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AMERICAN ENGINEERING TESTING, Inc.

CONSULTANTS
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GEOTECHNICAL EXPLORATION PROGRAM

PROPOSED EASTRIDGE SUBDIVISION PHASE II - GRADING RAPID CITY, SOUTH DAKOTA

AET # 18-01579

Date: June 29, 2004

Prepared for:

Dream Design International
528 Kansas City Street, Suite 4
Rapid City, South Dakota 57701

Attn: Mr. Hani Shafai

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June 29, 2004

Mr. Hani Shafai
Dream Design International
528 Kansas City Street, Suite 4
Rapid City, South Dakota 57701

Subject: Geotechnical Exploration Program
Proposed Eastridge Subdivision Phase II - Grading
Rapid City, South Dakota
AET# 18-01579

Dear Hani:

This report presents the results of a subsurface exploration program and geotechnical engineering review for the proposed Eastridge Subdivision Phase II - Grading project in Rapid City, South Dakota. Our work for this project was performed in accordance with American Engineering Testing's (AET) proposal dated June 9, 2004, and your written authorization to proceed on the same date.

The opinions expressed in this report are based upon the present conception of the proposed development and the data obtained from our subsurface exploration. Should there be any changes as the project develops, we request that we be notified so that these new conditions can be reviewed.

The soil samples remaining after the laboratory testing is complete will be retained for a period of fifteen (15) days, at which time they will be discarded. Please notify our office if you wish to have the samples retained for a longer period.

American Engineering Testing, Inc. appreciates this opportunity to serve you. As your project proceeds, we remain interested in providing additional consulting or testing services. If you have any questions about the report, or if we can provide additional services to you, please call our office at (605) 388-0029.

Sincerely,

Robert Temme P.E.
South Dakota Operations Manager

1745 Samco Road • Rapid City, SD 57702 • 605-388-0029 • Fax: 605-388-0064
St. Paul • Duluth • Mankato • Marshall • Pierre • Rapid City • Rochester • Sioux Falls • Wausau

GEOTECHNICAL EXPLORATION PROGRAM
PROPOSED EASTRIDGE SUBDIVISION PHASE I - GRADING
RAPID CITY, SOUTH DAKOTA
AET # 18-01579

CONTENTS

APPENDIX

EXECUTIVE SUMMARY

Specific discussion with recommendations are included in the body of the report. As a summary, the following construction issues should be followed:

- The geotechnical engineer should review the final grading plans prior to construction.
- Grading and excavations on the ridges, within the development, will encounter dense to hard shale and sandstone layers. Large excavation equipment should be able to make the required excavations however hard shale and sandstone layers should be expected in the areas of deeper cuts.
- Fill slopes should be built no steeper than 3H:1V.
- Proper preparation of areas to receive fill and the proper compaction of fill should be monitored in the field.
- When backfilling against existing slopes, new fill should be benched into existing slopes to maintain stability.
- All fill sections in excess of 10 feet in depth under street alignments and placed for structural support should be compacted to at least 95% of the maximum dry density (ASTM D:1557). Fill sections less than 10 feet in depth and in non-structural areas should be compacted to at least 92% of the maximum dry density.
- The need for subsurface drains, in either cut or fill areas, should be evaluated in the field by the geotechnical engineer during construction.
- We recommend that all utility lines be placed in accordance with Sections 8 and 9 of the "City of Rapid City Standard Specifications for Public Works Construction", 1994 edition.
- Our calculations indicate the pavement sections for the various streets will range from 5 inches of asphalt over 8 to 9 inches of base course. The use of edge drains is recommended.

GEOTECHNICAL EXPLORATION PROGRAM
PROPOSED EASTRIDGE SUBDIVISION PHASE II - GRADING
RAPID CITY, SOUTH DAKOTA
AET # 18-01579

INTRODUCTION

This report presents the results of a subsurface exploration program and geotechnical engineering review for the proposed Eastridge Subdivision Phase II - Grading project in Rapid City, South Dakota.

To protect you, AET, and the public, we authorize use of opinions and recommendations in this report only by you and your project team for this specific project. Contact us if other uses are intended. Even though this report is not intended to provide sufficient information to accurately determine quantities and locations of particular materials, we recommend that your potential contractors be advised of the report availability.

Scope of Services

This work was performed in accordance with American Engineering Testing's (AET) proposal dated June 9, 2004, and the written authorization of Mr. Hani Shafai, Dream Design International, Rapid City, South Dakota, on the same date. A review of our agreed-upon scope of services is as follows:

- Drill a total of ten (10) standard penetration test (SPT) borings across the site and along the proposed roadway alignments and areas to receive engineered fill.
- Perform laboratory testing on representative soil samples to determine characteristic engineering and index properties.
- Prepare an engineering report which includes logs of the test borings, presentation of the soil and ground water conditions, the laboratory test results and our geotechnical engineering opinions and recommendations regarding the following:
  - Mass grading cut and fill operations
  - Utility trench excavation and backfilling;
  - Use of site soils for engineered fill;
  - Recommendations regarding earthwork operations;
  - Pavement sections and subgrade preparation for the proposed streets
  - Quality control observations and testing.

The scope of our work is intended for geo-structural purposes only. This scope is not intended to explore for the presence or extent of environmental contamination at the site or to characterize the site relative to any other status such as wet land or historical significance.

PROJECT INFORMATION

Phase II of the Eastridge Subdivision will consist of the extension of Enchantment Road approximately 840 feet to the north. At this point, the street will intersect with the new extension of Enchanted Pines Drive which in turn will run east for a distance of approximately 820 feet at which point it will connect to 5th Street. The westward extension of Enchanted Pines Drive will require cutting and filling within a large drainage channel on the northwest corner of the project.

Project grading contours indicate up to 40 feet of fill will be required across the development and cuts up to 50 feet will be required from the ridges on the south side of the site. We understand 2 to 3 months of construction grading is anticipated to complete the project.

The presented project information represents our understanding of the proposed construction. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

SITE CONDITIONS

Surface Observations

At the time of our field work, the site consisted of gently rolling, vacant acreage vegetated by grasses. Cobbles and boulders are evident scattered across the ground surface along the top of the higher ridges. An existing drainage channel is present in the northeast section of the development.

SUBSURFACE EXPLORATION

General

The subsurface exploration program included drilling ten (10) standard penetration test (SPT) borings at the project site. These borings were drilled at the site on June 15 & 16, 2004. The approximate locations of the borings are shown on the attached Boring Location Map included as Figure 1 in the Appendix. Boring elevations were interpolated from the topo survey provided by Dream Design International, Rapid City, South Dakota.

Subsurface Soils

Logs of the test borings are included as Figures 2 through 11 in Appendix at the end of this report. The logs contain information concerning soil layering, soil classification, geologic description, standard penetration resistance (N-value), methods of advancing maintaining the drill holes, and associated laboratory testing. Included as Figure 12, is a copy of the Unified Soil Classification System, for your reference.

