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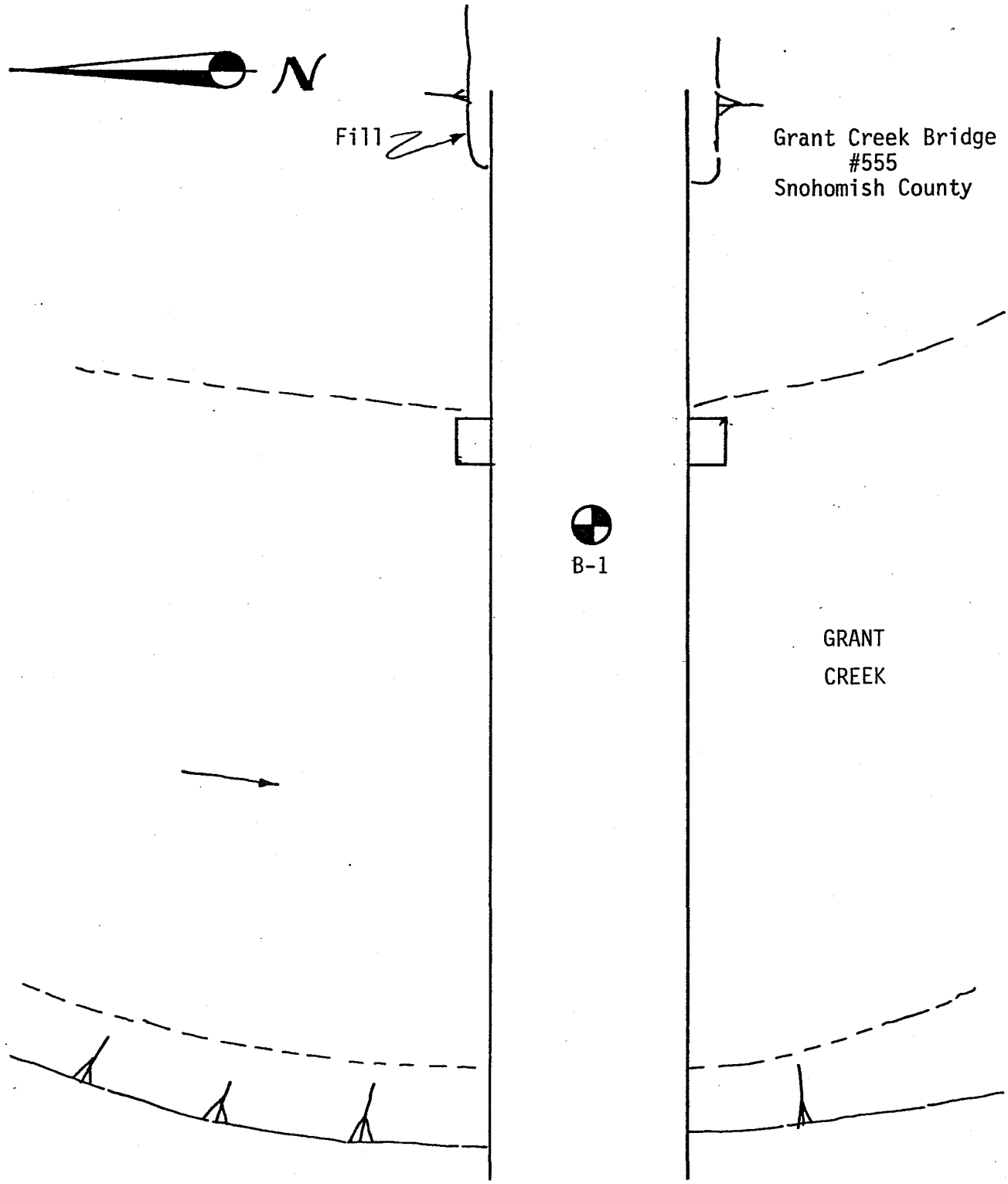
SOILS AND FOUNDATION EXPLORATION
GRANT CREEK ROAD BRIDGE #555
SNOHOMISH COUNTY, WASHINGTON

RITTENHOUSE-ZEMAN AND ASSOC., INC.

