25							60/6 (60/6")	D-5	GS MC	GW, M.C. = 9% Well graded GRAVEL with sand, rounded, very dense, grayish brown, wet, Homogeneous, no HCl reaction Length Recovered 0.5 ft, Length Retained 0.5 ft			
30							100/3 (100/3")	D-6		No Recovery			
							30 27 24 (51)	D-7			Well graded GRAVEL with sand, rounded, very dense, grayish brown, wet, Homogeneous, no HCl reaction, Note drilling indicates large gravel and small cobbles. Length Recovered 1.0 ft, Length Retained 1.0 ft		
35							24 46 50/4" (96/10")	D-8			Well graded GRAVEL with sand, subrounded, very dense, gray, wet, Homogeneous, no HCl reaction, Drilling behavior indicates large gravel and small cobbles. Length Recovered 1.0 ft, Length Retained 1.0 ft		
40							100/3 (100/3")	D-9			No Recovery		
							70/6" (70/6")	D-10			Well graded GRAVEL with sand, subrounded, very dense, gray, wet, Homogeneous, no HCl reaction, Abandoned Hole. Water reading after pumping fresh water, 7.8 ft. Length Recovered 0.5 ft, Length Retained 0.5 ft		
45				End of test hole boring at 40.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.									

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT 7/2/04 7:40:23 AM



LOG OF TEST BORING

Start Card S 23966

Job No. 0L-3549 SR 24

Elevation 993.0 ft (302.7 m)

HOLE No. H-3-04

Sheet 1 of 4

Project SR-24 / I-82 to Keys Road

Driller Copper Lic# 2552

Site Address SR24 Vic. M.P. 0.7

Inspector Hanning

Start March 30, 2004 Completion April 3, 2004

Well ID# NA

Equipment CME 45 w/ autohammer

Station 91+11

Offset CL

Casing NQ2.5"

Method Wet Rotary

Northing _____

Easting _____

Latitude _____

Longitude _____

County Yakima

Subsection SW/SW

Section 28

Range 19 EWM

Township 13N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
1													
5													
2						13 8 7 (15)	D-1			Poorly graded GRAVEL with sand, rounded, medium dense, gray, wet, Homogeneous, HCl reaction not tested, Drilling indicates cobbles. Length Recovered 0.9 ft, Length Retained 0.9 ft			
10						14 13 8 (21)	D-2			Poorly graded GRAVEL with sand, rounded, medium dense, olive gray, wet, Homogeneous, HCl reaction not tested, Drilling indicates cobbles. Length Recovered 0.8 ft, Length Retained 0.8 ft			
15						>> 23 37 33 (70)	D-3	GS MC	GP, MC=6% Poorly graded GRAVEL with sand, rounded, very dense, dark gray, wet, Homogeneous, HCl reaction not tested, Drilling indicates cobbles Length Recovered 0.8 ft, Length Retained 0.8 ft				
20													

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/30/04,10:17:55.A6



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7							>> ◆	60/5" (60/5")	◆	D-4	Poorly graded GRAVEL with sand, rounded, very dense, gray, wet, Homogeneous, HCl reaction not tested, Drilling indicates cobbles. Length Recovered 0.2 ft, Length Retained 0.2 ft		
8							>> ◆	60/5" (60/5")	◆	D-5	Poorly graded GRAVEL with sand and some silt, rounded, very dense, gray, wet, Homogeneous, HCl reaction not tested, Drilling indicates cobbles. Length Recovered 0.4 ft, Length Retained 0.4 ft		
9							>> ◆	70/5" (70/5")	◆	D-6	No Recovery		
11							>> ◆	100/4" (100/4")	◆	D-7	Poorly graded GRAVEL with sand, rounded, very dense, gray, wet, Homogeneous, HCl reaction not tested, Note recovery obtained from NQ core barrel, not from standard penetrometer. Sand determined from drill behavior and fluid return. Length Recovered 0.3 ft, Length Retained 0.3 ft		
12							>> ◆	100/4" (100/4")	◆	D-8	Poorly graded GRAVEL with sand, rounded, very dense, gray, wet, Homogeneous, HCl reaction not tested, Note recovery not obtained from standard penetrometer. Material retained from NQ core barrel. Sand determined from drill behavior and fluid return. Length Recovered 0.3 ft, Length Retained 0.3 ft		
13													
45													

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/30/04,10:17:55 A6



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
14							>> 100/6" (100/6")	D-9		Poorly graded GRAVEL with sand, rounded, very dense, gray, wet, Homogeneous, HCl reaction not tested, Note recovery not obtained from standard penetrometer. Material retained from NQ core barrel. Sand determined from drill behavior and fluid return. Length Recovered 0.5 ft, Length Retained 0.5 ft			
15													
50							>> 60/2" (60/2")	D-10		Poorly graded GRAVEL with sand and cobbles, rounded, very dense, gray, wet, Homogeneous, HCl reaction not tested, Note recovery not from standard penetrometer. Material retained from HQ core barrel. Sand determined from drilling behavior and fluid return. Length Recovered 0.2 ft, Length Retained 0.2 ft			
16													
55							50/1" (50/1")	D-11 C-12		Poorly graded GRAVEL with sand and cobbles, rounded, very dense, gray, wet, Homogeneous, HCl reaction not tested, Note sample not obtained from standard penetrometer. Material retained from NQ core barrel. Sand determined from drilling behavior and fluid return. Length Recovered 0.1 ft, Length Retained 0.1 ft			
17													
18													
60									C-13		Poorly graded GRAVEL with sand, rounded, very dense, gray, wet, Homogeneous, HCl reaction not tested, Note material retained put in sample bag. Length Recovered 2.5 ft, Length Retained 1.0 ft		
19													
65													
20									C-14		Poorly graded GRAVEL with sand and trace silt, rounded, very dense, gray, wet, Homogeneous, HCl reaction not tested, Note material retained in HQ core box. Sand determined from drilling behavior. Note 4.5" cobble. Length Recovered 2.0 ft, Length Retained 2.0 ft		
21													
70													

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 8/30/04,10:17:55 AB



LOG OF TEST BORING

Start Card S 23966

Job No. OL-3549

SR 24

Elevation 993.0 ft (302.7 m)

HOLE No. H-3-04

Sheet 4 of 4

Project SR-24 / I-82 to Keys Road

Driller Copper

Lic# 2552

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
22							>> 100/5" (100/5")	D-15 C-16		No Recovery			
75								C-17		Poorly graded GRAVEL with sand, rounded, very dense, gray, wet, Homogeneous, HCl reaction not tested, Water reading 4.5 ft. Length Recovered 0.5 ft, Length Retained 0.5 ft.			
24													
80													
25										End of test hole boring at 81 ft below ground elevation.			
85										This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.			
26													
27													
90													
28													
95													



Start Card S 23966

Job No. 0L-3549 SR 24

Elevation 995.9 ft (303.6 m)

HOLE No. H-5-04

Sheet 1 of 4

Project SR-24 / I-82 to Keys Road

Driller Kerry Cooper Lic# 2552

Site Address SR 24 Vic. of W. Birchfield Rd.

Inspector Hanning/Johnson

Start March 25, 2004 Completion April 5, 2005 Well ID# _____

Equipment CME 850 w/ autohammer

Station L 94+73 Offset Center Line Casing HWT/HQ

Method Wet Rotary

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection SW/SW Section 28 Range 19EWM Township 13N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
1													
5						28 22 34 (56)	D-1			Well graded GRAVEL with sand, subangular, very dense, brown, wet, Homogeneous, HCl reaction not tested, Drilling indicates small cobbles possible Length Recovered 0.8 ft, Length Retained 0.8 ft			
10						14 16 12 (28)	D-2			Well graded GRAVEL with sand, subangular, dense, gray brown, wet, Homogeneous, HCl reaction not tested, Cobbles (50% water loss) Length Recovered 0.6 ft, Length Retained 0.6 ft			
15						12 13 18 (31)	D-3			GW, MC=8% Well graded GRAVEL with sand, subangular, dense, gray brown, wet, Homogeneous, HCl reaction not tested, 100% fluid loss. 11.5 to 14.5 drilling indicates sand/scattered gravel. Penetration rate rapid. H2O reading when taken no water. Length Recovered 1.0 ft, Length Retained 1.0 ft			
20						18 30	D-4			Well graded GRAVEL with sand, subangular, very dense, gray brown, moist, Homogeneous, HCl reaction not			

04/04/2004

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:48 AM



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7													
25						60 (90)					tested, 14.5 to 17.0 Penetration rate fast Length Recovered 0.8 ft, Length Retained 0.8 ft		
25						33 29 34 (63)	>>	D-5			Well graded GRAVEL with sand, subangular, very dense, gray brown, moist, Homogeneous, HCl reaction not tested, Cobbles Length Recovered 1.0 ft, Length Retained 1.0 ft		
30						100/3 (100/3") 100/6 (100/6")	W	D-6a D-6b			Well graded GRAVEL with sand, subangular, very dense, gray brown, wet, Homogeneous, HCl reaction not tested, Water reading 6.8 Length Recovered 0.2 ft, Length Retained 0.2 ft. Well graded GRAVEL with sand, rounded, very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft		
35						111/6 (111/6")	>>	D-7			Well graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft, Length Retained 0.4 ft		
40						66 50/2 (50/2")		D-8			Well graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, HCl reaction not tested, Switched to HQ casing at 40.0' Length Recovered 0.6 ft, Length Retained 0.6 ft		
45						34 50/2		D-9			Well graded GRAVEL with sand, very dense, brown, wet, Homogeneous, HCl reaction not tested		

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:48 AG



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
14										Length Recovered 0.7 ft, Length Retained 0.7 ft			
15						>>	77/6 (77/6")	D-10		Well graded GRAVEL with sand, subrounded, very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft, Length Retained 0.4 ft			
16													
55						>>	57/6 (57/6")	D-11		Well graded GRAVEL with sand, subrounded, very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft			
17													
18						>>	108/5 (108/5")	D-12		Well graded GRAVEL with sand, slightly silty, angular, very loose, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft, Length Retained 0.4 ft			
60													
19													
65						>>	157/6 (157/6")	D-13		SP-SM, MC=14% Poorly graded SAND with silt and gravel, very dense, gray brown, moist, Stratified, HCl reaction not tested, 1st drive 0.1 recovery, 2nd drive 0.5 recovery. gray with brown layers of silty sand. Length Recovered 0.6 ft, Length Retained 0.6 ft			
20													
21						>>	125/6 (125/6")	D-14		Well graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, HCl reaction not tested			
70													

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:48 AM



LOG OF TEST BORING

Start Card S 23966

Job No. OL-3549 SR 24

Elevation 995.9 ft (303.6 m)

HOLE No. H-5-04

Sheet 4 of 4

Project SR-24 / I-82 to Keys Road

Driller Kerry Cooper

Lic# 2552

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
22													
75	23					>>	100/6 (100/6")	D-15		Length Recovered 0.5 ft, Length Retained 0.5 ft Poorly graded SAND with silt and gravel, very dense, brown, wet, Homogeneous, HCl reaction not tested, A.M. water reading at 11.4 Length Recovered 0.5 ft, Length Retained 0.5 ft End of test hole boring at 74.9 ft below ground elevation.			
24										This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.			
80													
25													
85	26												
27													
90													
28													
95													

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT 6/8/04,10:15:48 AG



LOG OF TEST BORING

Start Card S 23966

Job No. 0L-3549

SR 24

Elevation 994.0 ft (303.0 m)

HOLE No. H-6-04

Sheet 1 of 4

Project SR-24 / I-82 to Keys Road

Driller Kerry Cooper Lic# 2552

Site Address SR-24 Vicinity of M.P. 0.7

Inspector Cleo Andrews

Start April 6, 2004 Completion April 8, 2004 Well ID# _____ Equipment CME 850 w/ autohammer

Station L 96 + 54 Offset CL Casing (HWT 4" x 40.0')(HQ 3" x 82.0') Method Wet Rotary

Northing _____ Easting _____ Latitude _____ Longitude _____

County 39-Yakima Subsection SW 1/4 of the SW 1/4 Section 28 Range 19 EWM Township 13 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	SPT Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
1							>> 30	D-1	55/6 (55/6")		Well graded SAND with gravel, very dense, gray, wet, Homogeneous only, HCl reaction not tested, trace of silt Length Recovered 0.5 ft, Length Retained 0.5 ft		
5													
2								D-2	17 24 15 (39)		Well graded SAND with gravel, dense, gray, wet, Homogeneous only, HCl reaction not tested, (100% drilling fluid loss starting at 8.0'). Length Recovered 0.5 ft, Length Retained 0.5 ft	04/08/2004	
10	3												
4								D-3	10 21 39 (60)		Well graded SAND with gravel, very dense, gray, wet, Homogeneous only, HCl reaction not tested, trace of silt Length Recovered 0.3 ft, Length Retained 0.3 ft		
15							>>						
5							D-4	22 32		Well graded SAND with gravel, very dense, brownish gray, moist, Homogeneous only, HCl reaction not tested,			
20	6					>>							

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:53 AM



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7													
25							>>	50/4 (82/10")			loosely bonded together with a very fine grained silt matrix. Length Recovered 1.0 ft, Length Retained 1.0 ft		
8								23 45 50/3 (95/9")	D-5		Well graded SAND with gravel, very dense, brownish gray, moist, Homogeneous only, HCl reaction not tested, loosely bonded together with a very fine grained silt matrix. Length Recovered 1.2 ft, Length Retained 1.2 ft		
9							>>	93 83/6 (63/6")	D-6		SW, MC=10% Well graded SAND with gravel, very dense, brownish gray, moist, Homogeneous only, HCl reaction not tested, loosely bonded together with a very fine grained silt matrix. Approximately 2 to 3% drilling fluid loss. Length Recovered 1.0 ft, Length Retained 1.0 ft		
10													
35								35 50/2 (50/2")	D-7		Well graded SAND with gravel, very dense, brownish gray, moist, Homogeneous only, HCl reaction not tested, loosely bonded together with a very fine grained silt matrix. Length Recovered 0.6 ft, Length Retained 0.6 ft		
11													
40								45 50/3 (50/3")	D-8		Well graded SAND with gravel, very dense, brownish gray, moist, Homogeneous only, HCl reaction not tested, loosely bonded together with a very fine grained silt matrix. Length Recovered 0.7 ft, Length Retained 0.7 ft		
12													
13													
45								100 50/3	D-9		Well graded SAND with gravel, very dense, brownish gray, moist, Homogeneous only, HCl reaction not tested,		

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:53 AM



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
14							(50/3")				loosely bonded together with a very fine grained silt matrix. Length Recovered 0.7 ft, Length Retained 0.7 ft		
15							>> 150/6 (150/6")	D-10			Well graded SAND with gravel, very dense, brownish gray, moist, Homogeneous only, HCl reaction not tested, loosely bonded together with a very fine grained clayey silt matrix. Very little drilling fluid loss starting at 54.0'. Length Recovered 0.3 ft, Length Retained 0.3 ft		
16													
55							>> 52 44 29 (73)	D-11			Well graded SAND with gravel, very dense, brownish gray, moist, Homogeneous only, HCl reaction not tested, loosely bonded together with a very fine grained silt matrix. Length Recovered 1.2 ft, Length Retained 1.0 ft		
17													
18							>> 150/3 (150/3")	D-12			Well graded SAND with gravel, very dense, brownish gray, moist, Homogeneous only, HCl reaction not tested, loosely bonded together with a very fine grained silt matrix. Length Recovered 0.2 ft, Length Retained 0.2 ft		
19													
65							>> 118/6 (118/6")	D-13			Well graded SAND with gravel, very dense, brownish gray, moist, Homogeneous only, HCl reaction not tested, loosely bonded together with a very fine grained silt matrix. (Note gravel are subrounded to subangular as shown in sample starting at 54.0'). Length Recovered 0.5 ft, Length Retained 0.5 ft		
20													
21							>> 108 58/6	D-14			Well graded SAND with gravel, very dense, brownish gray, moist, Homogeneous only, HCl reaction not tested,		
70													

SOIL 0L-3549 SR 24 AND B2 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:53 AM



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
22							(58/6")				loosely bonded together with a very fine grained silt matrix. Approximately 2% drilling fluid loss at times starting at 69.0'. Length Recovered 1.0 ft, Length Retained 1.0 ft		
75	23						80 50/3 (50/3")	D-15		Well graded SAND with gravel, very dense, grayish brown, moist, Homogeneous only, HCl reaction not tested, loosely bonded together with a very fine grained silt matrix. Length Recovered 0.7 ft, Length Retained 0.7 ft			
24	80						>> 35 100/3 (100/3")	D-16		Well graded SAND with gravel, very dense, gray, moist, Homogeneous only, HCl reaction not tested, loosely bonded together with a very fine grained silt matrix. Length Recovered 0.5 ft, Length Retained 0.5 ft End of test hole boring at 79.7 ft below ground elevation.			
25										This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.			
85	26												
27													
90	28												
95													



Start Card R65823

Job No. 0L-3549 SR 24

Elevation 991.5 ft (302.2 m)

HOLE No. H-7-04

Sheet 1 of 4

Project SR-24 / I-82 to Keys Road

Driller Vince Jhonson Lic# 2532

Site Address SR 24 Vic. of MP 0.7

Inspector Dan Reed

Start April 6, 2004 Completion April 8, 2004

Well ID# AHN 622

Equipment CME 55 w/ autohammer

Station L 98+35

Offset CL

Casing HW 4.5 HQ3.5

Method Wet Rotary

Northing _____

Easting _____

Latitude _____

Longitude _____

County Yakima

Subsection SW Of The SW 1/4

Section 28

Range 19 EWM

Township 13N

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:57 AM

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	SPT Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
1													
5						>>	34 40 50/3 (90/9")	D-1		Well graded GRAVEL with sand, angular, very dense, Gray, wet, Homogeneous, no HCl reaction, With Large Gravel And Cobbles As Indicated By Drilling Process 50 % Drilling Fluid Loss Length Recovered 1.2 ft, Length Retained 1.2 ft			
10							13 13 13 (26)	D-2		Well graded GRAVEL with sand, subangular, dense, gray, wet, Homogeneous, no HCl reaction, With large gravels and cobbles as indicated by drilling process. 100% drilling fluid loss. Length Recovered 0.5 ft, Length Retained 0.5 ft	▼ 04/07/2004		
15						>>	28 37 50 (87)	D-3		Well graded GRAVEL with sand, subangular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 100% drilling fluid loss. Length Recovered 1.2 ft, Length Retained 1.2 ft	▼ 04/08/2004		
20						>>							



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7						>>	101/6 (101/6")	D-4		Well graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 100% drilling fluid loss. Length Recovered 0.4 ft, Length Retained 0.4 ft			
25	8						51 50/4 (50/4")	D-5		Well graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 100% drilling fluid loss at 22.0'. Length Recovered 0.9 ft, Length Retained 0.9 ft			
30	9						44 50/3 (50/3")	D-6		Well graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 100% drilling fluid return. Tripped out HQ steel to replace shoe at 30.0. Length Recovered 0.7 ft, Length Retained 0.7 ft			
35	11					>>	46 46 50/4 (96/10")	D-7		Well graded GRAVEL with sand, subangular, very dense, Lt. Brown, wet, Homogeneous, no HCl reaction, With large gravels and cobbles as indicated by drilling process. 100% drilling fluid loss. Length Recovered 0.5 ft, Length Retained 0.5 ft			
40	12					>>	101/6 (101/6")	D-8		Well graded GRAVEL with sand, angular, very dense, Lt. Brown, wet, Homogeneous, no HCl reaction, With large gravels and cobbles as indicated by drilling process. 100% drilling fluid loss. Length Recovered 0.4 ft, Length Retained 0.4 ft			
45	13												

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:57 AM



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
14							56 50/1 (50/1")	▲	D-9		Well graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 100% drilling fluid loss. Length Recovered 0.6 ft, Length Retained 0.6 ft.		
50						>>	53 57 64 (121)	▲	D-10		GW, MC=8% Well graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravels and cobbles as indicated by drilling process... 100% drilling fluid loss. Length Recovered 1.0 ft, Length Retained 1.0 ft		
55						>>	10 69 50 (119)	▲	D-11		Well graded GRAVEL with sand, angular, very dense, Lt. Brown, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 100% drilling fluid loss. Length Recovered 0.6 ft, Length Retained 0.6 ft		
60						>>	126/6 (126/6")	▲	D-12		Well graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel as indicated by drilling process. 100% drilling fluid loss. Length Recovered 0.5 ft, Length Retained 0.5 ft		
65						>>	106/6 (106/6")	▲	D-13		Well graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 25% drilling fluid loss. Length Recovered 0.5 ft, Length Retained 0.5 ft		
70						>>							

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:58 AG



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
22							150/6 (150/6")	D-14		Well graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 100% drilling fluid return. Length Recovered 0.5 ft, Length Retained 0.5 ft			
75	23						150/6 (150/6")	D-15		Well graded GRAVEL with sand, angular, very dense, gray, moist, Homogeneous, no HCl reaction, With large gravel, cobbles, and boulders as indicated by drilling process. 100% drilling fluid return. Length Recovered 0.5 ft, Length Retained 0.5 ft			
80							175/5 (175/5")	D-16		Well graded GRAVEL with sand, angular, very dense, gray, moist, Homogeneous, no HCl reaction, With large gravel, cobbles, and boulders as indicated by drilling process. 100% drilling fluid return. Flushed bore hole with fresh water. Water level before bailing 7.8', water level after bailed 30.0', water level after 5 minutes 24.0', after 10 minutes 21.0', after 15 minutes 17.0', Water table stabilized at 12.8' overnight. Length Recovered 0.4 ft, Length Retained 0.4 ft End of test hole boring at 80.4 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.			
25													
85	26												
27													
90													
28													
95													

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:58 AM



LOG OF TEST BORING

Start Card S-23966

Job No. 0L-3549 SR 24 Elevation 996.0 ft (303.6 m)

HOLE No. H-8-04

Sheet 1 of 4

Project SR-24 / I-82 to Keys Road

Driller Joe Judd Lic# 2454

Site Address SR 24 vic. MP 0.7

Inspector Dave Nelson

Start April 12, 2004 Completion April 14, 2004 Well ID# _____ Equipment CME 850 w/ autohammer

Station L 100+00 Offset 28ft Lt. Casing 6" x 44' & 4" x 79" Method Wet Rotary

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection SW 1/4 of SW 1/4 Section 28 Range 5 EWM Township 13 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
1													
5								100/3 (100/3")	D-1		Poorly graded GRAVEL with silt and sand, subrounded, very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.2 ft	▽	
													04/12/2004
10								23 14 8 (22)	D-2		Poorly graded GRAVEL with silt and sand, subrounded, medium dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft		
15								11 8 10 (18)	D-3		Poorly graded GRAVEL with silt and sand, subrounded, medium dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.6 ft		
20								>> 100/3 (100/3")	D-4		Poorly graded GRAVEL with silt and sand, subrounded, very dense, brown, wet, Homogeneous, HCl reaction not		

SOIL_0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT_6/8/04,3:37:51 P6



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7													
25							>>	68 36 50 (86)	D-5				
8													
30								23 50/3 (50/3")	D-6				
9													
10													
35							>>	100/5 (100/5")	D-7				
11													
40							>>	100/6 (100/6")	D-8				
12													
13													
45							>>	100/6 (100/6")	D-9				

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/6/04,10:16:03 AB



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
14													
15						>>	100/6 (100/6")	D-10			very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft		
50													
16						>>	100/5 (100/5")	D-11			Poorly graded GRAVEL with silt and sand, subrounded, very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.2 ft		
55													
17						>>	100/5 (100/5")	D-12			Poorly graded GRAVEL with silt and sand, subrounded, very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.2 ft		
60													
18						>>	100/5 (100/5")	D-13			Poorly graded GRAVEL with silt and sand, subrounded, very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.2 ft		
65													
19						>>	100/5 (100/5")	D-14			Poorly graded GRAVEL with silt and sand, subrounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.2 ft		
65													
20													
21						>>	100/3 (100/3")						
70													

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT 6/6/04,10:16:03 AG



LOG OF TEST BORING

Start Card S-23966

Job No. OL-3549

SR 24

Elevation 1028.0 ft (313.3 m)

HOLE No. H-8-04

Sheet 4 of 4

Project SR-24 / I-82 to Keys Road

Driller Joe Judd

Lic# 2454

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
22										tested Length Recovered 0.2 ft			
75	23					>> ◆ 100/3 (100/3")	◆	D-15		Poorly graded GRAVEL with silt and sand, subrounded, very dense, grey, wet, Homogeneous, HCl reaction not tested Length Recovered 0.1 ft			
24						>> ◆ 100/3 (100/3")	◆	D-16		Poorly graded GRAVEL with silt and sand, subrounded, very dense, grey, wet, Homogeneous, HCl reaction: not tested Length Recovered 0.1 ft			
80										End of test hole boring at 79.2 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.			
25													
85	26												
27													
90													
28													
95													

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT 6/6/04,10:16:03 A6



LOG OF TEST BORING

Start Card S-23964

Job No. 0L-3549

SR 24

Elevation 999.4 ft (304.6 m)

HOLE No. H-9-04

Sheet 1 of 3

Project SR-24 / I-82 to Keys Road

Driller Vince Johnson Lic# 2532

Site Address SR-24 Vic. of Keys Rd.

Inspector Brian Hilts

Start March 31, 2004

Completion April 1, 2004

Well ID#

Equipment CME 55 w/ autohammer

Station L 102+03.35

Offset 49.33ft Lt.

Casing 6"x20' 4"x52'

Method Wet Rotary

Northing

Easting

Latitude

Longitude

County Yakima

Subsection SE1/4 SW1/4

Section 28

Range 19 EWM

Township 13N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
1													
5							>>	34 52/6" (52/6")	D-1		Well graded GRAVEL with sand, cobbles, angular, very dense, dark grayish brown, moist, Homogeneous, HCl reaction not tested, At 5.5' to 8.5' we got out of the gravels and drilling became easier. Length Recovered 0.8 ft, Length Retained 0.8 ft		
10								11 17 26 (43)	D-2		Well graded GRAVEL with sand, angular, dense, dark grayish brown, wet, Homogeneous, HCl reaction not tested, (note) The top .2' was silty sand. Length Recovered 0.2 ft, Length Retained 0.2 ft		
15							>>	22 23 29 (52)	D-3		Well graded GRAVEL with sand, cobbles, angular, very dense, dark grayish brown, moist, Homogeneous, HCl reaction not tested, 25% water loss. Length Recovered 0.7 ft, Length Retained 0.7 ft		
20							>>	20 30 36 (66)	D-4		Well graded GRAVEL with sand, angular, very dense, very dark grayish brown, wet, Homogeneous, HCl reaction not tested, 25% water loss. At 21' we lost our water return and got it back at 23'.		

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:16:07 AB



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7							>> 27	D-5		Length Recovered 0.9 ft, Length Retained 0.9 ft			
25							27 33 (60)						
8							>>	D-6		Well graded GRAVEL with sand, cobbles, angular, very dense, grayish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft.			
30							100/6" (100/6")						
10							>>	D-7		Well graded GRAVEL with sand, cobbles, angular, very dense, grayish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft			
35						105/6" (105/6")							
11						>>	D-8		Well graded GRAVEL with sand, cobbles, angular, very dense, grayish brown, wet, Homogeneous, HCl reaction not tested, At 39' we got back 75% of our water return. Length Recovered 0.5 ft, Length Retained 0.5 ft				
40						108/6" (108/6")							
13						>>	D-9		Well graded GRAVEL with sand, cobbles, angular, very dense, grayish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft				
45						54/6" (54/6")							

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT 6/6/04,10:16:07 AB



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
14													
15							>> ◆ 160/6" (160/6")	◆ D-10					
50										Well graded GRAVEL with sand, angular, very dense, grayish brown, wet, Homogeneous, HCl reaction not tested, (note) Scattered gravels throughout the entire hole. After drilling the water table was at 16.8'. We bailed the hole to 23.3'. 5 min. later the water table was at 15.5', 15 min. later the water table was at 14.8'. Length Recovered 0.5 ft, Length Retained 0.5 ft			
16										End of test hole boring at 49 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.			
55													
17													
18													
60													
19													
65													
20													
21													
70													



LOG OF TEST BORING

Start Card S-23966

Job No. OL-3549

SR 24

Elevation 991.1 ft (302.1 m)

HOLE No. H-10-04

Sheet 1 of 3

Project SR-24 / I-82 to Keys Road

Driller Vince Johnson

Lic# 2532

Site Address Vic. of MP 0.7

Inspector Dan Reed

Start April 14, 2004

Completion April 14, 2004

Well ID# _____

Equipment CME 55 w/ autohammer

Station L 101+95

Offset CL

Casing HW-4.5/HQ-3.5

Method Wet Rotary

Northing _____

Easting _____

Latitude _____

Longitude _____

County Yakima

Subsection SW 1/4 of the SW 1/4

Section 28

Range 19 EWM

Township 13N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
1													
5													
2													
10													
4													
15													
5													
6													
20													

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 8/8/04,10:15:19 A6

18
19
30
(49)

D-1

Well graded GRAVEL, angular, dense, Lt. Brown, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. Length Recovered 1.2 ft, Length Retained 1.2 ft

17
22
20
(42)

D-2

Well graded GRAVEL, angular, dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process: 10% drilling fluid loss. Length Recovered 1.1 ft, Length Retained 1.1 ft

04/14/2004
04/14/2004

24
20
21
(41)

D-3

Well graded GRAVEL, angular, dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 50% drilling fluid loss. Length Recovered 1.1 ft, Length Retained 1.1 ft



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7						40	33 16 21 (37)	D-4		GW, MC=3% Well graded GRAVEL, angular, dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 50% drilling fluid loss. Length Recovered 1.2 ft, Length Retained 1.2 ft			
25	8						21 50/6 (50/6")	D-5		Well graded GRAVEL, angular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 25% drilling fluid loss. Length Recovered 0.8 ft, Length Retained 0.8 ft			
30	9						>> 71/6 (71/6")	D-6		Well graded GRAVEL, angular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 25% drilling fluid loss. Length Recovered 0.5 ft, Length Retained 0.5 ft			
35	11						16 15 28 (43)	D-7		Well graded GRAVEL, angular, dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 100% drilling fluid loss. Length Recovered 1.5 ft, Length Retained 1.5 ft			
40	12						>> 100/6 (100/6")	D-8		Well graded GRAVEL, angular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 100% drilling fluid loss. Length Recovered 0.4 ft, Length Retained 0.4 ft			
45	13					>>>							

SOIL_0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT_6/8/04,10:15:19 AG



LOG OF TEST BORING

Start Card S-23966

Job No. 0L-3549

SR 24

Elevation 991.1 ft (302.1 m)

HOLE No. H-10-04

Sheet 3 of 3

Project SR-24 / I-82 to Keys Road

Driller Vince Johnson

Lic# 2532

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
14							111/6 (111/6")	◆	D-9		Well graded GRAVEL, angular, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 100% drilling fluid loss. Length Recovered 0.5 ft, Length Retained 0.5 ft		
50							155/6 (155/6")	◆	D-10		SP, MC=22% Poorly graded SAND with gravel, very dense, gray, wet, Homogeneous, no HCl reaction, With large gravel and cobbles as indicated by drilling process. 100% drilling fluid loss. Bore hole water level before bailing 6.0', Bailed bore hole water level to 23.0', water level after 5 minutes 19.0', after 10 minutes 15.0', after 15 minutes 13.0'; water table stabilized at 12.0'. Length Recovered 0.5 ft, Length Retained 0.5 ft End of test hole boring at 50.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
16													
55													
17													
18													
60													
19													
65													
20													
21													
70													



LOG OF TEST BORING

Start Card R-65827

Job No. 0L-3549

SR 24

Elevation 1011.4 ft (308.3 m)

HOLE No. H-11-04

Sheet 1 of 3

Project SR-24 / I-82 to Keys Road

Driller Vince Johnson Lic# 2532

Site Address Vic. of I-82 and SR-24

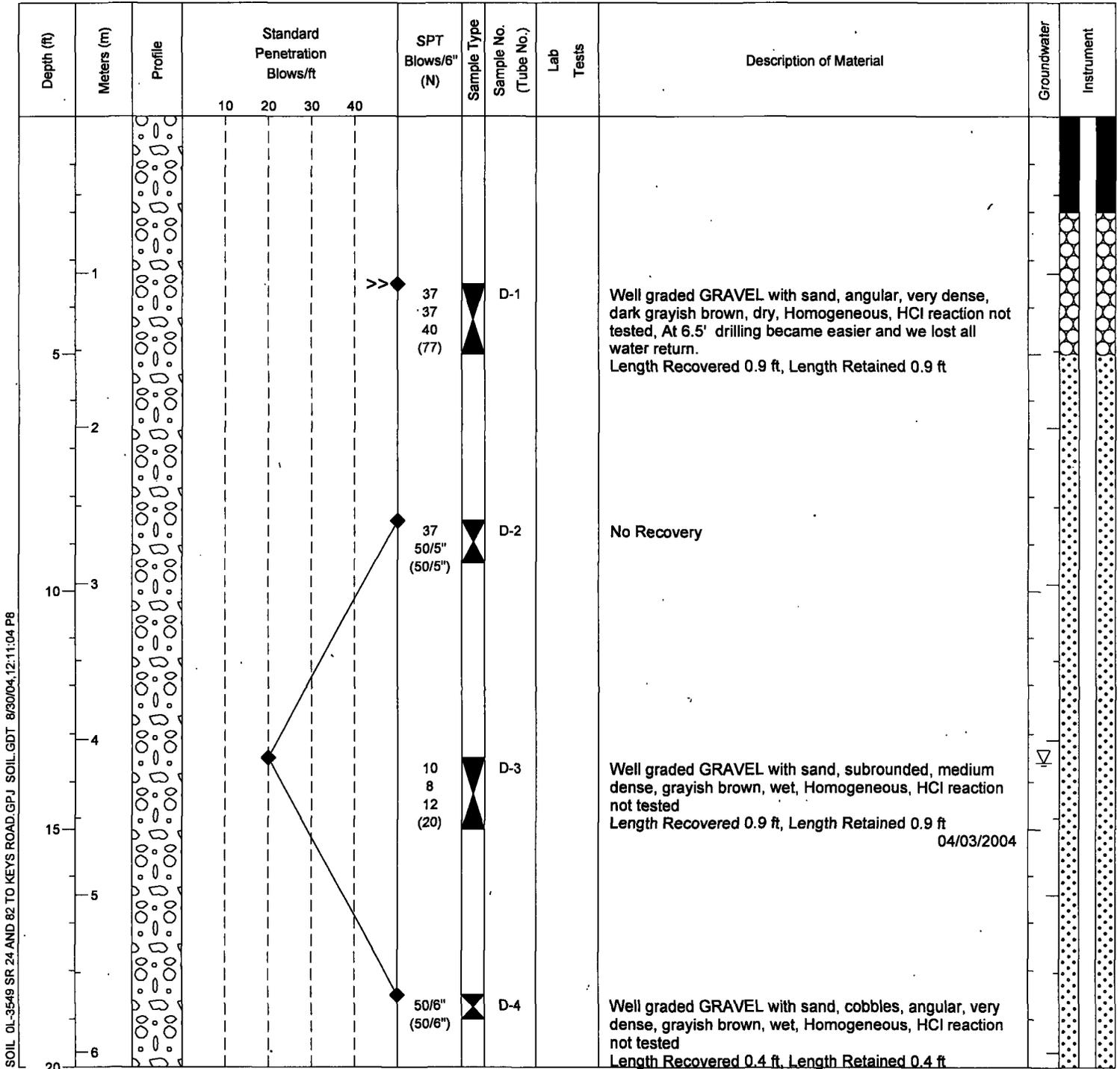
Inspector Brian Hilts

Start April 2, 2004 Completion April 3, 2004 Well ID# AHN-628 Equipment CME 55 w/ autohammer

Station L 59+65.02 Offset 159ft Lt. Casing 6"x20' 4"x52' Method Wet Rotary

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection NW1/4 SE1/4 Section 29 Range 19 EWM Township 13N



SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT 8/30/04,12:11:04 PB



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7													
25							>>	87/6" (87/6")	D-5		Well graded GRAVEL with sand, cobbles, angular, very dense, grayish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.3 ft, Length Retained 0.3 ft		
8													
30								39 50/3" (50/3")	D-6		GW, MC=12% Well graded GRAVEL with sand, cobbles, angular, very dense, grayish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft		
9													
35							>>	175/6" (175/6")	D-7		Well graded GRAVEL with sand, cobbles, angular, very dense, grayish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft, Length Retained 0.4 ft		
10													
40							>>	70/5" (70/5")	D-8		Well graded GRAVEL with sand, cobbles, angular, very dense, dark grayish brown, wet, Homogeneous, HCl reaction not tested, At 41.5' we got back 100% water return. Length Recovered 0.2 ft, Length Retained 0.2 ft		
11													
45							>>	100/4" (100/4")	D-9		Well graded GRAVEL with sand, cobbles, angular, very dense, dark grayish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft, Length Retained 0.4 ft		
12													
13													

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT 8/30/04,12:11:04 P8



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
14													
15							29 50 50/4" (100/10")	D-10			Well graded GRAVEL with sand, cobbles, angular, very dense, grayish brown, wet, Homogeneous, HCl reaction not tested, The water table inside the casing after drilling was at 14.8'. We bailed the hole to 16.8', 5 min. later 14.7', 10 min. later 14.4'. After the install the water table was at 13.6'. <u>Length Recovered 1.3 ft, Length Retained 1.3 ft</u> End of test hole boring at 49.8 ft below ground elevation.		
50													
16											This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
55													
17													
18													
60													
19													
65													
20													
21													
70													

SOIL_OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT 8/30/04,12:11:05 PB



Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
0 - 1	0 - 0.3	[Dotted pattern]			30								
1 - 5	0.3 - 1.5	[Sand pattern]			20		D-1	20 21 10 (31)		SP, MC=4% Poorly graded SAND with gravel, dense, brown, dry, Homogeneous, no HCl reaction Length Recovered 0.5 ft, Length Retained 0.5 ft			
5 - 10	1.5 - 3.0	[Gravel pattern]			18		D-2	18 13 7 (20)		Well graded GRAVEL with sand, medium dense, brown, dry, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft			
10 - 15	3.0 - 4.5	[Gravel pattern]			>>		D-3	44 44 42 (86)		Well graded GRAVEL with sand, angular, very dense, brown, wet, Homogeneous, no HCl reaction, Note: hit water table at approx. 6.5 to 7.0 feet Length Recovered 1.5 ft, Length Retained 1.0 ft	03/24/2004		
15 - 20	4.5 - 6.0	[Gravel pattern]			>>		D-4	17 21 45 (66)		GW, MC=3% Well graded GRAVEL with sand, angular, very dense, gray, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.0 ft			
20 - 25	6.0 - 7.5	[Gravel pattern]			>>		D-5	80/6 (80/6")		Well graded GRAVEL with sand, angular, very dense, brownish gray, wet, Homogeneous, no HCl reaction			

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:28 A6



LOG OF TEST BORING

Start Card S 23980

Job No. 0L-3549

SR 24

Elevation 1003.9 ft (306.0 m)

HOLE No. H-12-04

Sheet 2 of 2

Project SR-24 / I-82 to Keys Road

Driller Donny Henderson

Lic# 2598

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7													
25										<p><u>Length Recovered 0.5 ft, Length Retained 0.5 ft</u> End of test hole boring at 19.5 ft below ground elevation.</p> <p>This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.</p>			
8													
9													
30													
10													
35													
11													
40													
12													
45													
13													



LOG OF TEST BORING

Start Card S 23980

Job No. 0L-3549 SR 24

Elevation 1004.1 ft (306.0 m)

HOLE No. H-13-04

Sheet 1 of 2

Project SR-24 / I-82 to Keys Road

Driller Donny Henderson Lic# 2598

Site Address SR-24 and Arboritum Dr.