We would like to point out that the subsurface conditions at other times and locations at the site may differ from those found at our test boring locations. If different conditions are encountered during construction, it is necessary that you contact us so that our recommendations can be reviewed.

The general soil profiles across the site consisted of 1½ ' to 8' of sandy fat clay, with varying amounts of gravels, overlying shale associated with the Pierre Formation. The clays were brown in color, ranged from moist to dry and stiff to hard in consistency. The underlying shale tended to be olive brown in color, moist and very stiff to hard.

Exceptions to the above conditions were noted in Borings B-7 and B-9. Within Boring B-7, dry sandy silt was encountered to a depth of 4 ½ feet overlying dense sandy gravel with clay to a depth of 8 ½ feet below grade. The Pierre Shale was then encountered below the site soils. Boring B-9, drilled in the bottom of the existing drainage, consisted of medium dense silty sand, soft sandy clay and medium dense sandy gravel overlying the shale which was encountered at a depth of 14 feet below grade.

No free groundwater was encountered in any of the borings at the time of drilling, however the soils within the bottom of the existing drainage (Boring B-9) were very moist to wet. Based on past work in the area, we anticipate groundwater will be encountered during the excavations with in the bottom of the existing drainage.

Drilling Methods

The standard penetration test (SPT) borings were drilled using 4 inch flite augers. Bore holes were backfilled with on-site materials. Some settlement may occur; final closure of the holes is the responsibility of the client.

Sampling Methods

Standard penetration (California) samples were collected in general accordance with ASTM:D1586. This method consists of driving a 2 ½ " O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30". The sampler is driven a total of 18" into the soil. After an initial set of 6", the number of hammer blows to drive the sampler the final 12" is known as the standard penetration resistance or N-value.

Sampling Limitations

Unless actually observed in a sample contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

Classification Methods

Soil classifications shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM:D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, classifications per ASTM:D2487 are possible. Otherwise, soil classifications shown on the boring logs are visual-manual judgements.

Water Level Measurements

The ground water level measurements, if encountered, are shown at the bottom of the boring logs. The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings and weather conditions.

Sample Storage

We will retain representative samples of the soils recovered from the borings for a period of fifteen (15) days. The samples will then be discarded unless AET is notified otherwise.

LABORATORY TESTING

Representative samples of the soils encountered were selected for laboratory testing to determine index properties. The tests included the determination of moisture content and dry density. In addition, two moisture-density curves (proctors) and one California Bearing Ratio (CBR) test was performed for use in the pavement design analysis.

The laboratory tests were performed in accordance with appropriate American Society for Testing and Materials (ASTM) procedures. The test results can be noted on the attached boring logs opposite the samples upon which the tests were performed, with the exception of the proctor and CBR tests, which can be found in the Appendix as Figures 13 through 15.

GEOTECHNICAL CONSIDERATIONS & RECOMMENDATIONS

Site Preparation

Excavation

We recommend that all topsoil/organic matter, bushes, and any construction debris, if encountered, be removed from within the proposed roadway/utility alignments and all areas to receive fill. Where applicable, excavations should continue to the desired construction elevations. The excavated soils and bedrock, with the exception of any topsoil, may be used as engineered fill.

Areas to receive engineered fill should be scarified to a depth of 12 inches, moisture conditioned, and recompacted to at least 92% of the maximum density as determined by ASTM D:1557 (modified proctor).

Soft, wet subgrade soils will likely be encountered within the bottom of the existing drainage in the northwest corner of the development. As this area will receive up to 40 feet of fill, it is our recommendation the existing soft, wet soil should be excavated in their entirety, within the footprint of the required fill embankment, prior to the placement of engineered fill. Based on Boring B-9, at least 8 feet of excavation may be required. The geotechnical engineer should be allowed to observe the excavation in this area to determine the actual depths of excavation required to provide a solid base for fill placement.

Fill Placement Against Existing Slopes

Permanent cut and fill slopes should be constructed at slopes no steeper than 3H:1V. Where fill placement against existing slopes is required, engineered fill should be placed starting at the toe of the slope. The fill should be benched into the exposed soils/bedrock. All fill slopes and benches should be constructed across the entire width of the hillside and tied into the existing contours. The reconstructed hillside should be re-vegetated once construction is complete to alleviate excessive erosion of the slope.

As previously stated, the on-site soils and bedrock, with the exception of the topsoil, cleaned of all organic/frozen material may be used as engineered fill. We recommend the moisture content range of the engineered fill be within 3% of optimum. For fill slopes less than 10 feet in height, we recommend the soils be compacted to at least 92% of the maximum dry density as determined by ASTM D:1557 (modified proctor). For fill slopes greater than 10 feet in height under street alignments and where structural support is required, engineered fill should be compacted to at least 95% of the maximum dry density (ASTM D:1557).

Slope Stability

Based on the results of our field observations and lab testing, it is our opinion, cut and fill slopes constructed at 3H:1V or flatter will be stable. The geotechnical engineer should be allowed to review the conditions of the slopes at the time of construction to verify the parameters used in our evaluation. Any changes in the grading plan may affect the stability and should be reviewed.

UTILITY CONSTRUCTION

The following recommendations are based on the soil conditions observed in the soil borings we performed at the time of our exploration. The soils and bedrock between the boring locations may differ significantly from those encountered at the boring locations. Further, changes in climatic conditions between the time of exploration and the time of construction may also effect soil conditions, particularly groundwater levels and the moisture content of the soils.

We recommend that all utility lines be placed in accordance with Sections 8 and 9 of the "City of Rapid City Standard Specifications for Public Works Construction", 1994 edition. All trench excavation and backfilling should be performed in accordance with Section 11 "Utility Excavation and Backfill" of the same publication with the following exception. We recommend the moisture content of the compacted fill should be within 3% of the optimum moisture content.

Field Electrical Resistivity Tests

Due to the amount of cut and fill required across the site, we recommend field electrical resistivity tests be run once rough grading is complete. For preliminary design, the on-site soils/bedrock across the project area be considered to be strongly aggressive towards corrosion of iron and other buried metals.

Excavation

We recommend trench excavation for the utility lines be constructed as follows.. This should be verified in the field by Geotechnical Engineer.

Soil	Classification	Recommended Slope Layback
Bedrock	Type A	¾ H : 1 V
Alluvial Soils	Type B	1 H : 1 V
Compacted Fill	Type B	1 H : 1 V

Excavations deeper than 20 feet and/or in saturated soils or below the groundwater table should be considered on an individual basis. Water levels, due to climatic conditions should be evaluated at the time of construction. If the above trench layback recommendations are not feasible, due to space limitations or other factors, the OSHA rules should be consulted for alternative trench stabilization methods. Trench boxes or shoring in compliance with OSHA rules may be acceptable alternatives.

