

BURGESS ENGINEERING AND TESTING, INC.

**REPORT OF PEDOLOGICAL SOIL SURVEY
FOR U.S. HIGHWAY 77 IMPROVEMENTS SOUTH OF TONKAWA
KAY COUNTY, OKLAHOMA
PROJECT NO.: SSP-136C(101)SS
STATE JOB NO. 21854(04)
BETI PROJECT NO: 731-10119**

BURGESS ENGINEERING AND TESTING, INC.

October 12, 2010

Smith Roberts Baldischwiler, LLC.
104 S 2nd Street
Chickasha, OK 73018

Attention: Mr, Gray Noland, P.E.,

RE: Report of Pedological Soil Survey
For U.S. Highway 77 Improvements South of Tonkawa
Kay County, Oklahoma
Project No. SSP-136C(101)SS
Job Piece No. 21854(04)
BETI Project No. 731-10119

Dear Mr. Noland:

Burgess Engineering and Testing, Inc. is pleased to submit this report of Pedological Soil Survey for the above referenced project. Contained in this presentation are the results of the Pedological laboratory tests, geological description, soil series station extents, and recommendations with regard to pavement design on problem soils, shrinkage/swell factors for excavation as well as general site development. The subsurface exploration and the foundation recommendation for the proposed bridge over Birds Nest Creek will be submitted in the supplemental report.

We appreciate the opportunity to have provided you with our geotechnical engineering services, and look forward to working with you during the construction phase of this project. If you have any questions concerning this report or if we may be of further service in any manner please contact our office.

Respectfully;

Burgess Engineering And Testing, Inc.

James B. Noels, Jr., Ph.D., P.E.
Geotechnical Engineering Consultant

Ali H. Ebrahimi, Ph.D., P.E.
President



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KAY COUNTY, OKLAHOMA
PROJECT NO. SSP-136C(101)SS
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PREPARED FOR

SMITH ROBERTS BALDISCHWILER, LLC.
104 S. 2ND STREET
CHICKASHA, OK 73018

OCTOBER 12, 2010

BY

BURGESS ENGINEERING AND TESTING, INC.
809 N.W. 34TH STREET
MOORE, OKLAHOMA
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1.0 INTRODUCTION

1.1 Project Authorization

Burgess Engineering And Testing, Inc. has completed a Pedological Soil Survey, including laboratory testing, geological description, station extents for soil series, recommendation with regard to pavement design on problem soils and shrinkage/swell factors for the proposed improvement on U.S. Highway 77 Improvements South of Tonkawa in Kay County, Oklahoma. The work was authorized by Smith Roberts Baldischwiler, LLC., and the work was performed in accordance with the BETI Proposal #09426.

The purpose of this study was to explore the subsurface conditions at the site with regards to project earthwork and pavement subgrade construction. This report briefly outlines the testing procedures, describes the site and subsurface conditions and soil series station extent. The pedological soil survey was performed in accordance with "ODOT Preliminary Soil Survey of Pedological and soil survey" dated October 31, 2005.

The scope of this service did not include any environmental assessment for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, ground water, or air, on or below or around this site. Any statement in this report or on the boring logs regarding odors, colors, unusual or suspicious items or conditions are strictly for the information of the client.

1.2 Qualifications

Mr. James B. Nevels', Jr., Ph.D., P. E. responsibility was limited to selecting the representative soil series sampling locations, logging the soil series descriptions, reviewing BETI test data, and preparing the preliminary report. BETI conducted the laboratory processing and testing in general accordance with the current Oklahoma Department of Transportation (ODOT) geotechnical specifications for roadway design.

2.0 PEDOLOGICAL SOIL SURVEY

2.1 Site and Subsurface Conditions

The project description is 0.611 mile of grade and drain on US 77 over Birds Nest Creek in Kay County approximately 4.75 miles south of Tonkawa. The site of the referenced project is located along US 77 alignment between approximately 850 feet south of E-W 28 CR and 2500 feet north E-W 28 CR. The E-W 28 CR is also named as Cowboy Hill Road. Based on the plans and preliminary information provided by Smith Roberts Baldischwiler, LLC, the project consists of improvements to the existing US 77 by widening of existing US 77 to a two lane facility with 8.0 foot shoulders with new grade and drain in the northbound and southbound directions and a new bridge over Bird's Nest Creek in Kay County. According to the plans provided the grade line consists of an at-grade section at the beginning and ending

of the project with an increased height of the embankment section over Birds Nest Creek of approximately five feet above the existing grade line. Based on the plan set provided proposed roadway improvement project starts at station 1135+66.09 the beginning of project (BOP) on the existing alignment and swinging to the right of the existing alignment extending north to station 1169+14.94, the end of project (EOP) on the back on the existing alignment. The subsurface conditions throughout this project extent consist of soils developed from clayey and loamy alluvium deposits developed from terrace deposits, small alluvial deposits, and residual soil deposits. The geomorphic province at this site is the Central Red-Bed Plains that consists of Permian geologic age red shales and sandstones that form gently rolling hills and plains topography.

Of particular note is the Oil waste land-Huska complex (Od) soil series mapped south of the E-W 28 CR and west of the existing US 77 alignment. The alignment crosses an oil-waste land along this portion of the project due to the past and present oil exploration and production. This oil-waste land-Huska complex is made up of areas in which liquid oily waste has accumulated. This complex includes slush pits and the adjacent uplands and bottom lands that have been affected by liquid wastes, mainly salt water and oil. Note in the sampling of the oil-waste land-Huska complex soil series it was observed that although the texture and plasticity matched the Huska soil description; the color is believed to have been affected by the salt water and oil wastes. Site photographs are presented in Figures 1 through 3. The extent of the oil-waste land can also be seen in the Web Soil Survey 2.2 (to be discussed later in this report) soil map on page 1 denoted by the lighter map colors right and left of the existing US 77 centerline.

2.2 Field Investigation

A check with the USDA Natural Resources Conservation Service (NRCS) Web Soil Survey 2.2 program indicates that there are four soil series (**McLain, Brewer, Lela, and Oil-waste land-Huska** complex) that cross the alignment within the project extent. Mr. James B. Nevels, Jr., Ph.D., P.E., performed the field operations and soil sampling. These four soil series (**McLain, Brewer, Lela, and Oil waste land-Huska** complex) were sampled for this project as specified in the scope of work. Hereafter in this report the Oil waste land-Huska complex will be referred to as the Huska soil series. These soil series were sampled with a hand auger. The results of this Web Soil Survey 2.2 are presented in Appendix "A". The USDA Natural Resources Conservation Service (NRCS) official soil descriptions (OSD) were used to model the soil series profile depths and descriptions in the sampling process. There were no water tables recorded in the above listed four soil series hand auger borings. The upland alluvial, terrace, and residual soil deposits appeared to be very dry during the sampling process and site visits.

A check with the Kay County Soil Survey (December 1967) indicates that the soil series along this alignment project extent had not been re-correlated in the Web Soil Survey 2.2, and they are the same soil series as recorded in the Web Soil Survey 2.2.

2.3 Soil Taxonomy

The soil taxonomic classes for all soil series are presented in Table 2 of Appendix "B", and a further taxonomic description is given in Table 3 of Appendix "B". The soil series throughout this report are arranged in decreasing order and great group to reinforce and emphasize the taxonomic classification. A soil taxonomy statement for all soil series is presented in Appendix "B".

2.4 Soil Description

Regarding the pedological and geological soil survey, the four soil series as indicated above are from three soil orders, see Table 3 and the soil taxonomic statement in Appendix "B". The soil series identified along the alignment of this project are as follows: **McLain**, **Brewer**, **Lela**, and the **Huska complex**. A soil series complex means two or more dissimilar soil series that occur in a regular repeating pattern but that these soils can not be mapped separately on the 1:20,000 map scale in this case in the Web Soil Survey 2.2.

The **McLain** soil series diagnostic horizons and features include an mollic epipedon and an argillic horizon. The mollic epipedon refers to dark colored, organic rich surface horizons that are susceptible to subgrade instability during wet weather and includes the Ap, A, and Bt1 horizons from the ground surface to a depth of 30 inches. The argillic horizon develops through a process of illuviation where successive subhorizons with depth develop with increasing clay content at least 1.2 times more clay content as occurring in an overlying subhorizon and is represented by a lower case symbol 't' in the subhorizon identification and includes the Bt horizons from 14 to 38 inches.

The **Brewer** soil series diagnostic horizons and features include features include an mollic epipedon and an argillic horizon. The mollic epipedon as described above includes the A and Bt1 horizon from the ground surface to 32 inches. The argillic horizon as described above includes the Bt horizons from the ground surface down to 50 inches.

The **Lela** soil series diagnostic horizons and features include features include a mollic epipedon, cambic horizon, and slickensides. The mollic epipedon as described above includes the Ap and A1 horizons from the ground surface to a depth of 15 inches. The cambic horizon refers to a subsoil horizon of very fine sand, loamy very fine sand, or finer texture that is 15 cm (5.91 inches) or more thick with some weak indication of alteration in color from the pedogenic processes. The cambic horizons include the Bkss1 and Bkss2 horizons where the colors of these horizons have a reddish orange color. Slickensides referred to the 'ss' designation in the B and BC horizons below the A horizon throughout the soil profile depth. Slickensides are formed by shear failure as clay minerals swell upon wetting, and they

are an indicator of shrink-swell behavior. They are also an indicator of vertisol features which generally refers to deep wide cracks that are open 90 to 150 cumulative days in any one year.

The **Huska** soil series diagnostic horizons and features include an umbric epipedon, natric horizon, argillic horizon, and parallithic rock contact. The umbric epipedon is a surface horizon similar to the mollic epipedon but is less than 50 percent base saturated at a pH of 7 and includes the A horizon from the ground surface to 10 inches. The natric horizon meets the requirements of an argillic horizon but also a prismatic or columnar structure and over 15 percent of the cation exchange capacity is saturated with sodium ions or has more exchangeable Mg plus Na cations than Ca cations. The natric horizon is recognized by the 'n' attachment to the Bt horizons. The natric horizon includes the Btn horizons from 10 to 72 inches. A parallithic rock contact refers to a boundary between soil and the underlying parallithic rock material. When moist moist the parallithic rock contact can be excavated with hand tools. The parallithic rock contact was not encountered in this Huska soil profile at the depths indicated in the OSD description. According to NRCS convention a B'tn1 horizon was added between the depths of 50 to 72 inches.

2.5 Geologic Statement

The Kay County Soil Survey (December 1967) does not list underlying geologic descriptions within the publication other than generic rock types associated with the soil series along this alignment improvement. However in Figure 2 of the Kay County Soil Survey the underlying geology is identified as the Wellington Formation.

According to the Oklahoma Department of Transportation (ODOT) Engineering Classification of Geologic Materials Division Four, 1967 (Red Book), underlying the underlying geology for this project alignment is the **Wellington Unit (Pwe)**. This unit consists of dominantly of red, maroon, and gray blocky shales with minor amounts of sandstone, gypsum, and limestone. The gray shales located in Kay County change southward to maroon and red colors. The amount of sandstone also increases southward. The total thickness of the unit ranges from 400 to 800 feet. Topographically, the unit varies from nearly level to slightly rolling in the northern portion of the County and becomes slightly more rolling southward as the more prominent sandstones cap ridges and hills. Overlying the Wellington unit is extensive amounts of alluvium (Qas).

According to the Oklahoma Geological Survey Hydrological Atlas 7, by Roy H. Bingham and DeRoy L. Bergman of the U.S. Geological Survey, 1980 the geology is identified as the Wellington formation that consist of mainly red-brown shale to the north and grading into fine-grained sandstone and mudstone conglomerate southward into Logan County. Thickness is about 850 feet.

The Oklahoma Geological Survey has no definitive current publication (Bulletin or Circular) for Kay County. The most recent geologic map covering this specific site location Oklahoma Geologic

Quadrangle Map 69 by T. M. Stanley and G. W. Miller, 2007 at a map scale of 1:100,000. The site geology is recorded as the Wellington Formation (Pwe). Overlying the Wellington formation from just south of Birds Nest Creek to the project EOP is Older Alluvium (Qao).

2.6 Soil Series Station Extents

An estimate of the soil series station extents was based on using the Web Soil Survey 2.2 soil map on page 1 in Appendix "A". The Web Soil Survey 2.2 soil map was converted to a 1:20,000 map scale, and then the distances were scaled in feet referenced from E-W 28 CR centerline to set the station extents from the plan set. The soil series extents are presented in Table 4 in Appendix "B".

2.7 Ground Water Conditions

Water level observations were made during the boring operations. At the completion of drilling, the hand auger borings for all the soil series were dry at the completion of drilling.

Seasonal variations, temperature and recent rainfall conditions may influence the levels of the groundwater table and volumes of water will depend on the permeability of the soils. However, in relatively impervious soils, the accurate determination of the groundwater elevation may not be possible even after several days of observation. However, in relatively pervious soils, such as sandy soils, the indicated elevations are considered reliable groundwater levels

3.0 LABORATORY TESTING AND TEST DATA RESULTS

3.1 Laboratory Test Procedures and Test Results

The **McLain**, **Brewer**, **Lela**, and **Huska** soil series samples obtained during the field exploration were transported to the laboratory by Mr. James B. Nevels, Jr., Ph.D., P.E. and examined by a BETI soils engineer. The laboratory tests were performed on the submitted samples from these three soil series in substantial accordance with the current and applicable ASTM test procedures. The laboratory testing schedule included the determination of the samples' natural moisture contents (ASTM D2216), Atterburg limit values (ASTM D4318), grain size distributions (ASTM D421 and D422), pH (ASTM D4972), resistivity (ASTM G57), laboratory compaction characteristics of soil using a standard effort (ASTM D698), and the resilient modulus (RM) (AASHTO T-307). These test results are presented in the pedological soil logs and accompanying test data sheets, see Appendix "C". Samples not altered by laboratory testing will be retained at the BETI office for a period of sixty (60) days from the date of this report and then discarded unless otherwise instructed.

4.0 SHRINKAGE AND SWELL FACTORS

4.1 Estimation of Shrinkage and Swell Factors

Shrinkage and swell factors for earthwork excavation for the composite 'B' horizons for the, **Brewer**, **Lela**, and **Huska** soil series; and both the composite 'B' and 'C' horizons for the **McLain** soil

series are based on the laboratory Standard moisture-density relationship test result in comparison to the bank run unit weight. The method used for this estimate is based on an ODOT procedure using estimated ranges of bank run unit weight for each Unified Soil Classification class, see Table 5.

5.0 RECOMMENDATIONS

5.1 Soil Parameter Considerations and Compacted Fill Requirements

In Table 1 of Appendix "B", the general comments on the formation of these soils are summarized. Of the four soil series sampled the **McLain**, **Brewer**, and **Lela** soil series are derived from alluvial deposits and the **Huska** soil series are residual soils developed parent bedrock. Each soil classification has inherit characteristics regarding grading operations by the contractor:

The **McLain** and **Brewer** soil series have a relatively deep mollic epipedon (30 to 32 inches) which is a source of subgrade instability during wet periods if not undercut. The **Lela** soil series has a shallower mollic epipedon depth of 15 inches. The **Lela** soil series has shrink-swell potential being a vertisol. For the **oil waste land-Huska** complex there are two sources of problems: a) the oil-waste land contains salt from past and present oil well operations and b) the **Huska** soil series has natric horizons which mean that these two sources has the potential for dispersive soil behavior. There appears to be no paramount problems regarding physical earthwork grading of these soil series, however. The **Lela** soil series is rarely to occasionally flooded for very brief periods during April to October; therefore, caution is advised during this time of the year regrading the beginning of grading operations. Based on the analysis of the soil properties in Appendix "C", the pH is high for all of the tested soil horizons. There is also a relatively high soluble sulfate content of 1610 mg/Kg for the oil waste land-Huska composite B sample whereas all the other soil series composite samples are less than 200 mg/Kg. All soil series have horizons that have relatively high plasticity indexes.

The Web Soil Survey 2.2 rating for local roads and streets points out very limited ratings for the **McLain**, **Brewer**, and **Lela** soil series with regard to low strength and shrink-swell potential. The implication here is that these ratings imply potential problems in the long term performance of the earthwork grading unless accounted for in the design recommendations. The **oil waste land-Huska** complex soil series is not rated.

Based on the initial site inspection and plan review of the grading sections, there does not appear to be an anticipated approach fill settlement problem for the planned embankment grading due to foundation conditions of these alluvial and residual soils.

5.2 Cut Section Considerations

Based on the plan set provided for this project and a through walkout of the project, the cut-section considerations for the improved US 77 alignment will involve cuts for the roadway ditch sections

according to the current (ODOT) geotechnical specifications for roadway design. Cut-section excavation produced by the widening grading for this project is anticipated to involve the above listed soil series horizons investigated. All cut material is judged to be readily rippleable.

5.3 Recommendations

The soil map units shown on page 1 of the Web Soil Survey 2.2 in Appendix "B" compound the recommendations because of the **oil waste land-Huska complex, Brewer, and Lela** soil series map unit boundaries align with the centerline of US 77 between the BOP station 1135.66.09 and station 1147+66 on the right. Based on the findings of the field and laboratory investigation and study at this site the following are recommended:

1. This report of pedological soil survey is a preliminary report. Burgess Engineering And Testing, Inc. recommends that after the completion of the grading phase, an inplace soil survey be performed to confirm the subgrade materials for the pavement design resilient modulus values and adequacy of the subgrade and compatibility of the soils for stabilization. It is further recommended to test the subgrade at 200' intervals to ensure the compatibility of the soils with stabilizing agents.
2. From these four soil series investigated, availability of topsoil is not a problem, reference the mollic epipedon depths listed in Table 3 for the McLain, Brewer, and Lela soil series. Reference Table 4 for station extents of these soil series.
3. The recommended resilient modulus (RM) based on the appropriate composite B or C horizon test results and a deviator stress of 6 psi for pavement design is presented in Table 6.
4. Based on the pH and resistivity values recorded in the test data sheets, metal drainage pipe can be used because the site location is in Area I; however due to some high pH (greater than 7.3 pH) values metal drainage pipe is not recommended. Find enclosed in Appendix "D" appropriate abrasion and corrosion rating table and data.
5. The recommended cut-section and embankment-section slope design is a 3:1 slope ratio.
6. Regarding the soil stabilization of the finished grade soil material, low soluble sulfate test results are reported for the collected **McLain, Brewer, and Lela** soil samples; however, a relatively high soluble sulfate content of 1610 mg/Kg (ppm) are reported for the **Oil waste land-Huska** composite B sample. Per soil stabilization mix design (OHD L50) by ODOT, "if the soluble sulfate content is higher then 550 ppm, additional samples for soluble sulfate testing should be taken throughtout the length represented by the sample. If the soluble sulfate content is greater than 1000 ppm for any of the additional samples, stabilization with calcium-based additives may not be suitable." Since the proposed finished grade may contained additional **Oil waste land-**

Huska composite B sample due to fills, a chemical soil stabilization may not be suitable. As a result, a full-depth asphalt pavement systems with or without aggregate base are recommended..

7. With regard to the oil waste land-Huska complex soil series station extent, see Table 4, treatment of all the roadway ditch and embankment slope sections are recommended to be sub-excavated a minimum of 18 inches and replaced with a non-dispersive soil material (such as the mollic epipedon depths listed in Table 3 for the McLain, Brewer, and Lela soil series). The purpose is to counter the potential for dispersive soil problems with oil waste salt damaged soil and/or the Huska natric horizons to minimum depth of eight inches from the top of the slope surface. The treatment extents are from station 1135+66.09(BOP) to 1126+60 left of centerline and from 1135+66.09(BOP) to 1144+66 right of centerline. The Brewer soil series extent is included because of salt damage in the existing roadway ditch.
8. Apply appropriate mulches and native Bermuda grass to further control all erosion of the grading according to the 2010 ODOT construction specifications.

Burgess Engineering and Testing, Inc. cannot be responsible for the interpretation or implementation of this report by others. Burgess Engineering and Testing, Inc. should be retained to perform services sufficient to determine compliance with its recommendations. If Burgess Engineering and Testing, Inc. is not so retained, it will not accept any responsibility for the difficulties encountered during the construction or performance of the structures.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Site Preparation and Fill Requirements

In preparing the site for construction, we recommend that all topsoil, vegetation, roots, and any soft soils in the new alignment and shoulder areas be stripped from the site and either wasted or stockpiled for later use. Utilities should be located and rerouted as necessary.

After stripping and undercutting, the shoulder and new alignment area should be proof-rolled with a moderately heavy loaded pneumatic-tired vehicle such as a twenty (20) to twenty-five (25) ton dump truck or scraper. Soils which are observed to rut or deflect excessively under the moving loads should be undercut and replaced with properly compacted fills. All proof-rolling and undercutting activities should be witnessed by a qualified soil engineer and should be performed during a period of dry weather.

After stripping and excavating where required, and proof-rolling, the exposed soils should be scarified to a depth of six (6) inches and compacted. The moisture content should be maintained between one (1) percentage point below and three (3) percentage points above the optimum moisture as determined by the Standard Proctor test. The subgrade soils should be compacted to a dry density of at

least ninety-five (95) percent of the standard Proctor maximum dry density for a depth of at least six (6) inches below the surface.

After subgrade preparation and inspection have been completed, fill placement may begin. Structural fill materials used should be free of organic or other deleterious matters, have a maximum particle size of three (3) inches, and have a liquid limit less than thirty-five (35) and a plasticity index between five (5) and fifteen (15) and consists of sandy clays or clayey sands. Relatively clean sands are not recommended for use as structural fill. Fine-grained (silt or clay) soil used for the fill will require very close moisture content control to achieve the recommended degree of compaction. The fills should be placed in a maximum lifts of nine (9) inches of loose materials and should be compacted within the range of three (3) percent points above the optimum moisture content value as determined by the Standard Proctor test. Added water should be uniformly applied and thoroughly mixed into the soil by disking or scarifying. Fine-grained structural fills should be compacted to at least ninety-five (95) percent of the soils Standard Proctor maximum dry density as determined by ASTM Designation D698. It is recommended that field density tests be taken at a frequency of not less than one test per 1,000 square feet of surface area per lift in the pavement areas.

6.2 Weather Considerations

The upper fine-grained soils encountered at this site are expected to be relatively sensitive to disturbances caused by construction traffic and to changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils which become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork construction activities during dry weather. Earthwork activities performed during cooler, wetter months will certainly be more problematic than if performed during warmer, drier climatic periods.

7.0 GENERAL COMMENTS

The exploration and analysis of the subsurface conditions reported herein are considered in sufficient detail and scope to form reasonable basis for the preliminary design of the pavement and grading sections. The recommendations submitted are based on the available soil information, laboratory testing results, local experience with soils and their taxonomy. If deviations from the noted subsurface conditions are encountered during construction, they should be brought to the attention of the geotechnical engineer.

BETI and Mr. James B. Nevel, Jr., Ph.D., P.E. cannot be held responsible for the interpretation or implementation of this report by others. BETI should be retained to perform services sufficient to

determine compliance with its recommendations. If BETI is not retained in this capacity, it will not accept any responsibility. The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with the professional engineering practice of geotechnical engineering. No other warranties are implied or expressed. After the design plans and specifications are complete, it is recommended that the geotechnical engineer be provided the opportunity to review the final design plans and specifications so that the report recommendations have been properly interpreted and implemented. At this time, it may be necessary to submit supplementary recommendations

This report has been prepared for the exclusive use of Smith Roberts Baldischwiler, LLC for the specific application to the proposed roadway improvement on US 77 over the Birds Nest Creek in Kay County approximately 4.75 miles south of Tonkawa, Oklahoma.

Respectfully,

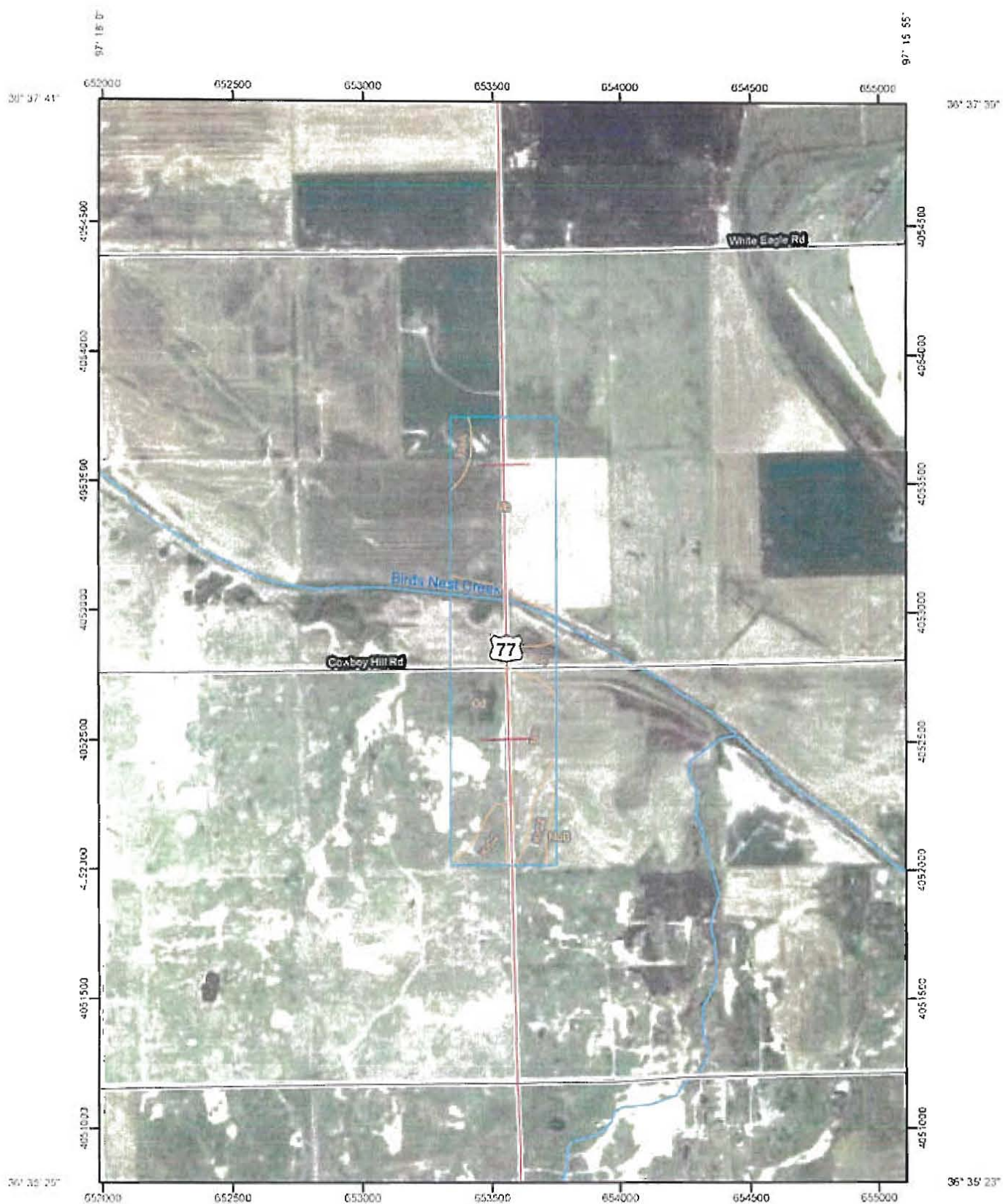
James B. Nesbitt, Jr., Ph.D., P.E.
Geotechnical Engineering Consultant

Alfonso M. Ebrahimi, Ph.D., P.E.
President

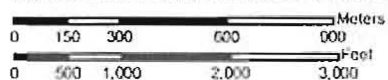


APPENDIX A
Web Soil Survey 2.2

Soil Map—Kay County, Oklahoma



Map Scale: 1:20,000 if printed on A size (8.5" x 11") sheet



MAP LEGEND

Area of Interest (AOI)		Area of Interest (AOI)		Very Stony Spot
Soils				Wet Spot
Soil Map Units				Other
Special Point Features		Special Line Features		
	Blowout		Gully	
	Borrow Pit		Short Steep Slope	
	Clay Spot		Other	
	Closed Depression	Political Features		
	Gravel Pit		Cities	
	Gravelly Spot	Water Features		
	Landfill		Oceans	
	Lava Flow		Streams and Canals	
	Marsh or swamp	Transportation		
	Mine or Quarry		Rails	
	Miscellaneous Water		Interstate Highways	
	Perennial Water		US Routes	
	Rock Outcrop		Major Roads	
	Saline Spot		Local Roads	
	Sandy Spot			
	Severely Eroded Spot			
	Sinkhole			
	Slide or Slip			
	Sodic Spot			
	Spoil Area			
	Stony Spot			

MAP INFORMATION

Map Scale: 1:20,000 if printed on A size (8.5" x 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: UTM Zone 14N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Kay County, Oklahoma
Survey Area Data: Version 7, Sep 12, 2008

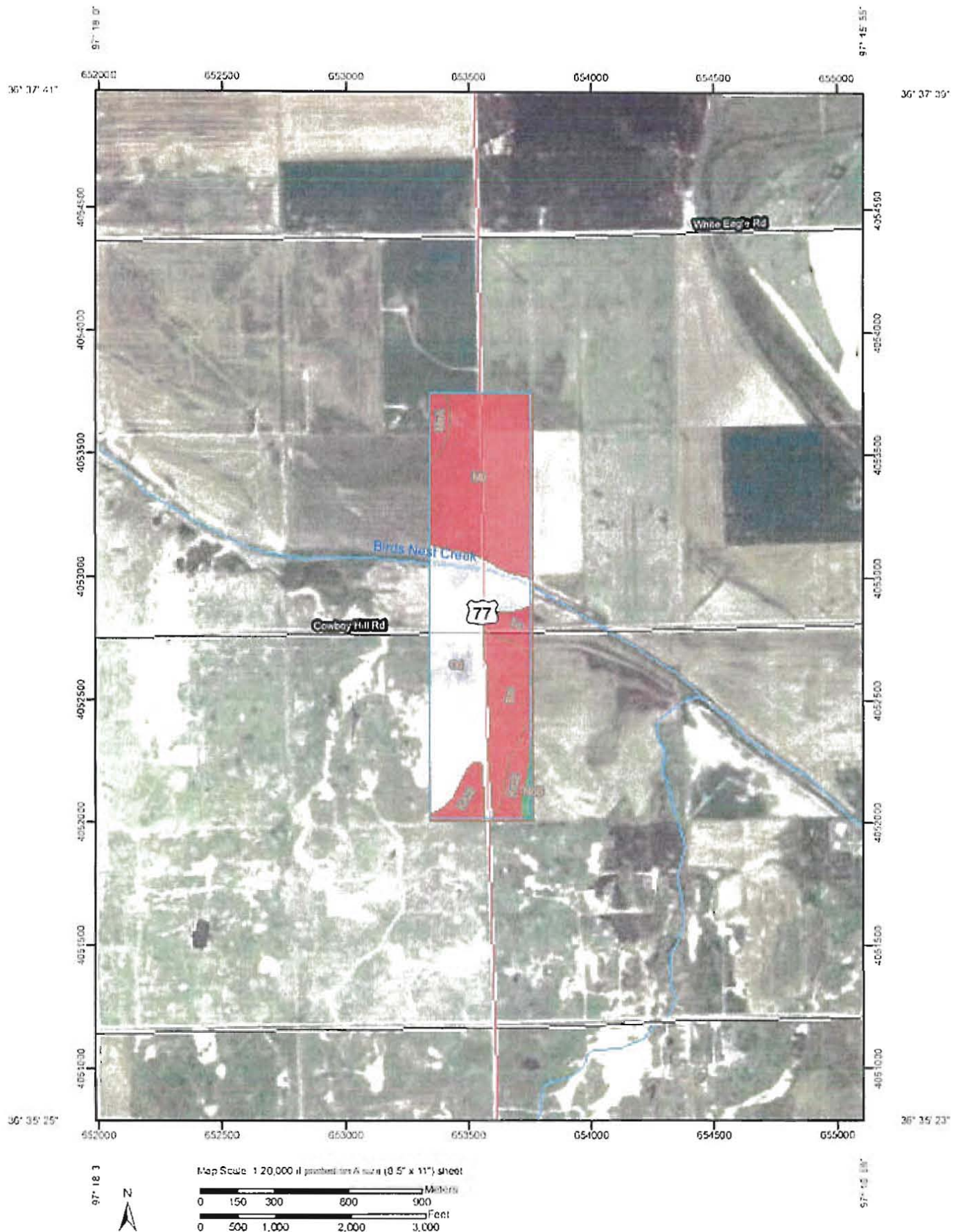
Date(s) aerial images were photographed: 7/4/2003

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Kay County, Oklahoma (OK071)			
Map Unit Symbol	Map Unit Name	Acres In AOI	Percent of AOI
Bm	Brewer silty clay loam, 0 to 1 percent slopes, rarely flooded	22.2	12.5%
KrC2	Kirkland-Renfrow complex, 3 to 5 percent slopes, eroded	14.1	7.9%
Lc	Lela clay, 0 to 1 percent slopes, occasionally flooded	6.2	3.5%
MaA	Braman silt loam, 0 to 1 percent slopes, rarely flooded	4.5	2.5%
Mb	McLain silty clay loam, 0 to 1 percent slopes, rarely flooded	64.7	36.4%
NoB	Milan loam, 1 to 3 percent slopes	2.1	1.2%
Od	Oil waste land-Huska complex, 1 to 8 percent slopes	63.9	36.0%
Totals for Area of Interest		177.7	100.0%

Local Roads and Streets—Kay County, Oklahoma



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

 Very limited
 Somewhat limited
 Not limited
 Not rated or not available

Political Features

 Cities

Water Features

 Oceans
 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

MAP INFORMATION

Map Scale: 1:20,000 if printed on A size (8.5" x 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for accurate map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
 Coordinate System: UTM Zone 14N NAD83

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Kay County, Oklahoma
 Survey Area Data: Version 7, Sep 12, 2008

Date(s) aerial images were photographed: 7/4/2003

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Local Roads and Streets

Local Roads and Streets— Summary by Map Unit — Kay County, Oklahoma						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
Brn	Brewer silty clay loam, 0 to 1 percent slopes, rarely flooded	Very limited	Brewer (90%)	Low strength (1.00)	22.2	12.5%
				Shrink-swell (1.00)		
				Flooding (0.40)		
			Port (5%)	Flooding (1.00)		
				Low strength (1.00)		
				Shrink-swell (0.50)		
			McLain (2%)	Low strength (1.00)		
				Shrink-swell (1.00)		
				Flooding (0.40)		
KrC2	Kirkland-Renfrow complex, 3 to 5 percent slopes, eroded	Very limited	Kirkland, Eroded (50%)	Low strength (1.00)	14.1	7.9%
				Shrink-swell (1.00)		
			Renfrow, Eroded (35%)	Low strength (1.00)		
				Shrink-swell (1.00)		
			Piedmont, Eroded (5%)	Shrink-swell (1.00)		
				Low strength (1.00)		
			Bethany, Eroded (3%)	Low strength (1.00)		
				Shrink-swell (1.00)		
			Grainola, Eroded (2%)	Low strength (1.00)		
Lc	Lela clay, 0 to 1 percent slopes, occasionally flooded	Very limited	Lela (85%)	Shrink-swell (1.00)	6.2	3.5%
				Flooding (1.00)		
				Low strength (1.00)		
			Braman (8%)	Low strength (1.00)		
				Shrink-swell (0.50)		
				Flooding (0.40)		
			Keokuk (5%)	Flooding (1.00)		
				Depth to saturated zone (1.00)		
			Harjo (2%)	Flooding (1.00)		
				Low strength (1.00)		
				Shrink-swell (1.00)		
				Ponding (1.00)		

Local Roads and Streets— Summary by Map Unit — Kay County, Oklahoma						
Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
MaA	Braman silt loam, 0 to 1 percent slopes, rarely flooded	Very limited	Braman (85%)	Low strength (1.00) Shrink-swell (0.50) Flooding (0.40)	4.5	2.5%
			Dale (5%)	Low strength (1.00) Shrink-swell (0.50) Flooding (0.40)		
			Lela (5%)	Flooding (1.00) Shrink-swell (1.00) Low strength (1.00)		
Mb	McLain silty clay loam, 0 to 1 percent slopes, rarely flooded	Very limited	McLain (85%)	Low strength (1.00) Shrink-swell (1.00) Flooding (0.40)	64.7	36.4%
			Dale (5%)	Low strength (1.00) Shrink-swell (0.50) Flooding (0.40)		
			Lela (3%)	Flooding (1.00) Shrink-swell (1.00) Low strength (1.00)		
			Harjo (2%)	Depth to saturated zone (1.00) Flooding (1.00) Low strength (1.00) Shrink-swell (1.00) Ponding (1.00)		
NoB	Milan loam, 1 to 3 percent slopes	Not limited	Milan (95%)			
Od	Oil waste land-Huska complex, 1 to 8 percent slopes	Not rated	Oil waste land (55%)			
Totals for Area of Interest					177.7	100.0%

Local Roads and Streets— Summary by Rating Value		
Rating	Acres in AOI	Percent of AOI
Very limited	111.7	62.9%
Not limited	2.1	1.2%
Null or Not Rated	63.9	36.0%
Totals for Area of Interest	177.7	100.0%

Description

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

Soil Taxonomy Statement

Soil Taxonomic Statement

Mclain

- Order: Mollisols
Mollisols are formed in a grassland setting and have a mollic epipedon that is a soft, dark, and organic rich surface horizon. The Mollisol also have a thick, illuvial, and argillic 'B' horizon. This horizon is typically very clayey and neutral to moderately alkaline.
- Suborder: Ustolls
Ustolls are the more or less freely drained Mollisols formed in Holocene to mid-Pleistocene geological deposits. Ustolls are found in sub-humid to semi-arid climates and are associated with regions where rainfall is erratic but often occurs in heavy rains. Drought is frequent and may be severe. During drought conditions wind erosion becomes a problem. Ustolls have mollic epipedon and a calcium or lime rich horizon. The mollic epipedon refers to a surface horizon (typically the A and parts of the B horizon) that is soft and has substantial organic matter.
- Great Group: Argiustolls
Argiustolls have an argillic horizon which means that the clay content increases with depth in the 'B' horizon.
- Subgroup
Modifier: Pachic
Pachic refers to a surface horizon that is dark and thick.
- Particle Size: Fine
Fine refers to a textural classification that have (by weight average) less than 60 percent (by weight) clay in the fine-earth fraction.
- Mineralogy: Mixed
Mixed refers to a mineralogical class where no one clay mineral is predominating.
- Temperature: Thermic
Thermic refers to a soil temperature classification that ranges from 59 to 72° F. Supports good plant growth.