Inspector Vince Johnson

Start March 24, 2004 Completion March 24, 2004 Well ID# _____ Equipment CME 55 w/ autohammer

Station FC 24+24 Offset 24ft Lt. Casing 8" Auger Method Auger

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection SE/NE Section 29 Range 19 EWM Township 13N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
0	0					2	D-1	D-1	GS	Silty SAND, with organics, very loose, brown, moist, Homogeneous, no HCl reaction Length Recovered 0.5 ft, Length Retained 0.5 ft			
						2							
1	0.3					(4)	D-2	D-2	MC	SM, M.C. = 17%, PI = 5 Silty SAND, with trace organics, loose, brown, dry, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft			
						2							
5	1.5					26	D-3	D-3	AL	Poorly graded SAND with silt and gravel, with trace organics(hair roots, subangular, dense, brownish gray, dry, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft			
						21							
10	3.0					18	D-4	D-4	GS	SP-SM, M.C. = 15% Poorly graded SAND with silt and gravel, angular, dense, gray, wet, Homogeneous, no HCl reaction Length Recovered 1.0 ft, Length Retained 1.0 ft	03/24/2004	▽	
						10							
15	4.5					10	D-5	D-5	MC	Poorly graded SAND with silt and gravel, angular, dense, gray, wet, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.0 ft			
						13							
20	6.0					>>	D-6	D-6	GS	SW-SM, M.C. = 17% Well graded SAND with silt, very dense, gray, wet,			
						(85/6')							

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:30 AM



LOG OF TEST BORING

Start Card S 23980

Job No. OL-3549 SR 24

Elevation 1004.1 ft (306.0 m)

HOLE No. H-13-04

Sheet 2 of 2

Project SR-24 / I-82 to Keys Road

Driller Donny Henderson Lic# 2598

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7													
25													
8													
9													
30													
10													
35													
11													
12													
40													
13													
45													

Homogeneous, no HCl reaction
Length Recovered 0.5 ft, Length Retained 0.5 ft
End of test hole boring at 19.5 ft below ground elevation.
This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:30 A6



LOG OF TEST BORING

Start Card R-65822

Job No. 0L-3549 SR 24

Elevation 991.2 ft (302.1 m)

HOLE No. H-14-04

Sheet 1 of 2

Project SR-24 / I-82 to Keys Road

Driller Vince Johnson Lic# 2532

Site Address SR-24 Vicinity of Keys Rd.

Inspector Brian Hilts

Start April 1, 2004 Completion April 1, 2004

Well ID# AHN-620

Equipment CME 55 w/ autohammer

Station L 105+00

Offset 75ft Lt.

Casing 6"x22'

Method Wet Rotary

Northing _____

Easting _____

Latitude _____

Longitude _____

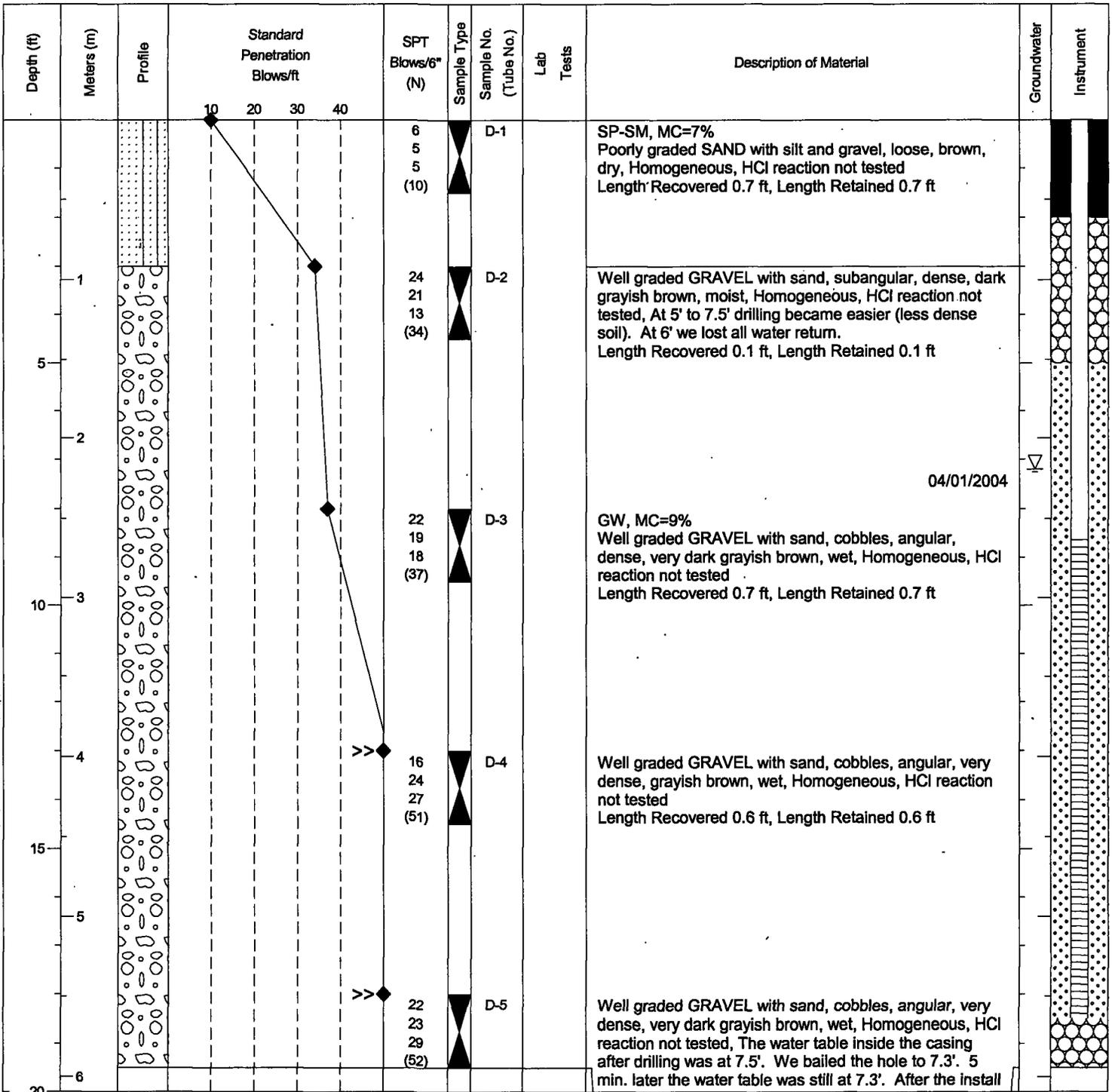
County Yakima

Subsection SE1/4 SW1/4

Section 28

Range 19 EWM

Township 13N





LOG OF TEST BORING

Start Card R-65822

Job No. 0L-3549

SR 24

Elevation 991.2 ft (302.1 m)

HOLE No. H-14-04

Sheet 2 of 2

Project SR-24 / I-82 to Keys Road

Driller Vince Johnson

Lic# 2532

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7													
25													
8													
9													
30													
10													
35													
11													
12													
40													
13													
45													

the water table was at 7.2'. The site map for H-14 is on the field notes of H-9-04.
 Length Recovered 0.7 ft, Length Retained 0.7 ft
 End of test hole boring at 19.5 ft below ground elevation.
 This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.



LOG OF TEST BORING

Start Card S-23978

Job No. 0L-3549 SR 24

Elevation 989.5 ft (301.6 m)

HOLE No. H-15-04

Sheet 1 of 2

Project SR-24 / I-82 to Keys Road

Driller Vince Johnson Lic# 2532

Site Address SR-24 @ mp 1, 100' North

Inspector Brian Hilts

Start March 30, 2004 Completion March 30, 2004 Well ID# _____ Equipment CME 55 w/ autohammer

Station L 114+33 Offset 91ft Lt. Casing 9"x20' Method Auger

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection SW1/4 SE1/4 Section 28 Range 19 EWM Township 13N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft.				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
1							15 22 15 (37)	D-1		Well graded GRAVEL with sand, angular, dense, brown, wet, Homogeneous, HCl reaction not tested, Hammering on a large gravel. Length Recovered 0.3 ft, Length Retained 0.3 ft 03/30/2004	▽		
5													
10							5 22 26 (48)	D-2		GP, MC=11% Poorly graded GRAVEL with sand, cobbles, subangular, dense, dark grayish brown, wet, Stratified, HCl reaction not tested, The top .4' was poorly graded sand. Length Recovered 1.1 ft, Length Retained 1.1 ft			
15							>> 68/6" (68/6")	D-3		Well graded GRAVEL with sand, cobbles, angular, very dense, dark grayish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.4 ft, Length Retained 0.4 ft			
20							>> 34 67/6"	D-4		Well graded GRAVEL with sand, cobbles, angular, very dense, grayish brown, wet, Homogeneous, HCl reaction			
20													

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:34 A6



LOG OF TEST BORING

Start Card S-23978

Job No. OL-3549 SR 24

Elevation 989.5 ft (301.6 m)

HOLE No. H-15-04

Sheet 2 of 2

Project SR-24 / I-82 to Keys Road

Driller Vince Johnson

Lic# 2532

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7													
25													
8													
9													
30													
10													
35													
11													
12													
40													
13													
45													

not tested, The water table inside the augers after drilling was at 5.5'. See the site map on my field notes for the hole location on H-15 and H-16-04.
Length Recovered 1.0 ft, Length Retained 1.0 ft
 End of test hole boring at 20 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.



LOG OF TEST BORING

Start Card S-23979

Job No. 0L-3549 SR 24

Elevation 989.7 ft (301.7 m)

HOLE No. H-16-04

Sheet 1 of 2

Project SR-24 / I-82 to Keys Road

Driller Vince Johnson Lic# 2532

Site Address SR-24 @ MP 1, 50' South

Inspector Brian Hills

Start March 30, 2004 Completion March 30, 2004 Well ID# _____ Equipment CME 55 w/ autohammer

Station L 115+29.4 Offset 76ft Rt. Casing 9"x20' Method Auger

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection NW1/4 NE1/4 Section 33 Range 19 EWM Township 13N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
1			10 20 30 40	1 6 20 (26)	D-1			GP, MC=11% Poorly graded GRAVEL with sand, angular, dense, very dark brown, moist, Homogeneous, HCl reaction not tested, with some organics. Length Recovered 0.9 ft, Length Retained 0.9 ft		
5				4 11 13 (24)	D-2			Poorly graded SAND with silt and gravel, medium dense, dark grayish brown, wet, Homogeneous, HCl reaction not tested, The top .4' was silty sand with FeO stains and the bottom .8' was well graded gravel (ang) and wet. At 8' drilling became easier. (less dense soil) Length Recovered 1.0 ft, Length Retained 1.0 ft 03/30/2004		
10				5 5 4 (9)	D-3			Poorly graded SAND with silt and gravel, loose, brown, wet, Homogeneous, HCl reaction not tested, At 12.5' drilling became harder. (denser soil) Length Recovered 1.0 ft, Length Retained 1.0 ft		
15				>> 73 35 57 (92)	D-4			SP-SM, MC=10% Poorly graded SAND with silt and gravel, cobbles, very dense, dark grayish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.9 ft, Length Retained 0.9 ft		
20				>> 100/6" (100/6")	D-5			Poorly graded SAND with silt and gravel, cobbles, very dense, dark grayish brown, wet, Homogeneous, HCl reaction not tested, The water table inside the auger after drilling was at 5.6'.		

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 8/30/04,7:05:17 AB



LOG OF TEST BORING

Start Card S-23979

Job No. 0L-3549 SR 24

Elevation 989.7 ft (301.7 m)

HOLE No. H-16-04

Sheet 2 of 2

Project SR-24 / I-82 to Keys Road

Driller Vince Johnson Lic# 2532

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7													
25													
8													
9													
30													
10													
35													
11													
12													
40													
13													
45													

Length Recovered 0.5 ft, Length Retained 0.5 ft
End of test hole boring at 19 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.

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 8/30/04,7:05:17 A8



LOG OF TEST BORING

Start Card S 23977

Job No. 0L-3549 SR 24

Elevation 1030.5 ft (314.1 m)

HOLE No. H-17-04

Sheet 1 of 2

Project SR-24 / I-82 to Keys Road

Driller Curry Cooper Lic# 2552

Site Address I-82 and Nobhill Blvd.

Inspector Cleo Andrews

Start April 13, 2004 Completion April 13, 2004

Well ID# _____

Equipment CME 45 w/ autohammer

Station M 57+90

Offset 25ft Lt.

Casing HQ 3" x 25.0'

Method Wet Rotary

Northing _____

Easting _____

Latitude _____

Longitude _____

County Yakima

Subsection NW 1/4 of the SE 1/4

Section 29

Range 19 EWM

Township 13 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
0	0												
1	0.3					>>	17	D-1		Top surface cobbles and small boulders shown on surface of fill slope. 0.0' to 2.0' Well graded GRAVEL with Sand, modifiers with cobbles and small boulders. (Fill material). 100% drilling fluid loss.			
5	1.5					>>	44	D-2		Well graded GRAVEL, subrounded, very dense, olive gray, dry, Homogeneous, HCl reaction not tested: Length Recovered 0.5 ft, Length Retained 0.5 ft			
10	3.0					>>	30	D-3		GW, MC=3% Well graded GRAVEL, subrounded, very dense, olive gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 0.5 ft, Length Retained 0.5 ft			
10	3.0					>>	50	D-3		Well graded GRAVEL, subrounded, very dense, olive gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 0.3 ft, Length Retained 0.3 ft			
10	3.0					>>	38	D-4		Well graded GRAVEL, subrounded, very dense, gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 0.3 ft, Length Retained 0.3 ft			
10	3.0					>>	88	D-4		Well graded GRAVEL, subrounded, very dense, gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 0.3 ft, Length Retained 0.3 ft			
10	3.0					>>	27	D-4		Well graded GRAVEL, subrounded, very dense, gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 0.3 ft, Length Retained 0.3 ft			
10	3.0					>>	28	D-4		Well graded GRAVEL, subrounded, very dense, gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 0.3 ft, Length Retained 0.3 ft			
10	3.0					>>	25	D-4		Well graded GRAVEL, subrounded, very dense, gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 0.3 ft, Length Retained 0.3 ft			
10	3.0					>>	53	D-4		Well graded GRAVEL, subrounded, very dense, gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 0.3 ft, Length Retained 0.3 ft			
13	3.9						32	D-5		Well graded GRAVEL, subrounded, medium dense, gray, moist, Homogeneous, HCl reaction not tested, (Note : Got out of fill material at 13.0' as indicated by SPT blow count and by drilling formation got looser. 100% drilling fluid loss. Length Recovered 0.4 ft, Length Retained 0.4 ft			
15	4.5						8	D-5		Well graded GRAVEL, subrounded, medium dense, gray, moist, Homogeneous, HCl reaction not tested, (Note : Got out of fill material at 13.0' as indicated by SPT blow count and by drilling formation got looser. 100% drilling fluid loss. Length Recovered 0.4 ft, Length Retained 0.4 ft			
15	4.5						4	D-5		Well graded GRAVEL, subrounded, medium dense, gray, moist, Homogeneous, HCl reaction not tested, (Note : Got out of fill material at 13.0' as indicated by SPT blow count and by drilling formation got looser. 100% drilling fluid loss. Length Recovered 0.4 ft, Length Retained 0.4 ft			
15	4.5						12	D-5		Well graded GRAVEL, subrounded, medium dense, gray, moist, Homogeneous, HCl reaction not tested, (Note : Got out of fill material at 13.0' as indicated by SPT blow count and by drilling formation got looser. 100% drilling fluid loss. Length Recovered 0.4 ft, Length Retained 0.4 ft			
15	4.5						5	D-6		Poorly graded GRAVEL with silt and sand, medium dense, dark brown, moist, Homogeneous, HCl reaction not tested Length Recovered 0.3 ft, Length Retained 0.3 ft			
15	4.5						7	D-6		Poorly graded GRAVEL with silt and sand, medium dense, dark brown, moist, Homogeneous, HCl reaction not tested Length Recovered 0.3 ft, Length Retained 0.3 ft			
15	4.5						4	D-6		Poorly graded GRAVEL with silt and sand, medium dense, dark brown, moist, Homogeneous, HCl reaction not tested Length Recovered 0.3 ft, Length Retained 0.3 ft			
15	4.5						11	D-6		Poorly graded GRAVEL with silt and sand, medium dense, dark brown, moist, Homogeneous, HCl reaction not tested Length Recovered 0.3 ft, Length Retained 0.3 ft			
15	4.5						9	D-7		GP-GM, MC=15% Poorly graded GRAVEL with silt and sand, subrounded, medium dense, dark brown, moist, Stratified, HCl reaction not tested Length Recovered 0.6 ft, Length Retained 0.6 ft			
15	4.5						8	D-7		GP-GM, MC=15% Poorly graded GRAVEL with silt and sand, subrounded, medium dense, dark brown, moist, Stratified, HCl reaction not tested Length Recovered 0.6 ft, Length Retained 0.6 ft			
15	4.5						19	D-7		GP-GM, MC=15% Poorly graded GRAVEL with silt and sand, subrounded, medium dense, dark brown, moist, Stratified, HCl reaction not tested Length Recovered 0.6 ft, Length Retained 0.6 ft			

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:38 AM



LOG OF TEST BORING

Start Card S 23977

Job No. OL-3549 SR 24

Elevation 1030.5 ft (314.1 m)

HOLE No. H-17-04

Sheet 2 of 2

Project SR-24 / I-82 to Keys Road

Driller Curry Cooper

Lic# 2552

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
							3 6 10 (16)	D-8		Poorty graded GRAVEL with silt and sand, subrounded, medium dense, dark brown, moist, Homogeneous, HCl reaction not tested, (Dry test hole). Length Recovered 0.5 ft, Length Retained 0.5 ft			
7										End of test hole boring at 21.5 ft below ground elevation.			
25										This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.			
8													
9													
30													
10													
35													
11													
12													
40													
13													
45													



LOG OF TEST BORING

Start Card S 23977

Job No. OL-3549 SR 24

Elevation 1030.7 ft (314.2 m)

HOLE No. H-18-04

Sheet 1 of 2

Project SR-24 / I-82 to Keys Road

Driller Curry Cooper Lic# 2552

Site Address I-82 and Nobhill Blvd.

Inspector Cleo Andrews

Start April 13, 2004 Completion April 13, 2004 Well ID# _____ Equipment CME 45 w/ autohammer

Station M 60+41 Offset 25ft Lt. Casing HQ 3" x 25.0' Method Wet Rotary

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection NW 1/4 of the SE 1/4 Section 29 Range 19 EWM Township 13 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	SPT Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
0										Top surface cobbles and small boulders shown on surface of fill slope. 0.0' to 2.5' Well graded GRAVEL with Sand modifiers with cobbles and small boulders as indicated by drilling. (Fill Material). 100% drilling fluid loss starting at 1.0'.			
1						14 10 14 (24)	D-1			Well graded GRAVEL with sand, subrounded, medium dense, olive gray, moist, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft			
5						7 9 12 (21)	D-2			Well graded GRAVEL with sand, subrounded, medium dense, olive gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 0.5 ft, Length Retained 0.5 ft			
2						20 20 19 (39)	D-3			Well graded GRAVEL with sand, subrounded, dense, olive gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 1.0 ft, Length Retained 1.0 ft			
10						>> 46 28 41 (69)	D-4			GW, MC=5% Well graded GRAVEL with sand, subrounded, very dense, olive gray, moist, Homogeneous; HCl reaction not tested, (Fill material) Length Recovered 1.2 ft, Length Retained 1.0 ft			
4						>> 100/2 (100/2")	D-5			Well graded GRAVEL with sand, subrounded, very dense, gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 0.1 ft, Length Retained 0.1 ft			
15						>> 23 34 22 (56)	D-6			Well graded GRAVEL with sand, subrounded, very dense, gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 0.5 ft, Length Retained 0.5 ft			
5						30 20 27 (47)	D-7			Well graded GRAVEL with sand, subrounded, dense, olive gray, moist, Homogeneous, HCl reaction not tested, (Fill material) Length Recovered 0.6 ft, Length Retained 0.6 ft			
6						>> 19 24	D-8			Well graded GRAVEL with sand, subrounded, very dense, brownish gray, moist, Homogeneous, HCl reaction			
20													

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:40 A6



LOG OF TEST BORING

Start Card S 23977

Job No. 0L-3549

SR 24

Elevation 1030.7 ft (314.2 m)

HOLE No. H-18-04

Sheet 2 of 2

Project SR-24 / I-82 to Keys Road

Driller Curry Cooper

Lic# 2552

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
7							27 (51)				<p>not tested, loosely bonded together with a fine grained silt matrix. (Note : Got out of fill material at 19.0' as indicated by drilling). 100% drilling fluid loss. Length Recovered 0.7 ft, Length Retained 0.7 ft Well graded GRAVEL with sand, subrounded, very dense, brownish gray, moist, Homogeneous, HCl reaction not tested, (Note : Some subangular shown in sampler). (Dry test hole). 4/13/04 Length Recovered 0.8 ft, Length Retained 0.8 ft End of test hole boring at 22.4 ft below ground elevation.</p> <p>This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.</p>		
						45 40 50/4 (90/10")	D-9						
25													
8													
9													
30													
10													
35													
11													
12													
40													
13													
45													

SOIL 0L-3549 SR 24 AND B2 TO KEYS ROAD.GPJ SOIL.GDT 6/8/04,10:15:40 AG



LOG OF TEST BORING

Start Card R 65825

Job No. 0L-3549 SR 24 Elevation 1018.3 ft (310.4 m)

HOLE No. TH-1-04

Sheet 1 of 1

Project SR-24 / I-82 to Keys Road

Driller Fetterly Lic# 2708

Site Address Vic. of I-82 & SR 24

Inspector Hanning

Start March 16, 2004 Completion March 16, 2004 Well ID# AHN 618 Equipment CME 850 w/ autohammer

Station S 10+00 Offset 50ft Rt. Casing 8" Method Auger

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection SW/NE Section 29 Range 19 EWM Township 13N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
0	0												
1	0.3					2 2 2 (4)		D-1	GS MC AL	SM, M.C. = 16%, LL = 24 Silty SAND, with organics, very loose, brown, moist, Homogeneous, no HCl reaction Length Recovered 1.5 ft, Length Retained 1.5 ft			
5	1.5					9 28 30 (58)		D-2		Poorly graded SAND with silt and gravel, subrounded, very dense, grayish brown, moist, Homogeneous, no HCl reaction, Drilling indicates large gravel, possible small cobbles. Length Recovered 1.0 ft, Length Retained 1.0 ft			
10	3.0					27 42 50/3" (50)		D-3	GS MC	SP-SM, M.C. = 2% Poorly graded SAND with silt and gravel, subrounded, very dense, pale brown, moist, Homogeneous, no HCl reaction, drilling indicates cobbles. Length Recovered 1.0 ft, Length Retained 1.0 ft			
15	4.5					19 50/5" (50)		D-4		Poorly graded SAND with silt and gravel, subrounded, very dense, pale brown, moist, Homogeneous, no HCl reaction, Drilling indicates large gravel and small cobbles Length Recovered 0.8 ft, Length Retained 0.8 ft			
15.5	4.7					28 34 39 (73)		D-5		Poorly graded SAND with silt and gravel, subrounded, very dense, grayish brown, moist, Homogeneous, no HCl reaction, Drilling indicates large gravel possible small cobbles. No water present, prior to install. Length Recovered 1.5 ft, Length Retained 1.5 ft			
20	6.1									End of test hole boring at 15.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.			

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT_6/3/04_1:21:40 P6



LOG OF TEST BORING

Start Card R 65825

Job No. 0L-3549 SR 24

Elevation 1010.2 ft (307.9 m)

HOLE No: TH-2-04

Sheet 1 of 1

Project SR-24 / I-82 to Keys Road

Driller Fetterly Lic# 2708

Site Address Vic. of I-82 & SR 24

Inspector Hanning

Start March 16, 2004 Completion March 16, 2004 Well ID# AHN 617

Equipment CME 850 w/ autohammer

Station L 61+00 Offset 130 ft Lt. Casing 8"

Method Auger

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection SW/NE Section 29 Range 19 EWM Township 13N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
0	0				30								
1	0.3					5 10 20 (30)		D-1		Poorly graded SAND with gravel, dense, brown, moist, Homogeneous, no HCl reaction, Drilling behavior indicates cobbles and possible small boulders. Length Recovered 1.2 ft, Length Retained 1.2 ft			
5	1.5					50/6" (50/6")		D-2		Poorly graded GRAVEL with sand, and some silt, subrounded, very dense, grayish brown, dry, Homogeneous, no HCl reaction, Drilling behavior indicates cobbles			
2	0.6					36 16 31 (47)		D-3		Length Recovered 0.2 ft, Length Retained 0.2 ft Poorly graded GRAVEL with sand, subrounded, dense, brownish gray, moist, Homogeneous, no HCl reaction, Drilling indicates cobbles. Length Recovered 0.8 ft, Length Retained 0.8 ft			
10	3.0					>> 100/2" (100/2")		D-4		Poorly graded GRAVEL with sand, subrounded, very dense, gray, moist, Homogeneous, no HCl reaction, Bag sample retained from auger run 5 ft to 10 ft. Length Recovered 0.2 ft, Length Retained 0.2 ft			
10	3.0					>> 100/6" (100/6")		D-5		GP, MC=3% Poorly graded GRAVEL with sand, rounded, very dense, gray, moist, Homogeneous, no HCl reaction, Drilling indicates cobbles. Length Recovered 0.5 ft, Length Retained 0.5 ft			
15	4.5					2 5 9 (14)		D-6		SP, MC=13% Poorly graded SAND with gravel, medium dense, brown, wet, Homogeneous, no HCl reaction, No bail test. water reading taken prior to install 12.0 ft. developed well. poured 20 gal. fresh water down piezometer. Water reading taken 20 min. later 11.8 ft. 3-16-04 Length Recovered 1.5 ft, Length Retained 1.5 ft			
20	6.0									End of test hole boring at 16.5 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.			

03/17/2004

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT 6/3/04 4:00:30 P6



LOG OF TEST BORING

Start Card R 65826

Job No. 0L-3549

SR 24

Elevation 1010.0 ft (307.8 m)

HOLE No. TH-3-04

Sheet 1 of 1

Project SR-24 / I-82 to Keys Road

Driller Cooper Lic# 2552

Site Address SR 24 and Arboretum Dr.

Inspector Hanning

Start April 3, 2004

Completion April 3, 2004

Well ID# AHN 625

Equipment CME 45 w/ autohammer

Station L 66+00

Offset 125ft Lt.

Casing 6"

Method Wet Rotary

Northing _____

Easting _____

Latitude _____

Longitude _____

County Yakima

Subsection SE/NE

Section 29

Range 19E

Township 13N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10 20 30 40	4		D-1		Sandy SILT, medium dense, brown, moist, Homogeneous, HCl reaction not tested Length Recovered 0.8 ft, Length Retained 0.8 ft		
				7						
				8						
				(15)		D-2		ML, MC=34%, PI=6 Sandy SILT, medium dense, brown, moist, Stratified, HCl reaction not tested Length Recovered 1.3 ft, Length Retained 1.3 ft		
				7						
				8						
				9						
1				(17)		D-3		SW-SM, MC=12% Well graded SAND with silt and gravel, dense, grayish brown, moist, Stratified, HCl reaction not tested Length Recovered 1.3 ft, Length Retained 1.3 ft		
				18						
				18		D-4		Gravelly SILT with sand, medium dense, brown, moist, Stratified, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
5				27						
				(45)		D-5		Well graded GRAVEL with silt and sand, rounded; dense, grayish brown, moist, Stratified, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
				15						
				18						
				23						
2				(41)		D-6		GW-GM, MC=11% Well graded GRAVEL with silt and sand, rounded, very dense, grayish brown, moist, Homogeneous, HCl reaction not tested Length Recovered 0.9 ft, Length Retained 0.9 ft		
				36						
				23						
				26						
				(49)		D-7		Well graded GRAVEL with silt and sand, rounded, very dense, gray, wet, Homogeneous, no HCl reaction Length Recovered 0.5 ft, Length Retained 0.5 ft		
10				30						
				70/5"						
				(70/5")		D-8		Well graded GRAVEL with silt and sand, rounded, very dense, gray, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft		
				70/6						
				(70/6")		D-9		Well graded GRAVEL with silt and sand, rounded, very dense, gray, wet, Homogeneous, HCl reaction not tested, Water reading after install, 7.5 ft Length Recovered 0.5 ft, Length Retained 0.5 ft End of test hole boring at 14.5 ft below ground elevation.		
				70/6						
				(70/6")						
15				60/6						
				(60/6")						
5										
20										

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/3/04, 4:00:31 P6

This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.



LOG OF TEST BORING

Start Card R 65828

Job No. OL-3549 SR 24

Elevation 1007.5 ft (307.1 m)

HOLE No. TH-4-04

Sheet 1 of 1

Project SR-24 / I-82 to Keys Road

Driller Fetterly Lic# 2708

Site Address SR 24 Vic. Birchfield Rd.

Inspector Hanning

Start March 17, 2004 Completion March 17, 2004 Well ID# AHN 629 Equipment CME 850 w/ autohammer

Station W 14+00 Offset 35 ft. Lt. Casing 8" Method Auger

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection NE/SE Section 29 Range 19 EWM Township 13N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
0-1	0-0.3												
1-5	0.3-1.5					2 3 5 (8)	▲	D-1		Silty SAND, loose, brown, moist, Homogeneous, no HCl reaction Length Recovered 0.5 ft, Length Retained 0.5 ft			
5-7	1.5-2.1					2 3 3 (6)	▲	D-2		Silty SAND, loose, brown, moist, Homogeneous, no HCl reaction Length Recovered 0.3 ft, Length Retained 0.3 ft			
7-10	2.1-3.0					2 2 7 (9)	▲	D-3		SM, MC=25% Silty SAND, loose, brown, moist, Stratified, no HCl reaction, Drilling indicates more gravel than recovered from sampler. Length Recovered 0.7 ft, Length Retained 0.7 ft			
10-15	3.0-4.6					13 17 19 (36)	▲	D-4		Well graded GRAVEL with sand, rounded, dense, grayish brown, moist, Stratified, no HCl reaction, Note drilling indicates large gravel and possible small cobbles. Length Recovered 1.2 ft, Length Retained 1.2 ft			
15-16	4.6-4.9					11 18 15 (23)	▲	D-5		Well graded GRAVEL with sand, rounded, medium dense, brown, wet, Homogeneous, no HCl reaction, Water reading taken. 11.5 ft. Length Recovered 0.5 ft, Length Retained 0.5 ft			
16-17	4.9-5.1					9 30 28 (58)	▲	D-6		GW, MC=12% Well graded GRAVEL with sand, rounded, very dense, brown, wet, Homogeneous, no HCl reaction, Drilled to 16 ft for install. Developed well, flushed with 20 gal. fresh water. Water reading after 20 min. 11.9 ft. Length Recovered 1.2 ft, Length Retained 1.2 ft			
17-16	5.1-4.9									End of test hole boring at 16 ft below ground elevation.			
<p>This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.</p>													



LOG OF TEST BORING

Start Card R-65824

Job No. 0L-3549

SR 24

Elevation 1009.3 ft (307.6 m)

HOLE No. TH-5-04

Sheet 1 of 1

Project SR-24 / I-82 to Keys Road

Driller Joe Judd Lic# 2454

Site Address SR 24 Vic of W. Birchfield Rd.

Inspector Dave Nelson

Start March 16, 2004 Completion March 16, 2004 Well ID# AHN-623 Equipment CME 850 w/ autohammer

Station L 73+78 Offset 65ft Lt. Casing 6" x 5' & 4" x 16.3 Method Wet Rotary

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection NW 1/4 of SW 1/4 Section 28 Range 19 EWM Township 13 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
1						16		D-1		Well graded GRAVEL with sand, subrounded, dense, brown, dry, Homogeneous, HCl reaction not tested, drilling behavior indicates cobbles & boulders Length Recovered 1.0 ft			
5						27 (44)		D-2		Well graded GRAVEL with sand, subrounded, very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft			
2						93 50/6 (50/6")		D-3		Well graded GRAVEL with sand, subrounded, very dense, dark brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.8 ft			
10						85 42 33 (75)		D-4		Well graded GRAVEL with sand, subrounded, very dense, dark brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.2 ft			
3						25 50/2 (50/2")		D-5		Well graded GRAVEL with sand, subrounded, very dense, dark brown, wet, Homogeneous, HCl reaction not tested No Recovery			
4						100/6 (100/6")		D-6		Well graded GRAVEL with sand, subrounded, very dense, dark brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.2 ft			
15						96/6 (96/6")		D-7	GS MC	GW-GM, M.C. = 6% Well graded GRAVEL with silt and sand, subrounded, very dense, dark brown, wet, Homogeneous, HCl reaction not tested, Bail Test was unable to bail hole below 5.0 Length Recovered 1.0 ft			
20						26 39 50 (89)				End of test hole boring at 18 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.			
7													

SOIL_0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL_GDT 6/17/04 8:29:10 A6



LOG OF TEST BORING

Start Card R-65824

Job No. 0L-3549 SR 24

Elevation 999.5 ft (304.6 m)

HOLE No. TH-6-04

Sheet 1 of 1

Project SR-24 / I-82 to Keys Road

Driller Joe Judd Lic# 2454

Site Address SR-24 Vic of W. Birchfield Rd.

Inspector Dave Nelson

Start March 15, 2004 Completion March 15, 2004 Well ID# AHN-624 Equipment CME 850 w/ autohammer

Station L 85+00 Offset 105ft Rt. Casing 6" x 5' & 4" x 10.5 Method Wet Rotary

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection NW 1/4 of SW 1/4 Section 28 Range 19 EWM Township 13 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
						2 3 3 (6)	D-1			Silty SAND, with organics, loose, dark brown, moist, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft			
1						2 3 4 (7)	D-2			Silty SAND, loose, dark brown, wet, Homogeneous, HCl reaction not tested, 4.5 drilling behavior indicates cobbles & boulders Length Recovered 1.0 ft			
5						10 16 7 (23)	D-3			Well graded GRAVEL with sand, subrounded, medium dense, dark brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.7 ft			
2						21 24 25 (49)	D-4	GS MC		GP-GM, M.C. = 7% Poorly graded GRAVEL with silt and sand, subrounded, dense, dark brown, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft			
10						25 32 43 (75)	D-5			Poorly graded GRAVEL with silt and sand, subrounded, very dense, dark brown, wet, Homogeneous, HCl reaction not tested, Bail Test was unable to bail hole below 7.2 Length Recovered 0.6 ft			
4										End of test hole boring at 12 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													
5													
6													
20													

SOIL 0L-3549 SR 24 AND 82 TO KEYS ROAD.GPJ - SOIL.GDT 6/17/04 8:30:04 AB



LOG OF TEST BORING

Start Card R 65822

Job No. OL-3549 SR 24

Elevation 989.5 ft (301.6 m)

HOLE No. TH-7-04

Sheet 1 of 1

Project SR-24 / I-82 to Keys Road

Driller Donny Henderson Lic# 2598

Site Address SR 24 Vic. of Keys Rd.