Precautions

It is our opinion that excessive settlement could occur above underground utility trenches. The exact amount of settlement cannot be predicted; however, we strongly recommend that compaction tests be taken in the trenches to assure that proper compaction does exist.

BACKFILL CONSIDERATIONS

It is our opinion that the on-site soils and bedrock may be used as engineered backfill. Should additional fill be required, the proposed import backfill should be submitted to the geotechnical engineer for approval prior to use. The fill should be free of organics, deleterious material and rock greater than six inches.

It is our opinion that engineered fill should be placed on the prepared subgrade as follows. All recommendations are based on the Modified Proctor method (ASTM: D 1557).

1. All backfill should be moisture conditioned to optimum to +3% of optimum moisture content prior to being placed.

2. All backfill should be placed in loose lift thicknesses of eight inches or less. If hand operated compaction equipment is used, the loose lift thickness should be reduced to four inches or less.

3. Each lift should be compacted to at least 92% of maximum proctor density for fills 10 feet or less in height. For fill greater than 10 feet in height, compaction should be at least 95% of maximum dry density.

4. Compaction density tests should be performed on alternating lifts to ensure the minimum density is maintained.

Asphalt Pavement Design

The following pavement section is designed based on the "Simplified Guide for the Design of Concrete Pavements" from the American Concrete Pavement Association which is based on the 1997 "AASHTO Guide for the Design of Pavement Structures". Traffic counts were estimated using Rapid City design criteria. In design calculations, a 20 year design life was used along with a correlation of 1500 x CBR value to estimate the resilient modulus (M_R).

California Bearing Ratio (CBR) Results

Modified proctors (ASTM D:1557) was performed on bulk soil samples obtained from Borings B-2, and B-10. A CBR test was run on the sample obtained from Boring B-10 compacted to approximately 95% of maximum dry density and optimum moisture content. Test results indicated a maximum dry density of 115.2 pcf with an optimum moisture content of 15.2% for the fat clay/shale from Boring B-2 and values of 126.8 pcf at 10.0% for the clayey sand with sandstone gravels from Boring B-10. Based on past work in the area, a CBR value of 3.5 was assigned to the fat clay/shale. The CBR run for the B-10 sample indicated a CBR value of 16.0.

Pavement Sections

The following table summarizes the result of our calculations:

Street	E-18 Traffic	Pavement Section
Enchantment Road	250,000	5" Asphalt over 9" base course
Enchanted Pines	200,000	5" Asphalt over 8" base course

The above sections assume edge drains will be used in design of the pavement section.

Subgrade Preparation

The exposed subgrade should be scarified to a depth of 12 inches below existing grade, moisture conditioned to within 3% of optimum moisture content and be compacted to at least 95% of maximum density as determined by ASTM: D 1557. The prepared subgrade should be proof rolled by a tandem axle dump truck loaded to its capacity. The proof rolling should be observed by our geotechnical engineer to identify areas of soft subgrade.

Any areas that "pump" under the loaded dump truck should be excavated to a depth to be determined by the geotechnical engineer and replaced with coarse clean gravel to stabilize the subgrade. Once the subgrade has been proof rolled and approved by the geotechnical engineer, base course may be placed.

Base Course

Base course gravel should be compacted to a minimum of 95% of maximum density as determined by the modified proctor method (ASTM D:1557/AASHTO T-180) and should meet the requirements as outlined in Section 117 "Aggregates for Granular Bases and Surfacing"of the Rapid City Public Works Department.

CONSTRUCTION CONSIDERATIONS

Excavation

Conventional earth moving equipment should be able to perform the excavations in the site soils. Larger equipment may be required for excavations in the deeper areas of excavation. We recommend that all excavation work be conducted according to the Federal Register, Tuesday, October 31, 1989, Part II, Department of Labor, Occupational Safety and Health Administration, 29 CFR Part 1926, Occupational Safety and Health Administration, Standards-Excavation; Final Rule.

OBSERVATION & TESTING

The construction plans and specifications should be reviewed by our firm to judge the applicability of the recommendations presented in this report. The recommendations in this report are based on the subsurface conditions found at our test boring locations. Since the soil conditions can be expected to vary away from the soil boring locations, we recommend on-site observation by a geotechnical engineer/technician during construction to review these potential changes. Soil compaction testing should be performed on new fill placed in order to judge that project specifications for compaction have been satisfied.

LIMITATIONS

The data derived through this sampling and observation program have been used to develop our opinions about the subsurface conditions at your site. However, because no exploration program can reveal totally what is in the subsurface, conditions between borings and between samples and at other times, may differ from conditions described in this report.

The exploration we conducted identified subsurface conditions only at those points where we took samples or observed ground water conditions. Depending on the sampling methods and sampling frequency, every soil layer may not be observed, and some materials or layers which are present in the ground may not be noted on the boring logs.

If conditions encountered during construction differ from those indicated by our borings, it may be necessary to alter our conclusions and recommendations, or to modify construction procedures, and the cost of construction may be affected.

The extent and detail of information about the subsurface condition is directly related to the scope of the exploration. It should be understood, therefore, that more information may be obtained by means of additional exploration.

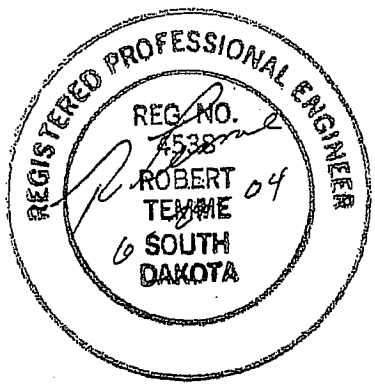
STANDARD OF CARE

Our services for your project have been conducted to those standards considered normal for services of this type at this time and location. Other than this, no warranty, either expressed or implied, is intended.