Brewer

Order: Mollisols

Mollisols are formed in a grassland setting and have a mollic epipedon that is a soft, dark, and organic rich surface horizon. The Mollisol also have a thick, illuvial, and argillic 'B' horizon. This horizon is typically very clayey and neutral to moderately alkaline.

Suborder: Ustolls

Ustolls are the more or less freely drained Mollisols formed in Holocene to mid-Pleistocene geological deposits. Ustolls are found in sub-humid to semi-arid climates and are associated with regions where rainfall is erratic but often occurs in heavy rains. Drought is frequent and may be severe. During drought conditions wind erosion becomes a problem. Ustolls have mollic epipedon and a calcium or lime rich horizon. The mollic epipedon refers to a surface horizon (typically the A and parts of the B horizon) that is soft and has substantial organic matter.

Great Group: Argiustolls

Argiustolls have an argillic horizon which means that the clay content increases with depth in the 'B' horizon.

Subgroup

Modifier: Udertic

Udertic refers to properties of a vertisols which means that the soil horizons have a shrink-swell potential and that cracks develop in dry seasons.

Particle Size: Fine

Fine refers to a textural classification that have (by weight average) less than 60 percent (by weight) clay in the fine-earth fraction.

Mineralogy: Mixed

Mixed refers to a mineralogical class where no one clay mineral is predominating.

Temperature: Thermic

Thermic refers to a soil temperature classification that ranges from 59 to 72° F. Supports good plant growth.

Lela

Order: Vertisols

The central concept of Vertisols is that of soils that have a high content of expanding clay and that at some time of the year deep wide cracks. They shrink when drying and swell when they become wetter. The soils are dark colored and very clayey. A common feature of Vertisols is the seasonal drying of the soil profile. A key feature of the Vertisols is the system of microrelief cracks and intersecting slickensides. The most common parent materials of Vertisols include calcareous sedimentary rocks, mafic igneous rocks, volcanic ash, and alluvium derived from these materials. Most Vertisols occur on nearly level to sloping landscapes. A common feature of all Vertisols is a neutral to alkaline reaction. Grasses and broad-leaved flowering plants (forbs) dominate the vegetative cover of Vertisols. The microcrack structure of Vertisols is the greatest for soils having udic and ustic soil moisture regimes.

Suborder: Usterts

Usterts have cracks that are open for at least 90 cumulative days per year.

Great Group: Haplusterts

Haplusterts that a densic, lithic, or paralithic contact or a duripan within 100 cm of the mineral surface.

Subgroup

Modifier: Udic

Udic refers to the udic soil moisture regime which means in normal years that these soils are not dry in any part of the moisture control section (depth of root penetration) for as long as 90 cumulative days.

Particle Size: Fine

Fine refers to a textural classification that have (by weight average) less than 60 percent (by weight) clay in the fine-earth fraction.

Mineralogy: Mixed refers to a mineralogical class where no one clay mineral is Predominating.

Temperature: Thermic

Thermic refers to a soil temperature classification that ranges from 59 to 72° F. Supports good plant growth.

Huska Series

Order: Alfisols

The central concept of Alfisols is that of soils that have an argillic horizon and a base saturation of 35 percent or greater. Alfisols have Redoximorphic features in all horizons. Argillic horizons refers to a B horizon that has at least 1.2 times as much clay as does an above horizon. Redoximorphic features refers to the alternation between reducing and oxidizing conditions that are responsible for the release of iron and manganese from primary minerals. This redox condition results in mottled soil colors and generally indicates a fluctuating watertables.

Suborder: Ustalfs

Ustalfs have an ustic moisture regime which implies that in most years part of the moisture control section (depth of root penetration) is dry for more than 90 cumulative days. Ustalfs have calcium carbonate accumulation throughout the horizons.

Great Group: Natrustalfs

Natrustalfs have a natric horizon which have sodium, calcium, and magnesium cations. These horizons may be dispersive.

Subgroup: Mollic

Modifier: Mollic refers the Osage series having an mollic epipedon (Ap1, Ap2, and A horizon, 0 - 13 inches).

Particle Size: Fine

Fine refers to a textural classification that have (by weight average) less than 60 percent (by weight) clay in the fine-earth fraction.

Mineralogy: Mixed

Mixed refers to a mineralogy class indicating that no one clay mineral type predominates.

Temperature: Thermic

Thermic refers to a soil temperature classification that ranges from 59 to 72° F. Supports good plant growth.

Table 1. General Comments on the Soil Series Investigated

Soil Series	Geology	Slope, percent ¹
Mclain	Soils formed in material weathered from clayey and loamy alluvium of Pleistocene geologic age	0 to 1
Brewer	Soils formed in material weathered from loamy and clayey alluvium of Pleistocene geologic age	0 to 1
Lela	Soils formed in clayey alluvium	0 to 1
Huska	Soils formed in interbedded shale and sandstone of Permian geologic age	1 to 5

1. Slopes as recorded from the OSD.

Table 2. Soil Series Taxonomic Class

Soil Series	Taxonomic Class
Mclain	Fine, mixed, superactive, thermic Pachic Argiustolls
Brewer	Fine, mixed, superactive, thermic Udertic Argiustolls
Lela	Fine, mixed, superactive, thermic Udic Haplusterts
Huska	Fine, mixed, superactive, thermic Mollic Natrustalfs

1. Superactive refers to a cation exchange activity class of the < 2mm fraction material in the control section.

Table 3. Soil taxonomy¹.

Soil Series	Order	Suborder	Great Group	Subgroup Modifier	Particle Size	Mineralogy	Soil Temperature	Mollic Epipedon, inches
McLain	Mollisols	Ustolls	Argiustolls	Pachic	Fine	Mixed	Thermic	30
Brewer	"	"	"	Udertic	"	"	"	32
Lela	Vertisols	Usterts	Haplusterts	Udic	"	"	"	15
Huska	Alfisols	Ustalfs	Natruustalfs	Mollic	"	"	"	-

1. Reference is the Keys to Soil Taxonomy, Eleventh Edition, 2010.

Table 4. Soil Series Station Extents¹.

Soil Series	Symbol	Station	Station ²
Oil-waste land-Huska complex	Od	1135+66.09 (BOP)	1126+60 Lt.
Brewer	Bm	1135+66.09 (BOP)	1144+66 Rt.
Lela	Lc	1144 +66	1147+66 Rt.
Mclain	Mb	1126+60	1169+14.94(EOP)

1. Soil station extents are split along the US 75 centerline for the Oil Waste land-Husk Complex, Brewer and Lela soil series.
2. Extents right and left existing US 77 centerline

Table 5. Shrinkage/Swell Factors for Earthwork Excavation

Soil Series		Unified Soil Classification	Dry Density, (pcf)	Bank Run In Situ Density Low (pcf)	Bank Run In Situ Density High , (pcf)	Shrinkage/Swell Factors Low	Shrinkage/Swell Factors High	Shrinkage/Swell Factors Average ¹
McLain	B-Horizon	CH	102.3	90	115	1.14	0.89	1.02
	C-Horizon	CH	103.4	90	115	1.15	0.90	1.03
Brewer	B-Horizon	CH	97.5	90	115	1.08	0.85	0.97
Lela	B-Horizon	CH	100.9	90	115	1.12	0.88	1.00
Huska	B-Horizon	CH	102.8	90	115	1.14	0.89	1.02

¹ Shrinkage/Swell Factor = Dry Density/ Bank Run In Situ Dry Density

Table 6. Recommended RM for Pavement Design

Soil Series	Horizon	Sample Number	RM at 6 psi
Mclain	B-Horizon OMC	MR3-1-A	11,000
	B-Horizon +2%	MR3-1-B	7,900
	C-Horizon OMC	MR3-2-A	10,500
	C-Horizon +2%	MR3-2-B	6,900
Brewer	B-Horizon OMC	MR2-1-A	9,000
	B-Horizon +2%	MR2-1-B	8,500
Lela	B-Horizon OMC	MR2-1-A	9,000
	B-Horizon +2%	MR2-1-B	8,500
Oil waste land- Huska complex	B-Horizon OMC	MR1-1-A	10,000
	B-Horizon +2%	MR1-1-B	8,000

APPENDIX C

Pedological Soil Logs and Test Data

FOR SURVEY CONTROL DATA,
SEE SURVEY DATA SHEET 4-17.

LOCATION MAP
DIVISION IV



DESIGN DATA

AADT 2010 = XX
AADT 2030 = XX
K = XX
D = XX
I (% DHV) = XX
T (% AADT) = XX
T3 (% AADT) = XX
V = 65
FLEX. ESALS = XX

SCALES

PLAN 1" = 50'
PROFILE HOR 1" = 50'
VER 1" = 5'
LAYOUT MAP 1" = 5280'

LEVEL DATA IS MEAN SEA LEVEL (USC&GS)
BEARINGS ARE FROM OBSERVATION OF
POLARIS

CONVENTIONAL SYMBOLS

- PROPOSED ROAD
- RAILROADS
- RANGE & TOWNSHIP
- SECTION LINES
- QUARTER SECTION LINES
- FENCES
- GROUND LINE
- EXISTING ROADS
- BASE LINE
- GRADE LINES
- TELEPHONE & TELEGRAPH
- POWER LINES
- BUILDINGS
- DRAINAGE STRUCTURES - IN PLACE
- DRAINAGE STRUCTURES - NEW
- RIGHT-OF-WAY LINES - EXISTING
- RIGHT-OF-WAY LINES - NEW
- RIGHT-OF-WAY MARKERS - IN PLACE
- RIGHT-OF-WAY MARKERS - REMOVE & REPLACE
- RIGHT-OF-WAY MARKERS - NEW
- CONTROLLED ACCESS
- RIGHT-OF-WAY FENCE

STATE OF OKLAHOMA DEPARTMENT OF TRANSPORTATION

PLAN OF PROPOSED STATE HIGHWAY

PROJECT NO. SSP-136C(101)SS
GRADING, DRAINAGE, SURFACING, BRIDGE, & EROSION CONTROL PLANS
U.S. HIGHWAY 77

KAY COUNTY

STATE JOB NO. 21854(04)
CONTROL SECTION NO. 77-36-12
BR. 'A' LOCATION NO. XXXXXXXXXX (OLD NBI NO. XXXXX)(NEW NBI NO. XXXXX)

DESIGN DIVISION	EROSION CONTROL	BRIDGE DIVISION	RIGHT-OF-WAY DIV.	UTILITIES DIVISION	TRAFFIC DIVISION	RAILROAD	FIELD DIVISION NO.	F. H. W. A.	COUNTY OF	CITY OF

PLAN-IN-HAND
FIELD INSPECTION

DATE _____

SEE SHEET 2 FOR INDEX OF SHEETS
AND LIST OF STANDARDS REQUIRED

DESIGN DIVISION _____
EROSION CONTROL _____
BRIDGE DIVISION _____
RIGHT-OF-WAY DIV. _____
UTILITIES DIVISION _____
TRAFFIC DIVISION _____
RAILROAD _____
FIELD DIVISION NO. _____
F. H. W. A. _____
COUNTY OF _____
CITY OF _____

PRELIMINARY EARTHWORK			
UNCLASSIFIED EXCAVATION 202(C)	EMBANKMENT +15% COMP.	EXCESS EXCAVATION	UNCLASSIFIED BORROW 202(D)
C.Y.	C.Y.	C.Y.	C.Y.
2,124	33,928		31,804
TOTALS	2,124	33,928	31,804

30% PLANS FOR REVIEW



SMITH ROBERTS HALDISCHWILER, LLC
OKLAHOMA CITY OFFICE
1015 N. 30th Street
Oklahoma City, OK 73104
Telephone: (405) 840-7074
Fax: (405) 840-8116

ENGINEERS • SURVEYORS • PLANNERS

SUBMITTED FOR APPROVAL BY _____

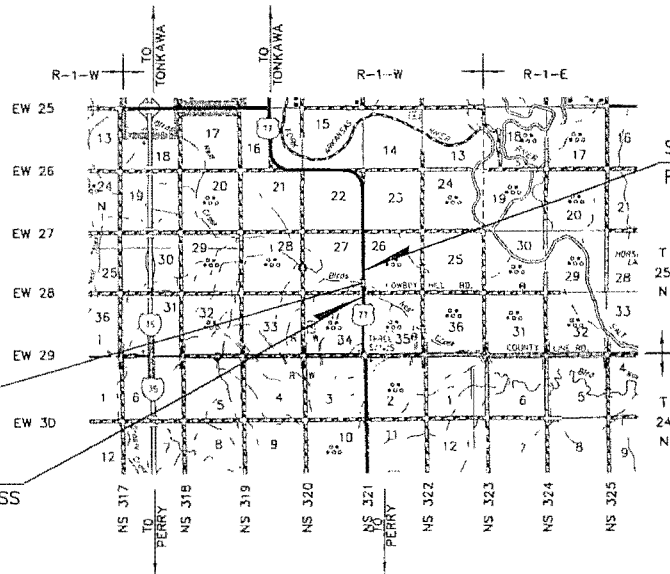
GARY KEITH SCHLOTTHAUER
REGISTERED PROFESSIONAL ENGINEER NO. 15026

DATE _____

OKLAHOMA DEPARTMENT OF TRANSPORTATION		DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION	
DATE APPROVED _____	DATE APPROVED _____	BY _____	BY _____
CHIEF ENGINEER		DIVISION ADMINISTRATOR	
SWO 4499(1) F.A. PROJECT NO. SSP-136C(101)SS		SHEET NO. 1	



THIS DOCUMENT IS PRELIMINARY
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SIGNED AND SEALED DOCUMENT

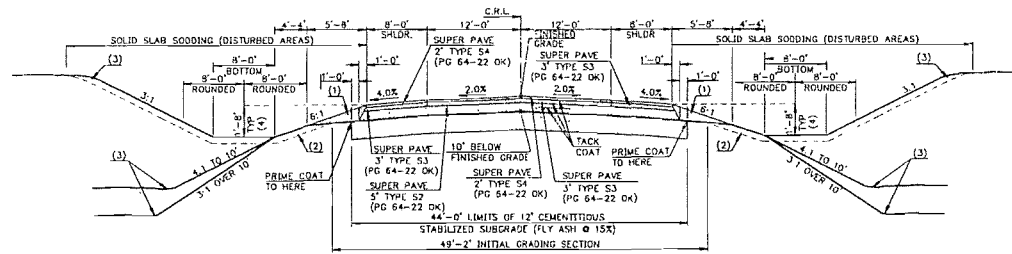


STA. 1151+90.00 BEG. BRIDGE "A"
BRIDGE LENGTH = 120.00'
STA. 1153+10.00 END BRIDGE "A"

STA. 1135+66.09 BEGIN
PROJ. NO. SSP-136C(101)SS

ROADWAY LENGTH 3,228.85 FT. 0.611 MI.
BRIDGE LENGTH 120.00 FT. 0.023 MI.
PROJECT LENGTH 3,348.85 FT. 0.634 MI.

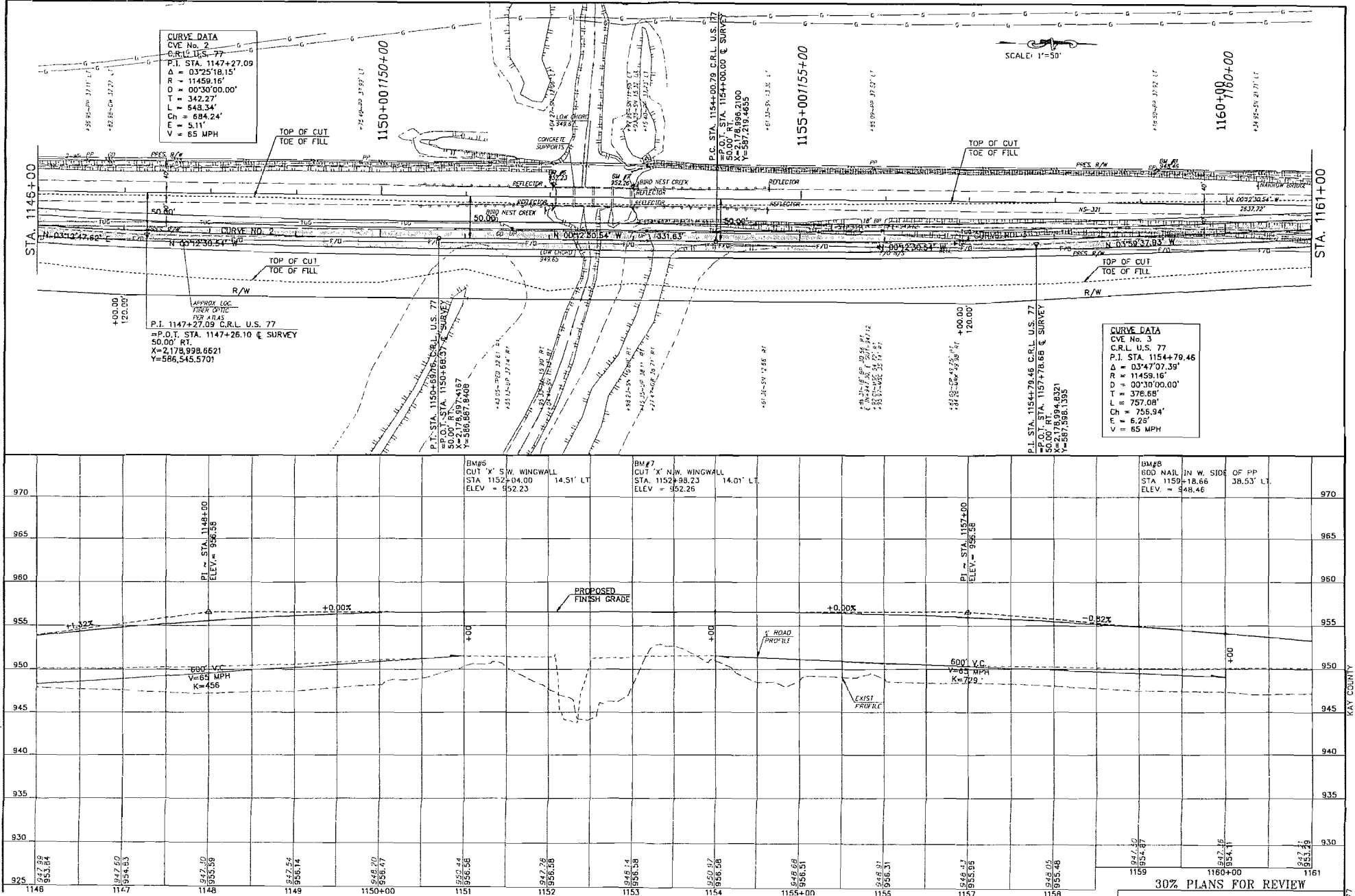
EQUATIONS: STA. 1169+13.05 @ SURVEY AHEAD =
STA. 1169+14.94 @ C.R.L. BACK 0.00' RT. LENGTH = 1.89'
EXCEPTIONS: XXXX

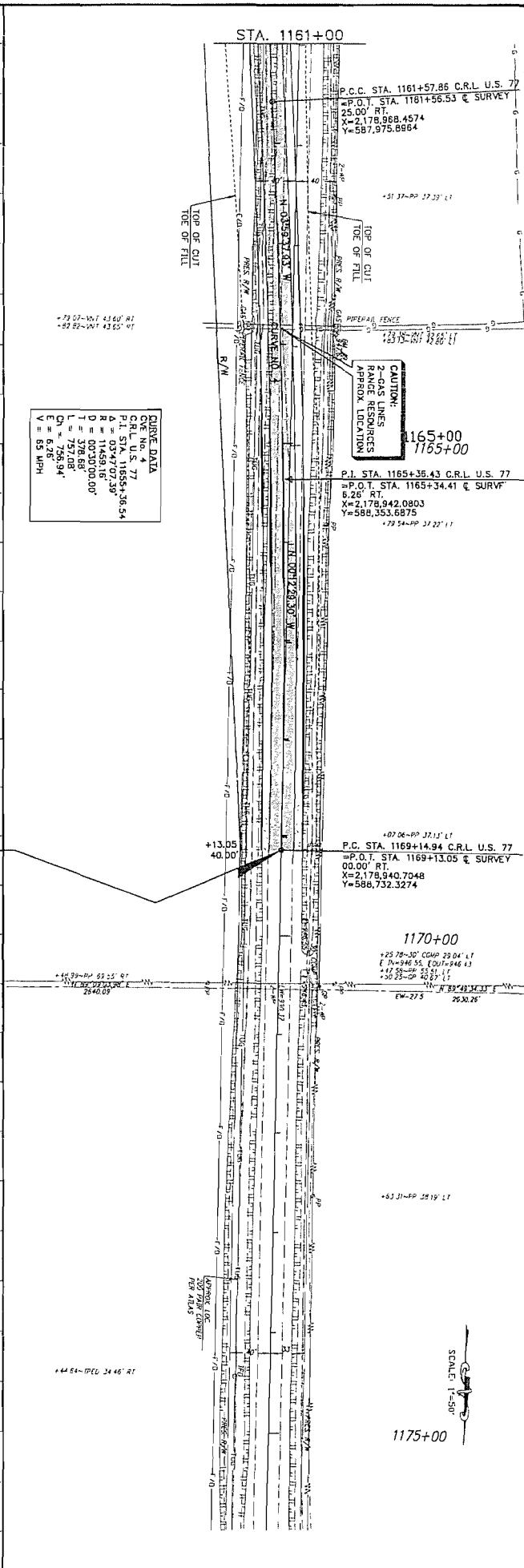
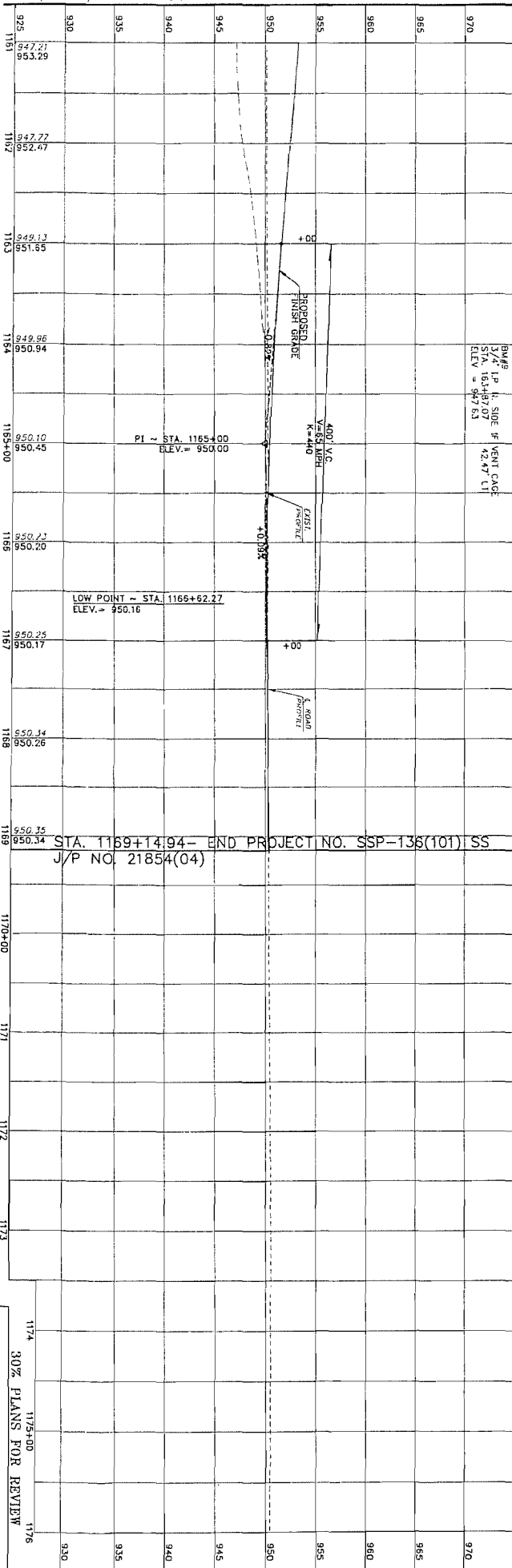


TYPICAL SECTION 1
STA. 1135+68.09 TO STA. 1169+14.94

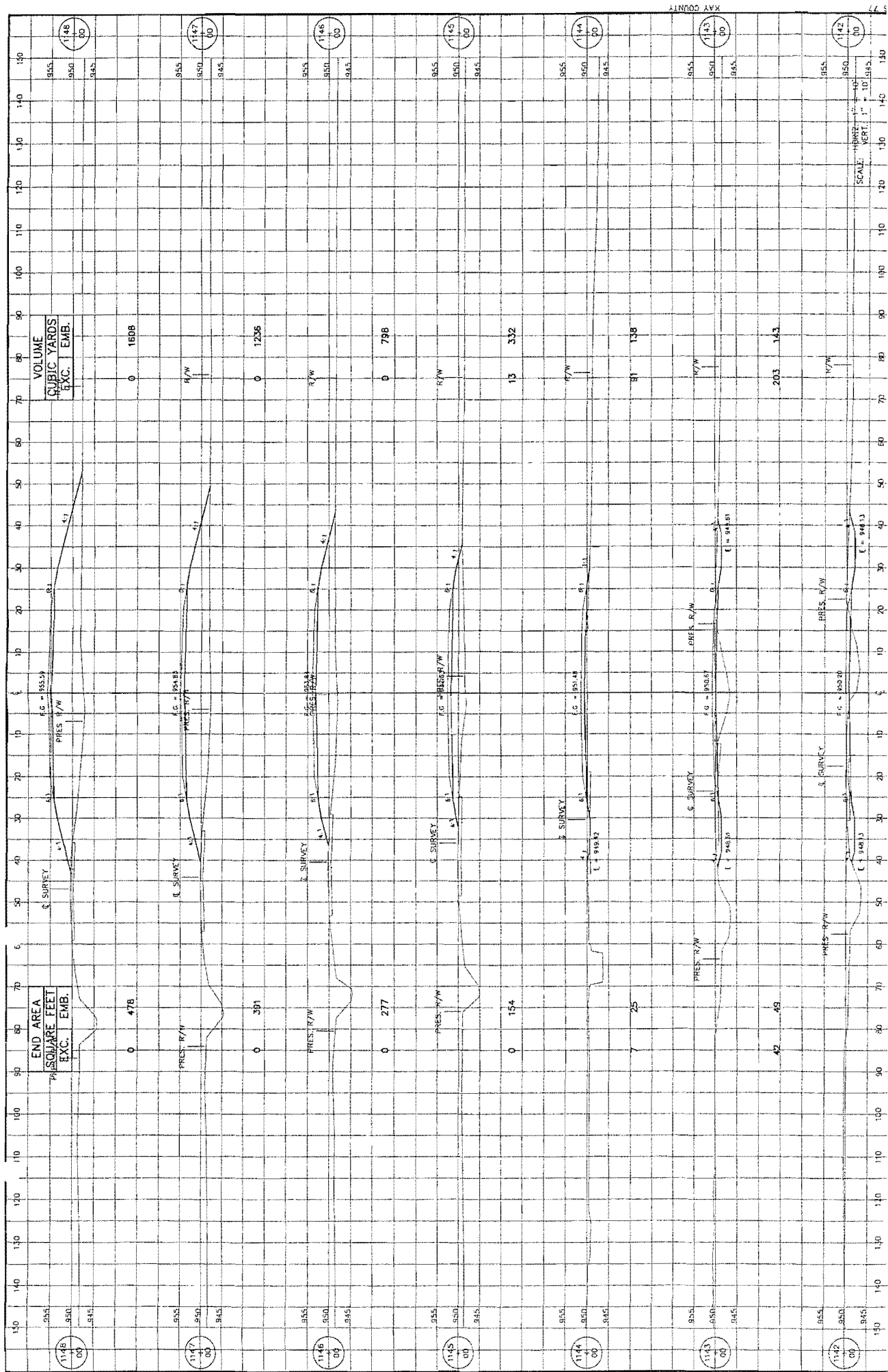
30% PLANS FOR REVIEW

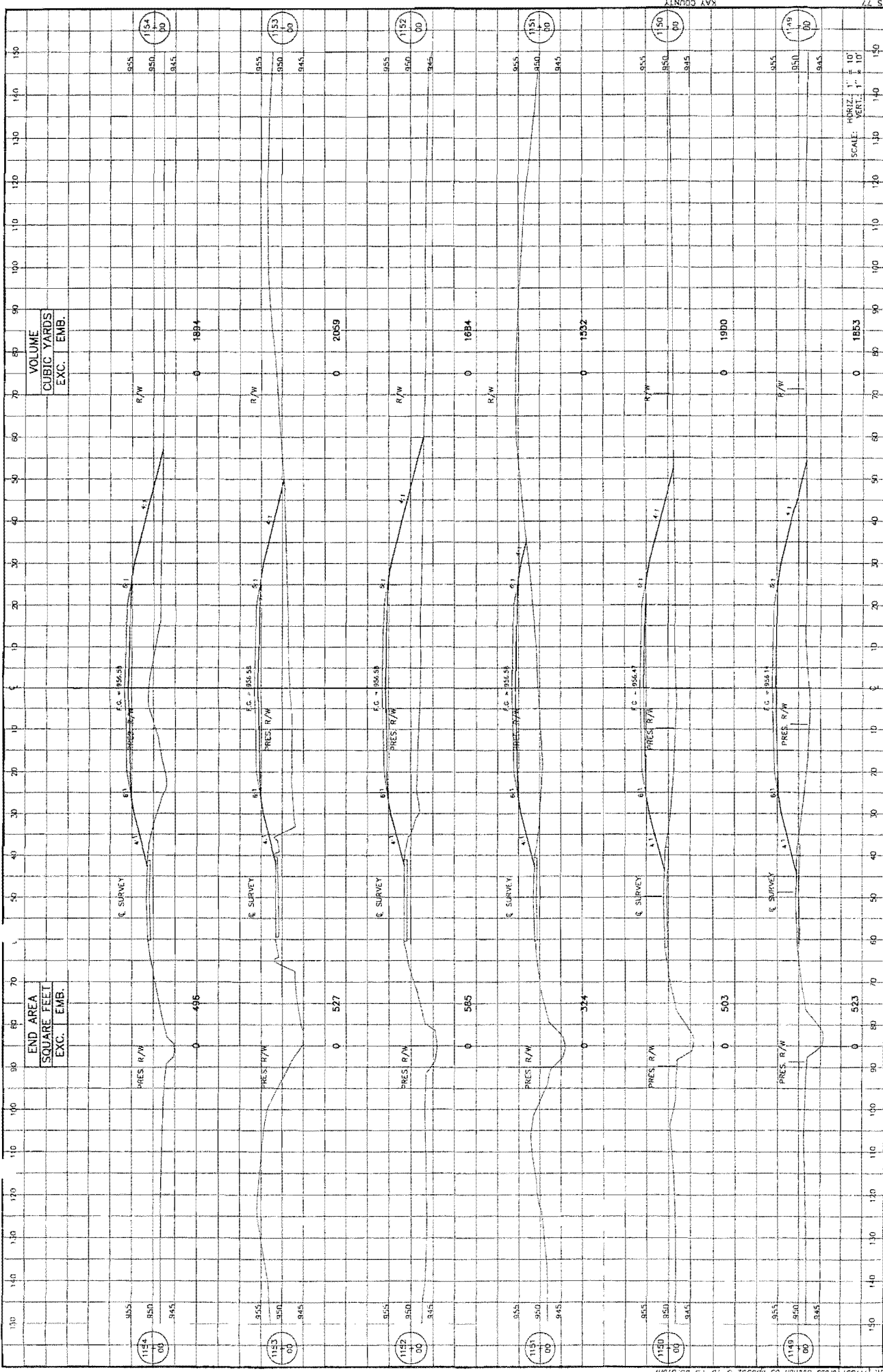
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SHEET NAME 2