Inspector Vince Johnson

Start March 24, 2004 Completion March 25, 2004 Well ID# AHN 619 Equipment CME 55 w/ autohammer

Station L 112+00 Offset 75ft Lt. Casing 8" Auger Method Auger

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection SE1/4 of SW1/4 Section 28 Range 19 EWM Township 13 N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument		
			10	20	30	40									
1-2	0.3-0.6						3		D-1		SM, MC=6%, LL=29 Silty SAND with gravel, medium dense, brown, dry, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft				
							5								
							10		(15)		D-2		Poorly graded GRAVEL with sand, subangular, very dense, grayish brown, dry, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
							18		27						
							31		(58)						
5	1.5						22		D-3		Poorly graded GRAVEL with sand, angular, dense, dry, Homogeneous, HCl reaction not tested Length Recovered 0.9 ft, Length Retained 0.9 ft				
							18		50/4"						
							50/4"		(68/10")		D-4		Poorly graded GRAVEL with sand, angular, very dense, brownish gray, wet, Stratified, HCl reaction not tested, Stratified with brown layers of silty sand Length Recovered 1.3 ft, Length Retained 1.0 ft		
				21		37									
				29		(66)									
10-3	3.0-3.3						8		D-5		GP, MC=9% Poorly graded GRAVEL with sand, subrounded, very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.0 ft				
							20		50						
						(70)									
4	15									End of test hole boring at 10.8 ft below ground elevation.					
5										This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.					
6															
20															

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/14/04,7:22:10 AS



LOG OF TEST BORING

Start Card R 65821

Job No. OL-3549 SR 24

Elevation 991.0 ft (302.1 m)

HOLE No. TH-8-04

Sheet 1 of 1

Project SR-24 / I-82 to Keys Road

Driller Donny Henderson Lic# 2598

Site Address SR 24 Vic of MP 1

Inspector Vince Johnson

Start March 25, 2004 Completion March 25, 2004 Well ID# AHN 615

Equipment CME 55 w/ autohammer

Station L 116+44 Offset 75ft Lt. Casing 8" Auger

Method Auger

Northing _____ Easting _____ Latitude _____ Longitude _____

County Yakima Subsection SW-SE Section 28 Range 19ewm Township 13n

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
0	0					2		D-1		Sandy SILT, very loose, brown, dry, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft			
0.5	0.5					2		D-2		ML, MC=33%, PI=7 Sandy SILT, loose, brown, moist, Laminated, Fissured, HCl reaction not tested Length Recovered 0.8 ft, Length Retained 0.8 ft			
1	1					(4)		D-3		Sandy SILT, very loose, brown, moist, Stratified, HCl reaction not tested, upper 0.6 of sample moist bottom 0.2 of sample wet Length Recovered 0.8 ft, Length Retained 0.8 ft			
2	2					1		D-4		Poorly graded GRAVEL with silt and sand, dense, brown, moist, Stratified, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft			
5	5					1		D-5		GP-GM, MC=9% Poorly graded GRAVEL with silt and sand, angular, very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 1.5 ft, Length Retained 1.0 ft			
10	10					1		D-6		Poorly graded GRAVEL with silt and sand, very dense, brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.5 ft, Length Retained 0.5 ft			
12.5	12.5					7				End of test hole boring at 12.5 ft below ground elevation.			
15	15					24				This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.			
20	20					(31)							

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ SOIL.GDT 6/14/04 7:22:12 AM

Appendix B-2
Logs of Test Borings
HWA-1999

RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALUE

COHESIONLESS SOILS			COHESIVE SOILS		
Density	N (blows/ft)	Approximate Relative Density(%)	Consistency	N (blows/ft)	Approximate Undrained Shear Strength (psf)
Very Loose	0 to 4	0 - 15	Very Soft	0 to 2	<250
Loose	4 to 10	15 - 35	Soft	2 to 4	250 - 500
Medium Dense	10 to 30	35 - 65	Medium Stiff	4 to 8	500 - 1000
Dense	30 to 50	65 - 85	Stiff	8 to 15	1000 - 2000
Very Dense	over 50	85 - 100	Very Stiff Hard	15 to 30 over 30	2000 - 4000 >4000

USCS SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP DESCRIPTIONS	
Coarse Grained Soils	Gravel and Gravelly Soils	Clean Gravel (little or no fines)		GW Well-graded GRAVEL
		Gravel with Fines (appreciable amount of fines)		GP Poorly-graded GRAVEL
	Sand and Sandy Soils	Clean Sand (little or no fines)		SW Well-graded SAND
		Sand with Fines (appreciable amount of fines)		SM Silty SAND
Fine Grained Soils	Silt and Clay	Liquid Limit Less than 50%		ML SILT
		Liquid Limit 50% or More		CL Lean CLAY
	Silt and Clay	Liquid Limit Less than 50%		MH Elastic SILT
		Liquid Limit 50% or More		CH Fat CLAY
Highly Organic Soils				OH Organic SILT/Organic CLAY
				PT PEAT

TEST SYMBOLS

%F	Percent Fines	
AL	Atterberg Limits:	PL = Plastic Limit LL = Liquid Limit
CBR	California Bearing Ratio	
CN	Consolidation	
DD	Dry Density (pcf)	
DS	Direct Shear	
GS	Grain Size Distribution	
K	Permeability	
MD	Moisture/Density Relationship (Proctor)	
MR	Resilient Modulus	
PID	Photoionization Device Reading	
PP	Pocket Penetrometer	Approx. Compressive Strength (tsf)
SG	Specific Gravity	
TC	Triaxial Compression	
TV	Torvane	Approx. Shear Strength (tsf)
UC	Unconfined Compression	

SAMPLE TYPE SYMBOLS

	2.0" OD Split Spoon (SPT) (140 lb. hammer with 30 in. drop)
	Shelby Tube
	3.0" OD Split Spoon with Brass Rings
	Small Bag Sample
	Large Bag (Bulk) Sample
	Core Run
	Non-standard Penetration Test (with split spoon sampler)

GROUNDWATER SYMBOLS

	Groundwater Level (measured at time of drilling)
	Groundwater Level (measured in well or open hole after water level stabilized)

COMPONENT DEFINITIONS

COMPONENT	SIZE RANGE
Boulders	Larger than 12 in
Cobbles	3 in to 12 in
Gravel	3 in to No 4 (4.5mm)
Coarse gravel	3 in to 3/4 in
Fine gravel	3/4 in to No 4 (4.5mm)
Sand	No. 4 (4.5 mm) to No. 200 (0.074 mm)
Coarse sand	No. 4 (4.5 mm) to No. 10 (2.0 mm)
Medium sand	No. 10 (2.0 mm) to No. 40 (0.42 mm)
Fine sand	No. 40 (0.42 mm) to No. 200 (0.074 mm)
Silt and Clay	Smaller than No. 200 (0.074mm)

COMPONENT PROPORTIONS

PROPORTION RANGE	DESCRIPTIVE TERMS
< 5%	Clean
5 - 12%	Slightly (Clayey, Silty, Sandy)
12 - 30%	Clayey, Silty, Sandy, Gravelly
30 - 50%	Very (Clayey, Silty, Sandy, Gravelly)
Components are arranged in order of increasing quantities.	

NOTES: Soil classifications presented on exploration logs are based on visual and laboratory observation. Soil descriptions are presented in the following general order:

Density/consistency, color, modifier (if any) GROUP NAME, additions to group name (if any), moisture content, Proportion, gradation, and angularity of constituents, additional comments.
(GEOLOGIC INTERPRETATION)

Please refer to the discussion in the report text as well as the exploration logs for a more complete description of subsurface conditions.

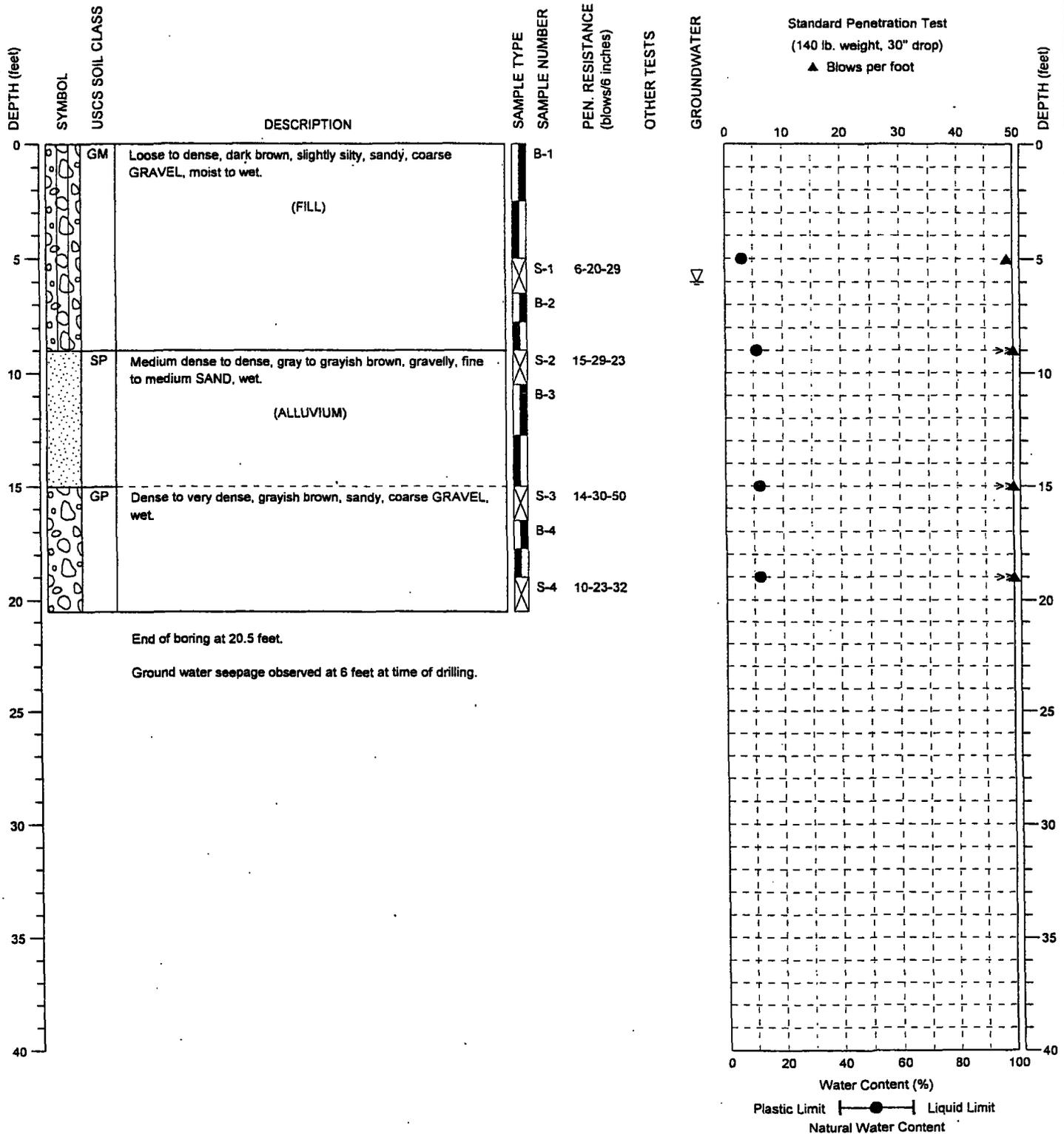
MOISTURE CONTENT

DRY	Absence of moisture, dusty, dry to the touch.
MOIST	Damp but no visible water.
WET	Visible free water, usually soil is below water table.

LEGEND OF TERMS AND SYMBOLS USED ON EXPLORATION LOGS

DRILLING COMPANY: Layne Christensen Company
 DRILLING METHOD: Becker Rig
 SAMPLING METHOD: Cutting Return & Split Spoon
 SURFACE ELEVATION: 1005 ± feet

LOCATION: See Figure 2
 DATE STARTED: 11/12/1999
 DATE COMPLETED: 11/12/1999
 LOGGED BY: S. Greene



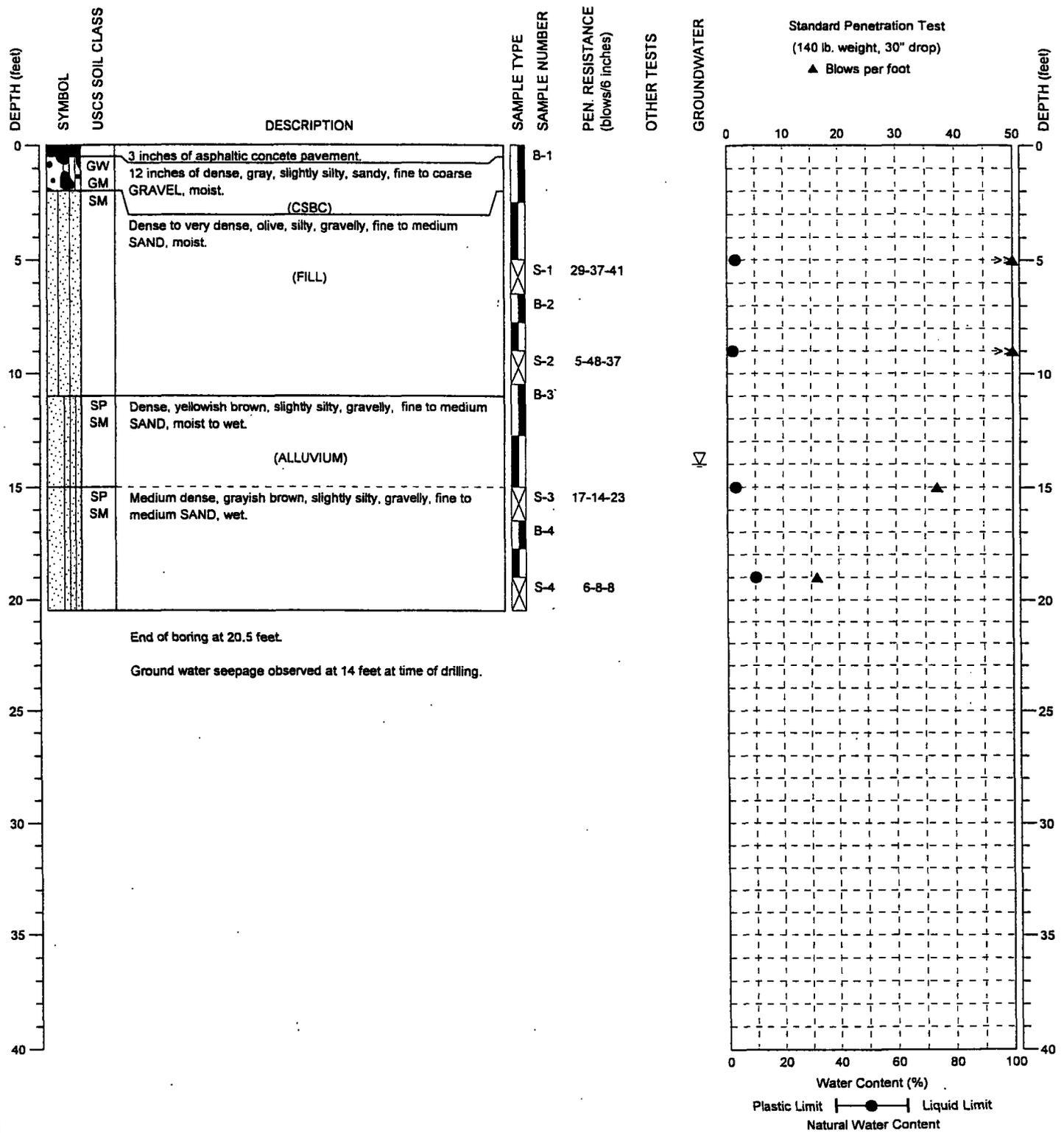
NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

BORING:
 BH-1

PAGE: 1 of 1

DRILLING COMPANY: Layne Christensen Company
 DRILLING METHOD: Becker Rig
 SAMPLING METHOD: Cutting Return & Split Spoon
 SURFACE ELEVATION: 1007 ± feet

LOCATION: See Figure 2
 DATE STARTED: 11/13/1999
 DATE COMPLETED: 11/13/1999
 LOGGED BY: S. Greene



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.



SR-24: I-82 TO KEYS ROAD
 YAKIMA, WASHINGTON

BORING:
 BH-2

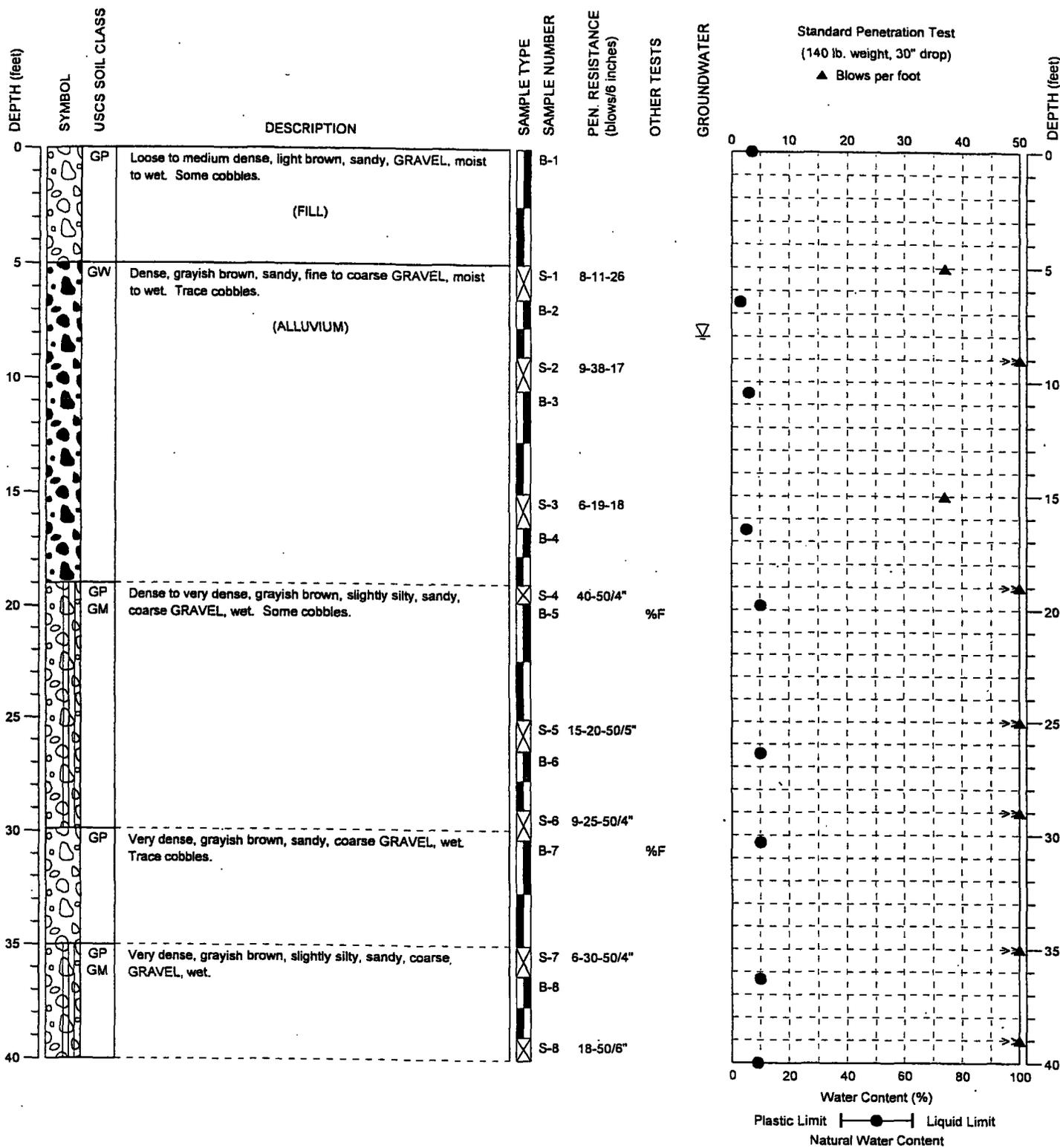
PAGE: 1 of 1

PROJECT NO.: 99123

FIGURE: A-3

DRILLING COMPANY: Layne Christensen Company
 DRILLING METHOD: Becker Rig
 SAMPLING METHOD: Cutting Return & Split Spoon
 SURFACE ELEVATION: 997 ± feet

LOCATION: See Figure 2
 DATE STARTED: 11/11/1999
 DATE COMPLETED: 11/12/1999
 LOGGED BY: S. Greene



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.



SR-24: I-82 TO KEYS ROAD
 YAKIMA, WASHINGTON

BORING:
 BH-3

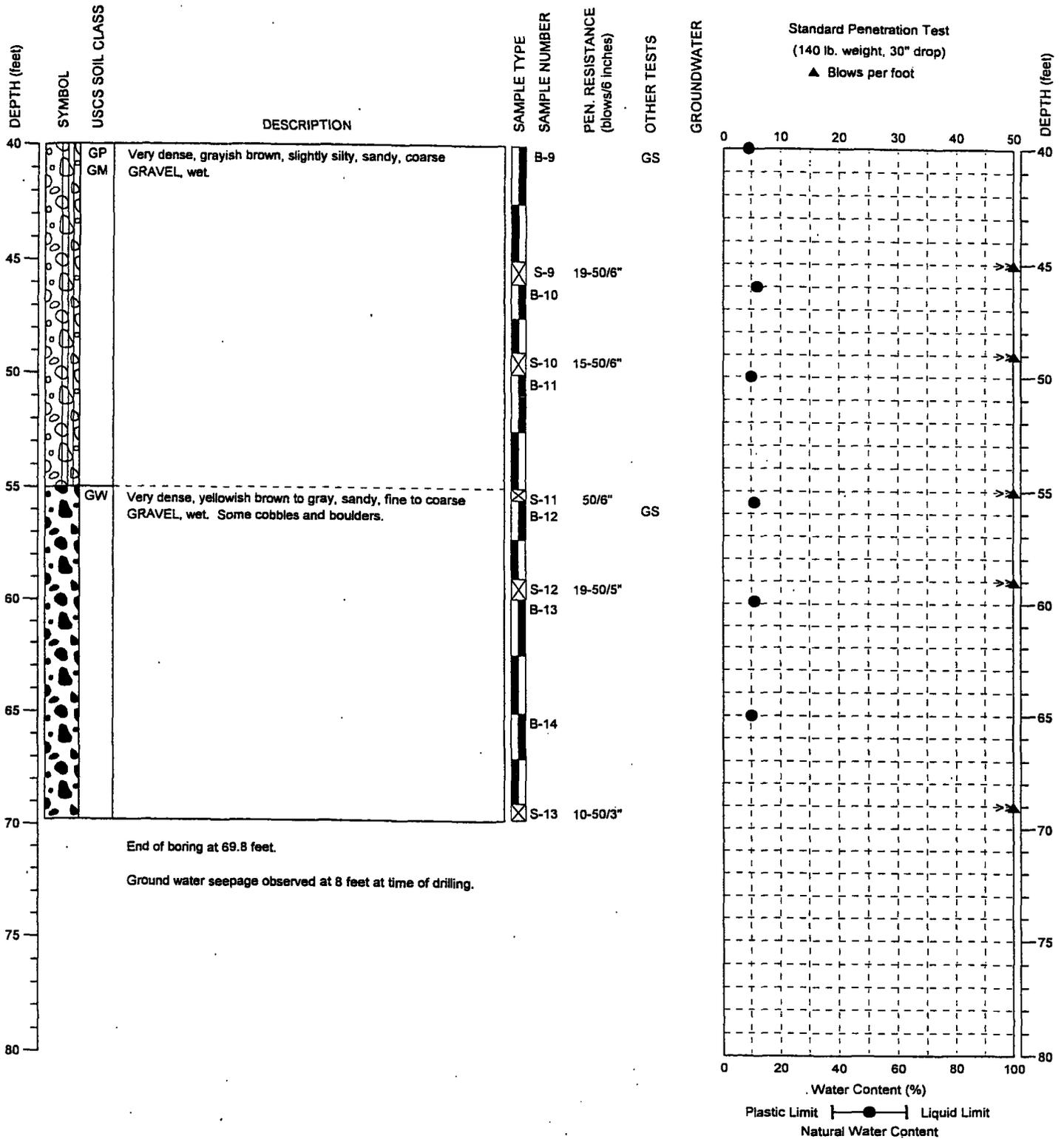
PAGE: 1 of 2

PROJECT NO.: 99123

FIGURE: A-4

DRILLING COMPANY: Layne Christensen Company
 DRILLING METHOD: Becker Rig
 SAMPLING METHOD: Cutting Return & Split Spoon
 SURFACE ELEVATION: 997 ± feet

LOCATION: See Figure 2
 DATE STARTED: 11/11/1999
 DATE COMPLETED: 11/12/1999
 LOGGED BY: S. Greene



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

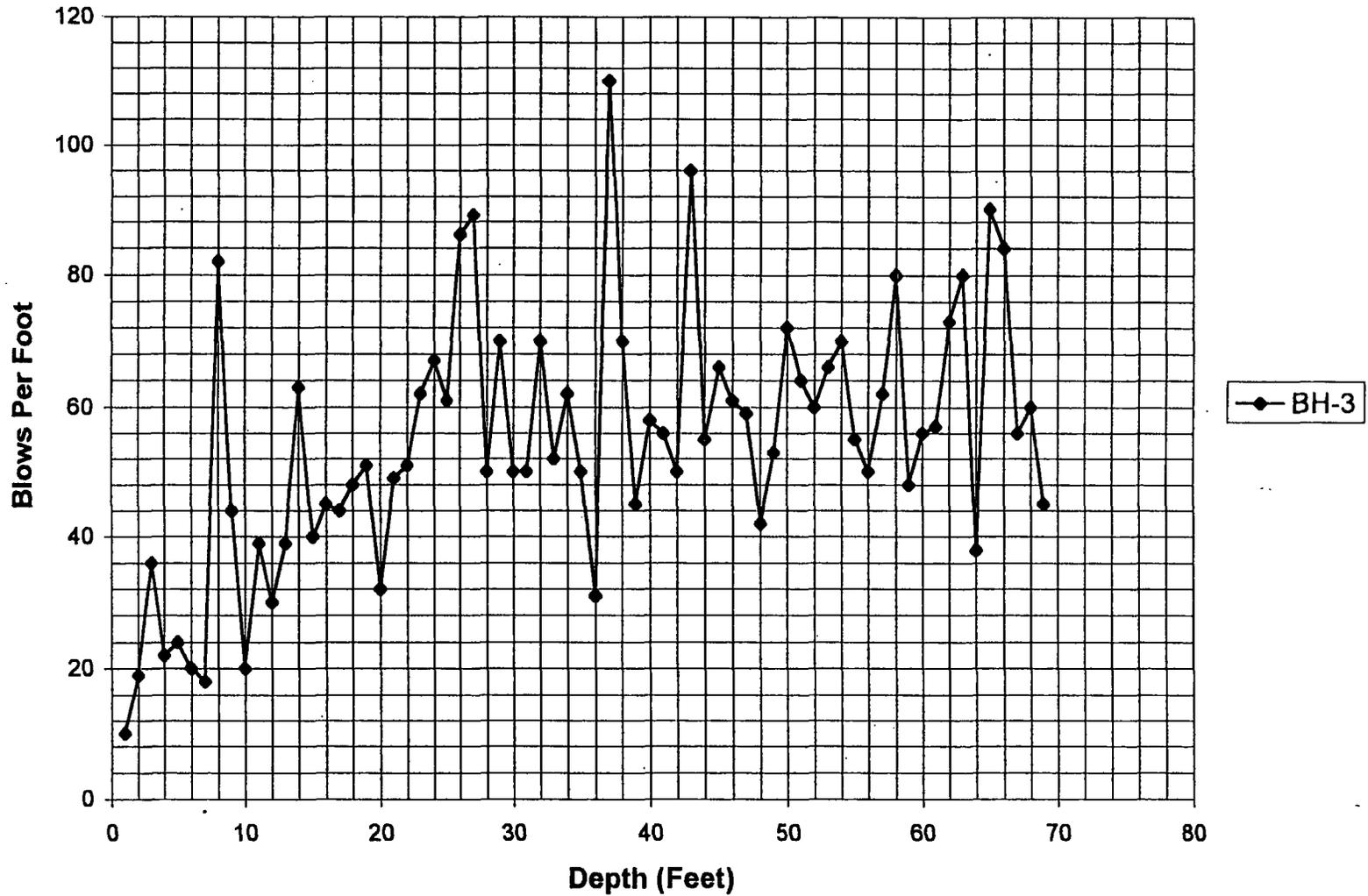


SR-24: I-82 TO KEYS ROAD
 YAKIMA, WASHINGTON

BORING:
 BH-3

PAGE: 2 of 2

BH-3: Becker Hammer Data



HWAGEOSCIENCES INC.

SR-24 : I-82 TO KEYS ROAD
YAKIMA, WASHINGTON

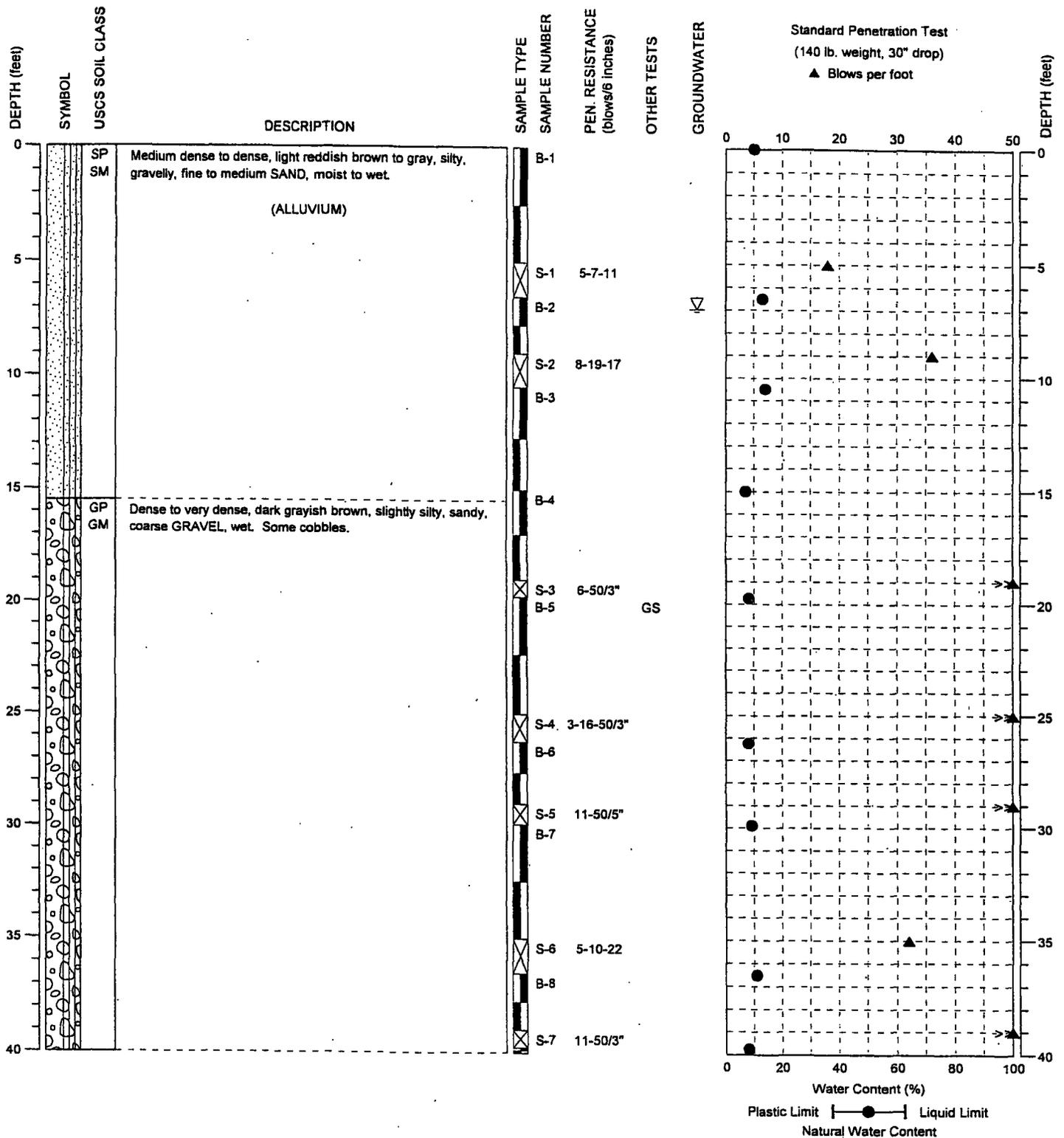
BH-3 BECKER
PENETRATION TESTS

DRAWN BY	HAC
CHECKED BY	JSS
DATE	6.29.00

FIGURE NO.	A-4a
PROJECT NO.	

DRILLING COMPANY: Layne Christensen Company
 DRILLING METHOD: Becker Rig
 SAMPLING METHOD: Cutting Return & Split Spoon
 SURFACE ELEVATION: 994 ± feet

LOCATION: See Figure 2
 DATE STARTED: 11/12/1999
 DATE COMPLETED: 11/12/1999
 LOGGED BY: S. Greene



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.



SR-24: I-82 TO KEYS ROAD
 YAKIMA, WASHINGTON

BORING:
 BH-4

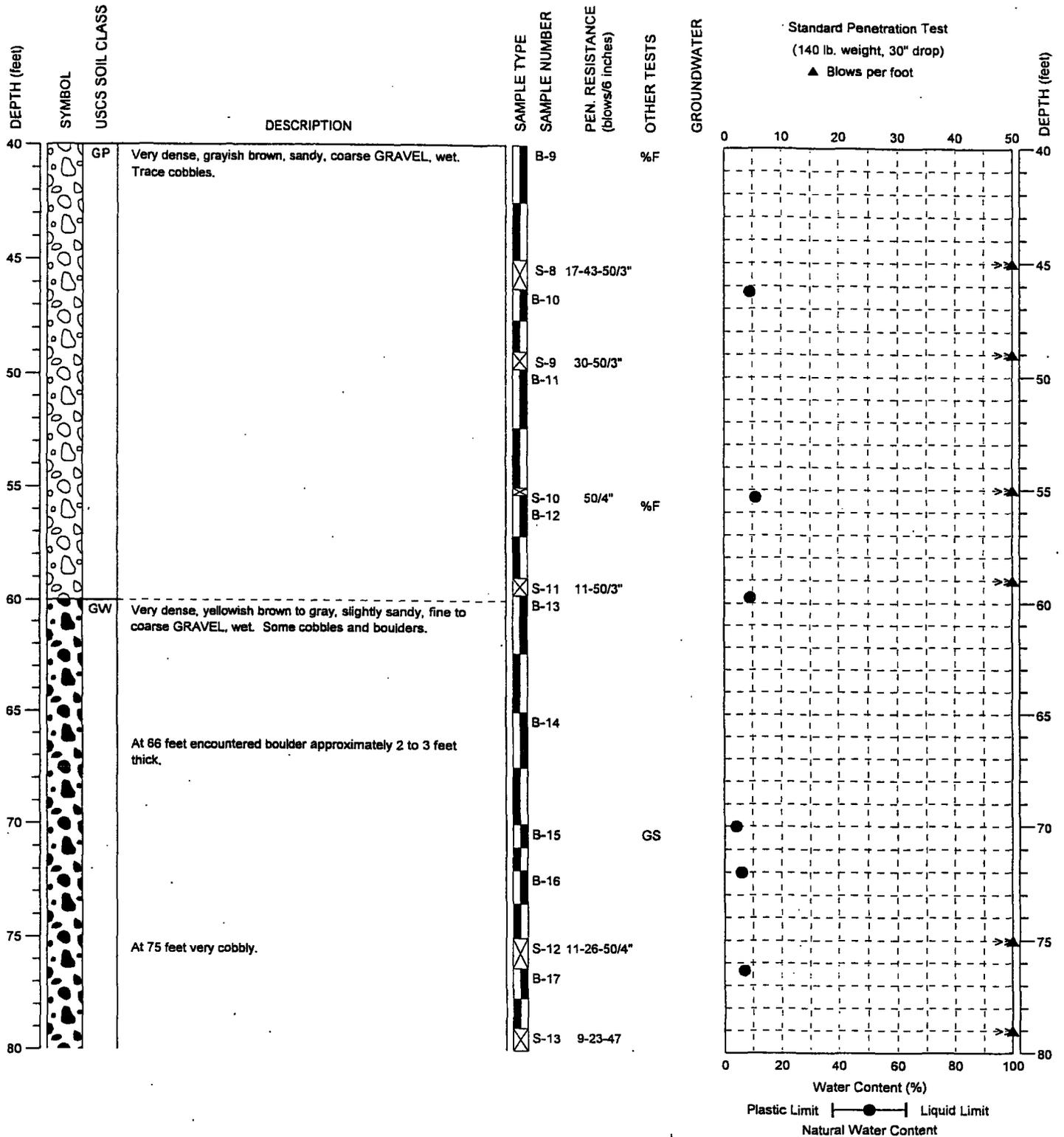
PAGE: 1 of 3

PROJECT NO.: 99123

FIGURE: A-5

DRILLING COMPANY: Layne Christensen Company
 DRILLING METHOD: Becker Rig
 SAMPLING METHOD: Cutting Return & Split Spoon
 SURFACE ELEVATION: 994 ± feet

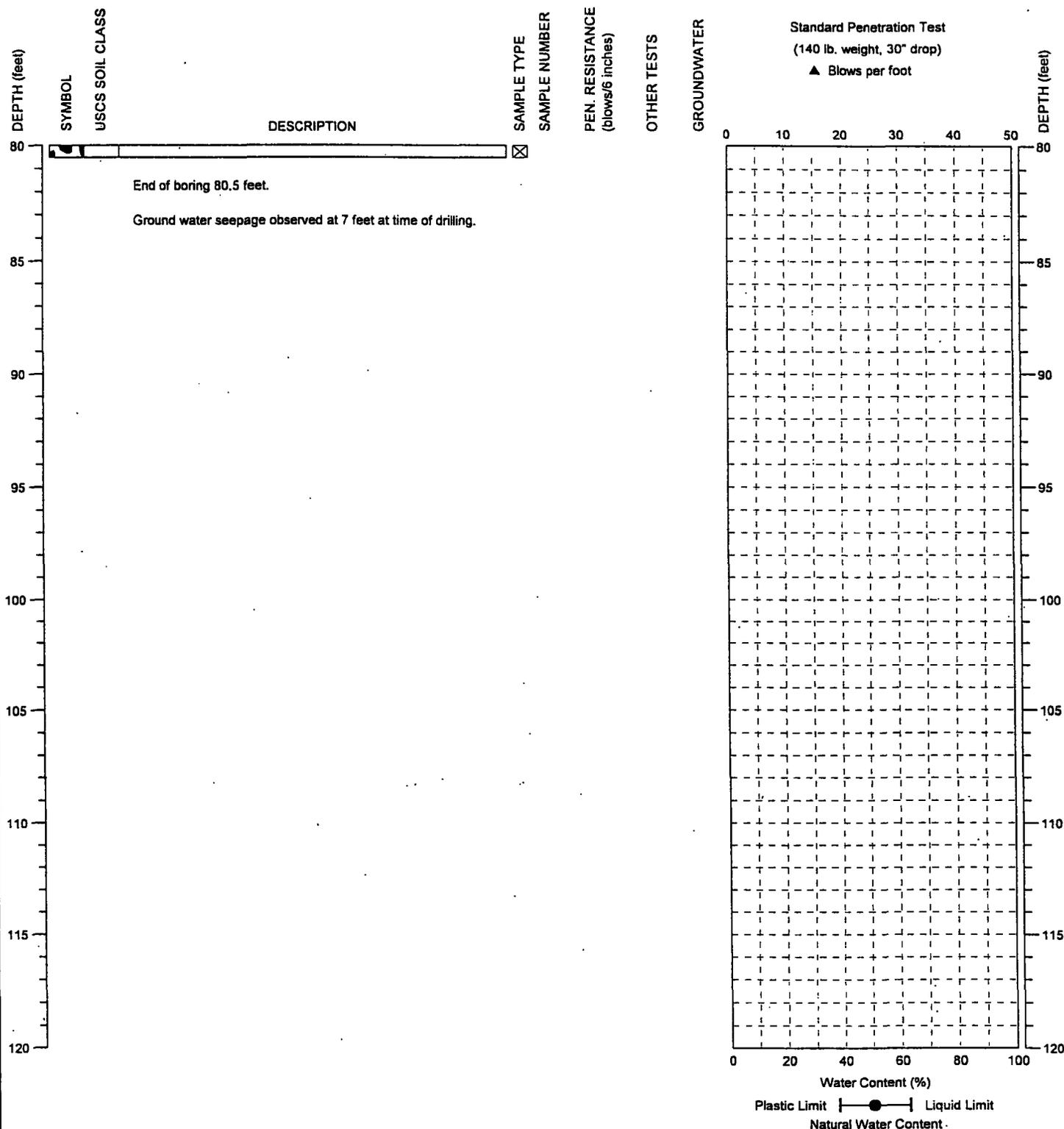
LOCATION: See Figure 2
 DATE STARTED: 11/12/1999
 DATE COMPLETED: 11/12/1999
 LOGGED BY: S. Greene



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

DRILLING COMPANY: Layne Christensen Company
 DRILLING METHOD: Becker Rig
 SAMPLING METHOD: Cutting Return & Split Spoon
 SURFACE ELEVATION: 994 ± feet

LOCATION: See Figure 2
 DATE STARTED: 11/12/1999
 DATE COMPLETED: 11/12/1999
 LOGGED BY: S. Greene



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.