SIGNATURES

Report Prepared by:

Robert Temme, PE
South Dakota Operations Manager



Reviewed by:

Ray Atkins P.E.
Geotechnical Project Manager

APPENDIX

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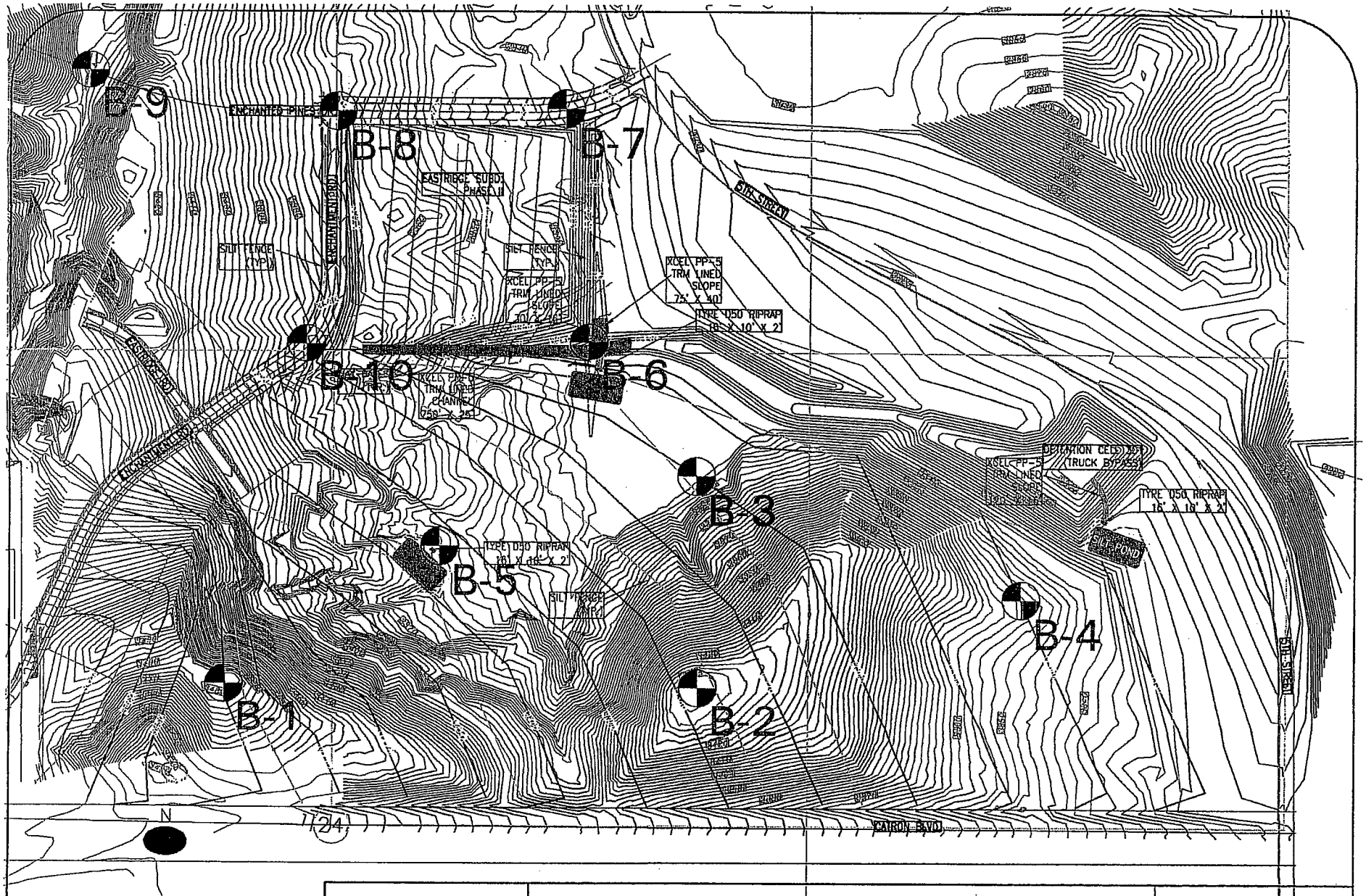

NOTE: THIS IS NOT A LEGAL SURVEY. ALL LOCATIONS ARE APPROXIMATE.

AMERICAN ENGINEERING TESTING, INC.	PROJECT: EASTRIDGE SUBDIVISION PHASE II		AET #: 18-01579
	SUBJECT: BORING LOCATION MAP		DATE: 6/21/04
	SCALE: 1 INCH = 360 FEET	DRAWN BY: KMP / CHECKED BY: RNT	FIGURE 1

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SUBSURFACE BORING LOG

FIGURE 2

AET JOB NO: 18-01579 LOG OF BORING NO. B-1

PROJECT: Eastridge Subdivision Phase II; Rapid City, SD

SURFACE ELEVATION: 3480.0

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1-3	**TOPSOIL**-Sandy Lean Clay with gravel, brown, moist, organics, cobbles and boulders at surface (CL)	Topsoil	13		2L	18					
1-3	**SANDY FAT CLAY**, brown, moist, stiff (CH)	Mixed Alluvium									
6-8	**WEATHERED SHALE** (Textural Classification: Fat Clay, olive brown, moist, hard (CH)	Pierre Formation	20		2L	18					
10-11			40		2L	18	14	116			
15-16			45		2L	18					
20-21			55		2L	18	20	112			
26	Concretion - 25.5'-26.0'		50/.4		2L	5					
30-31			79		2L	12	15	113			
35-36	Dark grey, less weathered										
36-37			50/.3		2L	4					
40-41			50/.3		2L	4	14	118			
45-46			50/.2		2L	3					
	End of Boring										

DEPTH: DRILLING METHOD

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
6/15/04	11:00			46.0		None

BORING COMPLETED: 6/15/04

CC: CA: Rig:

AET_CORP 18-01579.GPJ AET_CORP.GDT 6/23/04

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SUBSURFACE BORING LOG

FIGURE 3

AET JOB NO: 18-01579 LOG OF BORING NO. B-2

PROJECT: Eastridge Subdivision Phase II; Rapid City, SD

DEPTH IN FEET	SURFACE ELEVATION: 3433.0 MATERIAL DESCRIPTION	GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1-3	TOPSOIL- Sandy Lean Clay with gravel, brown, moist, organics, cobbles and boulders at surface (CL)	Topsoil Mixed Alluvium	13		2L	18					
4-8	SANDY FAT CLAY WITH GRAVEL, brown, dry, hard (CH)		57		2L	18	14	86			
9-15	WEATHERED SHALE (Textural Classification: Fat Clay, brown-grey, moist, hard (CH)	Pierre Formation	33		2L	18					
16-19			33		2L	18	21	104			
20-24			72		2L	18					
25-29			72		2L	12	21	102			
30-34			72		2L	12					
35-39			50/.3		2L	4	17	112			
40-45	Dark grey, less weathered		50/.4		2L	5					
46-50			50/.4		2L	5	18	104			
51			50/.4		2L	5					
	End of Boring										

DEPTH: DRILLING METHOD

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
6/15/04	15:00			51.5		None

BORING COMPLETED: 6/15/04

CC: CA: Rig:

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SUBSURFACE BORING LOG

FIGURE 4

AET JOB NO: 18-01579 LOG OF BORING NO. B-3

PROJECT: Eastridge Subdivision Phase II; Rapid City, SD

DEPTH IN FEET	SURFACE ELEVATION: 3336.0 MATERIAL DESCRIPTION	GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL**- Fat Clay, brown-grey, moist, stiff (CH)	Topsoil	29		2L	18	20	104			
	SANDY FAT CLAY WITH TRACE OF GRAVEL, brown, moist, very stiff, organics (CH)	Mixed Alluvium									
5	**WEATHERED SHALE** (Textural Classification: Fat Clay, brown, moist, very stiff to hard (CH)	Pierre Formation	16		2L	18					
10	Dark grey, very stiff, less weathered		36		2L	18	19	110			
15			50/.3		2L	4					
	End of Boring										

