Olympic Region

Geotechnical Report

For Construction of:

SR 7 MP 47.44 TO MP 52.30

SR 507 TO SR 512 SAFETY

PIERCE COUNTY

F. A. PROJECT NO. IGFSB-CM-0007(016) & CM-0007(016)

Washington State Department of Transportation

Washington State
Department of Transportation

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Memorandum

April 13, 2004

TO: Troy Cowan/John Klockenteger
Project Office, Olympic Region, 47448

FROM: T.M. Allen/D.A. Williams
E&EP Geotechnical Division, 47365

SUBJECT: SR-7, OL-2740
SR 507 to SR 512 Safety Improvements
MP 47.44 to MP 52.30
Geotechnical Recommendations, Addendum 1

JAMES G. CUTHBERTSON
STATE OF WASHINGTON
31992
REGISTERED
PROFESSIONAL ENGINEER
4/13/4
EXPIRES 03-13-06

We were requested by the Project Office to review and update our design recommendations of September 4, 1998. At that time, the project was in metric units and was put on-hold. Now, as part of the "nickel package", the project is scheduled for Ad in May. As part of this "update", we have prepared recommendations for Wall F-74, summarized ground water information, addressed seismic considerations, and provided retaining wall GSP inputs.

In our original memorandum dated September 4, 1998, modular block geosynthetic retaining wall systems (MBGR) were non-standard, non-pre-approved, non- proprietary wall systems. We provided a special design for these walls at that time. Since the time our original recommendations were made, two wall systems have been pre-approved, KeySystem 1 and Mesa.

In addition, we were asked to review Wall F-74 and make additional geotechnical recommendations. Wall F-74 is located adjacent to the left side of SR-7 between Stations 82+920 to 82+989. At this location, the property owner has excavated the existing embankment to an approximate 1H:1V slope. The change in the embankment's geometry prompted the review of this wall.

Ground Water

A series of exploration programs have been conducted within the project limits. In 1998, ten test holes and ten portable penetrometer holes were performed to characterize the foundation conditions for the proposed walls. In 1999, nine test holes were drilled for traffic signal foundations. In 2004, seven test holes with piezometers were drilled to determine the infiltration rates in the grass-lined ditches. Ground water was encountered in eleven holes at the time of drilling. Table 1 summarizes the available ground water information.

Table 1: Summary of Ground Water Information.

Test Hole	Station SR 7 Line	Offset (meters)	Ground Elevation	Water Elevation	Date
H-1-04	79+587	11.1 Rt.	106.4 m	102.3 m	March 18, 2004
H-3-04	81+438	13.6 Lt.	94.1 m	91.3 m	March 3, 2004
H-4-04	82+181	8.9 Lt.	91.8 m	88.4 m	March 9, 2004
H-1-99	82+495	12 Rt.	92.0 m	88.5 m	July 12, 1999
H-5-04	82+450	9.1 Lt.	95.5 m	92.5 m	March 16, 2004
H-4-98	82+950	10.4 Lt.	96.3 m	94.8 m	June 2, 1998
H-7-99	83+205	10 Rt.	102.8 m	98.3 m	July 12, 1999
H-7-98	83+800	10.1 Lt.	109.3 m	94.8 m	June 1, 1998
H-9-98	83+880	11.0 Lt.	111.0 m	108.9 m	June 1, 1998
P-2-98	83+888	15 Lt.	110.3 m	109.6 m	March 12, 1998
H-9-99	83+998	16 Rt.	115.4 m	111.5 m	July 16, 1999

Design Earthquake Parameters

In our recommendations dated September 4, 1998, seismic design for the retaining walls was not provided. A bedrock acceleration coefficient of 0.28g is recommended for seismic design of the structures on this project, in accordance with the Bridge Design Manual. The recommended acceleration coefficient is based on expected peak ground acceleration at the project site that has a 90 percent probability of not being exceeded in a 50-year period.

In the past, we have provided only the peak bedrock acceleration (PBA). The "Peak Ground Acceleration" (PGA) at the ground surface is a function of PBA and soil profile. We recommend a PGA of 0.33g at this site due to soil amplification.

Design Retaining Wall Parameters

Wall F-74 is located adjacent to the left side of SR-7 between Stations 82+920 to 82+989. The new wall may vary in height up to 3.6 meters along the wall. Conceptually, from a Geotechnical point of view, a soldier pile wall, MSE wall, and MBGR wall systems are feasible at this location. We have provided typical design figures, Figures 2 and 3 in Appendix A, for both the soldier pile and MDGR wall systems.

From our previous report dated September 4, 1998. There are 39 walls located along the alignment of SR 7 (Pacific Ave. South) with heights greater than one meter. The project limits

are shown in Figure 1 in Appendix A. Twenty-five of these walls will have approximately one meter of exposed wall face. Fifteen of these walls will have total heights greater than 1.2 meters in height. Four of these walls were designed as soldier pile walls. The wall locations and wall types are summarized in Table 2 below.

Table 2: Summary of Wall Locations over 1.2 m in height.

Wall	Station	Offset (meters)	Approx. Length (meters)	Max. Wall Height (meters)	Wall Type
SP- 1	80+978 to 81+040	15 Lt.	62	4.5	Soldier Pile
F-46	80+057 to 81+161	14.5 Lt.	104	1.8	MBGR
F-48	81+139.5 to 81+164.7	14.5 Rt.	25.2	1.7	MBGR
F-72	83+628 to 83+687	12.5 to 21 Lt.	49	2.2	MBGR
F-73	82+911 to 82+977	15 Rt.	66	2.0	MBGR
F-74	82+920 to 82+989	14.5 to 15 Lt.	78	3.3 / 3.5	MBGR/ Soldier Pile
SP- 2	83+014.9 to 83+026	13.9 Lt.	11.1	2.4	Soldier Pile
F-75	83+708 to 83+786	11.4 to 15 Lt.	78	2.5	MBGR
SP- 3	83+735 to 83+769	14.0 Rt.	34	2.8	Soldier Pile
SP- 4	83+798 to 83+861	14.0 Rt.	63	3.0	Soldier Pile
F-76	83+792 to 83+843	11.4 to 15 Lt.	51	2.5	MBGR
F-77	83+876 to 83+957	12.2 to 15 Lt.	81	2.4	MBGR
F-78	83+942 to 83+957	14.5 Lt.	15	1.6	MBGR
F-79	84+001 to 84+023	14.5 Lt.	22	1.5	MBGR

In general, the foundation soils encountered at most all of the wall sites consist of medium dense to dense, well graded to poorly graded gravel with silt and cobbles, underlain by very dense silty sand with gravel. However, loose foundation soils were encountered in the vicinity of walls F-76 and F-77 in test holes H-7-98 and H-9-98, respectively. We recommended over-excavating and recompacting the native, poorly graded gravel with silt and sand, as shown in Figure 4.

As of April 5, 2004, the Standard Specifications have been revised to include new sections for retaining walls. The revisions will be part of contracts that contain the amendments to the Standard Specifications, commonly referred to as "pink sheets". Associated with the new Standard Specifications sections are new General Special Provisions. For this project, Modular Block faced walls are preferred for aesthetic reasons. The following GSPs will need to be included in the contract along with the amendments:

13.FB6	1303.FB6	130302.FB6	130304.FB6
1302.FB6	13033.FB6	13030201.FB6	13035.FB6
1302.03 FB6			13030502.FB6

GSP 13030201 contains fill-ins that need to be completed by the PE Office. The following information should be included in the GSP:

- Line 5 of the GSP: F-46, F-48, F-73, F-75, F-76, F-77, F-78, and F-79
- The following soil properties:

Soil Properties	Wall Backfill	Retained Soil	Foundation Soil
Unit Weight (kN/m^3)	20.4	19.6	19.6
Friction Angle (degrees)	36°	35°	35°
Cohesion (kPa)	0	0	0
		AASHTO Load Group I	AASHTO Load Group VII
Allowable Bearing Capacity		290 kPa	435 kPa
Acceleration Coefficient (g)		0	0.33

The following items should be considered in preparation of contract documents:

1. The wall should be placed on a level foundation in the direction perpendicular to the wall face.

2. MSE wall base should be located above the water table, which will require using a minimum embedment of 300 mm below the final ground surface for an MSE wall on the flat ground and 600 mm for MSE wall on a 2H:1V slope.
3. MSE walls should have a wall face batter no steeper than 48V:1H.
4. The base width of the MSE walls should not be less than 70 percent of the wall height to insure overall stability. Greater wall base widths may be needed to provide adequate overturning, sliding, and internal stability for the walls.
5. Backfill within the reinforced wall prism should consist of gravel borrow.
6. Properly compacted (Method C) gravel borrow or select borrow may be used behind the reinforced wall prism depending on weather conditions during construction. Common Borrow is not recommended.

The design calculations should be based on the current AASHTO Standard Specifications for Highway Bridges.

Detailed wall plans and design for the propriety wall options will not be developed until after the contract is awarded. Therefore, a wall plan and profile should be prepared showing the following (Region responsibility):

1. A profile showing neat-line top and bottom of wall as well as final ground line in front of and in back of the wall.
2. The backfill slope above the wall should be shown in the Plans.
3. Typical cross-section.
4. Generic details for the desired appurtenances, drainage requirements, guardrail post, and/or traffic barrier, which need to be included in the contract PS&E for proprietary walls.
5. A geotextile wrapped underdrain should be provided at the base of the wall behind the reinforced zone. This should be shown in the plans. Figure 5 in Appendix A shows a typical example.
6. The drainage pipe needs to be connected to the projects drainage or daylight through the MSE wall at a sag (low) point or at a maximum 100 m interval along the wall face.

Ideally the catch basins, grate inlets, signal foundations should be located, outside the reinforced backfill zone of the 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 obstruction(s) relative to the wall must be clearly indicated in the retaining wall plans. The Region should contact the Bridge and Structures Office to find out the limits on the

size and location of the obstructions for which pre-approved wall details and designs are available, and regarding what generic details should be provided in the plans.

Once the detailed wall plans and designs are available as shop drawings after the contract is awarded, the Bridge and Structures Office will need to review and approve the wall shop drawings and calculations.

Construction Considerations

We understand that there are tight construction limits for this project. Temporary shoring or temporary slopes may be required to build the MBGR walls for this design. It is our understanding that temporary slopes are the responsibility of the contractor. The contractor must adhere to the Washington Administrative Code for temporary cuts, WAC 296-155-664. The WAC guidelines allow up to 3/4 H:1V cuts to a maximum depth of 20 ft in type A soils. Steeper slopes require a special design by a registered professional engineer.

A design consideration for Wall F-74 being a MBGR wall or a soldier pile wall may depend on the location of existing or future utilities located behind the wall. Ground water may also be encountered near the base of the wall base. If a soldier pile wall option is selected, the contractor should anticipate difficult drilling conditions due to the presence of gravel, cobbles and boulders in the soils. See H-4-98 for representative soils at this location. Temporary casing may be needed to avoid caving of soils in the sidewall of the excavations.

Copies of the test boring logs in our updated formate are included in Appendix B, and copies of the laboratory test data are included in Appendix C to further characterize the soils.

If you have any questions regarding this memorandum, please contact Donald Williams at (360) 709-5457.

TMA:daw
DAW
Attachments

cc: Henry Gertje, Project Engineer Office, Olympic Region, 47448
John Vanlund, Bridge and Structures, 47340
Munindra Talukdar, Bridge and Structures, 47340
Mel Hitzke, Materials Engineer, Olympic Region, 47440

APPENDIX A

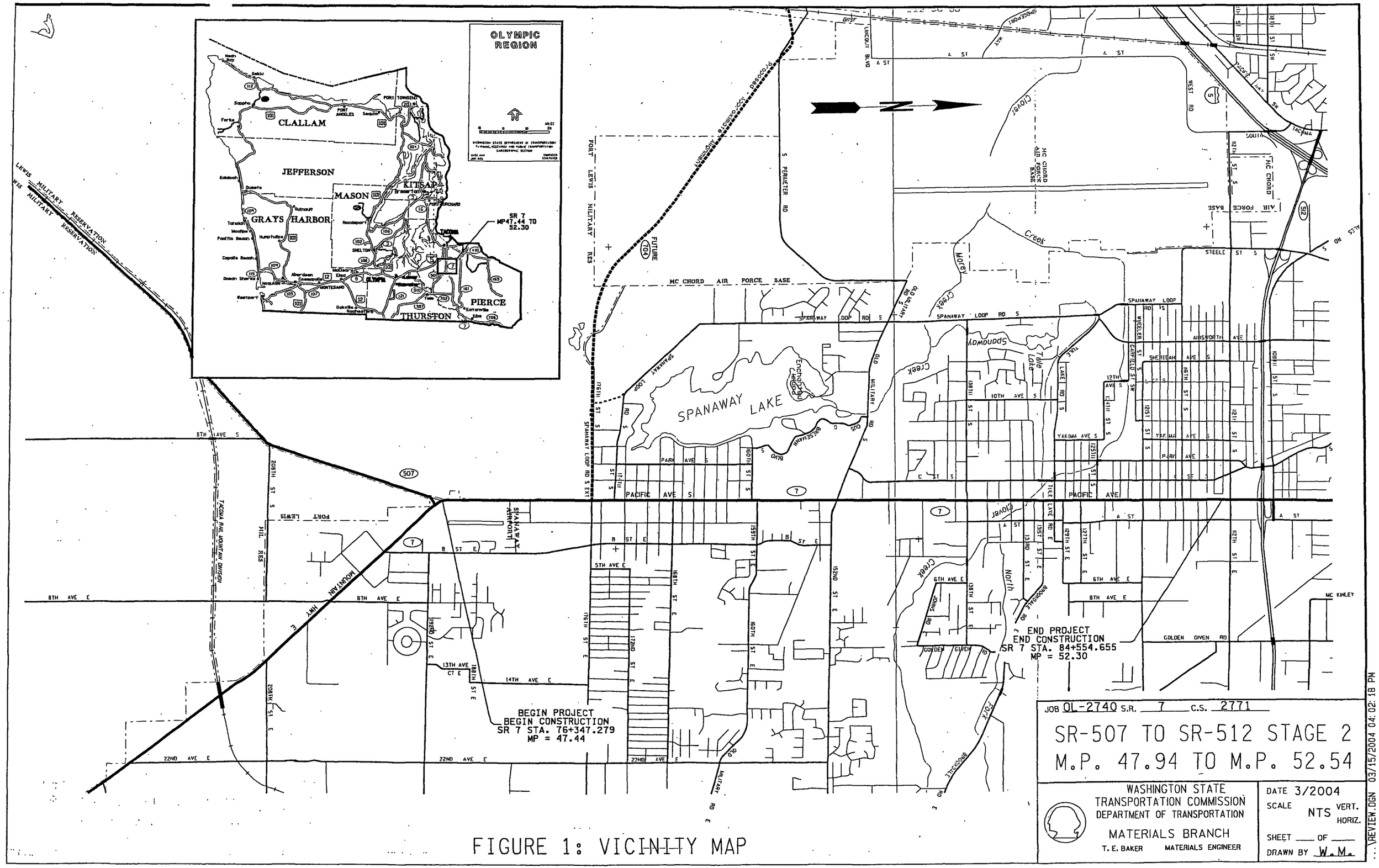
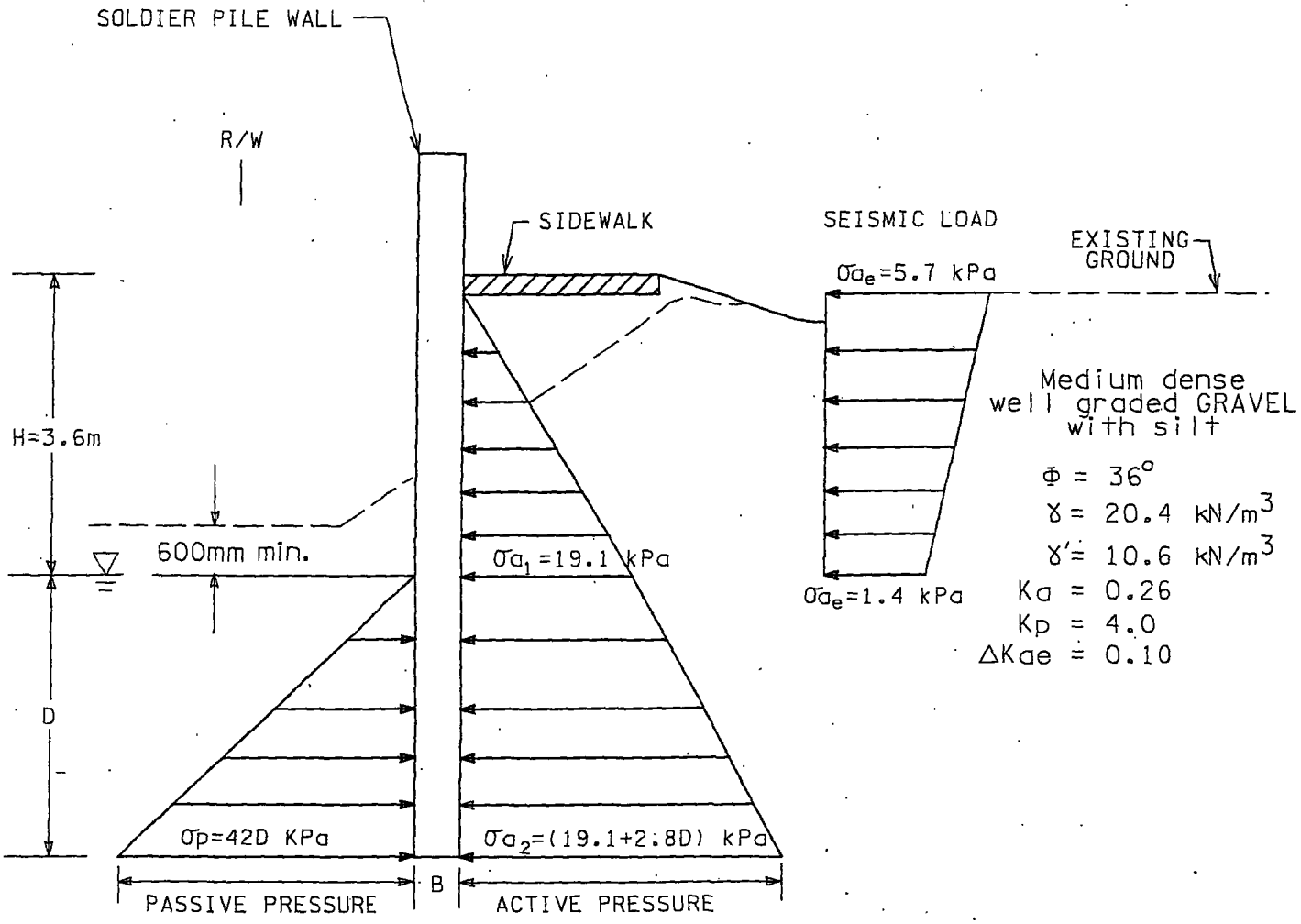


FIGURE 1: VICINITY MAP



NOTES: (1) ACTIVE PRESSURE IS GIVEN AS $\sigma a = Ka\gamma H$

(2) PASSIVE PRESSURE IS GIVEN AS $\sigma_p = Kp\gamma H$

Kp includes a Factor of Safety of 1.5(Kp/1.5).

Passive Pressure may be taken to act over three soldier pile diameters where piles are spaced greater than 3.0

FIGURE 2: TYPICAL EARTH PRESSURE DIAGRAM FOR WALL F-74 BETWEEN STATION 82+920 to STATION 82+989 LEFT

JOB OL-2740 S.R. 7 C.S. 2771 LAYOUT

SR-507 TO SR-512 STAGE 2

M.P. 47.94 TO M.P. 52.54

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

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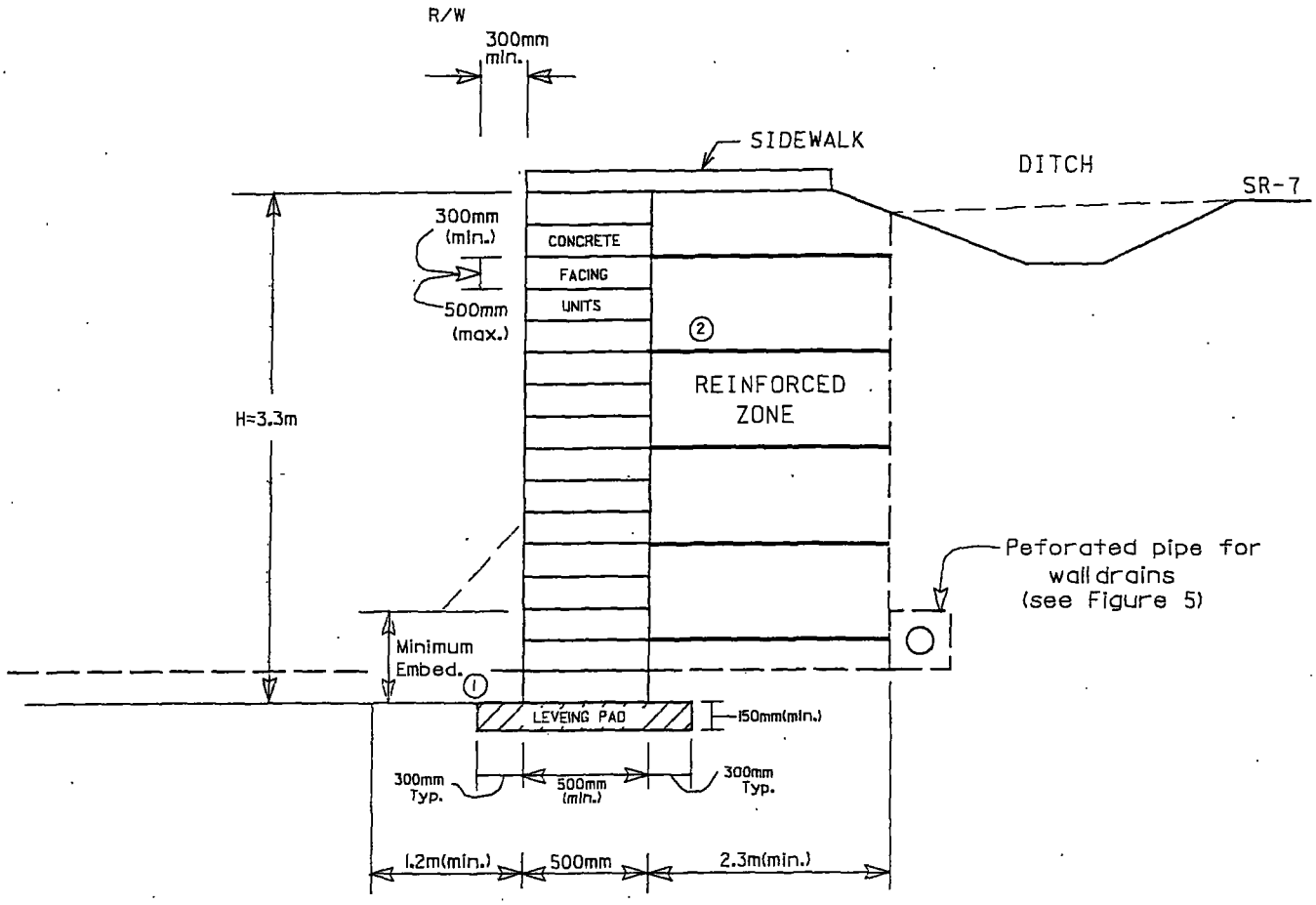

NOTES: (1) Minimum embedment varies with the embankement slope at the front face of the wall.
Horizontal slope=300mm
2H:1V slope=600mm

(2) Reinforcenent spacing, Sv, will follow the design recommened for structured earth

FIGURE 3: TYPICAL WALL DETAILS FOR VERTICAL WALL FACE WITH REINFORCEMENT

JOB OL-2740 S.R. 7 C.S. 2771 LAYOUT

SR-507 TO SR-512 STAGE 2
M.P. 47.94 TO M.P. 52.54

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DEPARTMENT OF TRANSPORTATION
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R. MOORE MATERIALS ENGINEER

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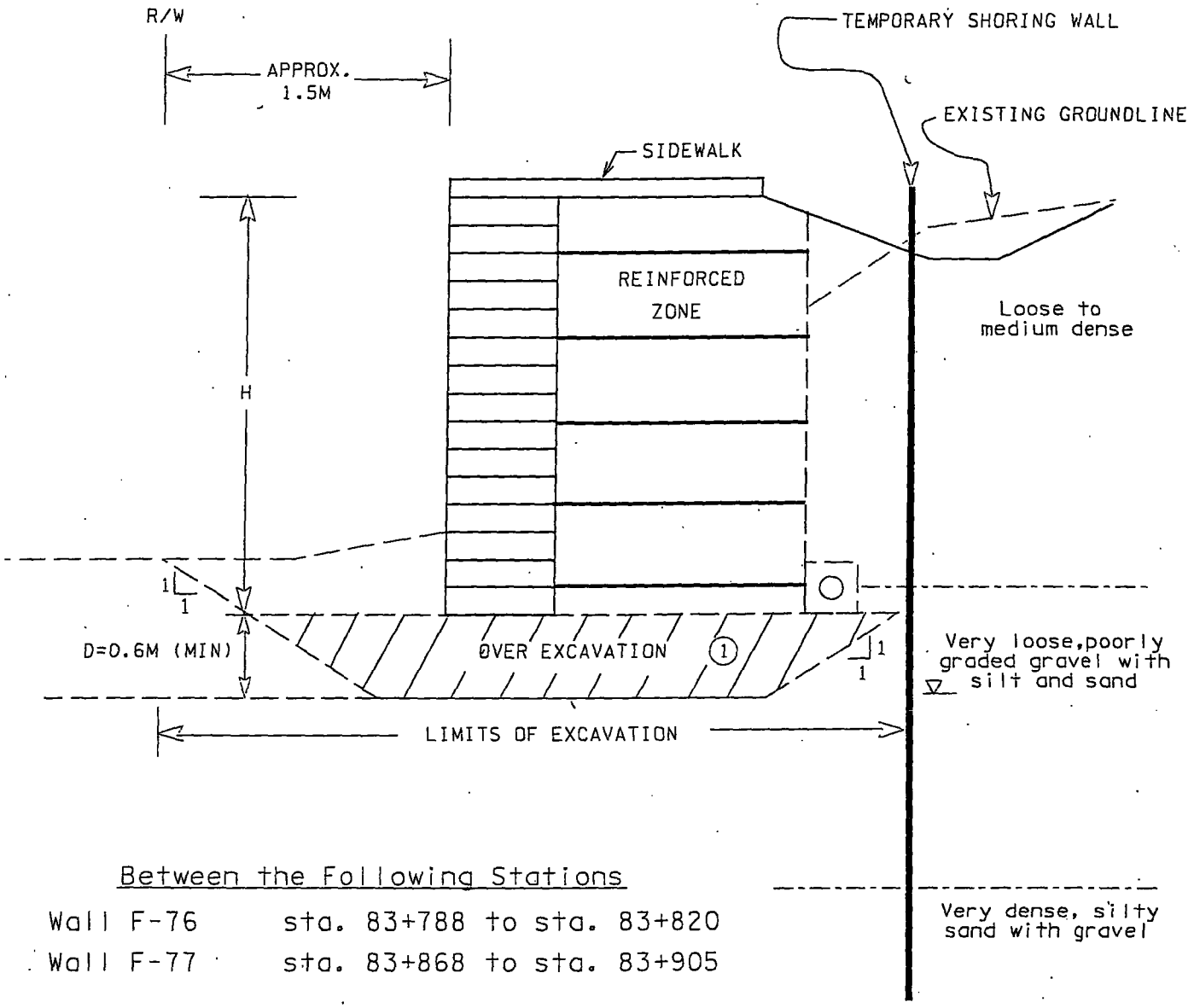

Between the Following Stations

Wall F-76 sta. 83+788 to sta. 83+820

Wall F-77 sta. 83+868 to sta. 83+905

NOTES: (1) Over-excavate and re-compact native soil to 95% of maximum density

FIGURE 4: TYPICAL OVER-EXCAVATION LIMITS

JOB OL-2740 S.R. 7 C.S. 2771 LAYOUT

SR-507 TO SR-512 STAGE 2

M.P. 47.94 TO M.P. 52.54

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

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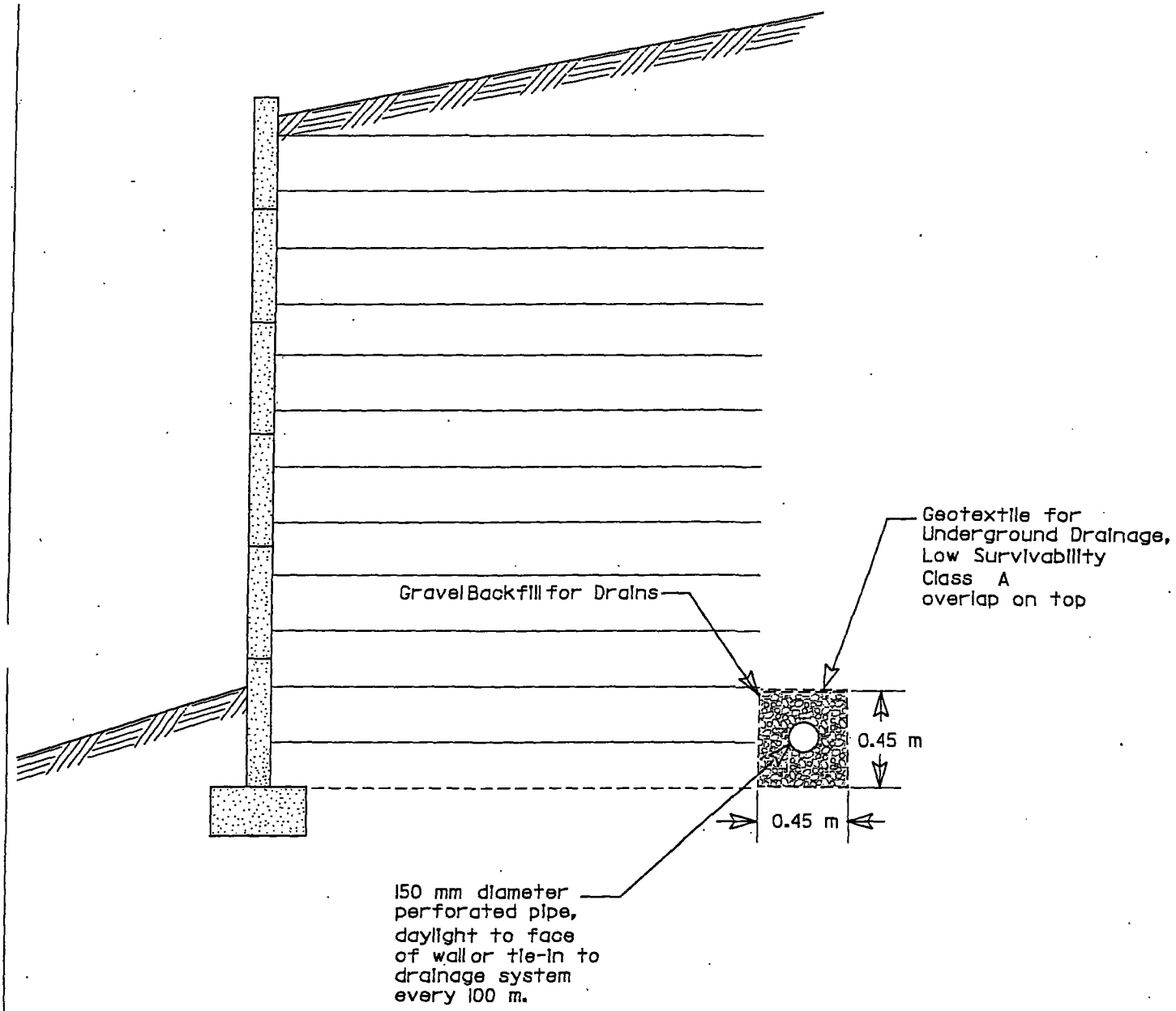

FIGURE 5: WALL DRAINAGE DETAIL

JOB DL-2740 S.R. 7

SR-507 TO SR-512 STAGE 2

M.P. 47.94 TO M.P. 52.54

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

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APPENDIX B

Test Hole Logs

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Washington State Department of Transportation

Test Boring Legend

Sampler Symbols

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

Well Symbols

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

Laboratory Testing Codes

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

Soil Density Modifiers

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

Angularity of Gravel & Cobbles

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

Soil Moisture Modifiers

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

Soil Structure

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

HCL Reaction

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

Degree of Vesicularity of Pyroclastic Rocks

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

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Washington State Department of Transportation

Test Boring Legend

Grain Size

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

Weathered State

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

Relative Rock Strength

Grade	Description	Field Identification	Uniaxial Compressive Strength approx
R1	Very Weak	Specimen crumbles under sharp blow from point of geological hammer, and can be cut with a pocket knife.	1 to 25 MPa
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.	25 to 50 MPa
R3	Moderately Strong	Specimen cannot be scraped or cut with a pocket knife, shallow indentation can be made under firm blows from a hammer.	50 to 100 MPa
R4	Strong	Specimen breaks with one firm blow from the hammer end of a geological hammer.	100 to 200 MPa
R5	Very Strong	Specimen requires many blows of a geological hammer to break intact sample.	Greater than 200 MPa

Discontinuities

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

RQD (%)

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

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

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

Washington State Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-1-98

Sheet 1 of 2

Job No. 0L-2740 SR 7 Elevation 351.3 ft (107.1 m)

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Site Address

Inspector Cleo Andrews

Start May 28, 1998 Completion May 28, 1998 Well ID#

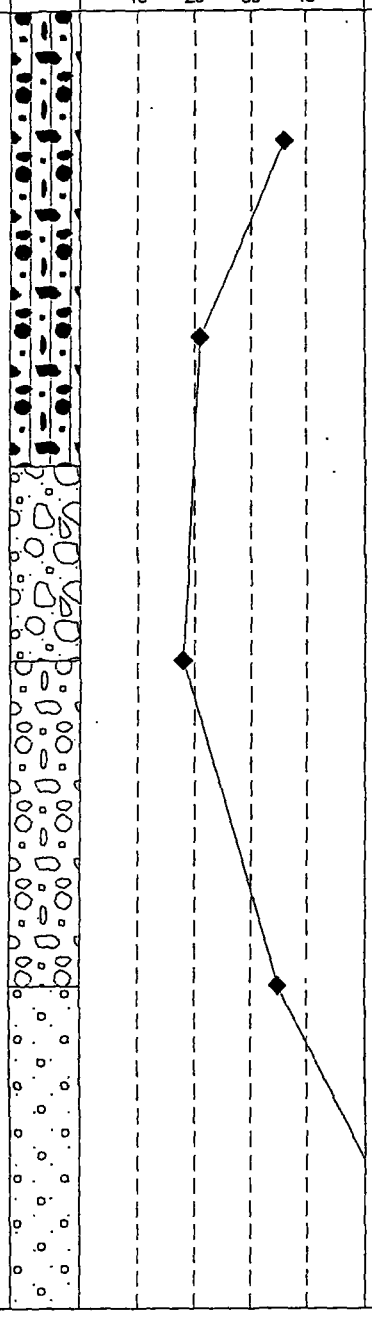
Equipment CME-55/Auto Hammer

Station 80+985 Offset 21.9m Lt. Casing HQ:21'(6.4m)

Method Wet Rotary

Northing Easting Latitude Longitude

County Pierce Subsection SE 1/4, SW 1/4 Section 16 Range 3 EWM Township 19N



Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
						1 ft. = 0.3048m Top surface: 3"(75mm) asphalt parking lot. 0.2' to 2.0': Well graded GRAVEL.		
	1	16 23 13 12 (36		D-1	MC GS	GW, M.C. = 5% Well graded GRAVEL with sand, subrounded to subangular, dense, dark yellowish brown, wet. Recovered and Retained: 0.8 ft.(240mm)		
5	2	10 10 11 15 (21		D-2		Well graded GRAVEL, subrounded to subangular, medium dense, dark yellowish brown, wet. Recovered and Retained: 0.2 ft.(50mm)		
						Note: Encountered some cobbles at a depth of 7.5 ft. (2.3m) Material change at depth of 7.5 ft. (2.3m).		
10	3	10 9 9 21 (18)		D-3		Well graded GRAVEL with cobbles, subrounded to angular, medium dense, dark yellowish brown, wet. Recovered and Retained: 0.3 ft.(120mm)		
15	4 5	10 15 20 16 (35		D-4		Well graded GRAVEL, angular to subangular, dense, dark yellowish brown, wet. Recovered and Retained: 0.5 ft.(150mm)		
20	6							

SOIL 0L-2740 SR 507 TO SR 512 SAFETY IMPROVEMENTS.GPJ SOIL.GDT 3/19/04 10:50:57 A3

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-1-98

Job No. 0L-2740 SR 7 Elevation 351.3 ft (107.1 m)

Sheet 2 of 2

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				43 63 (63/6")		D-5	MC GS	SM, M.C. = 10% Silty SAND with gravel, very dense, dark yellowish brown, moist, traces of of dark reddish brown oxidized staining (advance outwash till). Recovered and Retained: 0.8 ft.(240mm)		
								End of the Test Hole Boring at 21.0 ft. (6.4m) below ground elevation.		
	7							Water Table Elevation: Dry hole, not determined.		
25								This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	8									
	9									
30										
	10									
35										
	11									
	12									
40										
	13									
45										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-2-98

Sheet 1 of 2

Job No. 0L-2740 SR 7 Elevation 352.5 ft (107.4 m)