SR-24: I-82 TO KEYS ROAD
 YAKIMA, WASHINGTON

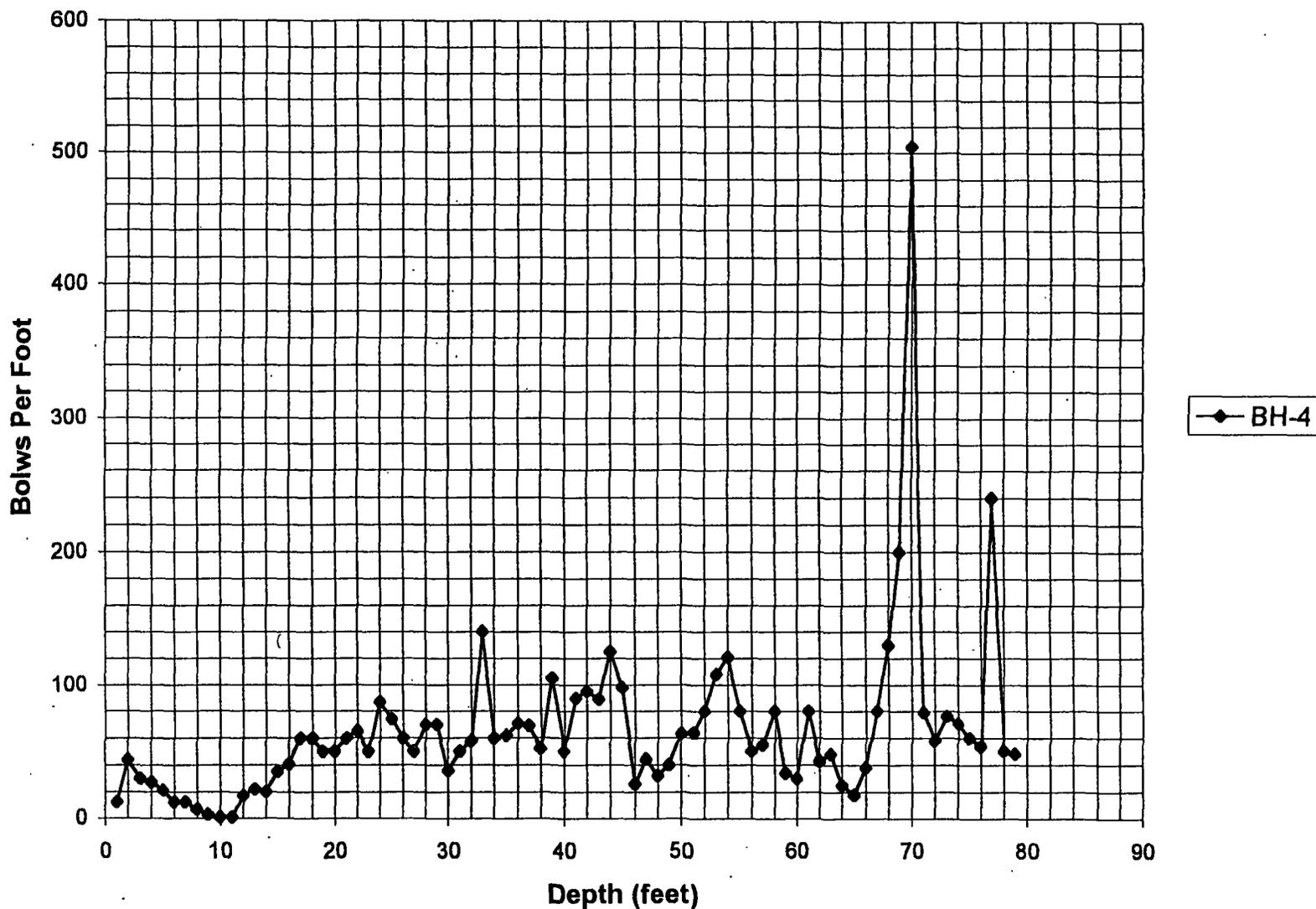
BORING:
 BH-4

PAGE: 3 of 3

PROJECT NO.: 99123

FIGURE: A-5

BH-4: Becker Hammer Data



HWA
HWA GEOSCIENCES INC.

SR-24 : I-82 TO KEYS ROAD
 YAKIMA, WASHINGTON

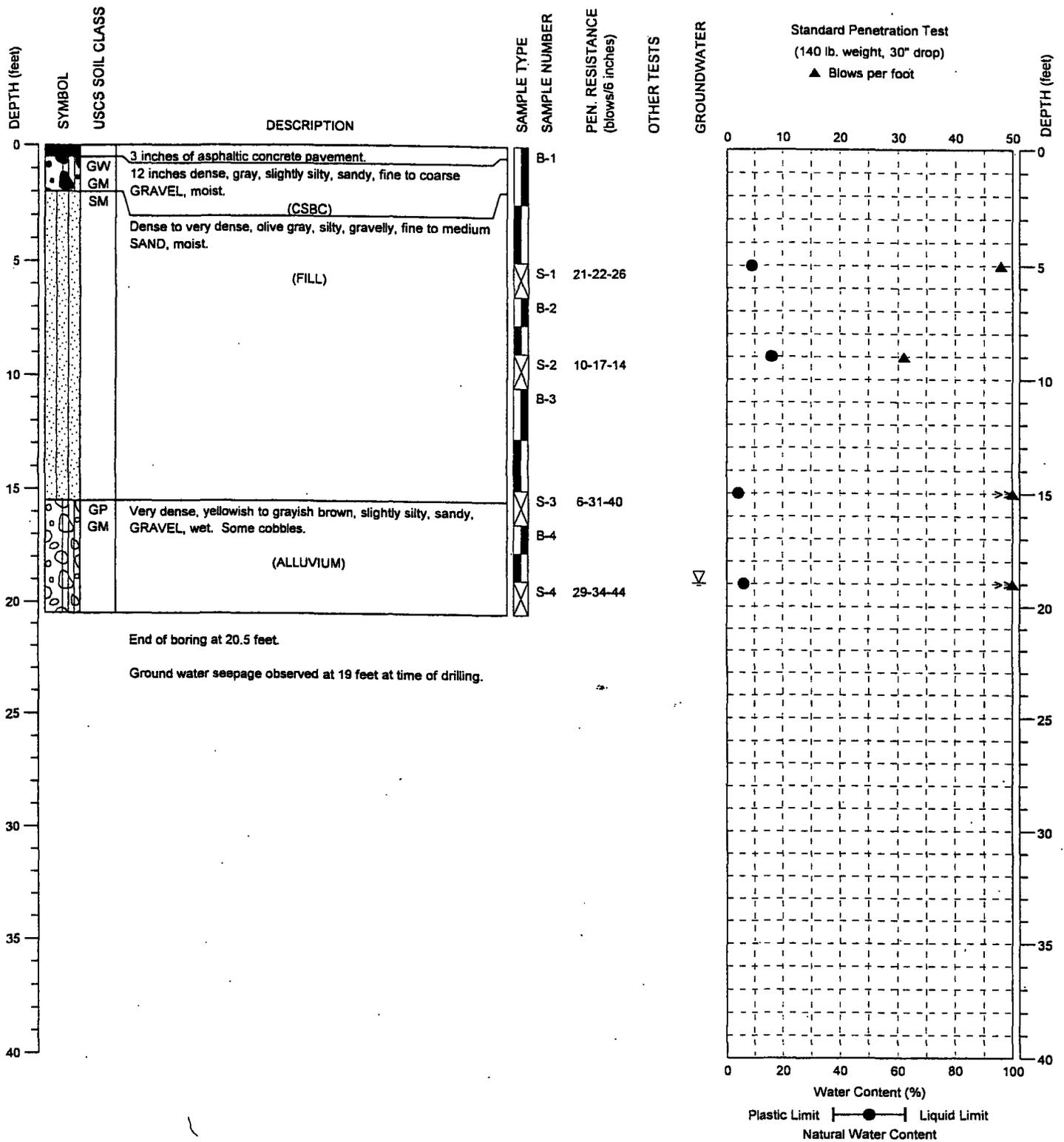
BH-4 BECKER
 PENETRATION TESTS

DRAWN BY HAC
 CHECKED BY JSS
 DATE
 6.29.00

FIGURE NO.
A-5a
 PROJECT NO.
 99123

DRILLING COMPANY: Layne Christensen Company
 DRILLING METHOD: Becker Rig
 SAMPLING METHOD: Cutting Return & Split Spoon
 SURFACE ELEVATION: 1005 ± feet

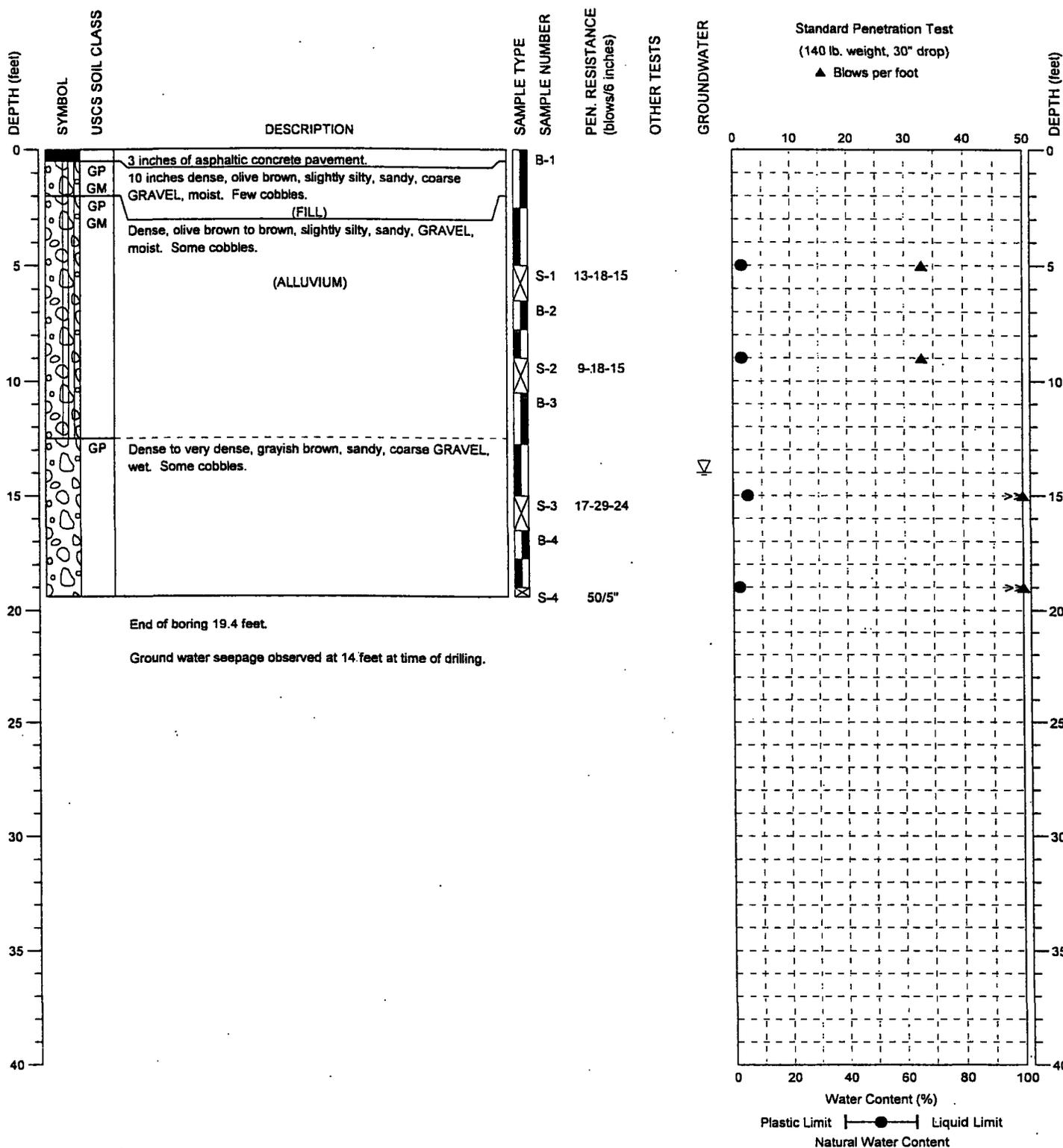
LOCATION: See Figure 2
 DATE STARTED: 11/13/1999
 DATE COMPLETED: 11/13/1999
 LOGGED BY: S. Greene



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.

DRILLING COMPANY: Layne Christensen Company
 DRILLING METHOD: Becker Rig
 SAMPLING METHOD: Cutting Return & Split Spoon
 SURFACE ELEVATION: 997 ± feet

LOCATION: See Figure 2
 DATE STARTED: 11/13/1999
 DATE COMPLETED: 11/13/1999
 LOGGED BY: S. Greene



NOTE: This log of subsurface conditions applies only at the specified location and on the date indicated and therefore may not necessarily be indicative of other times and/or locations.



SR-24: I-82 TO KEYS ROAD
 YAKIMA, WASHINGTON

BORING:
 BH-6

PAGE: 1 of 1

PROJECT NO.: 99123

FIGURE: A-7

Appendix B-3
Logs of Test Borings
1956 - Bridge 24/5

**Sheet 2 of 2 for this
boring log missing
when prepared for
scanning. See
handwritten log for
this hole for page 2
contents.**

Appendix B-4
Logs of Test Borings
1958 - Bridge 24/1



LOG OF TEST BORING

Start Card _____

Job No. OL-3549 SR 24

Elevation 1013.3 ft (308.9 m)

HOLE No. H-3-58

Sheet 1 of 1

Project SR-24 / I-82 to Keys Road

Driller _____ Lic# _____

Site Address _____

Inspector _____

Start May 8, 1958 Completion May 8, 1958 Well ID# _____ Equipment _____

Station 11A 59+62 (M 58+17) Offset 32' Rt. (20' Lt.) Casing _____ Method 20" Augers

Northing _____ Easting _____ Latitude _____ Longitude _____

County _____ Subsection _____ Section _____ Range _____ Township _____

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft				SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			10	20	30	40							
1													
5													
2													
10													
3													
4													
15													
5													
6													
20													

SOIL OL-3549 SR 24 AND 82 TO KEYS ROAD.GPJ_SOIL_GDT_6/8/04,9:18:56 A6

Brown organic SILT with a trace of sand and gravel.
3" (-) GRAVEL with silt and sand.

End of the Test Hole Boring at 4.0 ft. below ground elevation.
Water Table Elevation: Not determined.

This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.

APPENDIX C - LABORATORY TEST RESULTS

LABORATORY TESTING

Laboratory testing was performed on selected samples from the field exploration program, including moisture contents and grain size analyses. The tests were done in general accordance with AASHTO guide specifications. The results of these tests are presented on the boring logs in Appendix A and in this appendix. After the testing was complete, the samples were classified in general accordance with the Unified Soil Classification System (USCS).

**Appendix C-1
Laboratory Test Data
WSDOT 1994/2004**

Job No.
Hole No. **H-1-94**
Project

Date **August 23, 1994**
Sheet **1 of 1**

Laboratory Summary



Washington State
Department of Transportation

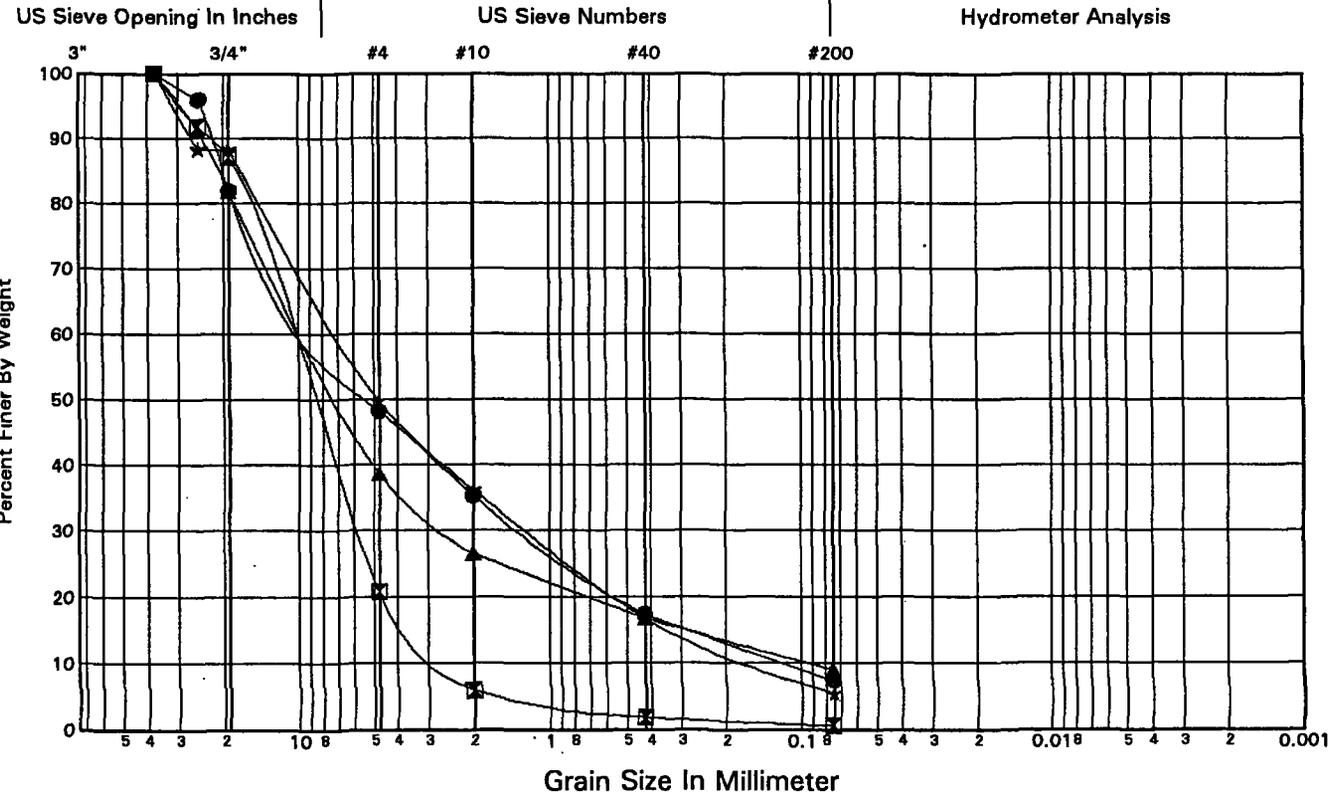
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	7.0	2.13	D-2	GW-GM	DARK OLIVE GRAY	WELL GRADED GRAVEL with SILT and SAND	7	NP	NP	NP
☒	10.0	3.05	D-3	GW	OLIVE	WELL GRADED GRAVEL with SAND	5	NP	NP	NP
▲	29.0	8.84	D-11	GP-GM	OLIVE	POORLY GRADED GRAVEL with SILT and SAND	14	NP	NP	NP
★	39.0	11.89	D-15	GW-GM	DARK GRAY	WELL GRADED GRAVEL with SILT and SAND	12	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cu	Cc
●	51.8	40.8	7.4	1.8	65.6
☒	79.2	20.2	0.6	1.2	4.3
▲	61.3	29.7	9.0	7.4	100.6
★	50.2	44.4	5.4	1.4	45.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●	7.72	5.12	1.26	0.53	0.12
☒	10.79	8.76	5.76	4.53	2.53
▲	9.42	6.83	2.56	0.71	0.09
★	6.86	4.78	1.22	0.55	0.15



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No.
Hole No. **H-2-94**
Project

Date **August 23, 1994**
Sheet **1 of 1**

Laboratory Summary



Washington State
Department of Transportation

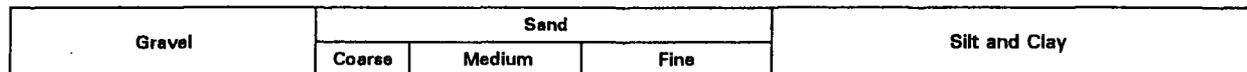
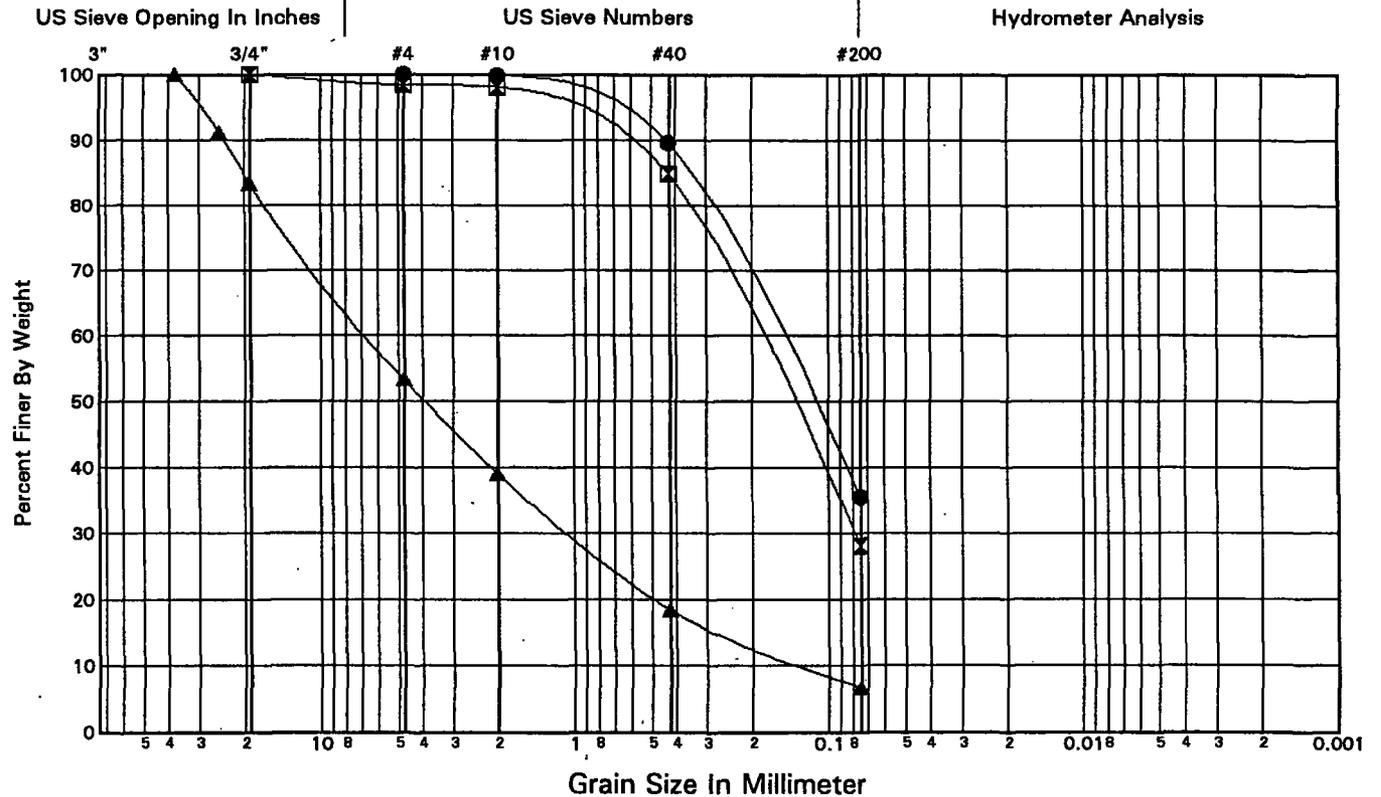
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	0.0	0.00	D-1	SM	OLIVE BROWN	SILTY SAND w/small roots & root hairs	7	NP	NP	NP
☒	5.0	1.52	D-2	SM	DARK OLIVE BROWN	SILTY SAND w/wood pieces	15	NP	NP	NP
▲	10.0	3.05	D-3	GW-GM	OLIVE GRAY	WELL GRADED GRAVEL with SILT and SAND	15	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cu	Cc
●	0.0	64.5	35.5		
☒	1.6	70.4	28.0		
▲	46.7	46.6	6.7	1.3	53.1

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.16	0.12			
☒	0.20	0.15	0.08		
▲	6.47	3.89	1.01	0.48	0.12



Job No. **OL-1646**
 Hole No. **H-3-94**
 Project **I-82 to Keys Road**

Date **September 26, 1994**
 Sheet **1 of 1**

Laboratory Summary



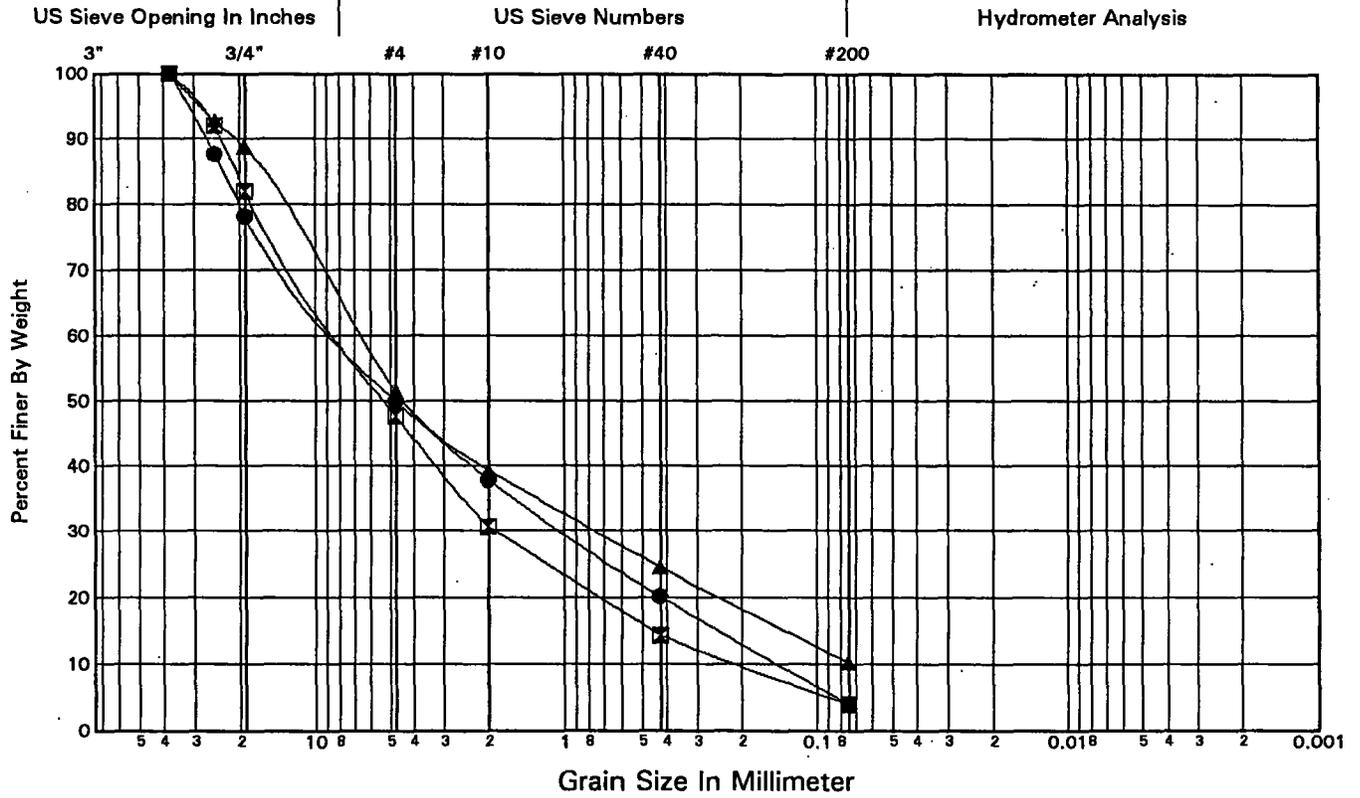
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	4.0	1.22	D-1	GP	DARK OLIVE GRAY	POORLY GRADED GRAVEL with SAND	4	NP	NP	NP
☒	14.0	4.27	D-3	GW	DARK OLIVE GRAY	WELL GRADED GRAVEL with SAND	9	NP	NP	NP
▲	19.0	5.79	D-4	GW-GM	OLIVE	WELL GRADED GRAVEL with SILT and SAND	14	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cu	Cc
●	50.0	46.0	4.0	0.9	54.5
☒	52.3	43.8	3.9	2.2	38.1
▲	48.5	41.2	10.3	1.2	93.1

GRADATION VALUES

	D60	D50	D30	D20	D10
●	7.77	4.75	1.01	0.42	0.14
☒	7.82	5.21	1.89	0.73	0.21
▲	6.52	4.27	0.75	0.24	



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-1646**
 Hole No. **H-7-94**
 Project **I-82 to Keys Road**

Date **September 26, 1994**
 Sheet **1 of 1**

Laboratory Summary



Washington State
 Department of Transportation

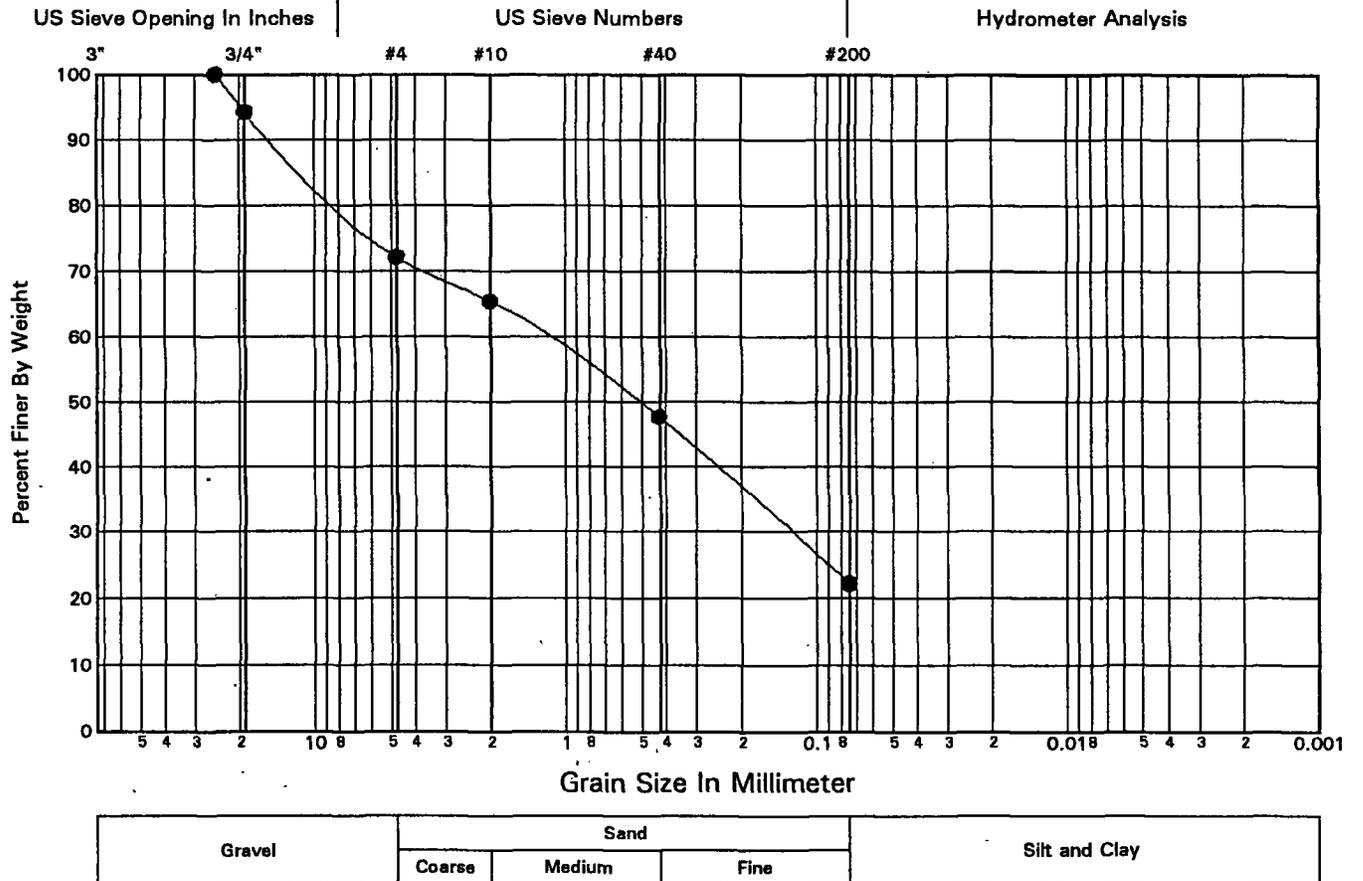
Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
● 20.0	6.10	D-4	SM	DARK OLIVE GRAY	SILTY SAND with GRAVEL	12	NP	NP	NP