DEPTH:	DRILLING METHOD	WATER LEVEL MEASUREMENTS						
		DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
		6/15/04	16:20			16.0		None
BORING COMPLETED: 6/15/04								
CC: CA:	Rig:							

AET_CORP 18-01579.GPJ AET_CORP.GDT 6/23/04

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FIGURE 5

SUBSURFACE BORING LOG

AET JOB NO: 18-01579 LOG OF BORING NO. B-4

PROJECT: Eastridge Subdivision Phase II; Rapid City, SD

DEPTH IN FEET	SURFACE ELEVATION: 3354.0 MATERIAL DESCRIPTION	GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL**-Sandy Lean Clay with some gravel, dark brown, moist, cobbles at surface (CL)	Topsoil	13		2L	18	25	93			
1	**SANDY FAT CLAY**, brown, moist, stiff (CH)	Mixed Alluvium									
5			33		2L	18					
6	**WEATHERED SHALE** (Textural Classificiation: Fat clay, olive and rust, moist, hard (CH)	Pierre Formation									
10			40		2L	18	25	98			
15			62		2L	18					
20			71		2L	18	26	100			
	End of Boring										

DEPTH: DRILLING METHOD

BORING COMPLETED: 6/16/04

CC: CA: Rig:

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
6/16/04	11:25			21.5		None

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SUBSURFACE BORING LOG

FIGURE 6

AET JOB NO: 18-01579 LOG OF BORING NO. B-5

PROJECT: Eastridge Subdivision Phase II; Rapid City, SD

DEPTH IN FEET	SURFACE ELEVATION: 3360.0 MATERIAL DESCRIPTION	GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	TOPSOIL-Sandy Lean Clay with some gravel, dark brown, moist, cobbles at surface (CL)	Topsoil	25		2L	18					
1	SANDY FAT CLAY WITH GRAVEL, brown, dry, very stiff (CH)										
2	WEATHERED SHALE (Textural Classification: Fat Clay, dark grey and rust, dry, hard (CH)										
5			50/.4		2L	5	20	115			
10	Dark grey only - competent shale		50/.4		2L	5					
15	Very hard drilling - sampler bouncing, concreation - no sample recovery		NS	M	2L	NS					
	End of Boring - 15'										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
	6/16/04	14:35			14.0		None
BORING COMPLETED: 6/16/04							
CC: CA: Rig:							

AET_CORP 18-01579.GPJ AET_CORP.GDT 6/23/04

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FIGURE 7

SUBSURFACE BORING LOG

AET JOB NO: 18-01579 LOG OF BORING NO. B-6

PROJECT: Eastridge Subdivision Phase II; Rapid City, SD

DEPTH IN FEET	SURFACE ELEVATION: 3333.0 MATERIAL DESCRIPTION	GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	**TOPSOIL**- Sandy Lean Clay, dark brown, moist, cobbles at surface (CL)	Topsoil	16		2L	18	18	96			
	SANDY FAT CLAY brown, dry, very stiff (CH)	Mixed Alluvium									
2	**WEATHERED SHALE** (Textural Classification: Fat Clay, dark grey and rust, dry, hard (CH)										
5			40		2L	18					
10	Competent shale - dark grey		50/.5		2L	6	17	104			
15	End of Boring		50/.3		2L	4					

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
	6/16/04	15:45			15.0		None
BORING COMPLETED: 6/16/04							
CC: CA: Rig:							

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SUBSURFACE BORING LOG

FIGURE 8

AET JOB NO: 18-01579 LOG OF BORING NO. B-7

PROJECT: Eastridge Subdivision Phase II; Rapid City, SD

DEPTH IN FEET	SURFACE ELEVATION: 3338.0 MATERIAL DESCRIPTION	GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
0	TOPSOIL-Sandy Lean Clay with traces of gravel, dark brown, moist (CL)	Topsoil	14		2L	18	15	85			
1	SANDY SILT, rusty brown, dry, stiff (ML)	Mixed Alluvium									
2											
3											
4											
5	SANDY GRAVEL WITH CLAY, rusty brown, dry, dense (GP)	Mixed Alluvium	42		2L	18					
6											
7											
8											
9	WEATHERED SHALE (Textural Classification: Fat Clay, dark grey and rust, moist, hard (CH)	Pierre Formation									
10			51		2L	18					
11											
	End of Boring										

DEPTH: DRILLING METHOD

WATER LEVEL MEASUREMENTS						
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
6/16/04	16:20			11.5		None

BORING COMPLETED: 6/16/04

CC: CA: Rig:

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SUBSURFACE BORING LOG

FIGURE 9

AET JOB NO: 18-01579 LOG OF BORING NO. B-8

PROJECT: Eastridge Subdivision Phase II; Rapid City, SD

DEPTH IN FEET	SURFACE ELEVATION: 3370.0 MATERIAL DESCRIPTION	GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	TOPSOIL-Sandy Lean Clay with traces of gravel, dark brown, moist (CL)	Topsoil	16		2L	18					
	SANDY SILT, rusty brown, dry, stiff (ML)	Mixed Alluvium									
1	WEATHERED SHALE (Textural Classification: Fat Clay, dark grey, layered with sandy silt, rusty brown, dry, hard (CH)	Pierre Formation									
2											
3											
4											
5			50/.3		2L	4	19	107			
6											
7											
8											
9											
10	End of Boring		NS		2L	NS					
11											

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
	6/16/04	17:05			9.5		None
BORING COMPLETED: 6/16/04							
CC: CA: Rig:							

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SUBSURFACE BORING LOG

FIGURE 10

AET JOB NO: 18-01579 LOG OF BORING NO. B-9

PROJECT: Eastridge Subdivision Phase II; Rapid City, SD

DEPTH IN FEET	SURFACE ELEVATION: 3380.0 MATERIAL DESCRIPTION	GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	TOPSOIL-Sandy Lean Clay, dark brown, moist (CL)	Topsoil	11		2L	18	8	101			
1	SILTY SAND with sandstone gravel, rusty brown, dry, medium dense (SM)	Mixed Alluvium									
2											
3											
4	SANDY CLAY WITH GRAVEL, brown, water bearing, soft (CL)	Mixed Alluvium									
5			3		2L	18	30	88			
6											
7											
8	SANDY GRAVEL WITH CLAY, rusty brown, water bearing, medium dense (GP)	Mixed Alluvium									
9											
10			13		2L	18	19	113			
11											
12											
13											
14	WEATHERED SHALE (Textural Classification: Fat Clay, dark grey layers mixed with rusty brown sand layers, wet from above, very stiff (CH)	Pierre Formation									
15	End of Boring		50/.5		2L	6					
16											