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Site Address

Inspector Cleo Andrews

Start June 3, 1998 Completion June 3, 1998 Well ID#

Equipment CME-55/Auto Hammer

Station 81+025 Offset 20.0m Lt. Casing HQ:25.0'(7.6m)

Method Wet Rotary

Northing Easting Latitude Longitude

County Pierce Subsection SE 1/4, SW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top surface: weeds and grass. 0.0' to 2.0': Silty GRAVEL with cobbles and sand as indicated by drilling.		
	1			5 7 7 6 (14)		D-1		Well graded GRAVEL with cobbles, subrounded to angular, medium dense, dark yellowish brown, moist, traces of silt and root hairs. Recovered and Retained: 0.1 ft.(25mm)		
5	2		>>	45 87 (87/6")		D-2	MC GS	GW, M.C. = 4% Well graded GRAVEL with cobbles, subrounded to angular, very dense, dark yellowish brown, moist. Recovered and Retained: 1.0 ft.(300mm)		
10	3			19 21 16 8 (37)		D-3		Well graded GRAVEL with cobbles, boulders and sand, subrounded to subangular, dense, dark yellowish brown, wet. Recovered and Retained: 1.0 ft.(300mm)		
15	4			10 22 15 30 (37		D-4	MC GS	GW, M.C. = 8% Well graded GRAVEL with cobbles, boulders and sand, subrounded to subangular, dense, dark yellowish brown, wet. Recovered and Retained: 1.0 ft.(300mm)		
20	5 6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-2-98

Job No. 0L-2740 SR 7 Elevation 352.5 ft (107.4 m)

Sheet 2 of 2

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
			>>	21 100 (100/6")		D-5		Silty SAND with gravel, very dense, dark yellowish brown, moist, (advanced outwash till) Recovered and Retained: 0.8 ft.(240mm)		
25	7		>>	100/6" (100/6")		D-6		Silty SAND with gravel, very dense, dark yellowish brown, moist, (advanced outwash till) Recovered and Retained: 0.3 ft.(100mm)		
30	8							End of the Test Hole Boring at 25.3 ft. (7.7m) below ground elevation.		
35	9							Water Table Elevation: dry hole, not determined.		
40	10							This is a Summary log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
45	11									
	12									
	13									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-3-98

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 311.2 ft (94.9 m)

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Site Address

Inspector Cleo Andrews

Start May 27, 1998 Completion May 27, 1998 Well ID#

Equipment CME-55/Auto Hammer

Station 81+103 Offset 21.9m Lt. Casing HQ:17'(5.2m)

Method Wet Rotary

Northing Easting Latitude Longitude

County Pierce Subsection SE 1/4, SW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top surface: 3"(75mm) asphalt parking lot		
	1			4 4 7 11 (11)		D-1	MC GS	GP-GM, M.C. = 14% Poorly graded GRAVEL with silt and sand, subrounded to subangular, medium dense, moderate yellowish brown, moist, traces of organics. Recovered and Retained: 1.0 ft.(300mm)		
5	2			8 10 20 31 (30)		D-2		Well graded GRAVEL with sand, subrounded to subangular, dense, moderate yellowish brown, moist, traces of silt and dark reddish brown oxidized staining. Recovered and Retained: 1.0 ft.(300mm)		
								Note: Started drilling harder at depth of 8 ft. (2.4m)		
10	3			9 22 23 22 (45)		D-3	MC GS	GW-GM, M.C. = 6% Well graded GRAVEL with silt and sand, subrounded to subangular, dense, moderate yellowish brown, moist. Recovered and Retained: 0.9 ft.(275mm)		
15	4		>>	20 30 31 36 (61		D-4		Well graded GRAVEL with silt and sand, subrounded to subangular, very dense, moderate yellowish brown, moist. Recovered and Retained: 0.9 ft.(275mm)		
	5							End of the Test Hole Boring at 17 ft. (5.2m) 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 and laboratory test data.		
20	6									

SOIL 0L-2740 SR 507 TO SR 512 SAFETY IMPROVEMENTS.GPJ SOIL.GDT 3/19/04 10:51:04 A3

Washington State Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-4-98

Job No. 0L-2740 SR 7 Elevation 316.0 ft (96.3 m)

Sheet 1 of 1

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Site Address

Inspector Cleo Andrews

Start June 2, 1998 Completion June 2, 1998 Well ID#

Equipment CME-55/Auto Hammer

Station 82+950 Offset 10.4m Lt. Casing HQ:15.0'(4.6m)

Method Wet Rotary

Northing Easting Latitude Longitude

County Pierce Subsection SE 1/4, SW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top Surface: 4"(100mm) thick asphalt shoulder 0.3' to 2.0': GRAVEL with sand.		
	1			7 8 16 10 (24)		D-1		Well graded GRAVEL with sand, angular to subangular, medium dense, dusky brown, moist (fill). Recovered and Retained: 1.0 ft.(300mm)		
5	2			4 6 4 2 (10)		D-2		6/2/98 Well graded GRAVEL with silt and sand, angular to subrounded, loose, dark yellowish brown, wet, homogeneous. Recovered and Retained: 0.4 ft.(120mm) Note: 100% drilling fluid loss down hole.	▽	
10	3			7 11 13 9 (24)		D-3		Well graded GRAVEL with silt and sand, subrounded to angular, medium dense, dark yellowish brown, wet, homogeneous. Recovered and Retained: 1.0 ft.(300mm) Note: Started drilling harder at depth of 12.5 ft. (3.8m) Possible cobbles as indicated by drilling.		
15	4 5			9 9 9 8 (18)		D-4		Well graded GRAVEL with silt and sand, subrounded to angular, medium dense, dark yellowish brown, wet, homogeneous. Recovered and Retained: 1.0 ft.(300mm)		
20	6							End of the Test Hole Boring at 17.0 ft. (5.2m) below ground elevation. Water Table Elevation: 311.0'(94.8m) This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-5-98

Job No. 0L-2740 SR 7 Elevation 348.6 ft (106.3 m)

Sheet 1 of 1

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Site Address

Inspector Cleo Andrews

Start May 26, 1998 Completion May 26, 1998 Well ID#

Equipment CME-55/Auto Hammer

Station 83+753 Offset 13.7m Lt. Casing HQ:16.5'(5.0m)

Method Wet Rotary

Northing Easting Latitude Longitude

County Pierce Subsection SE 1/4, SW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top Surface: 3"(75mm) asphalt parking lot. 0.2' to 5.0': Silty SAND with gravel.		
5	1			3 3 5 5 (8)		D-1	MC GS	SM, M.C. = 16% Silty SAND with gravel, subrounded, loose, moderate yellowish brown, moist. Recovered and Retained: 1.0 ft.(300mm)		
10	2			5 7 9 12 (16)		D-2	MC GS	SM, M.C. = 17% Silty SAND with gravel, subrounded to angular, medium dense, dark yellowish brown, moist, 3" of fine sand in end of sampler. Recovered and Retained: 1.0 ft.(300mm)		
	3							Note: Started drilling harder at depth of 12.5 ft. (3.8m). Some cobbles encountered as indicated by drilling.		
15	4		>>	11 41 50/5"		D-3	MC GS	SP, M.C. = 8% Poorly graded GRAVEL with sand, subrounded to angular, very dense, dark yellowish brown, moist. Recovered and Retained: 1.0 ft.(300mm)		
20	5 6							End of the Test Hole Boring at 17.0 ft (5.2m) below ground elevation. Water Table Elevation: dry hole, not determined. This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-6-98

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 358.8 ft (109.4 m)

Project SR-507 to SR-512 Safety Improvements Driller Steve Kreger Lic# 2274

Site Address Inspector Cleo Andrews

Start June 4, 1998 Completion June 4, 1998 Well ID# Equipment Port. Penetrometer

Station 83+740 Offset 14.9m Rt. Casing Method

Northing Easting Latitude Longitude

County Pierce Subsection SE 1/4, SW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top Surface: Landscaped 2:1 slope by Pediatrics office.		
				50/6" (25/6")		D-1	MC GS	SM, M.C. = 6% Silty GRAVEL with sand with fibrous organic material, subrounded to angular, very dense, dark yellowish brown, moist, traces of root hairs (advanced outwash till). Recovered and Retained: 1.0 ft.(300mm)		
	1			50/6" (25/6")		D-2		SAME AS ABOVE		
5				50/6" (25/6")		D-3		SAME AS ABOVE		
	2							End of the Test Hole Boring at 6.5 ft. (2.0m) below ground elevation.		
								Water Table Elevation: dry hole, not determined.		
10	3							The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
	4							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
15	5									
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-7-98

Sheet 1 of 2

Job No. 0L-2740 SR 7 Elevation 358.6 ft (109.3 m)

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Site Address

Inspector Cleo Andrews

Start June 1, 1998 Completion June 1, 1998 Well ID#

Equipment CME-55/Auto Hammer

Station 83+800 Offset 11.1m Lt. Casing HQ:22'(6.7m)

Method Wet Rotary

Northing Easting Latitude Longitude

County Pierce Subsection SE 1/4, SW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top Surface: Shoulder, 1.0 ft. of asphalt.		
								1.0' to 2.0': Silty SAND with gravel.		
	1			5 4 4 2 (8)		D-1		Silty SAND with gravel, loose, dark yellowish brown, moist (fill). Recovered and Retained: 0.5 ft.(150mm)		
5	2			3 2 2 1 (4)		D-2		Silty GRAVEL with sand, subrounded to angular, very loose, dark yellowish brown, wet. Recovered and Retained: 0.5 ft.(150mm)		
10	3			1/12" 1/12" (1)		D-3		6/1/98 Note: Casing sank 2.0 ft. (0.6m) under own weight from depth of 10.0 ft.(3.0m) to 12.0 ft.(3.7m), possible void 70% drilling loss. Well graded GRAVEL with silt and sand, subrounded to angular, very loose, dark yellowish brown, wet, traces of organics and small pieces of wood fiber. Possible void or decayed log from depth of 10.0 ft. to 12.0 ft. Recovered and Retained: 0.2 ft.(50mm)		
15	4 5			8 7 9 35 (16)		D-4		15.0'to 16.5': Well graded GRAVEL with silt and sand, subrounded to angular, medium dense, moderate yellowish brown, wet, traces of very dark reddish brown oxidized stains. 16.5' to 17.0': Silty SAND with gravel, medium dense, olive gray, moist, traces of very dark reddish brown oxidized stains (advanced outwash). Recovered and Retained: 1.5 ft.(460mm)		
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-7-98

Job No. 0L-2740 SR 7 Elevation 358.6 ft (109.3 m)

Sheet 2 of 2

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				33 50/5 (50/5")		D-5	MC GS	SM, M.C. = 11% Silty SAND with gravel, very dense, dark yellowish brown, moist (advanced outwash till). Recovered and Retained: 0.9 ft.(275mm)		
								End of the Test Hole Boring at 20.9 ft. (6.4m) below ground elevation.		
	7							Water Table Elevation: 348.6 ft. (106.2m)		
25								This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	8									
	9									
30										
	10									
35										
	11									
	12									
40										
	13									
45										

Washington State Department of Transportation

LOG OF TEST BORING

Start Card A-31212

HOLE No. H-8-98

Sheet 1 of 1

Job No. OL-2740 SR 7 Elevation 368.8 ft (112.4 m)

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Site Address

Inspector Cleo Andrews

Start May 27, 1998 Completion May 27, 1998 Well ID#

Equipment CME-55/Auto Hammer

Station 83+829 Offset 17.0m Rt. Casing HQ:16'(4.9m)

Method Wet Rotary

Northing Easting Latitude Longitude

County Pierce Subsection SE 1/4, SW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top Surface: 3" Asphalt parking lot. 0.2' to 2.0': Well graded GRAVEL with silt and sand.		
	1			2 3 11 19 (14)		D-1		Silty SAND with gravel, medium dense, moderate yellowish brown, moist, traces of organics. Recovered and Retained: 1.0 ft.(300mm)		
5	2			7 13 18 33 (31)		D-2		Silty SAND with gravel, dense, moderate yellowish brown, moist, traces of of dark yellowish orange oxidized staining. Recovered 1.5 ft.(460mm) and Retained: 1.0 ft.(300mm) Note: Started drilling harder at depth of 7.0 ft. (2.1m)		
10	3			31 50/4 (50/4")		D-3		Silty SAND with gravel, very dense, dark yellowish brown, moist (outwash till). Recovered and Retained: 0.5 ft.(150mm)		
15	4			32 50/5 (50/5")		D-4		Silty SAND with gravel, very dense, dark yellowish brown, moist (outwash till). Recovered and Retained: 0.9 ft.(275mm)		
	5							End of the Test Hole Boring at 15.9 ft. (4.8m) below ground elevation. Water Table Elevation: dry hole, not determined. This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-9-98

Sheet 1 of 2

Job No. 0L-2740 SR 7 Elevation 367.3 ft (112.0 m)

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Site Address

Inspector Cleo Andrews

Start June 1, 1998 Completion June 1, 1998 Well ID#

Equipment CME-55/Auto Hammer

Station 83+880 Offset 11.0m Lt. Casing HQ:21'(6.4m)

Method Wet Rotary

Northing Easting Latitude Longitude

County Pierce Subsection SE 1/4, SW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top Surface: Asphalt 1.0' thick		
								Silty GRAVEL with sand.		
	1			6 11 8 4 (19)		D-1		Well graded GRAVEL with silt and sand, subrounded to subangular, medium dense, dusky brown, moist, homogeneous (fill). Recovered and Retained: 0.4 ft. (120mm)		
5				1 1 1 1 (2)		D-2		Poorly graded GRAVEL with silt and sand, subrounded to angular, very loose, dusky brown, moist, traces of small chunks of wood debris and clay. Recovered and Retained: 0.4 ft. (120mm)		
10	3			2 2 1 4 (3)		D-3	MC GS	GP, M.C. = 3% Poorly graded GRAVEL, subangular to angular, very loose, dusky brown, wet, homogeneous. Recovered and Retained: 0.2 ft.(50mm)	6/1/98	
	4							Note: Started drilling harder at depth of 13.0 ft. (4.0m).		
15	5		>>	16 22 30 42 (52		D-4	MC GS	SM, M.C. = 11% Silty SAND, very dense, dark yellowish brown, moist, homogeneous (advanced outwash till). Recovered 1.5 ft.(460mm) and Retained: 1.0 ft.(300mm)		
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-9-98

Job No. 0L-2740 SR 7 Elevation 367.3 ft (112.0 m)

Sheet 2 of 2

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				33 50/5 (50/5")		D-5		Silty SAND with gravel, very dense, dark yellowish brown, moist (advanced outwash till). Recovered and Retained: 0.9 ft.(275mm).		
								End of the Test Hole Boring at 20.9 ft. (6.4m) below ground elevation.		
	7							Water Table Elevation: 357.3 ft.(108.9m)		
25								This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	8									
	9									
30										
	10									
35										
	11									
	12									
40										
	13									
45										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card A-31211

HOLE No. H-10-98

Job No. 0L-2740 SR 7 Elevation 331.2 ft (100.9 m)

Sheet 1 of 1

Project SR-507 to SR-512 Safety Improvements

Driller Steve Kreger Lic# 2274

Site Address

Inspector Cleo Andrews

Start June 4, 1998 Completion June 4, 1998 Well ID#

Equipment Port. Penetrometer

Station 83+020 Offset 15m Lt. Casing AW-Roads:8.9 ft.(2.7m)

Method

Northing Easting Latitude Longitude

County Pierce Subsection SE 1/4, SW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top Surface: Yard with a retaining wall		
				10 10 15 (13)		D-1	MC GS	SP-SM, M.C. = 13% Silty GRAVEL with silt, sand and fibrous organic material, subrounded to angular, dense, dusky brown to light brown, moist, traces of root hairs. Recovered and Retained: 1.0 ft.(300mm)		
	1			5 10 7 (9)		D-2	MC GS	GW, M.C. = 4% Well graded GRAVEL with sand, subrounded to angular, medium dense, moderate yellowish brown, moist, traces of silt and root hairs. Recovered and Retained: 1.0 ft.(300mm)		
5				12 15 13 (14)		D-3		Well graded GRAVEL with sand and fibrous organic material, subrounded to angular, dense, dark yellowish brown, moist. Recovered and Retained: 1.0 ft.(300mm)		
	2			24 50/3 (25/3")		D-4		Well graded GRAVEL with sand and fibrous organic material, very dense, moist (outwash till). Recovered and Retained: 1.0 ft.(300mm)		
10	3							End of the Test Hole Boring at 8.9 ft. (2.7m) below ground elevation.		
								Water Table Elevation: Dry hole, not determined.		
	4							The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
15								This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	5									
	6									
20										

SOIL 0L-2740 SR 507 TO SR 512 SAFETY IMPROVEMENTS.GPJ SOIL.GDT 3/19/04,10:50:56 A3

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card _____

HOLE No. P-1-98

Sheet 1 of 1

Job No. OL-2740 SR 7 Elevation 376.0 ft (114.6 m)

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address _____

Inspector Mildford Sanders

Start March 12, 1998 Completion March 12, 1998 Well ID# _____

Equipment Port. Penetrometer

Station 84+016 Offset 15m Lt. Casing _____

Method Hand Tools

Northing _____ Easting _____ Latitude _____ Longitude _____

County Pierce Subsection NE 1/4, NW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				12 20 14 9 (17)		PP-1		1 ft. = 0.3048m Silty GRAVEL, medium dense, brown, moist.		
				5 5 10 12 (5)		PP-2		Sandy SILT with gravel, medium stiff, brown, moist.		
5	1			21 24 29 (18)		PP-3		Sandy SILT with gravel, very stiff, brown, moist.		
10	2							End of the Test Hole Boring at 5.5 ft. (1.7m) below ground elevation. Water Table Elevation: Not determined. * The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience. This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
15	3									
20	4									
	5									
	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card _____

HOLE No. P-2-98

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 361.9 ft (110.3 m)

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address _____

Inspector Mildford Sanders

Start March 12, 1998 Completion March 12, 1998 Well ID# _____

Equipment Port. Penetrometer

Station 83+888 Offset 15m Lt. Casing _____

Method Hand Tools

Northing _____ Easting _____ Latitude _____ Longitude _____

County Pierce Subsection NW 1/4, NE 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Silty GRAVEL with sand, gray moist.		
								3/12/98	▽	
	1		◆	22 20 9 9 (15)		PP-1		Silty GRAVEL with sand, medium dense, gray, wet.		
5								End of the Test Hole Boring at 5.0 ft. (1.5m) below ground elevation.		
	2							* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
								Water Table Elevation: 359.9'(109.6m)		
10	3							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15										
	5									
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card _____

HOLE No. P-3-98

Job No. OL-2740 SR 7 Elevation 352.0 ft (107.3 m)

Sheet 1 of 1

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address _____

Inspector Mildford Sanders

Start March 12, 1998 Completion March 12, 1998 Well ID# _____

Equipment Port. Penetrometer

Station 83+790 Offset 15m Lt. Casing _____

Method Hand Tools

Northing _____ Easting _____ Latitude _____ Longitude _____

County Pierce Subsection SE 1/4, NW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Silty GRAVEL with pieces of concrete and asphalt concrete pavement, brown, moist.		
	1		◆	14 21 15 12 (18		PP-1		Silty GRAVEL with pieces of concrete and asphalt concrete pavement, medium dense, brown, moist.		
5	2							End of the Test Hole Boring at 4.5 ft. (1.4m) below ground elevation. * The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience. Water Table Elevation: Not determined. This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
10	3									
	4									
15	5									
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card _____

HOLE No. P-4-98

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 346.6 ft (105.6 m)

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address _____

Inspector Mildford Sanders

Start March 12, 1998 Completion March 12, 1998 Well ID# _____

Equipment Port. Penetrometer

Station 83+744 Offset 15m Lt. Casing _____

Method Hand Tools

Northing _____ Easting _____ Latitude _____ Longitude _____

County Pierce Subsection SE 1/4, NW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m		
				12 13 18 23 (16		PP-1		Silty GRAVEL with sand, medium dense, brown, moist.		
	1							End of the Test Hole Boring at 3.0 ft. (0.9m) below ground elevation.		
5								* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
	2							Water Table Elevation: Not determined.		
10	3							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15	5									
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card _____

HOLE No. P-5-98

Job No. OL-2740 SR 7 Elevation 342.4 ft (104.4 m)

Sheet 1 of 1

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address _____

Inspector Mildford Sanders

Start March 12, 1998 Completion March 12, 1998 Well ID# _____

Equipment Port. Penetrometer

Station 83+689 Offset 15m Lt. Casing _____

Method Hand Tools

Northing _____ Easting _____ Latitude _____ Longitude _____

County Pierce Subsection SE 1/4, NW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m		
				18 27 35 42 (31		PP-1		Silty GRAVEL with sand, dense, brown, moist.		
	1							End of the Test Hole Boring at 3.0 ft. (0.9) below ground elevation.		
5								* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
	2							Water Table Elevation: Not determined.		
10	3							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15										
	5									
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card _____

HOLE No. P-6-98

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 339.7 ft (103.5 m)

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address _____

Inspector Mildford Sanders

Start March 12, 1998 Completion March 12, 1998 Well ID# _____ Equipment Port. Penetrometer

Station 83+632 Offset 15m Lt. Casing _____ Method Hand Tools

Northing _____ Easting _____ Latitude _____ Longitude _____

County Pierce Subsection SE 1/4, NW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Silty GRAVEL with sand, brown, moist.		
				5 7 9 10 (5)		PP-1		SILT, medium stiff, brown, moist.		
	1			19 63 (27/6")		PP-2		SILT, very stiff, brown, moist.		
5								End of the Test Hole Boring at 5 ft. (1.5m) below ground elevation.		
	2							* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
								Water Table Elevation: Not determined.		
10	3							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15										
	5									
	6									
20										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card _____

HOLE No. P-7-98

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 312.7 ft (95.3 m)

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic#: 2399

Site Address _____

Inspector Mildford Sanders

Start March 12, 1998 Completion March 12, 1998 Well ID# _____

Equipment Port. Penetrometer

Station 82+968 Offset 15m Lt. Casing _____

Method Hand Tools

Northing _____ Easting _____ Latitude _____ Longitude _____

County Pierce Subsection SE 1/4, SW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Silty GRAVEL with sand, black, moist.		
	1		◆	12 13 15 18 (14		PP-1		Silty GRAVEL with sand, medium dense, black moist.		
5	2							End of the Test Hole Boring at 4.0 ft. (1.2m) below ground elevation. * The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience. Water Table Elevation: Not determined.		
10	3							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
15	4									
20	5									
	6									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card _____

HOLE No. P-8-98

Job No. 0L-2740 SR 7 Elevation 324.5 ft (98.9 m)

Sheet 1 of 1

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address _____

Inspector Mildford Sanders

Start March 12, 1998 Completion March 12, 1998 Well ID# _____

Equipment Port. Penetrometer

Station 81+072 Offset 15m Lt. Casing _____

Method Hand Tools

Northing _____ Easting _____ Latitude _____ Longitude _____

County Pierce Subsection SE 1/4, SW 1/4 Section 16 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Silty GRAVEL with sand, brown, moist.		
	1									
5				6 12 23 31 (18)		PP-1		Silty GRAVEL with sand, medium dense, brown, moist.		
	2							End of the Test Hole Boring at 6.0 ft. (1.8m) below ground elevation.		
								* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
10	3							Water Table Elevation: Not determined.		
								This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15										
	5									
20	6									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card _____

HOLE No. P-9-98

Job No. 0L-2740 SR 7 Elevation 314.3 ft (95.8 m)

Sheet 1 of 1

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address _____

Inspector Mildford Sanders

Start March 16, 1998 Completion March 16, 1998 Well ID# _____

Equipment Port. Penetrometer

Station 81+145 Offset 15m Rt. Casing _____

Method Hand Tools

Northing _____ Easting _____ Latitude _____ Longitude _____

County Pierce Subsection SE 1/4, SW 1/4 Section 16 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				4 12 11 (12) 12 8 7 4 (8)		PP-1 PP-2		1 ft. = 0.3048m Poorly graded GRAVEL with sand and silt, medium dense, dark brown, moist. Poorly graded GRAVEL with sand and silt, loose, dark brown, moist.		
	1							End of the Test Hole Boring at 3.5 ft. (1.1m) below ground elevation.		
5								* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
	2							Water Table Elevation: Not determined.		
10	3							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15	5									
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card _____

HOLE No. P-10-98

Job No. 0L-2740 SR 7 Elevation 312.8 ft (95.3 m)

Sheet 1 of 1

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address _____

Inspector Mildford Sanders

Start March 16, 1998 Completion March 16, 1998 Well ID# _____

Equipment CME-55/Auto Hammer

Station 82+962 Offset 15m Rt. Casing _____

Method _____

Northing _____ Easting _____ Latitude _____ Longitude _____

County Pierce Subsection SE 1/4, SW 1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Silty GRAVEL with sand, brown, moist.		
	1		◆	26 16 15 15 (16		PP-1		Poorly graded GRAVEL with sand and silt, medium dense, brown, moist.		
5	2							End of the Test Hole Boring at 4.0 ft. (1.2m) below ground elevation. * The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience. Water Table Elevation: Not determined.		
10	3							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
15	4									
	5									
20	6									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S 04693

HOLE No. H-1-99

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 301.8 ft (92.0 m)

Project SR-507 to SR-512 Safety Improvements Driller Dan Reed Lic# 2399

Site Address Tule Lake Rd. Traffic Signal Foundation Inspector M. Mulhern

Start July 12, 1999 Completion July 12, 1999 Well ID# Equipment CME 850

Station 82+495 Offset 12m Rt. Casing Method Auger

Northing 302579.45 Easting 453299.593 Latitude Longitude

County Pierce Subsection SE 1/4, NW 1/4 Section 16 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								6"-ASPHALT		
				5 5 6 8 (11)		D-1		SAND with gravel, dense, weak red, moist, homogeneous. Recovered and Retained: 1.0 ft.		
	1			10 12 14 15 (26)		D-2		SAND with gravel, dense, weak red, moist, homogeneous. Recovered and Retained: 1.0 ft.		
5				8 13 13 13 (26)		D-3		SAND with gravel, dense, weak red, moist, homogeneous. Recovered and Retained: 0.1 ft.		
	2			5 6 7 13 (13)		D-4		GRAVEL with sand, subangular, medium dense, dark reddish/brown, moist, homogeneous. Recovered and Retained: 0.9 ft.		
10	3			13 12 15 16 (27)		D-5		GRAVEL with sand, subangular, dense, dark reddish/brown, wet, homogeneous. Recovered and Retained: 1.3 ft.	▽	
	4			12 21 24 27 (45)		D-6		GRAVEL with sand, subangular, dense, dark reddish/brown, wet, homogeneous. Recovered and Retained: 0.1 ft.		
15	5			14 17 14 14 (32)		D-7		GRAVEL with sand, subangular, dense, dark reddish/brown, wet, homogeneous. Recovered and Retained: 1.5 ft.		
								End of Test Hole Boring at 17 feet below ground elevation.		
								This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S 04693

HOLE No. H-2-99

Job No. 0L-2740 SR 7 Elevation 371.1 ft (113.1 m)

Sheet 1 of 1

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address 166th St. South Traffic Signal Foundation

Inspector M. Mulhern

Start July 13, 1999 Completion July 13, 1999 Well ID# Equipment CME 850

Station 78+845 Offset 10.5m Rt. Casing Method Auger

Northing 298931.235 Easting 453191.889 Latitude Longitude

County Pierce Subsection SE 1/4, NW 1/4 Section 16 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								6" - Asphalt		
				5 5 6 9 (11)		D-1		SAND with gravel, medium dense, dark gray, moist, homogeneous. Recovered and Retained: 0.2 ft.		
	1			16 24 16 17 (40)		D-2		GRAVEL with sand, subangular, dense, gray, dry, homogeneous (till). Recovered and Retained: 0.2 ft.		
5				5 6 5 6 (11)		D-3		SAND with gravel, medium dense, dark gray, moist, homogeneous. Recovered and Retained: 0.3 ft.		
	2			10 12 12 20 (24)		D-4		GRAVEL with cobble, subangular, medium dense, dark greenish/gray, moist, homogeneous. Recovered and Retained: 0.1 ft.		
10	3			20 27 16 31 (43)		D-5		SAND with gravel, dense, dark gray, moist, homogeneous. Recovered and Retained: 0.2 ft.		
	4			34 13 16 25 (29)		D-6		SAND with gravel, dense, dark reddish/gray, moist, homogeneous. Recovered and Retained: 1.0 ft.		
15	5			11 11 11 15 (22)		D-7		SAND with gravel, medium dense, dark reddish/gray, moist, homogeneous. Recovered and Retained: 1.3 ft.		
								End of Test Hole Boring at 17 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S 04693

HOLE No. H-3-99

Sheet 1 of 1

Job No. OL-2740 SR 7 Elevation 364.6 ft (111.1 m)

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address 162nd St. South Traffic Signal Foundation

Inspector M. Mulhern

Start July 13, 1999 Completion July 13, 1999 Well ID# Equipment CME 850

Station 79+187 Offset 10m Rt. Casing Method Auger

Northing 299273.058 Easting 453202.891 Latitude Longitude

County Pierce Subsection SE 1/4, NW 1/4 Section 16 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								6" - Asphalt		
				4 2 5 7 (7)		D-1		SAND with gravel, loose, dark red/gray, moist, homogeneous. Recovered and Retained: 1.0 ft.		
	1			5 8 9 16 (17)		D-2		SAND with gravel, medium dense, dark red/gray, moist, homogeneous. Recovered and Retained: 1.0 ft.		
5				17 15 25 20 (40)		D-3		SAND with gravel, dense, dark red/brown, moist, homogeneous. Recovered and Retained: 1.0 ft.		
	2			56 20 12 36 (32)		D-4		SAND with gravel, dense, dark red/brown, moist, homogeneous. Recovered and Retained: 0.9 ft.		
10	3							End of Test Hole Boring at 9.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15										
	5									
	6									
20										

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S 04693

HOLE No. H-4-99

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 355.9 ft (108.5 m)

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address 159th St. South Traffic Signal Foundation

Inspector M. Mulhern

Start July 14, 1999 Completion July 14, 1999 Well ID# Equipment CME 850

Station 79+490 Offset 10m Rt. Casing Method Auger

Northing 299576.123 Easting 453211.502 Latitude Longitude

County Pierce Subsection SE 1/4, NW 1/4 Section 16 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								6" - Asphalt		
				14 8 7 9 (15)		D-1		SAND, medium dense, dark gray, moist, homogeneous. Recovered and Retained: 0.7 ft.		
	1			6 9 11 32 (20)		D-2		SAND with gravel, medium dense, reddish black, moist, homogeneous. Recovered and Retained: 0.7 ft.		
5				6 16 19 24 (35)		D-3		SAND with gravel, dense, very dark brown, moist, homogeneous. Recovered and Retained: 1.3 ft.		
	2		>>	60 29 22 23 (51)		D-4		SAND with gravel, very dense, dark reddish gray, moist, homogeneous. Recovered and Retained: 1.0 ft.		
10	3			14 7 6 10 (13)		D-5		SAND with gravel, medium dense, dark brownish gray, moist, homogeneous. Recovered and Retained: 1.5 ft.		
	4			12 13 20 14 (33)		D-6		SAND with gravel, dense, dark brownish gray, moist, homogeneous. Recovered and Retained: 0.5 ft.		
15	5							End of Test Hole Boring at 14.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S 04693

HOLE No. H-5-99

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 352.5 ft (107.4 m)

Project SR-507 to SR-512 Safety Improvements Driller Dan Reed Lic# 2399

Site Address Military Road Traffic Signal Foundation Inspector M. Mulhern

Start July 14, 1999 Completion July 14, 1999 Well ID# Equipment CME 850

Station 80+277 Offset 10m Rt. Casing Method Auger

Northing 300364.045 Easting 453222.556 Latitude Longitude

County Pierce Subsection SE 1/4, NW 1/4 Section 16 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								8" - Asphalt		
				4 8 8 8 (16)		D-1		SAND with gravel, medium dense, light olive brown to very dark gray, dry, stratified with organic soil.		
	1			9 10 10 11 (20)		D-2		SAND with gravel, medium dense, dark yellowish brown, dry to moist, homogeneous. Recovered and Retained: 0.9 ft.		
5	2			5 4 8 8 (12)		D-3		SAND with gravel, medium dense, dark gray, moist, homogeneous. Recovered and Retained: 0.3 ft.		
				13 17 9 11 (26)		D-4		SAND with gravel, dense, dark olive brown, moist, homogeneous. Recovered and Retained: 1.0 ft.		
10	3			8 13 14 8 (27)		D-5		SAND with gravel, dense, olive brown, moist, homogeneous. Recovered and Retained: 0.7 ft.		
	4			13 8 9 7 (17)		D-6		SAND with gravel, medium dense, light olive brown, moist, homogeneous. Recovered and Retained: 0.9 ft.		
15	5							End of Test Hole Boring at 14.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S 04694

HOLE No. H-6-99

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 311.6 ft (95.0 m)

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address 138th St. South Traffic Signal Foundation

Inspector M. Mulhern

Start July 15, 1999 Completion July 15, 1999 Well ID# Equipment CME 850

Station 81+619 Offset 10.5m Rt. Casing Method Auger

Northing 301703.947 Easting 453268.639 Latitude Longitude

County Pierce Subsection NE 1/4, NW 1/4 Section 28 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								6" - Asphalt		
				19 13 6 14 (19)		D-1		SAND with gravel, medium dense, dark brown, dry, stratified. Recovered and Retained: 1.2 ft.		
	1			5 19 11 20 (30)		D-2		SAND with gravel, dense, yellowish brown to very dark gray, dry to moist, stratified. Recovered and Retained: 1.0 ft.		
5				6 14 20 12 (34)		D-3		SAND with gravel, dense, yellowish brown to very dark gray brown, dry, stratified. Recovered and Retained: 1.0 ft.		
	2			5 8 26 18 (34)		D-4		SAND with gravel, dense, dark gray to dark grayish brown, dry to moist, stratified. Recovered and Retained: 0.4 ft.		
10	3			5 8 14 17 (22)		D-5		SAND with gravel, medium dense, dark olive brown, moist, homogeneous. Recovered and Retained: 0.3 ft. Cobble at 11 feet		
	4			7 9 14 14 (23)		D-6		GRAVEL with sand, subangular to subrounded, medium dense, olive brown, moist, homogeneous. Recovered and Retained: 1.0 ft.		
15	5							End of Test Hole Boring at 14.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S 04694

HOLE No. H-7-99

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 336.5 ft (102.6 m)

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address Garfield St. Traffic Signal Foundation

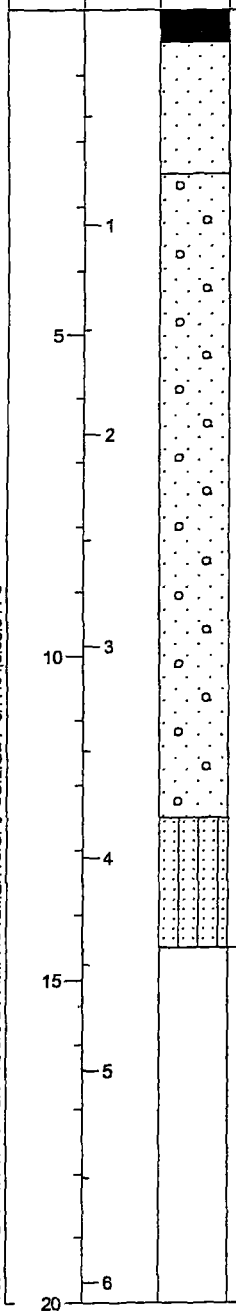
Inspector M. Mulhern

Start July 15, 1999 Completion July 15, 1999 Well ID# Equipment CME 850

Station 83+205 Offset 10m Rt. Casing Method Auger

Northing 303288.93 Easting 453325.094 Latitude Longitude

County Pierce Subsection NE 1/4, NW 1/4 Section 28 Range 3 EWM Township 19N



Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
						6" - Asphalt		
		6 8 7 4 (15)		D-1		SAND, medium dense, dark grayish brown to black, dry, stratified (4" organic). Recovered and Retained: 0.7 ft.		
	1	6 22 21 20 (43)		D-2		SAND with gravel, dense, dark gray brown to dark olive brown, dry to moist, stratified. Recovered and Retained: 0.5 ft.		
5		10 10 10 30 (20)		D-3		SAND with gravel, medium dense, dark olive gray to reddish brown, moist, stratified. Recovered and Retained: 0.5 ft. Cobble at 6 feet		
	2	6 4 11 25 (15)		D-4		SAND with gravel, medium dense, olive, moist, homogeneous. Recovered and Retained: 0.5 ft.		
10	3	27 20 23 23 (43)		D-5		SAND with gravel, dense, olive gray, moist to dry, stratified. Recovered and Retained: 1.0 ft.		
	4	14 14 29 50/5" (43)		D-6		Silty SAND, dense, olive gray, wet, homogeneous. Recovered and Retained: 1.0 ft.	▽	
15	5					End of Test Hole Boring at 14.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6							

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S 04695

HOLE No. H-8-99

Job No. 0L-2740 SR 7 Elevation 337.4 ft (102.8 m)

Sheet 1 of 1

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address 121 St. South Traffic Signal Foundation

Inspector M. Mulhern

Start July 16, 1999 Completion July 16, 1999 Well ID# Equipment CME 850

Station 83+398 Offset 11m Rt. Casing Method Auger

Northing 303481.735 Easting 453333.713 Latitude Longitude

County Pierce Subsection NE 1/4, SW 1/4 Section 21 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								6" - Asphalt		
				10 18 15 23 (33)		D-1		SAND with gravel, dense, olive brown to very dark gray brown, dry, stratified (6" organic). Recovered and Retained: 1.0 ft.		
			>>	37 42 33 30 (75)		D-2		SAND with gravel, very dense, light olive brown to dark gray, dry, stratified. Recovered and Retained: 0.5 ft.		
5	1			11 11 17 26 (28)		D-3		SAND with gravel, dense, light olive brown to olive gray, dry to moist, stratified. Recovered and Retained: 0.9 ft.		
	2							Cobble at 7 feet		
				10 13 11 12 (24)		D-4		SAND with gravel, medium dense, olive gray, moist, homogeneous. Recovered and Retained: 0.9 ft.		
10	3			13 11 32 38 (43)		D-5		SAND with gravel, dense, olive gray to olive, moist to dry, stratified. Recovered and Retained: 1.0 ft. Cobble at 11 feet		
	4			17 23 25 45 (48)		D-6		Silty SAND with gravel, dense, olive to olive gray, moist, stratified. Recovered: 1.7 ft. Retained: 1.0 ft.		
15	5							End of Test Hole Boring at 14.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card S 04695

HOLE No. H-9-99

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation ft (m)

Project SR-507 to SR-512 Safety Improvements

Driller Dan Reed Lic# 2399

Site Address 114th St. South Traffic Signal Foundation

Inspector M. Mulhern

Start July 16, 1999 Completion July 16, 1999 Well ID# Equipment CME 850

Station 83+998 Offset 16m Rt. Casing Method Auger

Northing 304081.062 Easting 453362.555 Latitude Longitude

County Pierce Subsection NE 1/4, SW1/4 Section 21 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								6" - Asphalt		
				5 5 4 6 (9)		D-1		SAND with gravel, loose, dark grayish brown, dry, homogeneous. Recovered and Retained: 0.1 ft.		
	1			2 5 5 5 (10)		D-2		Clayey SAND, loose, grayish brown, dry, homogeneous. Recovered: 1.5 ft. Retained: 1.0 ft.		
5	2			2 4 7 11 (11)		D-3		Clayey SAND, medium dense, grayish brown, dry, homogeneous. Recovered: 2.0 ft. Retained: 1.0 ft.		
				3 9 13 21 (22)		D-4		SILT, medium dense, gray, dry, homogeneous. Recovered: 2.0 ft. Retained: 1.0 ft.		
10	3			8 13 16 14 (29)		D-5		SILT, dense, gray to dark yellowish brown, moist, laminated. Recovered: 2.0 ft. Retained: 1.0 ft.		
	4			5 8 13 25 (21)		D-6		Silty SAND with gravel, medium dense, gray, moist to wet, stratified. Recovered: 2.0 ft. Retained: 1.0 ft.	▽	
15	5							End of Test Hole Boring at 14.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card R-62168

HOLE No. H-1A-04

Sheet 1 of 1

Job No. OL-2740 SR 7 Elevation 349.0 ft (106.4 m)

Project SR-507 to SR-512 Safety Improvements Driller Vince Johnson Lic# 2532

Site Address Vicinity of SR-7 and 159th St. S. Inspector Brian Hilts

Start March 17, 2004 Completion March 17, 2004 Well ID# AHN-801 Equipment CME 55 w/ autohammer

Station 79+587 Offset 11.1 Rt. Casing 9"x20' Method Auger

Northing Easting Latitude Longitude

County Pierce Subsection SE1/4 SE1/4 Section 27 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				2 7 3 (10)		D-1		3.5" of Asphalt Silty GRAVEL with sand, subrounded, loose, very dark brown, moist, Homogeneous, HCl reaction not tested, We encountered gravels at 4'. Length Recovered 0.5 ft, Length Retained 0.5 ft		
5	1					Bag-2		Well graded GRAVEL with sand, subangular, very dense, dark brown, moist, Homogeneous, HCl reaction not tested		
10	2									
15	3					Bag-3		Well graded GRAVEL, cobbles, subrounded, very dense, dark grayish brown, dry, Homogeneous, HCl reaction not tested, We drilled to 18.5' with no soil change. There was moisture at 13.4'. We bailed the hole to 18.4' and 10 minute later the water table was at 18'.	03/18/04 03/17/2004	
20	4							End of test hole boring at 18.5 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.		
25	5									
	6									
	7									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62169

HOLE No. H-2-04

Sheet 1 of 1

Job No. OL-2740 SR 7 Elevation 352.5 ft (107.4 m)

Project SR-507 to SR-512 Safety Improvements

Driller Vince Johnson Lic# 2532

Site Address Vicinity of SR-7 and 152nd St. S.

