GEODESIGN INC

November 22, 2005

David Evans and Associates, Inc.
2100 SW River Parkway
Portland, Oregon 97201

Attention: Mr. Neal Christensen, P.E.

Pavement Design Report
Rose Biggi Avenue
GeoDesign Project: DEA-58-03

GeoDesign, Inc. is pleased to submit this pavement design report for the proposed improvements to SW Rose Biggi Avenue in Beaverton, Oregon. We appreciate the opportunity to be of service to DEA. Please contact us if you have questions regarding this report.

Sincerely,

GeoDesign, Inc.

George Saunders, P.E.
Principal Geotechnical Engineer

KDY:GPS:kt
Attachments
Five copies submitted
Document ID: DEA-58-03-112205-geor.doc

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1.0 INTRODUCTION

GeoDesign, Inc. is pleased to submit this pavement design report for the proposed improvements to SW Rose Biggi Avenue in Beaverton, Oregon. The project will include approximately 550 lineal feet of new roadway extending north from SW Crescent Street to SW Millikan Way to the south. The approximate location of the site is shown on Figure 1.

The project will include the demolition of the existing Westgate Theatre located in the middle, west portion of site. The eastern edge of the theatre building extends nearly the entire width of the road from approximate Stations 8+40 to 11+25. The building extents are outlined on the site plan shown on Figure 2.

For your reference, definitions of all acronyms used are attached at the end of this document.

2.0 SCOPE OF WORK

Our scope of work was to explore subsurface conditions in the proposed roadway by observing three borings along the existing road alignment and providing recommendations for road materials and construction. Our specific scope of work included the following:

- Maintain a detailed log of the explorations and obtain samples of the subgrade materials encountered.
- Obtain soil samples at select depths in the borings.
- Complete the following laboratory tests:
    - Moisture content on five select samples
    - Resilient modulus tests on one select shelby tube soil sample
    - Wash analysis (material passing a U.S. Standard No. 200 Sieve) on one select sample
- Analyze laboratory data to determine the design subgrade resilient modulus.
- Estimate the traffic loading by calculating ESALs based on traffic information provided by DEA.
- Evaluate reconstruction options based on laboratory testing, subgrade conditions, soil explorations, and traffic data.
- Provide this report summarizing our recommendations.

3.0 SITE CONDITIONS

3.1 EXISTING SITE CONDITIONS

The project site is flat, developed land consisting of structures, assorted improvements, and paved surfaces that will be demolished during the course of the project. Additionally, the proposed road will cross the MAX tracks at approximate Station 8+00.

3.2 SUBSURFACE CONDITIONS

A total of three borings (B-1 through B-3) were completed to 6.5 feet BGS at locations identified on Figure 2. A copy of the boring logs is provided in Appendix A.

Boring B-1 was drilled south of the MAX tracks. We observed loose gravel fill to 2.5 feet BGS underlain by medium stiff silt fill to the depth of explorations (6.5 feet BGS). Borings B-2 and B-3 were obtained from paved portions of the theatre property. The AC thickness varied from 0.2 to 0.4 foot. Aggregate base was observed in both borings to 1.5 feet BGS. Underlying the aggregate is a medium stiff, silty to clayey silt fill to the depth of explorations (6.5 feet BGS).

Moisture content of the silt fill varied from approximately 28 to 31 percent, with an average of approximately 29 percent where tested. We performed resilient modulus testing in accordance with SHRP Protocol P-46 on a sample from B-1. Resilient modulus varied from 3,000 to 6,000 psi, depending on confining and deviator stresses.

4.0 PAVEMENT DESIGN INFORMATION

The standards used for pavement design are listed below:

- ODOT Pavement Design Guide, ODOT (September 2004)
- Guide for Design of Pavement Structures, AASHTO (1993)

Our designs include reconstruction analysis for the existing road alignment. The subgrade resilient modulus is based on subsurface explorations and laboratory testing. Traffic loading is based on the information provided by DEA. A description of our input parameters and the recommended pavement design is summarized below.

4.1 ESAL CALCULATIONS

Our ESAL estimations are based on data provided to us by DEA. The data consists of vehicle classification counts on Rose Biggi Avenue south of SW Millikan Way and SW Millikan Way west of Rose Biggi Avenue. The data was averaged, reduced, and grouped into ODOT categories of 2-axle, 3-axle, 4-axle, 5-axle, 6-axle, and busses. ESAL values are calculated for a 20-year design life assuming an annual growth factor of 1.5 percent over the project life. Detailed traffic calculation data is provided in Appendix B. We recommend a 20-year ESAL value of 305,000 based on the classification data and the assumed traffic growth of 1.5 percent.

4.2 SUBGRADE RESILIENT MODULUS

A resilient modulus laboratory test from a shelby tube sample at B-1 was used to determine the design subgrade resilient modulus. Based on the expected depth of subgrade and the type of loads, the appropriate design confining pressure and deviator stress for this project is 2 and 6 psi, respectively. Based on the test results, the corresponding design resilient modulus at this stress level is 3,500 psi.