GRADATION FRACTIONS

%Gravel	%Sand	%Fines	Cu	Cc
● 27.9	49.9	22.2		

GRADATION VALUES

D60	D50	D30	D20	D10
● 1.25	0.52	0.13		



Job No. **OL-1646**

Date **September 1, 1994**

Hole No. **H-8-94**

Sheet **1 of 1**

Laboratory Summary



Washington State
Department of Transportation

Project **I-82 to Keyes Road**

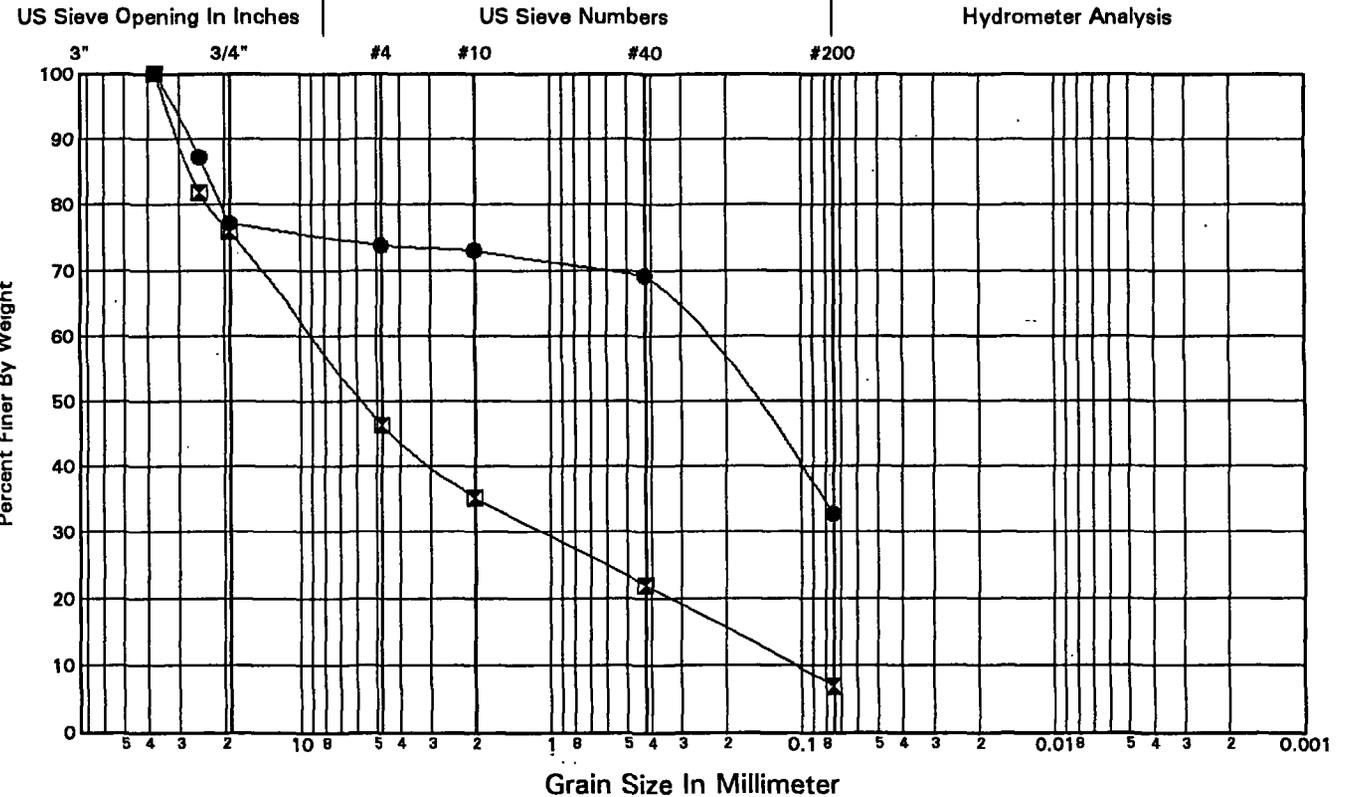
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	0.0	0.00	D-1	SM	Olive	SILTY SAND with GRAVEL with root hairs	4	NP	NP	NP
☒	4.0	1.22	D-2	GW-GM	Olive Gray	WELL GRADED GRAVEL with SILT and SAND	2	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cu	Cc
●	26.3	41.0	32.7		
☒	53.7	39.3	7.0	1.2	85.2

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.27	0.17			
☒	9.04	5.65	1.09	0.34	0.11



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-1646**
 Hole No. **H-9-94**
 Project **I-82 to Keys Road**

Date **September 26, 1994**
 Sheet **1 of 1**

Laboratory Summary



Washington State
 Department of Transportation

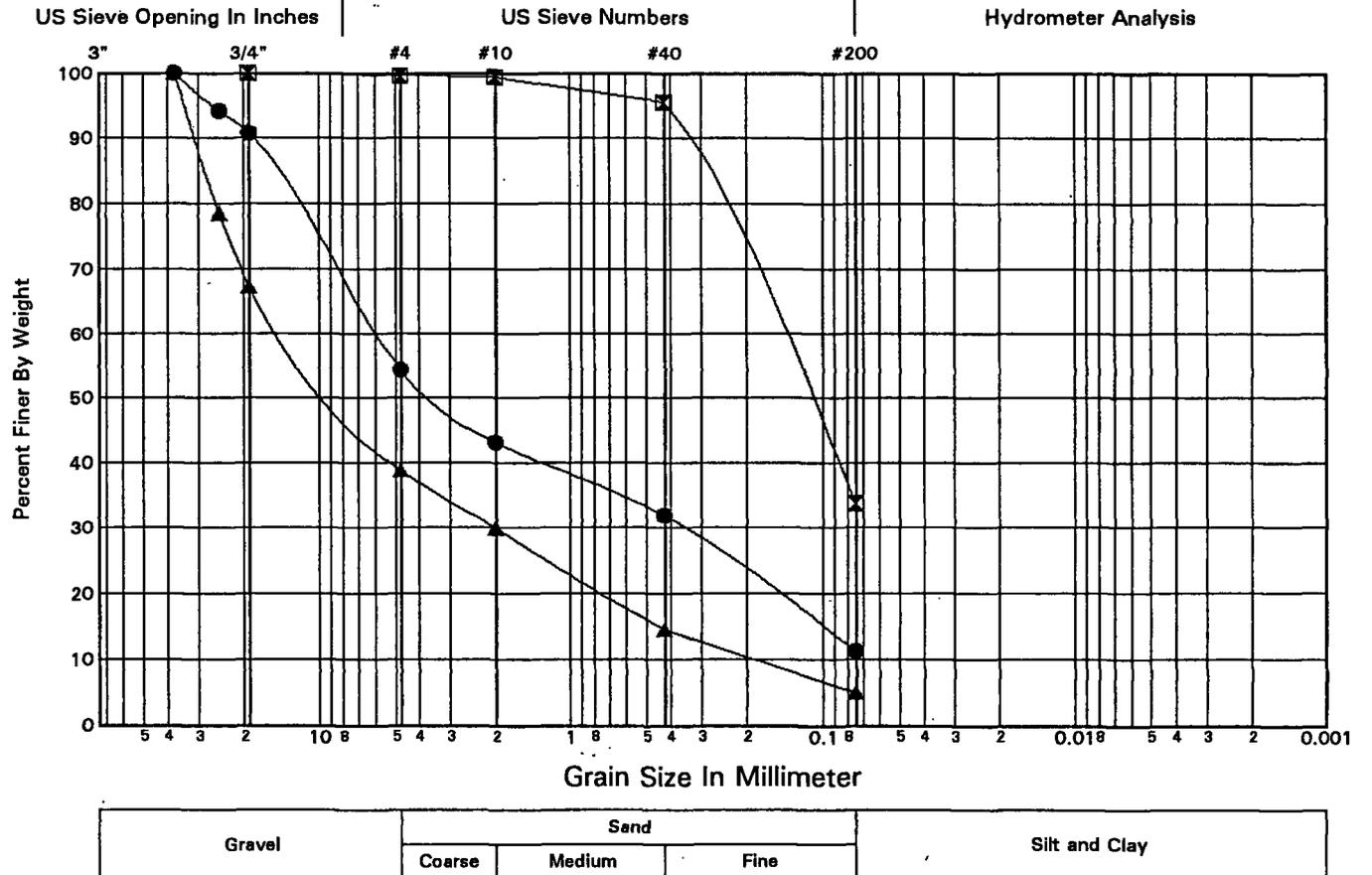
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	0.0	0.00	D-1	GP-GM	DARK OLIVE GRAY	POORLY GRADED GRAVEL with SILT and SAND	4	NP	NP	NP
☒	5.0	1.52	D-2	SM	VERY DK GRAYISH BRN	SILTY SAND	17	NP	NP	NP
▲	10.0	3.05	D-4	GW-GM	DARK GRAY	WELL GRADED GRAVEL with SILT and SAND	10	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cu	Cc
●	45.7	43.0	11.3	0.3	84.3
☒	0.4	65.9	33.7		
▲	61.2	33.8	5.0	1.7	72.0

GRADATION VALUES

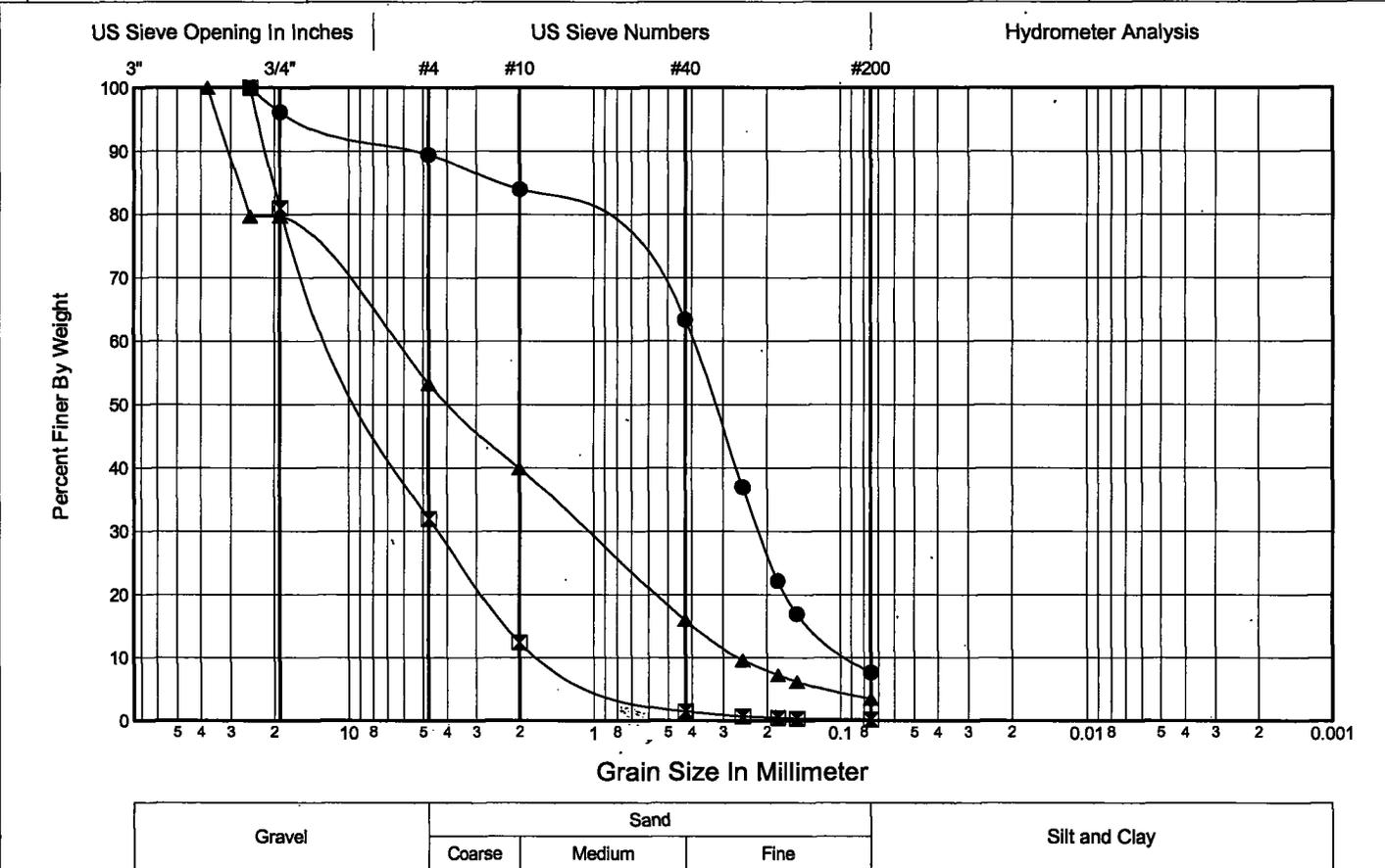
	D60	D50	D30	D20	D10
●	5.90	3.41	0.36	0.16	
☒	0.16	0.12			
▲	13.32	8.19	2.02	0.73	0.19



	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	4.0	1.22	D-1	SP-SM	See Boring Log	POORLY GRADED SAND with SILT	18			
☒	19.0	5.79	D-4	GW	See Boring Log	WELL-GRADED GRAVEL with SAND	5			
▲	39.0	11.89	D-8	SP	See Boring Log	POORLY GRADED SAND with GRAVEL	15			

GRADATION FRACTIONS					
	%Gravel	%Sand	%Fines	Cc	Cu
●	10.6	81.8	7.6	1.3	4.4
☒	68.0	31.8	0.2	1.3	7.3
▲	46.8	49.8	3.4	0.6	26.1

GRADATION VALUES					
	D60	D50	D30	D20	D10
●	0.397	0.32	0.21	0.17	0.089
☒	10.496	7.91	4.35	2.80	1.434
▲	6.770	3.85	1.05	0.55	0.259



Job No. **0L-3549**

Date **July 1, 2004**

Hole No. **H-2-04**

Sheet **1 of 1**

Laboratory Summary



Washington State
Department of Transportation

Project **SR-24 / I-82 to Keys Road**

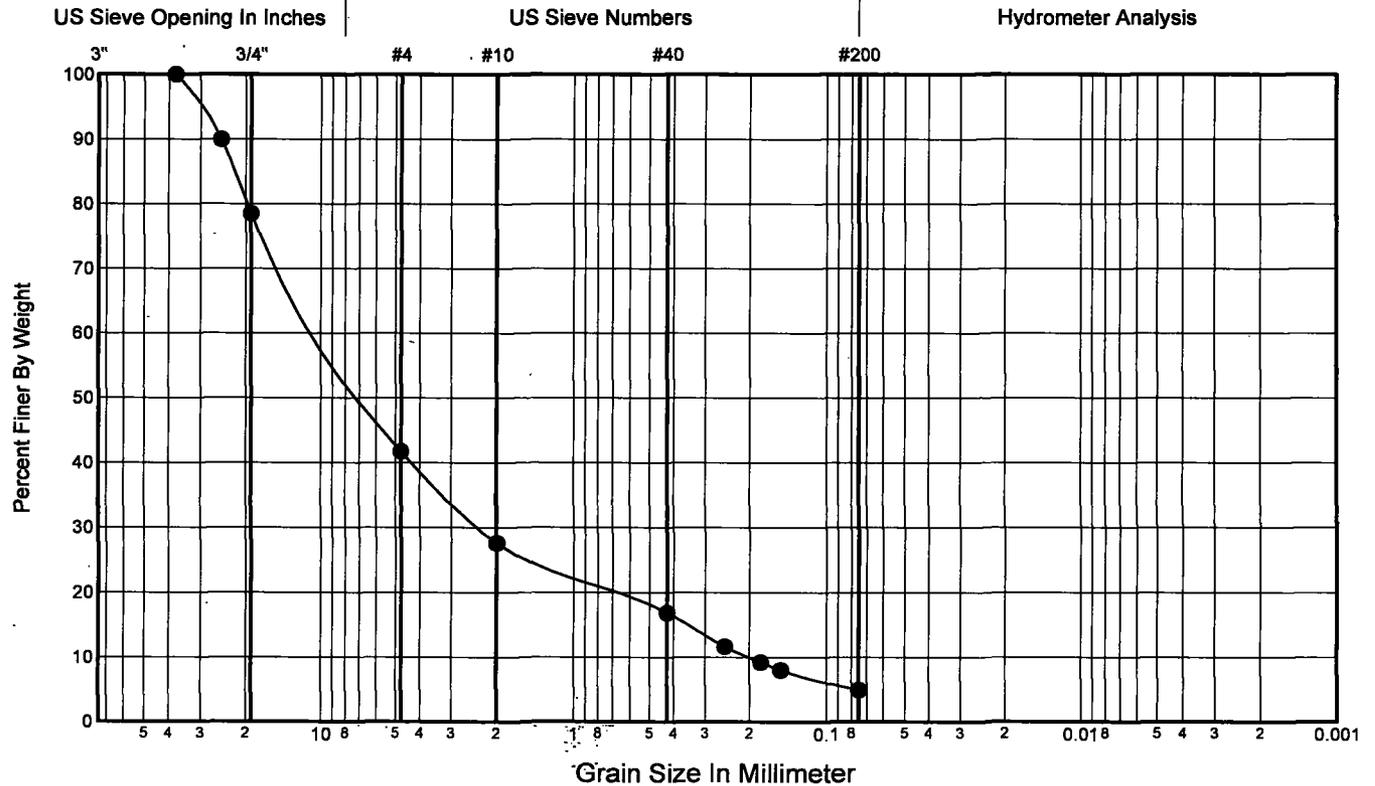
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	24.0	7.32	D-5	GW	See Boring Log.	WELL-GRADED GRAVEL with SAND	9			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	.Cc	Cu
●	58.3	36.8	4.9	2.8	47.3

GRADATION VALUES

	D60	D50	D30	D20	D10
●	9.462	6.49	2.32	0.67	0.200



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **0L-3549**

Date **June 30, 2004**

Hole No. **H-3-04**

Sheet **1 of 1**

Laboratory Summary



Washington State
Department of Transportation

Project **SR-24 / I-82 to Keys Road**

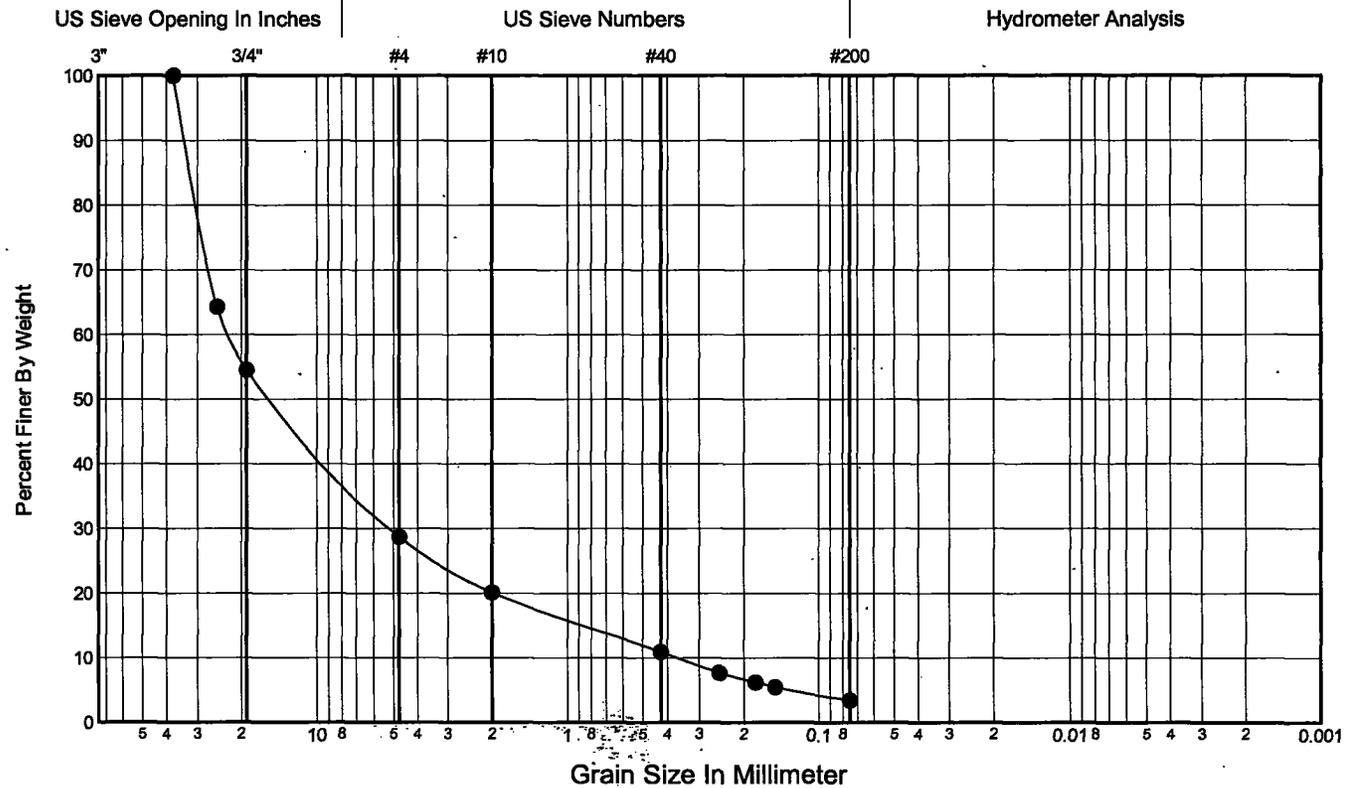
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	16.0	4.88	D-3	GP	See Boring Log	POORLY GRADED GRAVEL with SAND	6			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	71.3	25.3	3.4	3.2	60.6

GRADATION VALUES

	D60	D50	D30	D20	D10
●	22.167	14.93	5.10	1.96	0.366

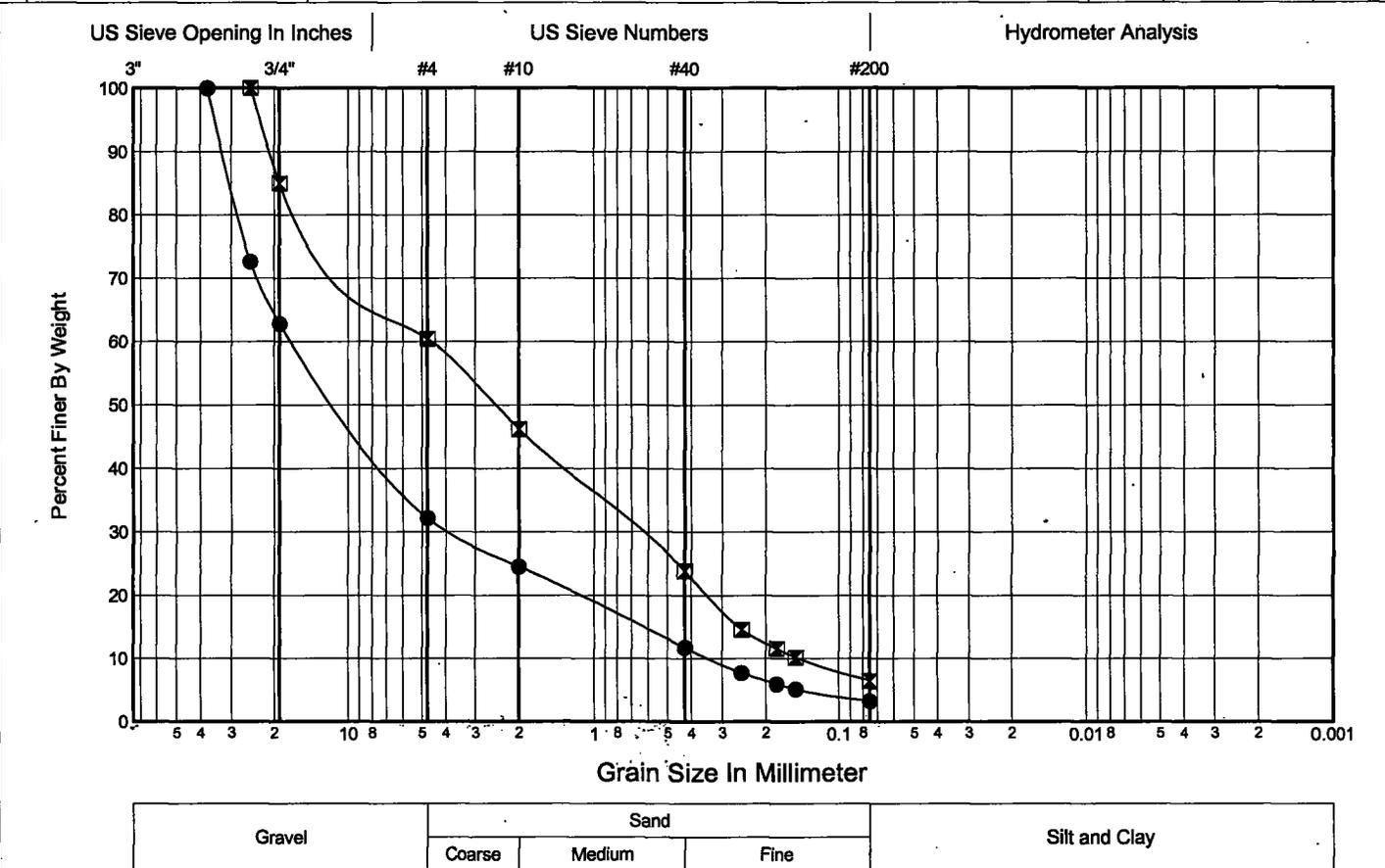


Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	14.0	4.27	D-3	GW	See Boring Log	WELL-GRADED GRAVEL with SAND	8			
☒	64.0	19.51	D-13	SP-SM	See Boring Log	POORLY GRADED SAND with SILT and GRAVEL	14			

GRADATION FRACTIONS					
	%Gravel	%Sand	%Fines	Cc	Cu
●	67.9	28.9	3.2	2.4	49.5
☒	39.6	54.0	6.4	0.6	31.9

GRADATION VALUES					
	D60	D50	D30	D20	D10
●	16.762	10.66	3.73	1.16	0.339
☒	4.632	2.52	0.65	0.34	0.145



Job No. **0L-3549**

Date **June 1, 2004**

Hole No. **H-6-04**

Sheet **1** of **1**

Laboratory Summary



Washington State
Department of Transportation

Project **SR-24 / I-82 to Keys Road**

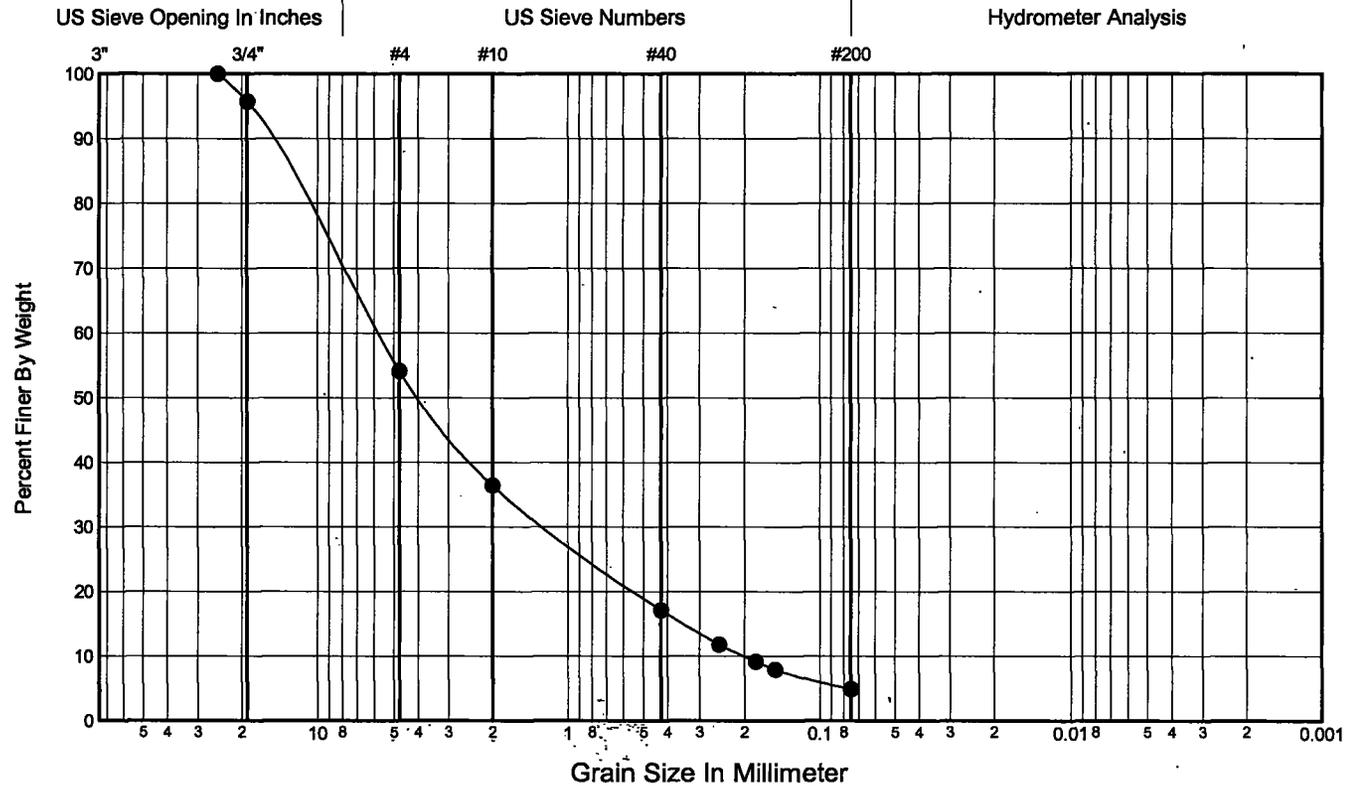
Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
● 29.0	8.84	D-6	SW	See Boring Log	WELL-GRADED SAND with GRAVEL	10			

GRADATION FRACTIONS

%Gravel	%Sand	%Fines	Cc	Cu
● 45.9	49.2	4.9	1.2	28.9

GRADATION VALUES

D60	D50	D30	D20	D10
● 5.784	3.89	1.19	0.53	0.200



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **0L-3549**
 Hole No. **H-7-04**
 Project **SR-24 / I-82 to Keys Road**

Date **June 1, 2004**
 Sheet **1 of 1**

Laboratory Summary



Washington State
 Department of Transportation

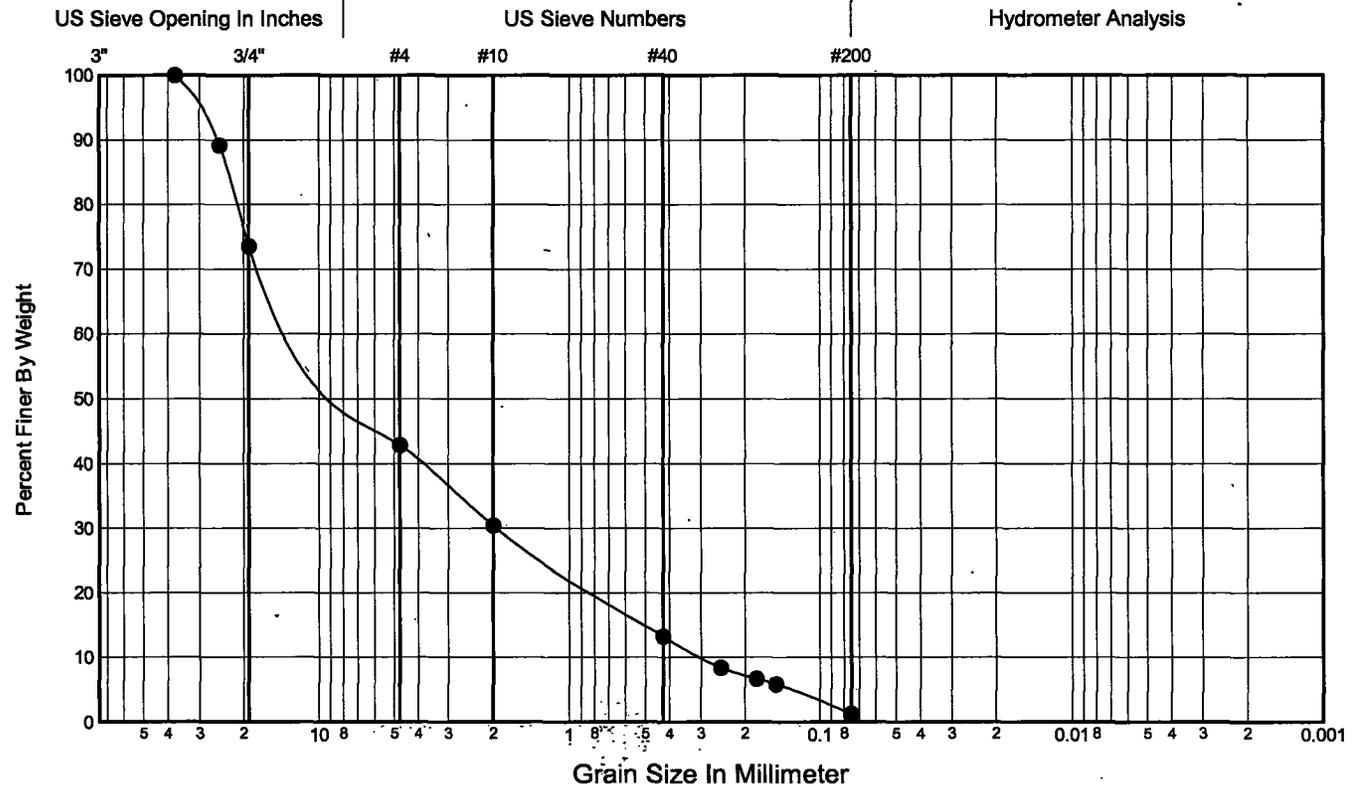
Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
● 50.0	15.24	D-10	GW	See Boring Log	WELL-GRADED GRAVEL with SAND	8			

GRADATION FRACTIONS

%Gravel	%Sand	%Fines	Cc	Cu
● 57.1	41.6	1.2	1.2	34.4

GRADATION VALUES

D60	D50	D30	D20	D10
● 10.310	6.56	1.93	0.78	0.299



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **0L-3549**

Date **June 1, 2004**

Hole No. **H-8-04**

Sheet **1 of 1**

Project **SR-24 / I-82 to Keys Road**

Laboratory Summary



Washington State
Department of Transportation

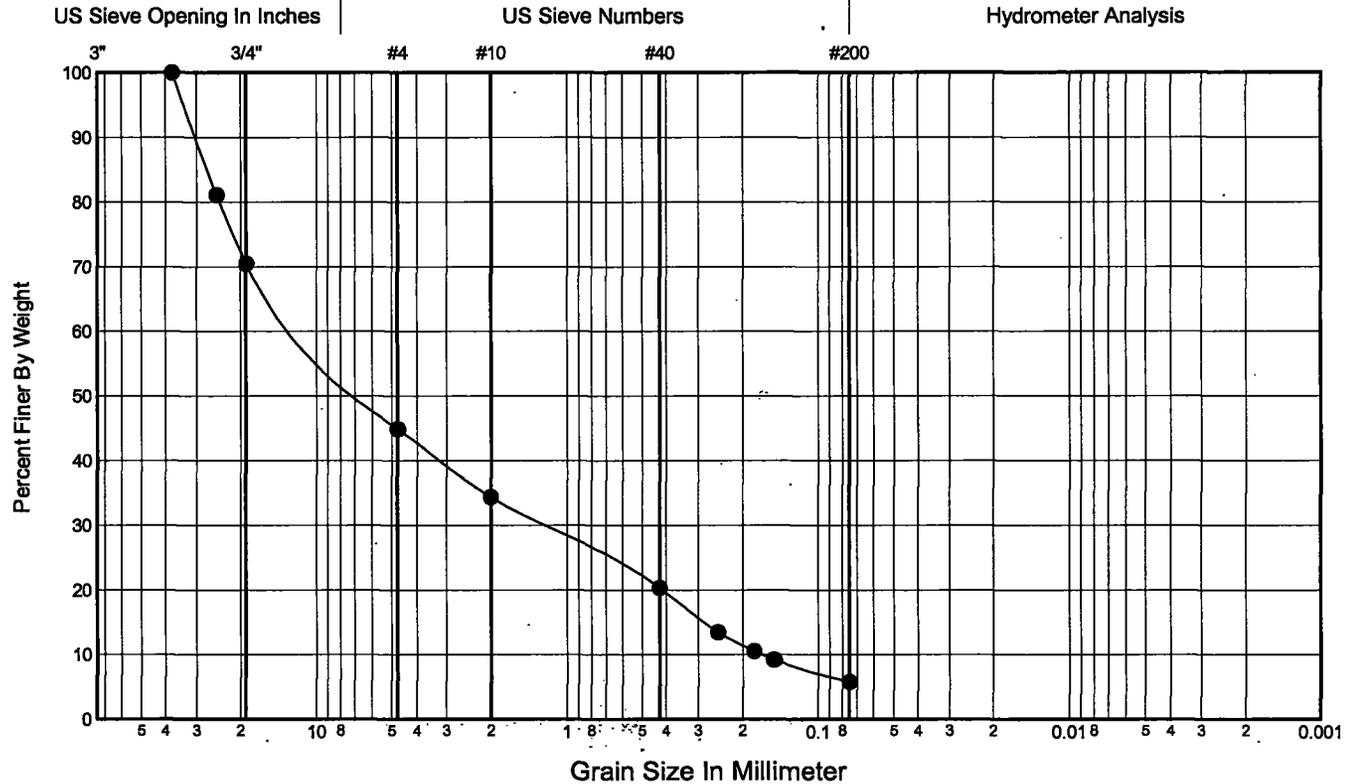
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	44.0	13.41	D-9	GP-GM	See Boring Log	POORLY GRADED GRAVEL with SILT and SAND	15			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	55.1	39.1	5.8	0.8	64.2