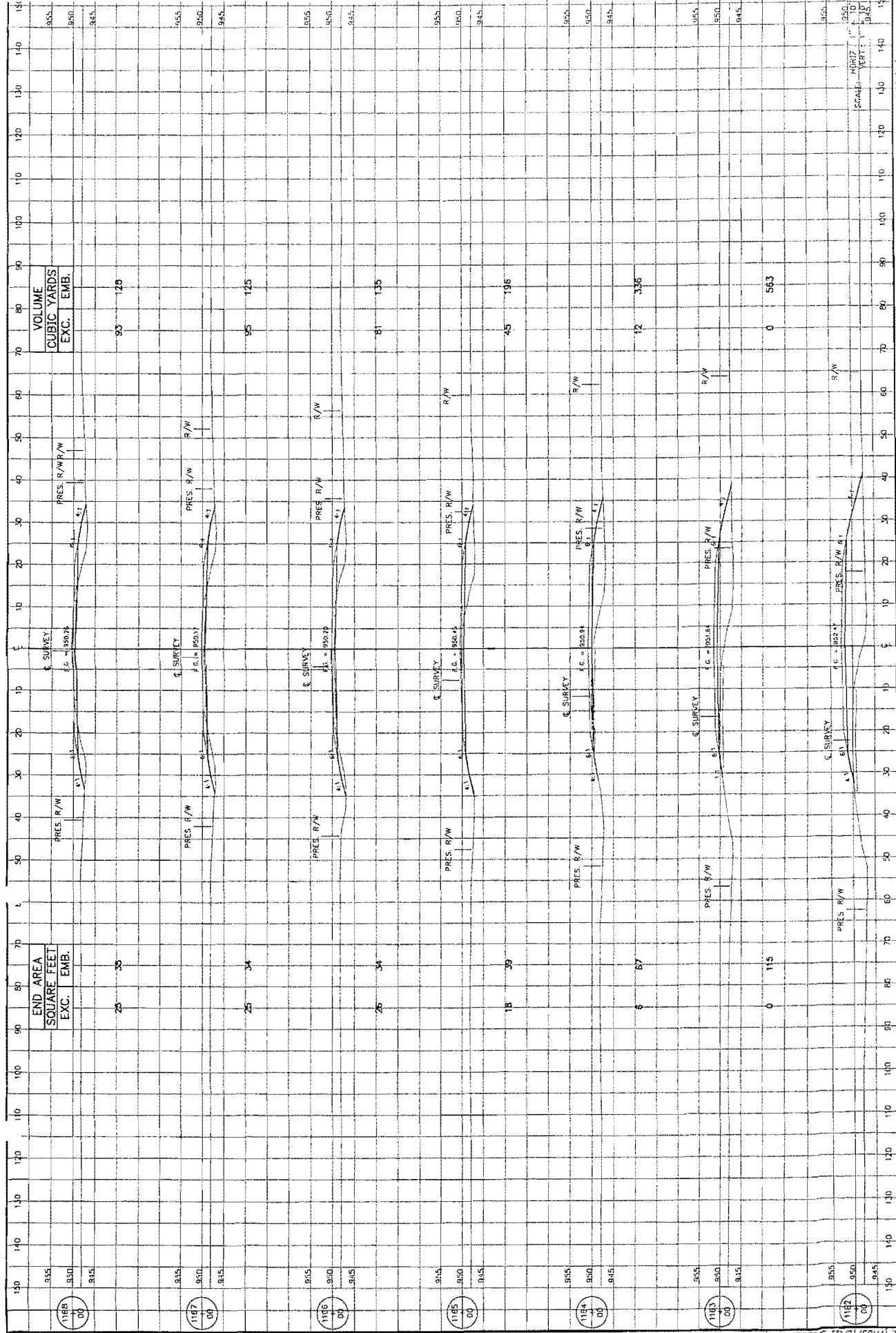


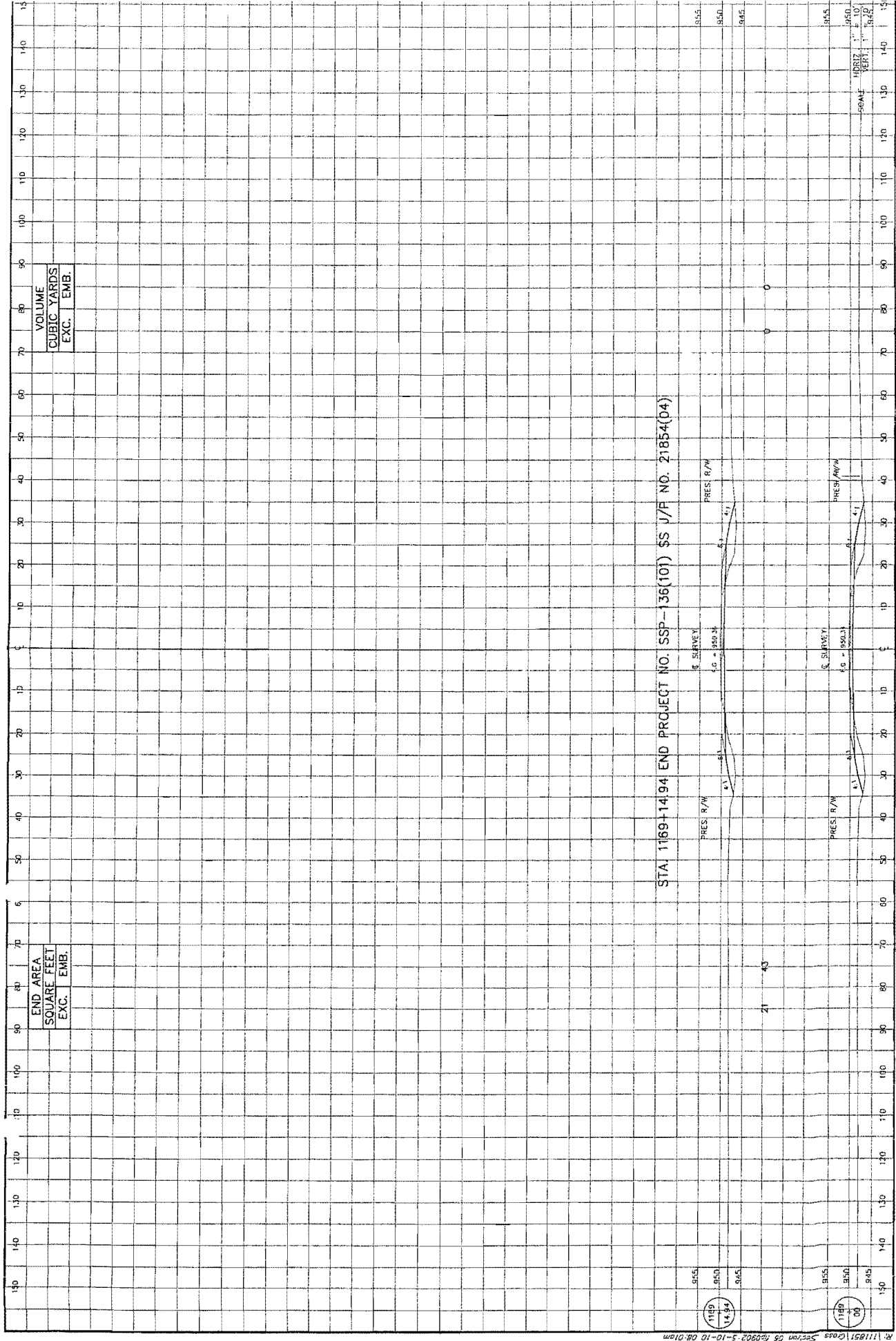


30% PLANS FOR REVIEW

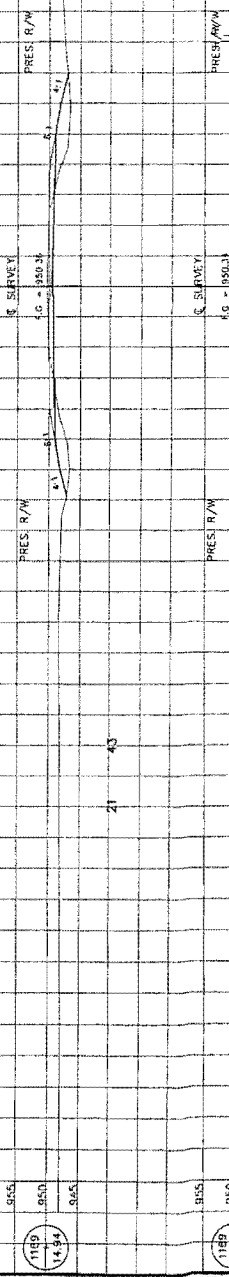








STA. 1189+14.94 END PROJECT NO. SSP-136(101) SS J/P NO. 21854(04)



BURGESS ENGINEERING AND TESTING, INC.
PEDOLOGICAL SOIL SURVEY CLASSIFICATION SUMMARY

Project: U.S. Highway 77 Improvements South of Tonkawa

Surveyed by: Jim Nevels

County: Kay County

Burgess Job No.: 731-10119

Date Surveyed: 9/26/10

Sample Location: Sta. 1135 + 66, 58.9' Lt. from Center Line of Survey US 77

Bore-Hole: B-1

Date Reported: 10/08/10

Project Number: SSP-136C(101)SS

State Job Number: 21854(04)

Soil Series: **Oil Waste Land-Huska Complex**

Depth (in)	Field No.	Sub-Horizon	AASHTO Soil Group	Soil Classification	MC %	Percent Passing								LL	PI	OSI
						3"	1-1/2"	3/4"	3/8"	#4	#10	#40	#200			
0-10	1A	A	A-6(10)	Lean Clay (CL)	6.4	100	100	100	100	99.8	98.3	97.8	94.5	31	11	11
10-19	1B	B _{tn1}	A-6(10)	Lean Clay (CL)	8.9	100	100	100	100	97.7	97.7	93.6	86.6	31	12	11
19-26	1C	B _{tnz1}	A-6(13)	Lean Clay (CL)	9.1	100	100	100	100	100	100	99.2	96.2	32	14	12
26-34	1D	B _{tnz2}	A-6(22)	Lean Clay (CL)	15.6	100	100	100	100	100	100	99.4	95.8	40	22	17
34-50	1E	B' _{tn}	A-7-6(41)	Fat Clay (CH)	22.6	100	100	100	100	100	100	99.7	97.9	57	38	27
50-72	1F	B' _{tn1}	A-7-6(34)	Fat Clay (CH)	23.3	100	100	100	100	100	100	99.7	98.4	50	32	22
10-72	Mr1-1	Composite B Horizon	A-7-6(33)	Fat Clay (CH)	14.1	100	100	100	100	100	100	99.3	98.0	50	31	22

Geology:

72+ Interbedded shale and sandstone

Note:

1-The color of this soil profile is believed to been affected by liquid wastes mainly salt water and soil. The Cr horizon was not found on this 0-1 percent slope ground.

BURGESS ENGINEERING AND TESTING, INC.
PEDOLOGICAL SOIL SURVEY CLASSIFICATION SUMMARY

Project: U.S. Highway 77 Improvements South of Tonkawa

Surveyed by: Jim Nevels

County: Kay County

Burgess Job No.: 731-10119

Date Surveyed: 10/02/10

Sample Location: Sta. 1138+72, 67.3' Rt. from center line of Survey US 77

Bore-Hole: B-2

Date Reported: 10/08/10

Project Number: SSP-136C(101)SS

State Job Number: 21854(04)

Soil Series: **Brewer Soil Series**

Depth (in)	Field No.	Sub-Horizon	AASHTO Soil Group	Soil Classification	MC %	Percent Passing								LL	PI	OSI
						3"	1-1/2"	3/4"	3/8"	#4	#10	#40	#200			
0-12	2A	A	A-6(14)	Lean Clay (CL)	1.8	100	100	100	100	100	100	99.5	95.2	33	15	13
12-32	2B	Bt1	A-7-6(25)	Lean Clay (CL)	14.1	100	100	100	100	100	100	99.6	93.9	43	26	19
32-50	2C	Bt2	A-7-6(33)	Fat Clay (CL)	21.9	100	100	100	100	100	100	99.4	97.0	52	31	23
50-81	2D	BC	A-7-6(41)	Fat Clay (CH)	24.0	100	100	100	100	100	100	98.9	96.9	57	38	27
81-90	2E	CK	A-7-6(37)	Fat Clay (CH)	22.3	100	100	100	100	100	100	98.4	96.5	53	35	25
12-81	Mr2-1	Composite B Horizon	A-7-6(24)	Sandy Fat Clay (CH)	19.4	100	100	100	100	100	100	99.3	97.3	59	39	28

Geology:

90+ Alluviums

Note:

1. The horizon texture and plasticity were similar to the Bt horizons.

BURGESS ENGINEERING AND TESTING, INC.
PEDOLOGICAL SOIL SURVEY CLASSIFICATION SUMMARY

Project: U.S. Highway 77 Improvements South of Tonkawa

Surveyed by: Jim Nevels

County: Kay County

Burgess Job No.: 731-10119

Date Surveyed: 10/03/10

Sample Location: Sta. 1161+81, 66' Rt. from center line of Survey US77

Bore-Hole: B-3

Date Reported: 10/08/10

Project Number: SSP-136C(101)SS

State Job Number: 21854(04)

Soil Series: **McLain Soil Series**

Depth (in)	Field No.	Sub-Horizon	AASHTO Soil Group	Soil Classification	MC %	Percent Passing								LL	PI	OSI
						3"	1-1/2"	3/4"	3/8"	#4	#10	#40	#200			
0-8	3A	Ap	A-7-6(21)	Lean Clay With Sand (CL)	22.6	100	100	100	100	100	100	92.7	76.8	48	27	20
8-14	3B	A	A-6(13)	Lean Clay (CL)	25.6	100	100	100	100	100	100	99.4	95.3	33	14	12
14-30	3C	Bt1	A-7-6(33)	Fat Clay (CH)	24.6	100	100	100	100	100	100	99.5	95.4	52	32	23
30-38	3D	Bt2	A-7-6(25)	Lean Clay (CL)	20.6	100	100	100	100	100	100	99.6	97.4	42	25	18
38-61	3E	C	A-7-6(32)	Fat Clay (CH)	21.6	100	100	100	100	100	100	99.2	96.4	50	31	22
14-38	Mr3-1	Composite B Horizon	A-7-6(32)	Fat Clay (CH)	24.6	100	100	100	100	100	100	99.1	96.4	50	31	22
38-61	Mr3-2	Composite C Horizon	A-7-6(43)	Fat Clay (CH)	22.1	100	100	100	100	100	100	99.2	97.3	58	40	28

Geology:

61+ Alluviums

BURGESS ENGINEERING AND TESTING, INC.
PEDOLOGICAL SOIL SURVEY CLASSIFICATION SUMMARY

Project: U.S. Highway 77 Improvements South of Tonkawa

Surveyed by: Jim Nevels

County: Kay County

Burgess Job No.: 731-10119

Date Surveyed: 10/02/10

Sample Location: Sta. 1184+16, 86' Rt. from center line of Survey US 77

Bore-Hole: B-4

Date Reported: 10/08/10

Project Number: SSP-136C(101)SS

State Job Number: 21854(04)

Soil Series: **Lela Soil Series**

Depth (in)	Field No.	Sub-Horizon	AASHTO Soil Group	Soil Classification	MC %	Percent Passing								LL	PI	OSI
						3"	1-1/2"	3/4"	3/8"	#4	#10	#40	#200			
0-9	4A	Ap	A-6(15)	Lean Clay (CL)	12.1	100	100	100	100	100	100	97.5	91.2	35	17	14
9-15	4B	A1	A-6(18)	Lean Clay (CL)	13.7	100	100	100	100	100	100	99.0	96.1	35	19	15
15-36	4C	Bss1	A-7-6(31)	Fat Clay (CH)	22.1	100	100	100	100	100	100	99.4	92.9	51	31	23
36-42	4D	Bss2	A-7-6(24)	Lean Clay (CL)	19.3	100	100	100	100	100	100	99.5	97.7	41	23	18
42-56	4E	Bss3	A-7-6(31)	Lean Clay (CL)	20.6	100	100	100	100	100	100	99.2	96.9	48	30	22
56-62	4F	Bkss1	A-7-6(37)	Fat Clay (CH)	22.1	100	100	100	100	100	100	99.2	97.6	54	34	24
62-74	4G	Bkss2	A-7-6(39)	Fat Clay (CH)	22.4	100	100	100	100	100	100	98.9	97.4	56	36	26
74-89	4H	BCss	A-7-6(38)	Fat Clay (CH)	23.3	100	100	100	100	100	100	98.2	96.4	56	36	26
15-89	Mr4-1	Composite B Horizon	A-7-6(41)	Fat Clay (CH)	21.5	100	100	100	100	100	100	98.9	96.6	58	38	27

Geology:

The BCss horizon texture and plasticity were similar to the Bss and Bkss horizons.

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF pH & RESISTIVITY TEST RESULTS

Project: US Highway 77 Improvements South of Tonkawa

Surveyed by: Jim Nevels

County: Kay County

Burgess Job No.: 731-10119

Date Surveyed: 9/26/10

Sample Location: Sta. 1135 + 66, 58.9' Lt. from Center Line of Survey US 77

Bore-Hole: B-1

Date Reported: 10/08/10

Project Number: SSP-136C(101)SS

State Job Number: 21854(04)

Soil Series: **Oil Waste Land-Huska Complex**

Depth (in)	Field No.	Sub-Horizon	AASHTO Soil Group	Soil Classification	pH	Resistivity (Ω * cm)
0-10	1A	A	A-6(10)	Lean Clay (CL)	8.53	570
10-19	1B	B _{tn1}	A-6(10)	Lean Clay (CL)	8.19	1010
19-26	1C	B _{tnz1}	A-6(13)	Lean Clay (CL)	8.20	920
26-34	1D	B _{tnz2}	A-6(22)	Lean Clay (CL)	8.44	480
34-50	1E	B' _{tn}	A-7-6(4)	Fat Clay (CH)	8.37	140
50-72	1F	B' _{tn1}	A-7-6(34)	Fat Clay (CH)	7.60	40

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF pH & RESISTIVITY TEST RESULTS

Project: U.S. Highway 77 Improvements South of Tonkawa

Surveyed by: Jim Nevels

County: Kay County

Project Number: SSP-136C(101)SS

Burgess Job No.: 731-10119

State Job Number: 21854(04)

Date Surveyed: 10/02/10

Sample Location: Sta. 1138+72, 67.3' Rt. from center line of Survey US 77

Bore-Hole: B-2

Soil Series: **Brewer Soil Series**

Date Reported: 10/08/10

Depth (in)	Field No.	Sub-Horizon	AASHTO Soil Group	Soil Classification	pH	Resistivity (Ω * cm)
0-12	2A	A	A-6(14)	Lean Clay (CL)	6.65	920
12-32	2B	Bt1	A-7-6(25)	Lean Clay (CL)	7.17	570
32-50	2C	Bt2	A-7-6(33)	Fat Clay (CL)	7.86	440
50-81	2D	BC	A-7-6(41)	Fat Clay (CH)	7.94	40
81-90	2E	CK	A-7-6(37)	Fat Clay (CH)	7.79	140

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF pH & RESISTIVITY TEST RESULTS

Project: U.S. Highway 77 Improvements South of Tonkawa

Surveyed by: Jim Nevels

County: Kay County

Project Number: SSP-136C(101)SS

Burgess Job No.: 731-10119

State Job Number: 21854(04)

Date Surveyed: 10/03/10

Sample Location: Sta. 1161+81, 66' Rt. from center line of Survey US77

Bore-Hole: B-3

Soil Series: **McLain Soil Series**

Date Reported: 10/08/10

Depth (in)	Field No.	Sub-Horizon	AASHTO Soil Group	Soil Classification	pH	Resistivity (Ω * cm)
0-8	3A	Ap	A-7-6(21)	Lean Clay With Sand (CL)	7.30	920
8-14	3B	A	A-6(13)	Lean Clay (CL)	7.25	610
14-30	3C	Bt1	A-7-6(33)	Fat Clay (CH)	7.04	700
30-38	3D	Bt2	A-7-6(25)	Lean Clay (CL)	7.08	920
38-61	3E	C	A-7-6(32)	Fat Clay (CH)	7.79	570

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF pH & RESISTIVITY TEST RESULTS

Project: U.S. Highway 77 Improvements South of Tonkawa

Surveyed by: Jim Nevels

County: Kay County

Project Number: SSP-136C(101)SS

Burgess Job No.: 731-10119

State Job Number: 21854(04)

Date Surveyed: 10/02/10

Sample Location: Sta. 1184+16, 86' Rt. from center line of Survey US 77

Bore-Hole: B-4

Soil Series: **Lela Soil Series**

Date Reported: 10/08/10

Depth (in)	Field No.	Sub-Horizon	AASHTO Soil Group	Soil Classification	pH	Resistivity (Ω * cm)
0-9	4A	Ap	A-6(15)	Lean Clay (CL)	8.5	700
9-15	4B	A1	A-6(18)	Lean Clay (CL)	8.03	700
15-36	4C	Bss1	A-7-6(31)	Fat Clay (CH)	8.13	520
36-42	4D	Bss2	A-7-6(24)	Lean Clay (CL)	8.22	616
42-56	4E	Bss3	A-7-6(31)	Lean Clay (CL)	8.31	480
56-62	4F	Bkss1	A-7-6(37)	Fat Clay (CH)	8.38	480
62-74	4G	Bkss2	A-7-6(39)	Fat Clay (CH)	8.36	480
74-89	4H	BCss	A-7-6(38)	Fat Clay (CH)	8.42	480

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF SOLUBLE SULFATE TEST RESULTS

Project: US Highway 77 Improvements South of Tonkawa

Surveyed by: Jim Nevels

County: Kay County

Project Number: SSP-136C(101)SS

Burgess Job No.: 731-10119

State Job Number: 21854(04)

Date Surveyed: 9/26/10

Sample Location: Sta. 1135 + 66, 58.9' Lt. from Center Line of Survey US 77

Bore-Hole: B-1

Soil Series: **Oil Waste Land-Huska Complex**

Date Reported: 10/08/10

Depth (in)	Field No.	Sub-Horizon	AASHTO Soil Group	Soil Classification	mg/Kg
10-72	Mr1-1	Composite B Horizon	A-7-6(33)	Fat Clay (CH)	1,610

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF SOLUBLE SULFATE TEST RESULTS

Project: US Highway 77 Improvements South of Tonkawa

Surveyed by: Jim Nevels

County: Kay County

Project Number: SSP-136C(101)SS

Burgess Job No.: 731-10119

State Job Number: 21854(04)

Date Surveyed: 10/02/10

Sample Location: Sta. 1138+72, 67.3' Rt. from center line of Survey US 77

Bore-Hole: B-2

Soil Series: **Brewer Soil Series**

Date Reported: 10/08/10

Depth (in)	Field No.	Sub-Horizon	AASHTO Soil Group	Soil Classification	mg/Kg
12-81	Mr2-1	Composite B Horizon	A-7-6(24)	Sandy Fat Clay (CH)	<200

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF SOLUBLE SULFATE TEST RESULTS

Project: US Highway 77 Improvements South of Tonkawa

Surveyed by: Jim Nevels

County: Kay County

Project Number: SSP-136C(101)SS

Burgess Job No.: 731-10119

State Job Number: 21854(04)

Date Surveyed: 10/03/10

Sample Location: Sta. 1161+81, 66' Rt. from center line of Survey US77

Bore-Hole: B-3

Soil Series: **McLain Soil Series**

Date Reported: 10/08/10

Depth (in)	Field No.	Sub-Horizon	AASHTO Soil Group	Soil Classification	mg/Kg
14-38	Mr3-1	Composite B Horizon	A-7-6(32)	Fat Clay (CH)	<200
38-61	Mr3-2	Composite C Horizon	A-7-6(43)	Fat Clay (CH)	<200

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF SOLUBLE SULFATE TEST RESULTS

Project: US Highway 77 Improvements South of Tonkawa

Surveyed by: Jim Nevels

County: Kay County

Project Number: SSP-136C(101)SS

Burgess Job No.: 731-10119

State Job Number: 21854(04)

Date Surveyed: 10/02/10

Sample Location: Sta. 1184+16, 86' Rt. from center line of Survey US 77

Bore-Hole: B-4

Soil Series: **Lela Soil Series**

Date Reported: 10/08/10

Depth (in)	Field No.	Sub-Horizon	AASHTO Soil Group	Soil Classification	mg/Kg
15-89	Mr4-1	Composite B Horizon	A-7-6(41)	Fat Clay (CH)	<200

Environmental Services
Petroleum Laboratory
www.oilab.com



4619 N. Santa Fe
Oklahoma City, OK 73118
Ph. (405) 528-TEST(8378)
Fax (405) 488-2404

Laboratory Report # 100324

October 8, 2010

BURGESS ENGINEERING

FIVE SOIL SAMPLES

PROJECT: 731-10119

ANALYSIS:

<u>SAMPLE ID</u>	<u>T.SOLUBLE SULFATES (PPM)</u>
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BREWER / COMP. B	<200
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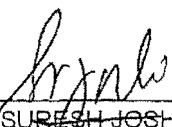
OIL LAND HUSKA / COMP. B	1,610
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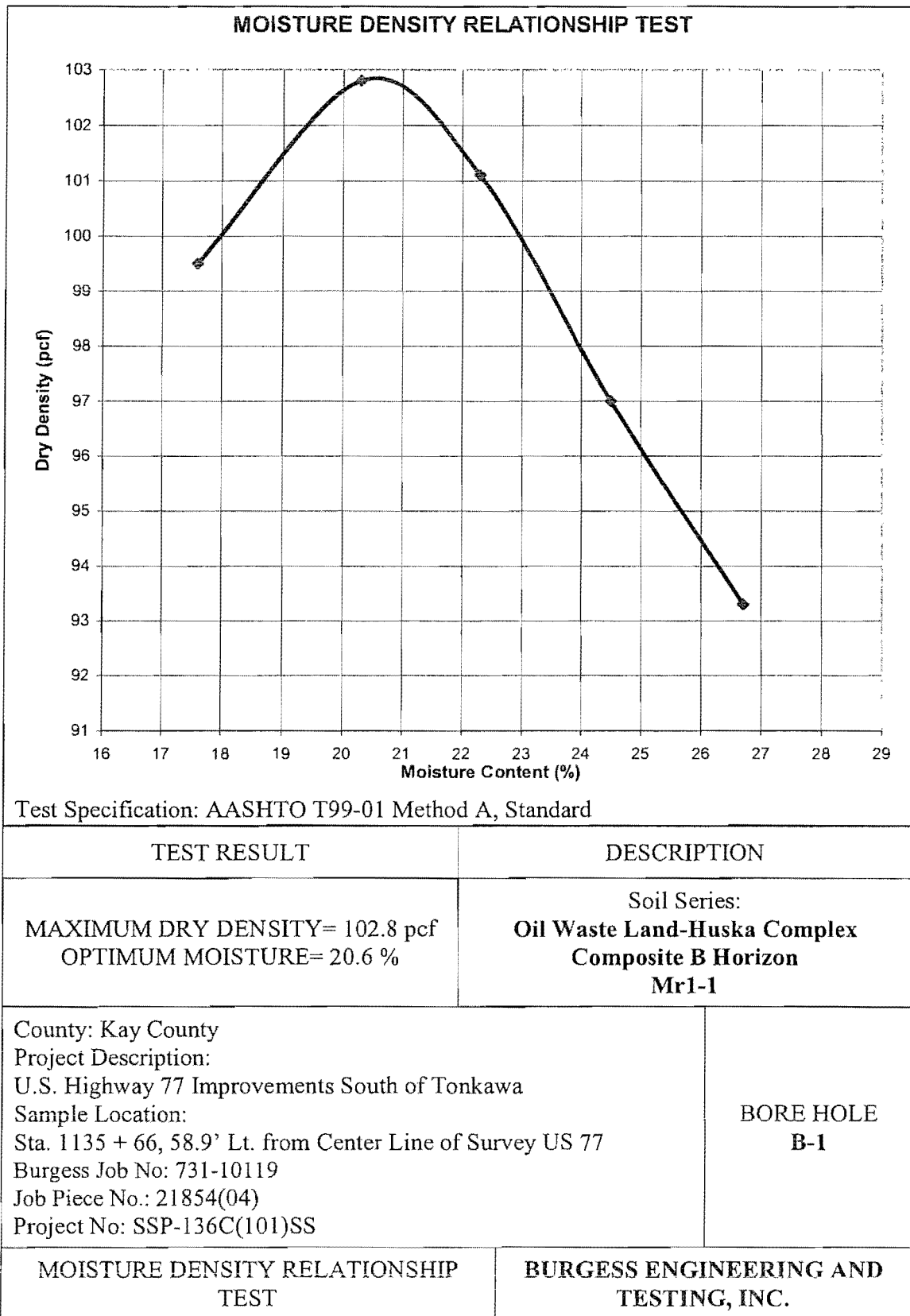
McLAIN / COMP. B	<200
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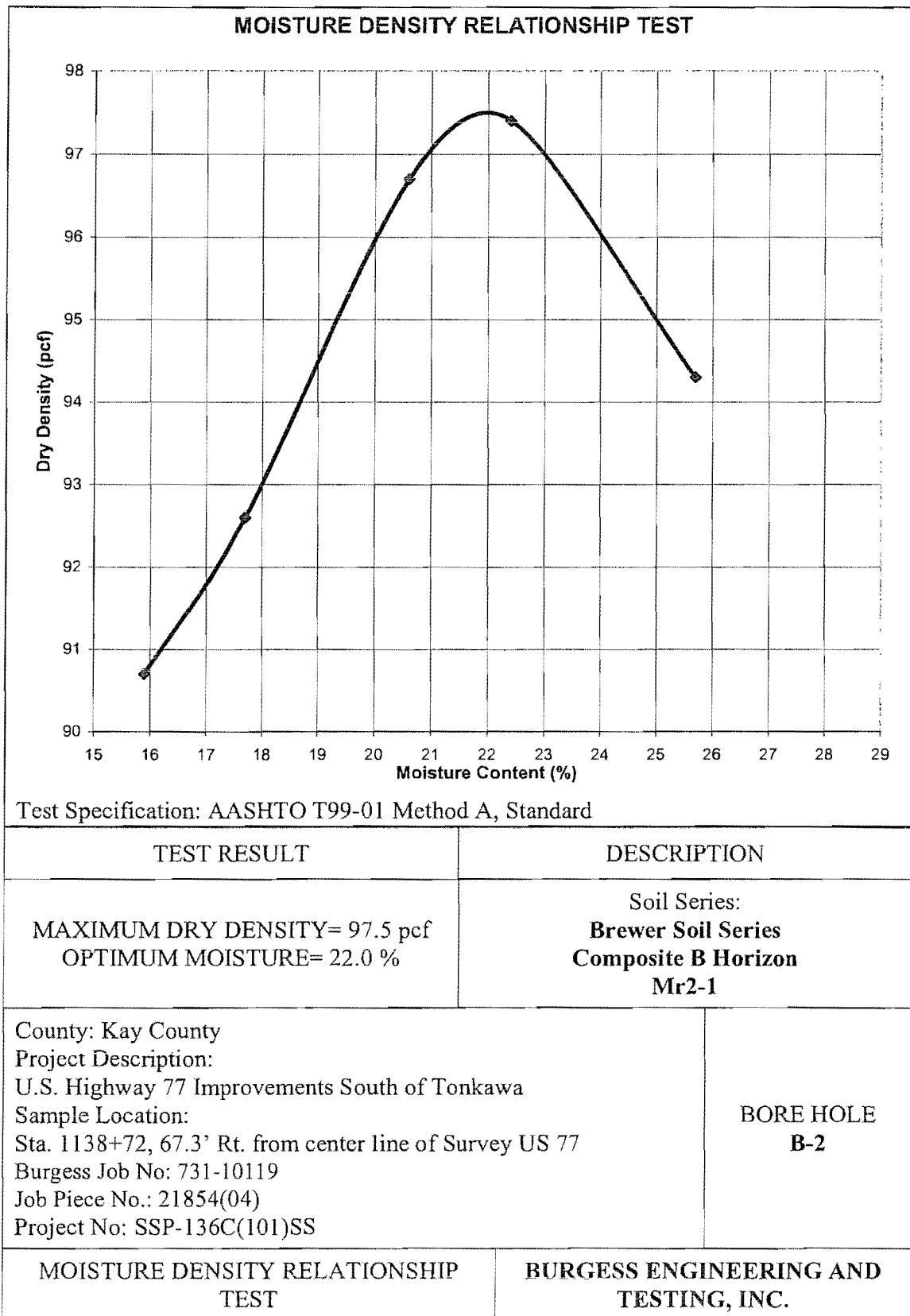
McLAIN / COMP. C	<200
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LELA / COMP. B	<200
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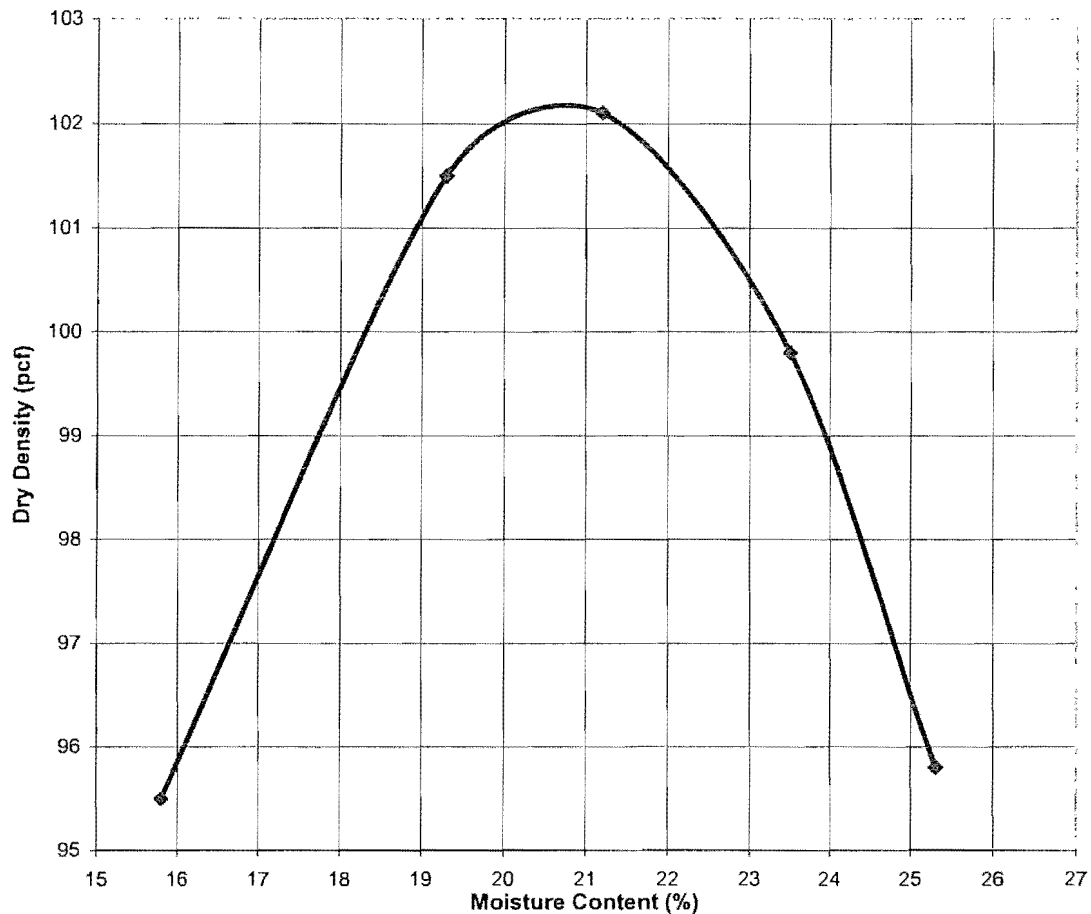
METHOD: OHD L-49


CERTIFIED BY: SURESH JOSHI
CHEMIST/ANALYST





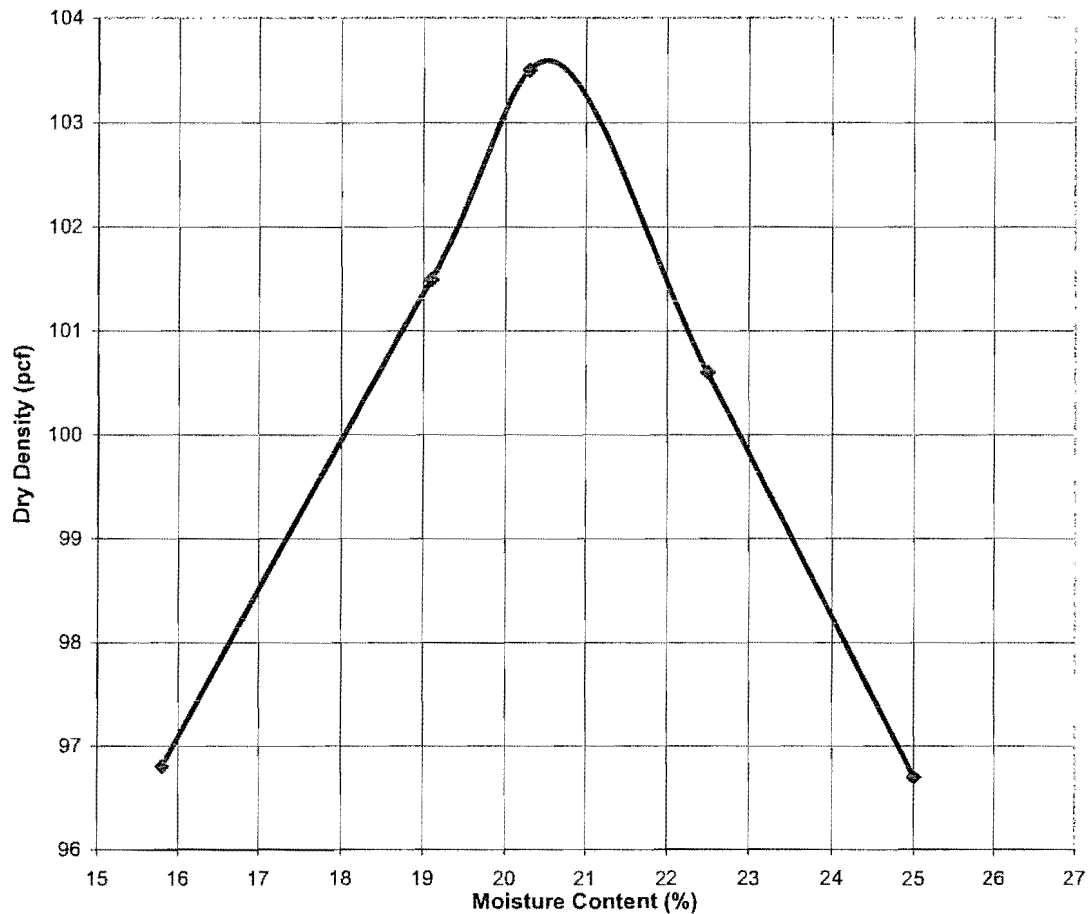
MOISTURE DENSITY RELATIONSHIP TEST



Test Specification: AASHTO T99-01 Method A, Standard

TEST RESULT	DESCRIPTION
MAXIMUM DRY DENSITY= 102.3pcf OPTIMUM MOISTURE= 20.7 %	Soil Series: McLain Soil Series Composite B Horizon Mr3-1
County: Kay County Project Description: U.S. Highway 77 Improvements South of Tonkawa Sample Location: 1161+81, 66' Rt. from center line of Survey US77 Burgess Job No: 731-10119 Job Piece No.: 21854(04) Project No: SSP-136C(101)SS	BORE HOLE B-3
MOISTURE DENSITY RELATIONSHIP TEST	BURGESS ENGINEERING AND TESTING, INC.