Inspector Brian Hilts

Start March 10, 2004 Completion March 10, 2004 Well ID# AHN-802

Equipment CME 55 w/ autohammer

Station 80+365 Offset 10.75m Rt. Casing 9"x15

Method Auger

Northing Easting Latitude Longitude

County Pierce Subsection NE1/4 NW1/4 Section 21 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								6"-ASPHALT		
5	1, 2				B	Bag-1		Well graded GRAVEL, subrounded, very dense, dark brown, dry, Homogeneous, HCl reaction not tested, The soil stayed the same to 14'. (dry hole)		
10	3, 4									
15	5							End of test hole boring at 14 ft below ground elevation.		
20	6							This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62170

HOLE No. H-3-04

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 308.9 ft (94.2 m)

Project SR-507 to SR-512 Safety Improvements

Driller Vince Johnson Lic# 2532

Site Address Vic. of SR-7 and 140th St. S.

Inspector Brian Hilts

Start March 9, 2004 Completion March 9, 2004 Well ID# AHN-803 Equipment CME 55 w/ autohammer

Station 81+438 Offset 13.6m Lt. Casing 8"x15.5 Method Auger

Northing Easting Latitude Longitude

County Pierce Subsection NW1/4 NW1/4 Section 21 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								5"-ASPHALT		
5	1				B	Bag-1		Well graded GRAVEL with sand, cobbles, subrounded, very dense, dark brown, moist, Homogeneous, HCl reaction not tested		
10	2 3								03/09/2004	
15	4			10 12 28 (40)	B / ▼	Bag-2 / D-3		Well graded GRAVEL, cobbles, subrounded, very dense, dark brown, moist, Homogeneous, HCl reaction not tested, At approx. 12' we encountered some moisture. Well graded GRAVEL with sand, subrounded, dense, light olive brown, wet, Homogeneous, HCl reaction not tested Length Recovered 1.0 ft, Length Retained 1.0 ft		
20	5 6							End of test hole boring at 15.5 ft below ground elevation. The water table was at 9.9' before the install. After the install the water table was at 9.3'. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card R-62171

HOLE No. H-4-04

Sheet 1 of 1

Job No. OL-2740 SR 7 Elevation 301.1 ft (91.8 m)

Project SR-507 to SR-512 Safety Improvements

Driller Vince Johnson Lic# 2532

Site Address Vic. of SR-7 and 133rd. st. s.

Inspector Brian Hilts

Start March 16, 2004 Completion March 16, 2004 Well ID# AHN 804

Equipment CME 55 w/ autohammer

Station 82+181 Offset 8.9 Lt. Casing 8" x 14

Method Auger

Northing 302264.67 Easting 453288.18 Latitude Longitude

County Pierce Subsection SE 1/4 of NW 1/4 Section 9 Range 3 e. Township 19 n.

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								Asphalt		
	1				B	B-1		Silty GRAVEL with sand, subrounded, very dense, very dark brown, moist, Homogeneous, no HCl reaction, 7' drilling got easier.		
5	2			2 13 23 (36)		D-2		Silty GRAVEL with sand, subrounded, dense, grayish brown, moist, Stratified,Laminated,Fissured, no HCl reaction, note: top 4" sandy silt with FeO stain throughout, bottom 8" well graded gravel with sand, still dry hole. Length Recovered 1.2 ft, Length Retained 1.2 ft		
10	3			12 24 19 (43)		D-3		Well graded GRAVEL with sand, angular, dense, brown, wet, Homogeneous, no HCl reaction, Length Recovered 0.9 ft, Length Retained 0.9 ft	▽ 03/16/2004	
	4									
15	5							End of test hole boring at 14 ft below ground elevation. Note: took water reading at 10', moisture at bottom of hole. Drilled to 14', water table was at 11'. After install water was at 11.5'. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
20	6									

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62172

HOLE No. H-5-04

Sheet 1 of 1

Job No. OL-2740 SR 7 Elevation 313.4 ft (95.5 m)

Project SR-507 to SR-512 Safety Improvements

Driller Vince Johnson Lic# 2532

Site Address Vicinity of SR-7 and Tule Lake Rd.

Inspector Brian Hilts

Start March 16, 2004 Completion March 16, 2004 Well ID# AHN-805

Equipment CME 55 w/ autohammer

Station 82+450 Offset 9.5m Lt. Casing 9"x15'

Method Auger

Northing Easting Latitude Longitude

County Pierce Subsection NE1/4 NW1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								6"-ASPHALT		
5	1				B	Bag-1		Well graded GRAVEL, cobbles, subrounded, very dense, dark brown, moist, Homogeneous, HCl reaction not tested		
10	2								03/16/2004	
15	3				B	Bag-2		Well graded GRAVEL, cobbles, subrounded, very dense, dark brown, moist, Homogeneous, HCl reaction not tested		
	4		◆	3 5 7 (12)		D-3		Well graded SAND with gravel, medium dense, dark grayish brown, wet, Homogeneous, HCl reaction not tested Length Recovered 0.9 ft, Length Retained 0.9 ft		
20	5							End of test hole boring at 16.5 ft below ground elevation. The water table was at 9.9'. After installing the piezometer the water table was at 10'. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	6									

Washington State
Department of Transportation

LOG OF TEST BORING

Start Card R-62173

HOLE No. H-6-04

Job No. 0L-2740 SR 7 Elevation 310.5 ft (94.6 m)

Sheet 1 of 1

Project SR-507 to SR-512 Safety Improvements

Driller Vince Johnson Lic# 2532

Site Address Vicinity of SR-7 and 125th St. E.

Inspector Brian Hilts

Start March 9, 2004 Completion March 9, 2004 Well ID# AHN-806

Equipment CME 55 w/ autohammer

Station 82+880 Offset 10.9m Lt. Casing 9"x15.5'

Method Auger

Northing Easting Latitude Longitude

County Pierce Subsection SW1/4 SE1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								6"-ASPHALT		
5	1, 2				B	Bag-1		Silty GRAVEL with sand, subrounded, dense, very dark brown, moist, Homogeneous, HCl reaction not tested		
10	3									
15	4, 5				B	Bag-2		Well graded GRAVEL with sand, subrounded, very dense, very dark brown, moist, Homogeneous, HCl reaction not tested, No soil change to 15'.		
20	6							End of test hole boring at 15 ft below ground elevation. Dry Hole This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		

Washington State Department of Transportation

LOG OF TEST BORING

Start Card R-62174

HOLE No. H-7-04

Sheet 1 of 1

Job No. 0L-2740 SR 7 Elevation 339.7 ft (103.5 m)

Project SR-507 to SR-512 Safety Improvements

Driller Vince Johnson Lic# 2532

Site Address Vicinity of SR-7 and 119th St. S.

Inspector Brian Hilts

Start March 10, 2004 Completion March 10, 2004 Well ID# AHN-807

Equipment CME 55 w/ autohammer

Station 83+605 Offset 11.0m Lt. Casing 9"x15.5'

Method Auger

Northing Easting Latitude Longitude

County Pierce Subsection SE1/4 NW1/4 Section 9 Range 3 EWM Township 19N

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				3 5 2 (7)		D-1		Silty SAND with gravel, loose, brown, moist, Homogeneous, HCl reaction not tested, with black organics. Length Recovered 1.5 ft, Length Retained 1.5 ft		
	1				B	Bag-2		SILT with sand, very loose, brown, moist, Homogeneous, HCl reaction not tested, (moisture tin obtained)		
5				2 2 2 (4)		D-3		SILT with sand, very loose, gray, moist, Laminated,Fissured, HCl reaction not tested, laminated with FeO stains and sand lenses. Length Recovered 1.3 ft, Length Retained 1.3 ft		
	2									
10	3									
	4				B	Bag-4		Well graded GRAVEL with sand, subrounded, very dense, gray, dry, Homogeneous, HCl reaction not tested		
15										
	5							End of test hole boring at 15.5 ft below ground elevation. Dry Hole. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
20	6									

SOIL 0L-2740 SR 507 TO SR 512 SAFETY IMPROVEMENTS.GPJ SOIL.GDT 3/22/04 10:38:36 A3

Job No. **OL-2470**
Hole No. **H-1-98**
Project **SR-507 to SR-512**

Date **March 17, 2004**
Sheet **1** of **1**

Laboratory Summary

Washington State Department of Transportation

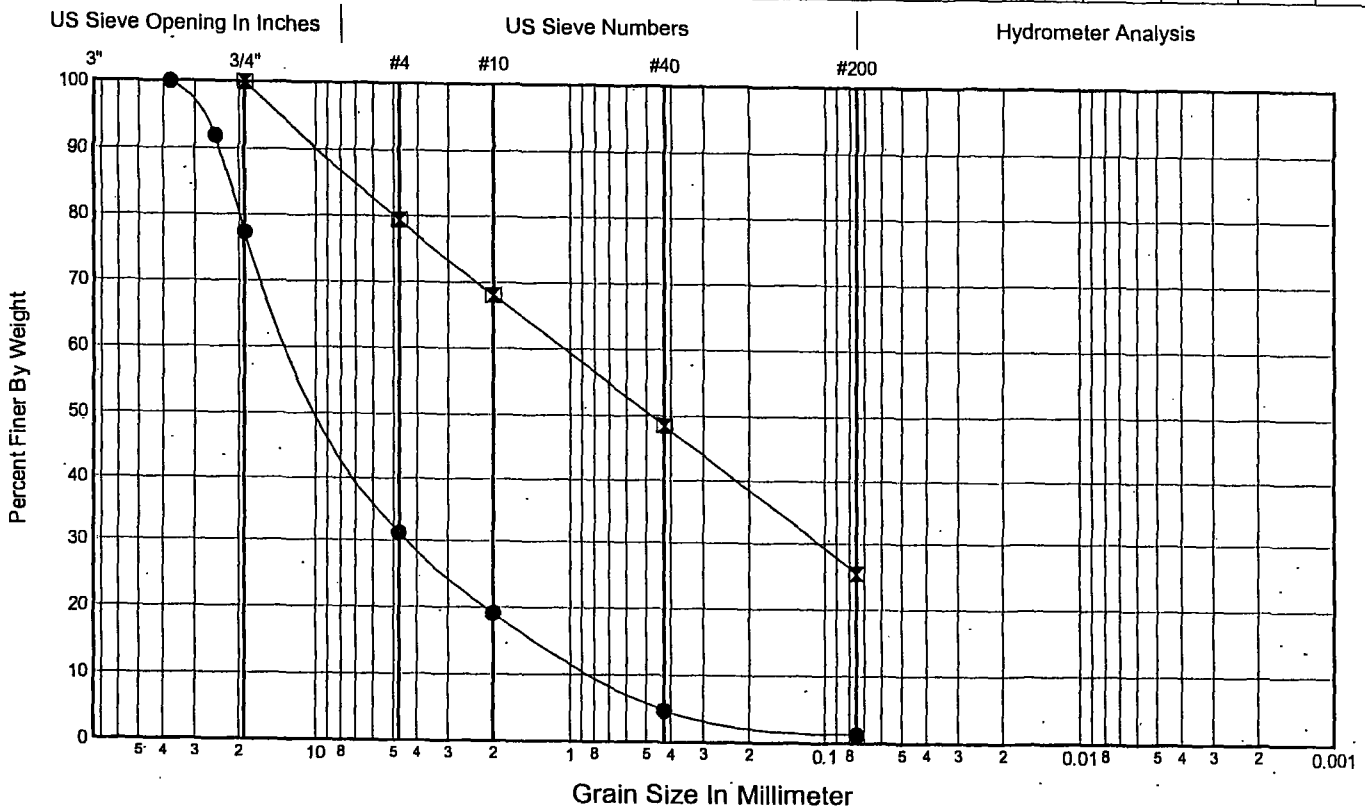
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	2.0	0.61	D-1	GW	SEE BORING LOG	WELL-GRADED GRAVEL with SAND	5			
⊠	20.0	6.10	D-5	SM	SEE BOEING LOG	SILTY SAND with GRAVEL	10			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	68.8	29.9	1.3	2.2	15.0
⊠	20.6	53.9	25.4		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	11.286	8.35	4.35	2.13	0.753
⊠	1.056	0.48	0.11		



Job No. **OL-2470**
Hole No. **H-2-98**
Project **SR-507 to SR-512**

Date **March 17, 2004**
Sheet **1** of **1**

Laboratory Summary

Washington State Department of Transportation

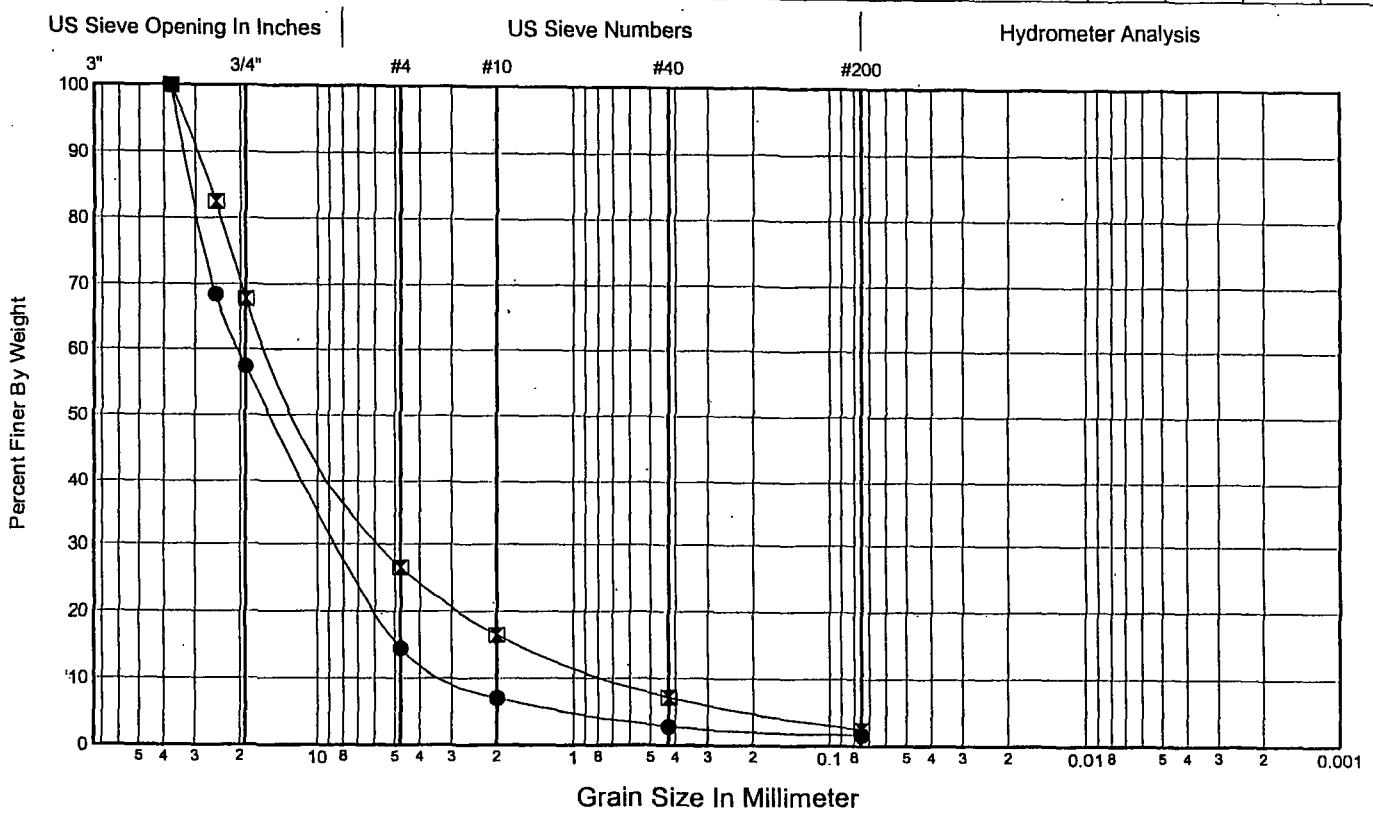
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-2	GW	SEE BORING LOG	WELL-GRADED GRAVEL	4			
⊠	15.0	4.57	D-4	GW	SEE BORING LOG	WELL-GRADED GRAVEL with SAND	8			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	85.5	12.8	1.6	1.1	7.1
⊠	73.5	24.1	2.4	2.8	21.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●	20.287	14.98	7.85	5.68	2.841
⊠	14.641	10.46	5.34	2.71	0.684



Job No. **OL-2470**
Hole No. **H-3-98**
Project **SR-507 to SR-512**

Date **March 17, 2004**
Sheet **1** of **1**

Laboratory Summary

Washington State Department of Transportation

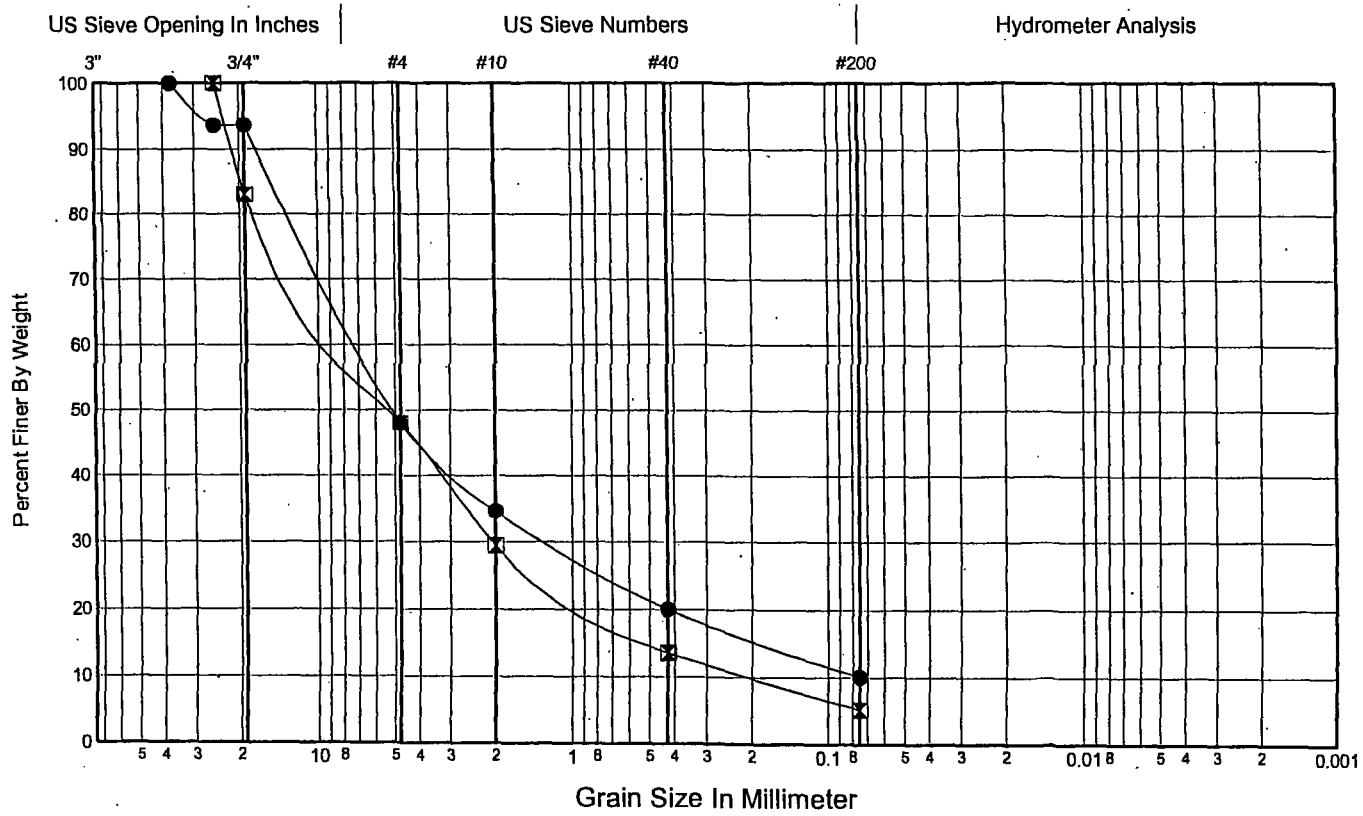
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	2.0	0.61	D-1	GP-GM	SEE BORING LOG	POORLY GRADED GRAVEL with SILT and SAND	14			
⊠	10.0	3.05	D-3	GW-GM	SEE BORING LOG	WELL-GRADED GRAVEL with SILT and SAND	6			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	52.1	37.8	10.1	3.0	92.8
⊠	52.1	42.7	5.2	2.7	37.7

GRADATION VALUES

	D60	D50	D30	D20	D10
●	6.858	5.06	1.23	0.42	
⊠	7.668	5.17	2.06	0.80	0.203



Job No. **OL-2470** Date **March 17, 2004**

Hole No. **H-5-98** Sheet **1** of **1**

Project **SR-507 to SR-512**

Laboratory Summary

Washington State Department of Transportation

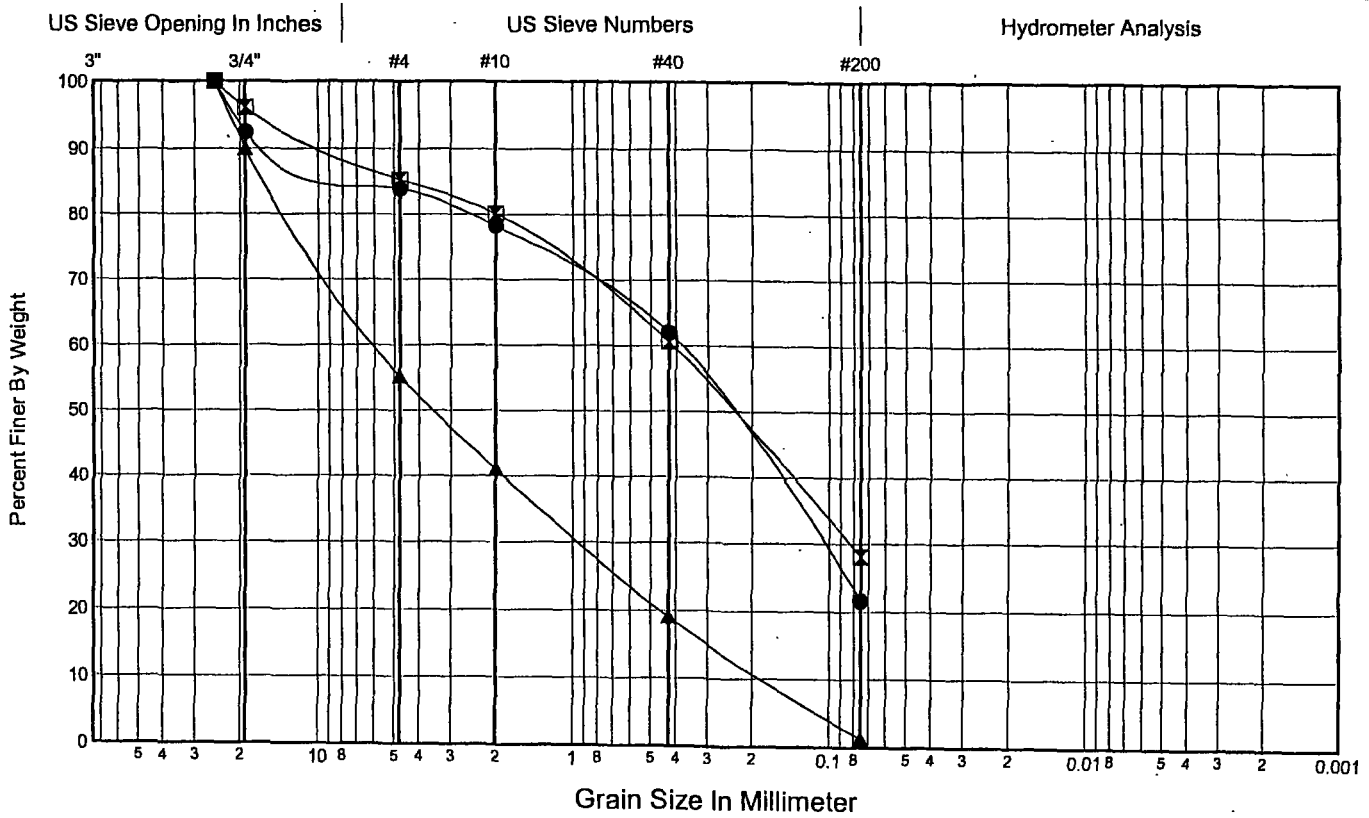
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-1	SM	SEE BORING LOG	SILTY SAND with GRAVEL	16			
⊠	10.0	3.05	D-2	SM	SEE BORING LOG	SILTY SAND	17			
▲	15.0	4.57	D-3	SP	SEE BORING LOG	POORLY GRADED SAND with GRAVEL	8			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	16.1	62.3	21.6		
⊠	14.7	57.2	28.1		
▲	44.9	53.7	1.4	0.8	33.0

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.390	0.25	0.11		
⊠	0.412	0.24	0.08		
▲	5.772	3.48	0.92	0.46	0.175



Job No. **OL-2470**
Hole No. **H-6-98**
Project **SR-507 to SR-512**

Date **March 17, 2004**
Sheet **1** of **1**

Laboratory Summary

Washington State Department of Transportation

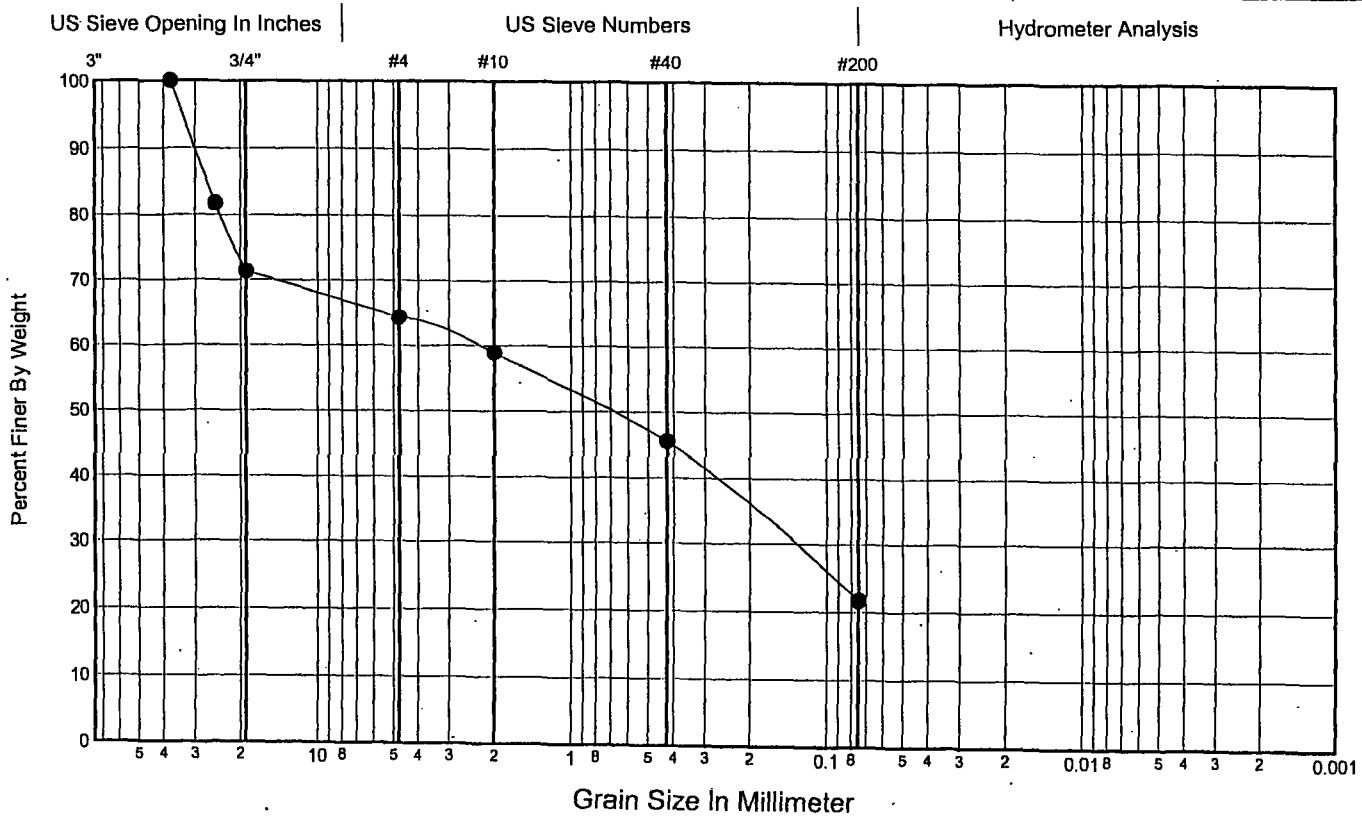
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	2.0	0.61	D-1	SM	SEE BORING LOG	SILTY SAND with GRAVEL w/fiborous organic material	6			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	35.7	42.5	21.7		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	2.379	0.71	0.14		



Job No. **OL-2470**
Hole No. **H-7-98**
Project **SR-507 to SR-512**

Date **March 17, 2004**
Sheet **1** of **1**

Laboratory Summary

Washington State Department of Transportation

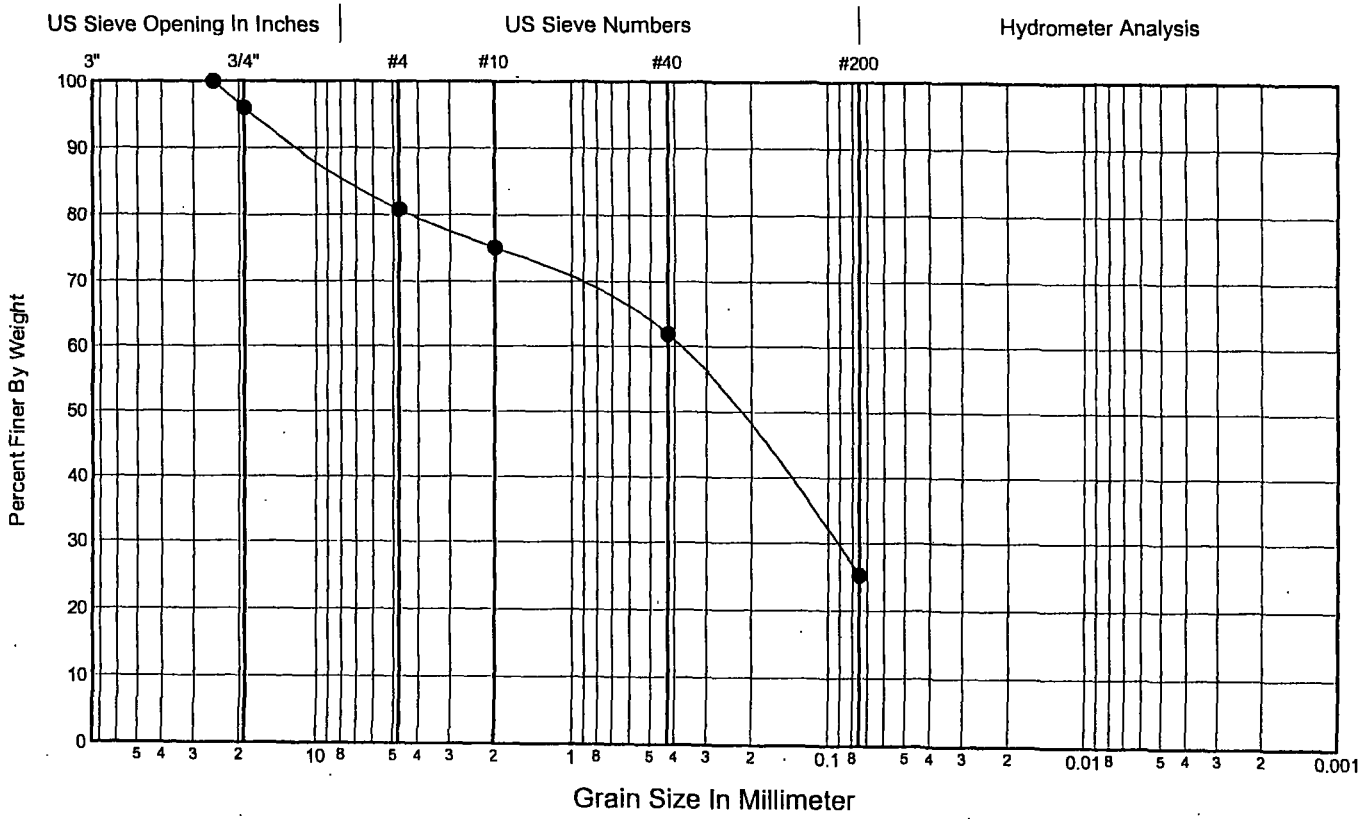
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	20.0	6.10	D-5	SM	SEE BORING LOG	SILTY SAND with GRAVEL	11			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	19.2	55.6	25.1		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.388	0.24	0.09		



Washington State Department of Transportation

Memorandum

July 27, 1999

TO: S. Kim
357-2683

FROM: Mel Hitzke

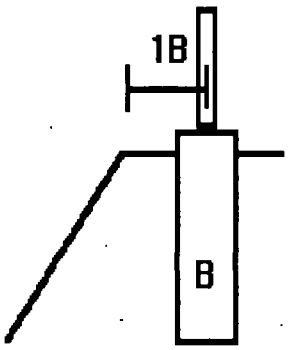
SUBJECT: SR 7 OL-2740
SR 507 to SR 512 Safety-Stage 2
Signal Foundation Recommendations

We have completed the requested soils investigation for the signal foundations for this project with the following results:

	Lateral Bearing Pressure
SR 7 / 168th St. S.	2500 psf
SR 7 / 166th St. S.	2500 psf
SR 7 / 162nd St. S.	2500 psf
SR 7 / 159th St. S.	2500 psf
SR 7 / Military Road	2500 psf
SR 7 / !38th St. S.	2500 psf
SR 7 / Tule Lake Road	2500 psf
SR 7 / Garfield St. S.	2500 psf
SR 7/ 121st St. S.	2500 psf
SR 7 / 114th St. S.	1500 psf

On the dates that the borings were advanced (July 13-16, 1999) water was encountered at the following three intersections:

SR 7 / Tule Lake Road	11'5" below ground elevation
SR 7 / Garfield St. S.	14'0" below ground elevation
SR 7 / 114th St. S.	12'8" below ground elevation



For all foundations placed in a slope or where the centerline of the foundation is less than 1B from the shoulder (B = width or diameter of the Standard Foundation), we recommend that the Standard Plan foundation depths be increased as follows:

2H:1V slopes add 0.5B to the depth
1.5H:1V slopes add 0.75B to the depth

For slopes 3H:1V or flatter, no additional depth is required. Interpolation between the values is acceptable. However, the Geotechnical Branch should be contacted if slopes are steeper than the 1.5H:1V.