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
	6/16/04	17:55			14.0		None
BORING COMPLETED: 6/16/04							
CC: CA: Rig:							

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FIGURE 11

SUBSURFACE BORING LOG

AET JOB NO: 18-01579 LOG OF BORING NO. B-10

PROJECT: Eastridge Subdivision Phase II; Rapid City, SD

DEPTH IN FEET	SURFACE ELEVATION: 3380.0 MATERIAL DESCRIPTION	GEOLOGY	N	GW	SAMPLE TYPE	REC. IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
	TOPSOIL-Lean Clay with gravel, dark brown, moist (CL)	Topsoil	17		2L	18	9	90			
1	SANDY FAT CLAY, brown dry, very stiff (CH)	Mixed Alluvium									
2											
3											
4	WEATHERED SHALE(Textural Classification: Fat Clay with sands tone lenses, rust and dark grey, dry, hard stiff (CH/SM)	Pierre Formation									
5	Shale with sandstone		50/.3		2L	4					
6											
7											
8											
9											
10	End of Boring		50/.2		2L	3					
11											

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
	6/16/04	18:45			9.5		None
BORING COMPLETED: 6/16/04							
CC: CA: Rig:							

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FIGURE 12

UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

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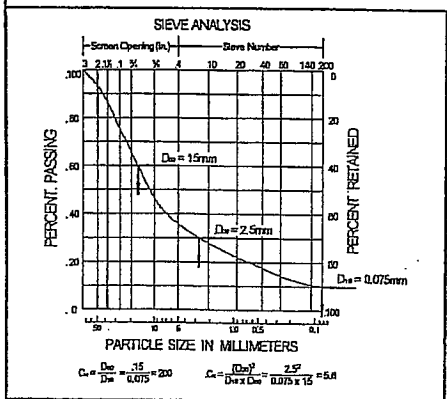
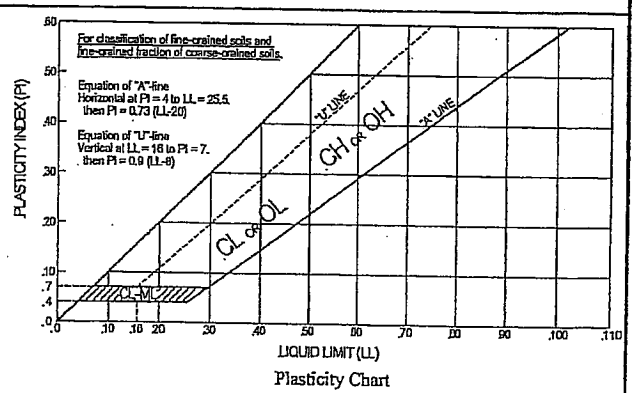
Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	Cu≥4 and 1≤Cc≤3[E]	GW	Well graded gravel[F]
			Cu<4 and/or 1>Cc>3[E]	GP	Poorly graded gravel[F]
		Gravels with Fines more than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	Cu≥6 and 1≤Cc≤3[E]	SW	Well-graded sand[I]
			Cu<6 and 1>Cc>3[E]	SP	Poorly-graded sand[I]
		Sands with Fines more than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve (see Plasticity Chart below)	Silts and Clays Liquid limit less than 50	inorganic	PI>7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI<4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	Liquid limit–oven dried / Liquid limit – not dried <0.75	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	Liquid limit–oven dried / Liquid limit – not dried <0.75	OH	Organic clay[K,L,M,P] / Organic silt[K,L,M,Q]
Highly organic soil			Primarily organic matter, dark in color, and organic in odor	PT	Peat[R]





Plasticity Chart

Notes

[A] Based on the material passing the 3-in (75-mm) sieve.
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
[D] Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
[E] $Cu = D_{60}/D_{10}$, $Cc = (D_{30})^2 / D_{10} \times D_{60}$
[F] If soil contains ≥15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot is hatched area, soils is a CL-ML silty clay.
[K] If soil contains 15 to 29% plus No. 200 add "with sand" or "with gravel", whichever is predominant.
[L] If soil contains ≥30% plus No. 200, predominantly sand, add "sandy" to group name.
[M] If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI≥4 and plots on or above "A" line.
[O] PI<4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.
[R] Fiber Content description shown below.

ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Grain Size

Term	Particle Size
Boulders	Over 12"
Cobbles	3" to 12"
Gravel	#4 sieve to 3"
Sand	#200 to #4 sieve
Fines (silt & clay)	Pass #200 sieve

Gravel Percentages

Term	Percent
A Little Gravel	3% - 14%
With Gravel	15% - 29%
Gravelly	30% - 50%

Consistency of Plastic Soils

Term	N-Value, BPF
Very Soft	less than 2
Soft	2 - 4
Firm	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	Greater than 30

Relative Density of Non-Plastic Soils

Term	N-Value, BPF
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Greater than 50

Moisture/Frost Condition (MC Column)

D (Dry): Absense of moisture, dusty, dry to touch.
M (Moist): Damp, although free water not visible. Soil may still have a high water content (over "optimum").
W (Wet/ Waterbearing): Free water visible intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt.
F (Frozen): Soil frozen

Layering Notes

Laminations: Layers less than ½" thick of differing material or color.
Lenses: Pockets or layers greater than ½" thick of differing material or color.

Fiber Content of Peat

Term	Fiber Content (Visual Estimate)
Fibric Peat:	Greater than 67%
Hemic Peat:	33 – 67%
Sapric Peat:	Less than 33%

Organic/Roots Description (if no lab tests)

Soils are described as *organic*, if soil is not peat and is judged to have sufficient organic fines content to influence the soil properties. *Slightly organic* used for borderline cases.

With roots: Judged to have sufficient quantity of roots to influence the soil properties.
Trace roots: Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.