GEOTECHNICAL ENGINEERING



Legend:

B-1 Boring Number and Approximate Location

RITTENHOUSE - ZEMAN & ASSOC.
FOUNDATION AND SOILS ENGINEERING, GEOLOGY

13837 N.E. 8th Street
Bellevue, Washington 98005
746-8020

AFFILIATE OFFICES IN MOST PRINCIPAL CITIES

W.O.	3493	DATE	1/81
BY	D. A	SCALE	None

RITTENHOUSE-ZEMAN & ASSOCIATES, INC.
GEOLOGY & SOILS ENGINEERING

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December 29, 1980 W-3493

Snohomish County
Department of Public Works
5th Floor, Administration Building
Everett, Washington 98201

Attention: Mr. Tom Slayton

Subject: Soils and Foundation Exploration
Grant Creek Road Bridge #555
SCP Number 80-963
Snohomish County, Washington

Gentlemen:

At your request, we have completed our soils and foundation exploration at the subject site. This report summairzes our findings and presents conclusions and recommendations pertinent to the proposed bridge replacement. The subject crossing is located in Section 10, T32N R6E, Snohomish County, Washington. The present structure is a timber post and beam bridge which spans Grant Creek. It will be replaced by either a large culvert or simple span bridge.

SUBSURFACE EXPLORATION

The subsurface exploration consisted of drilling a single test boring from the bridge deck to a depth of 40 feet below the existing ground surface. Drilling details are given in the Appendix. Soil samples were taken at selected intervals by the Standard Penetration method or with Shelby tubes. These samples were visually classified in the field by an Engineering Geologist from our firm. Representative portions of the samples were placed in air tight jars and returned to our office for laboratory evaluation. In addition, the

undisturbed Shelby tube samples were sealed and returned to the laboratory. The Boring Log is presented in the Appendix, while the boring location is shown on Plate 1, Site Plan.

SUBSURFACE CONDITIONS

At the boring location are 5 feet of river sands and gravels capping very stiff to hard, gray, bedded, fine, sandy silts with sand interbeds. The sand partings range in thickness from one-sixteenth of an inch to two feet.

DESIGN CONSIDERATIONS

I. General

The soils at the site are suitable for support of either a large culvert or a small bridge. If a bridge is selected, it may be supported by conventional foundations or by driven friction piles.

II. Bridge

A. Conventional Foundations

Bridge footings which penetrate at least four feet below stream bottom elevation may be designed with a maximum allowable bearing pressure of 4,000 pounds per square foot, including both dead and live loads. A one-third increase may be used for short term wind or seismic loadings.

In order to construct the bridge foundations, excavation will need to extend below river level. If an earth cofferdam is used, it may be possible to dewater a shallow excavation by pumping from a sump extending below footing level. However, the drawdown gradient through the stream gravels may develop an inclination of about 3H:1V. This work should be done at low water.

Dewatering with well points or deep wells may not be much more effective, on the other hand, because of the limited permeability of the silts present beneath the stream gravels.

Settlements for a bridge with conventional foundations may be on the order of three-quarters of an inch.

B. Pile Foundations

Full, depth treated, timber piling may be used for bridge support. When driven to depths on the order of twenty-five to thirty feet such piles should be capable of supporting design loads on the order of 20 tons each. The piling should have a tip diameter of at least 8 inches. They should be driven with an air, steam, or diesel hammer developing no less than 15,000 foot pounds of energy per blow.

Driving resistances in the very stiff silts are difficult to predict. Occasionally, these materials are difficult to penetrate with timber piles. To minimize damage to the piles, the contractor should be prepared to band both the tips and butts.

C. Abutments

Fully restrained abutment walls, if unable to yield, should be designed to support an equivalent fluid of 45 pounds per cubic foot. If the abutment can yield, an equivalent fluid of 35 pcf may be substituted. Surcharges due to traffic, construction equipment, etc., should be added to these values.

The abutment should be provided with a perforated pipe footing drain, or weep holes. It should be backfilled with a clean, free draining, granular material compacted to at least 95 percent density using

ASTM:D-698 or AASHTO:T-99 as a standard.

III. Culvert

A culvert, either concrete box or metal, may be constructed at this crossing site. The river gravels would be adequate for support of such a structure with no need for overexcavation. If a culvert is constructed, it would probably be necessary to temporarily divert the stream around the construction site. Assuming that the cobbles and large rocks are removed from the area, a culvert pipe could be installed atop an eight inch thick, compacted, gravel bedding. Culvert backfill should be compacted to at least 95 percent density using ASTM:D-698 or AASHTO:T-99 as a standard. This backfill should extend at least three feet beyond the culvert side walls. The balance of the fill may be placed and compacted as described below. During the backfill process, the soil should be brought upward evenly on both sides of the culvert so that the pipe or structure is not deflected.

Depending on the final invert elevation, it should be noted that a culvert may be underlain by permeable sands and gravels. Under high water conditions, there may be a potential for scour or piping beneath the culvert. We thus recommend that consideration be given to placing some form of cutoff wall or seepage barrier on the upstream toe of the culvert. Such a cutoff collar could be constructed out of a variety of materials including steel sheets, concrete, timber, or compacted clay.