GRADATION VALUES

	D60	D50	D30	D20	D10
●	10.774	6.27	1.24	0.41	0.168

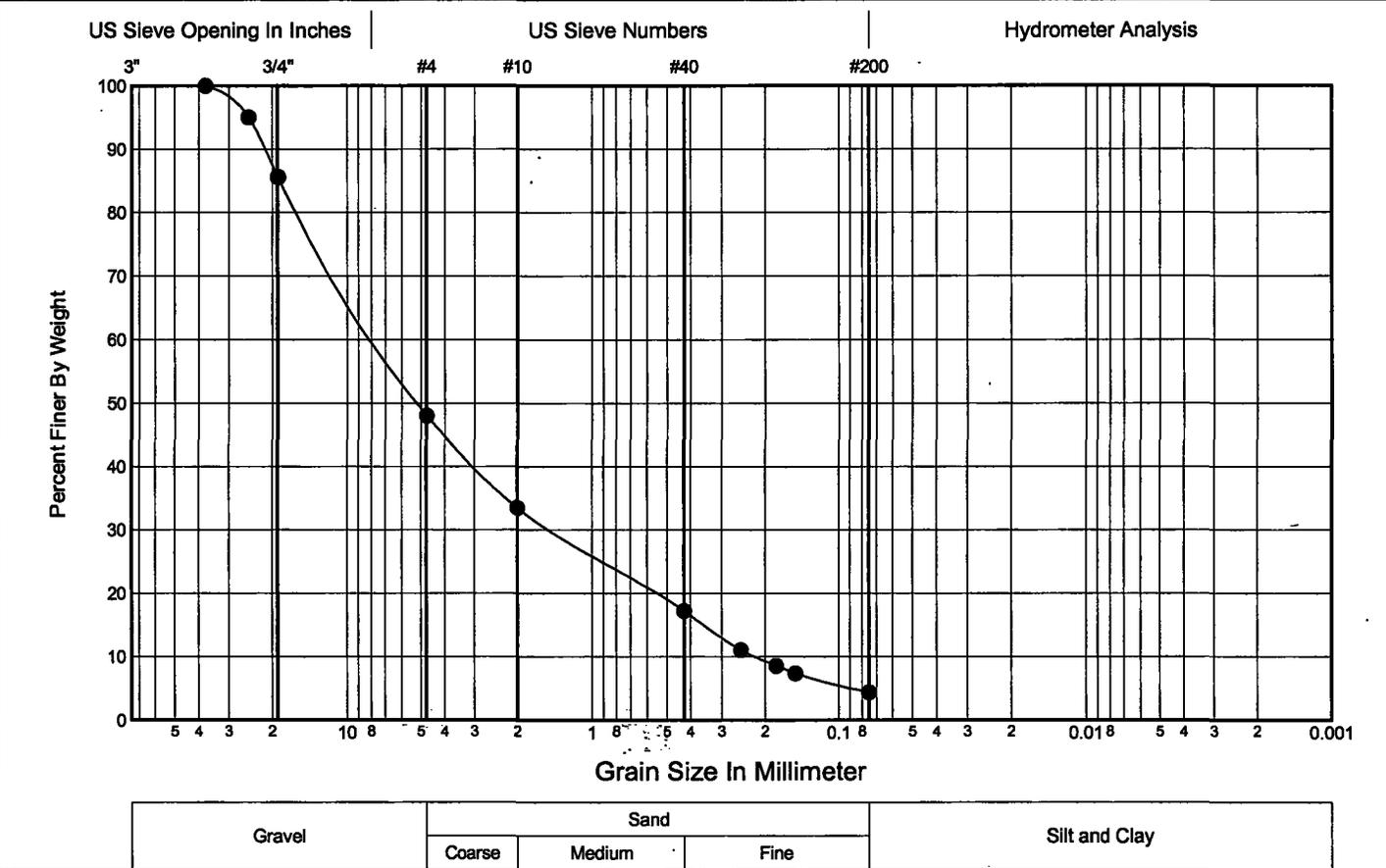


Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	23.5	7.16	D-5	GW	See Boring Log	WELL-GRADED GRAVEL with SAND	11			

GRADATION FRACTIONS					
	%Gravel	%Sand	%Fines	Cc	Cu
●	52.0	43.7	4.4	1.3	33.8

GRADATION VALUES					
	D60	D50	D30	D20	D10
●	7.387	5.11	1.44	0.55	0.219



Job No. **OL-3549**

Date **June 1, 2004**

Hole No. **H-10-04**

Sheet **1 of 1**

Project **SR-24 / I-82 to Keys Road**

Laboratory Summary



Washington State
Department of Transportation

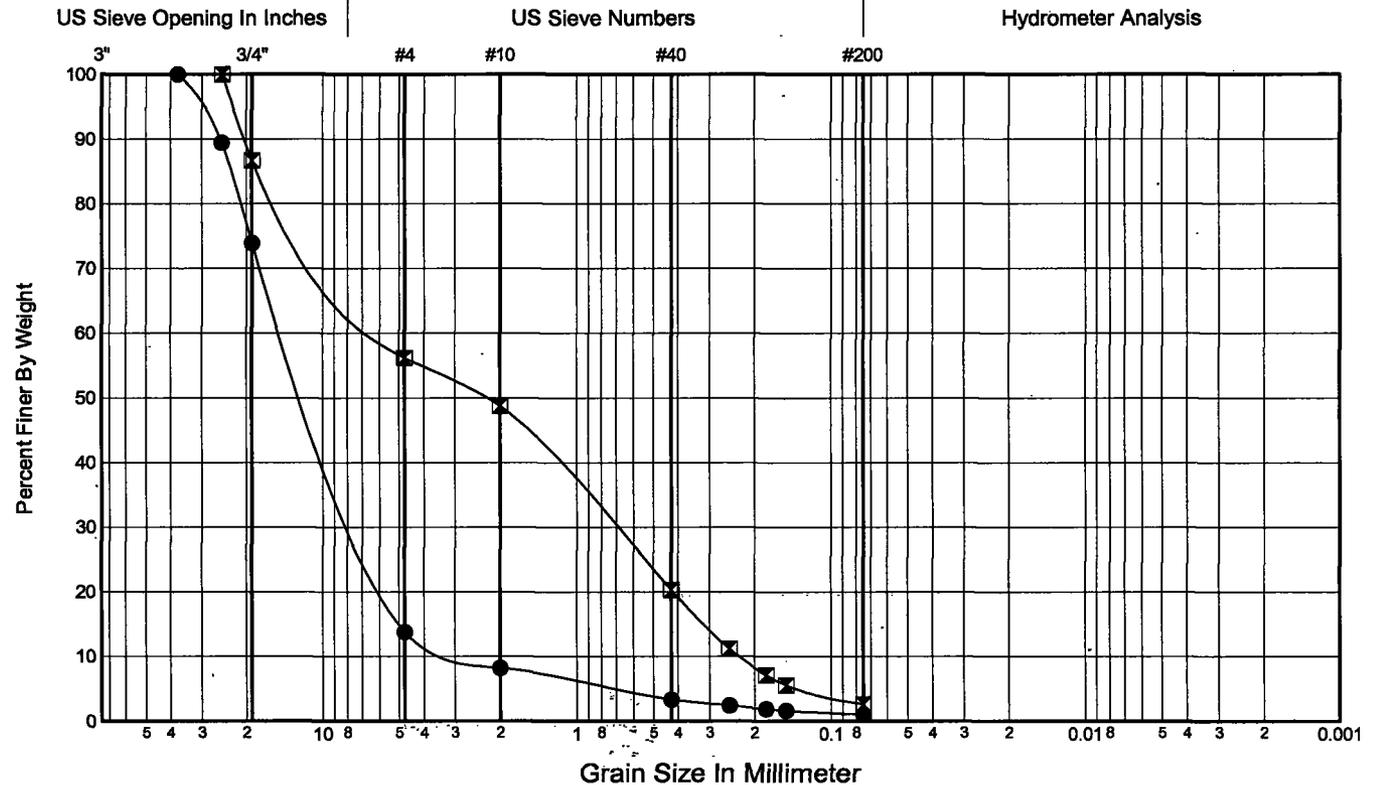
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	20.0	6.10	D-4	GW	See Boring Log	WELL-GRADED GRAVEL	3			
☒	50.0	15.24	D-10	SP	See Boring Log	POORLY GRADED SAND with GRAVEL	22			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	86.3	12.7	1.0	1.3	5.2
☒	43.8	53.6	2.6	0.4	24.9

GRADATION VALUES

	D60	D50	D30	D20	D10
●	13.798	10.96	6.91	5.49	2.651
☒	5.652	2.31	0.72	0.42	0.227

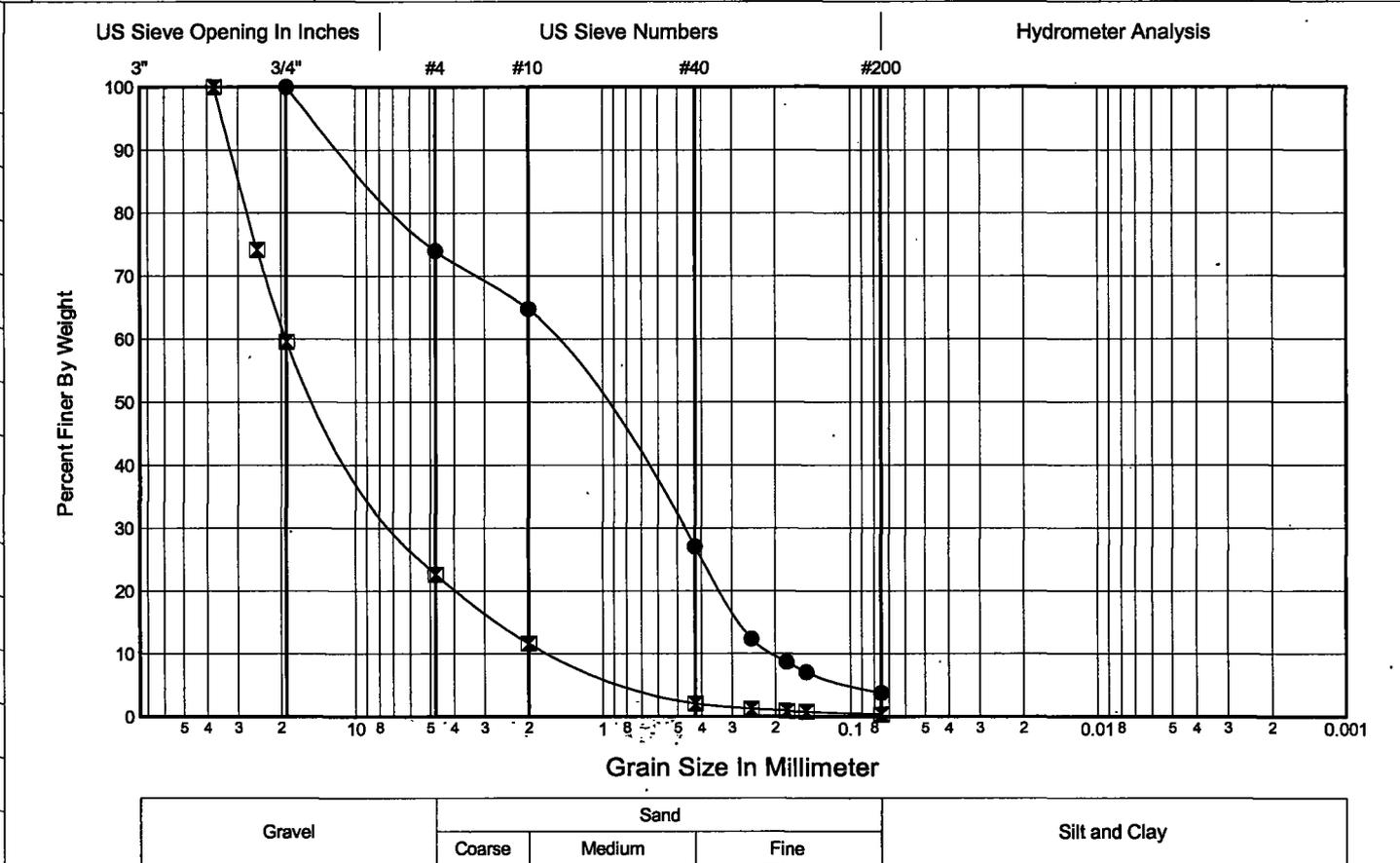


Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	0.0	0.00	D-1	SP	See Boring Log	POORLY GRADED SAND with GRAVEL	4			
☒	14.0	4.27	D-4	GW	See Boring Log	WELL-GRADED GRAVEL with SAND	3			

GRADATION FRACTIONS					
	%Gravel	%Sand	%Fines	Cc	Cu
●	26.0	70.2	3.8	0.7	8.1
☒	77.3	22.3	0.4	1.3	12.5

GRADATION VALUES					
	D60	D50	D30	D20	D10
●	1.644	1.09	0.48	0.33	0.203
☒	19.159	13.27	6.26	3.85	1.537



Job No. **0L-3549**
 Hole No. **H-13-04**
 Project **SR-24 / I-82 to Keys Road**

Date **June 3, 2004**
 Sheet **1 of 1**

Laboratory Summary



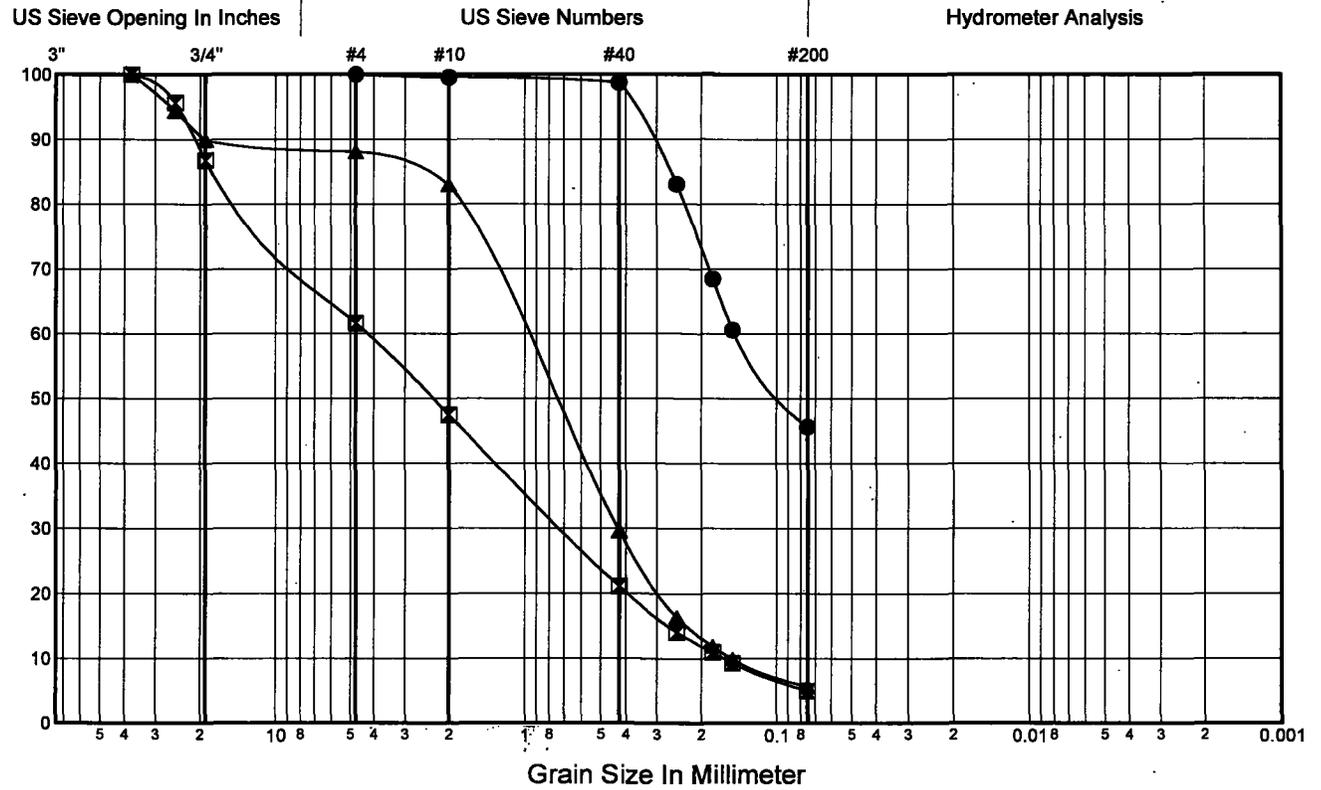
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	1.5	0.46	D-2	SM	See Boring Log	SILTY SAND	17	33	28	5
☒	9.0	2.74	D-4	SP-SM	See Boring Log	POORLY GRADED SAND with SILT and GRAVEL	15			
▲	19.0	5.79	D-6	SW-SM	See Boring Log	WELL-GRADED SAND with SILT	17			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	54.4	45.6		
☒	38.4	56.6	5.0	0.7	26.5
▲	11.9	82.4	5.6	1.2	6.8

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.146	0.09			
☒	4.302	2.33	0.72	0.39	0.162
▲	1.028	0.77	0.43	0.29	0.152



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3549** Date **June 1, 2004**
 Hole No. **H-14-04** Sheet **1 of 1**
 Project **SR-24 / I-82 to Keys Road**

Laboratory Summary



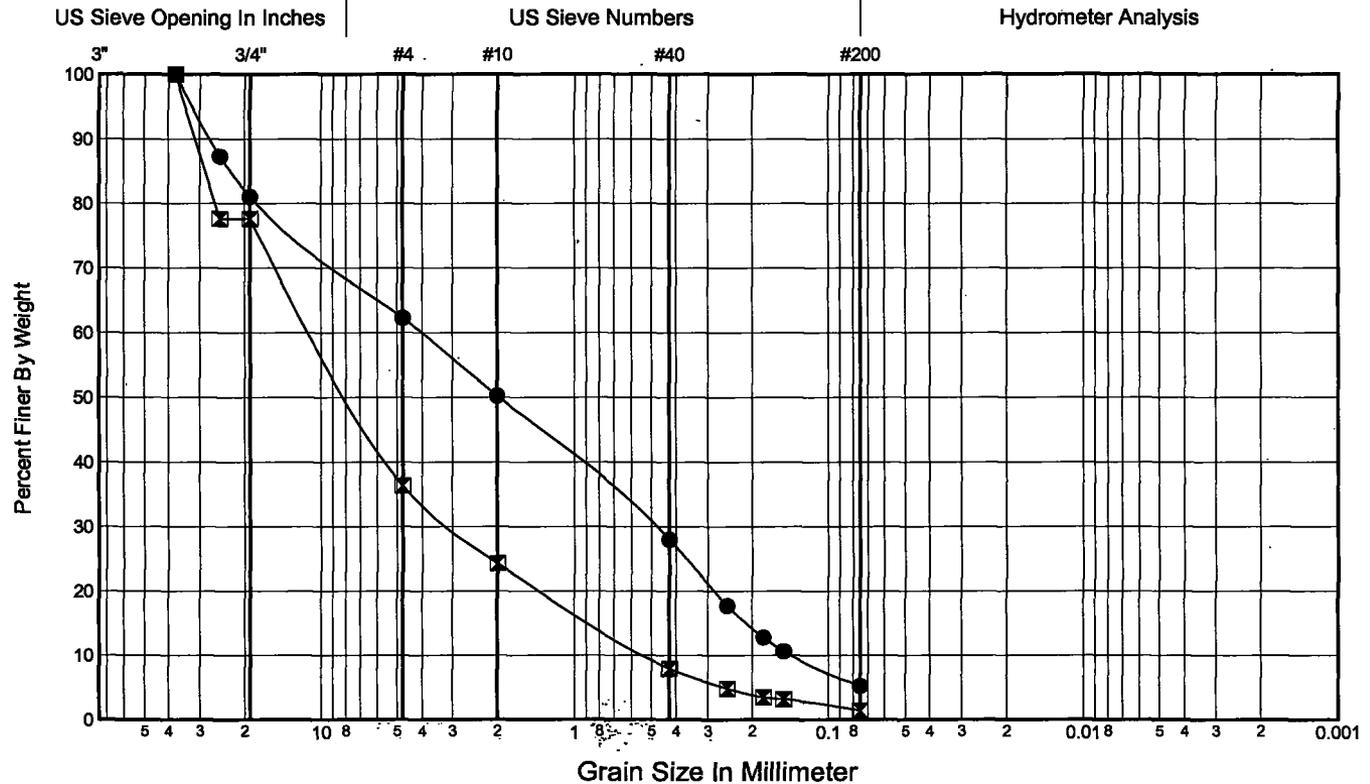
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	0.0	0.00	D-1	SP-SM	See Boring Log	POORLY GRADED SAND with SILT and GRAVEL	7			
☒	8.0	2.44	D-3	GW	See Boring Log	WELL-GRADED GRAVEL with SAND	9			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	37.7	57.1	5.2	0.4	29.1
☒	63.7	34.9	1.4	1.7	20.3

GRADATION VALUES

	D60	D50	D30	D20	D10
●	4.035	1.97	0.49	0.28	0.139
☒	10.522	7.52	3.01	1.33	0.518



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3549**

Date **June 1, 2004**

Hole No. **H-15-04**

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Project **SR-24 / I-82 to Keys Road**

Laboratory Summary



Washington State
Department of Transportation

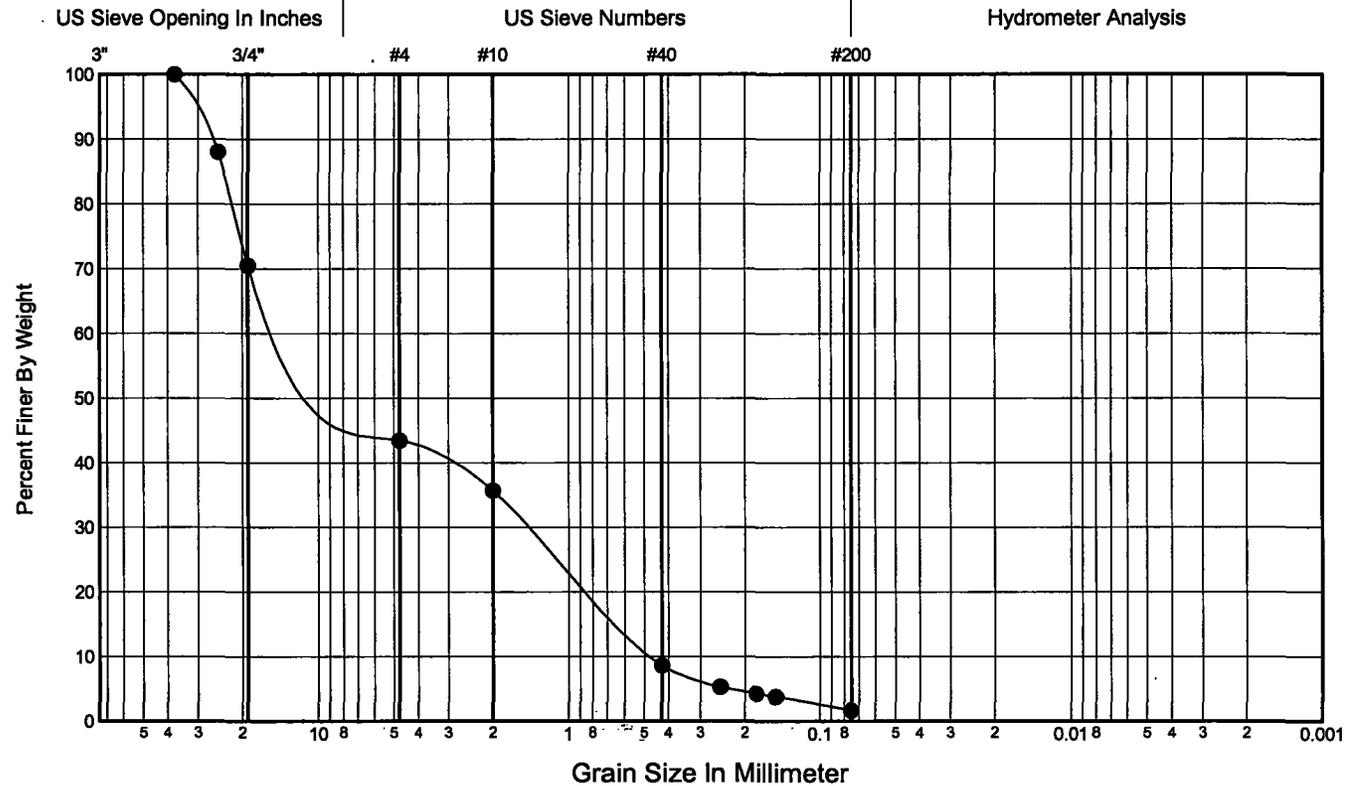
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	9.0	2.74	D-2	GP	See Boring Log	POORLY GRADED GRAVEL with SAND	11			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	56.6	41.8	1.7	0.4	24.1

GRADATION VALUES

	D60	D50	D30	D20	D10
●	11.105	6.65	1.45	0.82	0.460

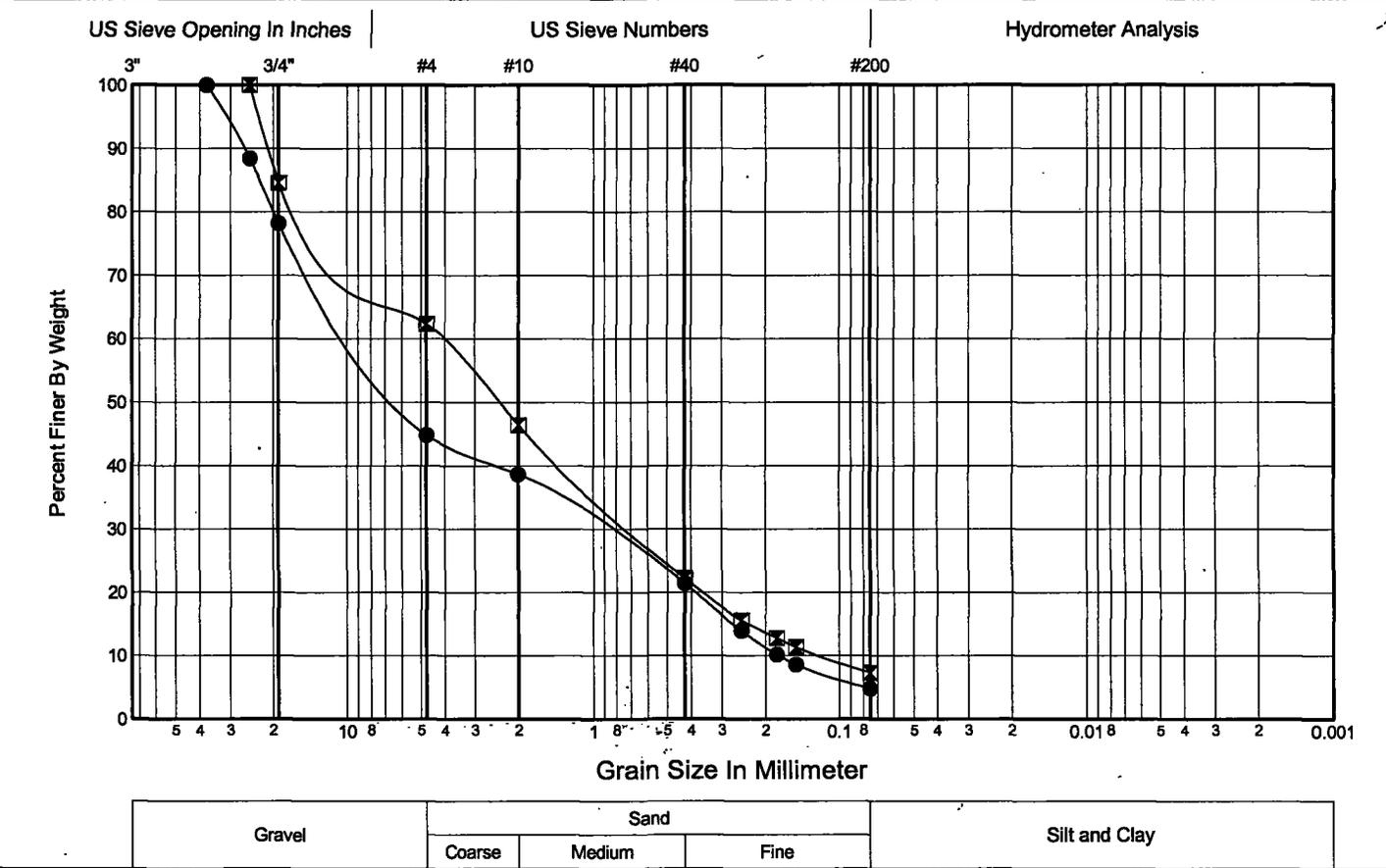


Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	0.0	0.00	D-1	GP	See Boring Log	POORLY GRADED GRAVEL with SAND	11			
☒	13.5	4.11	D-4	SP-SM	See Boring Log	POORLY GRADED SAND with SILT and GRAVEL	10			

GRADATION FRACTIONS					
	%Gravel	%Sand	%Fines	Cc	Cu
●	55.2	40.1	4.8	0.5	50.4
☒	37.6	55.1	7.3	1.0	34.9

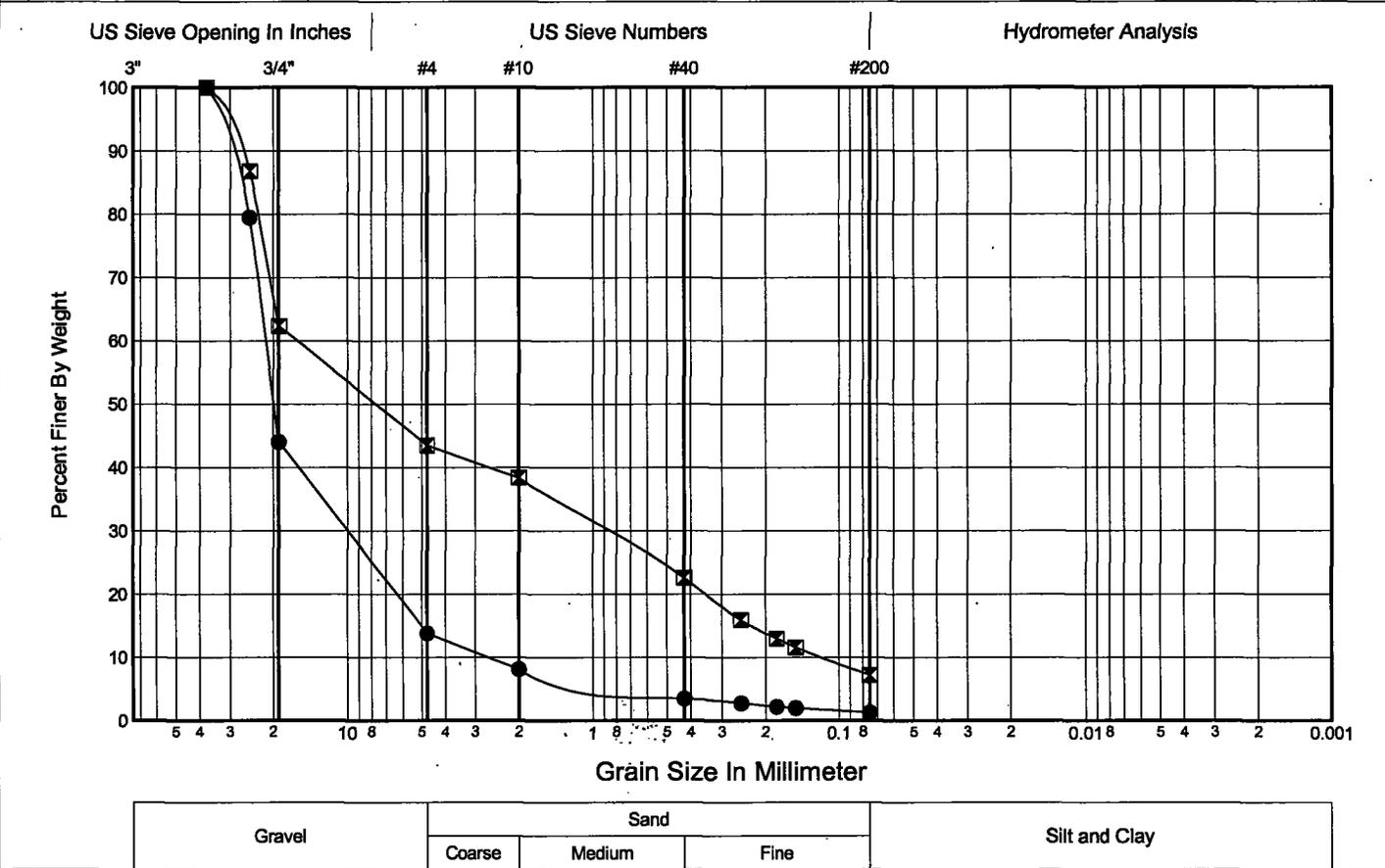
GRADATION VALUES					
	D60	D50	D30	D20	D10
●	8.922	5.89	0.92	0.39	0.177
☒	4.180	2.43	0.70	0.36	0.120



	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-2	GW	See Boring Log	WELL-GRADED GRAVEL	3			
☒	17.5	5.33	D-7	GP-GM	See Boring Log	POORLY GRADED GRAVEL with SILT and SAND	15			

GRADATION FRACTIONS					
	%Gravel	%Sand	%Fines	Cc	Cu
●	86.2	12.5	1.3	1.7	8.0
☒	56.5	36.3	7.2	0.4	136.6

GRADATION VALUES					
	D60	D50	D30	D20	D10
●	21.502	19.90	9.99	6.32	2.672
☒	15.991	7.67	0.88	0.35	0.117



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Date **June 1, 2004**

Hole No. **H-18-04**

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Laboratory Summary



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Project **SR-24 / I-82 to Keys Road**

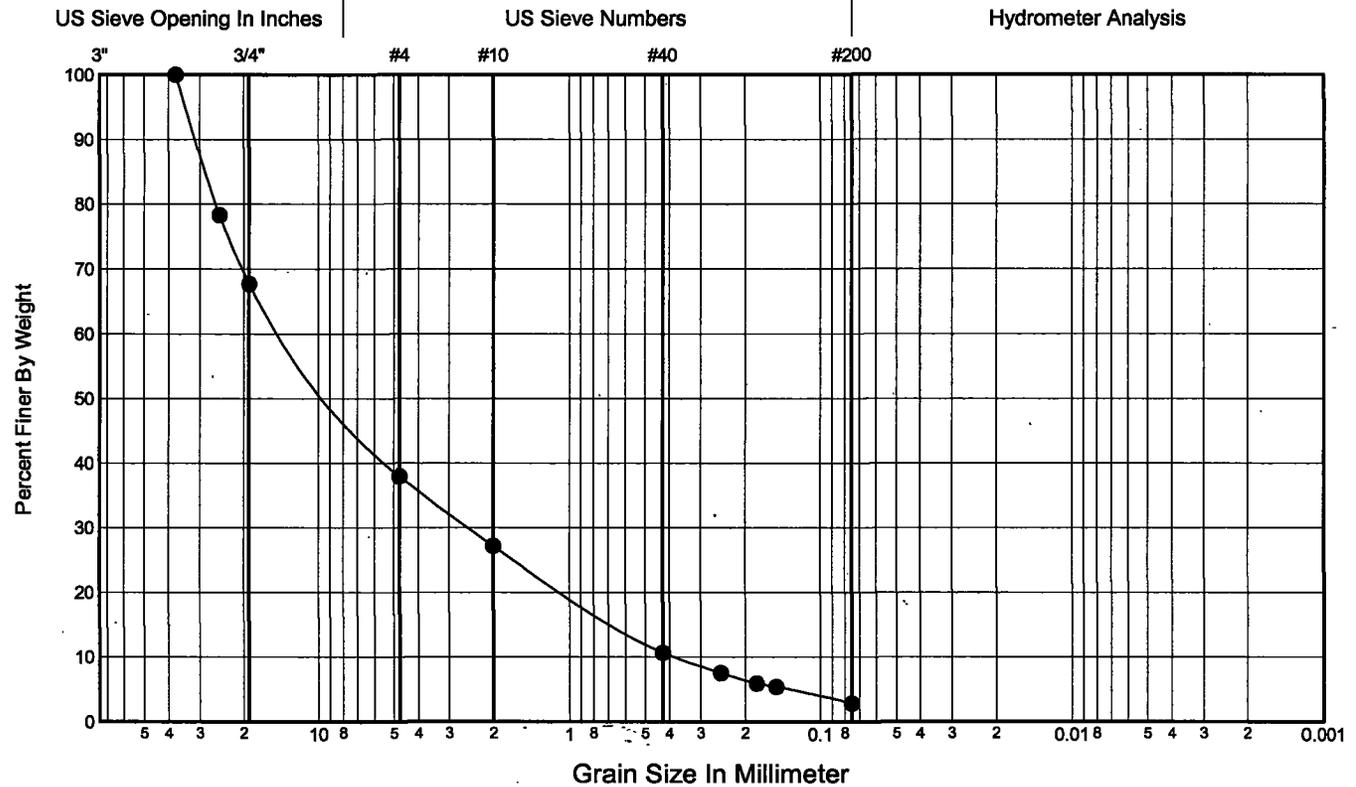
Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
● 10.0	3.05	D-4	GW	See Boring Log	WELL-GRADED GRAVEL with SAND	5			

GRADATION FRACTIONS

%Gravel	%Sand	%Fines	Cc	Cu
● 62.1	35.1	2.8	1.2	34.7

GRADATION VALUES

D60	D50	D30	D20	D10
● 13.274	8.33	2.51	1.02	0.382



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **0L-3549**
 Hole No. **TH-1-04**
 Project **SR-24 / I-82 to Keys Road**