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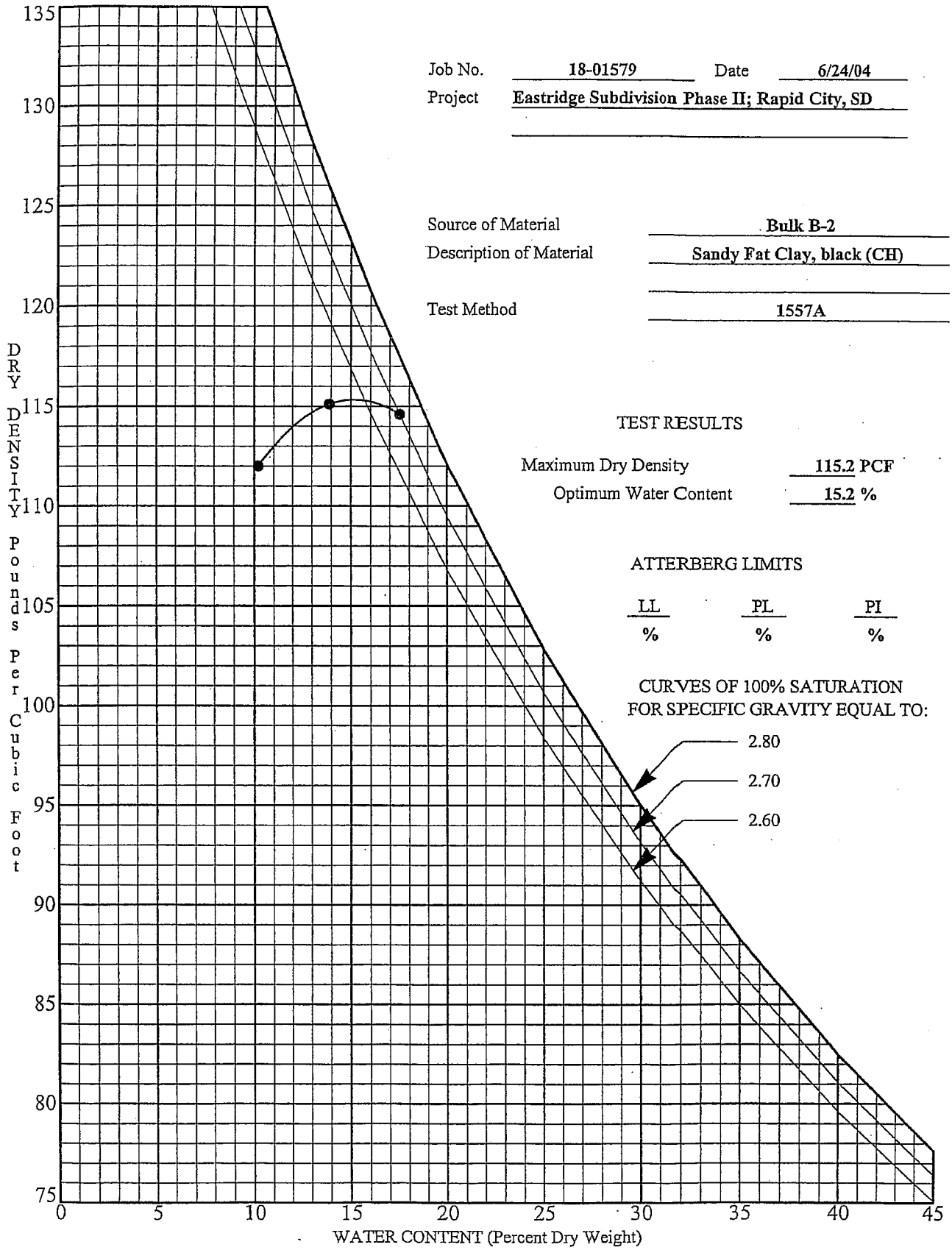
FIGURE 13



Job No. 18-01579 Date 6/24/04

Project Eastridge Subdivision Phase II; Rapid City, SD

Source of Material Bulk B-2

Description of Material Sandy Fat Clay, black (CH)

Test Method 1557A

TEST RESULTS

Maximum Dry Density 115.2 PCF

Optimum Water Content 15.2 %

ATTERBERG LIMITS

LL	PL	PI
%	%	%

CURVES OF 100% SATURATION FOR SPECIFIC GRAVITY EQUAL TO:

2.80

2.70

2.60

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MOISTURE-DENSITY RELATIONSHIP

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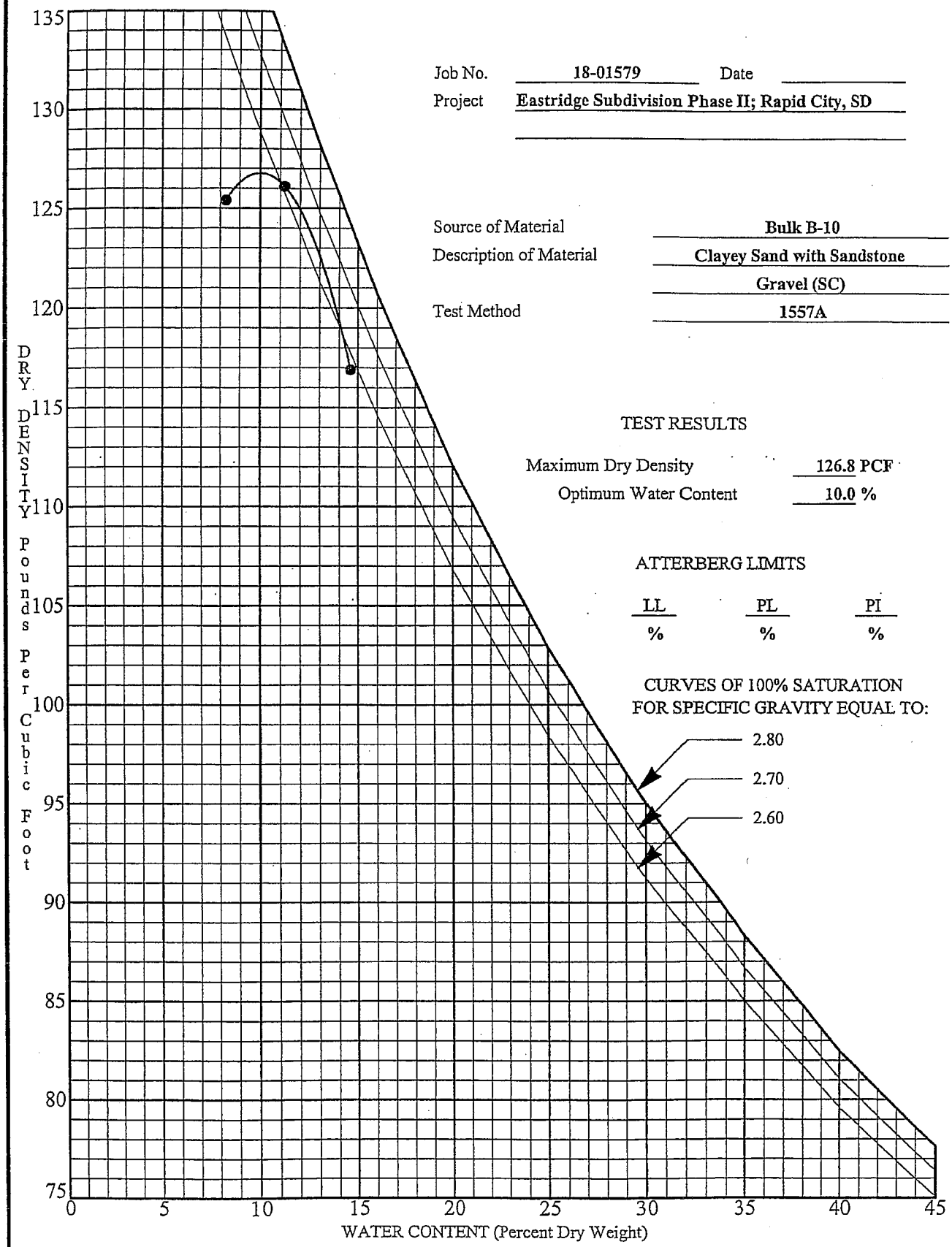
FIGURE 14