4.3 OTHER DESIGN PARAMETERS

The other pavement design parameters are summarized in Appendix C. These input parameters are as recommended by ODOT and AASHTO.

5.0 RECOMMENDATIONS

Based on the results of our subsurface explorations, laboratory testing, and analyses, it is our opinion that the road section can be constructed provided the recommendations in this report are followed. We have summarized our construction recommendations for new pavement construction in the following sections.

5.1 PAVEMENT DESIGN

We recommend a new pavement section of 5.0 inches of AC over 14.5 inches of aggregate base. We recommend that the following pavement structure be used:

- 2.5 inches of ½-inch, dense HMAC wearing course
- 2.5 inches of ½-inch, dense HMAC base course
- 14.5 inches of ¾- to 1 ½-inch-minus base aggregate
- Subgrade geotextile

Material recommendations are found in the "Pavement Materials" section of this report.

5.2 SITE PREPARATION

5.2.1 Demolition

As discussed above, the Westgate Theatre complex, other smaller structures, and parking improvements are present at the site. The current site plan indicates that these features will need to be removed. Demolition will require complete removal of these features within areas to receive new pavements. Underground utility lines in areas of new improvements should also be excavated at least 18 inches below design subgrade depth. Materials generated during demolition should be transported off site for disposal or stockpiled in areas designated by the owner. These materials will not be suitable for re-use as engineered fill unless approved by the geotechnical engineer for a specific use.

Old basement or crawlspace areas, or voids resulting from removal of improvements or loose soil in utility lines, should be backfilled with compacted structural fill, as discussed in the "Structural Fill" section of this report. The bottom of such excavations should be excavated to expose a firm subgrade before filling and their sides sloped at a minimum of 1H:1V to allow for more uniform compaction at the edges of the excavations.

5.2.2 Subgrade Preparation

Some agencies typically call for the pavement subgrade to be compacted to 95 percent of AASHTO T99 or T180. Scarification and compaction of the pavement subgrade is not recommended given the amount of demolition, potential backfill required, and soft sill soils at the site. We recommend that the base aggregate be placed over a subgrade geotextile. The geotextile should be placed over firm, undisturbed subgrade. Accordingly, site preparation activities should be staged such that construction equipment does not traffic the exposed silt subgrade. If construction occurs during the wet season (October through April/May), then the subgrade may need 12 to 18 inches of stabilization material.

Jim Brink

From: Krey D. Younger [kyounger@geodesigninc.com]
Sent: Monday, January 09, 2006 3:04 PM
To: Jim Brink
Subject: RE: Specific Gravity

Hi Jim!

2.4 is a reasonable assumption for the HMAC mixture. The aggregate itself is likely around 2.8 specific gravity.

So, your statement is incorrect. It would read better as:

> *The HMAC quantities presented in the Schedule of Items were computed using an assumed HMAC specific gravity of 2.4.*

If it must be related to aggregate specific gravity, use *"assumed aggregate specific gravity of 2.8."*

I hope this helps. Call me if you need more!

Krey Younger, P.E.
Project Engineer
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-----Original Message-----
From: Jim Brink [mailto:jbrink@ci.beaverton.or.us]
Sent: Monday, January 09, 2006 2:54 PM
To: Krey D. Younger
Subject: Specific Gravity

Below is a portion of the spec for the Rose biggi project:

00745.80 General - The quantities of HMAC shown in the Schedule of Items were computed on the basis of aggregates having a Specific Gravity of _____.

I used a Specific Gravity of 2.4 (or 2 tons/CY) to calculate the quantity of Lewvel 2, 1/2 inch dense HMAC. Do you agree?

5.2.3 Subgrade Evaluation

A member of our geotechnical staff should observe the exposed subgrades after site cutting and removal of the existing improvements to determine if there are areas of unsuitable, unstable, or disturbed soil. Our representative should observe a proofroll with a fully loaded dump truck or similar heavy, rubber-tire construction equipment to identify soft, loose, or unsuitable areas. Areas that appear to be too wet and soft to support proofrolling equipment should be evaluated by probing.

Over-excavated portions of the site should be backfilled with either additional aggregate base or with stabilization material. Stabilization material should be used in excavations in excess of 18 inches below bottom of subgrade. Recommendations for materials and levels of compaction are presented in the "Pavement Materials" section of this report.

5.2.4 Construction Considerations

The fine-grained fill soils at the site are easily disturbed. If not carefully executed, site preparation and roadway excavation can create extensive soft areas and significant subgrade repair costs can result. The construction methods and schedule should be carefully considered with respect to protecting the subgrade to reduce the need to over excavate disturbed or softened soil.

5.3 PAVEMENT MATERIALS

5.3.1 Aggregate Base

Imported granular material used as aggregate base should be clean, crushed rock or crushed gravel and sand that is well graded and have at least two crushed faces. The aggregate base should meet the gradation defined in Oregon Standard Specification for Construction Section 00641 – Aggregate Subbase, Base, and Shoulders Base Aggregate, with the exception that the aggregate has less than 5 percent passing a U.S. Standard No. 200 Sieve and a maximum particle size of 1½ inches. The base aggregate should be compacted to not less than 95 percent of the maximum dry density, as determined by AASHTO T99.