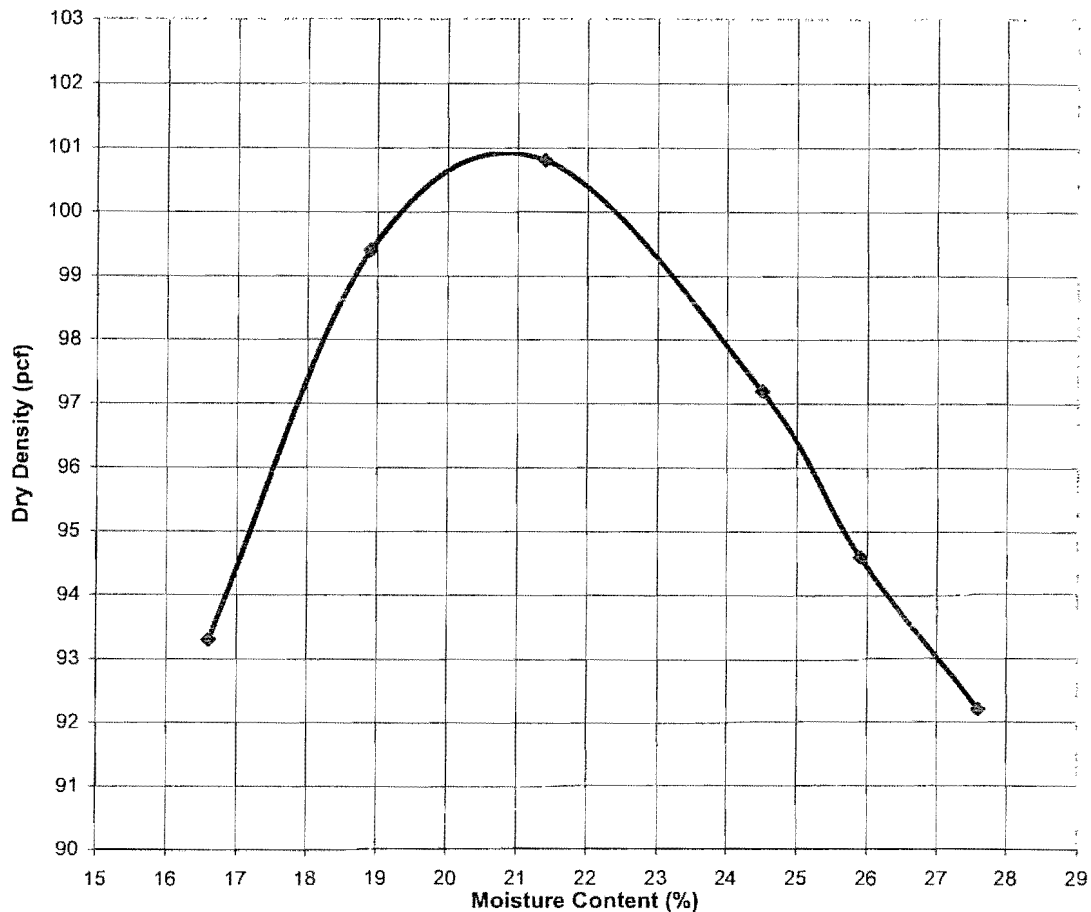
MOISTURE DENSITY RELATIONSHIP TEST



Test Specification: AASHTO T99-01 Method A, Standard

TEST RESULT	DESCRIPTION
MAXIMUM DRY DENSITY= 103.5 pcf OPTIMUM MOISTURE= 20.4 %	Soil Series: McLain Soil Series Composite C Horizon Mr3-2
County: Kay County Project Description: U.S. Highway 77 Improvements South of Tonkawa Sample Location: 1161+81, 66' Rt. from center line of Survey US77 Burgess Job No: 731-10119 Job Piece No.: 21854(04) Project No: SSP-136C(101)SS	BORE HOLE B-3
MOISTURE DENSITY RELATIONSHIP TEST	BURGESS ENGINEERING AND TESTING, INC.

MOISTURE DENSITY RELATIONSHIP TEST



Test Specification: AASHTO T99-01 Method A, Standard

TEST RESULT	DESCRIPTION
MAXIMUM DRY DENSITY= 100.9 pcf OPTIMUM MOISTURE= 21 %	Soil Series: Lela Soil Series Composite B Horizon Mr4-1
County: Kay County Project Description: U.S. Highway 77 Improvements South of Tonkawa Sample Location: Sta. 1184+16, 86' Rt. from center line of Survey US 77 Burgess Job No: 731-10119 Job Piece No.: 21854(04) Project No: SSP-136C(101)SS	BORE HOLE B-4
MOISTURE DENSITY RELATIONSHIP TEST	BURGESS ENGINEERING AND TESTING, INC.

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF RESILIENT MODULUS TESTING
FOR PEDEOLOGICAL SOIL SURVEY

Project Location: U.S. Highway 77 Improvement South of Tonkawa

Project No.: SSP-136C(101)SS

Job Piece No: 21854(04)

Surveyed by: Jim Nevels

County: Kay County

Date Surveyed: September 26, 2010

Lab No.: S10632

Burgess Job No.: 731-10119

Soil Series: **Oil Waste Land-Huska Complex Composite B**

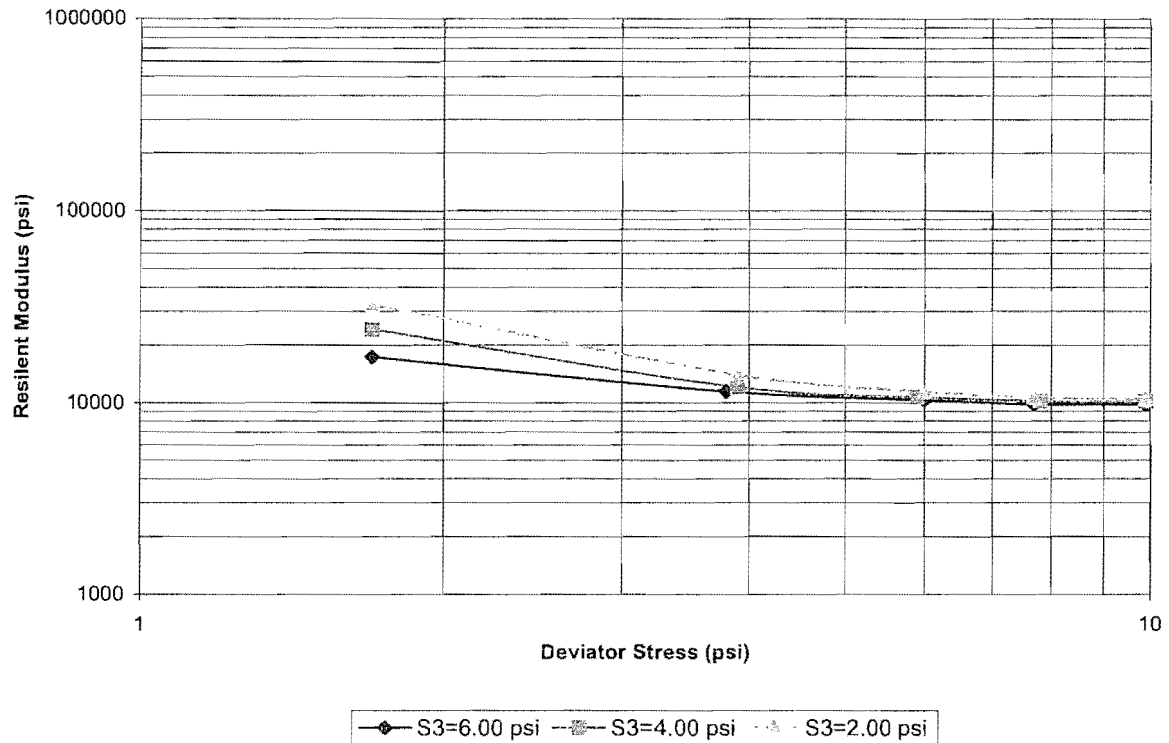
Desired Moisture Content: 20.6 %

Desired Dry Density: 97.7 pcf

Sample I.D.	Chamber Pressure (psi)	Axial Stress (psi)	Moisture Content (%)	Dry Density (pcf)	Resilient Strain (in/in)	Resilient Modulus (psi)	Standard Deviation for M_R
MR1-1-A	6.0	1.7	21.1	97.1	0.00010	17248.0	421.6
		3.8			0.00033	11412.6	196.6
		6.0			0.00058	10324.3	29.4
		7.7			0.00079	9804.6	58.7
		9.9			0.00101	9741.7	62.6
	4.0	1.7			0.00007	24018.8	982.9
		3.9			0.00032	12020.5	168.4
		5.9			0.00055	10685.8	88.1
		7.8			0.00076	10214.3	101.6
		9.9			0.00097	10173.2	65.0
	2.0	1.7			0.00005	32380.6	2209.0
		3.9			0.00028	13949.5	300.1
		6.0			0.00052	11444.1	92.9
		7.7			0.00073	10601.8	46.1
		9.9			0.00094	10478.1	52.4

RESILIENT MODULUS TESTING - AASHTO T307-99

MR1-1-A @ 95% Dry Density & Opt. Moisture



LOCATION		DESCRIPTION	
Project Location: U.S. Highway 77 Improvement		MR1-1-A	RM=a(S _d) ^b
Project No.: SSP-136C(101)SS		B Values for S _d are: S3=6.00psi: 1.7, 3.8, 6.0, 7.7, 9.9 psi S3=4.00psi: 1.7, 3.9, 5.9, 7.8, 9.9 psi S3=2.00psi: 1.7, 3.9, 6.0, 7.7, 9.9 psi Calculated units of values for RM are in psi	
Soil Series: Oil Waste Land-Huska Complex Composite			
Sample by: Jim Nevels			
Sample Date: September 26, 2010			
Burgess Job No.: 731-10119			
Sample No. MR1-1-A			
S ₃	6.00 psi	4.00 psi	2.00 psi
R ²	0.9231	0.8811	0.9157
a	19386	27954	40745
b	-0.3312	-0.4961	-0.6581
RESILENT MODULUS TESTING AASHTO T307-99		BURGESS ENGINEERING AND TESTING, INC.	

BURGESS ENGINEERING AND TESTING, INC.

Resilient Modulus Testing - AASHTO T307-99

Date: 10/08/2010

Client:
Smith Roberts Baldischwiler, LLC.

Attn: Mr. Gary Noland, P.E.
104 S 2nd Street
Chickasha, OK 73018

Project: U.S. Highway 77 Improvement South of
Tonkawa

Project Description: Resilient Modulus Test

AASHTO T307-99

BETI Project No.: 731-10119

Soil Series: Oil Waste Land-Huska Complex Con

Sample Information

Sample ID: MR1-1-A

Sample Type: 95% Dry Density & Opt. Moisture

Test Date: 10/06/10

Remarks:

Sample Diameter, in.: 4

Sample Height, in.: 8

Desired M.C., %: 20.6

Dry Den., pcf: 97.7

Sample M.C., %: 21.1

Sample Dry Den., pcf: 97.1

Failed in Shear?:

Triaxial Shear Strength, psi:

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	Chamber Confining Pressure	Nominal Maximu m Axial Stress	Cycle No.	Actual Applied Max. Axial Load	Actual Applied Cyclic Load	Actual Applied Contact Load	Actual Applied Max. Axial Stress	Actual Applied Cyclic Stress	Actual Applied Contact Stress	Recov. Def. LVDT #1 Reading	Recov. Def. LVDT #2 Reading	Average Recov. Def. LVDT 1 and 2	Resilient Strain	Resilient Modulus
DESIGNATION	S3	Scyclic	cl	Pmax	Pcyclic	Pcontact	Smax	Scyclic	Scontact	H1	H2	Havg	Er	Mr
UNIT	psi	psi	---	lbf	lbf	lbf	psi	psi	psi	in	in	in	in/in	psi
PRECISION	---	---	-	---	---	---	---	---	---	---	---	---	---	---
Sequence 1	6.00	2.00	1	24.6	21.6	3.0	2.0	1.7	0.2	0.00080	0.00080	0.00080	0.000100	17,535
			2	24.9	22.0	2.8	2.0	1.8	0.2	0.00090	0.00080	0.00085	0.000100	17,324
			3	23.4	20.5	2.9	1.9	1.6	0.2	0.00080	0.00070	0.00075	0.000090	17,658
			4	24.2	21.1	3.1	1.9	1.7	0.2	0.00080	0.00080	0.00080	0.000100	16,582
			5	23.8	20.9	2.9	1.9	1.7	0.2	0.00080	0.00080	0.00080	0.000100	17,142
	COLUMN AVERAGE			24.2	21.2	2.9	1.9	1.7	0.2	0.00080	0.00080	0.00080	0.000100	17,248
	STANDARD DEV.			0.6	0.6	0.1	0.0	0.0	0.0	0.00000	0.00010	0.00005	0.000000	422

BURGESS ENGINEERING AND TESTING, INC.

MR1-1-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 2	6.00	4.00	1	54.0	48.5	5.4	4.3	3.9	0.4	0.00270	0.00260	0.00265	0.00034	11,561
			2	53.5	48.1	5.4	4.3	3.8	0.4	0.00270	0.00270	0.00270	0.00034	11,462
			3	53.6	48.3	5.3	4.3	3.9	0.4	0.00270	0.00260	0.00265	0.00033	11,611
			4	53.0	47.7	5.3	4.2	3.8	0.4	0.00270	0.00270	0.00270	0.00034	11,292
			5	51.7	46.3	5.5	4.1	3.7	0.4	0.00270	0.00260	0.00265	0.00033	11,137
			COLUMN AVERAGE	53.1	47.8	5.4	4.3	3.8	0.4	0.00270	0.00260	0.00265	0.00033	11,413
			STANDARD DEV.	0.9	0.9	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	197
Sequence 3	6.00	6.00	1	82.5	74.6	8.0	6.6	6.0	0.6	0.00470	0.00450	0.00460	0.00058	10,335
			2	82.8	74.8	8.0	6.6	6.0	0.6	0.00470	0.00450	0.00460	0.00058	10,345
			3	82.8	74.9	7.9	6.6	6.0	0.6	0.00470	0.00460	0.00465	0.00058	10,355
			4	82.2	74.2	8.0	6.6	5.9	0.6	0.00460	0.00460	0.00460	0.00058	10,301
			5	82.6	74.7	7.9	6.6	6.0	0.6	0.00470	0.00450	0.00460	0.00058	10,286
			COLUMN AVERAGE	82.6	74.6	8.0	6.6	6.0	0.6	0.00470	0.00460	0.00465	0.00058	10,324
			STANDARD DEV.	0.2	0.3	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	29
Sequence 4	6.00	8.00	1	105.9	95.9	10.0	8.5	7.7	0.8	0.00630	0.00630	0.00630	0.00079	9,760
			2	107.0	96.8	10.2	8.6	7.7	0.8	0.00630	0.00630	0.00630	0.00079	9,854
			3	107.6	97.4	10.2	8.6	7.8	0.8	0.00640	0.00620	0.00630	0.00079	9,882
			4	106.8	96.7	10.1	8.5	7.7	0.8	0.00640	0.00630	0.00635	0.00079	9,767
			5	105.9	95.9	10.0	8.5	7.7	0.8	0.00630	0.00630	0.00630	0.00079	9,761
			COLUMN AVERAGE	106.6	96.5	10.1	8.5	7.7	0.8	0.00630	0.00630	0.00630	0.00079	9,805
			STANDARD DEV.	0.7	0.6	0.1	0.1	0.1	0.0	0.00010	0.00000	0.00005	0.00000	59
Sequence 5	6.00	10.00	1	135.2	122.8	12.5	10.8	9.8	1.0	0.00810	0.00810	0.00810	0.00101	9,736
			2	135.7	123.3	12.4	10.9	9.9	1.0	0.00810	0.00810	0.00810	0.00102	9,709
			3	137.1	124.6	12.5	11.0	10.0	1.0	0.00810	0.00810	0.00810	0.00101	9,849
			4	136.1	123.6	12.5	10.9	9.9	1.0	0.00810	0.00820	0.00815	0.00102	9,688
			5	135.9	123.5	12.4	10.9	9.9	1.0	0.00810	0.00810	0.00810	0.00102	9,726
			COLUMN AVERAGE	136.0	123.6	12.4	10.9	9.9	1.0	0.00810	0.00810	0.00810	0.00101	9,742
			STANDARD DEV.	0.7	0.7	0.0	0.1	0.1	0.0	0.00000	0.00010	0.00005	0.00000	63

BURGESS ENGINEERING AND TESTING, INC.

MR1-1-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 6	4.00	2.00	1	25.0	21.8	3.3	2.0	1.7	0.3	0.0006	0.0006	0.0006	0.0001	22,912
			2	23.5	20.3	3.2	1.9	1.6	0.3	0.0006	0.0005	0.0006	0.0001	23,231
			3	25.5	22.3	3.1	2.0	1.8	0.2	0.0006	0.0006	0.0006	0.0001	25,346
			4	24.6	21.4	3.2	2.0	1.7	0.3	0.0005	0.0006	0.0006	0.0001	24,524
			5	23.6	20.4	3.2	1.9	1.6	0.3	0.0006	0.0005	0.0006	0.0001	24,081
	COLUMN AVERAGE		24.4	21.2	3.2	2.0	1.7	0.3	0.0006	0.0005	0.0006	0.0001	24,019	
	STANDARD DEV.		0.9	0.9	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	983	
Sequence 7	4.00	4.00	1	55.1	49.6	5.5	4.4	4.0	0.4	0.0027	0.0025	0.0026	0.0003	12,133
			2	53.9	48.3	5.5	4.3	3.9	0.4	0.0026	0.0025	0.0026	0.0003	12,208
			3	52.9	47.3	5.5	4.2	3.8	0.4	0.0026	0.0025	0.0026	0.0003	11,969
			4	53.6	48.1	5.5	4.3	3.8	0.4	0.0026	0.0025	0.0026	0.0003	12,023
			5	52.8	47.3	5.5	4.2	3.8	0.4	0.0026	0.0025	0.0026	0.0003	11,770
	COLUMN AVERAGE		53.7	48.1	5.5	4.3	3.9	0.4	0.0026	0.0025	0.0026	0.0003	12,021	
	STANDARD DEV.		0.9	0.9	0.0	0.1	0.1	0.0	0.0001	0.0000	0.0001	0.0000	168	
Sequence 8	4.00	6.00	1	82.5	74.6	7.9	6.6	6.0	0.6	0.0044	0.0044	0.0044	0.0006	10,796
			2	81.7	73.8	7.8	6.5	5.9	0.6	0.0045	0.0045	0.0045	0.0006	10,587
			3	80.9	73.0	7.9	6.5	5.8	0.6	0.0044	0.0044	0.0044	0.0006	10,655
			4	82.1	74.3	7.8	6.6	5.9	0.6	0.0044	0.0044	0.0044	0.0006	10,759
			5	81.8	73.9	7.9	6.5	5.9	0.6	0.0045	0.0044	0.0045	0.0006	10,632
	COLUMN AVERAGE		81.8	73.9	7.9	6.5	5.9	0.6	0.0044	0.0044	0.0044	0.0006	10,686	
	STANDARD DEV.		0.6	0.6	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	88	
Sequence 9	4.00	8.00	1	108.5	98.2	10.3	8.7	7.8	0.8	0.0061	0.0061	0.0061	0.0008	10,276
			2	108.0	97.7	10.3	8.6	7.8	0.8	0.0060	0.0061	0.0061	0.0008	10,318
			3	105.7	95.5	10.3	8.5	7.6	0.8	0.0061	0.0061	0.0061	0.0008	10,075
			4	106.4	96.1	10.2	8.5	7.7	0.8	0.0061	0.0060	0.0061	0.0008	10,143
			5	107.7	97.4	10.3	8.6	7.8	0.8	0.0061	0.0061	0.0061	0.0008	10,260
	COLUMN AVERAGE		107.3	97.0	10.3	8.6	7.8	0.8	0.0061	0.0061	0.0061	0.0008	10,214	
	STANDARD DEV.		1.2	1.1	0.0	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	102	
Sequence 10	4.00	10.00	1	136.9	124.2	12.7	11.0	9.9	1.0	0.0077	0.0078	0.0078	0.0010	10,246
			2	134.9	122.3	12.6	10.8	9.8	1.0	0.0077	0.0078	0.0078	0.0010	10,075
			3	136.3	123.6	12.7	10.9	9.9	1.0	0.0078	0.0078	0.0078	0.0010	10,152
			4	136.5	123.9	12.5	10.9	9.9	1.0	0.0078	0.0077	0.0078	0.0010	10,210
			5	136.5	123.6	12.8	10.9	9.9	1.0	0.0078	0.0078	0.0078	0.0010	10,184
	COLUMN AVERAGE		136.2	123.5	12.7	10.9	9.9	1.0	0.0078	0.0078	0.0078	0.0010	10,173	
	STANDARD DEV.		0.8	0.7	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	65	

BURGESS ENGINEERING AND TESTING, INC.

MR1-1-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 11	2.00	2.00	1	24.0	20.8	3.1	1.9	1.7	0.2	0.00040	0.00040	0.00040	0.00005	31,521
			2	26.7	24.1	2.7	2.1	1.9	0.2	0.00050	0.00050	0.00050	0.00006	32,662
			3	22.3	19.4	2.9	1.8	1.6	0.2	0.00040	0.00030	0.00035	0.00004	36,078
			4	23.9	21.0	2.9	1.9	1.7	0.2	0.00050	0.00040	0.00045	0.00005	31,110
			5	24.8	22.1	2.7	2.0	1.8	0.2	0.00050	0.00050	0.00050	0.00006	30,533
	COLUMN AVERAGE			24.3	21.5	2.9	1.9	1.7	0.2	0.00040	0.00040	0.00040	0.00005	32,381
STANDARD DEV.			1.6	1.7	0.2	0.1	0.1	0.0	0.00000	0.00010	0.00005	0.00001	2,209	
Sequence 12	2.00	4.00	1	55.4	49.5	5.9	4.4	4.0	0.5	0.00220	0.00220	0.00220	0.00028	14,392
			2	55.1	49.2	5.9	4.4	3.9	0.5	0.00230	0.00220	0.00225	0.00028	14,079
			3	54.7	48.9	5.9	4.4	3.9	0.5	0.00230	0.00220	0.00225	0.00028	13,871
			4	52.8	47.0	5.8	4.2	3.8	0.5	0.00220	0.00220	0.00220	0.00028	13,603
			5	54.2	48.3	6.0	4.3	3.9	0.5	0.00230	0.00220	0.00225	0.00028	13,803
	COLUMN AVERAGE			54.4	48.6	5.9	4.4	3.9	0.5	0.00230	0.00220	0.00225	0.00028	13,950
STANDARD DEV.			1.0	1.0	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	300	
Sequence 13	2.00	6.00	1	82.5	74.8	7.7	6.6	6.0	0.6	0.00420	0.00410	0.00415	0.00052	11,516
			2	82.1	74.5	7.6	6.6	6.0	0.6	0.00410	0.00420	0.00415	0.00052	11,481
			3	81.9	74.2	7.7	6.6	5.9	0.6	0.00420	0.00420	0.00420	0.00053	11,302
			4	83.6	76.0	7.6	6.7	6.1	0.6	0.00420	0.00420	0.00420	0.00053	11,521
			5	82.8	75.0	7.7	6.6	6.0	0.6	0.00420	0.00420	0.00420	0.00053	11,400
	COLUMN AVERAGE			82.6	74.9	7.7	6.6	6.0	0.6	0.00420	0.00420	0.00420	0.00052	11,444
STANDARD DEV.			0.7	0.7	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	93	
Sequence 14	2.00	8.00	1	106.7	96.7	10.0	8.5	7.7	0.8	0.00580	0.00590	0.00585	0.00073	10,579
			2	107.8	97.7	10.1	8.6	7.8	0.8	0.00590	0.00590	0.00590	0.00073	10,641
			3	105.6	95.6	10.0	8.4	7.6	0.8	0.00580	0.00580	0.00580	0.00073	10,534
			4	107.2	97.1	10.1	8.6	7.8	0.8	0.00580	0.00590	0.00585	0.00073	10,611
			5	107.2	97.2	10.1	8.6	7.8	0.8	0.00580	0.00580	0.00580	0.00073	10,644
	COLUMN AVERAGE			106.9	96.9	10.1	8.6	7.7	0.8	0.00580	0.00590	0.00585	0.00073	10,602
STANDARD DEV.			0.8	0.8	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	46	
Sequence 15	2.00	10.00	1	135.3	122.8	12.5	10.8	9.8	1.0	0.00750	0.00750	0.00750	0.00094	10,431
			2	135.5	122.9	12.6	10.8	9.8	1.0	0.00750	0.00760	0.00755	0.00094	10,427
			3	136.3	123.8	12.5	10.9	9.9	1.0	0.00750	0.00760	0.00755	0.00095	10,473
			4	136.7	124.2	12.5	10.9	9.9	1.0	0.00750	0.00750	0.00750	0.00094	10,551
			5	136.5	124.0	12.5	10.9	9.9	1.0	0.00750	0.00760	0.00755	0.00094	10,508
	COLUMN AVERAGE			136.1	123.5	12.5	10.9	9.9	1.0	0.00750	0.00760	0.00755	0.00094	10,478
STANDARD DEV.			0.6	0.6	0.0	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	52	

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF RESILIENT MODULUS TESTING
FOR PEDELOGICAL SOIL SURVEY

Project Location: U.S. Highway 77 Improvement South of Tonkawa

Project No.: SSP-136C(101)SS

Job Piece No: 21854(04)

Surveyed by: Jim Nevels

County: Kay County

Date Surveyed: September 26, 2010

Lab No.: S10632

Burgess Job No.: 731-10119

Soil Series: **Oil Waste Land-Huska Complex Composite B**

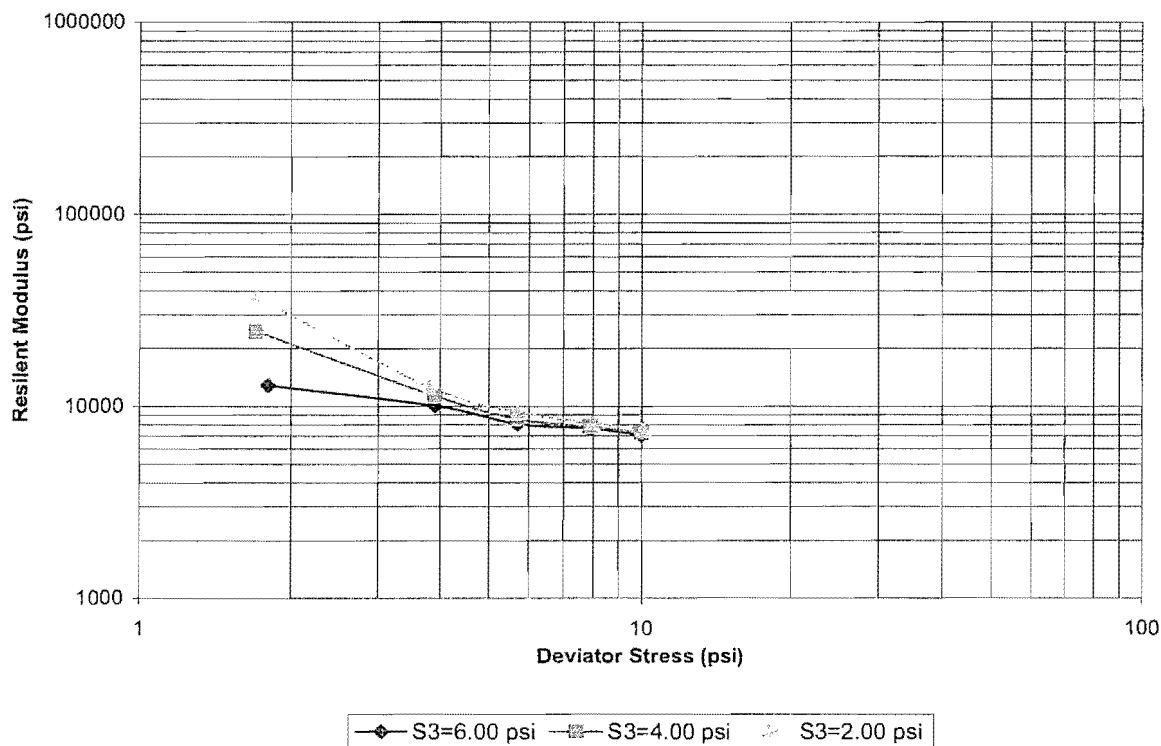
Desired Moisture Content: 22.6 %

Desired Dry Density: 100.7 pcf

Sample I.D.	Chamber Pressure (psi)	Axial Stress (psi)	Moisture Content (%)	Dry Density (pcf)	Resilient Strain (in/in)	Resilient Modulus (psi)	Standard Deviation for M_R
MR1-1-B	6.0	1.8	22.8	100.4	0.00014	12867.6	216.2
		3.9			0.00038	10065.7	91.0
		5.7			0.00071	8046.3	38.4
		7.9			0.00103	7650.6	54.8
		10.0			0.00142	7077.8	29.1
	4.0	1.7			0.00007	24465.0	452.4
		3.9			0.00035	11294.1	182.2
		5.7			0.00066	8575.9	70.3
		7.9			0.00102	7783.2	30.3
		10.0			0.00137	7300.2	26.8
	2.0	1.7			0.00005	37044.5	3454.0
		3.8			0.00030	12586.3	119.8
		5.7			0.00062	9318.4	53.7
		8.0			0.00098	8143.5	53.7
		10.1			0.00133	7561.5	18.7

RESILIENT MODULUS TESTING - AASHTO T307-99

MR1-1-B @ Opt. Moisture + 2%



LOCATION		DESCRIPTION	
Project Location: U.S. Highway 77 Improvement		MR1-1-B	$RM=a(S_d)^b$
Project No.: SSP-136C(101)SS		B Values for S_d are:	
Soil Series: Oil Waste Land-Huska Complex Composite		S3=6.00psi: 1.8, 3.9, 5.7, 7.9, 10.0 psi	
Sample by: Jim Nevels		S3=4.00psi: 1.7, 3.9, 5.7, 7.9, 10.0 psi	
Sample Date: September 26, 2010		S3=2.00psi: 1.7, 3.8, 5.7, 8.0, 10.1 psi	
Burgess Job No.: 731-10119		Calculated units of values for RM are in psi	
Sample No. MR1-1-B			
S_3	6.00 psi	4.00 psi	2.00 psi
R^2	0.9807	0.9534	0.9337
a	15876	32350	51142
b	-0.3578	-0.6965	-0.8972
RESILIENT MODULUS TESTING AASHTO T307-99		BURGESS ENGINEERING AND TESTING, INC.	

BURGESS ENGINEERING AND TESTING, INC.

Resilient Modulus Testing - AASHTO T307-99

Date: 10/08/2010

Client:
Smith Roberts Baldischwiler, LLC.
Attn: Mr. Gary Noland, P.E.
104 S 2nd Street
Chickasha, OK 73018

Project: U.S. Highway 77 Improvement South of
Tonkawa

Project Description: Resilient Modulus Test

AASHTO T307-99

BETI Project No.: 731-10119
Soil Series: Oil Waste Land-Huska Complex Con

Sample Information

Sample ID: MR1-1-B	Sample Diameter, in.: 4	Sample M.C., %: 22.8
Sample Type: Opt. Moisture + 2%	Sample Height, in.: 8	Sample Dry Den., pcf: 100.4
Test Date: 10/06/10	Desired M.C., %: 22.6	Failed in Shear?:
Remarks:	Dry Den., pcf: 100.7	Triaxial Shear Strength, psi:

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	Chamber Confining Pressure	Nominal Maximu m Axial Stress	Cycle No.	Actual Applied Max. Axial Load	Actual Applied Cyclic Load	Actual Applied Contact Load	Actual Applied Max. Axial Stress	Actual Applied Cyclic Stress	Actual Applied Contact Stress	Recov. Def. LVDT #1 Reading	Recov. Def. LVDT #2 Reading	Average Recov. Def. LVDT 1 and 2	Resilient Strain	Resilient Modulus
DESIGNATION	S3	Scyclic	cl	Pmax	Pcyclic	Pcontact	Smax	Scyclic	Scontact	H1	H2	Havg	Er	Mr
UNIT	psi	psi	---	lbf	lbf	lbf	psi	psi	psi	in	in	in	in/in	psi
PRECISION	---	---	-	---	---	---	---	---	---	---	---	---	---	---
Sequence 1	6.00	2.00	1	24.7	21.9	2.8	2.0	1.8	0.2	0.00110	0.00110	0.00110	0.000140	12,807
			2	25.1	22.3	2.8	2.0	1.8	0.2	0.00110	0.00120	0.00115	0.000140	12,633
			3	23.8	21.0	2.8	1.9	1.7	0.2	0.00100	0.00110	0.00105	0.000130	13,204
			4	25.7	23.1	2.7	2.1	1.8	0.2	0.00110	0.00120	0.00115	0.000140	12,932
			5	23.7	21.1	2.6	1.9	1.7	0.2	0.00110	0.00100	0.00105	0.000130	12,762
	COLUMN AVERAGE			24.6	21.9	2.7	2.0	1.8	0.2	0.00110	0.00110	0.00110	0.000140	12,868
	STANDARD DEV.			0.9	0.9	0.1	0.1	0.1	0.0	0.00000	0.00010	0.00005	0.000010	216

BURGESS ENGINEERING AND TESTING, INC.

MR1-1-B

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 2	6.00	4.00	1	53.8	48.4	5.4	4.3	3.9	0.4	0.00310	0.00300	0.00305	0.00038	10,086
			2	52.9	47.5	5.4	4.2	3.8	0.4	0.00300	0.00300	0.00300	0.00038	10,008
			3	54.6	49.3	5.4	4.4	3.9	0.4	0.00310	0.00310	0.00310	0.00039	10,217
			4	53.6	48.3	5.3	4.3	3.9	0.4	0.00310	0.00310	0.00310	0.00039	10,004
			5	53.1	47.7	5.3	4.2	3.8	0.4	0.00310	0.00300	0.00305	0.00038	10,014
			COLUMN AVERAGE	53.6	48.2	5.4	4.3	3.9	0.4	0.00310	0.00310	0.00310	0.00038	10,066
			STANDARD DEV.	0.7	0.7	0.0	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	91
Sequence 3	6.00	6.00	1	79.1	71.6	7.5	6.3	5.7	0.6	0.00560	0.00580	0.00570	0.00071	8,061
			2	78.8	71.3	7.5	6.3	5.7	0.6	0.00560	0.00580	0.00570	0.00071	8,020
			3	79.2	71.6	7.6	6.3	5.7	0.6	0.00560	0.00570	0.00565	0.00071	8,095
			4	78.4	71.0	7.4	6.3	5.7	0.6	0.00560	0.00570	0.00565	0.00071	7,997
			5	79.0	71.5	7.5	6.3	5.7	0.6	0.00560	0.00570	0.00565	0.00071	8,060
			COLUMN AVERAGE	78.9	71.4	7.5	6.3	5.7	0.6	0.00560	0.00570	0.00565	0.00071	8,046
			STANDARD DEV.	0.3	0.3	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	38
Sequence 4	6.00	8.00	1	108.9	98.4	10.5	8.7	7.9	0.8	0.00810	0.00830	0.00820	0.00102	7,686
			2	109.2	98.7	10.5	8.7	7.9	0.8	0.00810	0.00830	0.00820	0.00103	7,682
			3	108.9	98.4	10.5	8.7	7.9	0.8	0.00820	0.00830	0.00825	0.00103	7,668
			4	107.8	97.2	10.5	8.6	7.8	0.8	0.00810	0.00830	0.00820	0.00103	7,554
			5	109.9	99.4	10.5	8.8	7.9	0.8	0.00820	0.00840	0.00830	0.00104	7,664
			COLUMN AVERAGE	108.9	98.4	10.5	8.7	7.9	0.8	0.00810	0.00830	0.00820	0.00103	7,651
			STANDARD DEV.	0.8	0.8	0.0	0.1	0.1	0.0	0.00010	0.00000	0.00005	0.00001	55
Sequence 5	6.00	10.00	1	137.4	124.5	12.9	11.0	10.0	1.0	0.01120	0.01140	0.01130	0.00142	7,030
			2	138.2	125.3	12.9	11.1	10.0	1.0	0.01120	0.01140	0.01130	0.00141	7,097
			3	138.7	125.8	12.8	11.1	10.1	1.0	0.01120	0.01140	0.01130	0.00142	7,101
			4	138.7	125.8	12.9	11.1	10.1	1.0	0.01130	0.01140	0.01135	0.00142	7,091
			5	138.3	125.4	12.9	11.1	10.0	1.0	0.01120	0.01150	0.01135	0.00142	7,071
			COLUMN AVERAGE	138.3	125.4	12.9	11.1	10.0	1.0	0.01120	0.01140	0.01130	0.00142	7,078
			STANDARD DEV.	0.5	0.6	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	29

BURGESS ENGINEERING AND TESTING, INC.