Date **June 3, 2004**
 Sheet **1 of 1**

Laboratory Summary



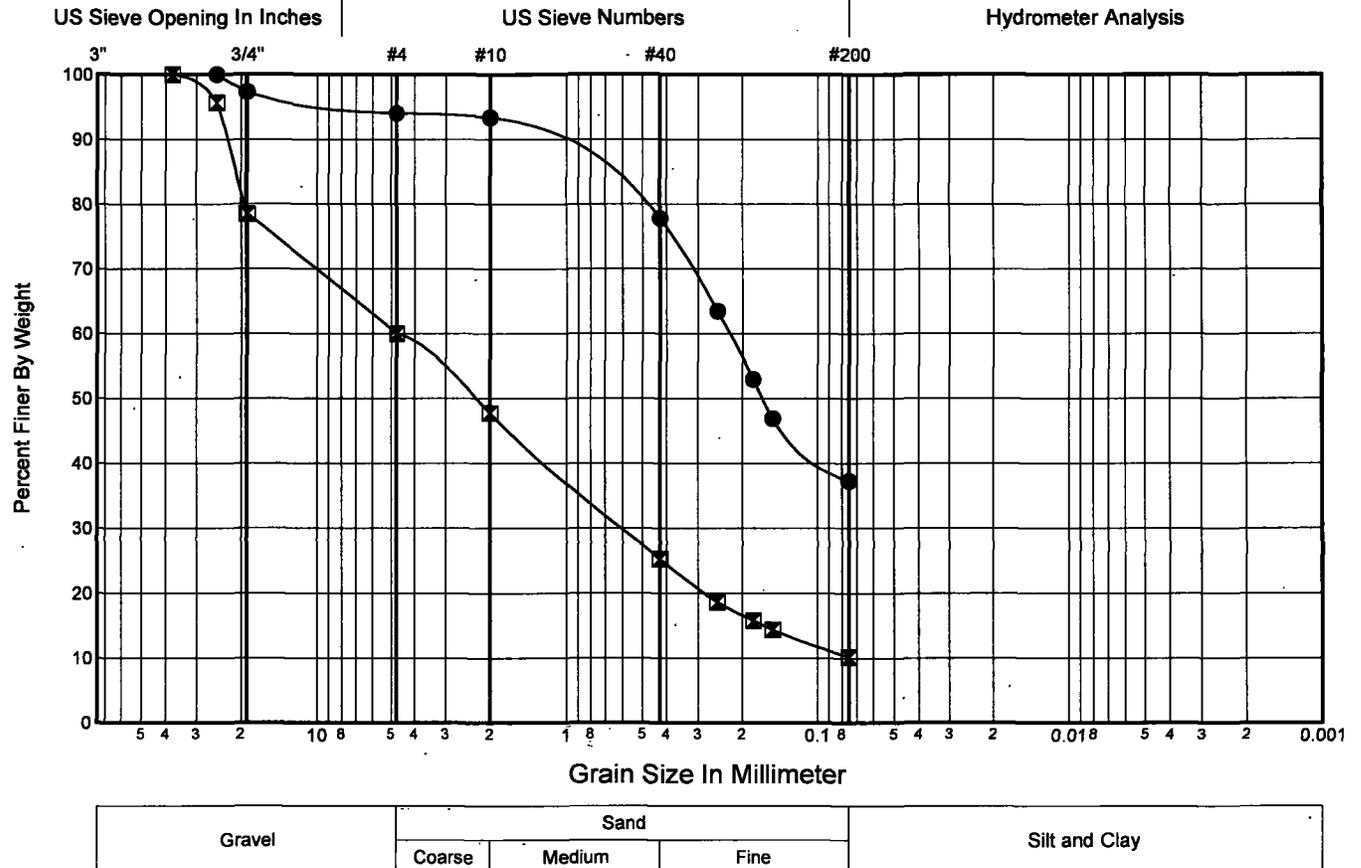
Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
● 0.0	0.00	D-1	SM	See Boring Log	SILTY SAND	16	24	NP	NP
☒ 7.0	2.13	D-3	SP-SM	See Boring Log	POORLY GRADED SAND with SILT and GRAVEL	2			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	6.0	56.7	37.3		
☒	40.1	49.8	10.2	1.0	65.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.224	0.16			
☒	4.770	2.34	0.59	0.28	



Job No. **OL-3549**

Date **June 1, 2004**

Hole No. **TH-2-04**

Sheet **1 of 1**

Laboratory Summary



Washington State
Department of Transportation

Project **SR-24 / I-82 to Keys Road**

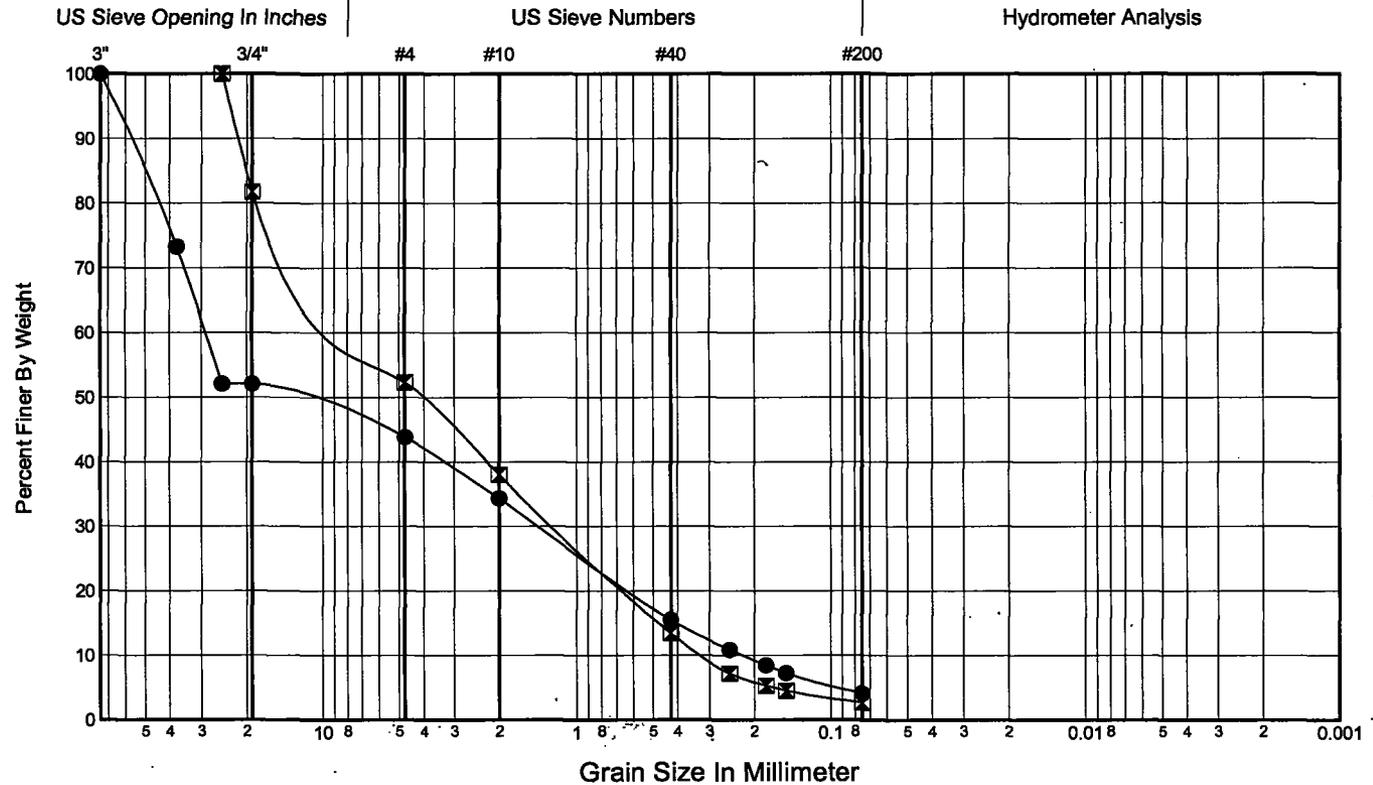
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	10.0	3.05	D-5	GP	See Boring Log	POORLY GRADED GRAVEL with SAND	3			
☒	15.0	4.57	D-6	SP	See Boring Log	POORLY GRADED SAND with GRAVEL	13			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	56.1	39.8	4.1	0.3	130.7
☒	47.7	49.6	2.6	0.7	21.5

GRADATION VALUES

	D60	D50	D30	D20	D10
●	29.092	13.38	1.40	0.62	0.223
☒	6.829	4.13	1.21	0.64	0.318



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3549**
 Hole No. **TH-3-04**
 Project **SR-24 / I-82 to Keys Road**

Date **June 1, 2004**
 Sheet **1 of 1**

Laboratory Summary



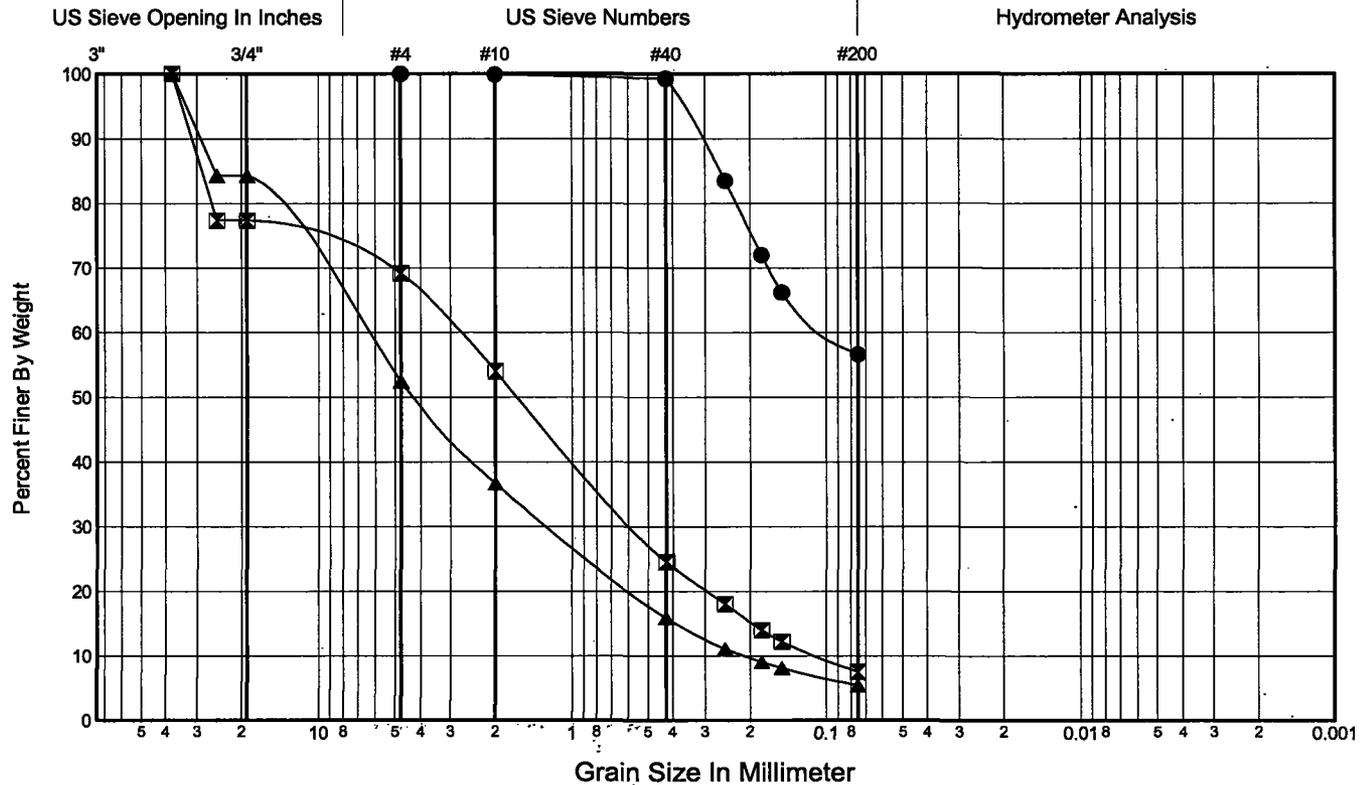
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	1.5	0.46	D-2	ML	See Boring Log	SANDY SILT	34	32	26	6
☒	3.0	0.91	D-3	SW-SM	See Boring Log	WELL-GRADED SAND with SILT and GRAVEL	12			
▲	7.5	2.29	D-6	GW-GM	See Boring Log	WELL-GRADED GRAVEL with SILT and SAND	11			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	43.4	56.6		
☒	30.8	61.7	7.5	1.0	26.0
▲	47.6	47.0	5.4	1.1	31.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.096				
☒	2.818	1.62	0.57	0.29	0.108
▲	6.607	4.16	1.22	0.58	0.211



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3549** Date **June 1, 2004**
 Hole No. **TH-4-04** Sheet **1 of 1**
 Project **SR-24 / I-82 to Keys Road**

Laboratory Summary



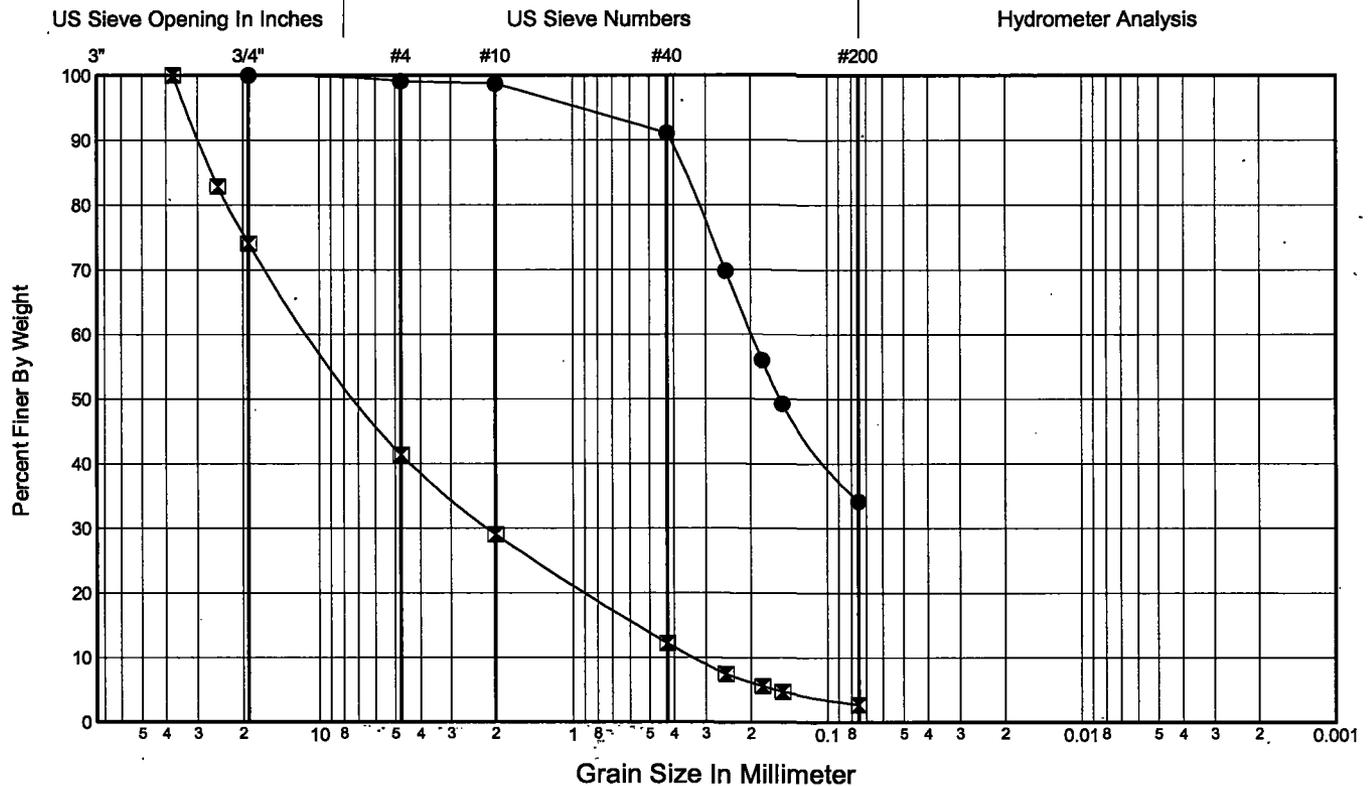
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	7.0	2.13	D-3	SM	See Boring Log	SILTY SAND	25	NA	NP	NA
☒	14.0	4.27	D-6	GW	See Boring Log	WELL-GRADED GRAVEL with SAND	12			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.9	65.0	34.1		
☒	58.6	38.7	2.7	1.3	31.5

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.198	0.15			
☒	10.472	6.85	2.14	0.87	0.333



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3549**

Date **June 17, 2004**

Hole No. **TH-5-04**

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Laboratory Summary



Washington State
Department of Transportation

Project **SR-24 / I-82 to Keys Road**

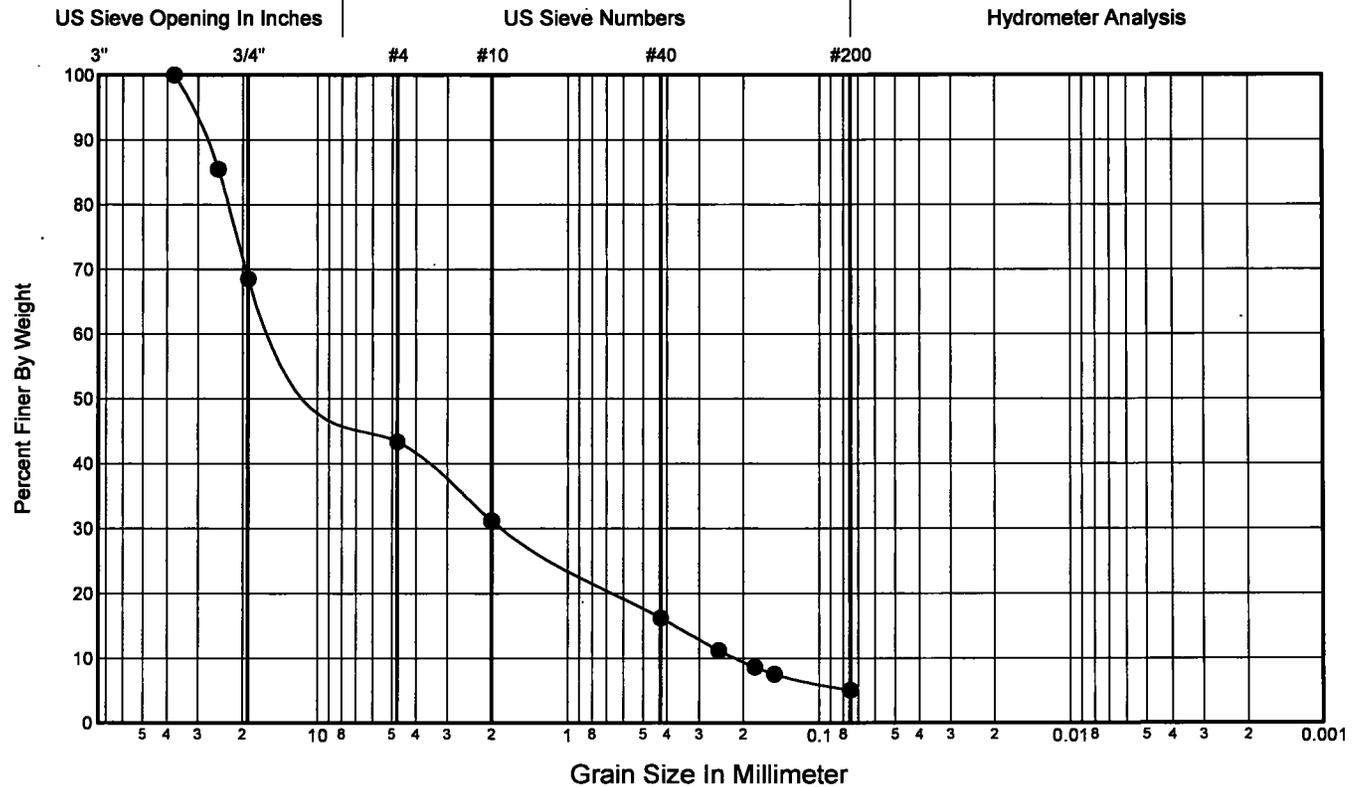
Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
● 16.5	5.03	D-7	GW-GM	See Boring Log	WELL-GRADED GRAVEL with SILT and SAND	6			

GRADATION FRACTIONS

%Gravel	%Sand	%Fines	Cc	Cu
● 56.6	38.3	5.1	1.2	55.4

GRADATION VALUES

D60	D50	D30	D20	D10
● 11.882	6.85	1.77	0.63	0.215



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **0L-3549**

Date **June 17, 2004**

Hole No. **TH-6-04**

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Laboratory Summary



Washington State
Department of Transportation

Project **SR-24 / I-82 to Keys Road**

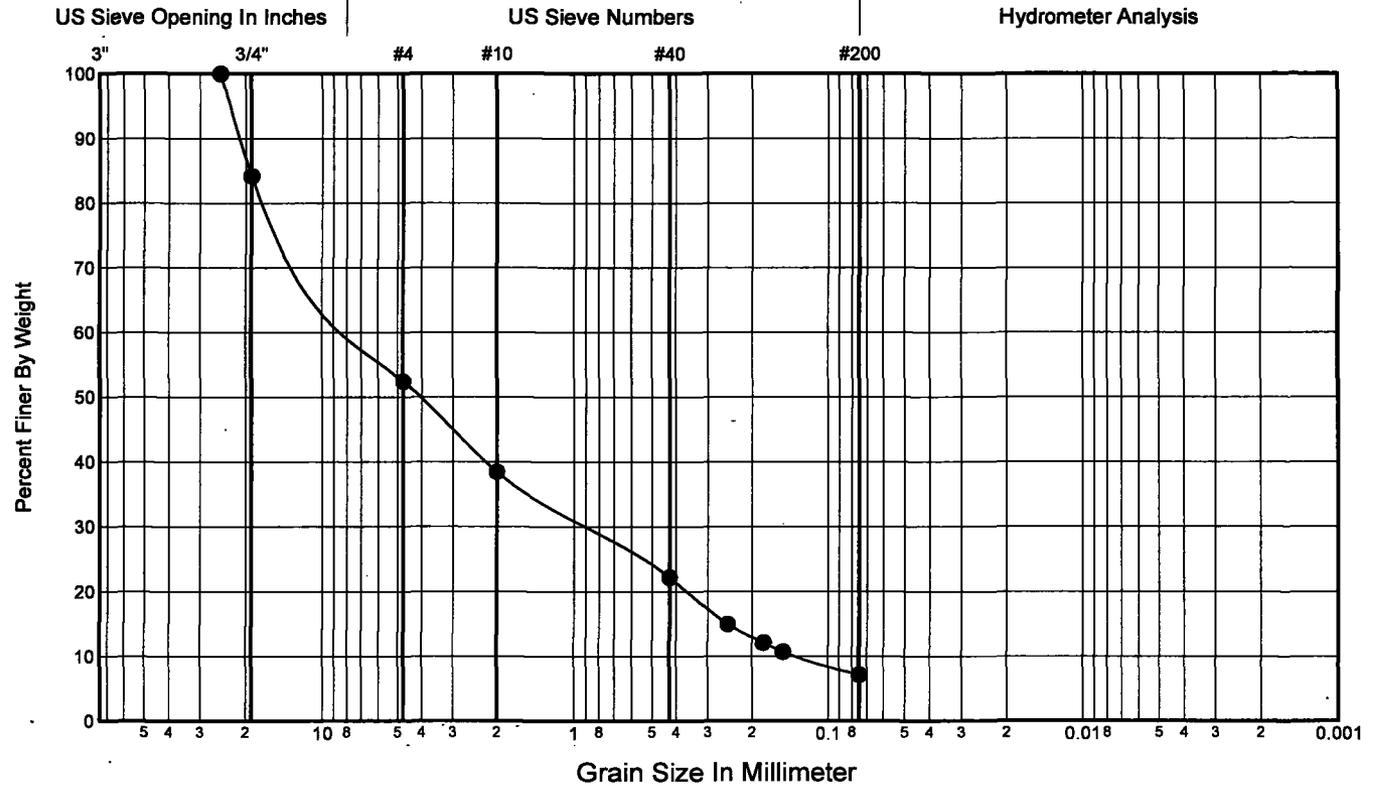
Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
● 7.5	2.29	D-4	GP-GM	See Boring Log	POORLY GRADED GRAVEL with SILT and SAND	7			

GRADATION FRACTIONS

%Gravel	%Sand	%Fines	Cc	Cu
● 47.6	45.2	7.1	0.9	50.6

GRADATION VALUES

D60	D50	D30	D20	D10
● 6.618	4.10	0.89	0.36	0.131



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3549**

Date **June 1, 2004**

Hole No. **TH-7-04**

Sheet **1 of 1**

Laboratory Summary



Washington State
Department of Transportation

Project **SR-24 / I-82 to Keys Road**

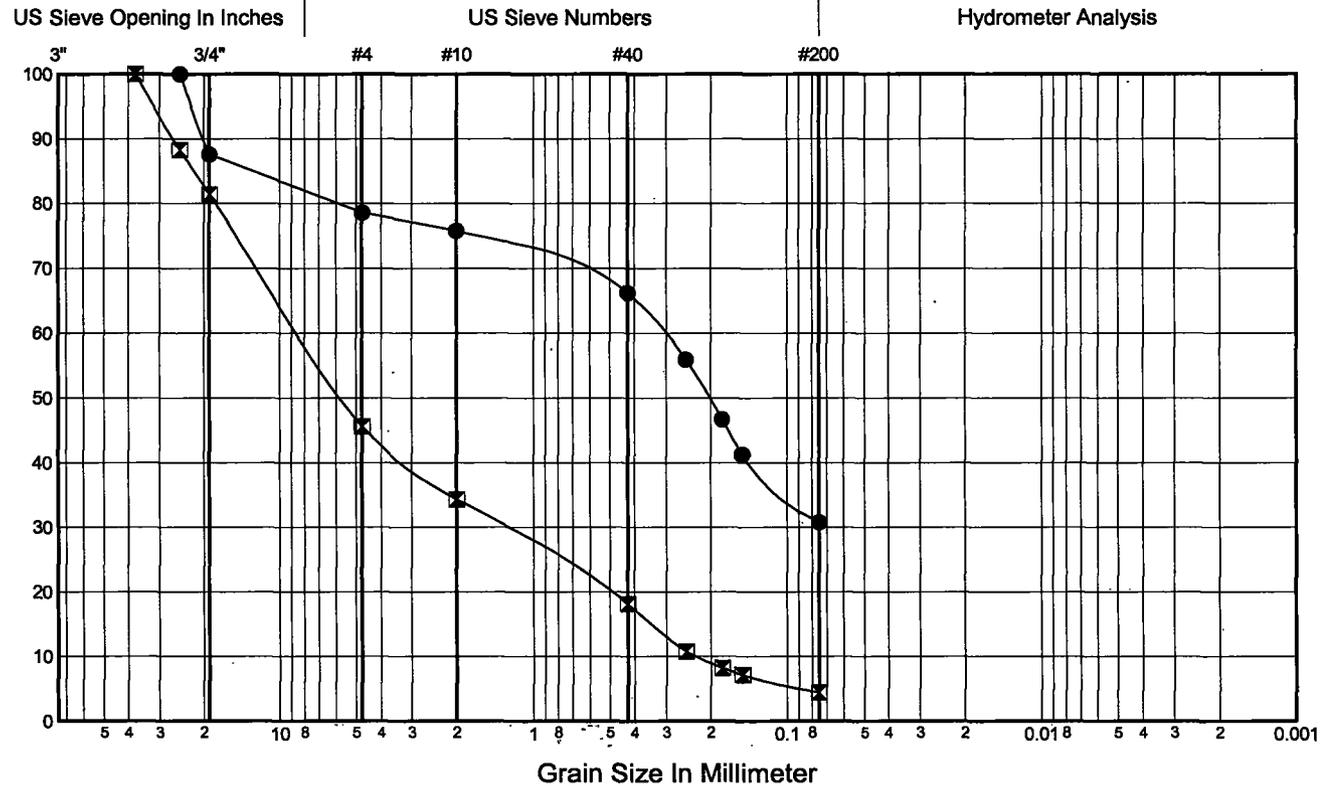
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	0.0	0.00	D-1	SM	See Boring Log	SILTY SAND with GRAVEL	6	29		
☒	9.0	2.74	D-5	GP	See Boring Log	POORLY GRADED GRAVEL with SAND	9			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	21.4	47.8	30.8		
☒	54.4	41.2	4.4	0.9	36.5

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.309	0.20			
☒	8.294	5.63	1.32	0.51	0.227



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. **OL-3549**

Date **June 1, 2004**

Hole No. **TH-8-04**

Sheet **1 of 1**

Project **SR-24 / I-82 to Keys Road**

Laboratory Summary



Washington State
Department of Transportation

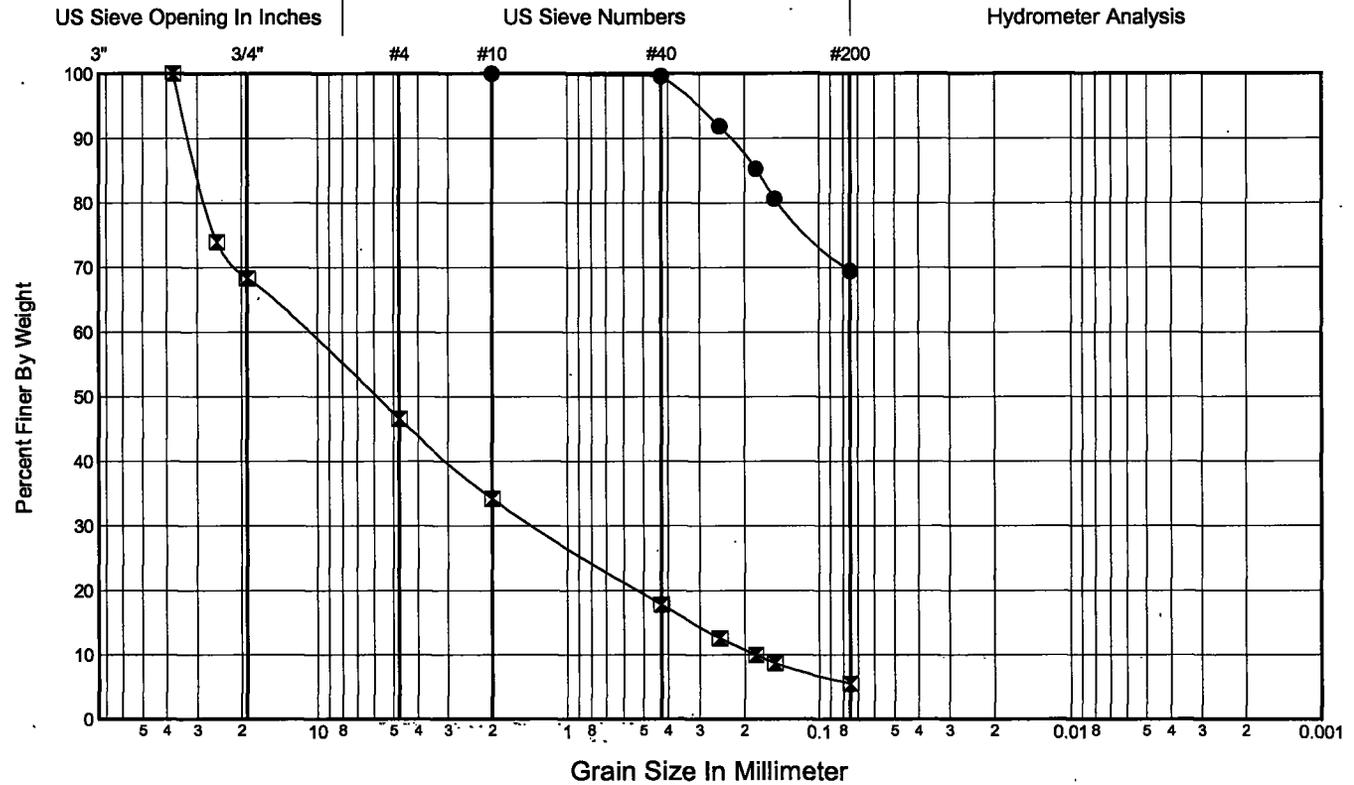
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	1.5	0.46	D-2	ML	See Boring Log	SANDY SILT	33	39	32	7
☒	9.0	2.74	D-5	GP-GM	See Boring Log	POORLY GRADED GRAVEL with SILT and SAND	9			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	0.0	30.5	69.5		
☒	53.4	41.1	5.5	0.9	61.7

GRADATION VALUES

	D60	D50	D30	D20	D10
●					
☒	11.167	5.91	1.35	0.52	0.181



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Appendix C-2
Laboratory Test Data
HWA 1999

APPENDIX B

LABORATORY TESTING

Laboratory tests were conducted on selected soil samples to characterize relevant engineering and index properties of the site soils. Laboratory testing, as described below, consisted of determining soil moisture content and grain size distribution. Laboratory testing was completed in general accordance with ASTM (American Society of Testing Materials) specifications.

Moisture Content Testing

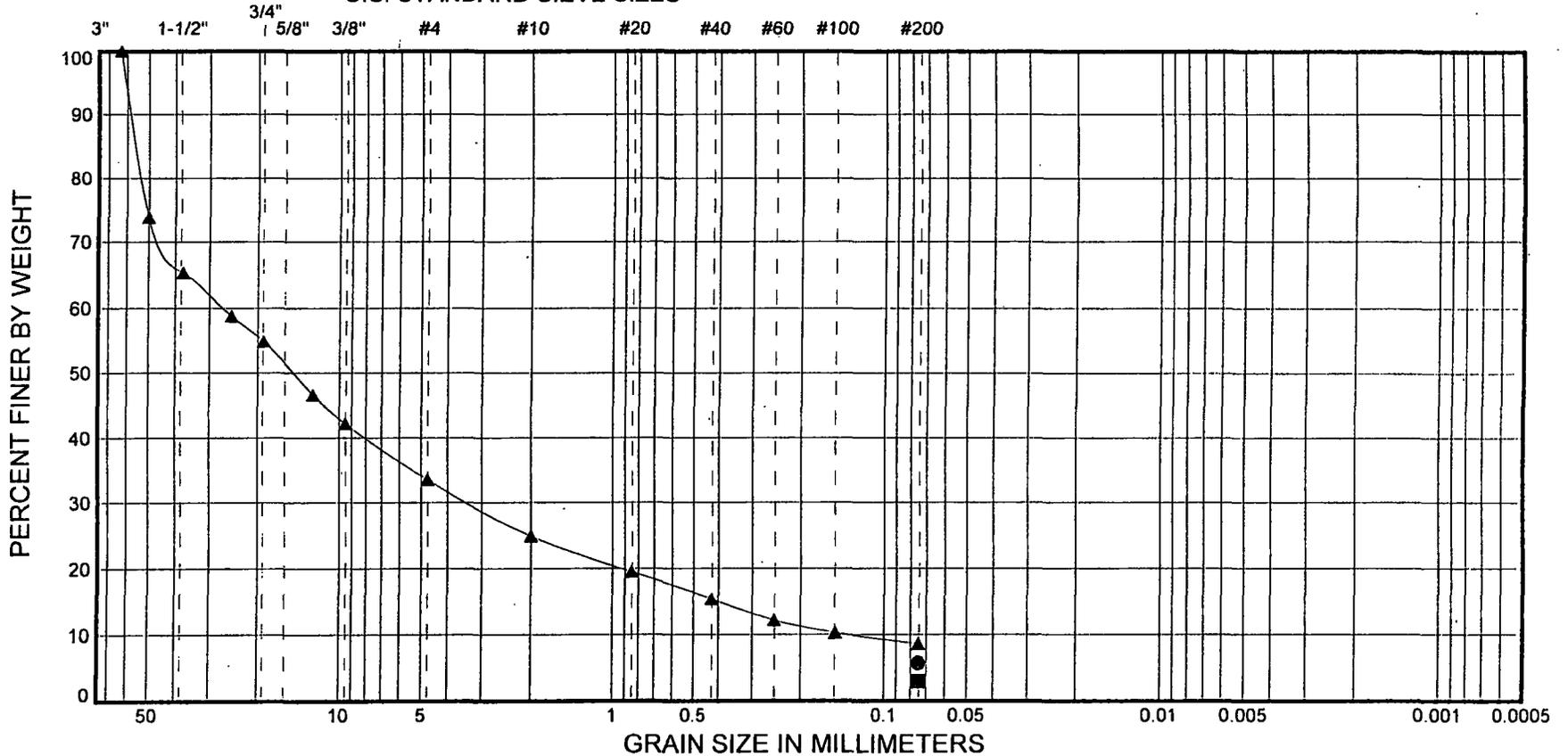
Soil moisture content was determined for select samples in general accordance with ASTM D-2216. The test results are indicated at the sample intervals on the borings logs in Appendix A.

Grain Size Distribution/Percent Fines Analysis

The grain size distribution and percentage fines was determined for selected samples in general accordance with ASTM D-422 and ASTM D-1140, respectively. Results are plotted on Figures B-1 through B-3.

GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		

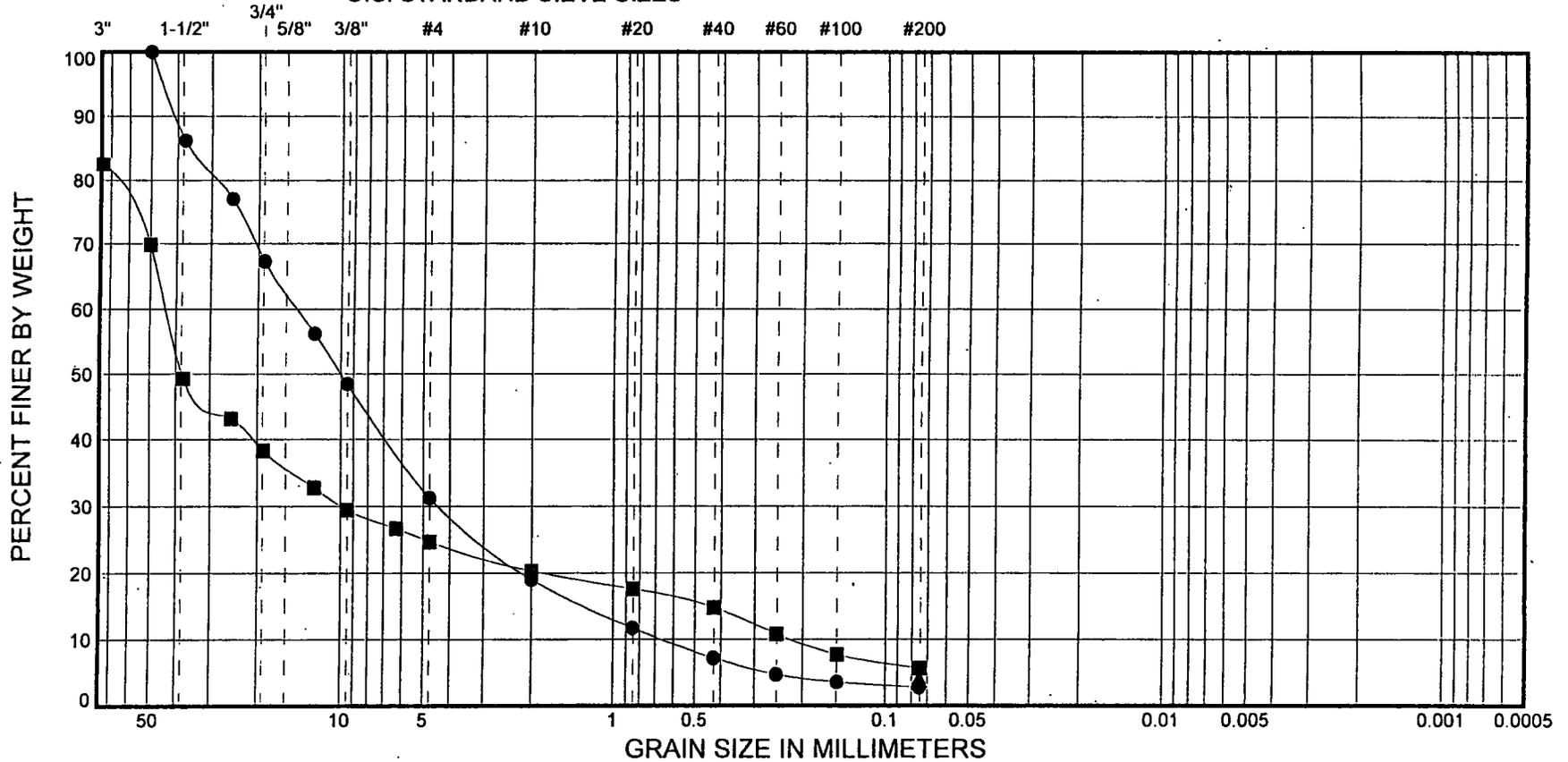
U.S. STANDARD SIEVE SIZES



SYMBOL	SAMPLE	DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Gravel	% Sand	% Fines
●	BH-3 B-5	19.8 - 25.0	(GP-GM) Grayish brown, slightly silty, sandy coarse GRAVEL	10						5.8
■	BH-3 B-7	30.3 - 35.0	(GP) Grayish brown, sandy, coarse GRAVEL	10						3.0
▲	BH-3 B-9	40.0 - 45.0	(GP-GM) Grayish brown, slightly silty, sandy, coarse GRAVEL	9				66.5	24.9	8.6

GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		

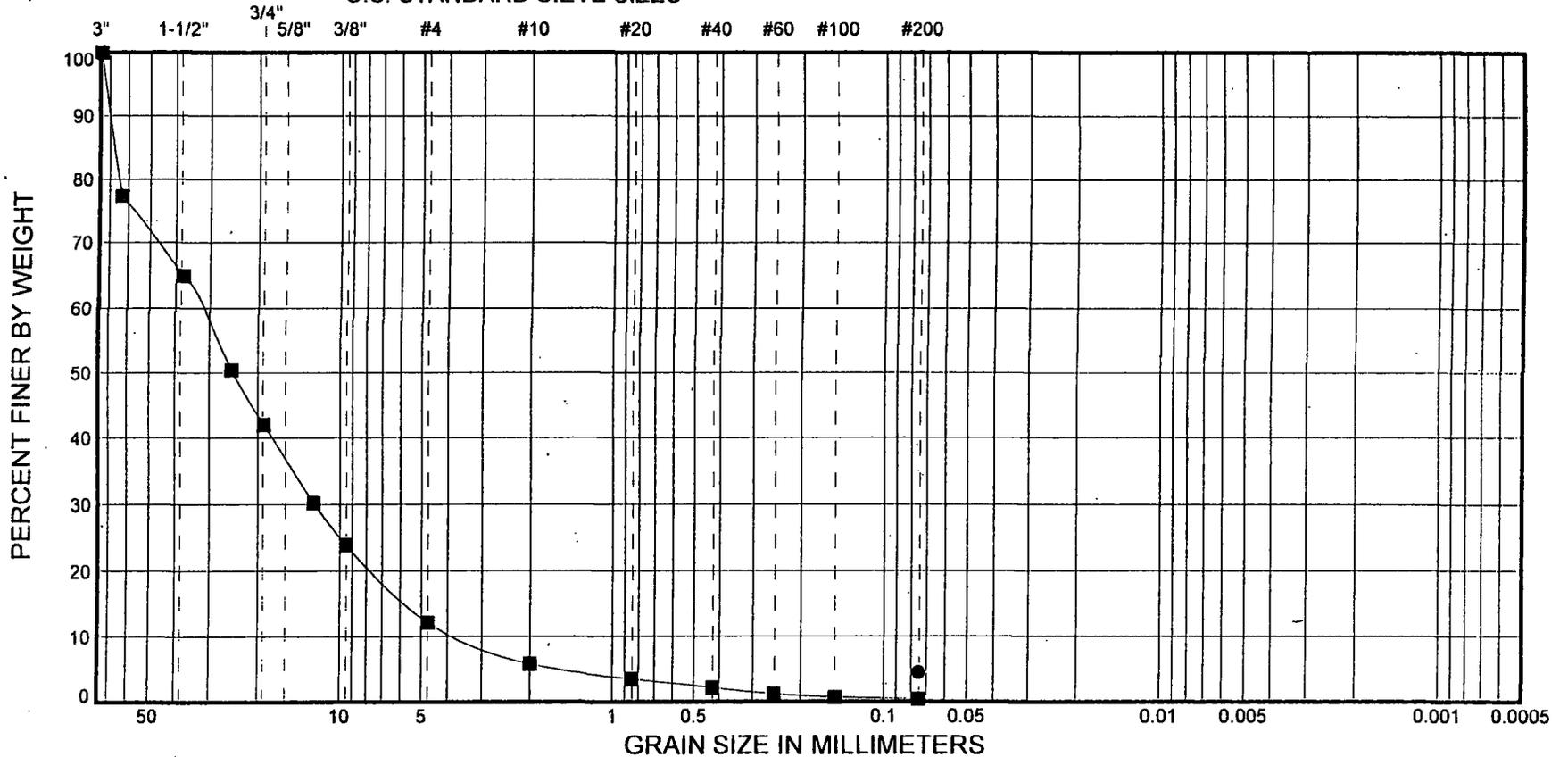
U.S. STANDARD SIEVE SIZES



SYMBOL	SAMPLE	DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Gravel	% Sand	% Fines
●	BH-3	B-12	55.5 - 59.0 (GW) Yellowish brown, sandy, fine to coarse GRAVEL	11				68.7	28.5	2.8
■	BH-4	B-5	19.8 - 25.0 (GP-GM) Dark grayish brown, slightly silty, sandy, coarse GRAVEL	8				57.8	19.0	5.7
▲	BH-4	B-9	39.8 - 45.0 (GP) Grayish brown, sandy, coarse GRAVEL	8						4.3

GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		

U.S. STANDARD SIEVE SIZES



SYMBOL	SAMPLE	DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Gravel	% Sand	% Fines
●	BH-4 B-12	55.3 - 59.0	(GP) Grayish brown, sandy, coarse GRAVEL	11						4.5
■	BH-4 B-15	70.0 - 72.0	(GW) Gray, slightly sandy, fine to coarse GRAVEL	4				87.8	11.7	0.4



HWAGEOSCIENCES INC.

SR-24: I-82 TO KEYS ROAD
YAKIMA, WASHINGTON

GRAIN SIZE
DISTRIBUTION
TEST RESULTS

**APPENDIX D - AXIAL CAPACITY CHARTS FOR DEEP
FOUNDATIONS AND BEARING CAPACITY CHARTS FOR
SHALLOW FOUNDATIONS**

Appendix D-1
Bridge 24/1

24/1 Bridge - Pier 1

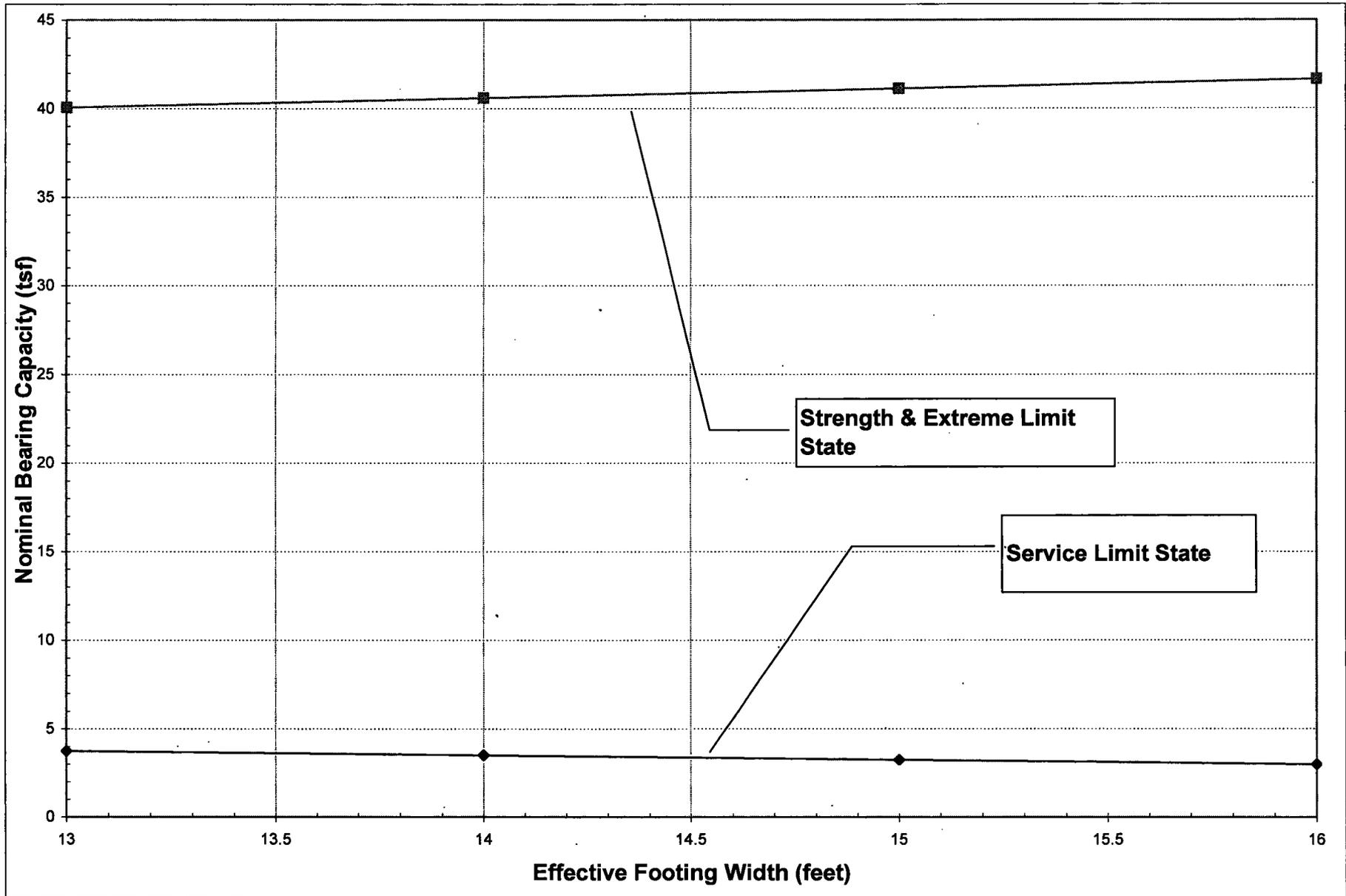


Figure 1: Pier 1 Spread Footing Capacity for Service and Strength Limit State

24/1 Bridge - Pier 2

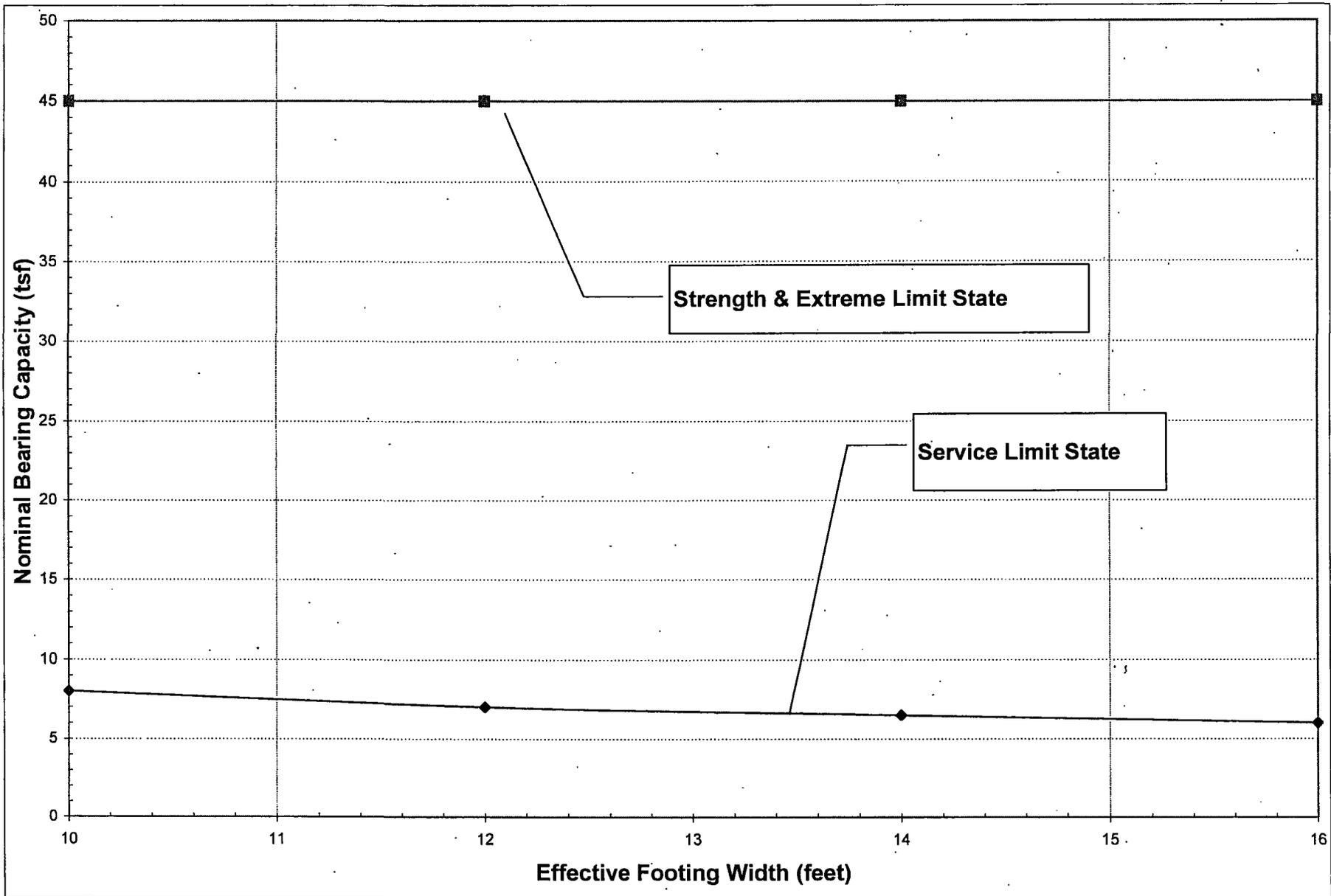


Figure 2: Pier 2 Spread Footing Capacity for Service and Strength Limit State

24/1 Bridge - Pier 3

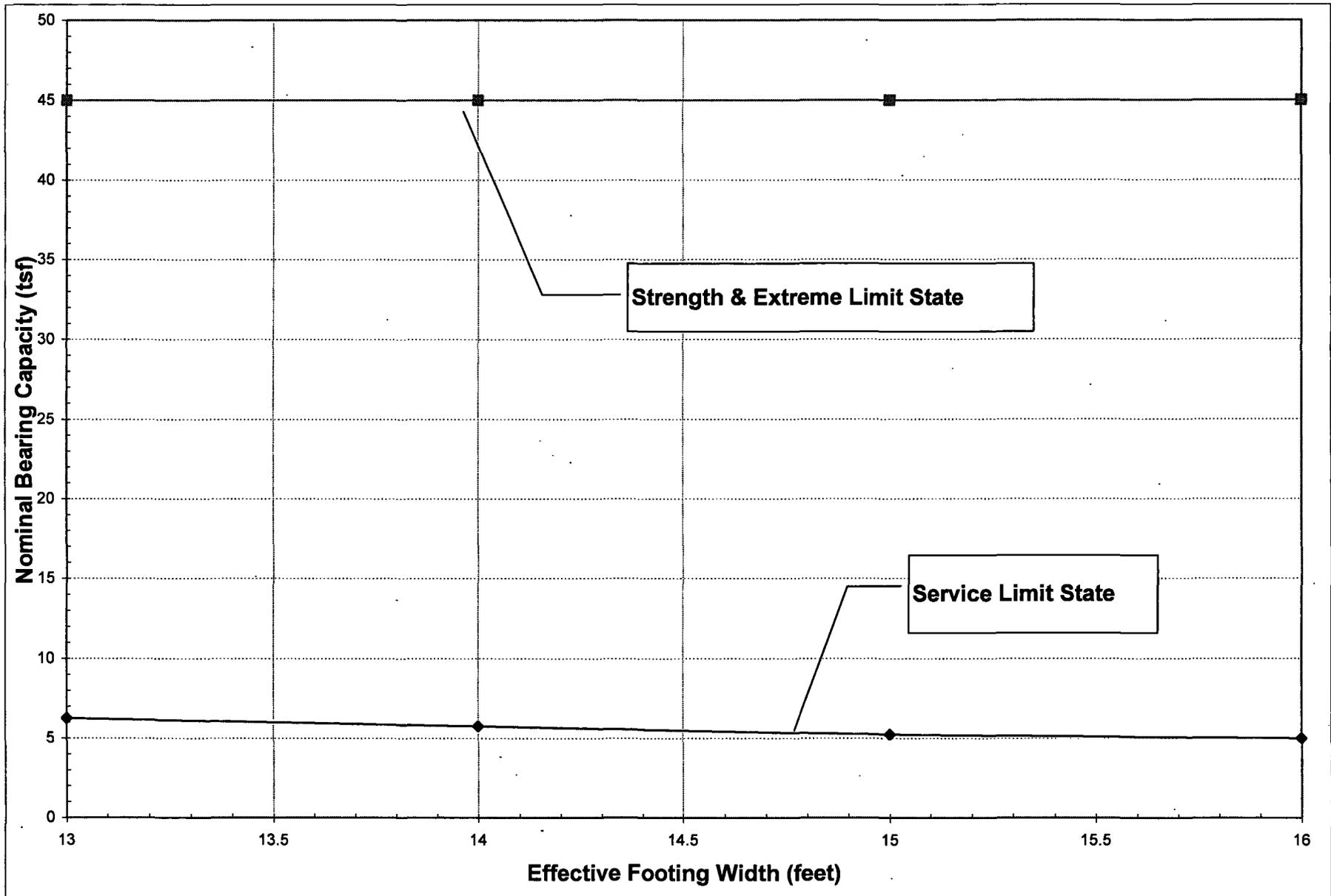


Figure 3: Pier 3 Spread Footing Capacity for Service and Strength Limit State

Appendix D-2
Bridge 24/5

SR24 Yakima River Bridge

Pier(s) 2,3,4,5,6
 Diameter 8.0 ft
 Casing None

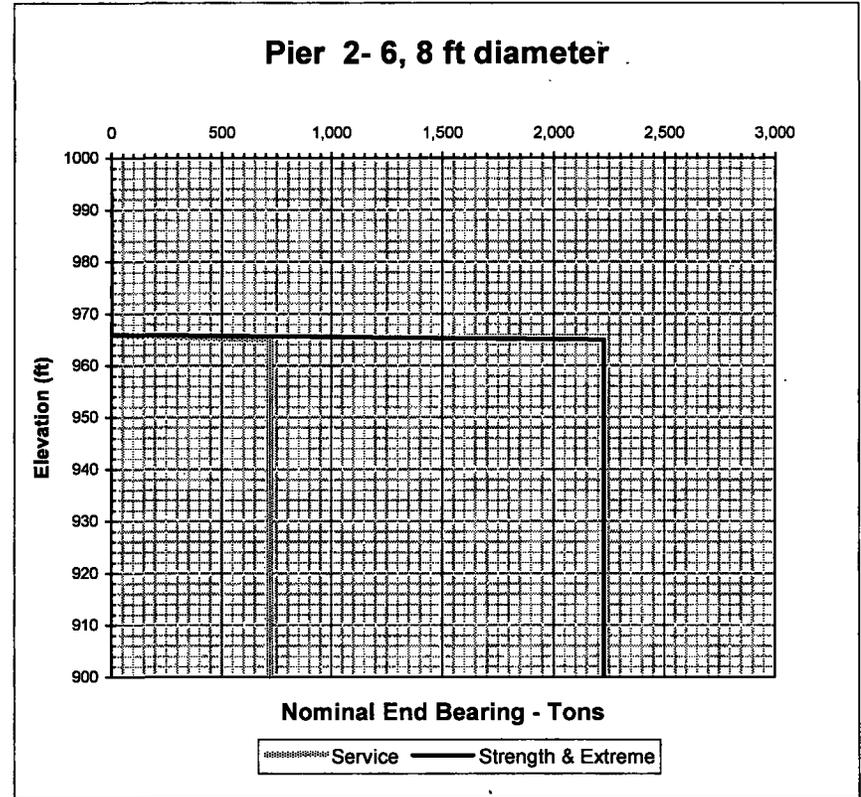
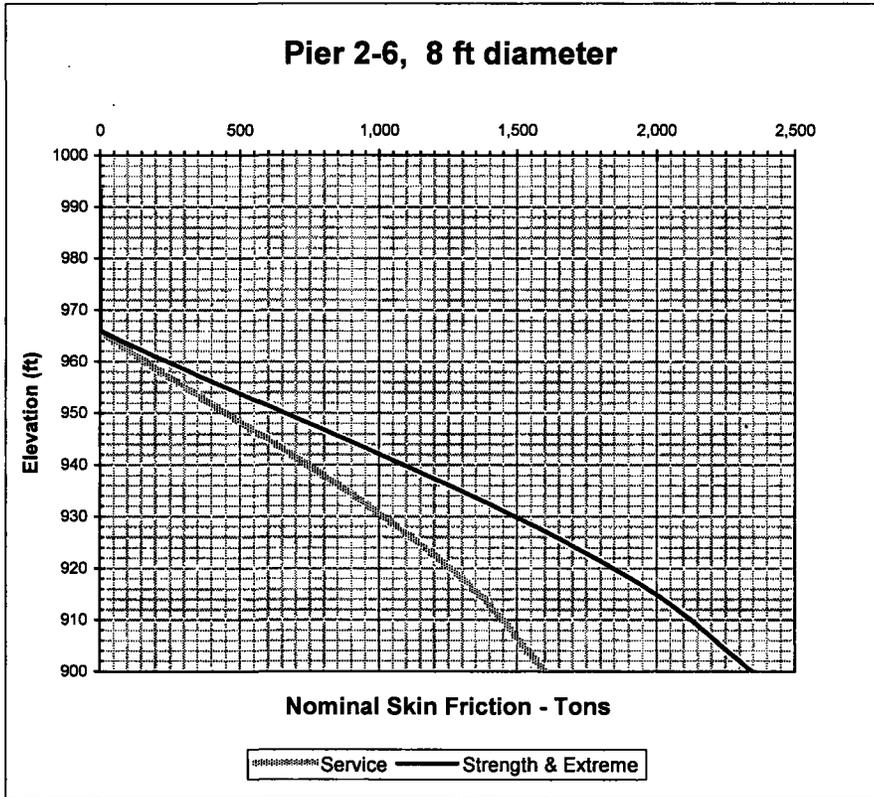


Figure 4: Axial Capacity for 8 ft Diameter Drilled Shafts for Piers 2 - 6

SR24 Yakima River Bridge

Pier(s) 7,8,9
 Diameter 8.0 ft
 Casing None

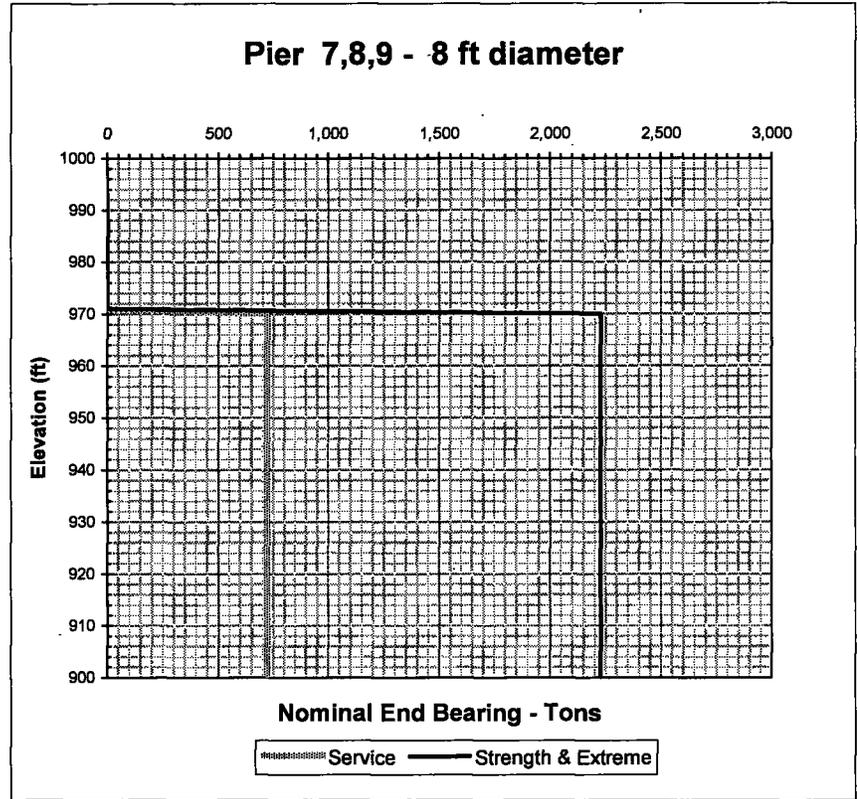
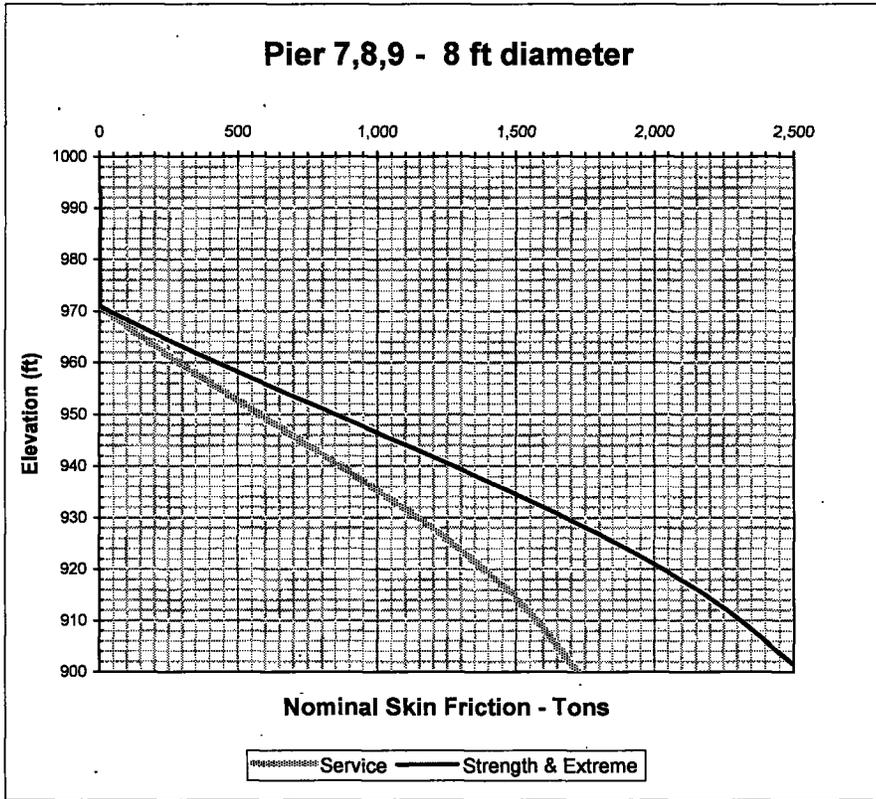


Figure 5: Axial Capacity for 8 ft Diameter Drilled Shafts for Piers 7 - 9

24/5 Bridge Pier 1 and 10

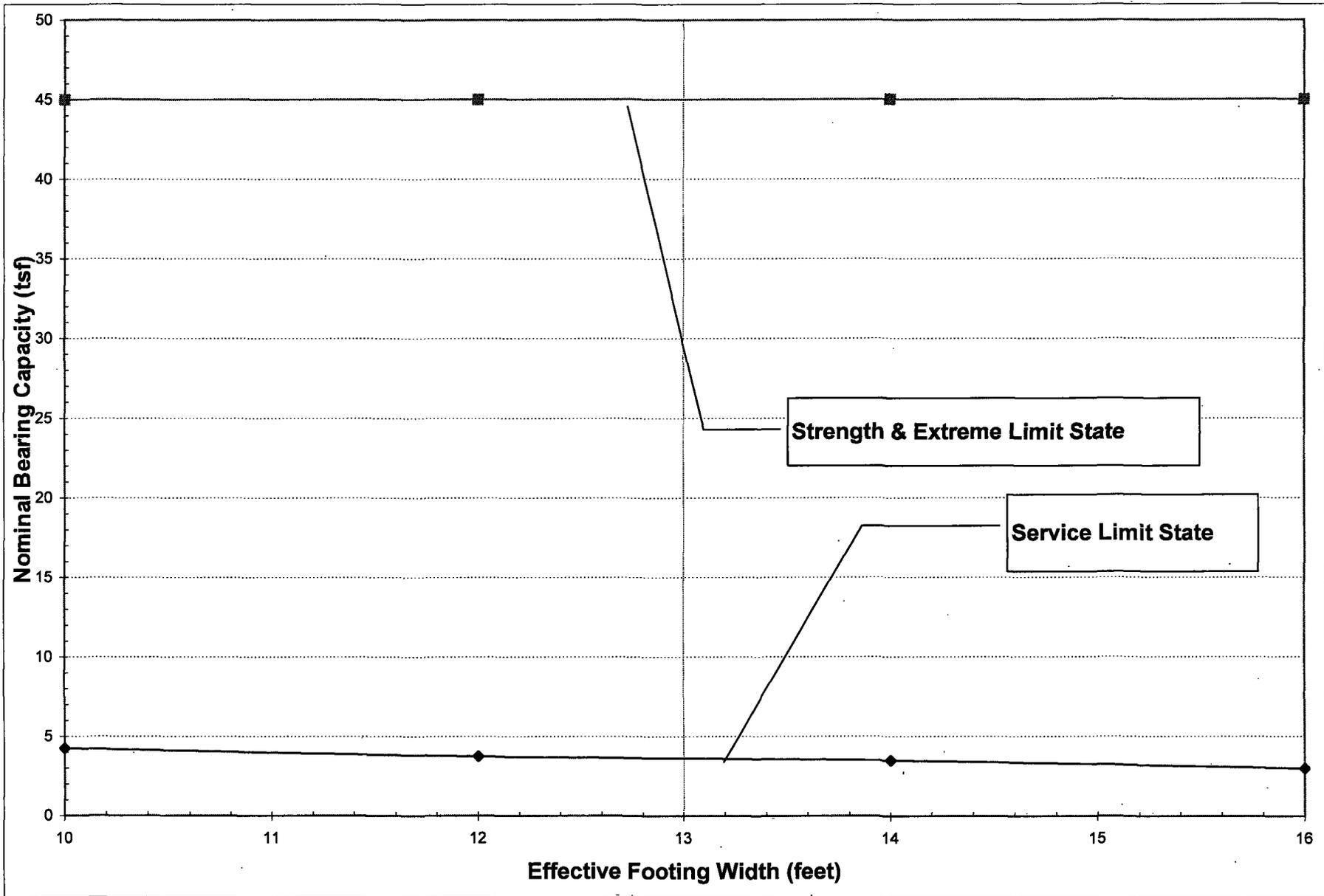


Figure 6: Pier 1 and 10 - Spread Footing Capacity for Service and Strength/Extreme Limit States

APPENDIX E - P-Y CURVE INPUT PARAMETERS

**SR-24 Yakima River Bridge 24/5 Replacement
Case 1 - Live loads only with SCOUR**

Py Curve Soil Data for COM-624

Applies to Piers: *PIER 2 - 9*

Reference Elevation: **966 (Piers 2-6); 971 (Piers 7-9)**

Soil Layer	Depth Below Reference Elevation to Bottom of Layer (feet)	Soil Type	Effective Unit Weight Soil, (pcf)	Cohesion (psf)	Axial Strain E50	STATIC ANALYSIS		DYNAMIC ANALYSIS	
						Friction Angle (degrees)	Modulus of Subgrade Reaction (pci)	Friction Angle (degrees)	Modulus of Subgrade Reaction (Mn/m ³)
2,3,4	Bottom of Shaft	SAND	68	0	NA	45	220	45	220

**SR-24 Yakima River Bridge 24/5 Replacement
Case 2 - Earthquake loads only**

Py Curve Soil Data for COM-624

Applies to Piers: *PIER 2 - 9*

Reference Elevation: **Ground Surface**

Soil Layer	Depth Below Reference Elevation to Bottom of Layer (feet)	Soil Type	Effective Unit Weight Soil, (pcf)	Cohesion (psf)	Axial Strain E50	STATIC ANALYSIS		DYNAMIC ANALYSIS	
						Friction Angle (degrees)	Modulus of Subgrade Reaction (pci)	Friction Angle (degrees)	Modulus of Subgrade Reaction (Mn/m ³)
2, 3, 4	990	SAND	130	0	NA	36	160	36	160
2, 3, 4	Bottom of Shaft	SAND	68	0	NA	45	220	45	220

24/5 Bridge Pier 1 and 10

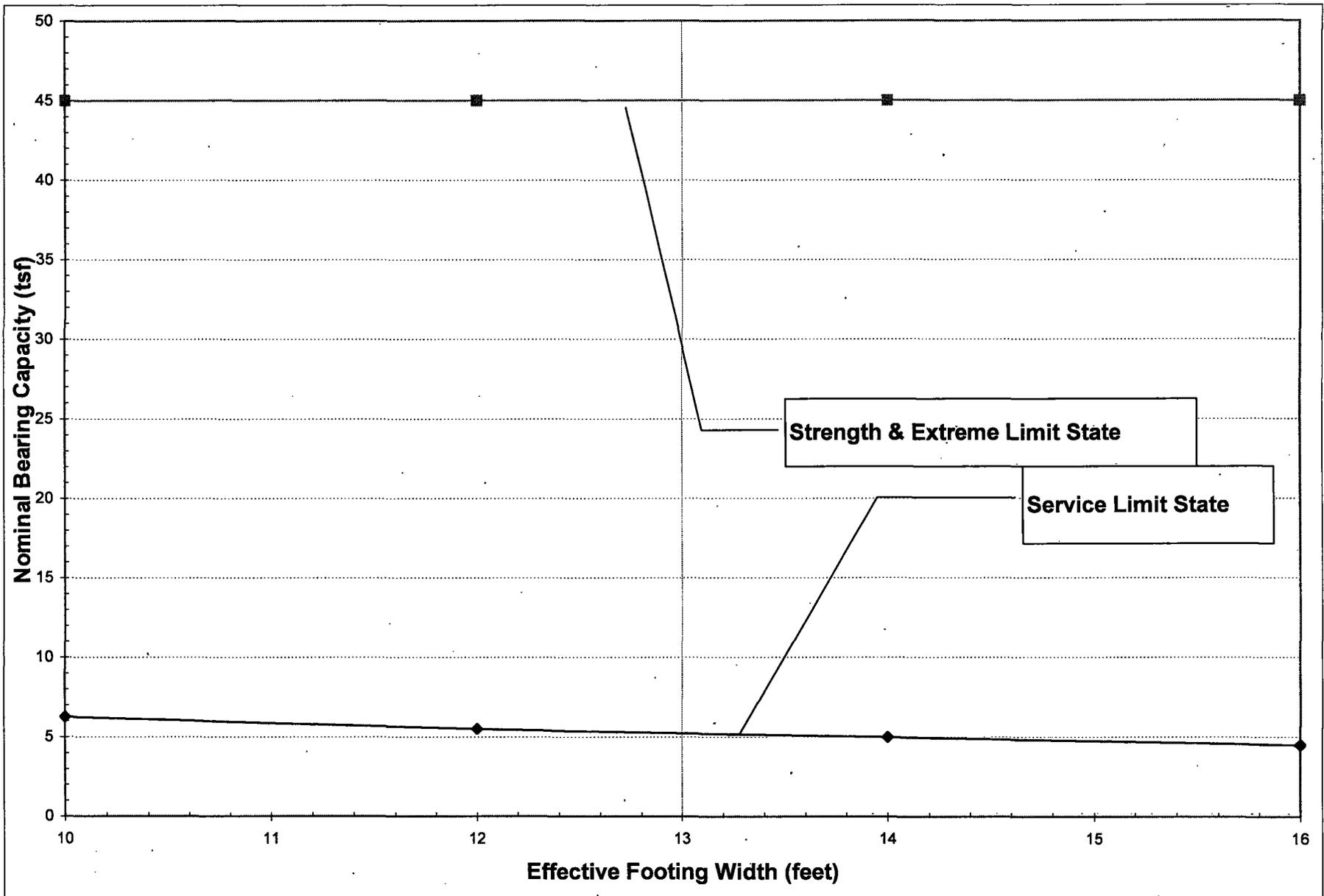


Figure 6: Pier 1 and 10 - Spread Footing Capacity for Service and Strength/Extreme Limit States