MH:tm
TM

cc: T. Allen, 4-7365

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1-99

PROJECT Traffic Signal Foundation

Job No. OL-2740

S.R. 7

Station

Offset

C.S. 2712

Equipment CME 850

Casing

Ground El (m)

Method of Boring

Start Date July 12, 1999

Completion Date

Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				5 5 6 8 (11)		D-1		Asphalt, medium dense, black, moist Recovered and Retained: 1.0 ft.		
	1			10 12 14 15 (26)		D-2		SAND with gravel, dense, weak red, moist, homogeneous. Recovered and Retained: 1.0 ft.		
5				8 13 13 13 (26)		D-3		SAND with gravel, dense, weak red, moist, homogeneous. Recovered and Retained: 0.1 ft.		
	2			5 6 7 13 (13)		D-4		GRAVEL with sand, subangular, medium dense, dark reddish/brown, moist, homogeneous. Recovered and Retained: 0.9 ft.		
10	3			13 12 15 16 (27)		D-5		GRAVEL with sand, subangular, dense, dark reddish/brown, wet, homogeneous. Recovered and Retained: 1.3 ft.	▽	
	4			12 21 24 27 (45)		D-6		GRAVEL with sand, subangular, dense, dark reddish/brown, wet, homogeneous. Recovered and Retained: 0.1 ft.		
15	5			14 17 14 14 (32)		D-7		GRAVEL with sand, subangular, dense, dark reddish/brown, wet, homogeneous. Recovered and Retained: 1.5 ft.		
								End of Test Hole Boring at 17 feet below ground elevation. *This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.*		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-2-99

PROJECT Traffic Signal Foundation

Job No. OL-2740

S.R. 7

Station

Offset

C.S. 2712

Equipment CME 850

Casing

Ground El (m)

Method of Boring

Start Date July 13, 1999

Completion Date

Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				5 5 6 9 (11)		D-1		6" - Asphalt SAND with gravel, medium dense, dark gray, moist, homogeneous. Recovered and Retained: 0.2 ft.		
	1			16 24 16 17 (40)		D-2		GRAVEL with sand, subangular, dense, gray, dry, homogeneous (till). Recovered and Retained: 0.2 ft.		
5	2			5 6 5 6 (11)		D-3		SAND with gravel, medium dense, dark gray, moist, homogeneous. Recovered and Retained: 0.3 ft.		
				10 12 12 20 (24)		D-4		GRAVEL with cobble, subangular, medium dense, dark greenish/gray, moist, homogeneous. Recovered and Retained: 0.1 ft.		
10	3			20 27 16 31 (43)		D-5		SAND with gravel, dense, dark gray, moist, homogeneous. Recovered and Retained: 0.2 ft.		
	4			34 13 16 25 (29)		D-6		SAND with gravel, dense, dark reddish/gray, moist, homogeneous. Recovered and Retained: 1.0 ft.		
15	5			11 11 11 15 (22)		D-7		SAND with gravel, medium dense, dark reddish/gray, moist, homogeneous. Recovered and Retained: 1.3 ft.		
								End of Test Hole Boring at 17 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-3-99

PROJECT Traffic Signal Foundation

Job No. OL-2740

S.R. 7

Station

Offset

C.S. 2712

Equipment CME 850

Casing

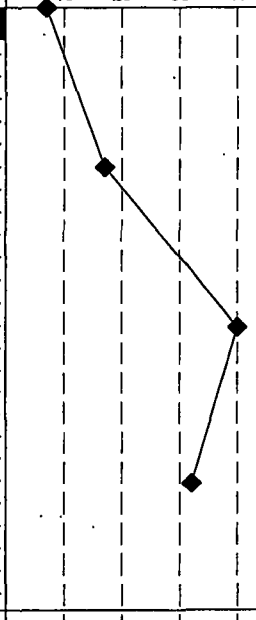
Ground El (m)

Method of Boring

Start Date July 13, 1999

Completion Date

Sheet 1 of 1



Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
		4 2 5 7 (7)		D-1		6" - Asphalt SAND with gravel, loose, dark red/gray, moist, homogeneous. Recovered and Retained: 1.0 ft.		
	1	5 8 9 16 (17)		D-2		SAND with gravel, medium dense, dark red/gray, moist, homogeneous. Recovered and Retained: 1.0 ft.		
5	2	17 15 25 20 (40)		D-3		SAND with gravel, dense, dark red/brown, moist, homogeneous. Recovered and Retained: 1.0 ft.		
		56 20 12 36 (32)		D-4		SAND with gravel, dense, dark red/brown, moist, homogeneous. Recovered and Retained: 0.9 ft.		
10	3					End of Test Hole Boring at 9.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4							
15	5							
20	6							

SOIL OL2740.GPJ SOIL.GDT 7/20/99□11:19:54 A7

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-4-99

PROJECT Traffic Signal Foundation

Job No. OL-2740

S.R. 7

Station

Offset

C.S. 2712

Equipment CME 850

Casing

Ground El (m)

Method of Boring

Start Date July 14, 1999

Completion Date

Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				14 8 7 9 (15)		D-1		6" - Asphalt SAND, medium dense, dark gray, moist, homogeneous. Recovered and Retained: 0.7 ft.		
	1			6 9 11 32 (20)		D-2		SAND with gravel, medium dense, reddish black, moist, homogeneous. Recovered and Retained: 0.7 ft.		
5				6 16 19 24 (35)		D-3		SAND with gravel, dense, very dark brown, moist, homogeneous. Recovered and Retained: 1.3 ft.		
	2		>>	60 29 22 23 (51)		D-4		SAND with gravel, very dense, dark reddish gray, moist, homogeneous. Recovered and Retained: 1.0 ft.		
10	3			14 7 6 10 (13)		D-5		SAND with gravel, medium dense, dark brownish gray, moist, homogeneous. Recovered and Retained: 1.5 ft.		
	4			12 13 20 14 (33)		D-6		SAND with gravel, dense, dark brownish gray, moist, homogeneous. Recovered and Retained: 0.5 ft.		
15	5							End of Test Hole Boring at 14.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-5-99

PROJECT Traffic Signal Foundation

Job No. OL-2740

S.R. 7

Station

Offset

C.S. 2712

Equipment CME 850

Casing

Ground El (m)

Method of Boring

Start Date July 14, 1999

Completion Date

Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				4 8 8 8 (16)		D-1		8" - Asphalt SAND with gravel, medium dense, light olive brown to very dark gray, dry, stratified with organic soil.		
	1			9 10 10 11 (20)		D-2		SAND with gravel, medium dense, dark yellowish brown, dry to moist, homogeneous. Recovered and Retained: 0.9 ft.		
5	2			5 4 8 8 (12)		D-3		SAND with gravel, medium dense, dark gray, moist, homogeneous. Recovered and Retained: 0.3 ft.		
				13 17 9 11 (26)		D-4		SAND with gravel, dense, dark olive brown, moist, homogeneous. Recovered and Retained: 1.0 ft.		
10	3			8 13 14 8 (27)		D-5		SAND with gravel, dense, olive brown, moist, homogeneous. Recovered and Retained: 0.7 ft.		
	4			13 8 9 7 (17)		D-6		SAND with gravel, medium dense, light olive brown, moist, homogeneous. Recovered and Retained: 0.9 ft.		
15	5							End of Test Hole Boring at 14.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

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LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-6-99

PROJECT Traffic Signal Foundation

Job No. OL-2740

S.R. 7

Station

Offset

C.S. 2712

Equipment CME 850

Casing

Ground El (m)

Method of Boring

Start Date July 15, 1999

Completion Date

Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				19		D-1		6" - Asphalt		
				13 6 14 (19)				SAND with gravel, medium dense, dark brown, dry, stratified. Recovered and Retained: 1.2 ft.		
	1			5 19 11 20 (30)		D-2		SAND with gravel, dense, yellowish brown to very dark gray, dry to moist, stratified. Recovered and Retained: 1.0 ft.		
5				6 14 20 12 (34)		D-3		SAND with gravel, dense, yellowish brown to very dark gray brown, dry, stratified. Recovered and Retained: 1.0 ft.		
	2			5 8 26 18 (34)		D-4		SAND with gravel, dense, dark gray to dark grayish brown, dry to moist, stratified. Recovered and Retained: 0.4 ft.		
10	3			5 8 14 17 (22)		D-5		SAND with gravel, medium dense, dark olive brown, moist, homogeneous. Recovered and Retained: 0.3 ft. Cobble at 11 feet		
	4			7 9 14 14 (23)		D-6		GRAVEL with sand, subangular to subrounded, medium dense, olive brown, moist, homogeneous. Recovered and Retained: 1.0 ft.		
15	5							End of Test Hole Boring at 14.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

Washington State Department of Transportation

Memorandum

June 7, 1999

TO: S. Roark/J. Klockenteger
Olympic Region, 47448

FROM: T. M. Allen/J. G. Cuthbertson
OSC Geotechnical Branch, 47365

SUBJECT: SR-7, C.S. 2712, OL-2740
SR-507 to SR-512 Stage 2
Walls and Utilities

As requested, we have reviewed the proposed placement of utilities in relation to the walls on the project. Two locations are proposed. Alternate one places the utility within the wall reinforcement. Alternate two places the utilities behind the reinforcement.

Alternate two is the preferred and recommended alternate for all utilities.

We understand that some of the utilities have acknowledged that they can use a conduit buried in the backfill and reinforcement (alternate one). We also understand that they realize that they may have to abandon the conduit should there be problems with the utility. The Region will have to assess the potential for the utility to alter this opinion in the future. Excavation to expose the utility at a later date will result in portions of the wall needing to be reconstructed. It is highly unlikely that excavation can occur with out damaging the reinforcement should the conduit or utility be placed within the reinforcement. If alternate one is used, the utility agreements should clearly indicate that wall replacement will be required should access to utilities buried within the reinforcement be needed in the future.

If you have questions or require further information, please contact Tony Allen at (360) 709-5450 or James Cuthbertson at (360) 709-5452.

TA:jc

cc: J. Spaid, OSC Construction, 47354
A. Young, Bridge and Structures, 47340
M. Talukdar, Bridge and Structures, 47340
M. Hitzke, Oly Materials, 47440

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Washington State Department of Transportation

Memorandum

RECEIVED
SEP 0 8 1998
DOT PROJECT ENGINEER

Date: September 4, 1998

From: T. M. Allen/D. A. Williams
FOSSC Materials Laboratory, 47365
Geotechnical Services Branch

Phone: 360-709-5457
(FAX 360-709-5585)

Subject: SR-7, CS 2712, OL-2740
SR 507 to SR 512 Stage 2
MP 47.44 to MP 52.54
Geotechnical Report

To: David E. Erickson / John Klockenteger
Project Engineer
Olympic Region, 47448

This memorandum provides wall recommendations for the subject project. Safety and environmental improvements are proposed for the communities of Parkland and Spanaway south of Tacoma. A combination roadside ditch with a new sidewalk is being proposed between the existing SR-7 shoulder and the existing right-of-way. The project is approximately 8.2 km long starting from the junctions of SR-507 and SR-512 on SR-7. The new sidewalk will be adjacent to the right-of-way boundary for the majority of the roadway alignment. In order to retain the fill/cut soils, new retaining wall structures will be required. The majority of the alignment will only require minor cuts and fills (1.0 m or less in height) for the new design section. For our design efforts, we looked only at the areas over one meter in height.

We investigated the following locations:

- 140-146L Wall located between Stations 80+798 and 81+~~798~~ 461 (15 m Left).
- 141-143R Wall located between Stations 81+138 and 81+261 (15 m Right).
- 124-127R Wall located between Stations 82+751 and 82+980 (15 m Right).
- 123-125L Wall located between Stations 82+913 and 83+~~508~~ 058 (15 m Left).
- 123-124R Wall located between Stations 82+991 and 83+058 (15 m Right).
- 118-119L Wall located between Stations 83+547 and 83+614 (15 m Left).
- 117-118L Wall located between Stations 83+624 and 83+694 (15 m Left).
- 116-117L Wall located between Stations 83+705 and 83+773 (15 m Left).
- 116-117R Wall located between Stations 83+705 and 83+~~733~~ 772 (15 m Right).
- VOI 116R Wall located between Stations 83+784 and 83+931 (15 m Right).
- 115-116L Wall located between Stations 83+784 and 83+851 (15 m Left).
- 112-115L Wall located between Stations 83+864 and ~~83~~ 84+241 (15 m Left).

See Next Page

See Next Page

Wall	Station			Offset	Approx.	Max. Wall	Wall Type	Embankments
	SR-7 Line			(meters)	Length	Height		Volume
					(meters)	(meters)		(M^3)
140-146 L	**80+798**	**to**	**81+461**	**15 Lt.**	**663**			
Cut Wall	80+972	to	81+040		68	4.0	Soldier Pile	
Fill Wall	81+054	to	81+163		109	3.0	MBGR	833.85
141-143 R	**81+138**	**to**	**81+261**	**15 Rt.**	**123**			
Fill Wall	81+138	to	81+169		31	2.0	MBGR	158.1
Cut Wall	81+214	to	81+230		16	1.3	MBGR or Regrade Slope	
124-127 R	**82+751**	**to**	**82+980**	**15 Rt.**	**229**			
Fill Wall	82+914	to	82+977		63	2.0	MBGR	321.3
123-125 L	**82+913**	**to**	**83+058**	**15 Lt.**	**145**			
Fill Wall	82+914	to	82+977		63	2.6	MBGR	417.69
Cut Wall	83+010	to	83+028		18	2.0	Discussed Below	
123-124 R	**82+991**	**to**	**83+058**	**15 Rt.**	**67**			
Cut Wall	82+991	to	83+058		67	1.4	MBGR or Regrade Slope	
118-119 L	**83+547**	**to**	**83+614**	**15 Lt.**	**67**			
Fill Wall	83+547	to	83+614		67	<=1.0	MBGR	170.85
117-118 R	**83+624**	**to**	**83+694**	**15 Lt.**	**70**			
Fill Wall	82+914	to	82+977		63	2.2	MBGR	353.43
116-117 L	**83+704**	**to**	**83+772**	**15 Lt.**	**68**			
Fill Wall	83+706	to	83+771		65	3.0	MBGR	497.25
116-117 R	**83+704**	**to**	**83+772**	**15 Rt.**	**68**			
Cut Wall	83+733	to	83+771		38	2.0	Soldier Pile	
VOI 116R	**83+784**	**to**	**83+931**	**15 Rt.**	**147**			
Cut Wall	83+797	to	83+884		87	2.5	Soldier Pile	
115-116 L	**83+784**	**to**	**83+851**	**15 Lt.**	**67**			
Fill Wall	83+785	to	83+833		48	3.1	MBGR	379.44
112-115 L	**83+864**	**to**	**84+241**	**15 Lt.**	**377**			
Fill Wall	83+864	to	83+920		56	2.3	MBGR	328.44
Fill Wall	84+009	to	84+023		14	1.9	MBGR	67.83
							Total Embankment (M^3)	3,528.18

Washington State
Department of Transportation

Memorandum

Date: September 4, 1998

From: T. M. Allen/D. A. Williams
FOSSC Materials Laboratory, 47365
Geotechnical Services Branch
Phone: 360-709-5457
(FAX 360-709-5585)

Subject: SR-7, CS 2712, OL-2740
SR 507 to SR 512 Stage 2
MP 47.44 to MP 52.54
Geotechnical Report

To: David E. Erickson / John Klockenteger
Project Engineer
Olympic Region, 47448

This memorandum provides wall recommendations for the subject project. Safety and environmental improvements are proposed for the communities of Parkland and Spanaway south of Tacoma. A combination roadside ditch with a new sidewalk is being proposed between the existing SR-7 shoulder and the existing right-of-way. The project is approximately 8.2 km long starting from the junctions of SR-507 and SR-512 on SR-7. The new sidewalk will be adjacent to the right-of-way boundary for the majority of the roadway alignment. In order to retain the fill/cut soils, new retaining wall structures will be required. The majority of the alignment will only require minor cuts and fills (1.0 m or less in height) for the new design section. For our design efforts, we looked only at the areas over one meter in height.

We investigated the following locations:

- 140-146L Wall located between Stations 80+798 and 81+641 (15 m Left).
- 141-143R Wall located between Stations 81+138 and 81+261 (15 m Right).
- 124-127R Wall located between Stations 82+751 and 82+980 (15 m Right).
- 123-125L Wall located between Stations 82+913 and 83+058 (15 m Left).
- 123-124R Wall located between Stations 82+991 and 83+058 (15 m Right).
- 118-119L Wall located between Stations 83+547 and 83+614 (15 m Left).
- 117-118L Wall located between Stations 83+624 and 83+694 (15 m Left).
- 116-117L Wall located between Stations 83+705 and 83+773 (15 m Left).
- 116-117R Wall located between Stations 83+704 and 83+772 (15 m Right).
- VOI 116R Wall located between Stations 83+784 and 83+931 (15 m Right).
- 115-116L Wall located between Stations 83+784 and 83+851 (15 m Left).
- 112-115L Wall located between Stations 83+864 and 84+241 (15 m Left).

We were asked to provide the geotechnical recommendations for potential wall systems. It is our understanding that the project office wants to use a modular block geosynthetic retaining wall system, MBGR. MBGR's are non-standard, non-pre-approved, non-proprietary wall systems which use masonry blocks and geosynthetic reinforcement or metallic fabric reinforcement as design components. This wall type requires a special design which this memorandum will provide. The new walls will be limited on one side by the existing right-of-way boundary and the wall reinforcement is limited by the new ditch.

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

PROJECT SITE SUBSURFACE CONDITIONS

Regional Geology And Seismicity

The project site is located in the central portion of the Puget Sound lowland between the Cascade Mountain range to the east and the Puget Sound. The topography and geology of the Puget Lowland are a direct result of several cycles of regional glaciation during the Pleistocene epoch. As a result of the glaciation, a north- south trending depression formed between the Cascade and Olympic Mountain ranges. The last major phase of glacial growth was the Fraser Glaciation which began 20,000 years ago and ended about 10,000 years ago. The Vashon Stade started about 13,000 years ago and covered the project area. The ice sheet is believed to have filled the lowland to a thickness of up to 1.68 km in the deepest part of the trough at the height of the glacial advance. The terminus of the ice sheet occurred in the vicinity of Olympia. The glacier melted which left a variable thickness of glacial sediment. The glacial deposits range from a few meters to over 640 m in thickness.

The project site is located on Vashon Drift and Till deposits. The soils beneath the project site includes glacially-consolidated sand and gravel deposits with cobbles and boulders to a mixture of silt, sand and gravel. There is a variable thickness of normally consolidated silt, sand, and gravel which may consist of either of glacial recessional deposits or recent alluvium deposits. Organic silt or peat may be encountered in the vicinity of Clover Creek which crosses SR-7 between the Stations 82+200 and 82+240.

Seismicity

The seismicity and subsurface geologic structure is complex in the vicinity of the project site. The Puget Lowland is seismically active. 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 35 km in depth) occur within the North American plate and are believed to be due to north-south compression and possibly crustal rebound resulting from the removal of the glacial ice. The deep focus earthquakes (greater than 40 km in

depth) are associated with crustal movement of the subducting Juan de Fuca plate beneath western Washington. In general, the deeper subcrustal seismic events have greater magnitude and less frequency than the shallower events.

The Puget Lowland is believed to have a series of buried geologic structures. The site is on a downward section of a thrust block. The thrust block is bounded to the north by a fault zone that is believed to follow the Puyallup River Valley from Commenent Bay through Bonney Lake. The thrust block is bounded to the south by a fault zone that is located near the Nisqually River Delta. The northern fault is between 9 km to 12 km north of the proposed wall sites. The southern fault is between 28 km to 35 km south of the proposed wall sites.

The Puget Sound area has experienced earthquakes up to magnitude 7.5. The largest earthquake in recent years occurred in the vicinity of the Nisqually River delta on April 13, 1949 with a Modified Mercalli intensity of VIII (estimated Richter magnitude of 7.1). On April 29, 1965, a Modified Mercalli intensity of VII (estimated Richter magnitude of 6.5) earthquake occurred in the vicinity of Des Moines. A magnitude 5.0 earthquake occurred in the vicinity of Robinson Point (near Des Moines) on January 28, 1995. A magnitude 5.3 earthquake occurred 8.5 km ENE of Duvall on May 3, 1996.

Field Investigation

The field investigation consisted of a site reconnaissance, 10 hand probe holes, 10 portable penetrometer test holes, and drilling 10 new test borings. The test borings were drilled to provide subsurface information for the new wall sites. The test hole locations are shown on the attached site plans in Appendix A. Location of the test borings, portable penetromter test holes, and probes are summarized in the following Tables 1, 2 and 3, respectively.

The hand probe holes consist of driving a metal probe into the ground until refusal.

Portable penetrometer test hole consist of driving a 40 mm steel rod with a metal conical tip into the ground. The rod is hammered into the ground by using a 13.6 kg weight falling freely from a height of approximately 790 mm.

Standard penetration test (SPT) consist of driving a 50 mm diameter standard sampler 300 mm to 510 mm into the ground. The standard penetrometer uses a 63.5 kg weight falling freely from a height of 760 mm.

Soil sampling was performed at the test hole locations. Standard penetration tests (SPT), in general, were taken at approximate 1.5 m intervals in the surficial soils to a depth up to 8 m below the ground surface. All disturbed soil samples were visually examined and were classified using the Unified Soil Classification System (USCS). Copies of all the test hole logs are included in Appendix B.

Table 1 *Test Boring and Ground Surface elevations.*

Test Hole No.	Station SR-7 Line	Offset (meters)	Ground Elevation (meters)	Wall
H-1-98	80+985	21.9 Lt.	107.1	140-146 L
H-2-98	81+025	20.0 Lt.	107.4	140-146 L
H-3-98	81+103	21.9 Lt.	94.8	140-146 L
H-4-98	82+950	10.4 Lt.	96.3	123-125 L
H-5-98	83+753	13.7 Lt.	106.2	116-117 L
H-6-98	83+740	14.9 Rt.	109.4	116-117 R
H-7-98	83+800	11.1 Rt.	109.3	115-116 L
H-8-98	83+829	17.0 Rt.	112.4	VOI 116 R
H-9-98	83+880	11.0 Lt.	111.9	112-115 L
H-10-98	83+020	15.0 Lt.	100.9	123-125 L

Table 2 *Portable Penetrometer Boring and Ground Surface elevations.*

Test Hole No.	Station SR-7 Line	Offset (meters)	Ground Elevation (meters)	Wall
P-1-98	84+015	15 Lt.	114.6	112-115 L
P-2-98	83+888	15 Lt.	100.3	112-115 L
P-3-98	83+790	15 Lt.	107.3	115-116 L
P-4-98	83+744	15 Lt.	105.6	116-117 L
P-5-98	83+689	15 Lt.	104.4	117-118 L
P-6-98	83+632	15 Lt.	103.5	117-118 L
P-7-98	82+968	15 Lt.	95.3	123-125 L
P-8-98	81+072	15 Lt.	98.9	140-146 L
P-9-98	81+145	15 Rt.	95.8	140-143 R
P-10-98	82+962	15 Rt.	95.3	124-127 R

Table 3: *Hand Probes and Ground Surface elevations.*

Station SR-7 Line	Offset (meters)	Ground Elevation (meters)	Depth of Refusal (meters)	Wall
80+826	15 Lt.	107.3	0.5	140 - 146 L
81+216	15 Lt.	95.4	0.6	140 - 146 L
81+276	14.5 Lt.	93.7	0.4	140 - 146 L
81+390	15 Lt.	93.9	0.3	140 - 146 L
81+444	15 Lt.	94.2	0.3	140 - 146 L
82+930	15 Lt.	95.3	1.0	123 - 125 L
82+950	15 Lt.	95.8	0.9	123 - 125 L
83+952	15 Lt.	113.9	0.9	112 - 115 L
83+960	15 Rt.	114.4	1.0	
84+016	15 Lt.	114.6	1.5	112 - 115 L

Ground water was observed in four test holes, P-2-98, H-4-98, H-7-98, and H-9-98.

Test Hole	Location	Elevation	Date
P-2-98	Station 83+888 15 m Lt.	109.6 m	March 3, 1998
H-9-98	Station 83+880 11 m Lt.	108.9 m	June 1, 1998
H-7-98	Station 83+800 11 m Lt.	106.2 m	June 1, 1998
H-4-98	Station 82+950 10 m Lt.	94.8 m	June 2, 1998

GEOTECHNICAL RECOMMENDATIONS for RETAINING WALLS

We have evaluated the foundation conditions for twelve wall locations listed in Table 4. The majority of the proposed alignment will require walls up to 1.0 m in exposed wall face. It is our understanding that the Project Office is responsible to determine the project geometry that includes the wall limits, to initiate all right-of-way issues, and relocation of utilities. Based on the proposed geometry, the front face of the proposed walls will be located 15 m from the existing center line of SR-7. Right-of-way will be approximately 0.5 m from the proposed wall face for most of the project length.

Pre-approved proprietary MSE Walls and standard walls are also feasible for the proposed fill wall sections. However, the Region prefers that modular block walls be used for the proposed alignment. If the project office desires to use a MSE wall system. The design process is outlined in Figure 1130-3 of the Design Manual instructional letter for walls.

Table 4: Summary of Wall Locations over 1.0 m in height.

Wall	Station SR-7 Line	Offset (meters)	Approx. Length (meters)	Max. Wall Height (meters)	Wall Type
140-146 L	**80+798 to 81+461**	**15 Lt.**	**663**		
Cut Wall	80+972 to 81+040		68	4.0	Soldier Pile
Fill Wall	81+054 to 81+163		109	3.0	MBGR
141-143 R	**81+138 to 81+261**	**15 Rt.**	**123**		
Fill Wall	81+138 to 81+169		31	2.0	MBGR
Cut Wall	81+214 to 81+230		16	1.3	MBGR or Regrade Slope
124-127 R	**82+751 to 82+980**	**15 Rt.**	**229**		
Fill Wall	82+914 to 82+977		63	2.0	MBGR
123-125 L	**82+913 to 83+058**	**15 Lt.**	**145**		
Fill Wall	82+914 to 82+977		63	2.6	MBGR
Cut Wall	83+010 to 83+028		18	2.0	Discussed Below
123-124 R	**82+991 to 83+058**	**15 Rt.**	**67**		
Cut Wall	82+991 to 83+058		67	1.4	MBGR or Regrade Slope
118-119 L	**83+547 to 83+614**	**15 Lt.**	**229**	≤ 1.0	MBGR
117-118 L	**83+640 to 83+694**	**15 Lt.**	**70**		
Fill Wall	~~82+914~~ 83+640 to ~~82+977~~ 83+694		54	2.2	MBGR
116-117 L	**83+705 to 83+773**	**15 Lt.**	**68**		
Fill Wall	83+706 to 83+771		65	3.0	MBGR
116-117 R	**83+704 to 83+772**	**15 Rt.**	**68**		
Cut Wall	83+733 to 83+771		38	2.0	Soldier Pile
VOI 116 R	**83+784 to 83+931**	**15 Rt.**	**147**		
Cut Wall	83+797 to 83+884		87	2.5	Soldier Pile
115-116 L	**83+784 to 83+851**	**15 Lt.**	**67**		
Fill Wall	83+785 to 83+833		48	3.1	MBGR
112-115 L	**83+864 to 84+241**	**15 Lt.**	**377**		
Fill Wall	83+864 to 83+920		56	2.3	MBGR
Fill Wall	84+009 to 84+023		14	1.9	MBGR

General Fill Wall Recommendations

For fill wall heights up to a 1.0 m of exposed wall face, non-preapproved, non-proprietary modular block walls without geosynthetic reinforcement can be constructed adjacent to the right-of-way boundary. Walls in fills greater than one meter in height will require additional base width in order to accommodate wall reinforcement. Utilities should be relocated prior to wall construction to minimize the damage to the MBGR walls. Utilities should not be placed beneath the walls or within the reinforcement. If the utilities require some repair during the life of the wall, the resulting excavation could damage the MBGR walls. For exposed wall heights up to 1.0 m, the level of damage may be acceptable to the Region with minimal repair work required. For fill walls with exposed wall heights greater than 1.0 m in height, the walls will require reinforcement, 2 m (minimum), behind the face of wall. The wall reinforcement will be placed under the proposed sidewalk. Repair to the utilities could cause severe damage to the wall system. If utilities are required to be placed under the sidewalk area of the fill walls greater than 1.0 m of exposed wall face, standard reinforced concrete retaining walls are recommended. A standard type wall system will require more room to build and they will likely fall outside the existing right-of-way. It is likely that additional right-of-way or a permanent construction easement or agreement from the adjacent property owner will be required for construction of standard reinforced concrete walls.

The fill walls for this project will have a maximum design height of approximately 3.0 m. The walls will have an ultimate exposed wall face of 2.7 m. The existing fill consists of medium dense sands and gravels underlain by dense to very dense sands and gravels. The settlement should be 25 mm or less and will occur during construction. Post construction settlement will be negligible. The exceptions are discussed below.

The general cases for various masonry block wall heights are shown as typical sections in the attached Figures 1 through 3. The walls are designed in accordance to the ASSHTO 1998 Interim Standard Specifications for Highway Bridges. We have limited the maximum spacing (S_v) between layers of reinforcement between 400 mm and 600 mm. The strength of the geosynthetic will depend on the spacing selected by the contractor for construction.

For the geosynthic reinforcement, we recommend that one strength be used throughout the wall. The strength required will depend on the spacing (S_v) between the reinforcement layers. All fill walls for this project are class 2 walls. Therefore, the Qualified Products List for Geosynthetic Retaining Walls Tables 1and 2 may be used. The reinforcement should meet or exceed the long-term tensile strength (T_{al}) for the following conditions:

Condition	Reinforcement Spacing	Minimum Long-term tensile strength
Horizontal back slope	S_v = 400 mm	T_{al} = 10.6 kN/m
	S_v = 600 mm	T_{al} = 16.0 kN/m

The special provisions required for the PS&E are included in Appendix D.

General Cut Wall Recommendations

In cut sections greater than one meter, we recommend using a cantilever soldier pile wall system. The soldier pile wall system requires a minimal wall space of approximately one meter in width to construct. The wall facing, in general, is 0.3 m thick with a 0.5 m concrete drainage gutter. Bridge and Structures will need to be contacted to provide design recommendations for the PS&E. Wall systems such as pre-approved proprietary mechanical stabilized earth (MSE) walls or non-preapproved non-proprietary modular block (MBGR) walls can be built. Standard plan reinforced concrete walls are also feasible. The MBGR and MSE walls need a minimum base width of approximately 0.7 H for a reinforcement zone behind the wall fascia. This does not include room for drainage or room for temporary excavation slopes during construction. If the Region would like to pursue these alternatives our office can provide recommendations at the Region's request.

We recommend cantilever soldier pile walls for cut sections along Walls 140-146 L, 116-117 L, and VOI-116 R. The walls will require a special design by Bridge and Structures. We have provided the earth pressure diagrams needed for design in the attached Figures 4, 5, 6 and 7. Wall 140-146 L has two different designs as shown in Figures 4 and 5. Figure 4 shows the case of a parking area behind the wall. Figure 5 shows the case of a 2H:1V slope with an undeveloped lot behind the wall. Figures 6 and 7 show walls along residential lots with a 2.5 H:1V slope and a horizontal back slope, respectively.

Wall Specific Recommendations

Walls 141-143 R and 123-124 R

We recommend looking into the feasibly of regrading the cuts in the vicinity of Walls 141-143 R and 123-124 R. The cut slopes will be approximately one meter in height. Cut slopes of 1.75H:1V or flatter will be stable in the native soils. Wall 141-143 R is adjacent to the existing right-of-way boundary. For Wall 123-124, the right-of-way boundary is 3 m to 6 m behind the proposed wall face. This will allow room for 1.75H:1V or flatter cuts to be constructed. A wall may not be needed at these sites.

Wall 123-125 L

There are two areas in this section where the exposed wall heights will be above 1.0 m. The first area is a fill in front of a Speedy Car Wash and Munson Realty properties. A small rock wall is located along the right-of-way boundary between approximate Stations 82+926 and 82+957 with loose foundation soils encountered to the bottom of the wall elevation. The second area is a cut which intersects an existing rock wall between approximate Stations 83+010 and 83+028. The new wall face will be at the existing right-of-way line.

The fill wall section is between Stations 82+914 and 82+977. The wall will vary in height up to 2.6 m. We recommend that the existing rock wall adjacent to the right-of-way boundary be removed prior to constructing the new wall. This will place the base of the wall at approximate elevation 94.7 meters. In test hole H-4-98, ground water was encountered at approximate elevation 94.8 meters on June 2, 1998. Wet ground conditions should be

expected during late September thought June at this site. Dewatering methods may be required to construct the wall in the dry.

We recommend that the existing rock wall between approximate Stations 83+010 and 83+028 be moved back from its present location to right-of-way line. The rock wall is approximately 2.0 meters in height. Typically we have required rock walls of this height to have a face batter of 6H:1V with a minimum embedment of 0.3 meters. The base width of the rock wall should be no less that 33 % of the wall height. The Standard Specifications for Rock Wall should be used. If moving the rock wall is not possible, we recommend a soldier pile wall be constructed. Figure 7 can be used to determined the earth pressured for the wall design.

Walls 115-116 L and 112-115 L

We encountered loose foundation soils in test holes, H-7-98, and H-9-98 which are in the vicinity of the highest section of Walls 115-116 L and 112-115 L, respectively. We recommend over-excavating and recompacting the native poorly graded gravel with silt and sand, as shown in Figure 8. The over-excavation is need to mitigate settlement under the wall. Settlements should be 65 mm or less at these sites once recompaction is performed. The soil should be compacted using Method C (95% of maximum density). Ground water may be encountered near the base of the excavation. Therefore, we do not recommend using a vibratory compaction methods for the recompaction of the native soils, static methods of compaction should be used. The limits of over-excavation are given in Figure 8. Please note that this option will likely require temporary shoring in order to maintain the existing roadway section.