5.3.2 AC

The AC should be Level 2 or 3, ½-inch, dense HMAC according to Oregon Standard Specification for Construction Section 00745 and be compacted to 91 percent of Rice Density, as determined by AASHTO T209. The minimum lift thickness is 2.0 inches for ½-inch HMAC. Asphalt binder should be performance graded and conform to PG 64-22 or better.

5.3.3 Stabilization Material

Stabilization material should consist of pit or quarry run rock, crushed rock, or crushed gravel and sand and should meet the requirements set forth in Oregon Standard Specification for Construction Section 00330.14 and 00330.15, with a maximum particle size of 6 inches and less than 5 percent passing the U.S. Standard No. 4 Sieve. The material should be free of organic matter and other deleterious material and have at least two crushed faces. Stabilization material should be placed over a geotextile fabric in one lift and compacted to a firm condition.

5.3.4 Subgrade Geotextile

Subgrade geotextile should conform to Oregon Standard Specification for Construction Section 00350. The geotextile should have a minimum Mullen burst strength of 250 psi for puncture resistance and an apparent opening size between an U.S. Standard No. 70 and No. 100 Sieve.

5.4 STRUCTURAL FILL

5.4.1 General

Fills should only be placed over a subgrade that has been prepared in conformance with the "Site Preparation" section of this report. All material used as structural fill should be free of organic matter or other unsuitable materials. The material should meet the specifications provided in Oregon Standard Specifications for Construction Section 00330, depending on the application. All structural fill should have a maximum particle size of 4 inches. A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill is provided below.

5.4.2 Native Soil

The silt materials on the site are suitable for use as structural fill if they meet the requirements set forth in Oregon Standard Specifications for Construction Section 00330.12 - Borrow Material. Based on laboratory test results, the moisture content of the on-site, near-surface, silty soil is between 28 and 31 percent. Based on our experience, we estimate the optimum moisture content for compaction to be approximately 16 and 18 percent for the on-site silt; therefore, significant moisture conditioning (drying) will be required to use on-site, silty soil for structural fill. Accordingly, extended dry weather will be required to adequately condition the soils for use as structural fill.

When used as structural fill, the on-site silty soil should be placed in lifts with a maximum uncompacted thickness of 8 inches and be compacted to not less than 92 percent of the maximum dry density, as determined by AASHTO T99.

5.4.3 Imported Granular Material

Imported granular material used for structural fill should be pit or quarry run rock, crushed rock, or crushed gravel and sand and should meet the requirements set forth in Oregon Standard Specifications for Construction Section 00330.14 and 00330.15. Imported granular material should be fairly well graded between coarse and fine material and have less than 5 percent by weight passing the U.S. Standard No. 200 Sieve. The material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by AASHTO T99. During the wet season or when wet subgrade conditions exists, the initial lift should be approximately 18 inches in uncompacted thickness and should be compacted by rolling with a smooth-drum roller without use of a drum vibrator.

5.4.5 Stabilization Material

6"-0 trench foundation 330.15

Stabilization material should consist of pit or quarry run rock, crushed rock, or crushed gravel and sand and should meet the requirements set forth in Oregon Standard Specifications for Construction Section 00330.14 and 00330.15, with a maximum particle size of 6 inches and less than 5 percent passing the U.S. Standard No. 4 Sieve. The material should be free of organic matter and other deleterious material and have at least two crushed faces. Stabilization material should be placed over a geotextile fabric in one lift and compacted to a firm condition.

6.0 OBSERVATION OF CONSTRUCTION

Satisfactory earthwork and pavement performance depends to a large degree on the quality of construction. Sufficient monitoring of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to determine if subsurface conditions change significantly from those anticipated.

We recommend that GeoDesign be retained to observe earthwork activities, including stripping; proofrolling of the subgrade and repair of soft areas; performing laboratory compaction and field moisture-density tests; and observing final proofrolling of the pavement subgrade and base rock; asphalt placement and compaction.

7.0 LIMITATIONS

We have prepared this report for use by DEA and the design and construction team for the proposed project. The report can be used for bidding or estimating purposes, but our report, conclusions, and interpretations should not be construed as warranty of the subsurface conditions and are not applicable to other sites.

Exploration observations indicate soil conditions and pavement conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata, pavement, or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No warranty, expressed or implied, should be understood.

♦ ♦ ♦

We appreciate the opportunity to be of continued service to you. Please call if you have questions concerning this report or if we can provide additional services.