MR1-1-B

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 6	4.00	2.00	1	24.1	20.9	3.2	1.9	1.7	0.3	0.0005	0.0006	0.0006	0.0001	25,026
			2	24.7	21.6	3.1	2.0	1.7	0.2	0.0005	0.0006	0.0006	0.0001	24,547
			3	23.7	20.8	3.0	1.9	1.7	0.2	0.0006	0.0005	0.0006	0.0001	23,945
			4	24.5	21.3	3.2	2.0	1.7	0.3	0.0006	0.0006	0.0006	0.0001	24,072
			5	23.8	20.6	3.2	1.9	1.6	0.3	0.0005	0.0005	0.0005	0.0001	24,734
	COLUMN AVERAGE			24.1	21.0	3.1	1.9	1.7	0.2	0.0005	0.0006	0.0006	0.0001	24,465
	STANDARD DEV.			0.4	0.4	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	452
Sequence 7	4.00	4.00	1	54.2	49.0	5.2	4.3	3.9	0.4	0.0028	0.0028	0.0028	0.0004	11,313
			2	54.0	49.0	5.0	4.3	3.9	0.4	0.0028	0.0028	0.0028	0.0004	11,316
			3	53.6	48.6	5.1	4.3	3.9	0.4	0.0028	0.0028	0.0028	0.0004	11,053
			4	54.5	49.3	5.2	4.4	3.9	0.4	0.0028	0.0028	0.0028	0.0004	11,230
			5	54.9	49.7	5.2	4.4	4.0	0.4	0.0028	0.0027	0.0028	0.0003	11,558
	COLUMN AVERAGE			54.3	49.1	5.1	4.3	3.9	0.4	0.0028	0.0028	0.0028	0.0004	11,294
	STANDARD DEV.			0.5	0.4	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	182
Sequence 8	4.00	6.00	1	78.7	70.9	7.8	6.3	5.7	0.6	0.0053	0.0054	0.0054	0.0007	8,491
			2	79.4	71.5	7.9	6.4	5.7	0.6	0.0053	0.0054	0.0054	0.0007	8,586
			3	77.7	69.7	8.0	6.2	5.6	0.6	0.0052	0.0053	0.0053	0.0007	8,520
			4	79.9	72.0	7.9	6.4	5.8	0.6	0.0053	0.0054	0.0054	0.0007	8,660
			5	79.8	71.8	7.9	6.4	5.7	0.6	0.0053	0.0054	0.0054	0.0007	8,623
	COLUMN AVERAGE			79.1	71.2	7.9	6.3	5.7	0.6	0.0053	0.0053	0.0053	0.0007	8,576
	STANDARD DEV.			0.9	0.9	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	70
Sequence 9	4.00	8.00	1	108.8	98.4	10.5	8.7	7.9	0.8	0.0081	0.0082	0.0082	0.0010	7,749
			2	108.9	98.5	10.4	8.7	7.9	0.8	0.0081	0.0081	0.0081	0.0010	7,764
			3	109.4	98.9	10.5	8.7	7.9	0.8	0.0081	0.0082	0.0082	0.0010	7,800
			4	109.9	99.5	10.5	8.8	8.0	0.8	0.0081	0.0082	0.0082	0.0010	7,826
			5	109.7	99.2	10.6	8.8	7.9	0.8	0.0081	0.0082	0.0082	0.0010	7,778
	COLUMN AVERAGE			109.4	98.9	10.5	8.7	7.9	0.8	0.0081	0.0082	0.0082	0.0010	7,783
	STANDARD DEV.			0.5	0.5	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	30
Sequence 10	4.00	10.00	1	137.8	124.8	13.0	11.0	10.0	1.0	0.0109	0.0110	0.0110	0.0014	7,277
			2	138.1	125.3	12.9	11.0	10.0	1.0	0.0110	0.0111	0.0111	0.0014	7,272
			3	138.8	125.8	13.0	11.1	10.1	1.0	0.0109	0.0111	0.0110	0.0014	7,329
			4	139.1	126.1	12.9	11.1	10.1	1.0	0.0110	0.0111	0.0111	0.0014	7,327
			5	138.3	125.1	13.2	11.1	10.0	1.1	0.0109	0.0110	0.0110	0.0014	7,296
	COLUMN AVERAGE			138.4	125.4	13.0	11.1	10.0	1.0	0.0109	0.0111	0.0110	0.0014	7,300
	STANDARD DEV.			0.5	0.5	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	27

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF RESILIENT MODULUS TESTING
FOR PEDELOGICAL SOIL SURVEY

Project Location: U.S. Highway 77 Improvement South of Tonkawa

Project No.: SSP-136C(101)SS

Job Piece No: 21854(04)

Surveyed by: Jim Nevels

County: Kay County

Date Surveyed: October 2, 2010

Lab No.: S10632

Burgess Job No.: 731-10119

Soil Series: **Brewer Soil Series Composite B**

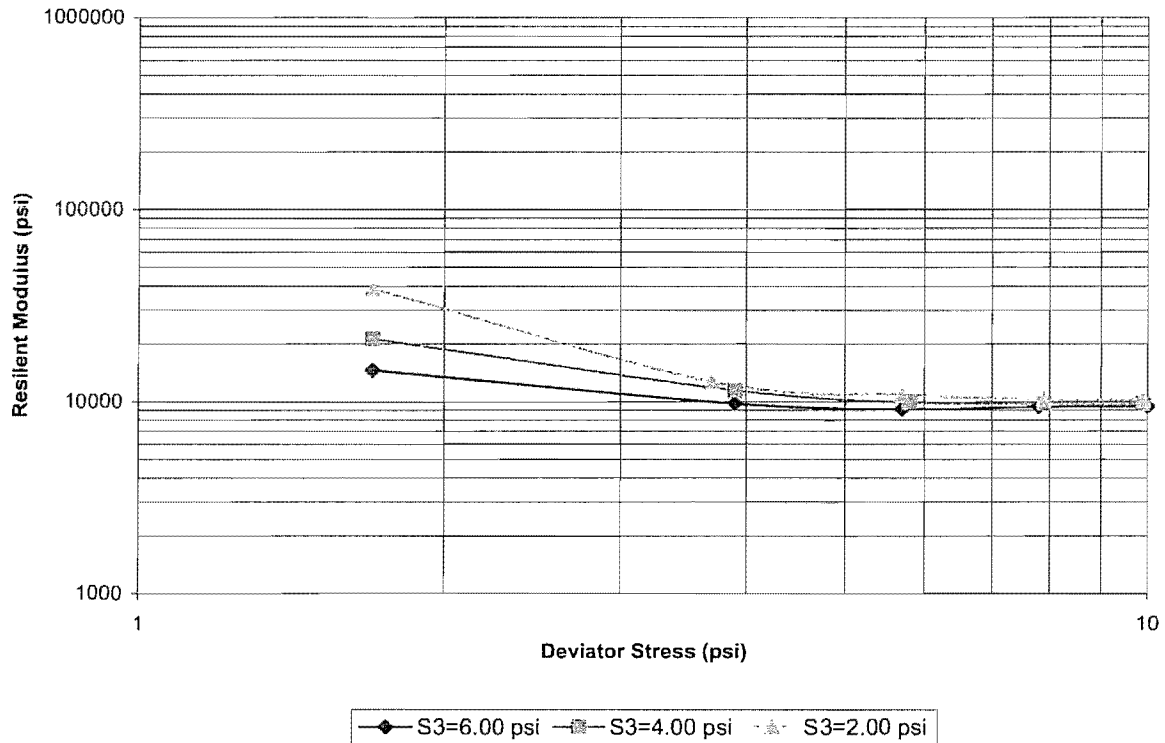
Desired Moisture Content: 22 %

Desired Dry Density: 92.6 pcf

Sample I.D.	Chamber Pressure (psi)	Axial Stress (psi)	Moisture Content (%)	Dry Density (pcf)	Resilient Strain (in/in)	Resilient Modulus (psi)	Standard Deviation for M_R
MR2-1-A	6.0	1.7	22.5	91.7	0.00012	14500.9	446.2
		3.9			0.00040	9742.7	105.5
		5.7			0.00062	9144.9	105.7
		7.8			0.00083	9404.4	73.2
		10.0			0.00106	9423.8	62.1
	4.0	1.7			0.00008	21163.5	255.4
		3.9			0.00034	11413.4	115.9
		5.8			0.00058	9890.0	101.2
		7.9			0.00081	9758.8	72.5
		9.9			0.00102	9755.4	59.7
	2.0	1.7			0.00004	38561.4	945.7
		3.7			0.00029	12689.0	167.2
		5.7			0.00053	10844.7	64.5
		7.9			0.00077	10270.3	50.0
		9.9			0.00097	10194.0	70.6

RESILIENT MODULUS TESTING - AASHTO T307-99

MR2-1-A @ 95% Dry Density & Opt. Moisture



LOCATION		DESCRIPTION	
Project Location: U.S. Highway 77 Improvement		MR2-1-A	
Project No.: SSP-136C(101)SS		RM=a(S _d) ^b	
Soil Series: Brewer Soil Series Composite B		Values for S _d are:	
Sample by: Jim Nevels		S3=6.00psi: 1.7, 3.9, 5.7, 7.8, 10.0 psi	
Sample Date: October 2, 2010		S3=4.00psi: 1.7, 3.9, 5.8, 7.9, 9.9 psi	
Burgess Job No.: 731-10119		S3=2.00psi: 1.7, 3.7, 5.7, 7.9, 9.9 psi	
Sample No. MR2-1-A		Calculated units of values for RM are in psi	
S ₃	6.00 psi	4.00 psi	2.00 psi
R ²	0.7747	0.8728	0.8381
a	15230	24225	46196
b	-0.2463	-0.4498	-0.7478
RESILIENT MODULUS TESTING AASHTO T307-99		BURGESS ENGINEERING AND TESTING, INC.	

BURGESS ENGINEERING AND TESTING, INC.

Resilient Modulus Testing - AASHTO T307-99

Date: 10/08/2010

Client:
Smith Roberts Baldischwiler, LLC.

Attn: Mr. Gary Noland, P.E.
104 S 2nd Street
Chickasha, OK 73018

Project: U.S. Highway 77 Improvement South of
Tonkawa

Project Description: Resilient Modulus Test

AASHTO T307-99

BETI Project No.: 731-10119

Soil Series: Brewer Soil Series Composite B

Sample Information

Sample ID: MR2-1-A
Sample Type: 95% Dry Density & Opt. Moisture
Test Date: 10/06/10
Remarks:

Sample Diameter, in.: 4
Sample Height, in.: 8
Desired M.C., %: 22.0
Dry Den., pcf: 92.6

Sample M.C., %: 22.5
Sample Dry Den., pcf: 91.7
Failed in Shear?:
Triaxial Shear Strength, psi:

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	Chamber Confining Pressure	Nominal Maximu m Axial Stress	Cycle No.	Actual Applied Max. Axial Load	Actual Applied Cyclic Load	Actual Applied Contact Load	Actual Applied Max. Axial Stress	Actual Applied Cyclic Stress	Actual Applied Contact Stress	Recov. Def. LVDT #1 Reading	Recov. Def. LVDT #2 Reading	Average Recov. Def. LVDT 1 and 2	Resilient Strain	Resilient Modulus
DESIGNATION	S3	Scyclic	cl	Pmax	Pcyclic	Pcontact	Smax	Scyclic	Scontact	H1	H2	Havg	Er	Mr
UNIT	psi	psi	---	lbf	lbf	lbf	psi	psi	psi	in	in	in	in/in	psi
PRECISION	---	---	-	---	---	---	---	---	---	---	---	---	---	---
Sequence 1	6.00	2.00	1	23.6	20.8	2.9	1.9	1.7	0.2	0.00090	0.00090	0.00090	0.000110	14,581
			2	23.7	21.1	2.7	1.9	1.7	0.2	0.00090	0.00100	0.00095	0.000120	13,856
			3	23.7	20.8	2.9	1.9	1.7	0.2	0.00090	0.00090	0.00090	0.000120	14,407
			4	23.7	20.9	2.8	1.9	1.7	0.2	0.00090	0.00090	0.00090	0.000110	14,558
			5	23.8	21.0	2.8	1.9	1.7	0.2	0.00090	0.00090	0.00090	0.000110	15,103
COLUMN AVERAGE				23.7	20.9	2.8	1.9	1.7	0.2	0.00090	0.00090	0.00090	0.000120	14,501
STANDARD DEV.				0.1	0.1	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.000000	446

BURGESS ENGINEERING AND TESTING, INC.

MR2-1-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 2	6.00	4.00	1	54.6	49.0	5.6	4.4	3.9	0.4	0.00310	0.00330	0.00320	0.00040	9,793
			2	53.6	47.9	5.7	4.3	3.8	0.5	0.00310	0.00320	0.00315	0.00039	9,737
			3	55.3	49.7	5.6	4.4	4.0	0.4	0.00320	0.00320	0.00320	0.00040	9,820
			4	53.9	48.4	5.6	4.3	3.9	0.4	0.00310	0.00320	0.00315	0.00039	9,801
			5	53.2	47.5	5.8	4.3	3.8	0.5	0.00320	0.00320	0.00320	0.00040	9,562
	COLUMN AVERAGE		54.1	48.5	5.7	4.3	3.9	0.5	0.00320	0.00320	0.00320	0.00040	9,743	
	STANDARD DEV.		0.8	0.9	0.1	0.1	0.1	0.0	0.00010	0.00000	0.00005	0.00000	106	
Sequence 3	6.00	6.00	1	78.7	70.6	8.1	6.3	5.6	0.6	0.00490	0.00510	0.00500	0.00063	9,003
			2	79.8	71.8	7.9	6.4	5.7	0.6	0.00480	0.00510	0.00495	0.00062	9,257
			3	79.6	71.5	8.1	6.4	5.7	0.6	0.00480	0.00510	0.00495	0.00062	9,157
			4	80.2	72.2	8.0	6.4	5.8	0.6	0.00480	0.00520	0.00500	0.00063	9,230
			5	78.7	70.8	8.0	6.3	5.7	0.6	0.00480	0.00520	0.00500	0.00062	9,077
	COLUMN AVERAGE		79.4	71.4	8.0	6.3	5.7	0.6	0.00480	0.00520	0.00500	0.00062	9,145	
	STANDARD DEV.		0.6	0.7	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	106	
Sequence 4	6.00	8.00	1	107.8	97.1	10.7	8.6	7.8	0.9	0.00640	0.00680	0.00660	0.00083	9,390
			2	107.2	96.6	10.7	8.6	7.7	0.9	0.00650	0.00680	0.00665	0.00083	9,291
			3	108.1	97.4	10.7	8.6	7.8	0.9	0.00640	0.00680	0.00660	0.00083	9,415
			4	109.3	98.6	10.7	8.7	7.9	0.9	0.00650	0.00680	0.00665	0.00083	9,489
			5	109.4	98.7	10.8	8.8	7.9	0.9	0.00650	0.00690	0.00670	0.00084	9,439
	COLUMN AVERAGE		108.4	97.7	10.7	8.7	7.8	0.9	0.00650	0.00680	0.00665	0.00083	9,404	
	STANDARD DEV.		1.0	0.9	0.0	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	73	
Sequence 5	6.00	10.00	1	137.3	124.3	13.1	11.0	9.9	1.0	0.00830	0.00870	0.00850	0.00106	9,352
			2	137.2	124.1	13.1	11.0	9.9	1.0	0.00830	0.00870	0.00850	0.00106	9,363
			3	138.6	125.5	13.1	11.1	10.0	1.0	0.00830	0.00860	0.00845	0.00106	9,476
			4	137.8	124.8	13.1	11.0	10.0	1.0	0.00830	0.00860	0.00845	0.00106	9,448
			5	138.6	125.5	13.1	11.1	10.0	1.0	0.00830	0.00860	0.00845	0.00106	9,481
	COLUMN AVERAGE		137.9	124.8	13.1	11.0	10.0	1.0	0.00830	0.00870	0.00850	0.00106	9,424	
	STANDARD DEV.		0.7	0.7	0.0	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	62	

BURGESS ENGINEERING AND TESTING, INC.

MR2-1-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 6	4.00	2.00	1	24.8	21.6	3.2	2.0	1.7	0.3	0.0006	0.0007	0.0007	0.0001	21,462
			2	23.9	20.7	3.2	1.9	1.7	0.3	0.0006	0.0007	0.0007	0.0001	20,996
			3	23.9	20.8	3.1	1.9	1.7	0.3	0.0006	0.0006	0.0006	0.0001	21,406
			4	25.3	22.2	3.1	2.0	1.8	0.3	0.0007	0.0007	0.0007	0.0001	21,065
			5	24.9	21.6	3.2	2.0	1.7	0.3	0.0006	0.0007	0.0007	0.0001	20,889
	COLUMN AVERAGE			24.6	21.4	3.2	2.0	1.7	0.3	0.0006	0.0007	0.0007	0.0001	21,164
	STANDARD DEV.			0.6	0.6	0.0	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	255
Sequence 7	4.00	4.00	1	55.9	50.2	5.7	4.5	4.0	0.5	0.0028	0.0028	0.0028	0.0004	11,592
			2	54.7	49.1	5.6	4.4	3.9	0.5	0.0028	0.0028	0.0028	0.0003	11,373
			3	54.0	48.4	5.6	4.3	3.9	0.4	0.0027	0.0028	0.0028	0.0003	11,299
			4	54.2	48.6	5.6	4.3	3.9	0.4	0.0027	0.0027	0.0027	0.0003	11,460
			5	54.1	48.5	5.6	4.3	3.9	0.5	0.0027	0.0028	0.0028	0.0003	11,344
	COLUMN AVERAGE			54.6	48.9	5.6	4.4	3.9	0.4	0.0027	0.0028	0.0028	0.0003	11,413
	STANDARD DEV.			0.8	0.7	0.0	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	116
Sequence 8	4.00	6.00	1	79.2	71.8	7.4	6.3	5.7	0.6	0.0046	0.0048	0.0047	0.0006	9,819
			2	80.2	72.8	7.4	6.4	5.8	0.6	0.0046	0.0048	0.0047	0.0006	9,930
			3	79.7	72.2	7.5	6.4	5.8	0.6	0.0045	0.0048	0.0047	0.0006	9,935
			4	80.4	72.9	7.5	6.4	5.8	0.6	0.0045	0.0048	0.0047	0.0006	10,010
			5	78.7	71.2	7.5	6.3	5.7	0.6	0.0046	0.0048	0.0047	0.0006	9,756
	COLUMN AVERAGE			79.7	72.2	7.5	6.4	5.8	0.6	0.0046	0.0048	0.0047	0.0006	9,890
	STANDARD DEV.			0.7	0.7	0.0	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	101
Sequence 9	4.00	8.00	1	110.1	100.1	10.0	8.8	8.0	0.8	0.0063	0.0067	0.0065	0.0008	9,857
			2	109.3	99.3	9.9	8.7	7.9	0.8	0.0064	0.0066	0.0065	0.0008	9,755
			3	109.6	99.7	9.9	8.8	8.0	0.8	0.0064	0.0067	0.0066	0.0008	9,762
			4	108.0	98.0	10.0	8.6	7.8	0.8	0.0064	0.0066	0.0065	0.0008	9,653
			5	109.8	99.8	10.0	8.8	8.0	0.8	0.0064	0.0067	0.0066	0.0008	9,767
	COLUMN AVERAGE			109.3	99.4	10.0	8.7	7.9	0.8	0.0064	0.0067	0.0066	0.0008	9,759
	STANDARD DEV.			0.8	0.8	0.0	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	73
Sequence 10	4.00	10.00	1	135.9	123.4	12.4	10.9	9.9	1.0	0.0081	0.0083	0.0082	0.0010	9,688
			2	137.7	125.3	12.4	11.0	10.0	1.0	0.0081	0.0083	0.0082	0.0010	9,819
			3	137.7	125.2	12.4	11.0	10.0	1.0	0.0081	0.0083	0.0082	0.0010	9,816
			4	136.0	123.6	12.4	10.9	9.9	1.0	0.0080	0.0083	0.0082	0.0010	9,715
			5	137.0	124.5	12.6	11.0	10.0	1.0	0.0080	0.0083	0.0082	0.0010	9,738
	COLUMN AVERAGE			136.9	124.4	12.4	10.9	9.9	1.0	0.0080	0.0083	0.0082	0.0010	9,755
	STANDARD DEV.			0.9	0.9	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	60

BURGESS ENGINEERING AND TESTING, INC.

MR2-1-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 11	2.00	2.00	1	24.2	21.5	2.7	1.9	1.7	0.2	0.00030	0.00040	0.00035	0.00004	38,663
			2	24.0	21.0	2.9	1.9	1.7	0.2	0.00030	0.00040	0.00035	0.00004	39,105
			3	23.8	20.8	3.0	1.9	1.7	0.2	0.00040	0.00030	0.00035	0.00004	37,115
			4	25.7	22.9	2.8	2.1	1.8	0.2	0.00040	0.00040	0.00040	0.00005	39,617
			5	23.6	20.7	2.9	1.9	1.7	0.2	0.00030	0.00040	0.00035	0.00004	38,308
	COLUMN AVERAGE			24.2	21.4	2.9	1.9	1.7	0.2	0.00030	0.00040	0.00035	0.00004	38,561
	STANDARD DEV.			0.8	0.9	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	946
Sequence 12	2.00	4.00	1	51.4	46.0	5.4	4.1	3.7	0.4	0.00230	0.00240	0.00235	0.00030	12,466
			2	51.2	46.0	5.3	4.1	3.7	0.4	0.00230	0.00240	0.00235	0.00029	12,583
			3	51.7	46.2	5.5	4.1	3.7	0.4	0.00220	0.00240	0.00230	0.00029	12,712
			4	53.0	47.4	5.5	4.2	3.8	0.4	0.00230	0.00240	0.00235	0.00030	12,798
			5	53.9	48.4	5.5	4.3	3.9	0.4	0.00230	0.00250	0.00240	0.00030	12,885
	COLUMN AVERAGE			52.2	46.8	5.4	4.2	3.7	0.4	0.00230	0.00240	0.00235	0.00029	12,689
	STANDARD DEV.			1.2	1.1	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	167
Sequence 13	2.00	6.00	1	79.3	71.2	8.1	6.3	5.7	0.7	0.00410	0.00430	0.00420	0.00052	10,869
			2	78.2	70.3	7.9	6.3	5.6	0.6	0.00410	0.00430	0.00420	0.00052	10,754
			3	80.2	72.2	8.0	6.4	5.8	0.6	0.00420	0.00430	0.00425	0.00053	10,883
			4	79.6	71.6	8.0	6.4	5.7	0.6	0.00410	0.00430	0.00420	0.00052	10,913
			5	79.3	71.3	7.9	6.3	5.7	0.6	0.00410	0.00430	0.00420	0.00053	10,805
	COLUMN AVERAGE			79.3	71.3	8.0	6.3	5.7	0.6	0.00410	0.00430	0.00420	0.00053	10,845
	STANDARD DEV.			0.7	0.7	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	65
Sequence 14	2.00	8.00	1	108.6	98.1	10.5	8.7	7.8	0.8	0.00600	0.00630	0.00615	0.00077	10,230
			2	109.5	99.1	10.3	8.8	7.9	0.8	0.00610	0.00630	0.00620	0.00078	10,212
			3	110.4	99.9	10.4	8.8	8.0	0.8	0.00610	0.00630	0.00620	0.00077	10,336
			4	109.9	99.4	10.5	8.8	8.0	0.8	0.00610	0.00630	0.00620	0.00077	10,295
			5	108.8	98.3	10.5	8.7	7.9	0.8	0.00600	0.00630	0.00615	0.00077	10,279
	COLUMN AVERAGE			109.4	99.0	10.4	8.8	7.9	0.8	0.00600	0.00630	0.00615	0.00077	10,270
	STANDARD DEV.			0.7	0.8	0.1	0.1	0.1	0.0	0.00010	0.00000	0.00005	0.00000	50
Sequence 15	2.00	10.00	1	137.2	124.7	12.5	11.0	10.0	1.0	0.00770	0.00790	0.00780	0.00097	10,268
			2	137.2	124.7	12.6	11.0	10.0	1.0	0.00770	0.00790	0.00780	0.00097	10,234
			3	137.3	124.9	12.5	11.0	10.0	1.0	0.00770	0.00790	0.00780	0.00098	10,218
			4	135.2	122.7	12.5	10.8	9.8	1.0	0.00760	0.00790	0.00775	0.00097	10,088
			5	136.9	124.3	12.6	10.9	9.9	1.0	0.00770	0.00790	0.00780	0.00098	10,162
	COLUMN AVERAGE			136.8	124.2	12.5	10.9	9.9	1.0	0.00770	0.00790	0.00780	0.00097	10,194
	STANDARD DEV.			0.9	0.9	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	71

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF RESILIENT MODULUS TESTING
FOR PEDELOGICAL SOIL SURVEY

Project Location: U.S. Highway 77 Improvement South of Tonkawa

Project No.: SSP-136C(101)SS

Job Piece No: 21854(04)

Surveyed by: Jim Nevels

County: Kay County

Date Surveyed: October 2, 2010

Lab No.: S10632

Burgess Job No.: 731-10119

Soil Series: **Brewer Soil Composite B**

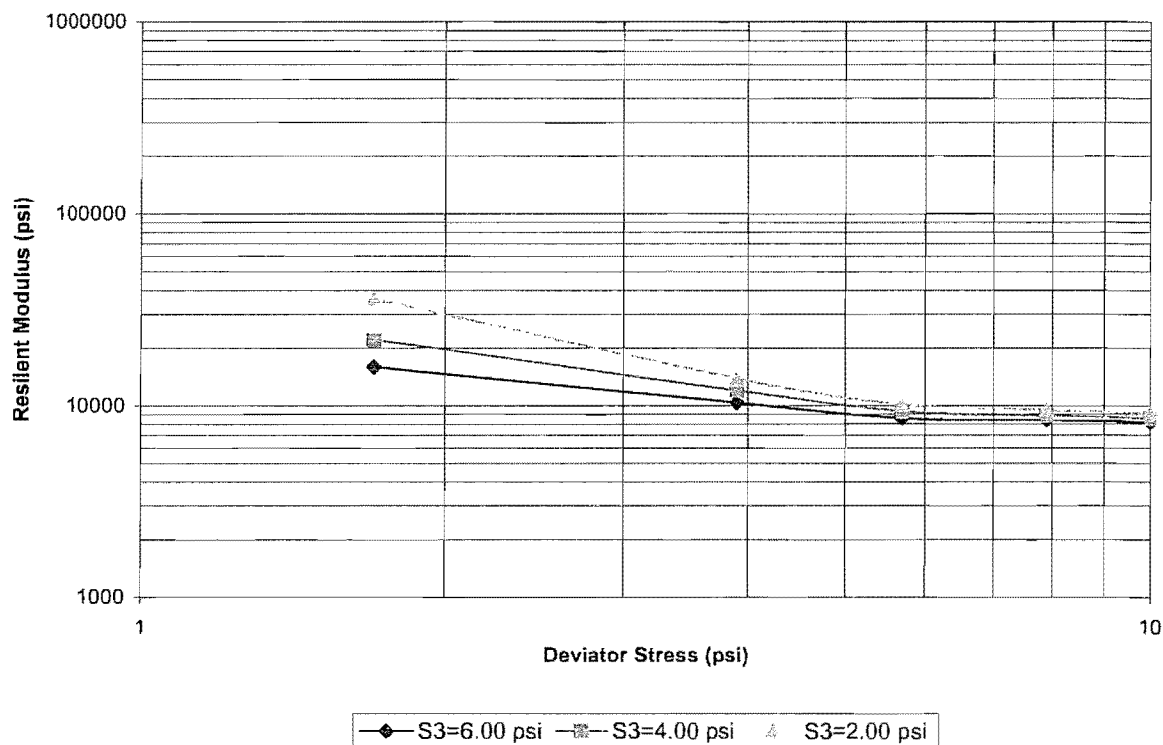
Desired Moisture Content: 24 %

Desired Dry Density: 96 pcf

Sample I.D.	Chamber Pressure (psi)	Axial Stress (psi)	Moisture Content (%)	Dry Density (pcf)	Resilient Strain (in/in)	Resilient Modulus (psi)	Standard Deviation for M_R
MR2-1-B	6.0	1.7	24.5	95.2	0.00011	15900.2	374.0
		3.9			0.00038	10360.2	207.6
		5.7			0.00067	8584.6	74.6
		7.9			0.00094	8383.7	40.0
		10.0			0.00123	8137.9	40.5
	4.0	1.7			0.00008	22042.2	595.3
		3.9			0.00033	11970.6	162.6
		5.7			0.00061	9347.6	42.9
		7.9			0.00089	8846.7	76.9
		10.0			0.00117	8572.1	27.8
	2.0	1.7			0.00005	35874.2	2980.5
		3.9			0.00028	13855.4	228.8
		5.7			0.00056	10158.4	139.7
		7.9			0.00084	9466.5	67.9
		10.0			0.00110	9081.1	20.8

RESILIENT MODULUS TESTING - AASHTO T307-99

MR2-1-B @ Opt. Moisture + 2%



LOCATION		DESCRIPTION	
Project Location: U.S. Highway 77 Improvement		MR2-1-B	
Project No.: SSP-136C(101)SS		$RM=a(S_d)^b$	
Soil Series: Brewer Soil Composite B		Values for S_d are:	
Sample by: Jim Nevels		S3=6.00psi: 1.7, 3.9, 5.7, 7.9, 10.0 psi	
Sample Date: October 2, 2010		S3=4.00psi: 1.7, 3.9, 5.7, 7.9, 10.0 psi	
Burgess Job No.: 731-10119		S3=2.00psi: 1.7, 3.9, 5.7, 7.9, 10.0 psi	
Sample No. MR2-1-B		Calculated units of values for RM are in psi	
S_3	6.00 psi	4.00 psi	2.00 psi
R^2	0.9377	0.9410	0.9248
a	18523	27346	47852
b	-0.3897	-0.5504	-0.7948
RESILIENT MODULUS TESTING AASHTO T307-99		BURGESS ENGINEERING AND TESTING, INC.	

BURGESS ENGINEERING AND TESTING, INC.

Resilient Modulus Testing - AASHTO T307-99

Date: 10/08/2010

Client:
Smith Roberts Baldischwiler, LLC.
 Attn: Mr. Gary Noland, P.E.
 104 S 2nd Street
 Chickasha, OK 73018

Project: U.S. Highway 77 Improvement South of
 Tonkawa

Project Description: Resilient Modulus Test

AASHTO T307-99

BETI Project No.: 731-10119
 Soil Series: Brewer Soil Composite B

Sample Information

Sample ID: MR2-1-B	Sample Diameter, in.: 4	Sample M.C., %: 24.5
Sample Type: Opt. Moisture + 2%	Sample Height, in.: 8	Sample Dry Den., pcf: 95.2
Test Date: 10/06/10	Desired M.C., %: 24.0	Failed in Shear?:
Remarks:	Dry Den., pcf: 96.0	Triaxial Shear Strength, psi:

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
PARAMETER	Chamber Confining Pressure	Nominal Maximu m Axial Stress	Cycle No.	Actual Applied Max. Axial Load	Actual Applied Cyclic Load	Actual Applied Contact Load	Actual Applied Max. Axial Stress	Actual Applied Cyclic Stress	Actual Applied Contact Stress	Recov. Def. LVDT #1 Reading	Recov. Def. LVDT #2 Reading	Average Recov. Def. LVDT 1 and 2	Resilient Strain	Resilient Modulus	
DESIGNATION	S3	Scyclic	cl	Pmax	Pcyclic	Pcontact	Smax	Scyclic	Scontact	H1	H2	Havg	Er	Mr	
UNIT	psi	psi	---	lbf	lbf	lbf	psi	psi	psi	in	in	in	in/in	psi	
PRECISION	---	---	-	---	---	---	---	---	---	---	---	---	---	---	
Sequence 1	6.00	2.00	1	24.8	21.3	3.5	2.0	1.7	0.3	0.00080	0.00090	0.00085	0.000110	16,179	
			2	24.3	21.0	3.3	1.9	1.7	0.3	0.00090	0.00090	0.00090	0.000110	15,295	
			3	24.1	20.7	3.4	1.9	1.7	0.3	0.00080	0.00080	0.00080	0.000100	15,790	
			4	23.9	20.8	3.0	1.9	1.7	0.2	0.00080	0.00090	0.00085	0.000100	16,054	
			5	24.3	21.1	3.2	1.9	1.7	0.3	0.00080	0.00090	0.00085	0.000100	16,183	
	COLUMN AVERAGE				24.3	21.0	3.3	1.9	1.7	0.3	0.00080	0.00090	0.00085	0.000110	15,900
	STANDARD DEV.				0.3	0.2	0.2	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.000000	374

BURGESS ENGINEERING AND TESTING, INC.

MR2-1-B

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 2	6.00	4.00	1	54.1	48.2	5.9	4.3	3.9	0.5	0.00290	0.00300	0.00295	0.00037	10,316
			2	56.5	51.1	5.4	4.5	4.1	0.4	0.00300	0.00310	0.00305	0.00038	10,727
			3	53.8	48.6	5.3	4.3	3.9	0.4	0.00300	0.00310	0.00305	0.00038	10,268
			4	54.3	48.8	5.5	4.3	3.9	0.4	0.00300	0.00310	0.00305	0.00038	10,222
			5	54.9	49.1	5.7	4.4	3.9	0.5	0.00300	0.00310	0.00305	0.00038	10,269
	COLUMN AVERAGE		54.7	49.2	5.6	4.4	3.9	0.4	0.00300	0.00310	0.00305	0.00038	10,380	
	STANDARD DEV.		1.1	1.1	0.2	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	208	
Sequence 3	6.00	6.00	1	79.4	71.3	8.1	6.3	5.7	0.6	0.00520	0.00550	0.00535	0.00067	8,481
			2	79.4	71.4	8.0	6.4	5.7	0.6	0.00510	0.00550	0.00530	0.00067	8,585
			3	79.6	71.5	8.1	6.4	5.7	0.6	0.00520	0.00550	0.00535	0.00067	8,570
			4	79.2	71.1	8.1	6.3	5.7	0.6	0.00510	0.00550	0.00530	0.00066	8,597
			5	80.2	72.3	7.9	6.4	5.8	0.6	0.00510	0.00550	0.00530	0.00067	8,690
	COLUMN AVERAGE		79.6	71.5	8.0	6.4	5.7	0.6	0.00520	0.00550	0.00535	0.00067	8,585	
	STANDARD DEV.		0.4	0.5	0.1	0.0	0.0	0.0	0.00010	0.00000	0.00005	0.00000	75	
Sequence 4	6.00	8.00	1	109.4	98.9	10.6	8.8	7.9	0.8	0.00730	0.00770	0.00750	0.00094	8,420
			2	108.5	98.0	10.5	8.7	7.8	0.8	0.00730	0.00780	0.00755	0.00094	8,321
			3	109.5	99.0	10.5	8.8	7.9	0.8	0.00740	0.00780	0.00760	0.00095	8,376
			4	109.2	98.6	10.6	8.7	7.9	0.8	0.00730	0.00770	0.00750	0.00094	8,417
			5	109.0	98.6	10.4	8.7	7.9	0.8	0.00730	0.00770	0.00750	0.00094	8,384
	COLUMN AVERAGE		109.1	98.6	10.5	8.7	7.9	0.8	0.00730	0.00770	0.00750	0.00094	8,384	
	STANDARD DEV.		0.4	0.4	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	40	
Sequence 5	6.00	10.00	1	138.5	125.7	12.9	11.1	10.0	1.0	0.00960	0.01010	0.00985	0.00123	8,152
			2	138.3	125.5	12.8	11.1	10.0	1.0	0.00960	0.01010	0.00985	0.00123	8,146
			3	138.5	125.8	12.7	11.1	10.1	1.0	0.00960	0.01010	0.00985	0.00123	8,148
			4	137.1	124.2	12.9	11.0	9.9	1.0	0.00960	0.01010	0.00985	0.00123	8,069
			5	138.5	125.5	13.0	11.1	10.0	1.0	0.00960	0.01010	0.00985	0.00123	8,176
	COLUMN AVERAGE		138.2	125.3	12.9	11.1	10.0	1.0	0.00960	0.01010	0.00985	0.00123	8,138	
	STANDARD DEV.		0.6	0.6	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	41	

BURGESS ENGINEERING AND TESTING, INC.