Job No. 18-01579 Date

Project Eastridge Subdivision Phase II; Rapid City, SD

Source of Material: Bulk B-10

Description of Material: Clayey Sand with Sandstone Gravel (SC)

Test Method: 1557A

TEST RESULTS

Maximum Dry Density: 126.8 PCF

Optimum Water Content: 10.0 %

ATTERBERG LIMITS

LL	PL	PI
%	%	%

CURVES OF 100% SATURATION FOR SPECIFIC GRAVITY EQUAL TO:

2.80

2.70

2.60

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MOISTURE-DENSITY RELATIONSHIP

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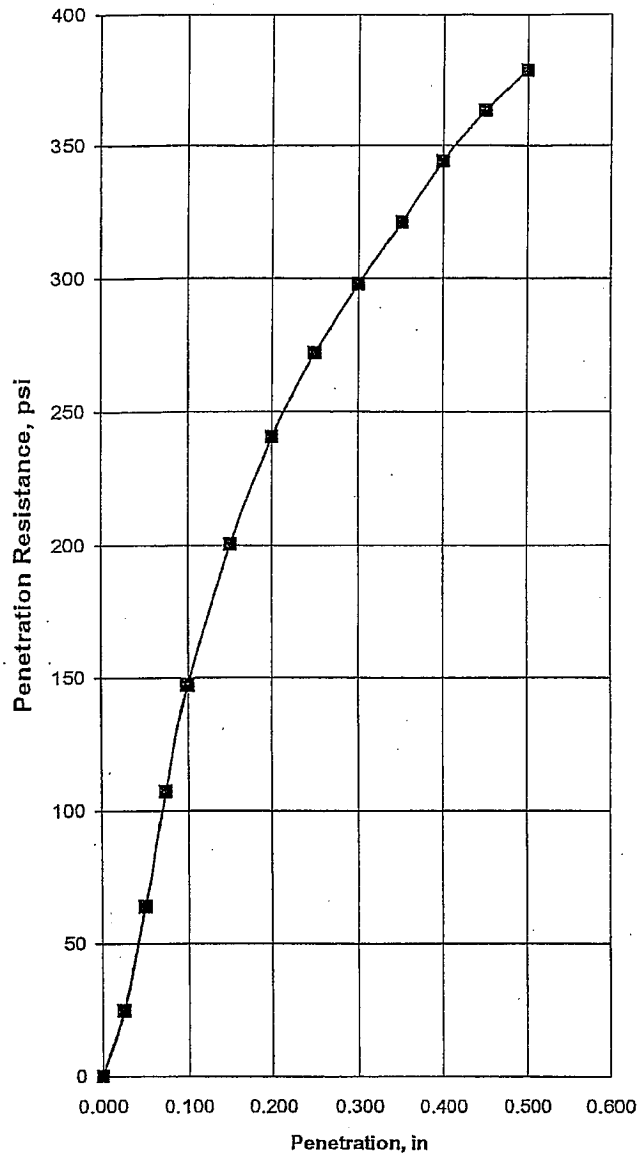

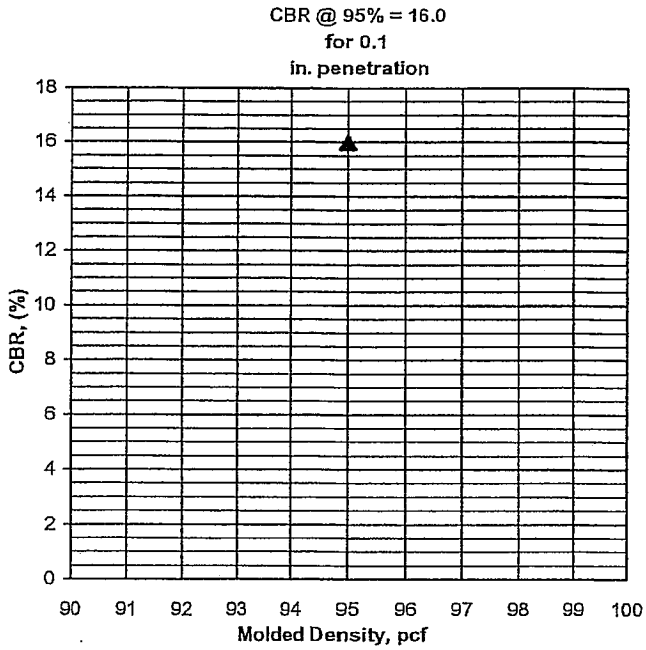

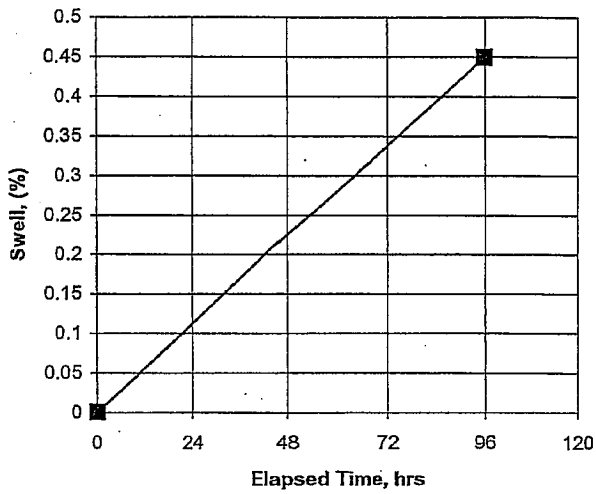

Molded			Soaked			CBR, (%)		Pen.	Swell
Dens.	% Max.	% Moisture	Dens.	% Max.	% Moisture	0.1 in	0.2 in	Surcharge	%
132.15	95.0	11			13.5	14.7	16	10	0.45

MATERIAL DESCRIPTION	USCS	Max. Dens.	Opt. Mois.	LL	PI
Clayey Sand with Gravel	SC	129	9		

Project No: 18-01579 Sample No: Bulk B-10

Project: Eastridge II
Rapid City, South Dakota

Date: 6/28/2004

Test Descr. / Remarks

CBR: ASTM D:1883

Proctor: ASTM D:1557Method A

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CALIFORNIA BEARING RATIO

FIGURE 15