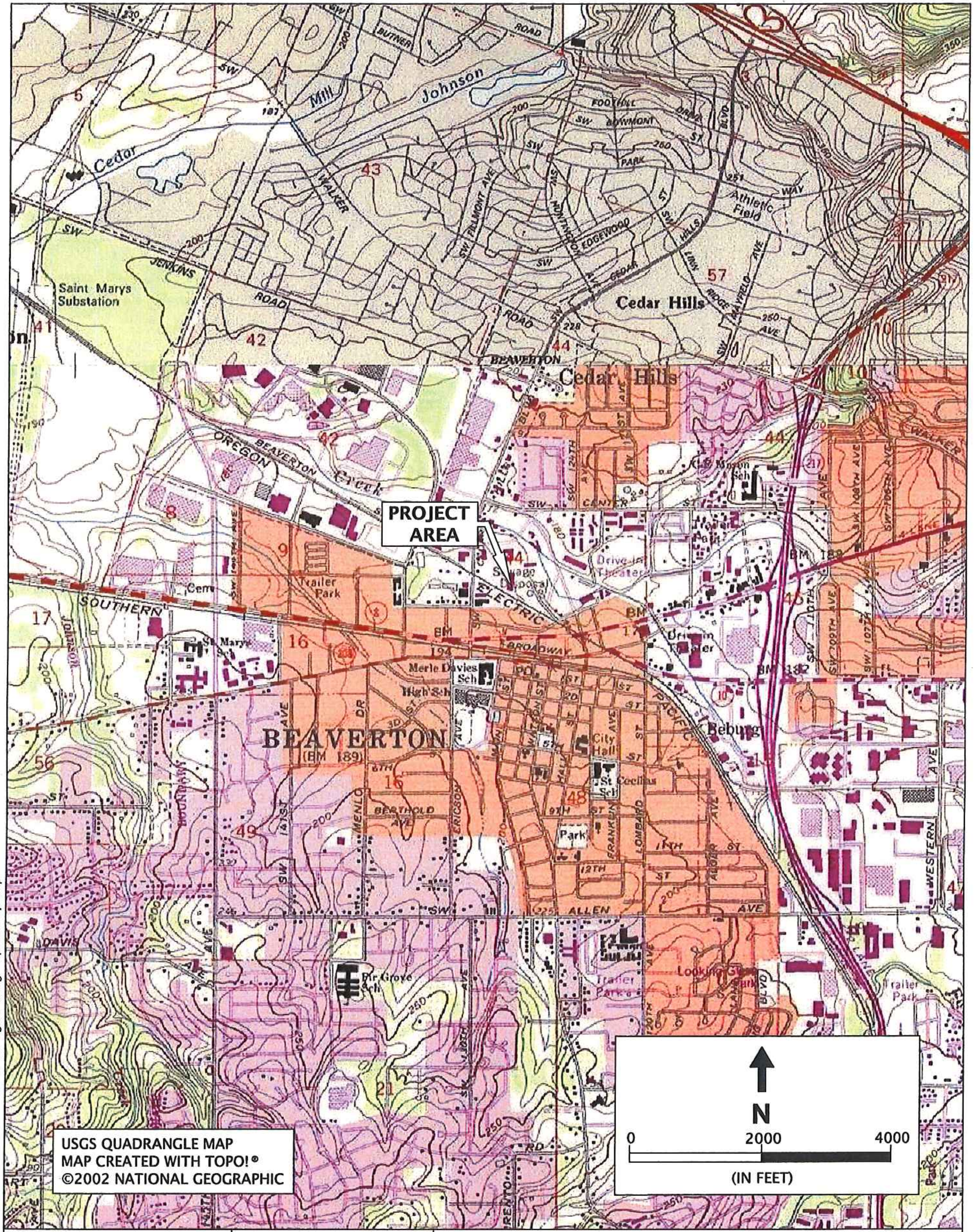
Sincerely,

GeoDesign, Inc.