MR2-1-B

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 6	4.00	2.00	1	23.7	20.1	3.5	1.9	1.6	0.3	0.0006	0.0006	0.0006	0.0001	21,617
			2	24.7	21.3	3.5	2.0	1.7	0.3	0.0006	0.0006	0.0006	0.0001	22,157
			3	24.1	20.8	3.4	1.9	1.7	0.3	0.0006	0.0006	0.0006	0.0001	21,544
			4	25.3	21.7	3.6	2.0	1.7	0.3	0.0006	0.0007	0.0007	0.0001	21,878
			5	23.4	20.0	3.4	1.9	1.6	0.3	0.0006	0.0005	0.0006	0.0001	23,016
	COLUMN AVERAGE		24.3	20.8	3.5	1.9	1.7	0.3	0.0006	0.0006	0.0006	0.0001	22,042	
	STANDARD DEV.		0.8	0.7	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	595	
Sequence 7	4.00	4.00	1	55.3	49.5	5.8	4.4	4.0	0.5	0.0026	0.0027	0.0027	0.0003	12,053
			2	55.6	49.8	5.8	4.5	4.0	0.5	0.0026	0.0027	0.0027	0.0003	12,150
			3	55.2	49.4	5.8	4.4	4.0	0.5	0.0026	0.0026	0.0026	0.0003	12,017
			4	55.4	49.7	5.6	4.4	4.0	0.5	0.0027	0.0027	0.0027	0.0003	11,908
			5	53.5	47.5	5.9	4.3	3.8	0.5	0.0026	0.0026	0.0026	0.0003	11,725
	COLUMN AVERAGE		55.0	49.2	5.8	4.4	3.9	0.5	0.0026	0.0027	0.0027	0.0003	11,971	
	STANDARD DEV.		0.9	0.9	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	163	
Sequence 8	4.00	6.00	1	79.1	71.1	8.0	6.3	5.7	0.6	0.0047	0.0051	0.0049	0.0006	9,299
			2	79.5	71.3	8.1	6.4	5.7	0.7	0.0047	0.0050	0.0049	0.0006	9,400
			3	78.6	70.6	8.0	6.3	5.6	0.6	0.0047	0.0050	0.0049	0.0006	9,316
			4	79.1	70.9	8.2	6.3	5.7	0.7	0.0047	0.0050	0.0049	0.0006	9,340
			5	79.8	71.8	8.0	6.4	5.7	0.6	0.0047	0.0051	0.0049	0.0006	9,383
	COLUMN AVERAGE		79.2	71.2	8.1	6.3	5.7	0.6	0.0047	0.0050	0.0049	0.0006	9,348	
	STANDARD DEV.		0.4	0.4	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	43	
Sequence 9	4.00	8.00	1	107.9	97.7	10.1	8.6	7.8	0.8	0.0069	0.0073	0.0071	0.0009	8,795
			2	109.6	99.4	10.2	8.8	7.9	0.8	0.0069	0.0074	0.0072	0.0009	8,881
			3	108.0	97.9	10.1	8.6	7.8	0.8	0.0070	0.0073	0.0072	0.0009	8,738
			4	109.1	99.1	10.1	8.7	7.9	0.8	0.0069	0.0073	0.0071	0.0009	8,905
			5	109.1	99.0	10.1	8.7	7.9	0.8	0.0069	0.0073	0.0071	0.0009	8,915
	COLUMN AVERAGE		108.7	98.6	10.1	8.7	7.9	0.8	0.0069	0.0073	0.0071	0.0009	8,847	
	STANDARD DEV.		0.8	0.8	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	77	
Sequence 10	4.00	10.00	1	137.4	124.9	12.6	11.0	10.0	1.0	0.0092	0.0096	0.0094	0.0012	8,533
			2	138.1	125.7	12.4	11.0	10.1	1.0	0.0092	0.0096	0.0094	0.0012	8,592
			3	137.6	125.2	12.4	11.0	10.0	1.0	0.0091	0.0096	0.0094	0.0012	8,583
			4	138.1	125.7	12.4	11.0	10.1	1.0	0.0091	0.0096	0.0094	0.0012	8,598
			5	138.2	125.9	12.3	11.1	10.1	1.0	0.0091	0.0097	0.0094	0.0012	8,554
	COLUMN AVERAGE		137.9	125.5	12.4	11.0	10.0	1.0	0.0091	0.0096	0.0094	0.0012	8,572	
	STANDARD DEV.		0.3	0.4	0.1	0.0	0.0	0.0	0.0000	0.0001	0.0001	0.0000	28	

BURGESS ENGINEERING AND TESTING, INC.

MR2-1-B

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 11	2.00	2.00	1	25.0	22.2	2.7	2.0	1.8	0.2	0.00040	0.00040	0.00040	0.00005	34,274
			2	24.6	22.0	2.6	2.0	1.8	0.2	0.00040	0.00040	0.00040	0.00005	37,393
			3	23.3	20.6	2.7	1.9	1.6	0.2	0.00030	0.00040	0.00035	0.00004	37,878
			4	24.7	22.0	2.7	2.0	1.8	0.2	0.00050	0.00040	0.00045	0.00006	31,392
			5	23.6	20.8	2.8	1.9	1.7	0.2	0.00030	0.00040	0.00035	0.00004	38,435
	COLUMN AVERAGE			24.2	21.5	2.7	1.9	1.7	0.2	0.00040	0.00040	0.00040	0.00005	35,874
	STANDARD DEV.			0.7	0.8	0.1	0.1	0.1	0.0	0.00010	0.00000	0.00005	0.00001	2,981
Sequence 12	2.00	4.00	1	57.7	51.8	5.9	4.6	4.1	0.5	0.00230	0.00230	0.00230	0.00029	14,185
			2	55.8	50.0	5.8	4.5	4.0	0.5	0.00230	0.00230	0.00230	0.00029	13,752
			3	54.8	49.0	5.8	4.4	3.9	0.5	0.00220	0.00230	0.00225	0.00028	13,926
			4	55.2	49.6	5.6	4.4	4.0	0.4	0.00230	0.00240	0.00235	0.00029	13,564
			5	51.9	46.1	5.8	4.1	3.7	0.5	0.00200	0.00220	0.00210	0.00027	13,851
	COLUMN AVERAGE			55.1	49.3	5.8	4.4	3.9	0.5	0.00220	0.00230	0.00225	0.00028	13,855
	STANDARD DEV.			2.1	2.1	0.1	0.2	0.2	0.0	0.00010	0.00010	0.00010	0.00001	229
Sequence 13	2.00	6.00	1	78.9	70.4	8.5	6.3	5.6	0.7	0.00430	0.00460	0.00445	0.00056	10,113
			2	77.6	69.4	8.2	6.2	5.5	0.7	0.00430	0.00460	0.00445	0.00056	9,947
			3	80.4	72.2	8.3	6.4	5.8	0.7	0.00430	0.00460	0.00445	0.00056	10,320
			4	79.4	71.3	8.1	6.4	5.7	0.7	0.00430	0.00460	0.00445	0.00056	10,227
			5	79.2	71.0	8.3	6.3	5.7	0.7	0.00430	0.00460	0.00445	0.00056	10,184
	COLUMN AVERAGE			79.1	70.8	8.3	6.3	5.7	0.7	0.00430	0.00460	0.00445	0.00056	10,158
	STANDARD DEV.			1.0	1.0	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	140
Sequence 14	2.00	8.00	1	108.5	98.4	10.1	8.7	7.9	0.8	0.00650	0.00690	0.00670	0.00084	9,410
			2	108.9	98.7	10.1	8.7	7.9	0.8	0.00650	0.00690	0.00670	0.00083	9,459
			3	109.3	99.2	10.1	8.7	7.9	0.8	0.00650	0.00690	0.00670	0.00084	9,442
			4	110.8	100.5	10.2	8.9	8.0	0.8	0.00650	0.00690	0.00670	0.00084	9,584
			5	109.9	99.5	10.4	8.8	8.0	0.8	0.00650	0.00700	0.00675	0.00084	9,438
	COLUMN AVERAGE			109.5	99.3	10.2	8.8	7.9	0.8	0.00650	0.00690	0.00670	0.00084	9,467
	STANDARD DEV.			0.9	0.8	0.1	0.1	0.1	0.0	0.00000	0.00010	0.00005	0.00000	68
Sequence 15	2.00	10.00	1	138.2	125.5	12.8	11.1	10.0	1.0	0.00860	0.00900	0.00880	0.00110	9,110
			2	138.0	125.1	12.9	11.0	10.0	1.0	0.00860	0.00900	0.00880	0.00110	9,082
			3	138.1	125.4	12.8	11.0	10.0	1.0	0.00870	0.00900	0.00885	0.00111	9,051
			4	137.7	124.9	12.8	11.0	10.0	1.0	0.00860	0.00900	0.00880	0.00110	9,082
			5	137.8	125.0	12.7	11.0	10.0	1.0	0.00860	0.00900	0.00880	0.00110	9,080
	COLUMN AVERAGE			138.0	125.2	12.8	11.0	10.0	1.0	0.00860	0.00900	0.00880	0.00110	9,081
	STANDARD DEV.			0.2	0.3	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	21

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF RESILIENT MODULUS TESTING
FOR PEDELOGICAL SOIL SURVEY

Project Location: U.S. Highway 77 Improvement South of Tonkawa

Project No.: SSP-136C(101)SS

Job Piece No: 21854(04)

Surveyed by: Jim Nevels

County: Kay County

Date Surveyed: October 3, 2010

Lab No.: S10632

Burgess Job No.: 731-10119

Soil Series: **McLain Soil Series Composite B**

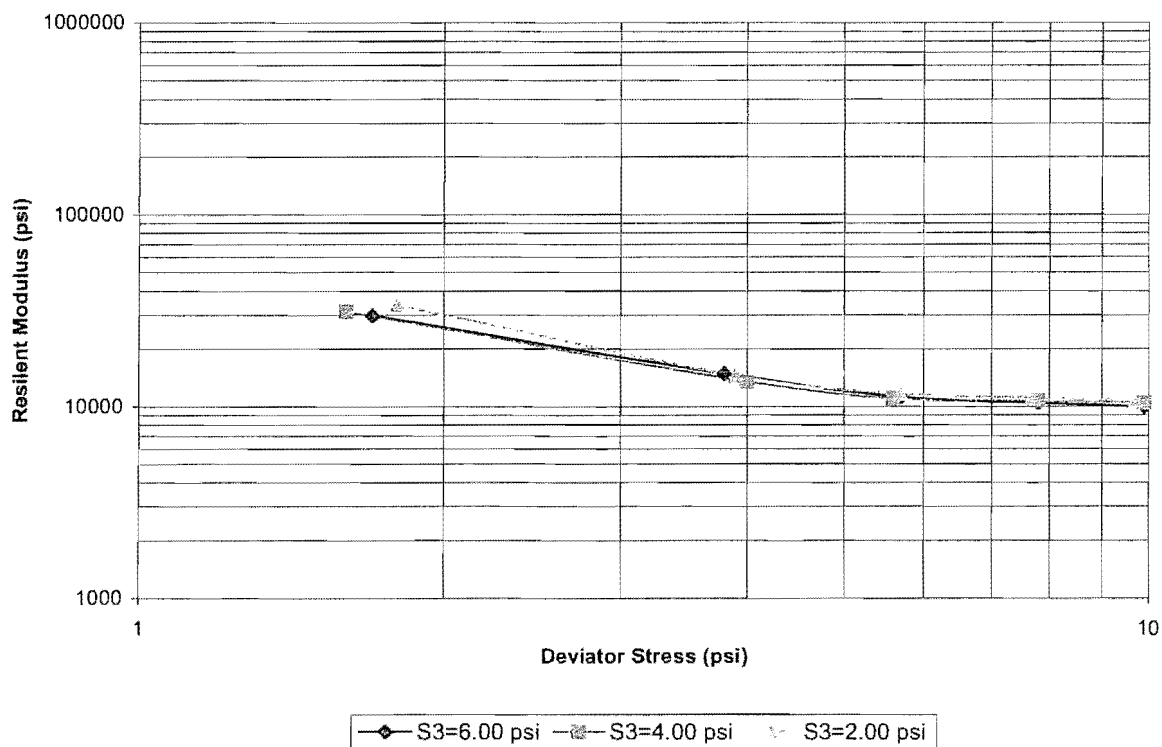
Desired Moisture Content: 20.7 %

Desired Dry Density: 97.2 pcf

Sample I.D.	Chamber Pressure (psi)	Axial Stress (psi)	Moisture Content (%)	Dry Density (pcf)	Resilient Strain (in/in)	Resilient Modulus (psi)	Standard Deviation for M _R
MR3-1-A	6.0	1.7	20.9	96.9	0.00006	29790.5	787.5
		3.8			0.00026	14833.0	344.6
		5.7			0.00051	11208.8	120.0
		7.8			0.00074	10426.7	73.4
		9.9			0.00099	9973.7	43.0
	4.0	1.6			0.00005	31054.1	2078.8
		4.0			0.00030	13491.6	192.4
		5.6			0.00051	11034.6	160.7
		7.8			0.00073	10639.7	87.4
		9.9			0.00094	10461.7	77.9
	2.0	1.8			0.00005	33728.5	698.1
		3.9			0.00027	14453.2	125.0
		5.7			0.00048	11705.7	202.5
		7.7			0.00070	11112.9	78.0
		9.7			0.00090	10762.4	65.0

RESILIENT MODULUS TESTING - AASHTO T307-99

MR3-1-A @ 95% Dry Density & Opt. Moisture



LOCATION		DESCRIPTION	
Project Location: U.S. Highway 77 Improvement		MR3-1-A	
Project No.: SSP-136C(101)SS		RM= $a(S_d)^b$	
Soil Series: McLain Soil Series Composite B		Values for S_d are:	
Sample by: Jim Nevels		S3=6.00psi: 1.7, 3.8, 5.7, 7.8, 9.9 psi	
Sample Date: October 3, 2010		S3=4.00psi: 1.6, 4.0, 5.6, 7.8, 9.9 psi	
Burgess Job No.: 731-10119		S3=2.00psi: 1.8, 3.9, 5.7, 7.7, 9.7 psi	
Sample No. MR3-1-A		Calculated units of values for RM are in psi	
S_3	6.00 psi	4.00 psi	2.00 psi
R^2	0.9456	0.9042	0.9004
a	38254	36925	44123
b	-0.6374	-0.6174	-0.6875
RESILIENT MODULUS TESTING AASHTO T307-99		BURGESS ENGINEERING AND TESTING, INC.	

BURGESS ENGINEERING AND TESTING, INC.

Resilient Modulus Testing - AASHTO T307-99

Date: 10/08/2010

Client:
Smith Roberts Baldischwiler, LLC.
 Attn: Mr. Gary Noland, P.E.
 104 S 2nd Street
 Chickasha, OK 73018

Project: U.S. Highway 77 Improvement South of
 Tonkawa

Project Description: Resilient Modulus Test

AASHTO T307-99

BETI Project No.: 731-10119

Soil Series: McLain Soil Series Composite B

Sample Information

Sample ID: MR3-1-A	Sample Diameter, in.: 4	Sample M.C., %: 20.9
Sample Type: 95% Dry Density & Opt. Moisture	Sample Height, in.: 8	Sample Dry Den., pcf: 96.9
Test Date: 10/07/10	Desired M.C., %: 20.7	Failed in Shear?:
Remarks:	Dry Den., pcf: 97.2	Triaxial Shear Strength, psi:

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	Chamber Confining Pressure	Nominal Maximu m Axial Stress	Cycle No.	Actual Applied Max. Axial Load	Actual Applied Cyclic Load	Actual Applied Contact Load	Actual Applied Max. Axial Stress	Actual Applied Cyclic Stress	Actual Applied Contact Stress	Recov. Def. LVDT #1 Reading	Recov. Def. LVDT #2 Reading	Average Recov. Def. LVDT 1 and 2	Resilient Strain	Resilient Modulus
DESIGNATION	S3	Scyclic	cl	Pmax	Pcyclic	Pcontact	Smax	Scyclic	Scontact	H1	H2	Havg	Er	Mr
UNIT	psi	psi	---	lbf	lbf	lbf	psi	psi	psi	in	in	in	in/in	psi
PRECISION	---	---	-	---	---	---	---	---	---	---	---	---	---	---
Sequence 1	6.00	2.00	1	24.5	22.0	2.5	2.0	1.8	0.2	0.00040	0.00050	0.00045	0.000060	29,158
			2	24.1	21.9	2.2	1.9	1.8	0.2	0.00040	0.00050	0.00045	0.000060	30,732
			3	24.0	21.8	2.3	1.9	1.7	0.2	0.00050	0.00050	0.00050	0.000060	28,911
			4	24.1	21.8	2.3	1.9	1.7	0.2	0.00050	0.00050	0.00050	0.000060	30,435
			5	23.4	21.2	2.2	1.9	1.7	0.2	0.00050	0.00040	0.00045	0.000060	29,716
	COLUMN AVERAGE			24.0	21.7	2.3	1.9	1.7	0.2	0.00050	0.00050	0.00050	0.000060	29,791
	STANDARD DEV.			0.4	0.3	0.2	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.000000	788

BURGESS ENGINEERING AND TESTING, INC.

MR3-1-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 2	6.00	4.00	1	51.7	46.2	5.5	4.1	3.7	0.4	0.00200	0.00210	0.00205	0.00026	14,444
			2	55.1	49.4	5.7	4.4	4.0	0.5	0.00210	0.00210	0.00210	0.00026	15,286
			3	54.3	48.9	5.5	4.3	3.9	0.4	0.00210	0.00210	0.00210	0.00026	14,946
			4	54.0	48.6	5.4	4.3	3.9	0.4	0.00210	0.00210	0.00210	0.00026	14,956
			5	52.5	47.0	5.5	4.2	3.8	0.4	0.00210	0.00210	0.00210	0.00026	14,533
	COLUMN AVERAGE		53.5	48.0	5.5	4.3	3.8	0.4	0.00210	0.00210	0.00210	0.00026	14,833	
	STANDARD DEV.		1.4	1.4	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	345	
Sequence 3	6.00	6.00	1	78.9	71.5	7.4	6.3	5.7	0.6	0.00400	0.00420	0.00410	0.00051	11,223
			2	78.9	71.4	7.5	6.3	5.7	0.6	0.00400	0.00410	0.00405	0.00050	11,345
			3	78.5	71.1	7.5	6.3	5.7	0.6	0.00400	0.00410	0.00405	0.00051	11,186
			4	77.7	70.3	7.3	6.2	5.6	0.6	0.00400	0.00410	0.00405	0.00051	11,022
			5	79.5	72.0	7.5	6.4	5.8	0.6	0.00400	0.00420	0.00410	0.00051	11,269
	COLUMN AVERAGE		78.7	71.3	7.4	6.3	5.7	0.6	0.00400	0.00410	0.00405	0.00051	11,209	
	STANDARD DEV.		0.7	0.6	0.1	0.1	0.0	0.0	0.00000	0.00000	0.00000	0.00000	120	
Sequence 4	6.00	8.00	1	107.3	97.0	10.3	8.6	7.8	0.8	0.00590	0.00610	0.00600	0.00075	10,416
			2	106.1	95.5	10.6	8.5	7.6	0.8	0.00580	0.00600	0.00590	0.00074	10,303
			3	108.1	97.6	10.5	8.6	7.8	0.8	0.00580	0.00610	0.00595	0.00074	10,476
			4	107.9	97.7	10.1	8.6	7.8	0.8	0.00590	0.00610	0.00600	0.00075	10,464
			5	108.2	97.5	10.7	8.7	7.8	0.9	0.00590	0.00610	0.00600	0.00074	10,475
	COLUMN AVERAGE		107.5	97.1	10.5	8.6	7.8	0.8	0.00590	0.00610	0.00600	0.00074	10,427	
	STANDARD DEV.		0.9	0.9	0.2	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	73	
Sequence 5	6.00	10.00	1	135.5	123.3	12.1	10.8	9.9	1.0	0.00780	0.00800	0.00790	0.00099	9,952
			2	134.7	122.3	12.4	10.8	9.8	1.0	0.00780	0.00800	0.00790	0.00098	9,937
			3	136.1	123.8	12.3	10.9	9.9	1.0	0.00790	0.00800	0.00795	0.00100	9,940
			4	136.5	124.2	12.2	10.9	9.9	1.0	0.00780	0.00800	0.00790	0.00099	10,025
			5	136.0	123.7	12.3	10.9	9.9	1.0	0.00780	0.00800	0.00790	0.00099	10,015
	COLUMN AVERAGE		135.8	123.5	12.3	10.9	9.9	1.0	0.00780	0.00800	0.00790	0.00099	9,974	
	STANDARD DEV.		0.7	0.7	0.1	0.1	0.1	0.0	0.00010	0.00000	0.00005	0.00000	43	

BURGESS ENGINEERING AND TESTING, INC.

MR3-1-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 6	4.00	2.00	1	24.4	20.7	3.7	2.0	1.7	0.3	0.0004	0.0004	0.0004	0.0001	30,858
			2	23.3	19.9	3.4	1.9	1.6	0.3	0.0004	0.0004	0.0004	0.0001	34,488
			3	23.7	20.4	3.3	1.9	1.6	0.3	0.0004	0.0004	0.0004	0.0001	30,996
			4	23.7	20.3	3.4	1.9	1.6	0.3	0.0004	0.0005	0.0005	0.0001	29,016
			5	24.4	21.0	3.4	1.9	1.7	0.3	0.0004	0.0005	0.0005	0.0001	29,914
	COLUMN AVERAGE		23.9	20.5	3.4	1.9	1.6	0.3	0.0004	0.0004	0.0004	0.0001	31,054	
	STANDARD DEV.		0.5	0.4	0.2	0.0	0.0	0.0	0.0000	0.0001	0.0001	0.0000	2,079	
Sequence 7	4.00	4.00	1	54.9	49.7	5.2	4.4	4.0	0.4	0.0024	0.0024	0.0024	0.0003	13,289
			2	54.9	49.8	5.1	4.4	4.0	0.4	0.0023	0.0024	0.0024	0.0003	13,597
			3	55.5	50.3	5.1	4.4	4.0	0.4	0.0024	0.0024	0.0024	0.0003	13,660
			4	55.5	50.4	5.0	4.4	4.0	0.4	0.0024	0.0024	0.0024	0.0003	13,636
			5	54.1	48.9	5.2	4.3	3.9	0.4	0.0024	0.0023	0.0024	0.0003	13,276
	COLUMN AVERAGE		55.0	49.8	5.1	4.4	4.0	0.4	0.0024	0.0024	0.0024	0.0003	13,492	
	STANDARD DEV.		0.5	0.6	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	192	
Sequence 8	4.00	6.00	1	76.6	68.8	7.8	6.1	5.5	0.6	0.0040	0.0041	0.0041	0.0005	10,886
			2	78.0	70.3	7.6	6.2	5.6	0.6	0.0041	0.0042	0.0042	0.0005	10,960
			3	79.3	71.6	7.7	6.3	5.7	0.6	0.0040	0.0042	0.0041	0.0005	11,130
			4	80.3	72.4	7.9	6.4	5.8	0.6	0.0041	0.0042	0.0042	0.0005	11,270
			5	77.8	70.2	7.6	6.2	5.6	0.6	0.0040	0.0042	0.0041	0.0005	10,927
	COLUMN AVERAGE		78.4	70.6	7.7	6.3	5.6	0.6	0.0040	0.0042	0.0041	0.0005	11,035	
	STANDARD DEV.		1.4	1.4	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	161	
Sequence 9	4.00	8.00	1	107.8	97.4	10.4	8.6	7.8	0.8	0.0058	0.0060	0.0059	0.0007	10,622
			2	107.1	97.0	10.1	8.6	7.8	0.8	0.0058	0.0059	0.0059	0.0007	10,578
			3	107.1	96.6	10.6	8.6	7.7	0.8	0.0058	0.0059	0.0059	0.0007	10,582
			4	108.2	97.8	10.5	8.7	7.8	0.8	0.0058	0.0059	0.0059	0.0007	10,625
			5	108.9	98.2	10.7	8.7	7.9	0.9	0.0058	0.0059	0.0059	0.0007	10,791
	COLUMN AVERAGE		107.8	97.4	10.4	8.6	7.8	0.8	0.0058	0.0059	0.0059	0.0007	10,640	
	STANDARD DEV.		0.7	0.6	0.2	0.1	0.0	0.0	0.0000	0.0000	0.0000	0.0000	87	
Sequence 10	4.00	10.00	1	136.8	123.7	13.1	10.9	9.9	1.0	0.0074	0.0077	0.0076	0.0010	10,465
			2	137.9	124.8	13.1	11.0	10.0	1.0	0.0075	0.0077	0.0076	0.0010	10,545
			3	135.2	121.9	13.3	10.8	9.7	1.1	0.0074	0.0076	0.0075	0.0009	10,391
			4	135.6	122.6	13.0	10.8	9.8	1.0	0.0075	0.0077	0.0076	0.0010	10,376
			5	137.4	124.5	12.9	11.0	10.0	1.0	0.0075	0.0077	0.0076	0.0010	10,533
	COLUMN AVERAGE		136.6	123.5	13.1	10.9	9.9	1.0	0.0075	0.0077	0.0076	0.0009	10,462	
	STANDARD DEV.		1.2	1.2	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	78	

BURGESS ENGINEERING AND TESTING, INC.

MR3-1-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 11	2.00	2.00	1	26.0	23.3	2.6	2.1	1.9	0.2	0.00040	0.00040	0.00040	0.00006	33,928
			2	24.1	21.6	2.5	1.9	1.7	0.2	0.00040	0.00040	0.00040	0.00005	33,050
			3	24.0	21.5	2.5	1.9	1.7	0.2	0.00040	0.00040	0.00040	0.00005	33,560
			4	24.2	21.7	2.5	1.9	1.7	0.2	0.00040	0.00040	0.00040	0.00005	34,830
			5	23.9	21.4	2.6	1.9	1.7	0.2	0.00040	0.00040	0.00040	0.00005	33,274
	COLUMN AVERAGE			24.4	21.9	2.5	2.0	1.8	0.2	0.00040	0.00040	0.00040	0.00005	33,729
	STANDARD DEV.			0.9	0.8	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	698
Sequence 12	2.00	4.00	1	55.1	49.4	5.7	4.4	4.0	0.5	0.00220	0.00220	0.00220	0.00027	14,550
			2	55.2	49.4	5.8	4.4	4.0	0.5	0.00220	0.00210	0.00215	0.00027	14,518
			3	54.6	49.1	5.5	4.4	3.9	0.4	0.00220	0.00220	0.00220	0.00027	14,561
			4	52.7	47.3	5.4	4.2	3.8	0.4	0.00210	0.00210	0.00210	0.00026	14,338
			5	53.6	47.9	5.7	4.3	3.8	0.5	0.00220	0.00210	0.00215	0.00027	14,299
	COLUMN AVERAGE			54.2	48.6	5.6	4.3	3.9	0.4	0.00220	0.00210	0.00215	0.00027	14,453
	STANDARD DEV.			1.1	1.0	0.2	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	125
Sequence 13	2.00	6.00	1	76.8	69.3	7.5	6.1	5.5	0.6	0.00380	0.00390	0.00385	0.00048	11,492
			2	79.6	71.7	7.8	6.4	5.7	0.6	0.00390	0.00390	0.00390	0.00049	11,650
			3	80.1	72.2	7.9	6.4	5.8	0.6	0.00380	0.00390	0.00385	0.00048	11,929
			4	77.0	69.5	7.5	6.2	5.6	0.6	0.00380	0.00390	0.00385	0.00048	11,550
			5	79.8	72.1	7.7	6.4	5.8	0.6	0.00380	0.00390	0.00385	0.00048	11,909
	COLUMN AVERAGE			78.7	71.0	7.7	6.3	5.7	0.6	0.00380	0.00390	0.00385	0.00048	11,706
	STANDARD DEV.			1.6	1.5	0.2	0.1	0.1	0.0	0.00010	0.00000	0.00005	0.00000	203
Sequence 14	2.00	8.00	1	106.3	95.8	10.5	8.5	7.7	0.8	0.00550	0.00560	0.00555	0.00070	11,009
			2	107.5	96.9	10.5	8.6	7.8	0.8	0.00550	0.00570	0.00560	0.00069	11,164
			3	107.8	97.4	10.4	8.6	7.8	0.8	0.00550	0.00570	0.00560	0.00070	11,135
			4	107.7	97.0	10.7	8.6	7.8	0.9	0.00550	0.00570	0.00560	0.00070	11,058
			5	108.1	97.4	10.7	8.6	7.8	0.9	0.00550	0.00570	0.00560	0.00070	11,198
	COLUMN AVERAGE			107.5	96.9	10.6	8.6	7.7	0.8	0.00550	0.00570	0.00560	0.00070	11,113
	STANDARD DEV.			0.7	0.6	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	78
Sequence 15	2.00	10.00	1	136.2	122.9	13.3	10.9	9.8	1.1	0.00710	0.00740	0.00725	0.00091	10,840
			2	134.9	121.7	13.2	10.8	9.7	1.1	0.00720	0.00730	0.00725	0.00090	10,785
			3	134.4	121.3	13.1	10.7	9.7	1.1	0.00710	0.00740	0.00725	0.00091	10,698
			4	133.5	120.6	12.9	10.7	9.6	1.0	0.00710	0.00730	0.00720	0.00090	10,692
			5	134.8	121.6	13.3	10.8	9.7	1.1	0.00710	0.00730	0.00720	0.00090	10,797
	COLUMN AVERAGE			134.8	121.6	13.1	10.8	9.7	1.1	0.00710	0.00730	0.00720	0.00090	10,762
	STANDARD DEV.			1.0	0.8	0.2	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	65

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF RESILIENT MODULUS TESTING
FOR PEDEOLOGICAL SOIL SURVEY

Project Location: U.S. Highway 77 Improvement South of Tonkawa

Project No.: SSP-136C(101)SS

Job Piece No: 21854(04)

Surveyed by: Jim Nevels

County: Kay County

Date Surveyed: October 3, 2010

Lab No.: S10632

Burgess Job No.: 731-10119

Soil Series: **McLain Soil Series Composite B**

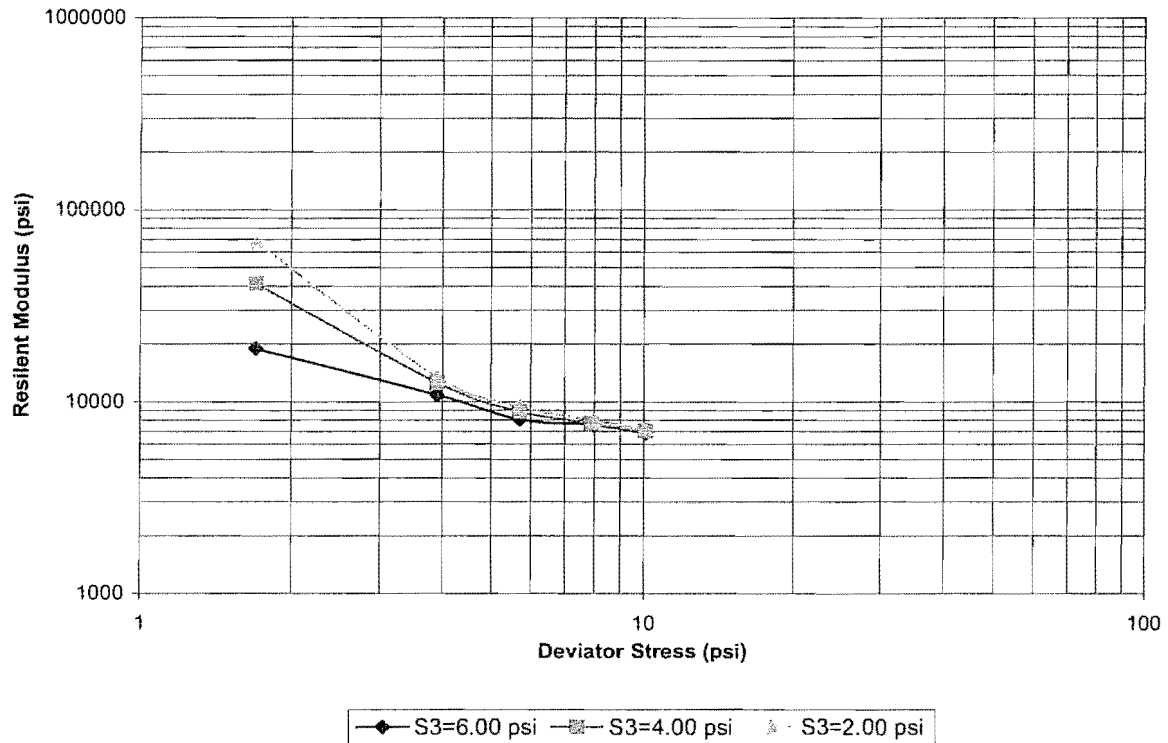
Desired Moisture Content: 22.7 %

Desired Dry Density: 100.9 pcf

Sample I.D.	Chamber Pressure (psi)	Axial Stress (psi)	Moisture Content (%)	Dry Density (pcf)	Resilient Strain (in/in)	Resilient Modulus (psi)	Standard Deviation for M_R
MR3-1-B	6.0	1.7	22.4	100.9	0.00009	18873.1	1424.0
		3.9			0.00036	10863.5	126.9
		5.7			0.00071	8046.4	69.0
		8.0			0.00105	7546.9	23.8
		10.1			0.00147	6865.9	15.9
	4.0	1.7			0.00004	41061.4	3998.3
		3.9			0.00031	12545.9	270.9
		5.7			0.00064	8874.3	129.7
		7.9			0.00102	7709.3	29.0
		10.1			0.00143	7040.3	31.5
	2.0	1.7			0.00003	67723.5	5288.0
		3.9			0.00029	13326.6	514.6
		5.7			0.00060	9446.9	125.3
		8.0			0.00100	7979.7	35.6
		10.1			0.00139	7249.4	24.7

RESILIENT MODULUS TESTING - AASHTO T307-99

MR3-1-B @ Opt. Moisture + 2%



LOCATION		DESCRIPTION	
Project Location: U.S. Highway 77 Improvement		MR3-1-B	
Project No.: SSP-136C(101)SS		RM=a(S _d) ^b	
Soil Series: McLain Soil Series Composite B		Values for S _d are:	
Sample by: Jim Nevels		S3=6.00psi: 1.7, 3.9, 5.7, 8.0, 10.1 psi	
Sample Date: October 3, 2010		S3=4.00psi: 1.7, 3.9, 5.7, 7.9, 10.1 psi	
Burgess Job No.: 731-10119		S3=2.00psi: 1.7, 3.9, 5.7, 8.0, 10.1 psi	
Sample No. MR3-1-B		Calculated units of values for RM are in psi	
S ₃	6.00 psi	4.00 psi	2.00 psi
R ²	0.9716	0.9413	0.9172
a	24503	59982	103967
b	-0.5780	-1.0046	-1.2602
RESILIENT MODULUS TESTING AASHTO T307-99		BURGESS ENGINEERING AND TESTING, INC.	