IV. Embankment

Prior to construction, the approach fills, the existing vegetation, and topsoil should be removed and wasted. Fills should be placed in eight inch thick level lifts. Each lift should be mechanically compacted to at least 90 percent density based on ASTM:D-698 or AASHTO:T-99. The uppermost two feet of fill should be more thoroughly compacted so that it has a density of 95 percent of the same laboratory maximum. Where new

fill is placed against sloping, original ground or the side of the existing embankment, the fill should be tied to the adjacent soil with proper keying and benching.

Side slopes on the fill should be made at angles no steeper than 2H:1V. These slopes should be compacted to the same density as the body of the fill. This may be accomplished by overbuilding the fill and cutting back to its compacted core. Instead, it would also be feasible to compact the face of the fill.

We appreciate having the opportunity to assist you. If you have any further questions during the design or construction phases, please call.

Respectfully submitted,

RITTENHOUSE-ZEMAN & ASSOC., INC.

ALVIN R. ZEMAN
STATE OF WASHINGTON
REGISTERED
PROFESSIONAL ENGINEER

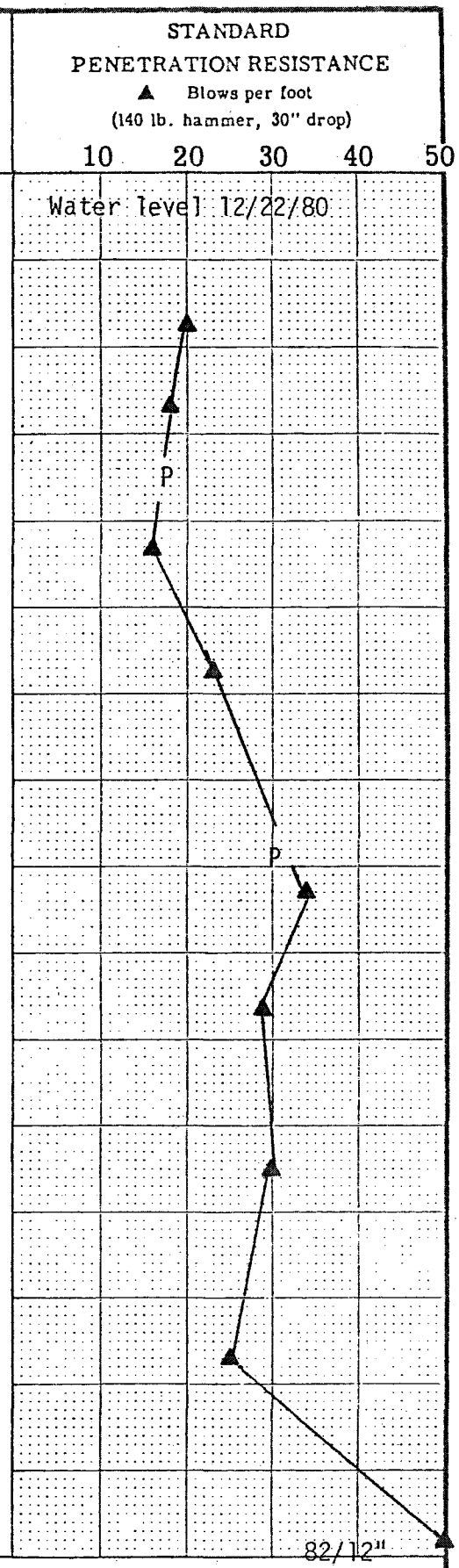
Tom Bekey, Chief Geologist

Alvin R. Zeman, P.E.

APPENDIX A

TEST BORING LOGS

DEPTH, FEET	SOIL DESCRIPTION B-1 Surface Elevation:	SAMPLES / GROUNDWATER
	Coarse gravel with sand and occasional cobbles	
5	Medium dense, saturated, brown, slightly silty, fine to coarse, sandy gravel with cobbles	
10	Very stiff, saturated, bedded, gray, fine, sandy silt Torvane: C=0.5 TSF	
15		
20		
25	Very stiff to hard, saturated, bedded, gray, fine, sandy silt	
30	Very stiff, saturated, bedded, gray, fine, sandy silt with occasional gravel	
35	Medium dense, saturated, mottled, brown, fine to medium sand	
40	Hard, saturated, bedded, gray, fine, sandy silt Bottom of boring - 40 feet	



LEGEND

I 2.0" O.D. split spoon sampler
II 3.0" O.D. undisturbed sampler
P Sampler pushed
• Sample not recovered
Piezometer tip
▽ Water level
Atterberg limits: ⊢●⊣ ← Liquid limit
Natural water content
Plastic Limit

● % Water Content

Grant Creek Bridge
Snohomish County
LOG OF BORING NO. 1
W-3493

RITTENHOUSE-ZEMAN & ASSOC.
SOILS ENGINEERING AND GEOLOGY