REGISTERED PROFESSIONAL ENGINEER
50882
OREGON
JAN. 14 2003
KREY D. YOUNGER
EXPIRES: 6/30/06

Krey D. Younger, P.E.
Project Geotechnical Engineer

George Saunders, P.E.
Principal Geotechnical Engineer



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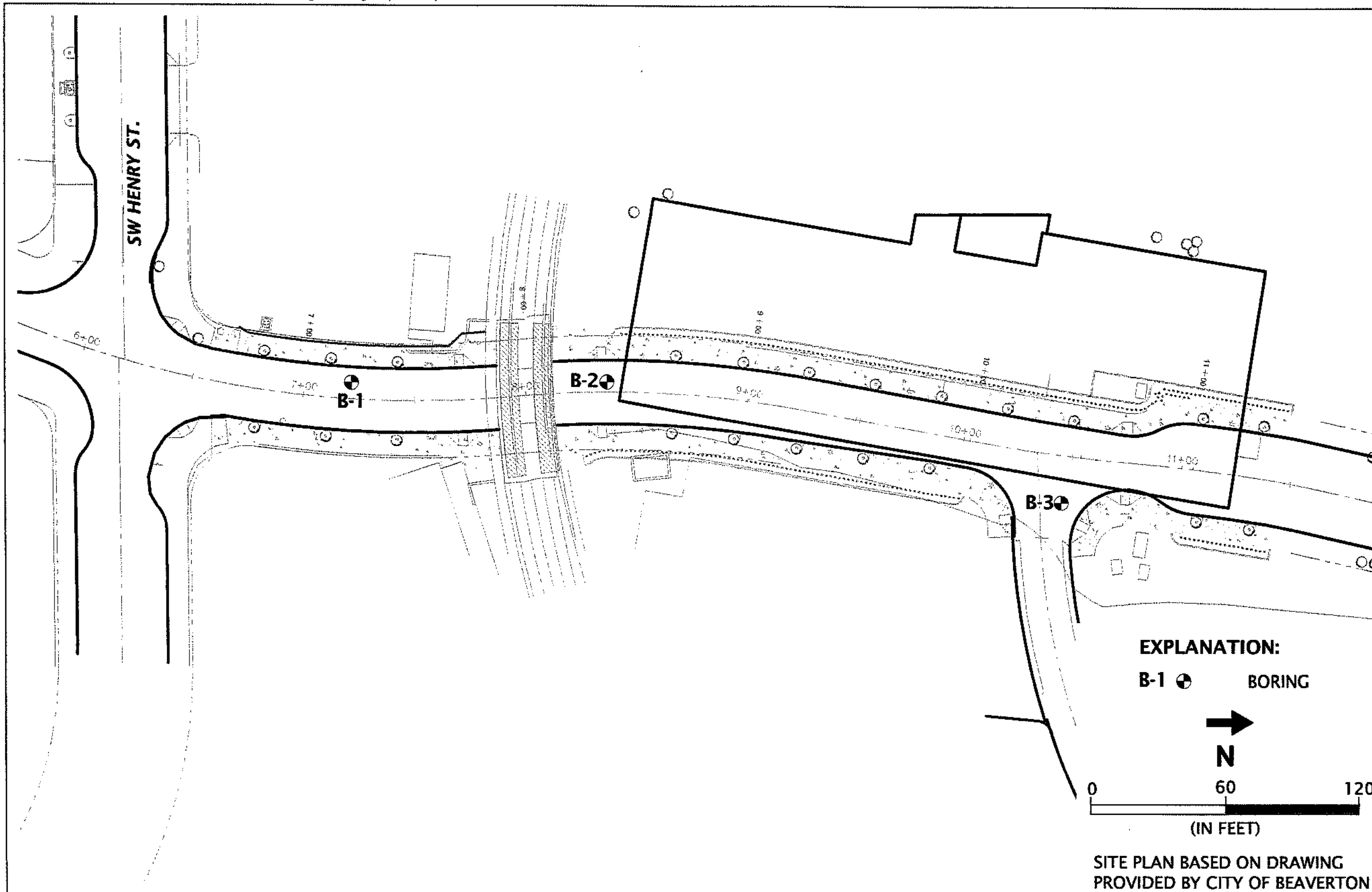
DEA-58-03	**VICINITY MAP**	
NOVEMBER 2005	ROSE BIGGI AVENUE BEAVERTON, OR	**FIGURE 1**

Nov 22, 2005 - 07:52:41 DWG Name: DEA-58-03-VM-Figure-1.dwg Updated By: cmp

Nov 22, 2005 - 07:50:34 DWG Name: DEA-58-03-SP-Figure-2.dwg Updated By: kt



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DEA-58-03	SITE PLAN	
NOVEMBER 2005	ROSE BIGGI AVENUE BEAVERTON, OR	FIGURE 2

APPENDIX A

FIELD EXPLORATION DATA

GENERAL

We explored the existing pavement conditions along the roadway alignment by observing three soil borings (B-1 through B-3) on September 21, 2005. The locations of these borings are shown on Figure 2. The borings were performed by our subcontractor. The borings were advanced to the full depth of the AC (if present), through base material and subgrade to a depth of 6.5 feet BGS. The borings were backfilled by our subcontractor and a polymer modified pavement patch material was applied where appropriate.

SOIL SAMPLING

A member of our geologic staff observed the explorations. We obtained representative samples of the various soils encountered in the borings for geotechnical laboratory testing. Representative grab and tube samples of the soil were obtained from the soil.

Soil classifications and sampling intervals are shown in the exploration logs included in this appendix.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the "Key to Test Pit and Boring Log Symbols" (Table A-1) and "Soil Classification System and Guidelines" (Table A-2), copies of which are included in this appendix. The exploration logs indicate the depths at which the soils or their characteristics change, although the change actually could be gradual. Classifications and sampling intervals are shown on the exploration logs included in this appendix.

LABORATORY TESTING

CLASSIFICATION AND MOISTURE CONTENT

We tested the natural moisture content of selected soil samples in general accordance with ASTM D 2216. The natural moisture content is a ratio of the weight of the water to soil in a test sample and is expressed as a percentage. The moisture contents are included on the exploration logs presented in this appendix.

RESILIENT MODULUS TESTING

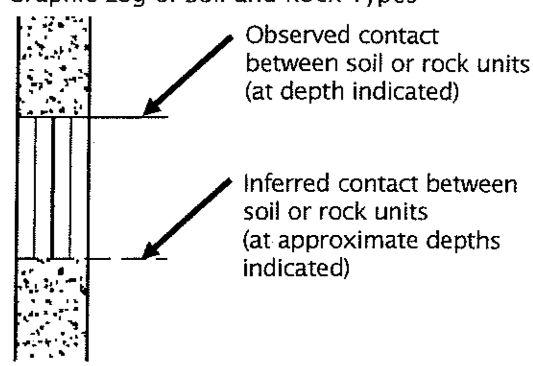
We performed resilient modulus testing on a shelby tube sample from B-1. Resilient modulus testing was performed in general accordance with the procedures outlined in the Strategic Highway Research Program protocol P-46. Samples were tested in our GeoComp LoadTrak II soil testing system. The test results are presented in this appendix.