BURGESS ENGINEERING AND TESTING, INC.

Resilient Modulus Testing - AASHTO T307-99

Date: 10/08/2010

Client:
Smith Roberts Baldischwiler, LLC.
 Attn: Mr. Gary Noland, P.E.
 104 S 2nd Street
 Chickasha, OK 73018

Project: U.S. Highway 77 Improvement South of
 Tonkawa

Project Description: Resilient Modulus Test

AASHTO T307-99

BETI Project No.: 731-10119
 Soil Series: McLain Soil Series Composite B

Sample Information

Sample ID: MR3-1-B	Sample Diameter, in.: 4	Sample M.C., %: 22.4
Sample Type: Opt. Moisture + 2%	Sample Height, in.: 8	Sample Dry Den., pcf: 100.9
Test Date: 10/07/10	Desired M.C., %: 22.7	Failed in Shear?:
Remarks:	Dry Den., pcf: 100.9	Triaxial Shear Strength, psi:

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	Chamber Confining Pressure	Nominal Maximu m Axial Stress	Cycle No.	Actual Applied Max. Axial Load	Actual Applied Cyclic Load	Actual Applied Contact Load	Actual Applied Max. Axial Stress	Actual Applied Cyclic Stress	Actual Applied Contact Stress	Recov. Def. LVDT #1 Reading	Recov. Def. LVDT #2 Reading	Average Recov. Def. LVDT 1 and 2	Resilient Strain	Resilient Modulus
DESIGNATION	S3	Scyclic	cl	Pmax	Pcyclic	Pcontact	Smax	Scyclic	Scontact	H1	H2	Havg	Er	Mr
UNIT	psi	psi	---	lbf	lbf	lbf	psi	psi	psi	in	in	in	in/in	psi
PRECISION	---	---	-	---	---	---	---	---	---	---	---	---	---	---
Sequence 1	6.00	2.00	1	24.5	21.6	2.9	2.0	1.7	0.2	0.00080	0.00080	0.00080	0.000100	17,166
			2	25.5	22.8	2.7	2.0	1.8	0.2	0.00080	0.00080	0.00080	0.000100	18,950
			3	24.2	21.5	2.7	1.9	1.7	0.2	0.00080	0.00070	0.00075	0.000090	18,216
			4	23.9	21.1	2.8	1.9	1.7	0.2	0.00060	0.00070	0.00065	0.000080	21,052
			5	24.5	21.5	3.0	2.0	1.7	0.2	0.00070	0.00070	0.00070	0.000090	18,983
	COLUMN AVERAGE			24.5	21.7	2.8	2.0	1.7	0.2	0.00070	0.00070	0.00070	0.000090	18,873
	STANDARD DEV.			0.6	0.6	0.1	0.0	0.1	0.0	0.00010	0.00010	0.00010	0.000010	1,424

BURGESS ENGINEERING AND TESTING, INC.

MR3-1-B

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 2	6.00	4.00	1	55.3	49.8	5.5	4.4	4.0	0.4	0.00290	0.00290	0.00290	0.00036	11,084
			2	53.3	47.8	5.5	4.3	3.8	0.4	0.00280	0.00280	0.00280	0.00035	10,764
			3	53.4	47.9	5.5	4.3	3.8	0.4	0.00280	0.00290	0.00285	0.00035	10,806
			4	54.4	48.8	5.6	4.4	3.9	0.4	0.00290	0.00290	0.00290	0.00036	10,814
			5	53.6	47.9	5.6	4.3	3.8	0.5	0.00280	0.00280	0.00280	0.00035	10,849
	COLUMN AVERAGE		54.0	48.5	5.5	4.3	3.9	0.4	0.00280	0.00290	0.00285	0.00036	10,864	
	STANDARD DEV.		0.8	0.9	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	127	
Sequence 3	6.00	6.00	1	79.0	71.4	7.7	6.3	5.7	0.6	0.00550	0.00580	0.00565	0.00071	8,035
			2	79.8	72.1	7.7	6.4	5.8	0.6	0.00560	0.00580	0.00570	0.00071	8,092
			3	79.8	72.2	7.6	6.4	5.8	0.6	0.00560	0.00580	0.00570	0.00071	8,114
			4	78.0	70.4	7.7	6.2	5.6	0.6	0.00560	0.00580	0.00570	0.00071	7,936
			5	79.0	71.3	7.7	6.3	5.7	0.6	0.00550	0.00580	0.00565	0.00071	8,055
	COLUMN AVERAGE		79.1	71.5	7.7	6.3	5.7	0.6	0.00560	0.00580	0.00570	0.00071	8,046	
	STANDARD DEV.		0.7	0.7	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	69	
Sequence 4	6.00	8.00	1	109.1	98.8	10.2	8.7	7.9	0.8	0.00840	0.00850	0.00845	0.00105	7,513
			2	109.9	99.6	10.3	8.8	8.0	0.8	0.00840	0.00850	0.00845	0.00106	7,546
			3	110.2	99.9	10.3	8.8	8.0	0.8	0.00840	0.00850	0.00845	0.00105	7,579
			4	109.4	99.1	10.3	8.8	7.9	0.8	0.00830	0.00850	0.00840	0.00105	7,541
			5	109.9	99.6	10.3	8.8	8.0	0.8	0.00830	0.00850	0.00840	0.00105	7,556
	COLUMN AVERAGE		109.7	99.4	10.3	8.8	8.0	0.8	0.00840	0.00850	0.00845	0.00105	7,547	
	STANDARD DEV.		0.5	0.4	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	24	
Sequence 5	6.00	10.00	1	138.6	125.8	12.8	11.1	10.1	1.0	0.01160	0.01180	0.01170	0.00146	6,874
			2	138.1	125.5	12.6	11.0	10.0	1.0	0.01160	0.01180	0.01170	0.00147	6,847
			3	138.6	126.0	12.6	11.1	10.1	1.0	0.01160	0.01180	0.01170	0.00147	6,877
			4	138.3	125.7	12.6	11.1	10.1	1.0	0.01160	0.01190	0.01175	0.00147	6,851
			5	138.7	126.2	12.5	11.1	10.1	1.0	0.01160	0.01180	0.01170	0.00147	6,881
	COLUMN AVERAGE		138.5	125.8	12.6	11.1	10.1	1.0	0.01160	0.01180	0.01170	0.00147	6,866	
	STANDARD DEV.		0.3	0.3	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	16	

BURGESS ENGINEERING AND TESTING, INC.

MR3-1-B

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 6	4.00	2.00	1	24.2	21.3	2.9	1.9	1.7	0.2	0.0004	0.0004	0.0004	0.0001	35,460
			2	24.9	21.9	3.1	2.0	1.7	0.2	0.0003	0.0004	0.0004	0.0001	38,625
			3	23.4	20.5	3.0	1.9	1.6	0.2	0.0003	0.0003	0.0003	0.0000	45,367
			4	23.9	21.0	2.9	1.9	1.7	0.2	0.0003	0.0003	0.0003	0.0000	43,680
			5	24.4	21.5	2.9	2.0	1.7	0.2	0.0003	0.0003	0.0003	0.0000	42,176
			COLUMN AVERAGE	24.2	21.3	2.9	1.9	1.7	0.2	0.0003	0.0003	0.0003	0.0000	41,061
			STANDARD DEV.	0.6	0.5	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	3,998
Sequence 7	4.00	4.00	1	56.1	50.2	5.9	4.5	4.0	0.5	0.0025	0.0025	0.0025	0.0003	12,805
			2	54.7	48.8	5.8	4.4	3.9	0.5	0.0026	0.0024	0.0025	0.0003	12,464
			3	52.2	46.3	6.0	4.2	3.7	0.5	0.0024	0.0024	0.0024	0.0003	12,181
			4	55.9	50.0	5.9	4.5	4.0	0.5	0.0025	0.0025	0.0025	0.0003	12,826
			5	54.5	48.5	6.0	4.4	3.9	0.5	0.0025	0.0024	0.0025	0.0003	12,455
			COLUMN AVERAGE	54.7	48.8	5.9	4.4	3.9	0.5	0.0025	0.0025	0.0025	0.0003	12,546
			STANDARD DEV.	1.6	1.6	0.1	0.1	0.1	0.0	0.0001	0.0000	0.0001	0.0000	271
Sequence 8	4.00	6.00	1	79.9	71.8	8.1	6.4	5.7	0.7	0.0051	0.0052	0.0052	0.0007	8,866
			2	78.1	70.1	7.9	6.2	5.6	0.6	0.0051	0.0052	0.0052	0.0007	8,678
			3	80.3	72.2	8.1	6.4	5.8	0.6	0.0051	0.0052	0.0052	0.0006	8,950
			4	79.4	71.3	8.1	6.3	5.7	0.6	0.0051	0.0052	0.0052	0.0006	8,853
			5	80.4	72.3	8.1	6.4	5.8	0.7	0.0051	0.0052	0.0052	0.0006	9,025
			COLUMN AVERAGE	79.6	71.5	8.1	6.4	5.7	0.6	0.0051	0.0052	0.0052	0.0006	8,874
			STANDARD DEV.	1.0	0.9	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	130
Sequence 9	4.00	8.00	1	109.8	99.3	10.5	8.8	7.9	0.8	0.0081	0.0083	0.0082	0.0010	7,744
			2	110.0	99.5	10.5	8.8	8.0	0.8	0.0082	0.0082	0.0082	0.0010	7,736
			3	109.7	99.1	10.6	8.8	7.9	0.9	0.0082	0.0083	0.0083	0.0010	7,694
			4	108.6	98.1	10.6	8.7	7.8	0.8	0.0081	0.0082	0.0082	0.0010	7,696
			5	108.3	97.7	10.5	8.7	7.8	0.8	0.0081	0.0082	0.0082	0.0010	7,677
			COLUMN AVERAGE	109.3	98.7	10.6	8.7	7.9	0.8	0.0082	0.0082	0.0082	0.0010	7,709
			STANDARD DEV.	0.8	0.8	0.0	0.1	0.1	0.0	0.0001	0.0000	0.0001	0.0000	29
Sequence 10	4.00	10.00	1	138.8	126.0	12.8	11.1	10.1	1.0	0.0114	0.0115	0.0115	0.0014	7,044
			2	138.3	125.7	12.6	11.1	10.1	1.0	0.0113	0.0115	0.0114	0.0014	7,026
			3	139.2	126.5	12.7	11.1	10.1	1.0	0.0114	0.0115	0.0115	0.0014	7,073
			4	138.0	125.4	12.6	11.0	10.0	1.0	0.0114	0.0115	0.0115	0.0014	6,994
			5	138.9	126.2	12.7	11.1	10.1	1.0	0.0113	0.0115	0.0114	0.0014	7,064
			COLUMN AVERAGE	138.6	126.0	12.7	11.1	10.1	1.0	0.0114	0.0115	0.0115	0.0014	7,040
			STANDARD DEV.	0.5	0.4	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	32

BURGESS ENGINEERING AND TESTING, INC.

MR3-1-B

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 11	2.00	2.00	1	24.8	21.7	3.1	2.0	1.7	0.3	0.00020	0.00020	0.00020	0.00003	60,834
			2	24.1	21.0	3.2	1.9	1.7	0.3	0.00020	0.00020	0.00020	0.00002	71,595
			3	24.4	21.2	3.2	2.0	1.7	0.3	0.00020	0.00020	0.00020	0.00003	63,263
			4	24.9	21.7	3.2	2.0	1.7	0.3	0.00020	0.00020	0.00020	0.00002	72,343
			5	24.6	21.4	3.2	2.0	1.7	0.3	0.00020	0.00020	0.00020	0.00002	70,582
	COLUMN AVERAGE		24.6	21.4	3.2	2.0	1.7	0.3	0.00020	0.00020	0.00020	0.00003	67,724	
	STANDARD DEV.		0.3	0.3	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	5,288	
Sequence 12	2.00	4.00	1	52.2	46.6	5.6	4.2	3.7	0.4	0.00220	0.00230	0.00225	0.00028	13,224
			2	51.3	45.6	5.7	4.1	3.6	0.5	0.00230	0.00240	0.00235	0.00029	12,567
			3	54.1	48.2	5.8	4.3	3.9	0.5	0.00230	0.00230	0.00230	0.00029	13,328
			4	58.1	52.3	5.8	4.6	4.2	0.5	0.00240	0.00240	0.00240	0.00030	13,981
			5	54.2	48.6	5.6	4.3	3.9	0.4	0.00230	0.00230	0.00230	0.00029	13,533
	COLUMN AVERAGE		53.9	48.2	5.7	4.3	3.9	0.5	0.00230	0.00230	0.00230	0.00029	13,327	
	STANDARD DEV.		2.6	2.6	0.1	0.2	0.2	0.0	0.00010	0.00000	0.00005	0.00001	515	
Sequence 13	2.00	6.00	1	80.1	72.3	7.8	6.4	5.8	0.6	0.00490	0.00490	0.00490	0.00061	9,494
			2	77.8	69.9	7.9	6.2	5.6	0.6	0.00480	0.00490	0.00485	0.00061	9,241
			3	78.6	70.8	7.9	6.3	5.7	0.6	0.00470	0.00480	0.00475	0.00060	9,456
			4	78.9	71.0	7.9	6.3	5.7	0.6	0.00480	0.00480	0.00480	0.00060	9,463
			5	79.7	71.8	7.9	6.4	5.7	0.6	0.00470	0.00490	0.00480	0.00060	9,581
	COLUMN AVERAGE		79.0	71.2	7.9	6.3	5.7	0.6	0.00480	0.00490	0.00485	0.00060	9,447	
	STANDARD DEV.		0.9	0.9	0.1	0.1	0.1	0.0	0.00010	0.00000	0.00005	0.00000	125	
Sequence 14	2.00	8.00	1	109.8	99.5	10.3	8.8	8.0	0.8	0.00790	0.00800	0.00795	0.00100	7,989
			2	109.3	99.0	10.2	8.7	7.9	0.8	0.00790	0.00800	0.00795	0.00100	7,943
			3	109.3	99.1	10.3	8.7	7.9	0.8	0.00790	0.00800	0.00795	0.00100	7,943
			4	109.9	99.7	10.3	8.8	8.0	0.8	0.00790	0.00800	0.00795	0.00100	8,002
			5	110.4	100.1	10.3	8.8	8.0	0.8	0.00790	0.00800	0.00795	0.00100	8,022
	COLUMN AVERAGE		109.7	99.5	10.3	8.8	8.0	0.8	0.00790	0.00800	0.00795	0.00100	7,980	
	STANDARD DEV.		0.5	0.5	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	36	
Sequence 15	2.00	10.00	1	138.9	126.1	12.8	11.1	10.1	1.0	0.01110	0.01120	0.01115	0.00139	7,266
			2	138.1	125.4	12.8	11.0	10.0	1.0	0.01100	0.01110	0.01105	0.00139	7,228
			3	139.2	126.5	12.7	11.1	10.1	1.0	0.01110	0.01120	0.01115	0.00139	7,261
			4	138.1	125.4	12.7	11.0	10.0	1.0	0.01110	0.01120	0.01115	0.00139	7,218
			5	139.0	126.4	12.6	11.1	10.1	1.0	0.01110	0.01120	0.01115	0.00139	7,274
	COLUMN AVERAGE		138.7	126.0	12.7	11.1	10.1	1.0	0.01110	0.01120	0.01115	0.00139	7,249	
	STANDARD DEV.		0.5	0.6	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	25	

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF RESILIENT MODULUS TESTING
FOR PEDEOLOGICAL SOIL SURVEY

Project Location: U.S. Highway 77 Improvement South of Tonkawa

Project No.: SSP-136C(101)SS

Job Piece No: 21854(04)

Surveyed by: Jim Nevels

County: Kay County

Date Surveyed: October 3, 2010

Lab No.: S10632

Burgess Job No.: 731-10119

Soil Series: **McLain Soil Series Composite C**

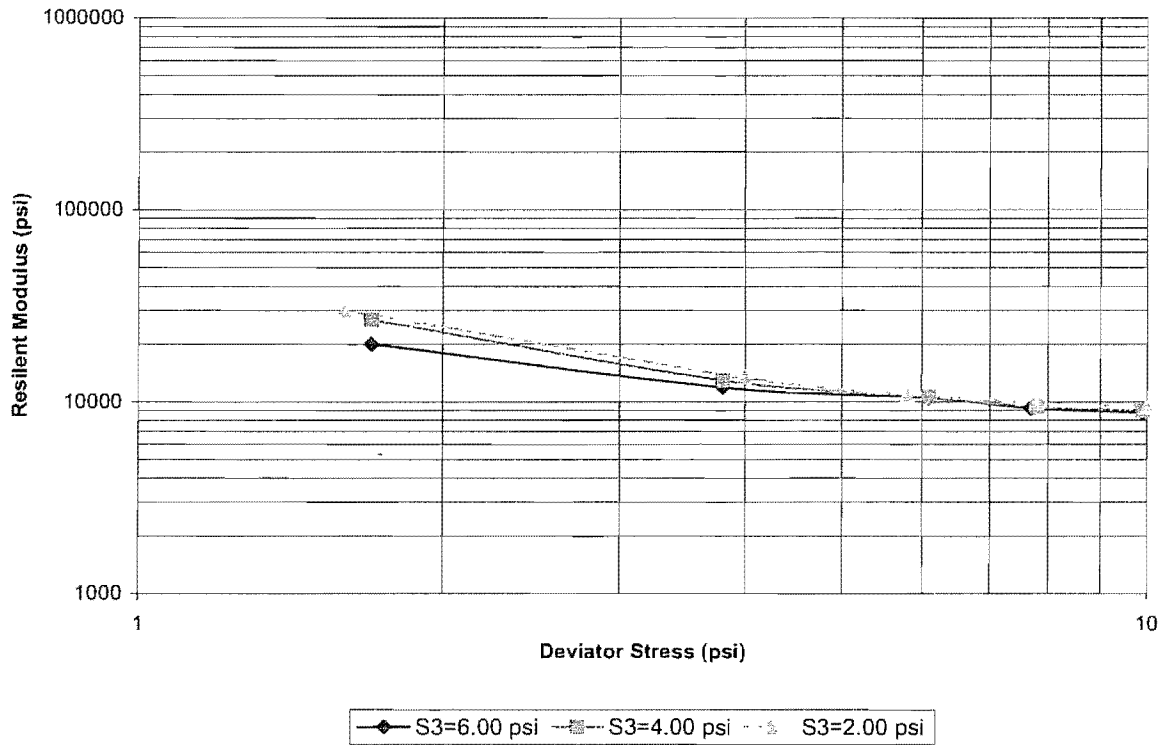
Desired Moisture Content: 20.8 %

Desired Dry Density: 97.9 pcf

Sample I.D.	Chamber Pressure (psi)	Axial Stress (psi)	Moisture Content (%)	Dry Density (pcf)	Resilient Strain (in/in)	Resilient Modulus (psi)	Standard Deviation for M _R
MR3-2-A	6.0	1.7	20.4	98.3	0.00009	19936.0	700.1
		3.8			0.00032	11863.2	90.1
		6.1			0.00058	10518.0	91.4
		7.7			0.00083	9278.2	58.8
		9.9			0.00113	8766.4	37.3
	4.0	1.7			0.00006	26665.9	737.8
		3.8			0.00030	12900.6	79.2
		6.1			0.00057	10613.1	116.4
		7.8			0.00083	9386.1	48.3
		9.9			0.00110	8970.1	35.0
	2.0	1.6			0.00006	29843.6	274.8
		4.0			0.00030	13320.2	192.6
		5.8			0.00053	10902.4	85.0
		7.8			0.00079	9914.7	60.6
		10.0			0.00106	9392.6	27.7

RESILIENT MODULUS TESTING - AASHTO T307-99

MR3-2-A @ 95% Dry Density & Opt. Moisture



LOCATION		DESCRIPTION	
Project Location: U.S. Highway 77 Improvement		MR3-2-A	
Project No.: SSP-136C(101)SS		RM=a(S _d) ^b	
Soil Series: McLain Soil Series Composite C		Values for S _d are:	
Sample by: Jim Nevels		S3=6.00psi: 1.7, 3.8, 6.1, 7.7, 9.9 psi	
Sample Date: October 3, 2010		S3=4.00psi: 1.7, 3.8, 6.1, 7.8, 9.9 psi	
Burgess Job No.: 731-10119		S3=2.00psi: 1.6, 4.0, 5.8, 7.8, 10.0 psi	
Sample No. MR3-2-A		Calculated units of values for RM are in psi	
S ₃	6.00 psi	4.00 psi	2.00 psi
R ²	0.9676	0.9532	0.9501
a	24241	34067	37034
b	-0.4649	-0.6241	-0.6462
RESILIENT MODULUS TESTING AASHTO T307-99		BURGESS ENGINEERING AND TESTING, INC.	

BURGESS ENGINEERING AND TESTING, INC.

Resilient Modulus Testing - AASHTO T307-99

Date: 10/08/2010

Client:
Smith Roberts Baldischwiler, LLC.
 Attn: Mr. Gary Noland, P.E.
 104 S 2nd Street
 Chickasha, OK 73018

Project: U.S. Highway 77 Improvement South of
 Tonkawa

Project Description: Resilient Modulus Test

AASHTO T307-99

BETI Project No.: 731-10119

Soil Series: McLain Soil Series Composite C

Sample Information

Sample ID: MR3-2-A	Sample Diameter, in.: 4	Sample M.C., %: 20.4
Sample Type: 95% Dry Density & Opt. Moisture	Sample Height, in.: 8	Sample Dry Den., pcf: 98.3
Test Date: 10/07/10	Desired M.C., %: 20.8	Failed in Shear?:
Remarks:	Dry Den., pcf: 97.9	Triaxial Shear Strength, psi:

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	Chamber Confining Pressure	Nominal Maximum Axial Stress	Cycle No.	Actual Applied Max. Axial Load	Actual Applied Cyclic Load	Actual Applied Contact Load	Actual Applied Max. Axial Stress	Actual Applied Cyclic Stress	Actual Applied Contact Stress	Recov. Def. LVDT #1 Reading	Recov. Def. LVDT #2 Reading	Average Recov. Def. LVDT 1 and 2	Resilient Strain	Resilient Modulus
DESIGNATION	S3	Scyclic	cl	Pmax	Pcyclic	Pcontact	Smax	Scyclic	Scontact	H1	H2	Havg	Er	Mr
UNIT	psi	psi	---	lbf	lbf	lbf	psi	psi	psi	in	in	in	in/in	psi
PRECISION	---	---	-	---	---	---	---	---	---	---	---	---	---	---
Sequence 1	6.00	2.00	1	24.1	21.6	2.5	1.9	1.7	0.2	0.00070	0.00060	0.00065	0.000080	20,588
			2	23.9	21.4	2.5	1.9	1.7	0.2	0.00070	0.00070	0.00070	0.000090	19,391
			3	24.7	22.0	2.7	2.0	1.8	0.2	0.00080	0.00070	0.00075	0.000090	19,029
			4	24.4	21.9	2.5	2.0	1.8	0.2	0.00070	0.00070	0.00070	0.000090	20,554
			5	24.7	22.2	2.5	2.0	1.8	0.2	0.00070	0.00070	0.00070	0.000090	20,118
	COLUMN AVERAGE			24.4	21.8	2.5	1.9	1.7	0.2	0.00070	0.00070	0.00070	0.000090	19,936
	STANDARD DEV.			0.4	0.3	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.000000	700

BURGESS ENGINEERING AND TESTING, INC.

MR3-2-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 2	6.00	4.00	1	52.9	47.6	5.3	4.2	3.8	0.4	0.00260	0.00250	0.00255	0.00032	12,017
			2	51.4	46.3	5.1	4.1	3.7	0.4	0.00250	0.00250	0.00250	0.00031	11,813
			3	52.1	46.9	5.2	4.2	3.7	0.4	0.00260	0.00250	0.00255	0.00032	11,815
			4	51.3	45.9	5.3	4.1	3.7	0.4	0.00250	0.00240	0.00245	0.00031	11,799
			5	53.3	48.3	5.1	4.3	3.9	0.4	0.00260	0.00260	0.00260	0.00033	11,872
	COLUMN AVERAGE		52.2	47.0	5.2	4.2	3.8	0.4	0.00260	0.00250	0.00255	0.00032	11,863	
	STANDARD DEV.		0.9	0.9	0.1	0.1	0.1	0.0	0.00000	0.00010	0.00005	0.00001	90	
Sequence 3	6.00	6.00	1	85.1	77.2	7.9	6.8	6.2	0.6	0.00470	0.00450	0.00460	0.00058	10,658
			2	83.6	75.9	7.7	6.7	6.1	0.6	0.00470	0.00450	0.00460	0.00058	10,539
			3	82.8	75.1	7.7	6.6	6.0	0.6	0.00460	0.00450	0.00455	0.00057	10,521
			4	83.2	75.2	8.0	6.7	6.0	0.6	0.00460	0.00460	0.00460	0.00058	10,444
			5	84.1	76.4	7.7	6.7	6.1	0.6	0.00480	0.00460	0.00470	0.00059	10,428
	COLUMN AVERAGE		83.8	76.0	7.8	6.7	6.1	0.6	0.00470	0.00450	0.00460	0.00058	10,518	
	STANDARD DEV.		0.9	0.9	0.1	0.1	0.1	0.0	0.00010	0.00000	0.00005	0.00001	91	
Sequence 4	6.00	8.00	1	106.8	96.4	10.4	8.5	7.7	0.8	0.00680	0.00660	0.00670	0.00084	9,216
			2	107.3	97.0	10.3	8.6	7.8	0.8	0.00670	0.00670	0.00670	0.00084	9,284
			3	107.7	97.3	10.4	8.6	7.8	0.8	0.00670	0.00670	0.00670	0.00083	9,338
			4	106.3	95.9	10.3	8.5	7.7	0.8	0.00670	0.00660	0.00665	0.00083	9,220
			5	107.7	97.2	10.5	8.6	7.8	0.8	0.00670	0.00670	0.00670	0.00083	9,333
	COLUMN AVERAGE		107.2	96.8	10.4	8.6	7.7	0.8	0.00670	0.00670	0.00670	0.00083	9,278	
	STANDARD DEV.		0.6	0.6	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	59	
Sequence 5	6.00	10.00	1	137.0	124.0	13.0	11.0	9.9	1.0	0.00910	0.00900	0.00905	0.00113	8,768
			2	136.5	123.2	13.3	10.9	9.9	1.1	0.00910	0.00900	0.00905	0.00113	8,710
			3	136.9	123.8	13.2	11.0	9.9	1.1	0.00900	0.00900	0.00900	0.00112	8,801
			4	137.2	124.1	13.1	11.0	9.9	1.1	0.00910	0.00900	0.00905	0.00113	8,755
			5	137.3	124.1	13.2	11.0	9.9	1.1	0.00900	0.00900	0.00900	0.00113	8,799
	COLUMN AVERAGE		137.0	123.8	13.2	11.0	9.9	1.1	0.00910	0.00900	0.00905	0.00113	8,766	
	STANDARD DEV.		0.3	0.4	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	37	

BURGESS ENGINEERING AND TESTING, INC.

MR3-2-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 6	4.00	2.00	1	24.8	21.7	3.1	2.0	1.7	0.2	0.0005	0.0005	0.0005	0.0001	26,679
			2	24.4	21.4	3.0	2.0	1.7	0.2	0.0005	0.0005	0.0005	0.0001	27,745
			3	24.6	21.5	3.1	2.0	1.7	0.2	0.0005	0.0005	0.0005	0.0001	26,878
			4	24.4	21.4	3.0	1.9	1.7	0.2	0.0005	0.0006	0.0006	0.0001	26,254
			5	24.7	21.6	3.2	2.0	1.7	0.3	0.0006	0.0005	0.0006	0.0001	25,773
	COLUMN AVERAGE		24.6	21.5	3.1	2.0	1.7	0.2	0.0005	0.0005	0.0005	0.0001	26,666	
	STANDARD DEV.		0.2	0.1	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	738	
Sequence 7	4.00	4.00	1	54.6	49.0	5.7	4.4	3.9	0.5	0.0025	0.0023	0.0024	0.0003	12,990
			2	53.4	47.7	5.7	4.3	3.8	0.5	0.0025	0.0023	0.0024	0.0003	12,777
			3	53.4	47.9	5.5	4.3	3.8	0.4	0.0024	0.0023	0.0024	0.0003	12,921
			4	52.6	47.0	5.6	4.2	3.8	0.4	0.0024	0.0023	0.0024	0.0003	12,933
			5	54.1	48.7	5.5	4.3	3.9	0.4	0.0025	0.0023	0.0024	0.0003	12,882
	COLUMN AVERAGE		53.6	48.1	5.6	4.3	3.8	0.4	0.0025	0.0023	0.0024	0.0003	12,901	
	STANDARD DEV.		0.8	0.8	0.1	0.1	0.1	0.0	0.0001	0.0000	0.0001	0.0000	79	
Sequence 8	4.00	6.00	1	83.6	75.8	7.8	6.7	6.1	0.6	0.0047	0.0044	0.0046	0.0006	10,646
			2	83.3	75.6	7.6	6.7	6.0	0.6	0.0047	0.0045	0.0046	0.0006	10,590
			3	83.9	76.0	7.9	6.7	6.1	0.6	0.0047	0.0044	0.0046	0.0006	10,686
			4	84.1	76.5	7.6	6.7	6.1	0.6	0.0047	0.0045	0.0046	0.0006	10,720
			5	82.5	74.7	7.9	6.6	6.0	0.6	0.0047	0.0045	0.0046	0.0006	10,424
	COLUMN AVERAGE		83.5	75.7	7.8	6.7	6.1	0.6	0.0047	0.0045	0.0046	0.0006	10,613	
	STANDARD DEV.		0.6	0.7	0.1	0.0	0.1	0.0	0.0000	0.0000	0.0000	0.0000	116	
Sequence 9	4.00	8.00	1	107.2	97.2	10.0	8.6	7.8	0.8	0.0066	0.0066	0.0066	0.0008	9,404
			2	107.3	97.3	10.0	8.6	7.8	0.8	0.0066	0.0066	0.0066	0.0008	9,417
			3	108.1	98.1	10.0	8.6	7.8	0.8	0.0067	0.0066	0.0067	0.0008	9,414
			4	106.0	95.9	10.1	8.5	7.7	0.8	0.0066	0.0066	0.0066	0.0008	9,301
			5	106.8	96.9	9.9	8.5	7.8	0.8	0.0067	0.0065	0.0066	0.0008	9,395
	COLUMN AVERAGE		107.1	97.1	10.0	8.6	7.8	0.8	0.0067	0.0066	0.0067	0.0008	9,386	
	STANDARD DEV.		0.8	0.8	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	48	
Sequence 10	4.00	10.00	1	135.7	123.5	12.2	10.8	9.9	1.0	0.0088	0.0088	0.0088	0.0011	8,938
			2	135.2	123.0	12.2	10.8	9.8	1.0	0.0088	0.0088	0.0088	0.0011	8,937
			3	135.7	123.5	12.2	10.9	9.9	1.0	0.0089	0.0087	0.0088	0.0011	8,961
			4	136.0	123.6	12.4	10.9	9.9	1.0	0.0088	0.0087	0.0088	0.0011	9,001
			5	136.4	124.1	12.3	10.9	9.9	1.0	0.0088	0.0088	0.0088	0.0011	9,013
	COLUMN AVERAGE		135.8	123.5	12.3	10.9	9.9	1.0	0.0088	0.0088	0.0088	0.0011	8,970	
	STANDARD DEV.		0.4	0.4	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	35	

BURGESS ENGINEERING AND TESTING, INC.