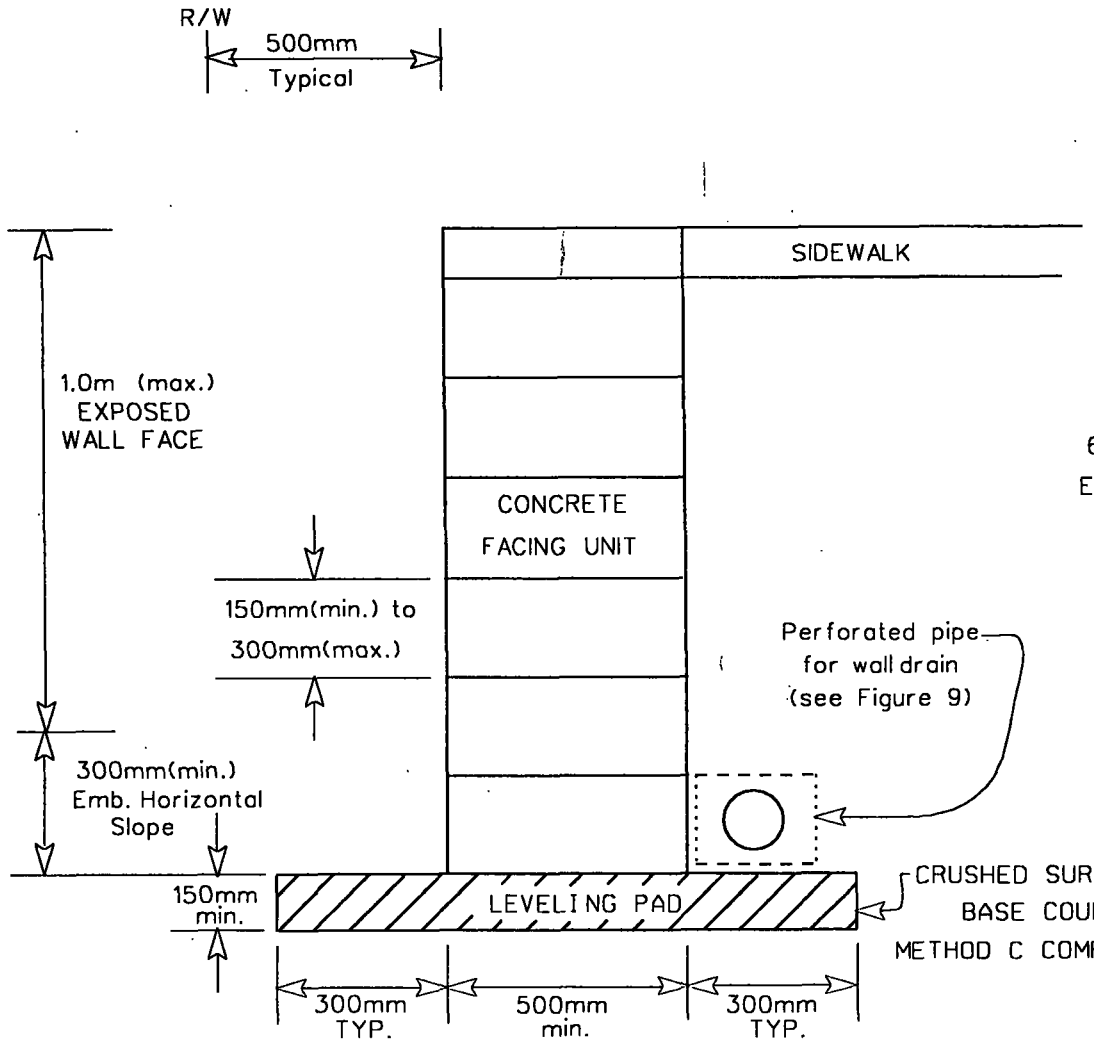
CLOSURE

The foundation recommendations are summarized within the text of the geotechnical addendum and the attached figures. We have provided a plan view showing the approximate test hole locations relative to the new wall site in Appendix A. Logs of Test Borings and Laboratory Data are included in Appendix B and Appendix C respectively. A copy of the special provision required for Modular Block Geosynthetic Walls is included in Appendix D.

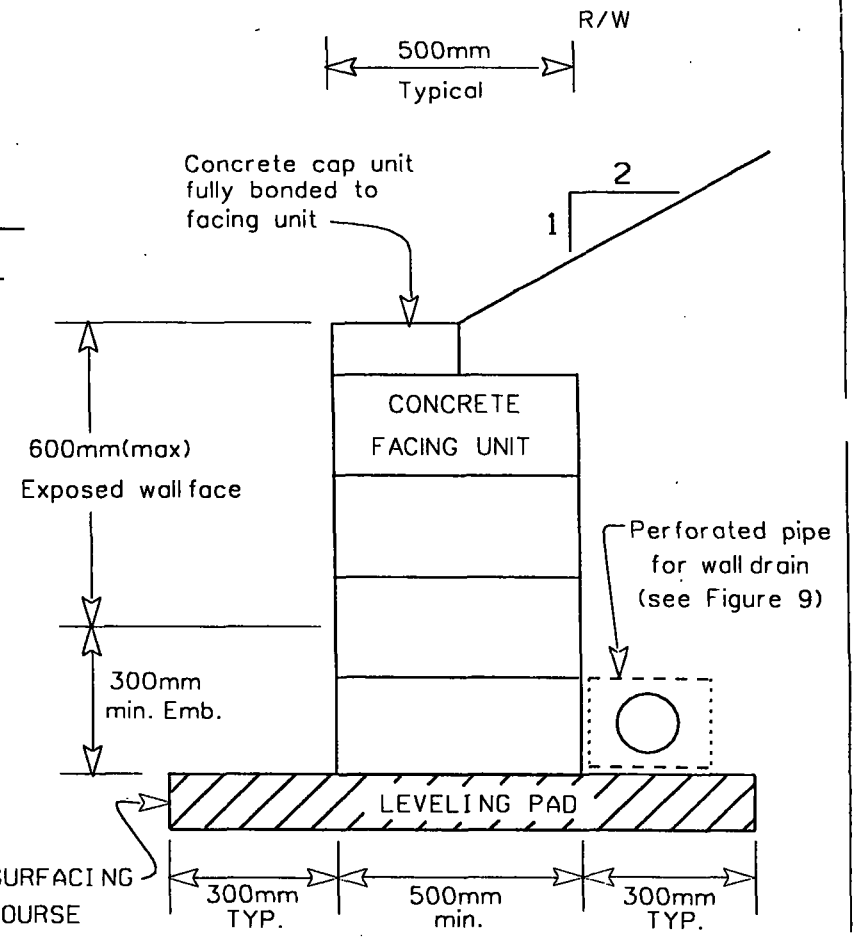
If you have any questions regarding this memorandum, please contact Donald Williams at (360) 709-5457.

TMA:daw
DAW
Attachments

cc: K. N. Kirker / Munindra Talukar, Bridge and Structures, 47340
Jerry Weigel, FOSSC Construction, 47354-2B21
Alex Young, Principal Architect, 47340
Mel Hitzke, Materials Engineer, Olympic Region, 47440



FILL WALL SECTION TO
HORIZONTAL CUT SECTION



CUT SECTION WITH
2:1 BACK SLOPE

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SR-507 TO SR-512 STAGE 2
M.P. 47.94 TO M.P. 52.54

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FIGURE 1 - TYPICAL MODULAR BLOCK WALL DETAILS
(VERTICAL, WALL FACE WITH NO REINFORCEMENT)

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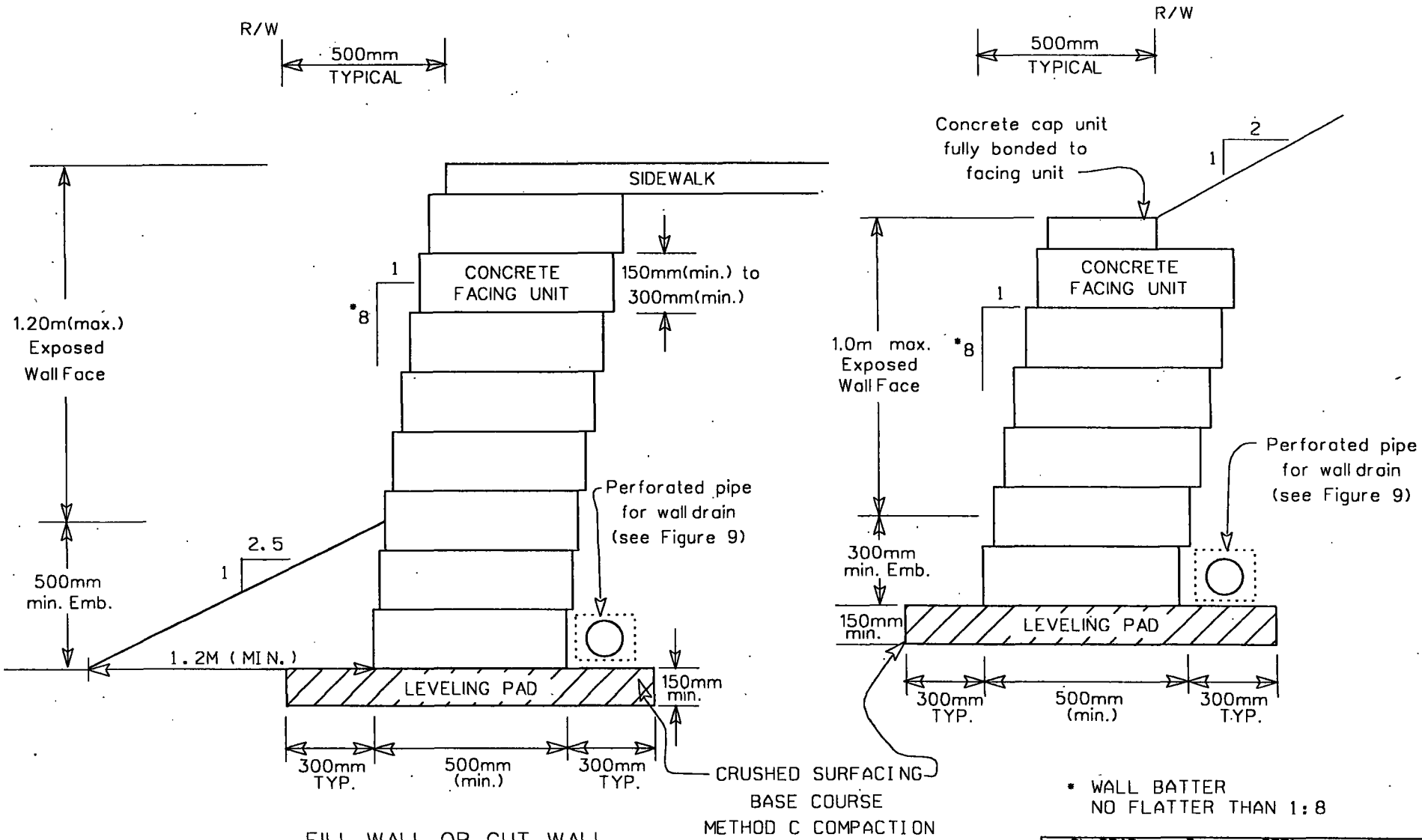

FILL WALL OR CUT WALL
WITH HORIZONTAL BACK SLOPE

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FIGURE 2 - TYPICAL MODULAR BLOCK WALL DETAILS
(SLOPING WALL FACE WITH NO REINFORCEMENT)

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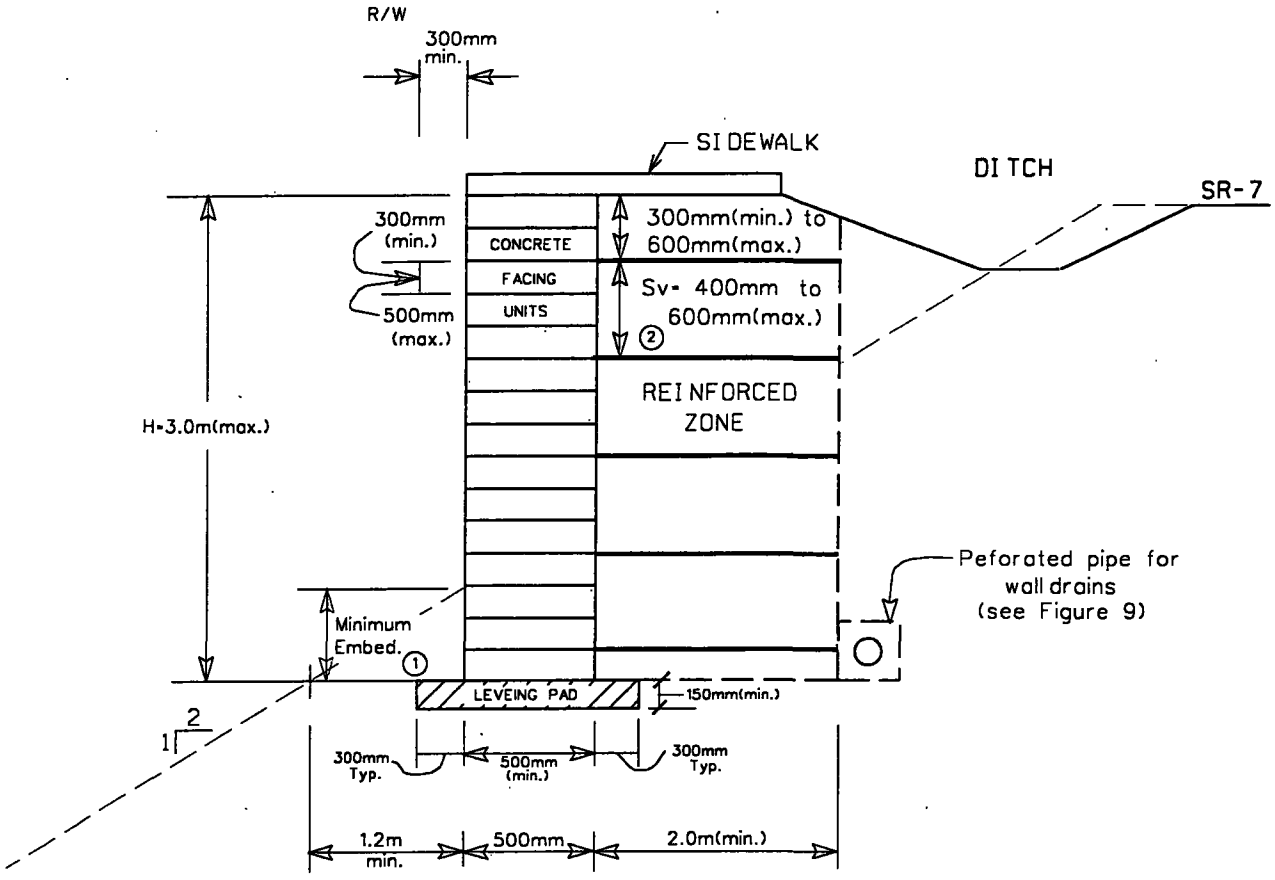

NOTES: (1) Minimum embedment varies with the embankement slope at the front face of the wall.
Horizontal slope=300mm
2H:1V slope=600mm

(2) Reinforcenent spacing,Sv,will affect the geosynthetic strength (Tal) required for the wall.

Sv=400mm	Tal=10.6 kN/m
Sv=600mm	Tal=16.0 kN/m

FIGURE 3: TYPICAL MBGR WALL DETAILS
VERTICAL WALL FACE
WITH REINFORCEMENT

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SR-507 TO SR-512 STAGE 2
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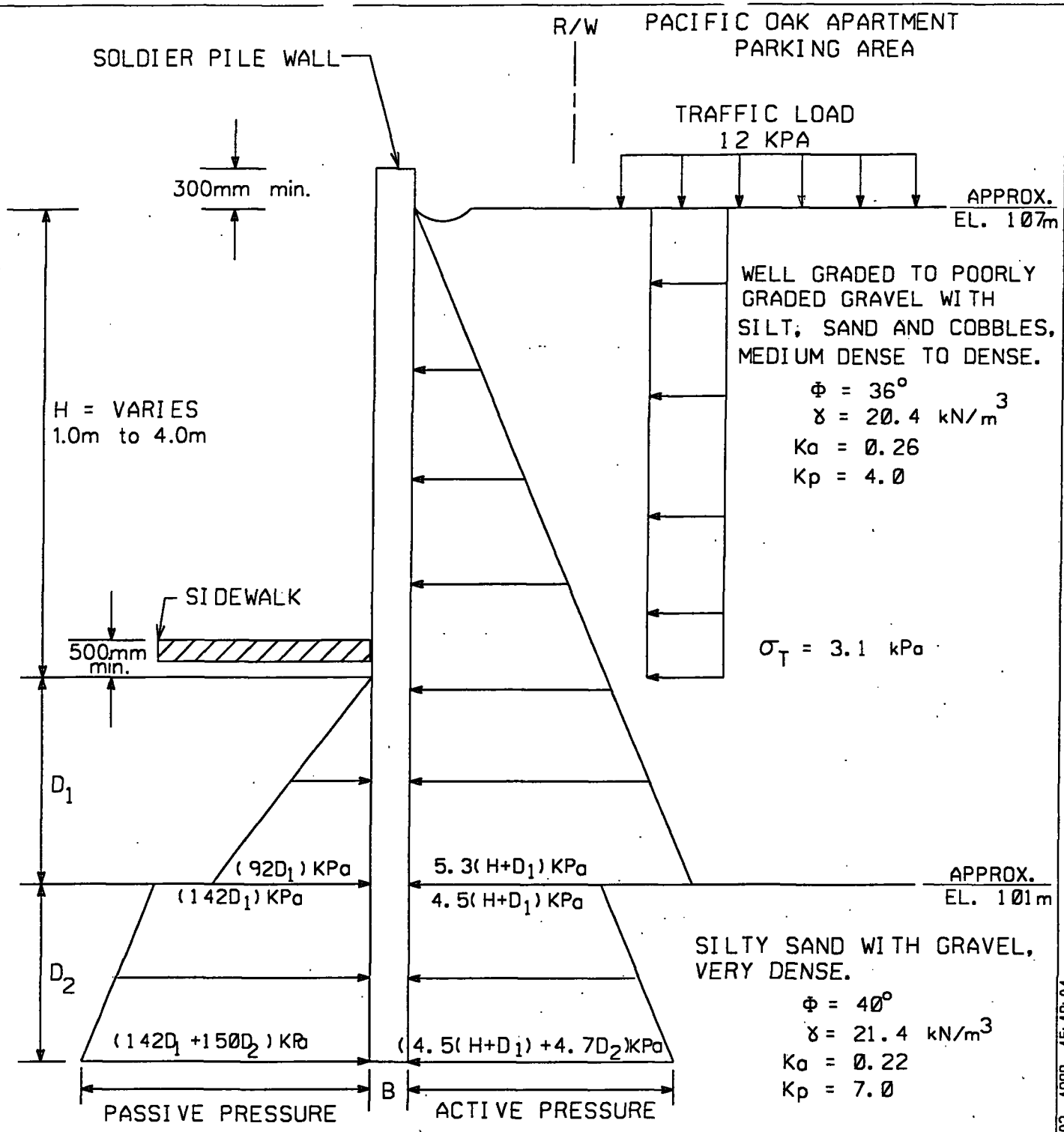

NOTES: (1) ACTIVE PRESSURE IS GIVEN AS $\sigma_a = K_a \gamma H$

(2) PASSIVE PRESSURE IS GIVEN AS $\sigma_p = K_p \gamma H$

Kp INCLUDES A FACTOR OF SAFETY OF 1.5(Kp/1.5).

PASSIVE PRESSURE MAY BE TAKEN TO ACT OVER THREE SOLDIER PILE DIAMETERS WHERE PILES ARE SPACED GREATER THAN 3.0

FIGURE 4: TYPICAL EARTH PRESSURE DIAGRAM FOR WALL 140-146L BETWEEN STATION 80+972 TO STATION 81+015

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SR-507 TO SR-512 STAGE 2

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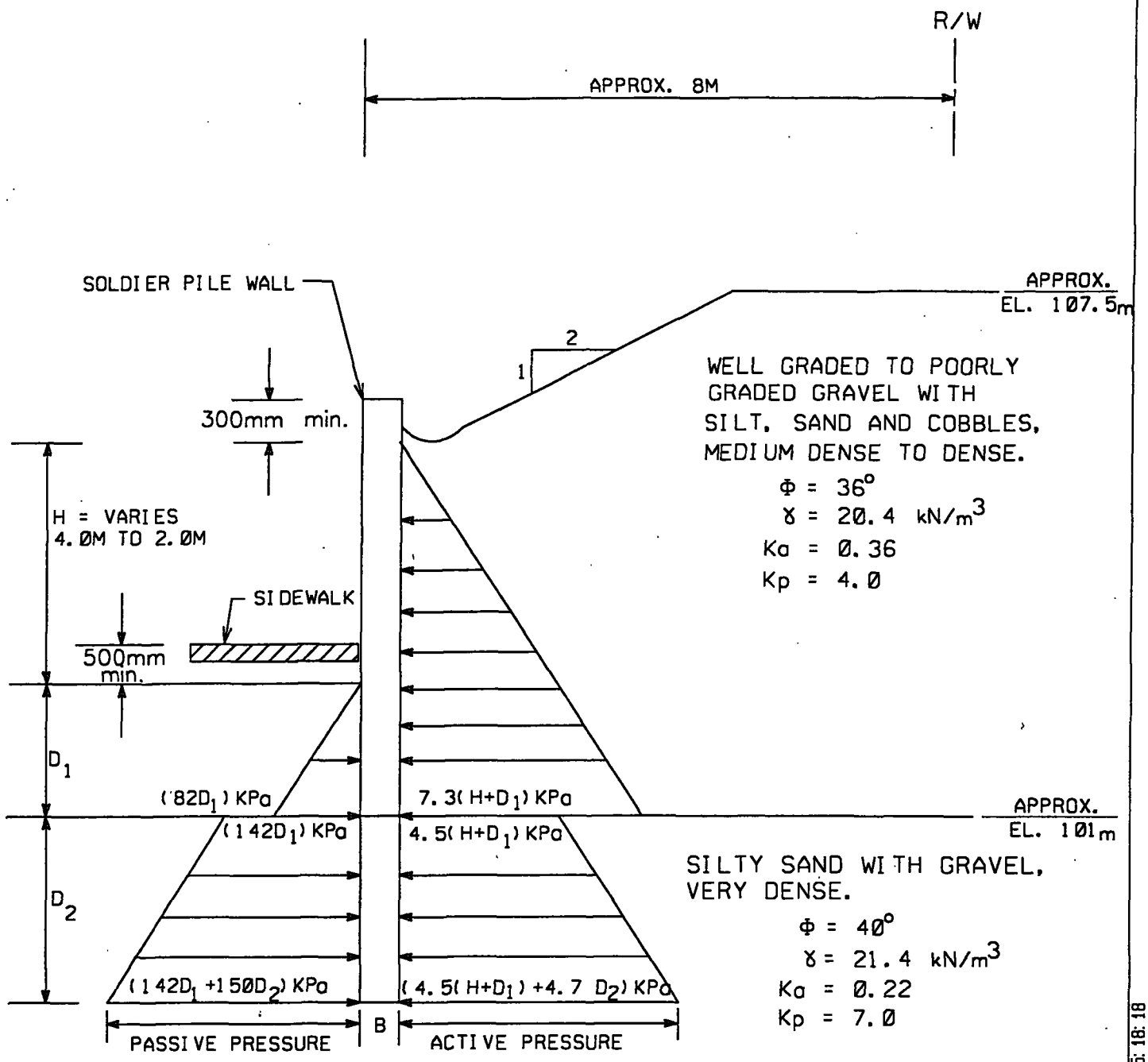

NOTES: (1) ACTIVE PRESSURE IS GIVEN AS $\sigma a = Ka \gamma H$

(2) PASSIVE PRESSURE IS GIVEN AS $\sigma p = Kp \gamma H$

Kp INCLUDES A FACTOR OF SAFETY OF 1.5(Kp/1.5).

PASSIVE PRESSURE MAY BE TAKEN TO ACT OVER THREE SOLDIER PILE DIAMETERS WHERE PILES ARE SPACED GREATER THAN 3.0

FIGURE 5: TYPICAL EARTH PRESSURE DIAGRAM FOR WALL 140-146L BETWEEN STATION 81+015 TO STATION 81+041

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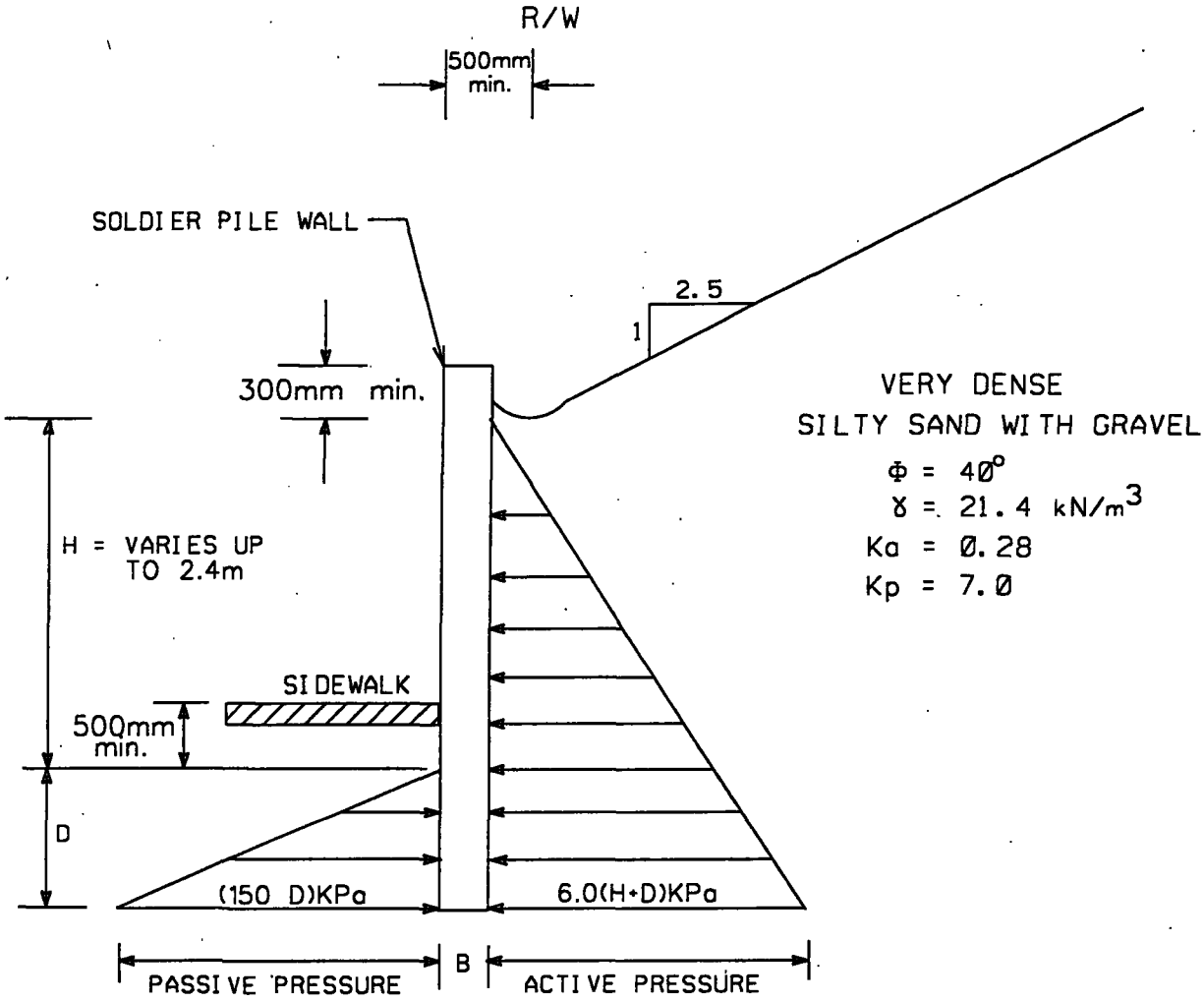

NOTES: USE FIGURE 5 DETENTS

FIGURE 6: TYPICAL EARTH PRESSURE DIAGRAM FOR WALL 116-117R BETWEEN STATION 83+733 TO STATION 83+770

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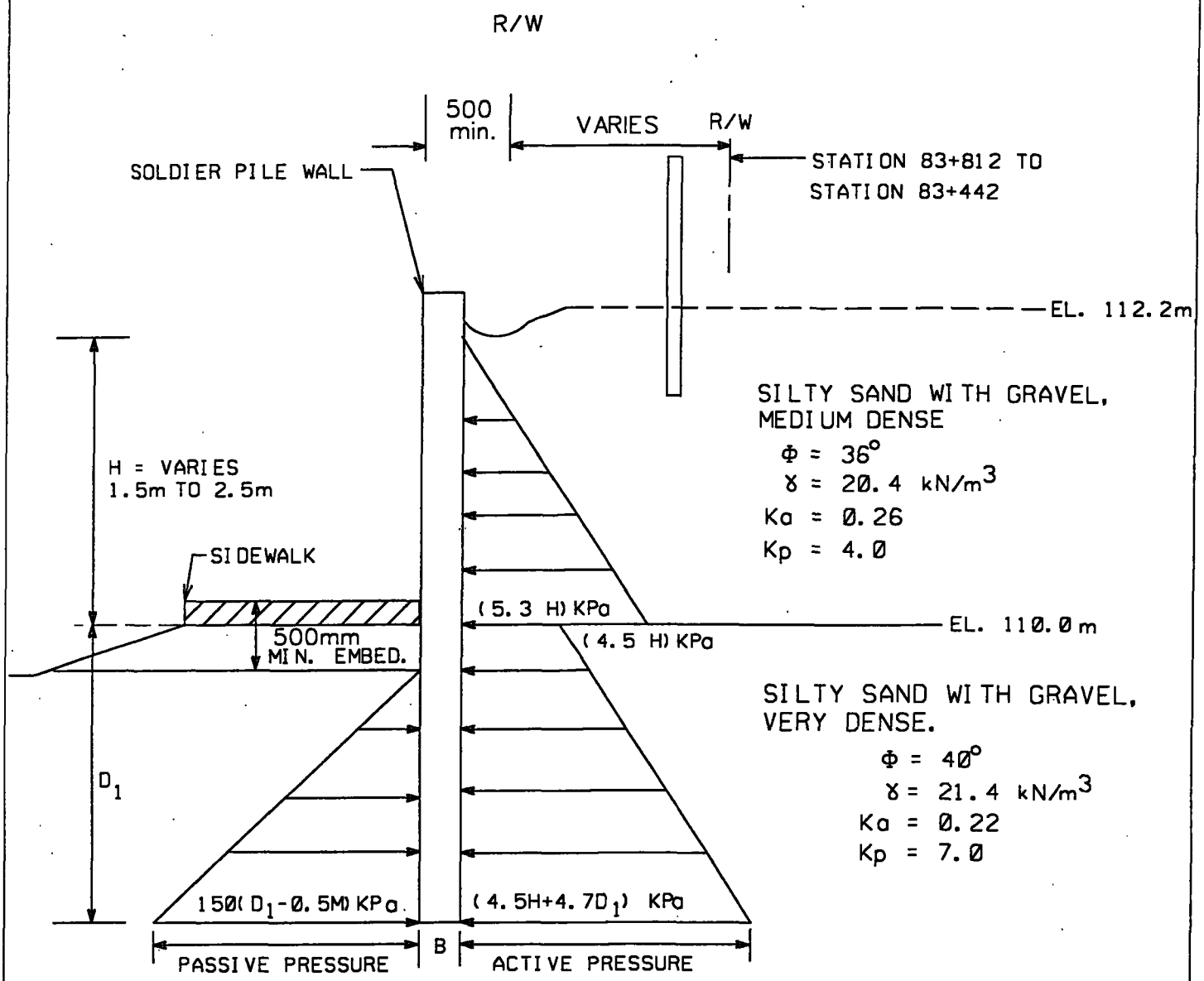

NOTES: (1) ACTIVE PRESSURE IS GIVEN AS $\sigma_a = K_a \gamma H$

(2) PASSIVE PRESSURE IS GIVEN AS $\sigma_p = K_p \gamma H$

Kp INCLUDES A FACTOR OF SAFETY OF 1.5(Kp/1.5).

PASSIVE PRESSURE MAY BE TAKEN TO ACT OVER THREE SOLDIER PILE DIAMETERS WHERE PILES ARE SPACED GREATER THAN 3.0

FIGURE 7: TYPICAL EARTH PRESSURE DIAGRAM FOR WALL VIO 116 BETWEEN STATION 83+797 TO STATION 83+884 WALL 123-125 L BETWEEN STATION 83+010 to STATION 83+028

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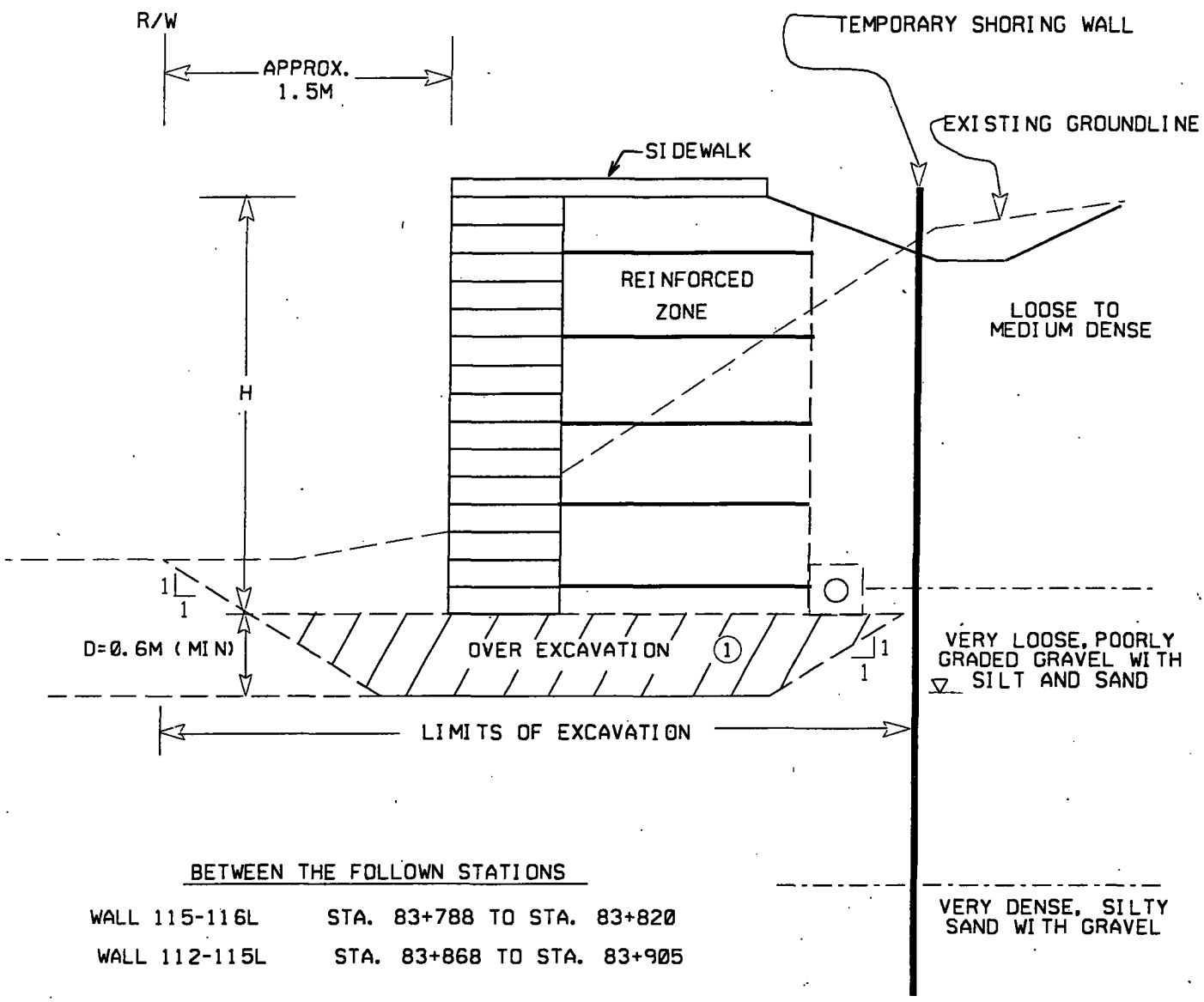

BETWEEN THE FOLLOWN STATIONS

WALL 115-116L	STA. 83+788 TO STA. 83+820
WALL 112-115L	STA. 83+868 TO STA. 83+905

FIGURE 8: TYPICAL OVER-EXCAVATION LIMITS

NOTES: (1) OVER EXAVATE AND RECOMPACT NATIVE SOIL TO 95% OF MAXIMUM DENSITY

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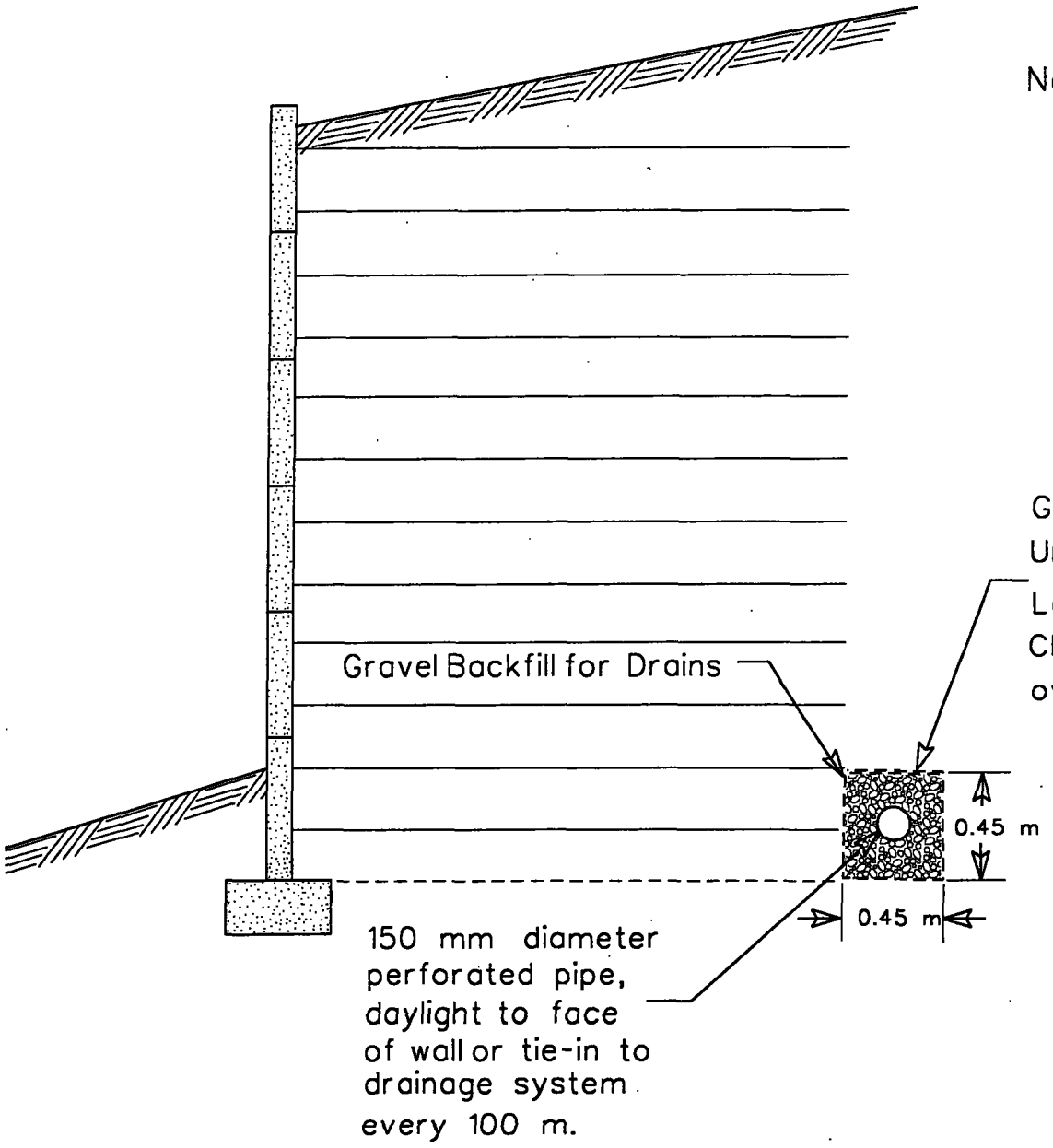