GRAIN-SIZE TESTING

Grain-size testing was completed on several selected samples. Testing included percent fines determinations in general accordance with guidelines presented in ASTM C 136 and ASTM D 1140. The results of the testing are included on the exploration logs presented in this appendix.

KEY TO TEST PIT AND BORING LOG SYMBOLS

SYMBOL	SOIL DESCRIPTION
	Location of sample obtained in general accordance with ASTM D 1586 Standard Penetration Test with recovery
	Location of sample obtained using thin wall, shelby tube, or Geoprobe® sampler in general accordance with ASTM D 1587 with recovery
	Location of sample obtained using Dames & Moore sampler and 300-pound hammer or pushed with recovery
	Location of sample obtained using Dames & Moore sampler and 140-pound hammer or pushed with recovery
	Location of grab sample
	Rock coring interval
	Water level during drilling
	Water level taken on date shown



GEOTECHNICAL TESTING EXPLANATIONS

PP	Pocket Penetrometer	DD	Dry Density
TOR	Torvane	ATT	Atterberg Limits
CON	Consolidation	CBR	California Bearing Ratio
DS	Direct Shear	OC	Organic Content
P200	Percent Passing U.S. Standard No. 200 Sieve	P	Pushed Sample
HYD	Hydrometer Gradation	RES	Resilient Modulus
UC	Unconfined Compressive Strength	VS	Vane Shear
SIEV	Sieve Gradation	kPa	kiloPascal

ENVIRONMENTAL TESTING EXPLANATIONS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
PID	Photoionization Detector Headspace Analysis	NS	No Visible Sheen
ppm	Parts Per Million	SS	Slight Sheen
P	Pushed Sample	MS	Moderate Sheen
		HS	Heavy Sheen

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KEY TO TEST PIT AND BORING LOG SYMBOLS

TABLE A-1

SOIL CLASSIFICATION SYSTEM

CONSISTENCY - COARSE-GRAINED SOILS

Relative Density	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)
Very Loose	0 – 4	0 - 11	0 - 4
Loose	4 – 10	11 - 26	4 - 10
Medium Dense	10 – 30	26 - 74	10 - 30
Dense	30 – 50	74 - 120	30 - 47
Very Dense	More than 50	More than 120	More than 47

CONSISTENCY - FINE-GRAINED SOILS

Consistency	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)	Unconfined Compressive Strength (tsf)
Very Soft	Less than 2	Less than 3	Less than 2	Less than 0.25
Soft	2 - 4	3 – 6	2 - 5	0.25 - 0.50
Medium Stiff	4 - 8	6 - 12	5 - 9	0.50 - 1.0
Stiff	8 - 15	12 – 25	9 - 19	1.0 - 2.0
Very Stiff	15 - 30	25 – 65	19 – 31	2.0 - 4.0
Hard	More than 30	More than 65	More than 31	More than 4.0

SOIL CLASSIFICATION NAME

Name and Modifier Terms		Constituent Percentage
Coarse-grained	GRAVEL, SAND	>50%
	sandy, gravelly	30 - 50%
	silty, clayey	15 - 50%
	some (gravel, sand)	15 - 30%
	some (silt, clay)	5 - 15%
	trace (gravel, sand)	
	trace (silt, clay)	<5%
Fine-grained	CLAY, SILT	>50%
	silty, clayey	30 - 50%
	sandy, gravelly	
	some (sand, gravel)	15 - 30%
	some (silt, clay)	
	trace (sand, gravel)	5 - 15%
	trace (silt, clay)	
Organic	PEAT	50 - 100%
	organic (soil name)	15 - 50%
	(soil name) with some organics	5 - 15%

MOISTURE CLASSIFICATION

Term	Field Test
dry	very low moisture, dry to touch
moist	damp, without visible moisture
wet	visible free water, usually saturated

GRAIN SIZE CLASSIFICATION

Description		Sieve*	Observed Size
boulders		-	>12"
cobbles		-	3" - 12"
gravel	coarse	0.75" - 3"	0.75" - 3"
	fine	#4 - 0.75"	0.19" - 0.75"
sand	coarse	#10 - #4	0.079" - 0.19"
	medium	#40 - #10	0.017" - 0.079"
	fine	#200 - #40	00029" - 0.017"
fines		<#200	<0.0029"

* Use of #200 field sieve encouraged

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SOIL CLASSIFICATION SYSTEM AND GUIDELINES

TABLE A-2

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEV / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % RQD% CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
0.0		Loose, brown to gray GRAVEL with some silt; moist, angular (fill).				▲9	
2.5		Medium stiff, brown-gray SILT; moist (fill).	2.5	RES	P	● ; ▲9 ●	
6.5		Boring completed at 6.5 feet.	6.5				
7.5							
10.0							

DRILLED BY: Geo-Tech Explorations, Inc. LOGGED BY: CRH COMPLETED: 09/21/05

BORING METHOD: hollow-stem auger (see report text) BORING BIT DIAMETER: 8-inch

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DEA-58-03	BORING B-1		
NOVEMBER 2005	ROSE BIGGI AVENUE BEAVERTON, OR	FIGURE A-1	

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEV / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % RQD% CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
0.0		ASPHALT CONCRETE.					
		GRAVEL (base rock).	0.4				
		Medium stiff, gray-brown, clayey SILT with orange and black mottles; moist, medium to high plasticity (fill).	1.5				
2.5				P200		▲ 5 ●	P200 = 77%
5.0		Medium stiff to stiff, brown, sandy SILT with gray and dark brown mottles; moist low plasticity.	5.0			▲ 8 ●	
		Boring completed at 6.5 feet.	6.5				
7.5							
10.0							

DRILLED BY: Geo-Tech Explorations, Inc. LOGGED BY: CRH COMPLETED: 09/21/05

BORING METHOD: hollow-stem auger (see report text) BORING BIT DIAMETER: 8-inch

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DEA-58-03	BORING B-2	
NOVEMBER 2005	ROSE BIGGI AVENUE BEAVERTON, OR	FIGURE A-2

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEV / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % RQD% CORE REC% (0 – 50 – 100)	INSTALLATION AND COMMENTS
0.0		ASPHALT CONCRETE.					
		GRAVEL (base rock).	0.2				
		Soft to medium stiff, gray, sandy SILT with some clay; moist (fill).	1.5				
2.5						P	
5.0		becomes very soft to soft at 5.0 feet				▲2/18" ●	
		Boring completed at 6.5 feet.	6.5				
7.5							
10.0							

DRILLED BY: Geo-Tech Explorations, Inc. LOGGED BY: CRH COMPLETED: 09/21/05

BORING METHOD: hollow-stem auger (see report text) BORING BIT DIAMETER: 8-inch

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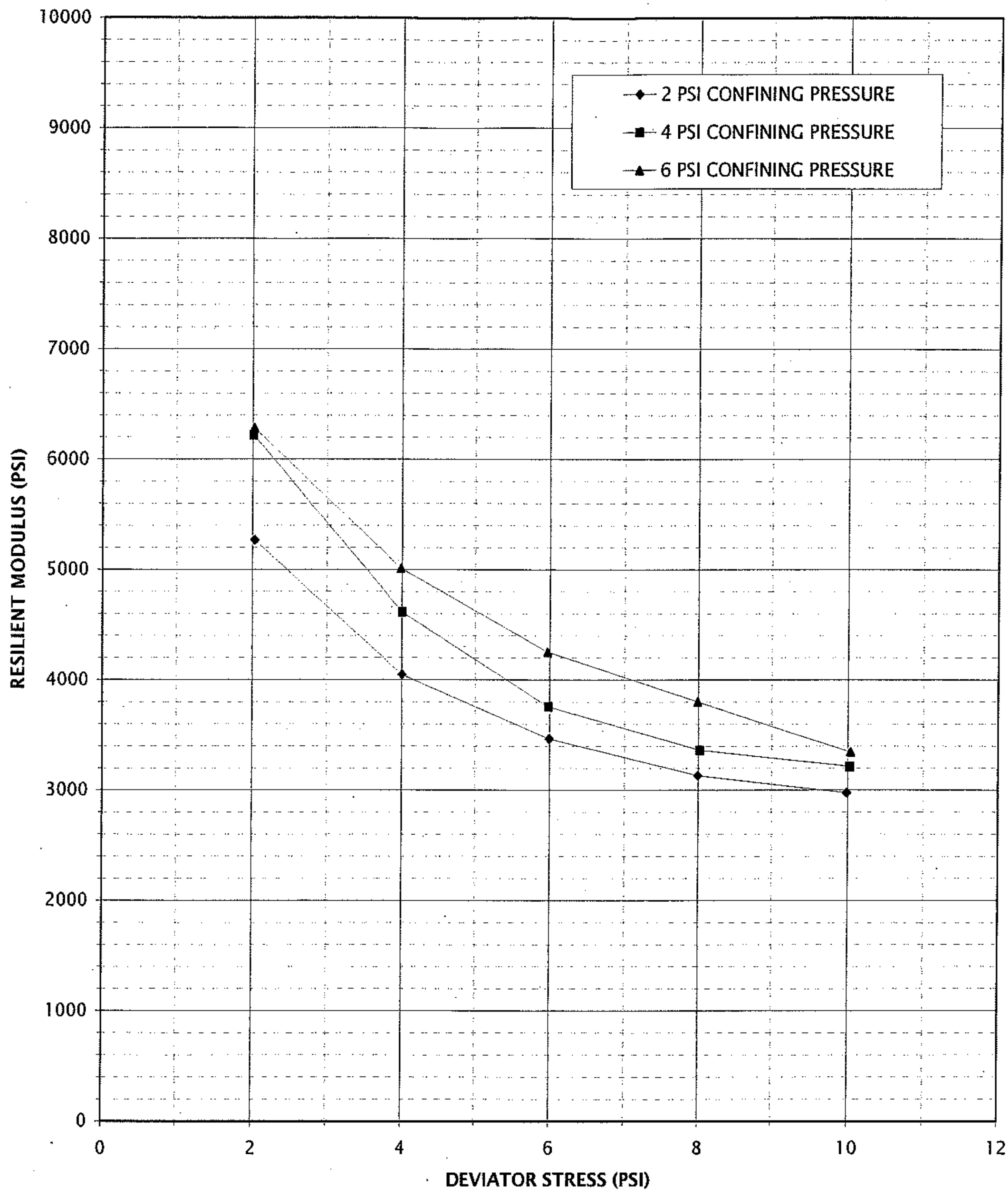
DEA-58-03	**BORING B-3**	
NOVEMBER 2005	ROSE BIGGI AVENUE BEAVERTON, OR	**FIGURE A-3**



EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	DRY UNIT WEIGHT (PCF)	SOIL DESCRIPTION
B-1	3.0	30.7	92.2	Brown-gray SILT

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DEA-58-03

RESILIENT MODULUS TEST RESULTS

NOVEMBER 2005

ROSE BIGGI AVENUE
BEAVERTON, OR

FIGURE A-4

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APPENDIX B

ESAL CALCULATIONS

Our ESAL estimations are based on data provided to us by DEA. The data consist of vehicle classification counts on Rose Biggi Avenue south of SW Millikan Way and SW Millikan Way west of Rose Biggi Avenue. The data was averaged, reduced and grouped into ODOT categories of 2-axle, 3-axle, 4-axle, 5-axle, 6-axle, and busses. ESAL values are calculated for a 20-year design life assuming an annual growth factor of 1.5 percent over the project life. Data is provided in the following table. Based on the classification data provided and an assumed traffic growth of 1.5 percent per year, we recommend a 20-year ESAL value of 305,000.

TABLE B-1

Project Number: DEA-58-03

Total ADT:	2,337	Total Lanes	1	Total Trucks	71	Total Trucks In Design Lane	71
Percent Trucks	3.0%	Total One Direction	2,337	Total Trucks in Travel Lane	100%	Traffic Growth	1.5%

by: KDY

One- or Two-Way Traffic Data — one

Axles	71	ADT
Cars		0.0
2	77.3%	54.6
3	10.6%	7.5
4	6.4%	4.5
5	1.4%	1.0
6	0.7%	0.5
Bus	3.5%	2.5
Sum	1.000	71

Axles	Truck ADT	One-way ADTT	Daily One-Way 18 kEAL Factor	Average Annual 18 kEAL
Cars	0.0	0.0	0.001	0
2	54.6	54.6	0.274	5,457
3	7.5	7.5	0.603	1,653
4	4.5	4.5	0.877	1,442
5	1.0	1.0	1.781	651
6	0.5	0.5	1.781	325
Bus	2.5	2.5	1.980	1,809
Total	70.6			11,336
Design Period		20	Years	
			W/O growth	With growth
Annual 18 kEAL			11,336	15,268
18 kEALs/day			31	42
Total 18 kEALs			226,720	305,359
Traffic Coefficient			7.54	7.82

Total ADT value from vehicle classification tube counter data obtained from SW Rose Biggi Avenue south of Millikan and SW Millikan Way west of SW Rose Biggi. Traffic growth of 1.5 percent assumed. Total ESAL value calculated using ODOT ESAL factors for AC pavements.

APPENDIX C

PAVEMENT DESIGN INPUT

This section summarizes input parameters for pavement designs. These input parameters are as recommended by ODOT's Pavement Design Guide.

SUBGRADE RESILIENT MODULUS

Subgrade resilient modulus values were calculated from laboratory testing at a confining pressure of 2 psi and a deviation pressure of 4 psi.

OTHER DESIGN INPUTS

RELIABILITY

A reliability of 75 percent was used for the rural road section. This value is the mid-range value as recommended by AASHTO (1993).

SERVICEABILITY

The initial and terminal serviceability values used were 4.2 and 2.5, respectively, as recommended by the ODOT and AASHTO guides.

OVERALL STANDARD DEVIATION

The overall standard deviation value used was 0.45 as recommended by AASHTO (1993). This value is at the mid-range of values as suggested by AASHTO.

STRUCTURAL LAYER COEFFICIENT

The structural layer coefficient for new asphalt pavement was 0.42 and the structural layer coefficient for base rock was 0.10.

ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
AC	asphalt concrete
AOS	apparent opening size
ASTM	American Society for Testing and Materials
BGS	below the ground surface
DEA	David Evans and Associates, Inc.
ESAL	equivalent single-axle load
H:V	horizontal to vertical
HMAC	hot mix asphalt concrete
ODOT	Oregon Department of Transportation
PG	performance grade
psi	pounds per square inch
SHRP	Strategic Highway Research Program