WALL DRAINAGE DETAIL

FIGURE 9

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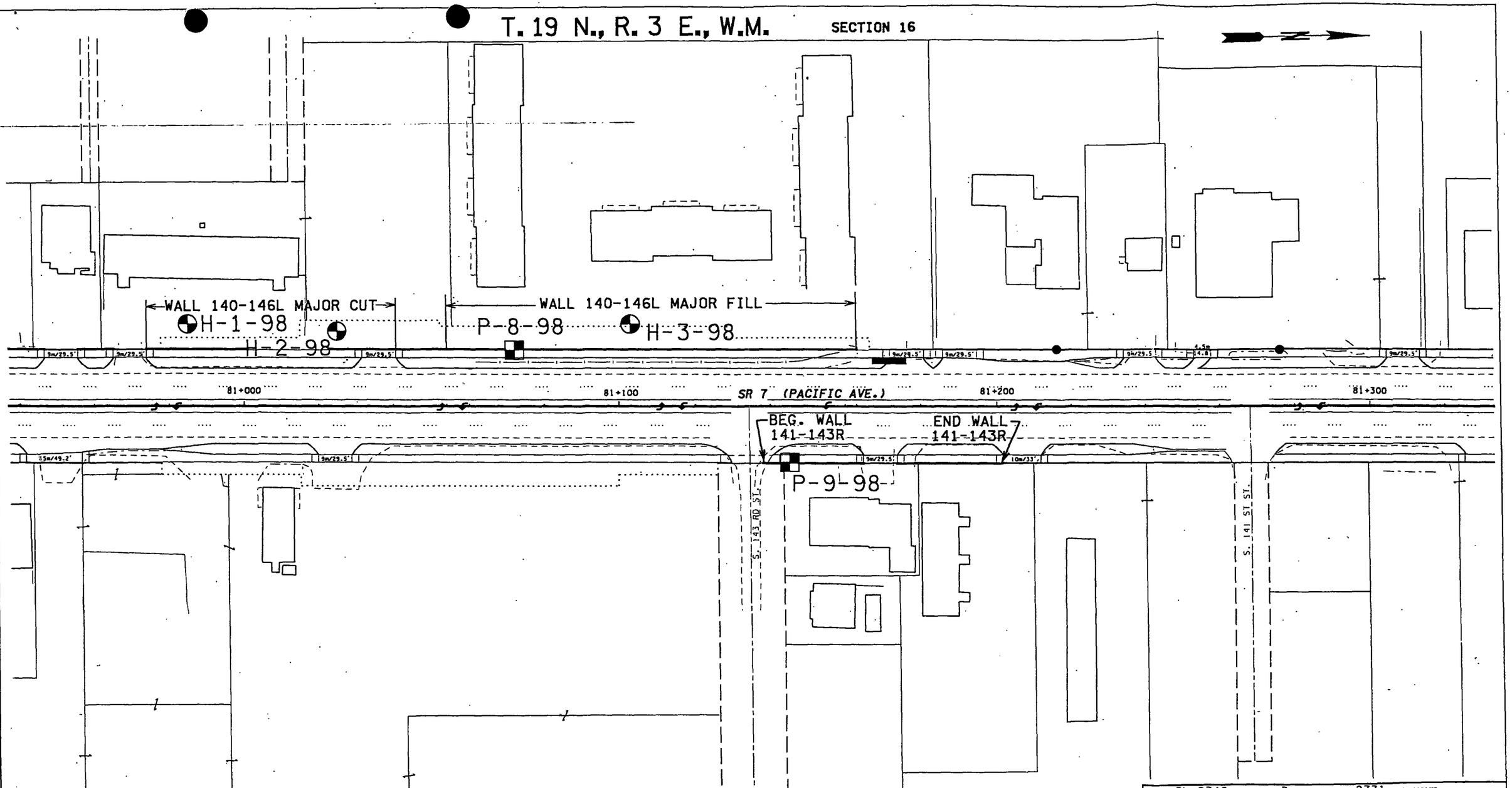
APPENDIX - A

Test Hole Plan -- SR-7 Alignment

ITEM	LOCATION	SHEET No.
Wall 140-146 L	L 80+800 to L 81+050	1 of 7
Wall 141-143 R & Wall 140-146 L	L 80+050 to L 81+330	2 of 7
Wall 140-146 L	L 81+240 to L 81+630	3 of 7
Wall 124- 127 R to Wall 123-125 L	L 82+650 to L 83+030	4 of 7
Wall 123-124 R	L 82+990 to L 83+380	5 of 7
Wall 118-199 L to Wall 117-118 L	L 83+360 to L 83+730	6 of 7
Wall 116 -117 R&L to Wall 112-115 L	L 83+680 to L 84+030	7 of 7



LEGEND

- ● - TEST HOLE BORING LOCATION
- ■ - PORTABLE PENETROMETER TEST HOLE LOCATION
- ● - HAND PROBE

TEST HOLE PLAN

JOB OL-2740 S.R. 7 C.S. 2771 LAYOUT

SR-507 TO SR-512, STG. 2

M.P 47.94 TO M.P. 52.54

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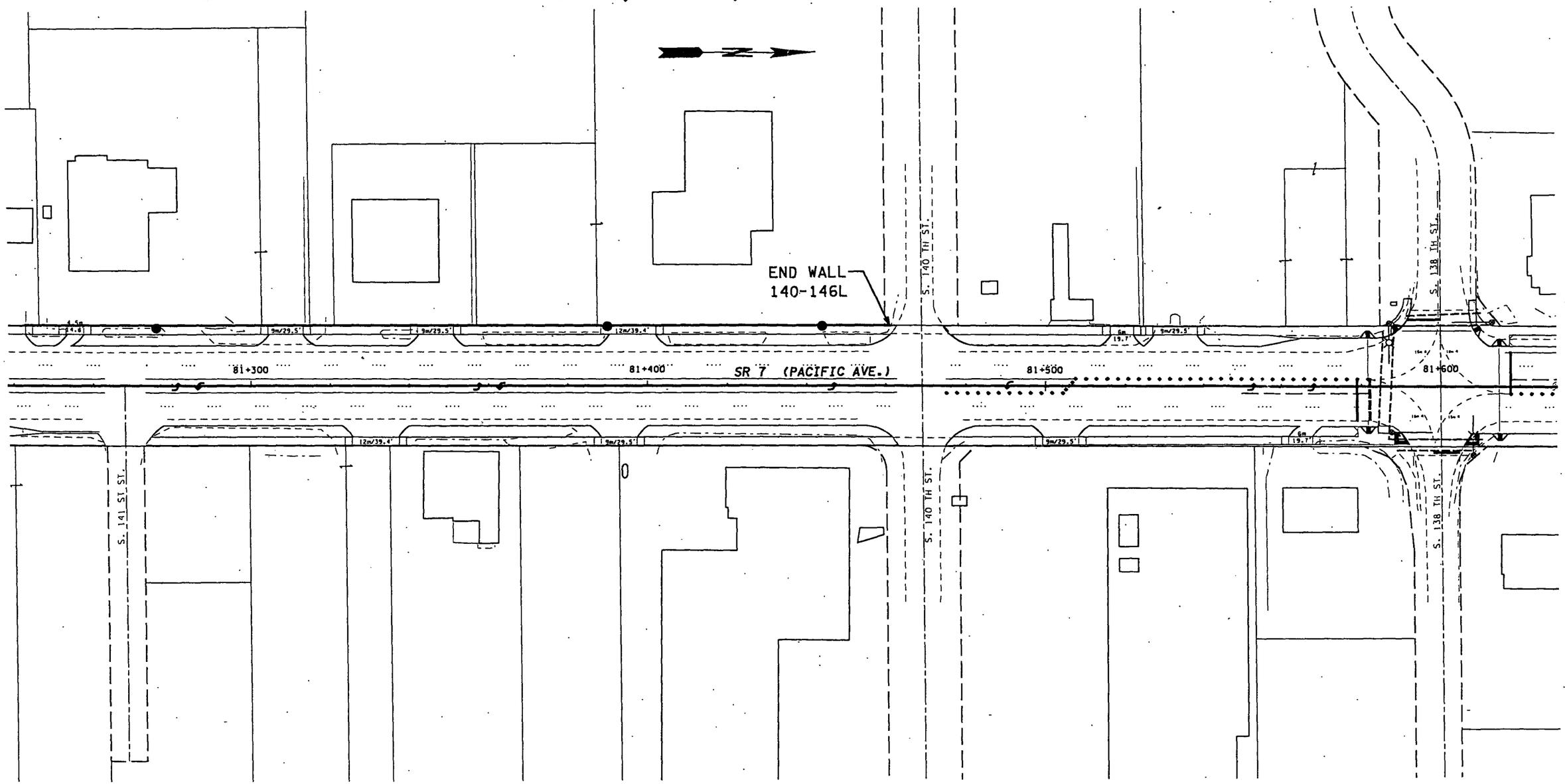
SECTION 16



LEGEND

- TEST HOLE BORING LOCATION
- PORTABLE PENETROMETER TEST HOLE LOCATION
- HAND PROBE

TEST HOLE PLAN

JOB OL-2740 S.R. 7 C.S. 2771 LAYOUT

SR-507 TO SR-512, STG. 2

M.P 47.94 TO M.P. 52.54

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DATE: JULY 1998

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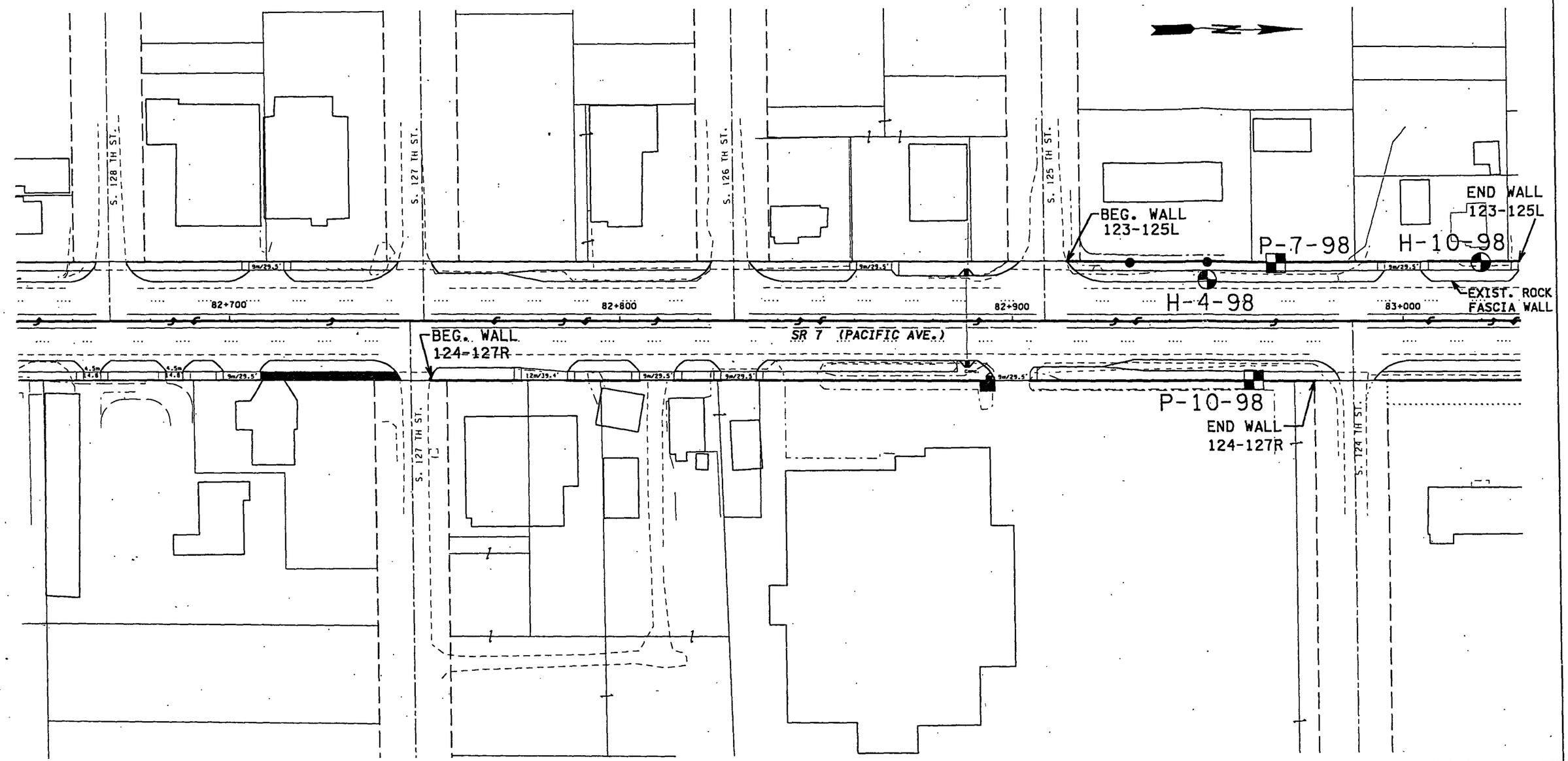
SECTION 09



LEGEND

- ◐ - TEST HOLE BORING LOCATION
- ■ - PORTABLE PENETROMETER TEST HOLE LOCATION
- ● - HAND PROBE

TEST HOLE PLAN

JOB OL-2740 S.R. 7 C.S. 2771 LAYOUT

SR-507 TO SR-512, STG. 2

M.P 47.94 TO M.P. 52.54

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DATE: JULY 1998

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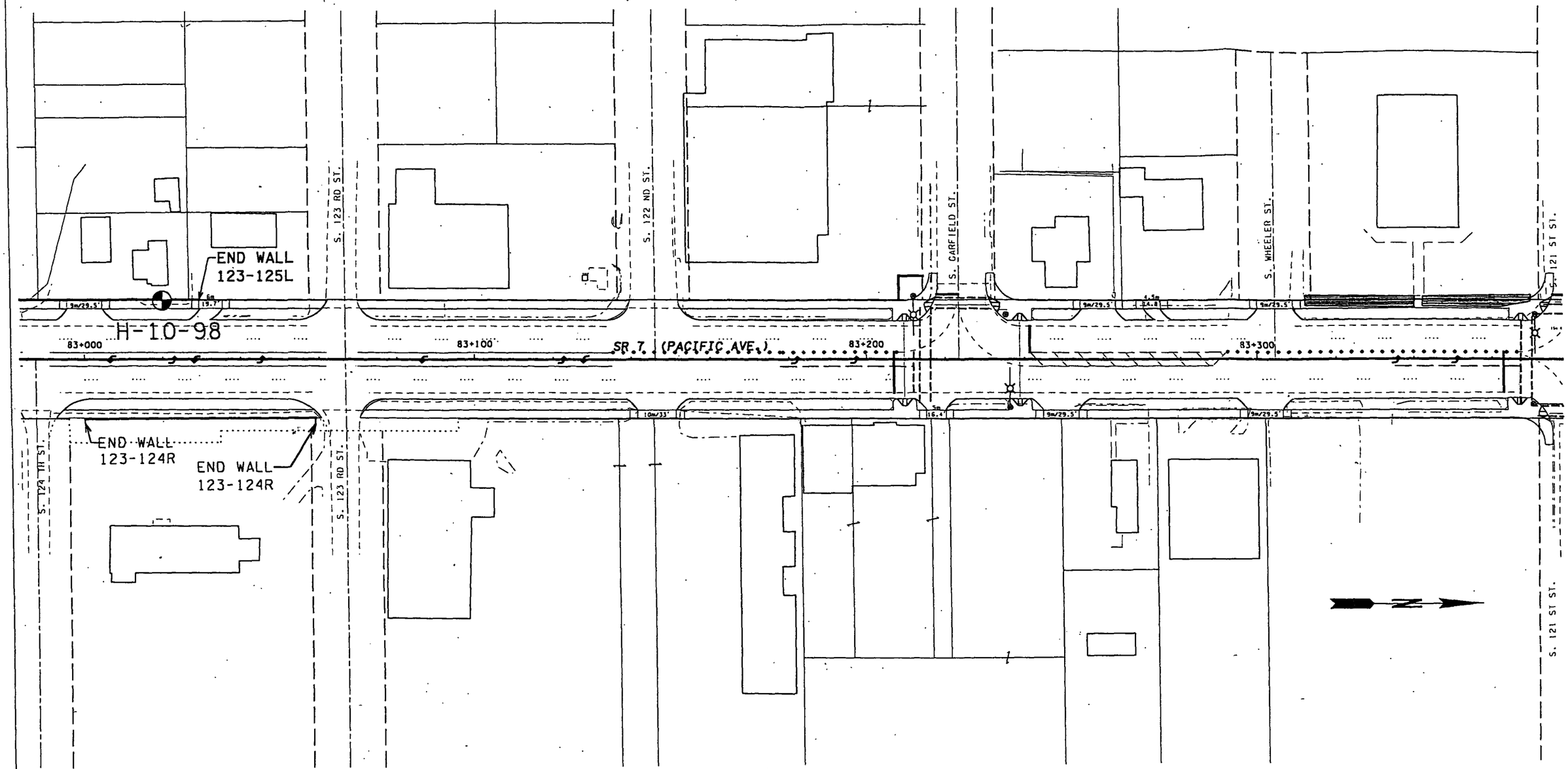

LEGEND

- TEST HOLE BORING LOCATION
- PORTABLE PENETROMETER TEST HOLE LOCATION
- HAND PROBE

TEST HOLE PLAN

JOB OL-2740 S.R. 7 C.S. 2771 LAYOUT

SR-507 TO SR-512, STG. 2

M.P 47.94 TO M.P. 52.54

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MATERIALS BRANCH

R. C. FINKLE MATERIALS ENGINEER

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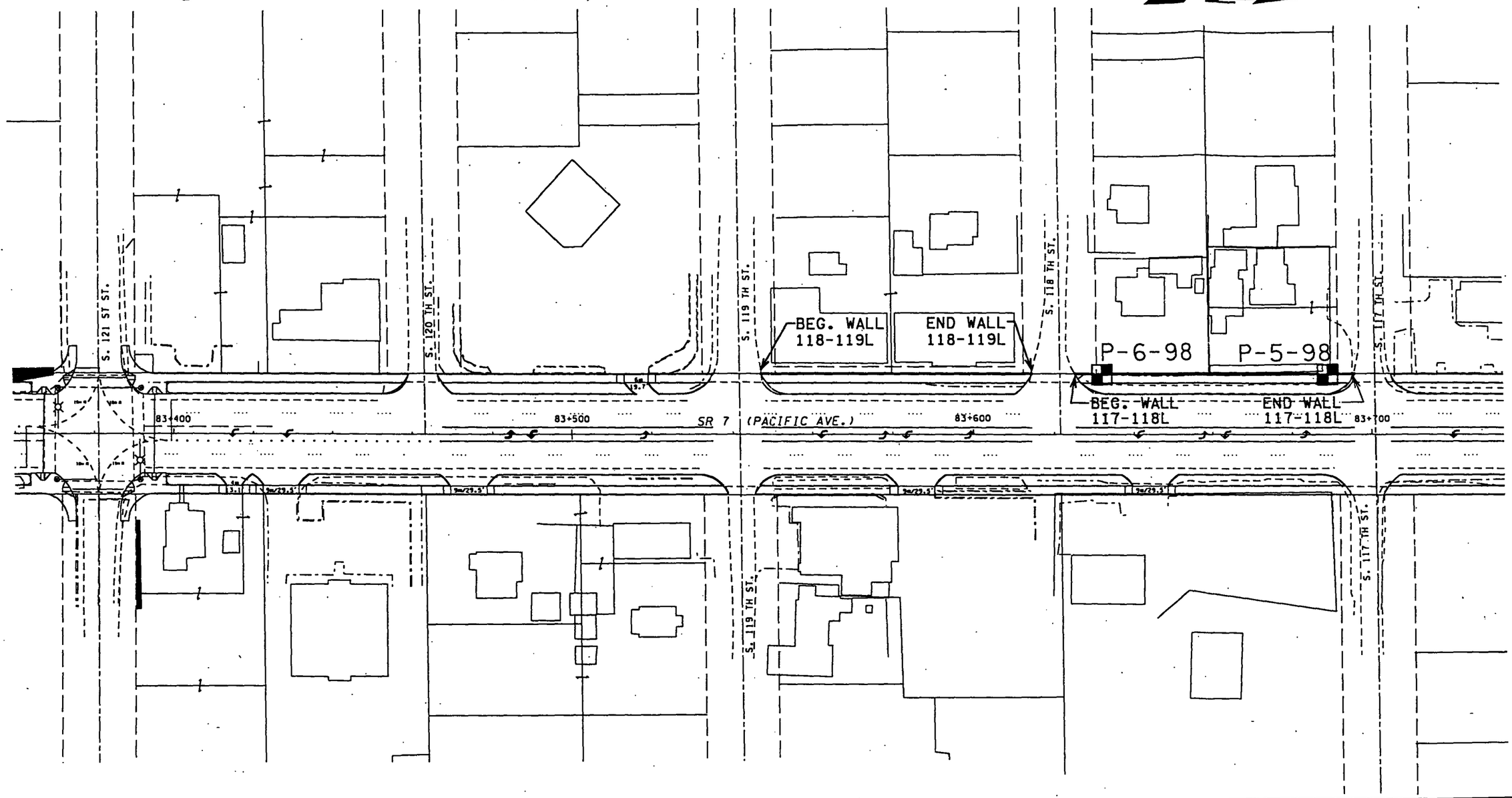

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M.P 47.94 TO M.P. 52.54

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SHEET 6 OF 7

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LEGEND

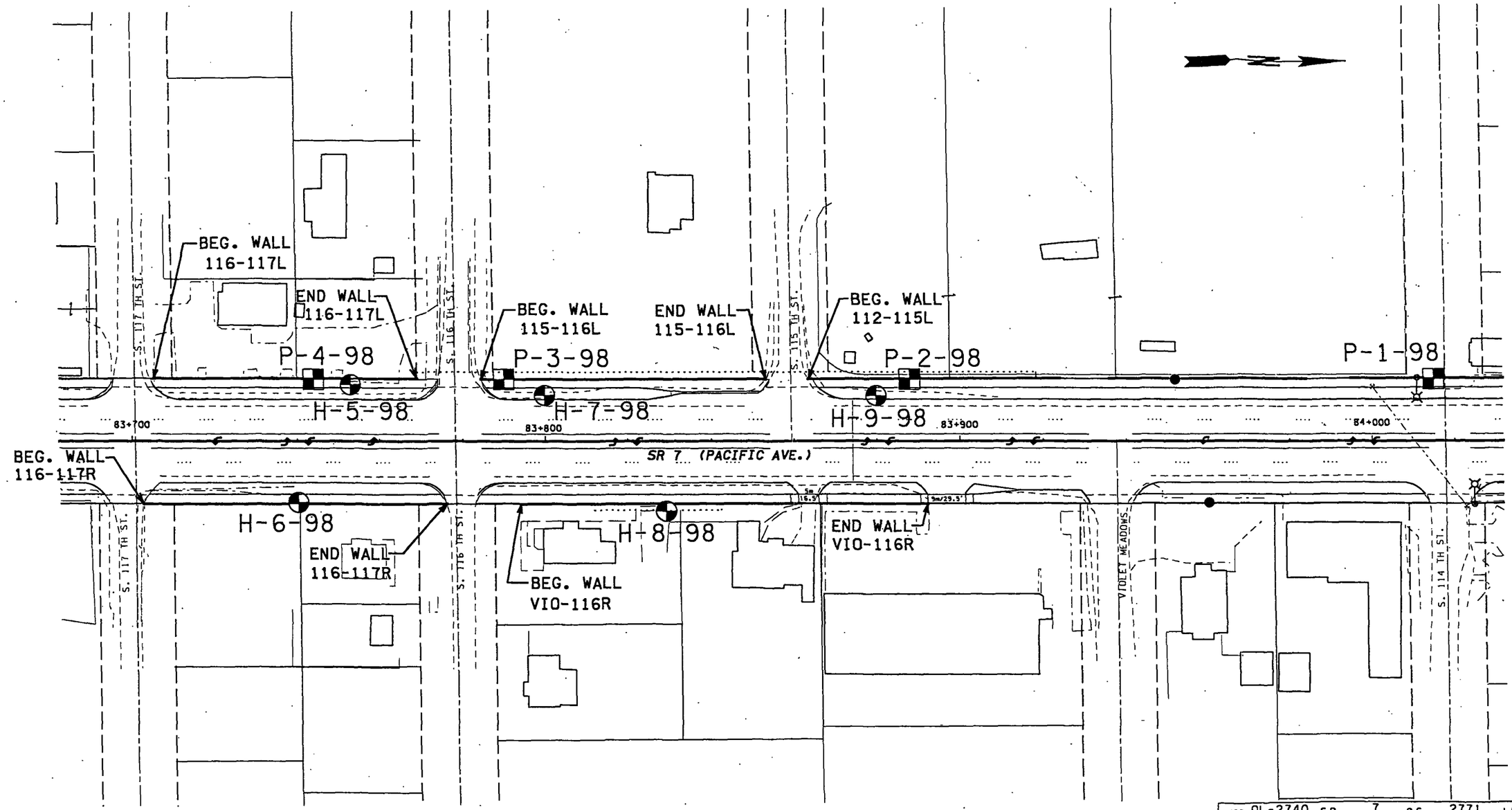
- TEST HOLE BORING LOCATION
- PORTABLE PENETROMETER TEST HOLE LOCATION
- HAND PROBE

TEST HOLE PLAN

c:\dgn\sr507tosr512\review.dgn Jul. 23, 1998 09:20:42

T. 19 N., R. 3 E., W.M.

SECTION 09



JOB OL-2740 S.R. 7 C.S. 2771 LAYOUT

SR-507 TO SR-512, STG. 2

M.P 47.94 TO M.P. 52.54

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION

MATERIALS BRANCH

R. G. FINKLE MATERIALS ENGINEER

DATE: JULY 1998
SCALE NS VERT.
1:100 HORIZ.
SHEET 7 OF 7
DRAWN BY PAA

LEGEND

- TEST HOLE BORING LOCATION
- PORTABLE PENETROMETER TEST HOLE LOCATION
- HAND PROBE

TEST HOLE PLAN

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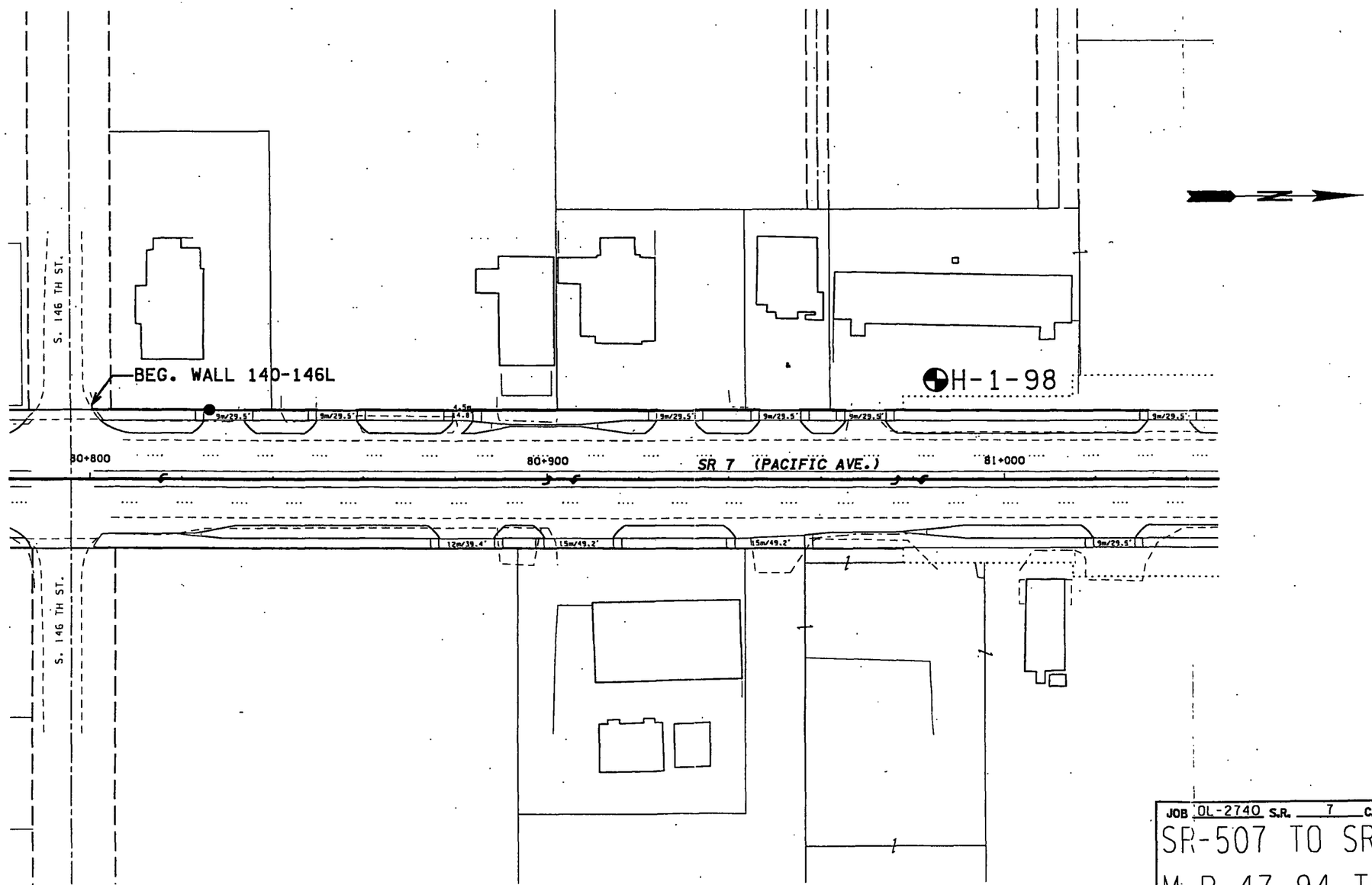
T. 19 N., R. 3 E., W.M.

SECTION 21



LEGEND

- TEST HOLE BORING LOCATION
- PORTABLE PENETROMETER TEST HOLE LOCATION
- HAND PROBE

TEST HOLE PLAN

JOB OL-2740 S.R. 7 C.S. 2771 LAYOUT

SR-507 TO SR-512, STG. 2

M.P 47.94 TO M.P. 52.54

WASHINGTON STATE
TRANSPORTATION COMMISSION
DEPARTMENT OF TRANSPORTATION

MATERIALS BRANCH

R. MOORE MATERIALS ENGINEER

DATE: JULY 1998

SCALE NS VERT.
1:100 HORIZ.

SHEET 1 OF 7

DRAWN BY PAA

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APPENDIX - B

Logs of Test Borings

Table 9.7
Typical Values of Optimum Moisture Content and Suggested Compactions (Based on Standard Proctor Test)

class group symbol	description	range of maximum dry densities lbm/ft^3	range of optimum moisture content %	recommended percentage of Proctor maximum class 1	2	3
GW	well-graded, clean gravels, gravel-sand mixtures	125–135	11–8	97	94	90
GP	poorly-graded clean gravels, gravel-sand mixtures	115–125	14–11	97	94	90
GM	silty gravels, poorly graded gravel-sand silt	120–135	12–8	98	94	90
GC	clayey gravels, poorly-graded gravel-sand-clay	115–130	14–9	98	94	90
SW	well-graded clean sands, gravely sands	110–130	16–9	97	95	91
SP	poorly-graded clean sands, sand-gravel mix	100–120	21–12	98	95	91
SM	silty sands, poorly-graded sand-silt mix	110–125	16–11	98	95	91
SM-SC	sand-silt-clay mix with slightly plastic fines	110–130	15–11	99	96	92
SC	clayey sands, poorly-graded sand-clay mix	105–125	19–11	99	96	92
ML	inorganic silts and clayey silts	95–120	24–12	100	96	92
ML-CL	mixture of organic silt and clay	100–120	22–12	100	96	92
CL	inorganic clays of low-to-medium plasticity	95–120	24–12	100	96	92
OL	organic silts and silt-clays, low plasticity	80–100	33–21	–	96	93
MH	inorganic clayey silts, elastic silts	70–95	40–24	–	97	93
CH	inorganic clays of high plasticity	75–105	36–19	–	–	93
OH	organic and silty clays	65–100	45–21	–	97	93

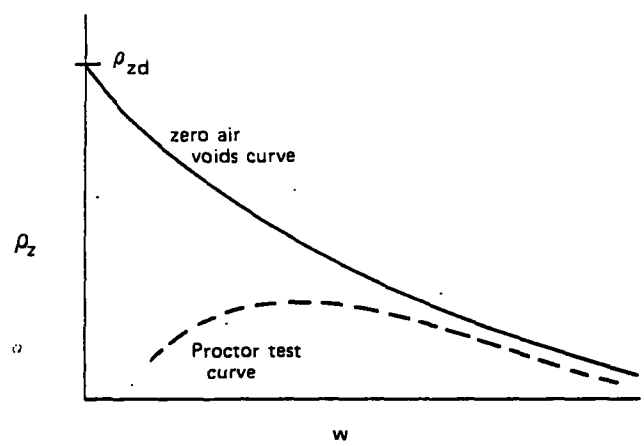


Figure 9.6 A Typical Zero Air Voids Curve

Example 9.4

A Proctor test using a 1/30 ft^3 mold is performed on a sample of soil.

test no.	sample net mass (lbm)	water content (%)
1	4.28	7.3
2	4.52	9.7
3	4.60	11.0
4	4.55	12.8
5	4.50	14.4

If 0.032 cubic feet of compacted soil tested at a construction site weighed 3.87 pounds wet and 3.74 pounds dry, what is the percent of compaction?

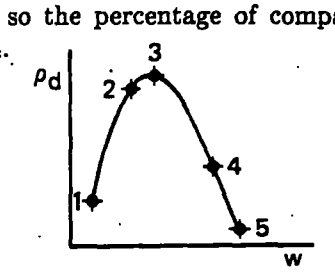
The actual density of sample 1 is (4.28)(30) = 128.4 lbm/ft^3. From equation 9.10, the dry density is

$$\rho_d = \frac{\rho}{1+w} = \frac{128.4}{1+0.073} = 119.7 \text{ lbm/ft}^3$$

The following table is constructed from the results of all 5 tests.

test no.	dry density
1	119.7
2	123.6
3	124.3
4	121.0
5	118.0

If these data are graphed, the following figure results. The peak is near point 3, so take the maximum density to be 124.3 lbm/ft^3. The sample density is 3.74/0.032 = 116.9, so the percentage of compaction is 116.9/124.3 = 0.94.



LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1-98

PROJECT SR-507 to SR-512 | Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 | S.R. 7

Station 80+985 | Offset 21.9m Lt. | C.S. 2771

Equipment CME-55/Auto Hammer | Casing HQ:21'(6.4m) | Ground El 351.3 (107.08 m)

Method of Boring Wet Rotary

Start Date May 28, 1998 | Completion Date May 28, 1998 | Sheet 1 of 2

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top surface: 3"(75mm) asphalt parking lot. 0.2' to 2.0': Well graded GRAVEL.		
	1			16 23 13 12 (36		D-1	MC GS	GW, M.C. = 5% Well graded GRAVEL with sand, subrounded to subangular, dense, dark yellowish brown, wet. Recovered and Retained: 0.8 ft.(240mm)		
5	2			10 10 11 15 (21		D-2		Well graded GRAVEL, subrounded to subangular, medium dense, dark yellowish brown, wet. Recovered and Retained: 0.2 ft.(50mm)		
								Note: Encountered some cobbles at a depth of 7.5 ft. (2.3m) Material change at depth of 7.5 ft. (2.3m).		
10	3			10 9 9 21 (18)		D-3		Well graded GRAVEL with cobbles, subrounded to angular, medium dense, dark yellowish brown, wet. Recovered and Retained: 0.3 ft.(120mm)		
	4									
15	5			10 15 20 16 (35		D-4		Well graded GRAVEL, angular to subangular, dense, dark yellowish brown, wet. Recovered and Retained: 0.5 ft.(150mm)		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-1-98

Sheet 2 of 2

PROJECT SR-507 to SR-512

Job No. OL-2740

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				43 63 (63/6")		D-5	MC GS	SM, M.C. = 10% Silty SAND with gravel, very dense, dark yellowish brown, moist, traces of of dark reddish brown oxidized staining (advance outwash till). Recovered and Retained: 0.8 ft.(240mm)		
								End of the Test Hole Boring at 21.0 ft. (6.4m) below ground elevation.		
	7							Water Table Elevation: Dry hole, not determined.		
25								This is a Summary Log of the Test Hole 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

Washington State Department of Transportation

HOLE No. H-2-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 81+025 — Offset 20.0m Lt. — C.S. 2771

Equipment CME-55/Auto Hammer — Casing HQ:25.0'(7.6m) — Ground El 352.5 (107.44 m)

Method of Boring Wet Rotary

Start Date June 3, 1998 — Completion Date June 3, 1998 — Sheet 1 of 2

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top surface: weeds and grass. 0.0' to 2.0': Silty GRAVEL with cobbles and sand as indicated by drilling.		
	1			5 7 7 6 (14)		D-1		Well graded GRAVEL with cobbles, subrounded to angular, medium dense, dark yellowish brown, moist, traces of silt and root hairs. Recovered and Retained: 0.1 ft.(25mm)		
5	2		> >	45 87 (87/6")		D-2	MC GS	GW, M.C. = 4% Well graded GRAVEL with cobbles, subrounded to angular, very dense, dark yellowish brown, moist. Recovered and Retained: 1.0 ft.(300mm)		
10	3			19 21 16 8 (37)		D-3		Well graded GRAVEL with cobbles, boulders and sand, subrounded to subangular, dense, dark yellowish brown, wet. Recovered and Retained: 1.0 ft.(300mm)		
15	4			10 22 15 30 (37		D-4	MC GS	GW, M.C. = 8% Well graded GRAVEL with cobbles, boulders and sand, subrounded to subangular, dense, dark yellowish brown, wet. Recovered and Retained: 1.0 ft.(300mm)		
20	5 6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-2-98

Sheet 2 of 2

PROJECT SR-507 to SR-512

Job No. OL-2740

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				21 100 (100/6")		D-5		Silty SAND with gravel, very dense, dark yellowish brown, moist, (advanced outwash till) Recovered and Retained: 0.8 ft.(240mm)		
25	7			100/6" (100/6")		D-6		Silty SAND with gravel, very dense, dark yellowish brown, moist, (advanced outwash till) Recovered and Retained: 0.3 ft.(100mm)		
	8							End of the Test Hole Boring at 25.3 ft. (7.7m) below ground elevation.		
								Water Table Elevation: dry hole, not determined.		
30	9							This is a Summary log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	10									
35	11									
40	12									
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-3-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 81+103 — Offset 21.9m Lt. — C.S. 2771

Equipment CME-55/Auto Hammer — Casing HQ:17'(5.2m) — Ground El 311.2 (94.85 m)

Method of Boring Wet Rotary

Start Date May 27, 1998 — Completion Date May 27, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top surface: 3"(75mm) asphalt parking lot		
	1			4 4 7 11 (11)		D-1	MC GS	GP-GM, M.C. = 14% Poorly graded GRAVEL with silt and sand, subrounded to subangular, medium dense, moderate yellowish brown, moist, traces of organics. Recovered and Retained: 1.0 ft.(300mm)		
5	2			8 10 20 31 (30)		D-2		Well graded GRAVEL with sand, subrounded to subangular, dense, moderate yellowish brown, moist, traces of silt and dark reddish brown oxidized staining. Recovered and Retained: 1.0 ft.(300mm)		
								Note: Started drilling harder at depth of 8 ft. (2.4m)		
10	3			9 22 23 22 (45)		D-3	MC GS	GW-GM, M.C. = 6% Well graded GRAVEL with silt and sand, subrounded to subangular, dense, moderate yellowish brown, moist. Recovered and Retained: 0.9 ft.(275mm)		
15	4 5		> >	20 30 31 36 (61		D-4		Well graded GRAVEL with silt and sand, subrounded to subangular, very dense, moderate yellowish brown, moist. Recovered and Retained: 0.9 ft.(275mm)		
20	6							End of the Test Hole Boring at 17 ft. (5.2m) 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 and laboratory test data.		

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-4-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 82+950 — Offset 10.4m Lt. — C.S. 2771

Equipment CME-55/Auto Hammer — Casing HQ:15.0'(4.6m) — Ground El 316.0 (96.32 m)

Method of Boring Wet Rotary

Start Date June 2, 1998 — Completion Date June 2, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top Surface: 4"(100mm) thick asphalt shoulder 0.3' to 2.0': GRAVEL with sand.		
	1			7 8 16 10 (24)		D-1		Well graded GRAVEL with sand, angular to subangular, medium dense, dusky brown, moist (fill). Recovered and Retained: 1.0 ft.(300mm)		
5	2			4 6 4 2 (10)		D-2		6/2/98 Well graded GRAVEL with silt and sand, angular to subrounded, loose, dark yellowish brown, wet, homogeneous. Recovered and Retained: 0.4 ft.(120mm) Note: 100% drilling fluid loss down hole.	▽	
10	3			7 11 13 9 (24)		D-3		Well graded GRAVEL with silt and sand, subrounded to angular, medium dense, dark yellowish brown, wet, homogeneous. Recovered and Retained: 1.0 ft.(300mm)		
	4							Note: Started drilling harder at depth of 12.5 ft. (3.8m) Possible cobbles as indicated by drilling.		
15	5			9 9 9 8 (18)		D-4		Well graded GRAVEL with silt and sand, subrounded to angular, medium dense, dark yellowish brown, wet, homogeneous. Recovered and Retained: 1.0 ft.(300mm)		
20	6							End of the Test Hole Boring at 17.0 ft. (5.2m) below ground elevation. Water Table Elevation: 311.0'(94.8m) This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-5-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 83+753 — Offset 13.7m Lt. — C.S. 2771

Equipment CME-55/Auto Hammer — Casing HQ:16.5'(5.0m) — Ground El 348.6 (106.25 m)

Method of Boring Wet Rotary

Start Date May 26, 1998 — Completion Date May 26, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top Surface: 3"(75mm) asphalt parking lot. 0.2' to 5.0': Silty SAND with gravel.		
5	1, 2			3 3 5 5 (8)		D-1	MC GS	SM, M.C. = 16% Silty SAND with gravel, subrounded, loose, moderate yellowish brown, moist. Recovered and Retained: 1.0 ft.(300mm)		
10	3			5 7 9 12 (16)		D-2	MC GS	SM, M.C. = 17% Silty SAND with gravel, subrounded to angular, medium dense, dark yellowish brown, moist, 3" of fine sand in end of sampler. Recovered and Retained: 1.0 ft.(300mm)		
	4							Note: Started drilling harder at depth of 12.5 ft. (3.8m). Some cobbles encountered as indicated by drilling.		
15	5		> >	11 41 50/5"		D-3	MC GS	SP, M.C. = 8% Poorly graded GRAVEL with sand, subrounded to angular, very dense, dark yellowish brown, moist. Recovered and Retained: 1.0 ft.(300mm)		
								End of the Test Hole Boring at 17.0 ft (5.2m) below ground elevation. Water Table Elevation: dry hole, not determined. This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-6-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 83+740 — Offset 14.9m Rt. — C.S. 2771

Equipment Port. Penetrometer — Casing — Ground El 358.8 (109.36 m)

Method of Boring

Start Date June 4, 1998 — Completion Date June 4, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top Surface: Landscaped 2:1 slope by Pediatrics office.		
				50/6" (25/6")		D-1	MC GS	SM, M.C. = 6% Silty GRAVEL with sand with fibrous organic material, subrounded to angular, very dense, dark yellowish brown, moist, traces of root hairs (advanced outwash till). Recovered and Retained: 1.0 ft.(300mm)		
	1			50/6" (25/6")		D-2		SAME AS ABOVE		
5				50/6" (25/6")		D-3		SAME AS ABOVE		
	2							End of the Test Hole Boring at 6.5 ft. (2.0m) below ground elevation.		
								Water Table Elevation: dry hole, not determined.		
10	3							The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
	4							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
15										
	5									
	6									
20										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-7-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 83+800 — Offset 11.1m Lt. — C.S. 2771

Equipment CME-55/Auto Hammer — Casing HQ:22'(6.7m) — Ground El 358.6 (109.30 m)

Method of Boring Wet Rotary

Start Date June 1, 1998 — Completion Date June 1, 1998 — Sheet 1 of 2

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top Surface: Shoulder, 1.0 ft. of asphalt.		
								1.0' to 2.0': Silty SAND with gravel.		
	1			5 4 4 2 (8)		D-1		Silty SAND with gravel, loose, dark yellowish brown, moist (fill). Recovered and Retained: 0.5 ft.(150mm)		
5	2			3 2 2 1 (4)		D-2		Silty GRAVEL with sand, subrounded to angular, very loose, dark yellowish brown, wet. Recovered and Retained: 0.5 ft.(150mm)		
10	3			1/12" 1/12" (1)		D-3		6/1/98 Note: Casing sank 2.0 ft. (0.6m) under own weight from depth of 10.0 ft.(3.0m) to 12.0 ft.(3.7m), possible void 70% drilling loss. Well graded GRAVEL with silt and sand, subrounded to angular, very loose, dark yellowish brown, wet, traces of organics and small pieces of wood fiber. *Possible void or decayed log from depth of 10.0 ft. to 12.0 ft.* Recovered and Retained: 0.2 ft.(50mm)		
	4									
15	5			8 7 9 35 (16)		D-4		15.0'to 16.5': W-" graded GRAVEL with silt and sand, subrounded to angular, medium dense, moderate yellowish brown, wet, traces of very dark reddish brown oxidized stains.		
								16.5' to 17.0': Silty SAND with gravel, medium dense, olive gray, moist, traces of very dark reddish brown oxidized stains (advanced outwash). Recovered and Retained: 1.5 ft.(460mm)		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-7-98

Sheet 2 of 2

PROJECT SR-507 to SR-512

Job No. OL-2740

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				33 50/5 (50/5")		D-5	MC GS	SM, M.C. = 11% Silty SAND with gravel, very dense, dark yellowish brown, moist (advanced outwash till). Recovered and Retained: 0.9 ft.(275mm)		
								End of the Test Hole Boring at 20.9 ft. (6.4m) below ground elevation.		
	7							Water Table Elevation: 348.6 ft. (106.2m)		
25										
	8							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	9									
30										
	10									
35										
	11									
	12									
40										
	13									
45										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-8-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 83+829 — Offset 17.0m Rt. — C.S. 2771

Equipment CME-55/Auto Hammer — Casing HQ:16'(4.9m) — Ground El 368.8 (112.41 m)

Method of Boring Wet Rotary

Start Date May 27, 1998 — Completion Date May 27, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Top Surface: 3" Asphalt parking lot. 0.2' to 2.0': Well graded GRAVEL with silt and sand.		
	1			2 3 11 19 (14)		D-1		Silty SAND with gravel, medium dense, moderate yellowish brown, moist, traces of organics. Recovered and Retained: 1.0 ft.(300mm)		
5	2			7 13 18 33 (31)		D-2		Silty SAND with gravel, dense, moderate yellowish brown, moist, traces of of dark yellowish orange oxidized staining. Recovered 1.5 ft.(460mm) and Retained: 1.0 ft.(300mm) Note: Started drilling harder at depth of 7.0 ft. (2.1m)		
10	3			31 50/4 (50/4")		D-3		Silty SAND with gravel, very dense, dark yellowish brown, moist (outwash till). Recovered and Retained: 0.5 ft.(150mm)		
15	4			32 50/5 (50/5")		D-4		Silty SAND with gravel, very dense, dark yellowish brown, moist (outwash till). Recovered and Retained: 0.9 ft.(275mm)		
	5							End of the Test Hole Boring at 15.9 ft. (4.8m) below ground elevation. Water Table Elevation: dry hole, not determined. This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-9-98

PROJECT SR-507 to SR-512 | Job No. OL-2740

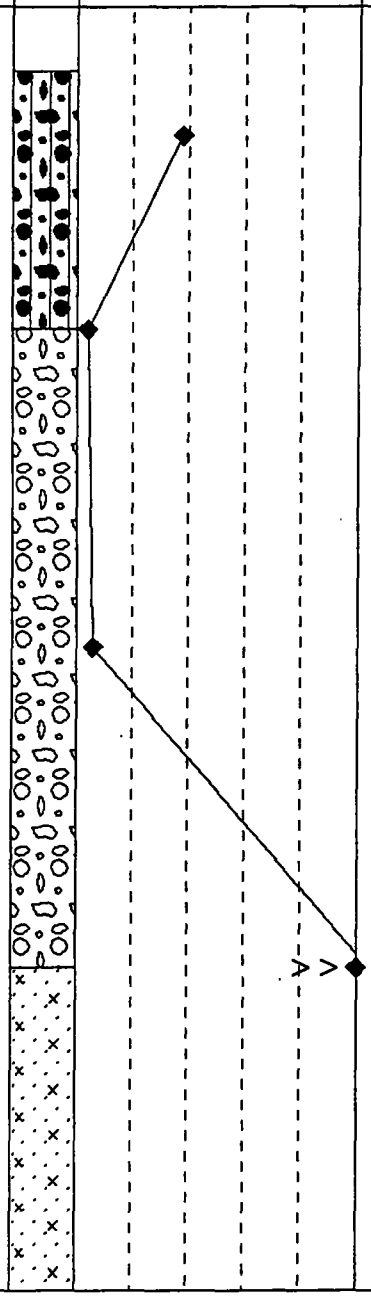
Stage 2, M.P. 47.94 to M.P. 52.54 | S.R. 7

Station 83+880 | Offset 11.0m Lt. | C.S. 2771

Equipment CME-55/Auto Hammer | Casing HQ:21'(6.4m) | Ground El 367.3 (111.95 m)

Method of Boring Wet Rotary

Start Date June 1, 1998 | Completion Date June 1, 1998 | Sheet 1 of 2



Depth (ft)	Meters (m)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
						1 ft. = 0.3048m Top Surface: Asphalt 1.0' thick		
						Silty GRAVEL with sand.		
	1	6 11 8 4 (19)		D-1		Well graded GRAVEL with silt and sand, subrounded to subangular, medium dense, dusky brown, moist, homogeneous (fill). Recovered and Retained: 0.4 ft. (120mm)		
5	2	1 1 1 1 (2)		D-2		Poorly graded GRAVEL with silt and sand, subrounded to angular, very loose, dusky brown, moist, traces of small chunks of wood debris and clay. Recovered and Retained: 0.4 ft. (120mm)		
10	3	2 2 1 4 (3)		D-3	MC GS	GP, M.C. = 3% Poorly graded GRAVEL, subangular to angular, very loose, dusky brown, wet, homogeneous. Recovered and Retained: 0.2 ft.(50mm)	6/1/98	
	4					Note: Started drilling harder at depth of 13.0 ft. (4.0m).		
15	5	16 22 30 42 (52		D-4	MC GS	SM, M.C. = 11% Silty SAND, very dense, dark yellowish brown, moist, homogeneous (advanced outwash till). Recovered 1.5 ft.(460mm) and Retained: 1.0 ft.(300mm)		
20	6							

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-9-98

Sheet 2 of 2

PROJECT SR-507 to SR-512

Job No. OL-2740

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				33 50/5 (50/5")		D-5		Silty SAND with gravel, very dense, dark yellowish brown, moist (advanced outwash till). Recovered and Retained: 0.9 ft.(275mm).		
								End of the Test Hole Boring at 20.9 ft. (6.4m) below ground elevation.		
	7							Water Table Elevation: 357.3 ft.(108.9m)		
25								This is a Summary Log of the Test Hole 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

Washington State Department of Transportation

HOLE No. H-10-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

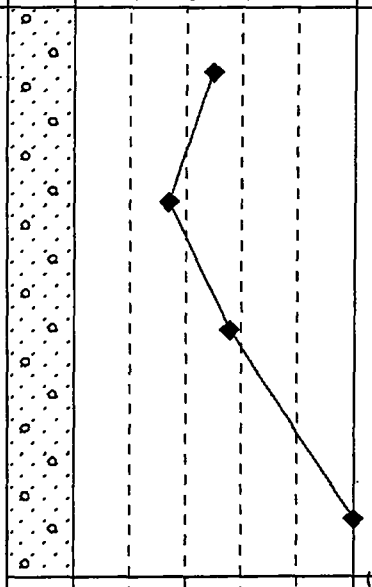
Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 83+020 — Offset 15m Lt. — C.S. 2771

Equipment Port. Penetrometer — Casing AW-Roads:8.9 ft.(2.7m) — Ground El 331.2 (100.95 m)

Method of Boring

Start Date June 4, 1998 — Completion Date June 4, 1998 — Sheet 1 of 1



Depth (ft)	Meters (m)	Profile	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
							1 ft. = 0.3048m Top Surface: Yard with a retaining wall		
			10 10 15 (13)		D-1	MC GS	SP-SM, M.C. = 13% Silty GRAVEL with silt, sand and fibrous organic material, subrounded to angular, dense, dusky brown to light brown, moist, traces of root hairs. Recovered and Retained: 1.0 ft.(300mm)		
1			5 10 7 (9)		D-2	MC GS	GW, M.C. = 4% Well graded GRAVEL with sand, subrounded to angular, medium dense, moderate yellowish brown, moist, traces of silt and root hairs. Recovered and Retained: 1.0 ft.(300mm)		
5			12 15 13 (14)		D-3		Well graded GRAVEL with sand and fibrous organic material, subrounded to angular, dense, dark yellowish brown, moist. Recovered and Retained: 1.0 ft.(300mm)		
2									
			24 50/3 (25/3")		D-4		Well graded GRAVEL with sand and fibrous organic material, very dense, moist (outwash till). Recovered and Retained: 1.0 ft.(300mm)		
10	3						End of the Test Hole Boring at 8.9 ft. (2.7m) below ground elevation.		
							Water Table Elevation: Dry hole, not determined.		
	4						The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
15							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data.		
	5								
	6								
20									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. P-1-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 84+015 — Offset 15m Lt. — C.S. 2771

Equipment Port. Penetrometer — Casing — Ground El 376.0 (114.60 m)

Method of Boring Hand Tools

Start Date March 12, 1998 — Completion Date March 12, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				12 20 14 9 (17)		PP-1		1 ft. = 0.3048m Silty GRAVEL, medium dense, brown, moist.		
	1			5 5 10 12 (5)		PP-2		Sandy SILT with gravel, medium stiff, brown, moist.		
5				21 24 29 (18)		PP-3		Sandy SILT with gravel, very stiff, brown, moist.		
	2							End of the Test Hole Boring at 5.5 ft. (1.7m) below ground elevation. Water Table Elevation: Not determined.		
10	3							* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience. This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15	5									
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. P-2-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 83+888 — Offset 15m Lt. — C.S. 2771

Equipment Port. Penetrometer — Casing — Ground El 361.9 (110.31 m)

Method of Boring Hand Tools

Start Date March 12, 1998 — Completion Date March 12, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Silty GRAVEL with sand, gray moist.		
								3/12/98	▽	
	1		◆	22 20 9 9 (15)		PP-1		Silty GRAVEL with sand, medium dense, gray, wet.		
5								End of the Test Hole Boring at 5.0 ft. (1.5m) below ground elevation.		
	2							* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
								Water Table Elevation: 359.9'(109.6m)		
10	3							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15										
	5									
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. P-3-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 83+790 — Offset 15m Lt. — C.S. 2771

Equipment Port. Penetrometer — Casing — Ground El 352.0 (107.29 m)

Method of Boring Hand Tools

Start Date March 12, 1998 — Completion Date March 12, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Silty GRAVEL with pieces of concrete and asphalt concrete pavement, brown, moist.		
	1		◆	14 21 15 12 (18)		PP-1		Silty GRAVEL with pieces of concrete and asphalt concrete pavement, medium dense, brown, moist.		
5	2							End of the Test Hole Boring at 4.5 ft. (1.4m) below ground elevation. * The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience. Water Table Elevation: Not determined. This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
10	3									
	4									
15	5									
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. P-4-98

PROJECT SR-507 to SR-512 Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 S.R. 7

Station 83+744 Offset 15m Lt. C.S. 2771

Equipment Port. Penetrometer Casing Ground El 346.6 (105.64 m)

Method of Boring Hand Tools

Start Date March 12, 1998 Completion Date March 12, 1998 Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m		
			◆	12 13 18 23 (16)		PP-1		Silty GRAVEL with sand, medium dense, brown, moist.		
	1							End of the Test Hole Boring at 3.0 ft. (0.9m) below ground elevation.		
5								* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
	2							Water Table Elevation: Not determined.		
10	3							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15										
	5									
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. P-5-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 83+689 — Offset 15m Lt. — C.S. 2771

Equipment Port. Penetrometer — Casing — Ground El 342.4 (104.36 m)

Method of Boring Hand Tools

Start Date March 12, 1998 — Completion Date March 12, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m		
				18 27 35 42 (31)		PP-1		Silty GRAVEL with sand, dense, brown, moist.		
	1							End of the Test Hole Boring at 3.0 ft. (0.9) below ground elevation.		
5								* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
	2							Water Table Elevation: Not determined.		
								This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
10	3									
	4									
15										
	5									
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. P-6-98

PROJECT SR-507 to SR-512 | Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 | S.R. 7

Station 83+632 | Offset 15m Lt. | C.S. 2771

Equipment Port. Penetrometer | Casing | Ground El 339.7 (103.54 m)

Method of Boring Hand Tools

Start Date March 12, 1998 | Completion Date March 12, 1998 | Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Silty GRAVEL with sand, brown, moist.		
	1			5 7 9 10 (5)		PP-1		SILT, medium stiff, brown, moist.		
				19 63 (27/6")		PP-2		SILT, very stiff, brown, moist.		
5								End of the Test Hole Boring at 5 ft. (1.5m) below ground elevation.		
	2									
								* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
								Water Table Elevation: Not determined.		
10	3									
								This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15										
	5									
	6									
20										

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. P-7-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 82+968 — Offset 15m Lt. — C.S. 2771

Equipment Port. Penetrometer — Casing — Ground El 312.7 (95.31 m)

Method of Boring Hand Tools

Start Date March 12, 1998 — Completion Date March 12, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Silty GRAVEL with sand, black, moist.		
	1		◆	12 13 15 18 (14)		PP-1		Silty GRAVEL with sand, medium dense, black moist.		
5	2							End of the Test Hole Boring at 4.0 ft. (1.2m) below ground elevation. * The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience. Water Table Elevation: Not determined.		
10	3							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15	5									
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. P-8-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 81+072 — Offset 15m Lt. — C.S. 2771

Equipment Port. Penetrometer — Casing — Ground El 324.5 (98.91 m)

Method of Boring Hand Tools

Start Date March 12, 1998 — Completion Date March 12, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Silty GRAVEL with sand, brown, moist.		
	1									
5			◆	6 12 23 31 (18)		PP-1		Silty GRAVEL with sand, medium dense, brown, moist.		
	2							End of the Test Hole Boring at 6.0 ft. (1.8m) below ground elevation.		
10	3							* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience. Water Table Elevation: Not determined.		
	4							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
15	5									
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. P-9-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 81 + 145 — Offset 15m Rt. — C.S. 2771

Equipment Port. Penetrometer — Casing — Ground El 314.3 (95.80 m)

Method of Boring Hand Tools

Start Date March 16, 1998 — Completion Date March 16, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				4 12 11 (12)		PP-1		1 ft. = 0.3048m Poorly graded GRAVEL with sand and silt, medium dense, dark brown, moist.		
				12 8 7 4 (8)		PP-2		Poorly graded GRAVEL with sand and silt, loose, dark brown, moist.		
	1							End of the Test Hole Boring at 3.5 ft. (1.1m) below ground elevation.		
5								* The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience.		
	2							Water Table Elevation: Not determined.		
10	3							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
	4									
15										
	5									
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. P-10-98

PROJECT SR-507 to SR-512 — Job No. OL-2740

Stage 2, M.P. 47.94 to M.P. 52.54 — S.R. 7

Station 82+962 — Offset 15m Rt. — C.S. 2771

Equipment CME-55/Auto Hammer — Casing — Ground El 312.8 (95.34 m)

Method of Boring

Start Date March 16, 1998 — Completion Date March 16, 1998 — Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
								1 ft. = 0.3048m Silty GRAVEL with sand, brown, moist.		
	1		◆	26 16 15 15 (16		PP-1		Poorly graded GRAVEL with sand and silt, medium dense, brown, moist.		
5	2							End of the Test Hole Boring at 4.0 ft. (1.2m) below ground elevation. * The portable penetrometer blows per foot have been converted to approximate Standard Penetrometer blows based on WSDOT experience. Water Table Elevation: Not determined.		
10	3							This is a Summary Log of the Test Hole Boring. Soil/Rock descriptions are derived from visual field identifications.		
15	4									
	5									
20	6									

APPENDIX - C

Laboratory Test Data

Job No. OL-2740 | Date June 19, 1998

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

Project SR-507 TO SR-512 STAGE 2

Laboratory Summary

Washington State Department of Transportation

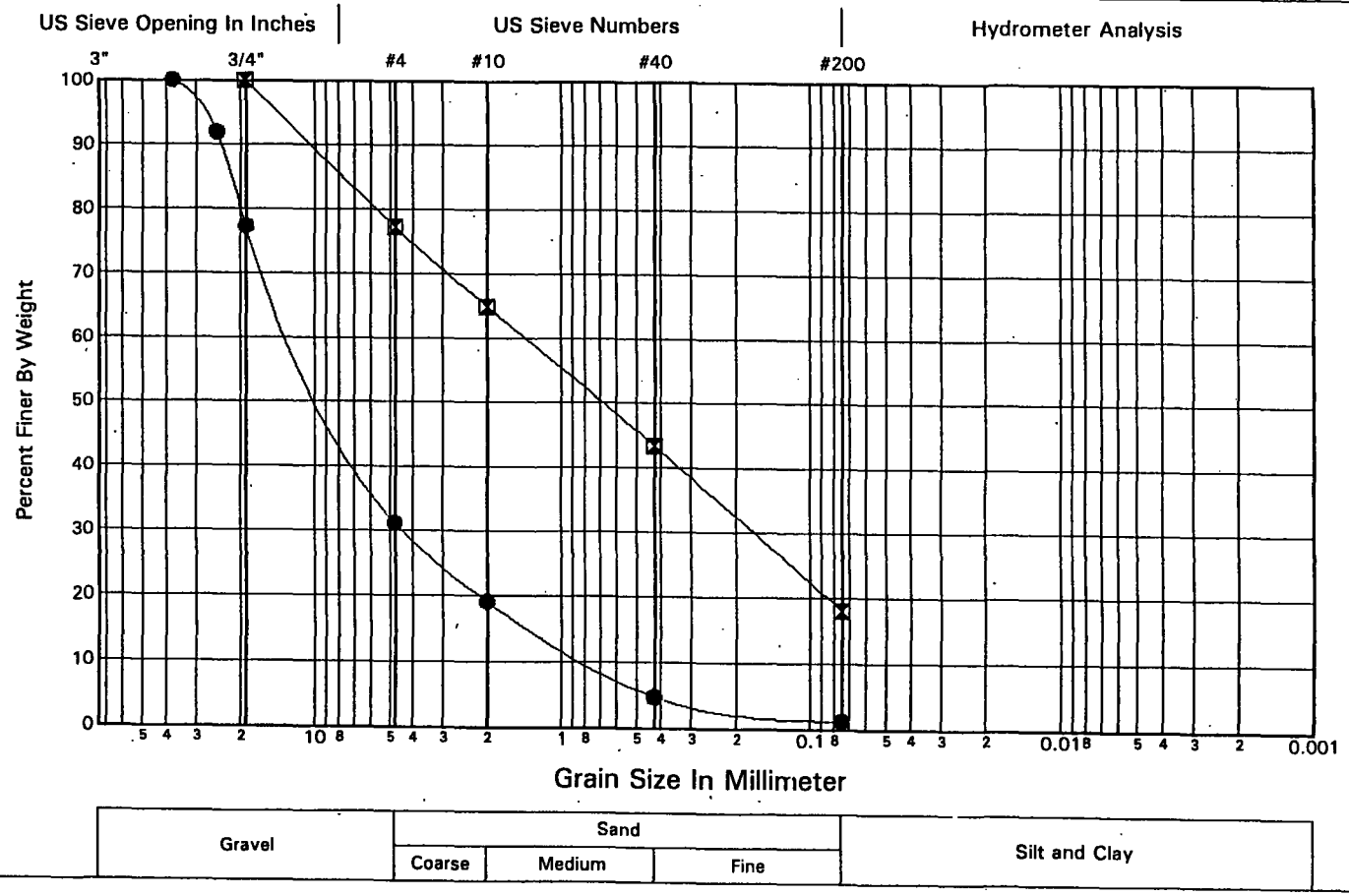
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	2.0	0.61	D-1	GW	SEE BORING LOG	WELL GRADED GRAVEL with SAND	5	NP	NP	NP
⊠	20.0	6.10	D-5	SM	SEE BOEING LOG	SILTY SAND with GRAVEL	10	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	68.8	29.9	1.3	2.2	15.0
⊠	22.7	59.2	18.1		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	11.29	8.36	4.36	2.13	0.75
⊠	1.40	0.68	0.17	0.09	



Job No. **OL-2740** Date **June 19, 1998**

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

Project **SR-507 TO SR-512 STAGE 2**

Laboratory Summary

Washington State Department of Transportation

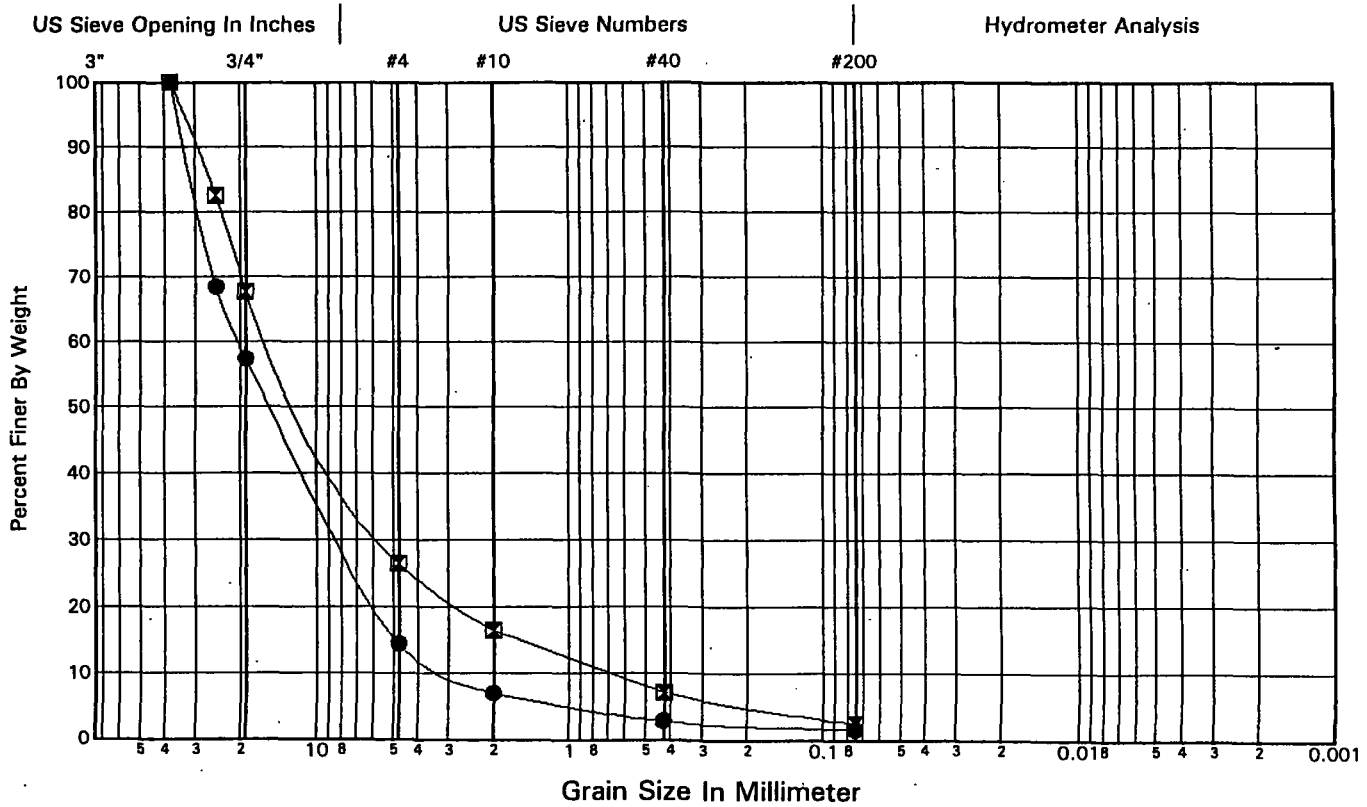
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-2	GW	SEE BORING LOG	WELL GRADED GRAVEL	4	NP	NP	NP
⊠	15.0	4.57	D-4	GW	SEE BORING LOG	WELL GRADED GRAVEL with SAND	8	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	85.5	12.9	1.6	1.1	7.2
⊠	73.5	24.1	2.4	2.8	21.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●	20.27	14.96	7.84	5.67	2.83
⊠	14.66	10.47	5.34	2.71	0.69



Job No. OL-2740 Date June 19, 1998

Hole No. H-3-98 Sheet 1 of 1

Project SR-507 TO SR-512 STAGE 2

Laboratory Summary

Washington State Department of Transportation

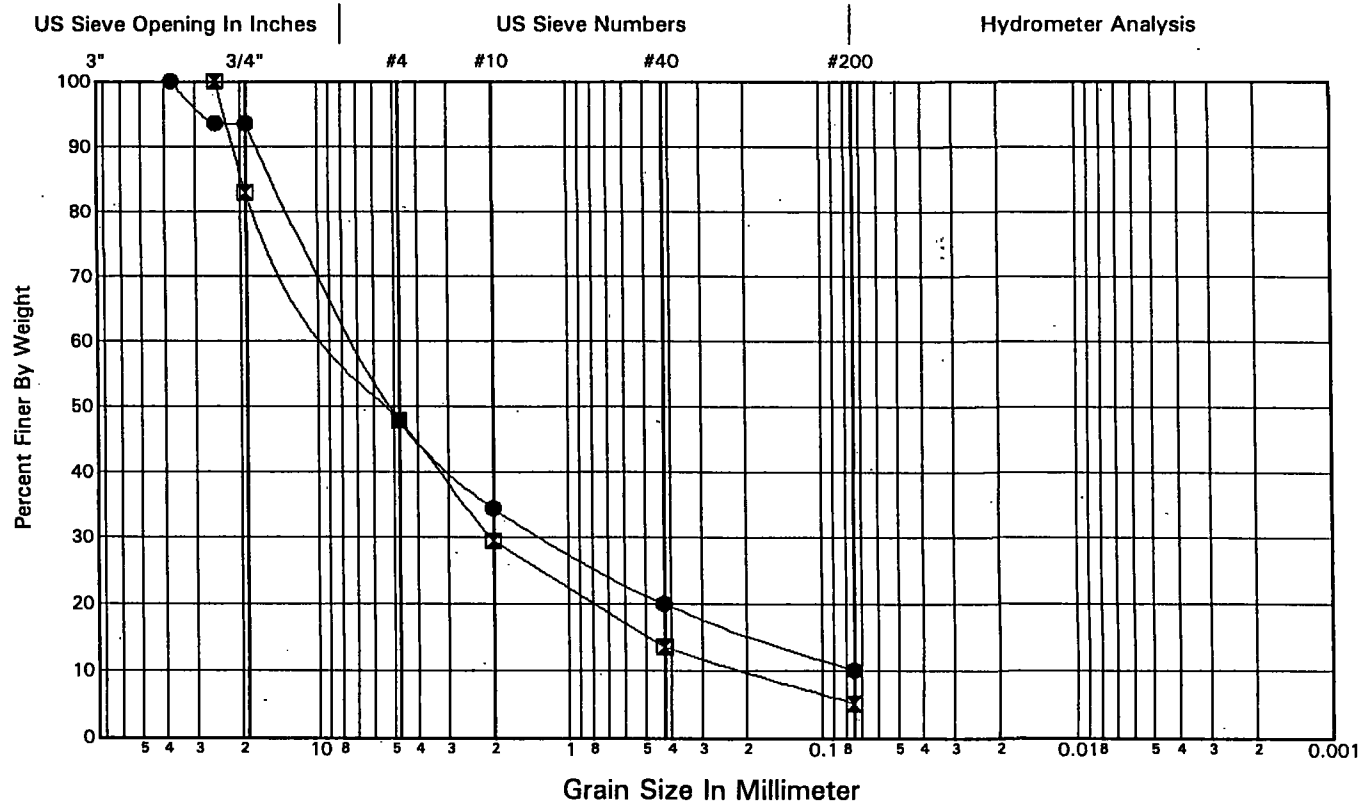
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	2.0	0.61	D-1	GP-GM	SEE BORING LOG	POORLY GRADED GRAVEL with SILT and SAND	14	NP	NP	NP
⊠	10.0	3.05	D-3	GW-GM	SEE BORING LOG	WELL GRADED GRAVEL with SILT and SAND	6	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	52.1	37.8	10.1	3.2	97.9
⊠	52.1	42.7	5.2	2.7	37.5

GRADATION VALUES

	D60	D50	D30	D20	D10
●	6.86	5.06	1.24	0.43	
⊠	7.66	5.16	2.06	0.80	0.20



Job No. OL-2740 Date June 19, 1998

Hole No. H-5-98 Sheet 1 of 1

Project SR-507 TO SR-512 STAGE 2

Laboratory Summary

Washington State Department of Transportation

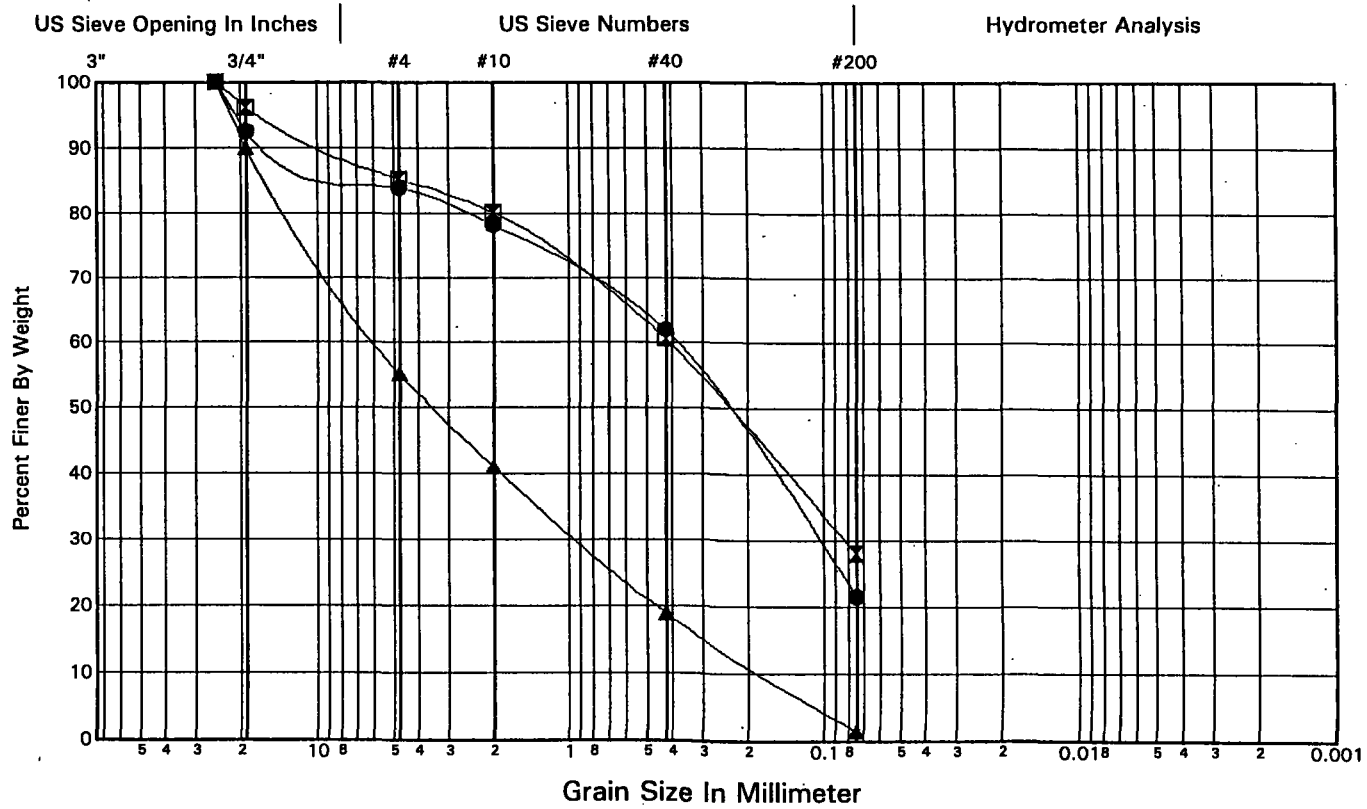
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	5.0	1.52	D-1	SM	SEE BORING LOG	SILTY SAND with GRAVEL	16	NP	NP	NP
⊠	10.0	3.05	D-2	SM	SEE BORING LOG	SILTY SAND with GRAVEL	17	NP	NP	NP
▲	15.0	4.57	D-3	SP	SEE BORING LOG	POORLY GRADED SAND with GRAVEL	8	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	16.1	62.3	21.6		
⊠	14.7	57.2	28.1		
▲	44.9	53.7	1.4	0.8	33.0

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.39	0.25	0.11		
⊠	0.41	0.24	0.08		
▲	5.77	3.47	0.92	0.46	0.18



Job No. **OL-2740** Date **June 19, 1998**

Hole No. **H-6-98** Sheet **1** of **1**

Project **SR-507 TO SR-512 STAGE 2**

Laboratory Summary

Washington State Department of Transportation

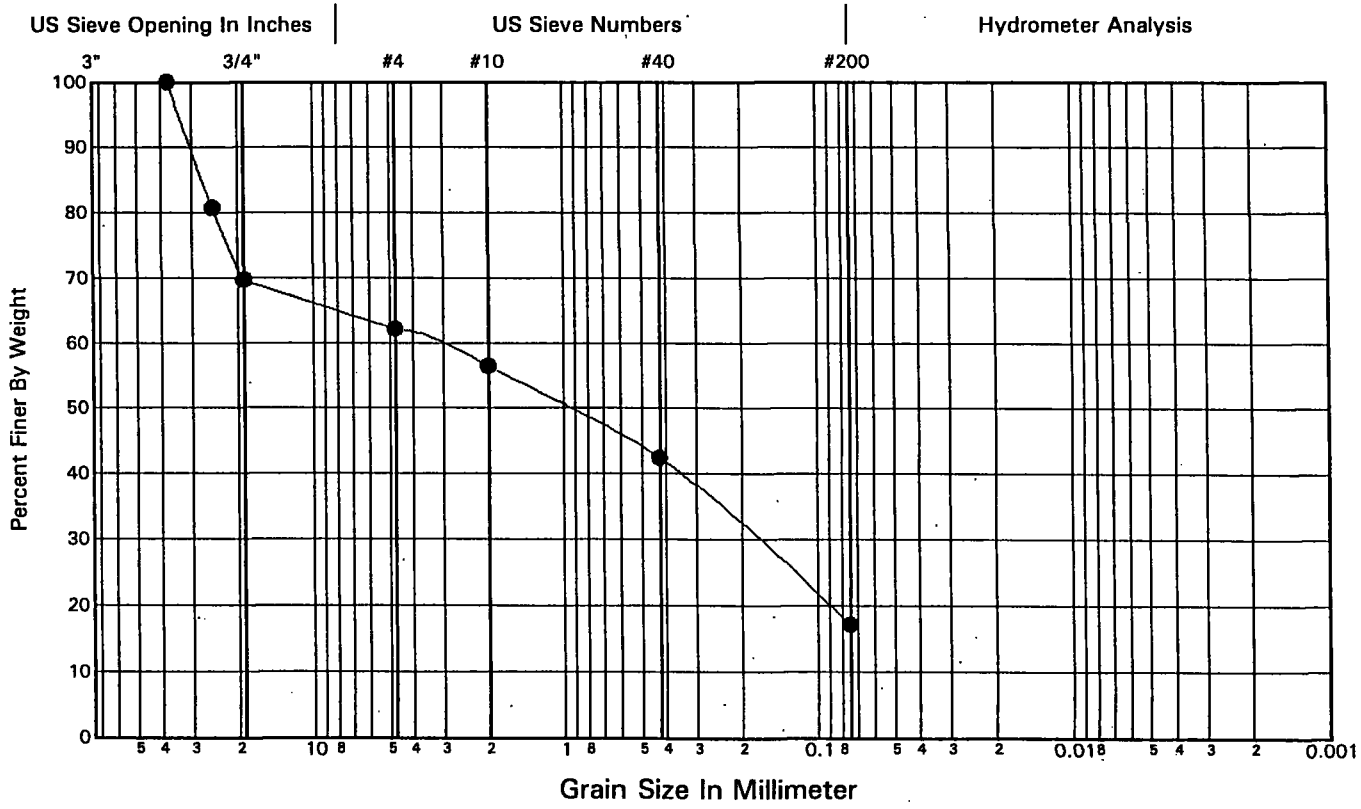
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	2.0	0.61	D-1	SM	SEE BORING LOG	SILTY SAND with GRAVEL w/fiborous organic material	6	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	37.8	45.0	17.2		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	3.40	0.98	0.18	0.09	



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. OL-2740 Date June 19, 1998

Hole No. H-7-98 Sheet 1 of 1

Project SR-507 TO SR-512 STAGE 2

Laboratory Summary

Washington State Department of Transportation

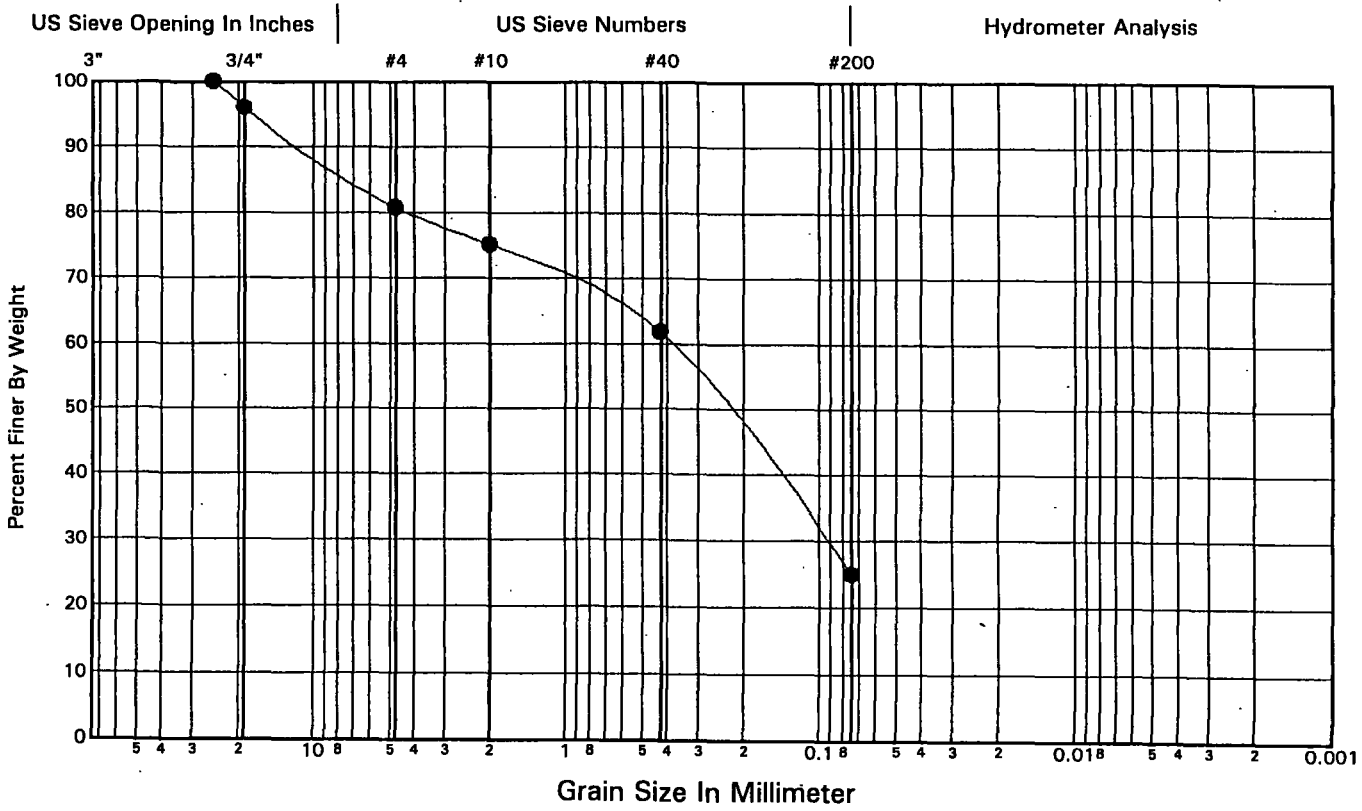
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	20.0	6.10	D-5	SM	SEE BORING LOG	SILTY SAND with GRAVEL	11	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	19.2	55.7	25.1		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	0.39	0.24	0.09		



Gravel	Sand			Silt and Clay
	Coarse	Medium	Fine	

Job No. OL-2470
Hole No. H-9-98
Project SR-507 to SR-512

Date July 21, 1998
Sheet 1 of 1

Laboratory Summary

Washington State Department of Transportation

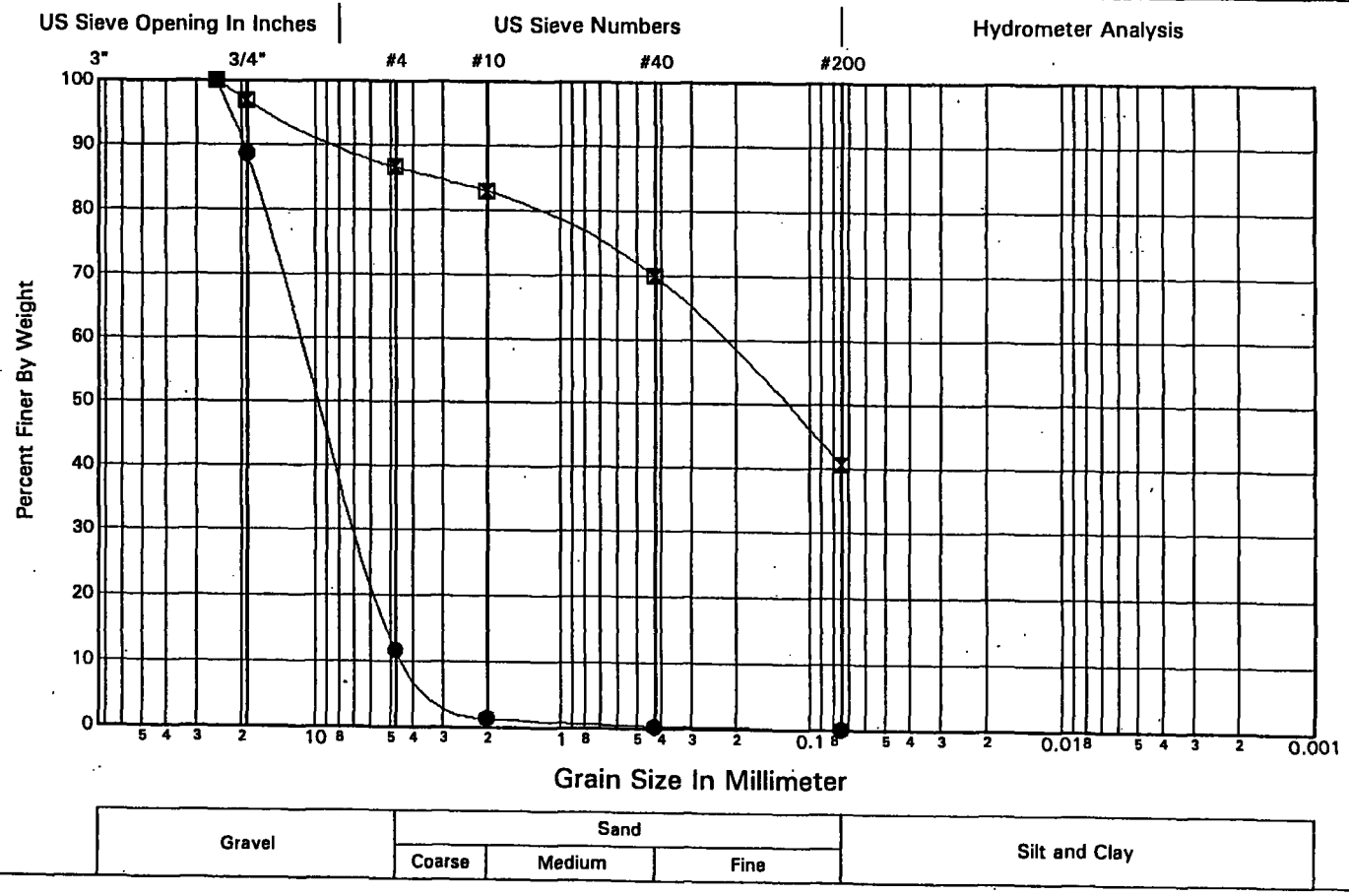
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	10.0	3.05	D-3	GP	SEE BORING LOG	POORLY GRADED GRAVEL	3	NP	NP	NP
⊠	15.0	4.57	D-4	SM	SEE BORING LOG	SILTY SAND	11	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	88.3	11.6	0.1	0.9	2.8
⊠	13.4	45.9	40.7		

GRADATION VALUES

	D60	D50	D30	D20	D10
●	11.35	9.47	6.61	5.52	4.12
⊠	0.24	0.13			



Job No. OL-2740 Date June 19, 1998

Hole No. H-10-98 Sheet 1 of 1

Project SR-507 TO SR-512 STAGE 2

Laboratory Summary

Washington State Department of Transportation

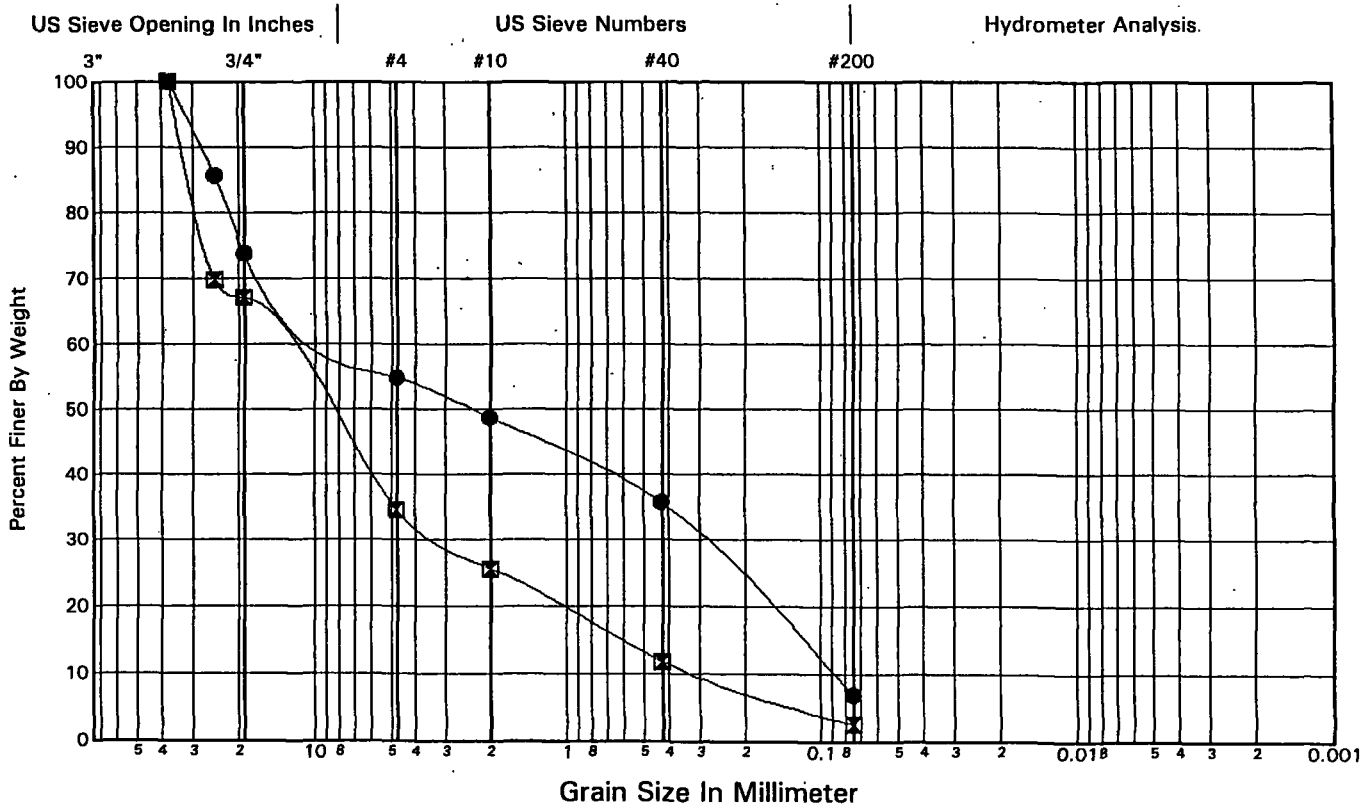
	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	1.0	0.30	D-1	SP-SM	SEE BORING LOG	POORLY GRADED SAND with SILT and GRAVEL w/fiborous organic material	13	NP	NP	NP
⊠	3.0	0.91	D-2	GW	SEE BORING LOG	WELL GRADED GRAVEL with SAND w/fiborous organic material	4	NP	NP	NP

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	45.2	47.9	6.9	0.1	76.8
⊠	65.4	32.0	2.6	2.2	47.1

GRADATION VALUES

	D60	D50	D30	D20	D10
●	6.94	2.41	0.30	0.17	0.09
⊠	14.04	9.16	3.05	1.06	0.30



APPENDIX - D

Modular Block Geosynthetic Retaining Wall (MBGR) Special Provision

MODULAR BLOCK GEOSYNTHETIC RETAINING WALL

Description

Section 2-12.1 is supplemented with the following:

Where shown in the Plans or where designated by the Engineer, the Contractor shall construct modular block geosynthetic retaining wall(s).

Materials

Section 2-12.2 is supplemented with the following:

The provisions of this section shall also apply to geogrids.

Gravel Borrow

Section 9-03.14(1) is supplemented with the following:

All backfill material used in the reinforced soil zone of the modular block geosynthetic retaining wall shall be free from organic material. The material shall not contain recycled materials. The backfill material shall meet the following requirements:

Property	Test Method	Allowable Test Value
Los Angeles Wear, 500 rev.	AASHTO T 96	35 percent max.
Degradation	WSDOT Test Method 113	15 min.
pH	AASHTO T 289-91	4.5 to 9.0

Wall backfill material satisfying these gradation, durability and chemical requirements shall be classified as nonaggressive.

Geotextile and Thread for Sewing

Section 9-33.1 is supplemented with the following:

The term geosynthetics shall include both geotextiles and geogrids.

Geotextile reinforcement in modular block geosynthetic retaining walls shall conform to the properties specified in Tables 7 and 8 for permanent walls.

Geogrids shall consist of a regular network of integrally connected polymer tensile elements with an aperture geometry sufficient to permit mechanical interlock with the surrounding backfill. The long chain polymers in the geogrid tensile elements, not including coatings, shall consist of at least 95 percent by mass of the material of polyolefins or

polyesters. The material shall be free of defects, cuts, and tears. Geogrid reinforcement in modular block geosynthetic retaining walls shall conform to the properties specified in Table 8 for permanent walls.

Geotextile Properties

Section 9-33.2 is supplemented with the following:

Geosynthetic Properties

All geotextile properties provided in Table 7 are minimum average roll values. The average test results for any sampled roll in a lot shall meet or exceed the values shown in the table. The test procedures specified in the table are in conformance with the most recently approved ASTM geotextile test procedures, except for geotextile sampling and specimen conditioning, which are in accordance with WSDOT Test Methods 914 and 915, respectively.

Table 7: Minimum properties required for geotextile reinforcement used in modular block geosynthetic retaining walls.

Geotextile Property	Test Method	Geotextile Property Requirements Woven/Nonwoven
Water Permittivity	ASTM D4491	.02 sec.$^{-1}$ min.
AOS	ASTM D4751	.84 mm max.
Grab Tensile Strength, min. in machine and x-machine direction	ASTM D4632	900 N/530 N min.
Grab Failure Strain, in machine and x-machine direction	ASTM D4632	< 50% / ≥ 50%
Seam Breaking Strength[1]	ASTM D4632	700 N/430 N min.
Puncture Resistance	ASTM D4833	280 N/220 N min.
Tear Strength, min. in machine and x-machine direction	ASTM D4533	280 N/220 N min.
Ultraviolet (UV) Radiation Stability	ASTM D4355	70% (for polypropylene and polyethylene) and 50% (for polyester) Strength Retained min., after 500 Hr. in weatherometer

[1]Applies only to seams perpendicular to the wall face.

For geogrids, the summation of the geogrid joint strengths determined in accordance with Geosynthetic Research Institute test method GRI:GG2 occurring in a 300 mm length of grid in the direction of loading (i.e., perpendicular to the wall face) shall be greater than or equal to the ultimate strength (T_{ult}) of the grid element to which they are attached. For this determination, T_{ult} is to be determined using Geosynthetic Research Institute test method GRI:GG1. If the joint spacing is greater than or equal to 300 mm, two joints shall be included in this summation of joint strengths. The ultraviolet (UV) radiation stability, ASTM D4355, shall be a minimum of 70% strength retained after 500 hours in the weatherometer for polypropylene and polyethylene geogrids, and 50% strength retained after 500 hours in the weatherometer for polyester geogrids..

Geosynthetic Properties for Permanent Retaining Walls

Table 8: Long-term tensile strength, T_{al}, required for the geosynthetic reinforcement used in modular block geosynthetic retaining wallss.

[3]Wall Location	Vertical Spacing of Reinforcement Layers	Reinforcement Layer Distance from Top of Wall	[1,2,3]Minimum Long-Term Tensile Strength, T_{al}
$$1$$	***$$2$$***	***$$3$$***	***$$4$$***

[1]These long-term tensile strength requirements apply only in the geosynthetic direction perpendicular to the wall face.

[2]T_{al} shall be determined in accordance with WSDOT Test Method 925.

[3]Walls ***$$5$$*** are classified as Class ***$$6$$*** structures.

Source Approval

Section 9-33.4(1) is supplemented with the following:

Modular Block Geosynthetic Retaining Wall

Geosynthetic products which are qualified for use in geosynthetic reinforced structures (Classes 1, 2, or both) are listed in the current Qualified Products List (QPL).

For geosynthetic products proposed for use which are not listed in the current QPL, the Contractor shall submit test information and the calculations used in the determination of T_{al} performed in accordance with WSDOT Test Method 925 to the Olympia Service Center Materials

Laboratory in Tumwater for evaluation. The Contracting Agency will require up to 30 calendar days after receipt of the information to complete the evaluation.

Source approval for retaining wall geosynthetic materials listed in the current QPL, or as approved based on data developed and submitted in accordance with WSDOT Test Method 925, will be based on conformance to the applicable values in Tables 7 and 8.

Acceptance Samples

Section 9-33.4(3) is supplemented with the following:

Modular Block Geosynthetic Retaining Wall

Geotextile acceptance testing shall meet the requirements of Table 7, and both geotextile and geogrid acceptance testing shall meet the required ultimate tensile strength T_{ult} as provided in the QPL for the selected product(s). If the selected product(s) are not listed in the current QPL, the result of the testing for T_{ult} must be greater than or equal to T_{ult} as determined from the product data submitted and approved by the Olympia Service Center Materials Laboratory during source approval. If the results of the testing show that the retaining wall geosynthetic lot does not meet the specified properties, the roll or rolls which were sampled will be rejected, and additional sampling and testing will be performed as specified.

Acceptance by Certificate of Compliance

Section 9-33.4(4) is supplemented with the following:

The Contractor shall provide a Manufacturer's Certificate of Compliance to the Engineer, including polymer type in addition to all information as specified, for all quantities of retaining wall geosynthetic material.

Concrete Blocks

Section 9-12.1 is supplemented with the following:

Concrete block for facing units shall be constructed to the dimension and shape as detailed in the Plans and shall meet all the materials, manufacturing, and physical requirements of ASTM C 90 except for the following:

Compressive Strength minimum, per ASTM C-140	28 MPa at 28 days
Water absorption maximum	5 percent

Unit Weight minimum	4.5 KN per sq. meter of wall face

The block manufacturer shall provide a certificate of compliance and test data for the lot of material sent to the job site demonstrating that the property requirements provided above have been met. The maximum lot size for the purposes of this specification shall be 2,000 blocks.

The units shall have angled sides and capable of attaining concave and convex alignment curves with a minimum radius of 1.1 meters. The facing units shall have a broken face finish. The height of each individual block shall be within ± 1.6 mm of the specified dimension.

The length and width of each block shall be within ± 3.2 mm of the specified dimensions. Hollow units shall have a minimum wall thickness of 32 mm. Any blocks which have defects which indicate imperfect molding, defects indicating honeycomb or open texture concrete, or cracked or severely chipped blocks will be rejected.

Facing units shall be interlocked with concrete shear keys or noncorrosive polyester/fiberglass or polyethylene solid pins. The pins shall have a minimum diameter of 13 mm.

Construction Requirements

Section 2-12.3 is supplemented with the following:

Submittals

The Contractor shall submit to the Engineer, a minimum of 30 calendar days prior to beginning construction of each wall, detailed plans for each wall and as a minimum, the submittals shall include the following:

1. Detailed wall plans showing the actual lengths proposed for the geosynthetic reinforcing layers and the locations of each geosynthetic product proposed for use in each of the geosynthetic reinforcing layers
2. The Contractor's proposed wall construction method, including types of equipment to be used and proposed erection sequence.
3. Manufacturer's Certificate of Compliance, samples of the retaining wall geosynthetic and sewn seams for the purpose of acceptance as specified.

Approval of the Contractor's proposed wall construction details and methods shall not relieve the Contractor of their responsibility to construct the walls in accordance with the requirements of these Specifications.

Wall Construction

The Contractor shall excavate for the retaining wall in accordance with Section 2-09, and conforming to the limits and construction stages shown in the Plans.

The Contractor shall direct all surface runoff from adjacent areas away from the retaining wall construction site.

The Contractor shall begin wall construction at the lowest portion of the excavation and shall place each layer horizontally as shown in the Plans. The Contractor shall complete each layer entirely before beginning the next layer. The first course of the wall units shall be checked for level and proper alignment, prior to proceeding with the next course.

Geotextile splices shall consist of a sewn seam or a minimum 300 mm overlap. Geogrid splices shall consist of adjacent geogrid strips butted together and fastened using hog rings, or other methods approved by the Engineer, in such a manner to prevent the splices from separating during geogrid installation and backfilling. Splices exposed at the wall face shall prevent loss of backfill material through the face. The splicing material exposed at the wall face shall be as durable and strong as the material to which the splices are tied. The Contractor shall offset geosynthetic splices in one layer from those in the other layers such that the splices shall not line up vertically. Splices parallel to the wall face will not be allowed, as shown in the Plans.

The Contractor shall stretch out the geosynthetic in the direction perpendicular to the wall face to ensure that no slack or wrinkles exist in the geosynthetic prior to backfilling.

For geogrids, the length of the reinforcement required as shown in the Plans shall be defined as the distance from the back of the modular block geosynthetic retaining walland the last geogrid node at the end of the reinforcement in the wall backfill.

The Contractor shall place fill material on the geosynthetic in lifts such that 150 mm minimum of fill material is between the vehicle or equipment tires or tracks and the geosynthetic at all times. The Contractor shall remove all particles within the backfill material greater than 75 mm in size. Turning of vehicles on the first lift above the geosynthetic will not be permitted. The Contractor shall not end dump fill material directly on the geosynthetic without the prior approval of the Engineer.

Should the geosynthetic be damaged or the splices disturbed, the backfill around the damaged or displaced area shall be removed and the damaged strip of geosynthetic replaced by the Contractor at no expense to the Contracting Agency.

Soil piles or the geosynthetic manufacturer's recommended method, in combination with the facing blocks, shall be used to hold the geosynthetic in place until the specified cover material is placed.

The end of the geosynthetic reinforcement shall be placed between blocks in a way which will insure good interlock between the facing units and the geosynthetic.

The Contractor shall place and compact the wall backfill in accordance with the wall construction sequence detailed in the Plans. The minimum compacted backfill lift thickness of the first lift above each geosynthetic layer shall be 150 mm. The maximum compacted lift thickness anywhere within the wall shall be 250 mm.

The Contractor shall compact each layer to 95 percent of maximum density. The water content of the wall backfill shall not exceed the optimum water content by more than 3 percent. The Contractor shall not use sheepsfoot rollers or rollers with protrusions. Rollers which have a mass of more than 2,700 Kg shall be used with the vibrator turned off. The Contractor may use rollers which have a mass of 2,700 Kg or less with the vibrator turned on with the prior approval of the Engineer. The Contractor shall compact the zone within 1 meter of the wall face without causing damage or distortion to the wall facing elements or reinforcing layers by using light mechanical tampers approved by the Engineer.

The Contractor shall construct wall corners at the locations shown in the Plans, and in accordance with the wall corner construction sequence and method submitted by the Contractor and approved by the Engineer. Wall angle points with an interior angle of less than 150 degrees shall be considered to be a wall corner. The wall corner shall provide a positive connection between the sections of the wall on each side of the corner such that the wall backfill material cannot spill out through the corner at any time during the design life of the wall. The Contractor shall construct the wall corner such that the wall sections on both sides of the corner attain the full geosynthetic layer embedment lengths shown in the Plans.

The wall face leveling pad shall be crushed surfacing base course compacted using Method C. The surface of the leveling pad shall be hard and level. The leveling pad shall be prepared in a manner which will insure complete contact between each wall facing unit in the lowest course of facing units and the leveling pad.

Facing units may be saw cut as required using standard masonry tools. Sawn, half width blocks shall not be used in the base course.

If connecting pins are used between facing units for shear restraint, they shall be installed in each concrete facing unit in a manner which will insure that the pins will protrude a minimum of 25 mm into each facing unit.

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-7-99

PROJECT Traffic Signal Foundation

Job No. OL-2740

S.R. 7

Station

Offset

C.S. 2712

Equipment CME 850

Casing

Ground El (m)

Method of Boring

Start Date July 15, 1999

Completion Date

Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				6 8 7 4 (15)		D-1		6" - Asphalt SAND, medium dense, dark grayish brown to black, dry, stratified (4" organic). Recovered and Retained: 0.7 ft.		
	1			6 22 21 20 (43)		D-2		SAND with gravel, dense, dark gray brown to dark olive brown, dry to moist, stratified. Recovered and Retained: 0.5 ft.		
5	2			10 10 10 30 (20)		D-3		SAND with gravel, medium dense, dark olive gray to reddish brown, moist, stratified. Recovered and Retained: 0.5 ft. Cobble at 6 feet		
				6 4 11 25 (15)		D-4		SAND with gravel, medium dense, olive, moist, homogeneous. Recovered and Retained: 0.5 ft.		
10	3			27 20 23 23 (43)		D-5		SAND with gravel, dense, olive gray, moist to dry, stratified. Recovered and Retained: 1.0 ft.		
	4			14 14 29 50/5" (43)		D-6		Silty SAND, dense, olive gray, wet, homogeneous. Recovered and Retained: 1.0 ft.	▽	
15	5							End of Test Hole Boring at 14.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-8-99

PROJECT Traffic Signal Foundation

Job No. OL-2740

S.R. 7

Station

Offset

C.S. 2712

Equipment CME 850

Casing

Ground El (m)

Method of Boring

Start Date July 16, 1999

Completion Date

Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				10 18 15 23 (33)		D-1		6" - Asphalt SAND with gravel, dense, olive brown to very dark gray brown, dry, stratified (6" organic). Recovered and Retained: 1.0 ft.		
	1		>>	37 42 33 30 (75)		D-2		SAND with gravel, very dense, light olive brown to dark gray, dry, stratified. Recovered and Retained: 0.5 ft.		
5	2			11 11 17 26 (28)		D-3		SAND with gravel, dense, light olive brown to olive gray, dry to moist, stratified. Recovered and Retained: 0.9 ft. Cobble at 7 feet		
				10 13 11 12 (24)		D-4		SAND with gravel, medium dense, olive gray, moist, homogeneous. Recovered and Retained: 0.9 ft.		
10	3			13 11 32 38 (43)		D-5		SAND with gravel, dense, olive gray to olive, moist to dry, stratified. Recovered and Retained: 1.0 ft. Cobble at 11 feet		
	4			17 23 25 45 (48)		D-6		Silty SAND with gravel, dense, olive to olive gray, moist, stratified. Recovered: 1.7 ft. Retained: 1.0 ft.		
15	5							End of Test Hole Boring at 14.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

SOIL OL2740.GPJ SOIL.GDT 7/20/99 11:20:24 A7

LOG OF TEST BORING

Washington State Department of Transportation

HOLE No. H-9-99

PROJECT Traffic Signal Foundation

Job No. OL-2740

S.R. 7

Station

Offset

C.S. 2712

Equipment CME 850

Casing

Ground El (m)

Method of Boring

Start Date July 16, 1999

Completion Date

Sheet 1 of 1

Depth (ft)	Meters (m)	Profile	Standard Penetration Blows/ft (10 20 30 40)	SPT Blows/6" (N)	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				5 5 4 6 (9)		D-1		6" - Asphalt SAND with gravel, loose, dark grayish brown, dry, homogeneous. Recovered and Retained: 0.1 ft.		
	1			2 5 5 5 (10)		D-2		Clayey SAND, loose, grayish brown, dry, homogeneous. Recovered: 1.5 ft. Retained: 1.0 ft.		
5	2			2 4 7 11 (11)		D-3		Clayey SAND, medium dense, grayish brown, dry, homogeneous. Recovered: 2.0 ft. Retained: 1.0 ft.		
				3 9 13 21 (22)		D-4		SILT, medium dense, gray, dry, homogeneous. Recovered: 2.0 ft. Retained: 1.0 ft.		
10	3			8 13 16 14 (29)		D-5		SILT, dense, gray to dark yellowish brown, moist, laminated. Recovered: 2.0 ft. Retained: 1.0 ft.		
	4			5 8 13 25 (21)		D-6		Silty SAND with gravel, medium dense, gray, moist to wet, stratified. Recovered: 2.0 ft. Retained: 1.0 ft.	▽	
15	5							End of Test Hole Boring at 14.5 feet below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications.		
20	6									

SOIL OL2740.GPJ SOIL.GDT 7/20/99□11:20:29 A7