MR3-2-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 11	2.00	2.00	1	23.3	19.4	3.8	1.9	1.6	0.3	0.00050	0.00040	0.00045	0.00005	29,480
			2	24.4	20.7	3.8	2.0	1.7	0.3	0.00050	0.00040	0.00045	0.00005	30,187
			3	24.2	20.4	3.8	1.9	1.6	0.3	0.00040	0.00040	0.00040	0.00005	29,847
			4	24.7	20.8	3.9	2.0	1.7	0.3	0.00040	0.00040	0.00040	0.00006	30,013
			5	25.3	21.5	3.7	2.0	1.7	0.3	0.00050	0.00040	0.00045	0.00006	29,691
	COLUMN AVERAGE			24.4	20.6	3.8	2.0	1.6	0.3	0.00050	0.00040	0.00045	0.00006	29,844
	STANDARD DEV.			0.7	0.8	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	275
Sequence 12	2.00	4.00	1	54.5	49.5	5.0	4.4	4.0	0.4	0.00240	0.00230	0.00235	0.00029	13,455
			2	54.7	49.8	4.9	4.4	4.0	0.4	0.00250	0.00230	0.00240	0.00030	13,143
			3	53.2	47.9	5.3	4.3	3.8	0.4	0.00240	0.00220	0.00230	0.00029	13,414
			4	57.1	52.0	5.1	4.6	4.2	0.4	0.00260	0.00240	0.00250	0.00031	13,505
			5	55.4	50.2	5.2	4.4	4.0	0.4	0.00260	0.00240	0.00250	0.00031	13,084
	COLUMN AVERAGE			55.0	49.9	5.1	4.4	4.0	0.4	0.00250	0.00230	0.00240	0.00030	13,320
	STANDARD DEV.			1.4	1.5	0.2	0.1	0.1	0.0	0.00010	0.00010	0.00010	0.00001	193
Sequence 13	2.00	6.00	1	80.9	73.2	7.7	6.5	5.9	0.6	0.00430	0.00420	0.00425	0.00053	11,008
			2	80.8	73.1	7.8	6.5	5.8	0.6	0.00430	0.00420	0.00425	0.00053	10,959
			3	80.1	72.2	7.9	6.4	5.8	0.6	0.00430	0.00420	0.00425	0.00053	10,820
			4	80.1	72.2	7.9	6.4	5.8	0.6	0.00430	0.00420	0.00425	0.00053	10,911
			5	79.9	71.9	7.9	6.4	5.8	0.6	0.00430	0.00420	0.00425	0.00053	10,814
	COLUMN AVERAGE			80.4	72.5	7.8	6.4	5.8	0.6	0.00430	0.00420	0.00425	0.00053	10,902
	STANDARD DEV.			0.5	0.6	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	85
Sequence 14	2.00	8.00	1	107.5	97.4	10.1	8.6	7.8	0.8	0.00640	0.00630	0.00635	0.00079	9,832
			2	108.3	98.0	10.3	8.7	7.8	0.8	0.00640	0.00620	0.00630	0.00079	9,961
			3	108.9	98.6	10.3	8.7	7.9	0.8	0.00640	0.00630	0.00635	0.00079	9,986
			4	108.0	97.7	10.3	8.6	7.8	0.8	0.00630	0.00630	0.00630	0.00079	9,890
			5	108.0	97.7	10.3	8.6	7.8	0.8	0.00640	0.00630	0.00635	0.00079	9,906
	COLUMN AVERAGE			108.1	97.9	10.3	8.6	7.8	0.8	0.00640	0.00630	0.00635	0.00079	9,915
	STANDARD DEV.			0.5	0.5	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	61
Sequence 15	2.00	10.00	1	137.7	125.0	12.8	11.0	10.0	1.0	0.00850	0.00850	0.00850	0.00106	9,393
			2	138.0	125.3	12.7	11.0	10.0	1.0	0.00850	0.00850	0.00850	0.00107	9,404
			3	138.0	125.3	12.8	11.0	10.0	1.0	0.00860	0.00850	0.00855	0.00107	9,390
			4	137.6	124.9	12.7	11.0	10.0	1.0	0.00850	0.00840	0.00845	0.00106	9,426
			5	136.9	124.3	12.6	11.0	9.9	1.0	0.00850	0.00850	0.00850	0.00106	9,350
	COLUMN AVERAGE			137.7	125.0	12.7	11.0	10.0	1.0	0.00850	0.00850	0.00850	0.00106	9,393
	STANDARD DEV.			0.4	0.4	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	28

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF RESILIENT MODULUS TESTING
FOR PEDEOLOGICAL SOIL SURVEY

Project Location: U.S. Highway 77 Improvement South of Tonkawa

Project No.: SSP-136C(101)SS

Job Piece No: 21854(04)

Surveyed by: Jim Nevels

County: Kay Cour`

Date Surveyed: October 3, 2010

Lab No.: S10632

Burgess Job No.: 731-10119

Soil Series: **McLain Soil Series Composite C**

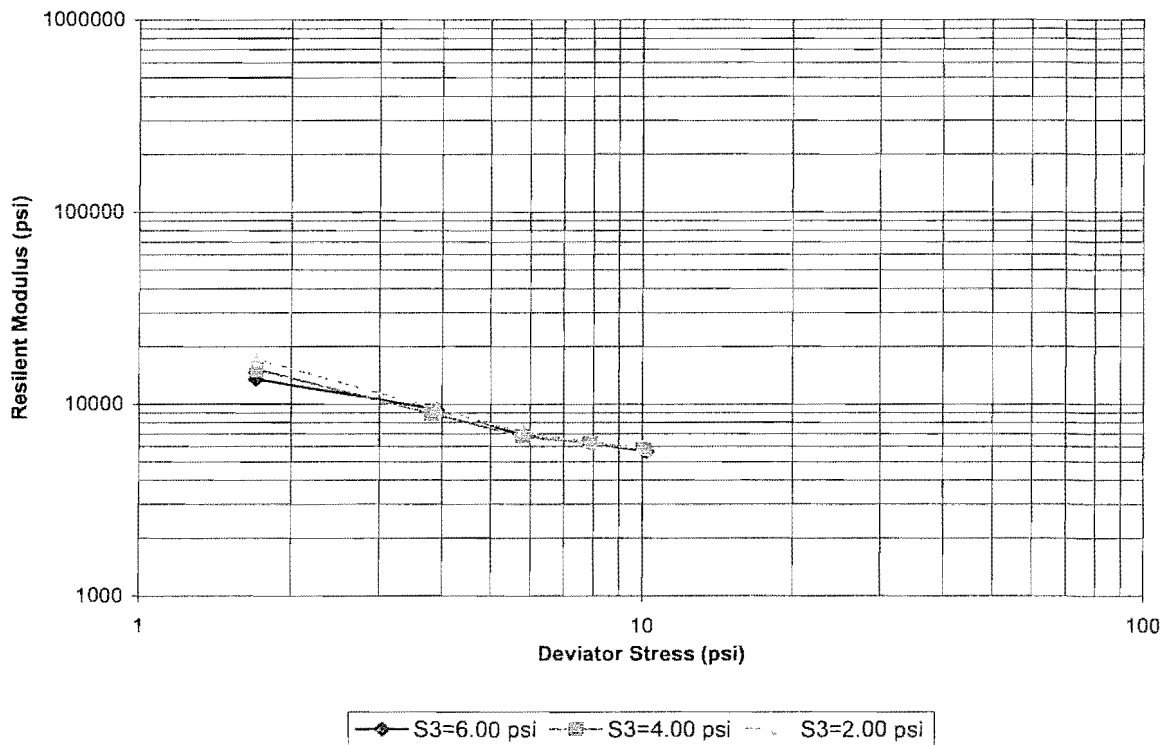
Desired Moisture Content: 22.4 %

Desired Dry Density: 100.8 pcf

Sample I.D.	Chamber Pressure (psi)	Axial Stress (psi)	Moisture Content (%)	Dry Density (pcf)	Resilient Strain (in/in)	Resilient Modulus (psi)	Standard Deviation for M_R
MR3-2-B	6.0	1.7	22.9	99.6	0.00012	13481.7	430.4
		3.9			0.00041	9316.7	70.3
		5.8			0.00084	6917.9	59.4
		7.9			0.00126	6256.0	22.1
		10.2			0.00179	5658.9	21.0
	4.0	1.7			0.00011	15222.5	466.7
		3.8			0.00042	8942.8	56.8
		5.8			0.00085	6833.3	62.6
		7.9			0.00126	6260.4	39.8
		10.1			0.00174	5789.6	34.1
	2.0	1.7			0.00010	17056.4	738.7
		3.9			0.00041	9453.5	156.8
		5.8			0.00081	7125.5	65.4
		7.9			0.00125	6331.9	34.5
		10.0			0.00171	5864.7	15.1

RESILIENT MODULUS TESTING - AASHTO T307-99

MR3-2-B @ Opt. Moisture + 2%



LOCATION		DESCRIPTION	
Project Location: U.S. Highway 77 Improvement		MR3-2-B	
Project No.: SSP-136C(101)SS		RM= $a(S_d)^b$	
Soil Series: McLain Soil Series Composite C		Values for S_d are:	
Sample by: Jim Nevels		S3=6.00psi: 1.7, 3.9, 5.8, 7.9, 10.2 psi	
Sample Date: October 3, 2010		S3=4.00psi: 1.7, 3.8, 5.8, 7.9, 10.1 psi	
Burgess Job No.: 731-10119		S3=2.00psi: 1.7, 3.9, 5.8, 7.9, 10.0 psi	
Sample No. MR3-2-B		Calculated units of values for RM are in psi	
S_3	6.00 psi	4.00 psi	2.00 psi
R^2	0.9886	0.9775	0.9826
a	17639	19513	22703
b	-0.4997	-0.5535	-0.6175
RESILIENT MODULUS TESTING AASHTO T307-99		BURGESS ENGINEERING AND TESTING, INC.	

BURGESS ENGINEERING AND TESTING, INC.

Resilient Modulus Testing - AASHTO T307-99

Date: 10/08/2010

Client:
Smith Roberts Baldischwiler, LLC.

Attn: Mr. Gary Noland, P.E.
104 S 2nd Street
Chickasha, OK 73018

Project: U.S. Highway 77 Improvement South of
Tonkawa

Project Description: Resilient Modulus Test

AASHTO T307-99

BETI Project No.: 731-10119

Soil Series: McLain Soil Series Composite C

Sample Information

Sample ID: MR3-2-B
Sample Type: Opt. Moisture + 2%
Test Date: 10/07/10
Remarks:

Sample Diameter, in.: 4
Sample Height, in.: 8
Desired M.C., %: 22.4
Dry Den., pcf: 100.8

Sample M.C., %: 22.9
Sample Dry Den., pcf: 99.6
Failed in Shear?:
Triaxial Shear Strength, psi:

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	Chamber Confining Pressure	Nominal Maximu m Axial Stress	Cycle No.	Actual Applied Max. Axial Load	Actual Applied Cyclic Load	Actual Applied Contact Load	Actual Applied Max. Axial Stress	Actual Applied Cyclic Stress	Actual Applied Contact Stress	Recov. Def. LVDT #1 Reading	Recov. Def. LVDT #2 Reading	Average Recov. Def. LVDT 1 and 2	Resilient Strain	Resilient Modulus
DESIGNATION	S3	Scyclic	cl	Pmax	Pcyclic	Pcontact	Smax	Scyclic	Scontact	H1	H2	Havg	Er	Mr
UNIT	psi	psi	---	lbf	lbf	lbf	psi	psi	psi	in	in	in	in/in	psi
PRECISION	---	---	-	---	---	---	---	---	---	---	---	---	---	---
Sequence 1	6.00	2.00	1	25.1	21.2	3.9	2.0	1.7	0.3	0.00100	0.00100	0.00100	0.000130	13,082
			2	24.0	20.8	3.2	1.9	1.7	0.3	0.00100	0.00100	0.00100	0.000130	12,989
			3	24.9	21.2	3.7	2.0	1.7	0.3	0.00100	0.00100	0.00100	0.000120	13,570
			4	23.8	20.4	3.4	1.9	1.6	0.3	0.00100	0.00090	0.00095	0.000120	13,946
			5	23.6	20.0	3.6	1.9	1.6	0.3	0.00090	0.00090	0.00090	0.000120	13,821
	COLUMN AVERAGE			24.3	20.7	3.6	1.9	1.7	0.3	0.00100	0.00100	0.00100	0.000120	13,482
	STANDARD DEV.			0.7	0.5	0.3	0.1	0.0	0.0	0.00000	0.00010	0.00005	0.000010	430

BURGESS ENGINEERING AND TESTING, INC.

MR3-2-B

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 2	6.00	4.00	1	54.4	48.4	6.0	4.4	3.9	0.5	0.00330	0.00330	0.00330	0.00041	9,389
			2	55.0	49.1	6.0	4.4	3.9	0.5	0.00330	0.00330	0.00330	0.00042	9,393
			3	54.8	48.7	6.1	4.4	3.9	0.5	0.00340	0.00330	0.00335	0.00042	9,298
			4	53.5	47.5	6.1	4.3	3.8	0.5	0.00330	0.00330	0.00330	0.00041	9,250
			5	53.5	47.3	6.2	4.3	3.8	0.5	0.00330	0.00320	0.00325	0.00041	9,254
	COLUMN AVERAGE		54.2	48.2	6.1	4.3	3.9	0.5	0.00330	0.00330	0.00330	0.00041	9,317	
	STANDARD DEV.		0.7	0.8	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	70	
Sequence 3	6.00	6.00	1	80.5	72.5	8.1	6.4	5.8	0.6	0.00650	0.00690	0.00670	0.00084	6,924
			2	80.2	72.4	7.8	6.4	5.8	0.6	0.00670	0.00670	0.00670	0.00084	6,908
			3	78.5	70.8	7.7	6.3	5.7	0.6	0.00660	0.00670	0.00665	0.00083	6,833
			4	81.1	73.4	7.7	6.5	5.9	0.6	0.00660	0.00680	0.00670	0.00084	7,000
			5	80.2	72.6	7.6	6.4	5.8	0.6	0.00660	0.00680	0.00670	0.00084	6,925
	COLUMN AVERAGE		80.1	72.3	7.8	6.4	5.8	0.6	0.00660	0.00680	0.00670	0.00084	6,918	
	STANDARD DEV.		1.0	0.9	0.2	0.1	0.1	0.0	0.00010	0.00010	0.00010	0.00000	59	
Sequence 4	6.00	8.00	1	108.7	98.6	10.1	8.7	7.9	0.8	0.00990	0.01030	0.01010	0.00127	6,222
			2	108.3	98.0	10.4	8.7	7.8	0.8	0.00990	0.01020	0.01005	0.00125	6,245
			3	108.6	98.5	10.1	8.7	7.9	0.8	0.00990	0.01020	0.01005	0.00126	6,268
			4	109.0	98.9	10.2	8.7	7.9	0.8	0.00990	0.01030	0.01010	0.00126	6,274
			5	108.9	98.3	10.6	8.7	7.9	0.8	0.00990	0.01020	0.01005	0.00125	6,271
	COLUMN AVERAGE		108.7	98.5	10.2	8.7	7.9	0.8	0.00990	0.01020	0.01005	0.00126	6,256	
	STANDARD DEV.		0.3	0.3	0.2	0.0	0.0	0.0	0.00000	0.00010	0.00005	0.00001	22	
Sequence 5	6.00	10.00	1	140.0	127.4	12.5	11.2	10.2	1.0	0.01420	0.01450	0.01435	0.00180	5,672
			2	139.4	127.0	12.4	11.2	10.2	1.0	0.01430	0.01460	0.01445	0.00180	5,635
			3	138.8	126.3	12.5	11.1	10.1	1.0	0.01420	0.01450	0.01435	0.00179	5,640
			4	139.5	126.7	12.7	11.2	10.1	1.0	0.01410	0.01440	0.01425	0.00178	5,685
			5	139.7	127.1	12.6	11.2	10.2	1.0	0.01420	0.01450	0.01435	0.00179	5,663
	COLUMN AVERAGE		139.5	126.9	12.5	11.2	10.2	1.0	0.01420	0.01450	0.01435	0.00179	5,659	
	STANDARD DEV.		0.4	0.4	0.1	0.0	0.0	0.0	0.00010	0.00010	0.00010	0.00001	21	

BURGESS ENGINEERING AND TESTING, INC.

MR3-2-B

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 6	4.00	2.00	1	24.6	20.9	3.6	2.0	1.7	0.3	0.0009	0.0010	0.0010	0.0001	14,666
			2	24.7	21.4	3.4	2.0	1.7	0.3	0.0009	0.0009	0.0009	0.0001	15,181
			3	24.0	20.4	3.6	1.9	1.6	0.3	0.0008	0.0009	0.0009	0.0001	15,018
			4	25.4	22.1	3.3	2.0	1.8	0.3	0.0009	0.0009	0.0009	0.0001	15,311
			5	23.6	20.1	3.4	1.9	1.6	0.3	0.0008	0.0008	0.0008	0.0001	15,937
	COLUMN AVERAGE		24.4	21.0	3.5	2.0	1.7	0.3	0.0009	0.0009	0.0009	0.0001	15,223	
	STANDARD DEV.		0.7	0.8	0.1	0.1	0.1	0.0	0.0000	0.0001	0.0001	0.0000	467	
Sequence 7	4.00	4.00	1	53.2	47.4	5.8	4.3	3.8	0.5	0.0034	0.0035	0.0035	0.0004	8,877
			2	53.8	48.0	5.9	4.3	3.8	0.5	0.0034	0.0035	0.0035	0.0004	8,925
			3	52.9	47.0	5.9	4.2	3.8	0.5	0.0033	0.0034	0.0034	0.0004	8,926
			4	53.2	47.1	6.1	4.3	3.8	0.5	0.0033	0.0034	0.0034	0.0004	8,954
			5	53.8	47.8	6.0	4.3	3.8	0.5	0.0034	0.0034	0.0034	0.0004	9,032
	COLUMN AVERAGE		53.4	47.4	5.9	4.3	3.8	0.5	0.0034	0.0034	0.0034	0.0004	8,943	
	STANDARD DEV.		0.4	0.4	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	57	
Sequence 8	4.00	6.00	1	80.5	72.7	7.8	6.4	5.8	0.6	0.0067	0.0069	0.0068	0.0009	6,855
			2	81.3	73.5	7.8	6.5	5.9	0.6	0.0067	0.0069	0.0068	0.0009	6,930
			3	78.7	70.9	7.8	6.3	5.7	0.6	0.0066	0.0068	0.0067	0.0008	6,791
			4	80.0	72.3	7.7	6.4	5.8	0.6	0.0066	0.0069	0.0068	0.0009	6,818
			5	79.6	71.7	7.9	6.4	5.7	0.6	0.0067	0.0069	0.0068	0.0009	6,772
	COLUMN AVERAGE		80.0	72.2	7.8	6.4	5.8	0.6	0.0067	0.0069	0.0068	0.0009	6,833	
	STANDARD DEV.		1.0	1.0	0.1	0.1	0.1	0.0	0.0001	0.0000	0.0001	0.0000	63	
Sequence 9	4.00	8.00	1	108.7	98.0	10.7	8.7	7.8	0.9	0.0100	0.0102	0.0101	0.0013	6,212
			2	108.8	98.3	10.6	8.7	7.9	0.8	0.0099	0.0102	0.0101	0.0013	6,232
			3	109.6	98.9	10.6	8.8	7.9	0.9	0.0100	0.0102	0.0101	0.0013	6,261
			4	110.3	99.7	10.6	8.8	8.0	0.8	0.0100	0.0103	0.0102	0.0013	6,309
			5	110.4	99.7	10.6	8.8	8.0	0.9	0.0100	0.0103	0.0102	0.0013	6,289
	COLUMN AVERAGE		109.5	98.9	10.6	8.8	7.9	0.8	0.0100	0.0102	0.0101	0.0013	6,260	
	STANDARD DEV.		0.8	0.8	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	40	
Sequence 10	4.00	10.00	1	138.0	124.9	13.1	11.0	10.0	1.0	0.0137	0.0140	0.0139	0.0017	5,756
			2	138.8	125.9	13.0	11.1	10.1	1.0	0.0138	0.0141	0.0140	0.0017	5,790
			3	138.5	125.5	13.0	11.1	10.0	1.0	0.0138	0.0141	0.0140	0.0017	5,755
			4	139.3	126.3	13.0	11.1	10.1	1.0	0.0137	0.0140	0.0139	0.0017	5,824
			5	139.7	126.7	13.0	11.2	10.1	1.0	0.0138	0.0141	0.0140	0.0017	5,823
	COLUMN AVERAGE		138.9	125.9	13.0	11.1	10.1	1.0	0.0138	0.0141	0.0140	0.0017	5,790	
	STANDARD DEV.		0.6	0.7	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	34	

BURGESS ENGINEERING AND TESTING, INC.

MR3-2-B

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 11	2.00	2.00	1	24.1	21.0	3.1	1.9	1.7	0.2	0.00080	0.00080	0.00080	0.00010	16,690
			2	25.0	21.9	3.1	2.0	1.8	0.2	0.00080	0.00080	0.00080	0.00010	17,138
			3	24.5	21.4	3.1	2.0	1.7	0.2	0.00080	0.00090	0.00085	0.00011	16,003
			4	23.3	20.4	2.9	1.9	1.6	0.2	0.00070	0.00070	0.00070	0.00009	17,856
			5	24.4	21.3	3.0	1.9	1.7	0.2	0.00080	0.00080	0.00080	0.00010	17,597
	COLUMN AVERAGE		24.2	21.2	3.0	1.9	1.7	0.2	0.00080	0.00080	0.00080	0.00010	17,056	
	STANDARD DEV.		0.6	0.6	0.1	0.1	0.0	0.0	0.00010	0.00000	0.00005	0.00001	739	
Sequence 12	2.00	4.00	1	55.1	49.0	6.2	4.4	3.9	0.5	0.00320	0.00330	0.00325	0.00041	9,507
			2	54.0	47.7	6.2	4.3	3.8	0.5	0.00320	0.00330	0.00325	0.00041	9,416
			3	55.5	49.6	5.9	4.4	4.0	0.5	0.00320	0.00330	0.00325	0.00041	9,649
			4	54.0	48.1	5.9	4.3	3.8	0.5	0.00320	0.00330	0.00325	0.00041	9,478
			5	52.9	46.9	5.9	4.2	3.8	0.5	0.00330	0.00330	0.00330	0.00041	9,218
	COLUMN AVERAGE		54.3	48.2	6.0	4.3	3.9	0.5	0.00320	0.00330	0.00325	0.00041	9,454	
	STANDARD DEV.		1.0	1.0	0.2	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	157	
Sequence 13	2.00	6.00	1	81.2	73.4	7.8	6.5	5.9	0.6	0.00640	0.00670	0.00655	0.00082	7,193
			2	79.3	71.4	7.9	6.3	5.7	0.6	0.00640	0.00650	0.00645	0.00081	7,072
			3	80.6	72.8	7.8	6.4	5.8	0.6	0.00640	0.00670	0.00655	0.00082	7,081
			4	81.3	73.3	8.0	6.5	5.9	0.6	0.00640	0.00660	0.00650	0.00081	7,201
			5	78.5	70.8	7.7	6.3	5.7	0.6	0.00630	0.00650	0.00640	0.00080	7,081
	COLUMN AVERAGE		80.2	72.3	7.8	6.4	5.8	0.6	0.00640	0.00660	0.00650	0.00081	7,126	
	STANDARD DEV.		1.2	1.2	0.1	0.1	0.1	0.0	0.00010	0.00010	0.00010	0.00001	65	
Sequence 14	2.00	8.00	1	109.3	99.1	10.3	8.7	7.9	0.8	0.00990	0.01020	0.01005	0.00125	6,318
			2	108.5	97.9	10.6	8.7	7.8	0.8	0.00980	0.01010	0.00995	0.00124	6,292
			3	110.3	100.1	10.2	8.8	8.0	0.8	0.00990	0.01020	0.01005	0.00125	6,387
			4	109.3	99.1	10.3	8.7	7.9	0.8	0.00990	0.01010	0.01000	0.00125	6,330
			5	109.2	98.7	10.5	8.7	7.9	0.8	0.00980	0.01010	0.00995	0.00125	6,333
	COLUMN AVERAGE		109.3	99.0	10.4	8.7	7.9	0.8	0.00990	0.01010	0.01000	0.00125	6,332	
	STANDARD DEV.		0.6	0.8	0.2	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	35	
Sequence 15	2.00	10.00	1	138.2	125.5	12.7	11.1	10.0	1.0	0.01360	0.01380	0.01370	0.00172	5,850
			2	138.0	125.1	12.9	11.0	10.0	1.0	0.01350	0.01380	0.01365	0.00171	5,863
			3	138.9	126.2	12.8	11.1	10.1	1.0	0.01360	0.01380	0.01370	0.00171	5,887
			4	138.4	125.4	12.9	11.1	10.0	1.0	0.01350	0.01380	0.01365	0.00171	5,871
			5	138.6	125.7	12.9	11.1	10.1	1.0	0.01360	0.01390	0.01375	0.00172	5,853
	COLUMN AVERAGE		138.4	125.6	12.8	11.1	10.0	1.0	0.01360	0.01380	0.01370	0.00171	5,865	
	STANDARD DEV.		0.4	0.4	0.1	0.0	0.0	0.0	0.00010	0.00000	0.00005	0.00000	15	

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF RESILIENT MODULUS TESTING
FOR PEDEOLOGICAL SOIL SURVEY

Project Location: U.S. Highway 77 Improvement South of Tonkawa

Project No.: SSP-136C(101)SS

Job Piece No: 21854(04)

Surveyed by: Jim Nevels

County: Kay County

Date Surveyed: October 2, 2010

Lab No.: S10632

Burgess Job No.: 731-10119

Soil Series: **Lela Soil Series Composite B**

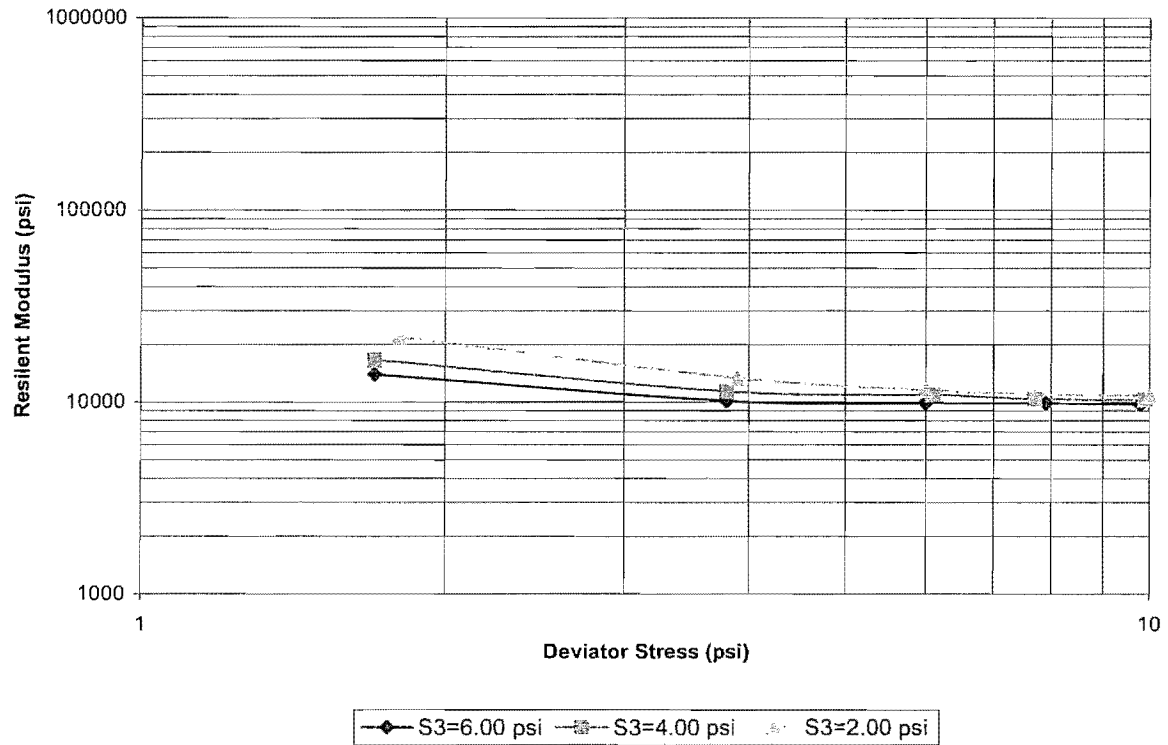
Desired Moisture Content: 21 %

Desired Dry Density: 95.6 pcf

Sample I.D.	Chamber Pressure (psi)	Axial Stress (psi)	Moisture Content (%)	Dry Density (pcf)	Resilient Strain (in/in)	Resilient Modulus (psi)	Standard Deviation for M _R
MR4-1-A	6.0	1.7	20.5	95.9	0.00013	13934.0	416.1
		3.8			0.00037	10146.2	173.9
		6.0			0.00060	9913.5	84.5
		7.9			0.00080	9853.7	33.2
		9.8			0.00101	9718.6	52.7
	4.0	1.7			0.00010	16517.2	305.7
		3.8			0.00034	11372.0	122.4
		6.1			0.00056	10909.6	115.9
		7.7			0.00074	10373.0	82.3
		9.9			0.00095	10326.5	43.7
	2.0	1.8			0.00008	21722.8	716.7
		3.9			0.00029	13318.8	187.6
		6.0			0.00052	11562.8	44.2
		7.7			0.00070	11033.4	69.8
		10.0			0.00093	10817.4	53.7

RESILIENT MODULUS TESTING - AASHTO T307-99

MR4-1-A @ 95% Dry Density & Opt. Moisture



LOCATION		DESCRIPTION	
Project Location: U.S. Highway 77 Improvement		MR4-1-A	
Project No.: SSP-136C(101)SS		RM=a(S _d) ^b	
Soil Series: Lela Soil Series Composite B		Values for S _d are:	
Sample by: Jim Nevels		S3=6.00psi: 1.7, 3.8, 6.0, 7.9, 9.8 psi	
Sample Date: October 2, 2010		S3=4.00psi: 1.7, 3.8, 6.1, 7.7, 9.9 psi	
Burgess Job No.: 731-10119		S3=2.00psi: 1.8, 3.9, 6.0, 7.7, 10.0 psi	
Sample No. MR4-1-A		Calculated units of values for RM are in psi	
S ₃	6.00 psi	4.00 psi	2.00 psi
R ²	0.8234	0.8890	0.9247
a	14612	17942	25836
b	-0.2001	-0.2668	-0.4158
RESILIENT MODULUS TESTING AASHTO T307-99		BURGESS ENGINEERING AND TESTING, INC.	

BURGESS ENGINEERING AND TESTING, INC.

Resilient Modulus Testing - AASHTO T307-99

Date: 10/08/2010

Client:
Smith Roberts Baldischwiler, LLC.

Attn: Mr. Gary Noland, P.E.
104 S 2nd Street
Chickasha, OK 73018

Project: U.S. Highway 77 Improvement South of
Tonkawa

Project Description: Resilient Modulus Test

AASHTO T307-99

BETI Project No.: 731-10119

Soil Series: Lela Soil Series Composite B

Sample Information

Sample ID: MR4-1-A	Sample Diameter, in.: 4	Sample M.C., %: 20.5
Sample Type: 95% Dry Density & Opt. Moisture	Sample Height, in.: 8	Sample Dry Den., pcf: 95.9
Test Date: 10/08/10	Desired M.C., %: 21.0	Failed in Shear?:
Remarks:	Dry Den., pcf: 95.6	Triaxial Shear Strength, psi:

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	Chamber Confining Pressure	Nominal Maximum Axial Stress	Cycle No.	Actual Applied Max. Axial Load	Actual Applied Cyclic Load	Actual Applied Contact Load	Actual Applied Max. Axial Stress	Actual Applied Cyclic Stress	Actual Applied Contact Stress	Recov. Def. LVDT #1 Reading	Recov. Def. LVDT #2 Reading	Average Recov. Def. LVDT 1 and 2	Resilient Strain	Resilient Modulus
DESIGNATION	S3	Scyclic	cl	Pmax	Pcyclic	Pcontact	Smax	Scyclic	Scontact	H1	H2	Havg	Er	Mr
UNIT	psi	psi	---	lbf	lbf	lbf	psi	psi	psi	in	in	in	in/in	psi
PRECISION	---	---	-	---	---	---	---	---	---	---	---	---	---	---
Sequence 1	6.00	2.00	1	25.1	22.6	2.5	2.0	1.8	0.2	0.00110	0.00110	0.00110	0.000130	13,396
			2	23.6	21.4	2.2	1.9	1.7	0.2	0.00090	0.00100	0.00095	0.000120	13,873
			3	24.1	22.1	2.0	1.9	1.8	0.2	0.00090	0.00100	0.00095	0.000120	14,539
			4	23.0	20.9	2.1	1.8	1.7	0.2	0.00090	0.00100	0.00095	0.000120	14,062
			5	23.9	21.8	2.0	1.9	1.7	0.2	0.00100	0.00100	0.00100	0.000130	13,801
	COLUMN AVERAGE			23.9	21.8	2.2	1.9	1.7	0.2	0.00100	0.00100	0.00100	0.000130	13,934
	STANDARD DEV.			0.8	0.7	0.2	0.1	0.1	0.0	0.00010	0.00010	0.00010	0.000010	416

BURGESS ENGINEERING AND TESTING, INC.

MR4-1-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 2	6.00	4.00	1	53.9	48.6	5.3	4.3	3.9	0.4	0.00290	0.00310	0.00300	0.00037	10,433
			2	52.2	47.1	5.2	4.2	3.8	0.4	0.00290	0.00300	0.00295	0.00037	10,104
			3	51.9	46.9	5.0	4.1	3.7	0.4	0.00290	0.00300	0.00295	0.00037	10,119
			4	51.2	46.1	5.1	4.1	3.7	0.4	0.00290	0.00300	0.00295	0.00037	9,958
			5	52.4	47.5	4.9	4.2	3.8	0.4	0.00300	0.00300	0.00300	0.00038	10,116
	COLUMN AVERAGE		52.3	47.2	5.1	4.2	3.8	0.4	0.00290	0.00300	0.00295	0.00037	10,146	
	STANDARD DEV.		1.0	0.9	0.2	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	174	
Sequence 3	6.00	6.00	1	82.0	74.3	7.7	6.6	5.9	0.6	0.00470	0.00490	0.00480	0.00060	9,921
			2	82.7	75.2	7.6	6.6	6.0	0.6	0.00470	0.00490	0.00480	0.00060	9,940
			3	83.2	75.8	7.4	6.7	6.1	0.6	0.00470	0.00500	0.00485	0.00060	10,027
			4	81.3	73.8	7.5	6.5	5.9	0.6	0.00460	0.00490	0.00475	0.00060	9,886
			5	80.9	73.2	7.7	6.5	5.9	0.6	0.00470	0.00490	0.00480	0.00060	9,794
	COLUMN AVERAGE		82.0	74.5	7.6	6.6	6.0	0.6	0.00470	0.00490	0.00480	0.00060	9,914	
	STANDARD DEV.		1.0	1.0	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	85	
Sequence 4	6.00	8.00	1	108.7	98.5	10.2	8.7	7.9	0.8	0.00620	0.00660	0.00640	0.00080	9,869
			2	109.1	99.0	10.2	8.7	7.9	0.8	0.00620	0.00660	0.00640	0.00080	9,874
			3	108.8	98.8	10.0	8.7	7.9	0.8	0.00620	0.00670	0.00645	0.00080	9,847
			4	109.0	98.8	10.2	8.7	7.9	0.8	0.00620	0.00660	0.00640	0.00080	9,880
			5	108.7	98.6	10.1	8.7	7.9	0.8	0.00620	0.00670	0.00645	0.00080	9,799
	COLUMN AVERAGE		108.9	98.7	10.1	8.7	7.9	0.8	0.00620	0.00660	0.00640	0.00080	9,854	
	STANDARD DEV.		0.2	0.2	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	33	
Sequence 5	6.00	10.00	1	134.6	122.0	12.7	10.8	9.8	1.0	0.00780	0.00840	0.00810	0.00101	9,671
			2	134.8	122.2	12.6	10.8	9.8	1.0	0.00770	0.00840	0.00805	0.00101	9,704
			3	134.6	122.1	12.5	10.8	9.8	1.0	0.00780	0.00830	0.00805	0.00101	9,699
			4	135.7	123.1	12.6	10.9	9.8	1.0	0.00770	0.00830	0.00800	0.00100	9,809
			5	135.0	122.3	12.7	10.8	9.8	1.0	0.00780	0.00830	0.00805	0.00101	9,711
	COLUMN AVERAGE		135.0	122.3	12.6	10.8	9.8	1.0	0.00780	0.00830	0.00805	0.00101	9,719	
	STANDARD DEV.		0.5	0.4	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	53	

BURGESS ENGINEERING AND TESTING, INC.

MR4-1-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 6	4.00	2.00	1	24.3	20.4	3.9	1.9	1.6	0.3	0.0008	0.0008	0.0008	0.0001	16,593
			2	24.7	21.0	3.7	2.0	1.7	0.3	0.0008	0.0009	0.0009	0.0001	16,297
			3	24.0	20.2	3.8	1.9	1.6	0.3	0.0008	0.0008	0.0008	0.0001	16,128
			4	24.5	20.3	4.2	2.0	1.6	0.3	0.0007	0.0008	0.0008	0.0001	16,897
			5	25.3	21.4	3.9	2.0	1.7	0.3	0.0008	0.0008	0.0008	0.0001	16,672
	COLUMN AVERAGE		24.6	20.7	3.9	2.0	1.7	0.3	0.0008	0.0008	0.0008	0.0001	16,517	
	STANDARD DEV.		0.5	0.5	0.2	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	306	
Sequence 7	4.00	4.00	1	54.1	48.9	5.2	4.3	3.9	0.4	0.0027	0.0029	0.0028	0.0004	11,310
			2	53.3	48.1	5.1	4.3	3.8	0.4	0.0026	0.0028	0.0027	0.0003	11,467
			3	51.6	46.5	5.2	4.1	3.7	0.4	0.0026	0.0027	0.0027	0.0003	11,291
			4	53.6	48.4	5.2	4.3	3.9	0.4	0.0027	0.0028	0.0028	0.0003	11,256
			5	51.8	46.6	5.2	4.1	3.7	0.4	0.0025	0.0026	0.0026	0.0003	11,536
	COLUMN AVERAGE		52.9	47.7	5.2	4.2	3.8	0.4	0.0026	0.0028	0.0027	0.0003	11,372	
	STANDARD DEV.		1.1	1.1	0.0	0.1	0.1	0.0	0.0001	0.0001	0.0001	0.0000	122	
Sequence 8	4.00	6.00	1	83.3	75.4	7.9	6.7	6.0	0.6	0.0043	0.0045	0.0044	0.0006	10,899
			2	84.0	76.6	7.4	6.7	6.1	0.6	0.0044	0.0046	0.0045	0.0006	10,870
			3	82.3	74.4	7.9	6.6	5.9	0.6	0.0043	0.0045	0.0044	0.0006	10,761
			4	83.8	75.7	8.2	6.7	6.1	0.7	0.0043	0.0045	0.0044	0.0006	10,939
			5	85.7	77.7	8.0	6.9	6.2	0.6	0.0044	0.0046	0.0045	0.0006	11,080
	COLUMN AVERAGE		83.8	76.0	7.9	6.7	6.1	0.6	0.0044	0.0045	0.0045	0.0006	10,910	
	STANDARD DEV.		1.2	1.3	0.3	0.1	0.1	0.0	0.0001	0.0000	0.0001	0.0000	116	
Sequence 9	4.00	8.00	1	107.2	96.1	11.1	8.6	7.7	0.9	0.0058	0.0061	0.0060	0.0007	10,320
			2	107.3	96.2	11.1	8.6	7.7	0.9	0.0059	0.0061	0.0060	0.0008	10,256
			3	107.6	96.4	11.2	8.6	7.7	0.9	0.0057	0.0061	0.0059	0.0007	10,414
			4	107.6	96.5	11.2	8.6	7.7	0.9	0.0057	0.0061	0.0059	0.0007	10,420
			5	107.6	96.4	11.2	8.6	7.7	0.9	0.0057	0.0061	0.0059	0.0007	10,455
	COLUMN AVERAGE		107.5	96.3	11.2	8.6	7.7	0.9	0.0058	0.0061	0.0060	0.0007	10,373	
	STANDARD DEV.		0.2	0.2	0.0	0.0	0.0	0.0	0.0001	0.0000	0.0001	0.0000	82	
Sequence 10	4.00	10.00	1	135.8	122.6	13.2	10.9	9.8	1.1	0.0074	0.0078	0.0076	0.0010	10,288
			2	137.1	123.9	13.2	11.0	9.9	1.1	0.0074	0.0078	0.0076	0.0010	10,381
			3	136.2	123.1	13.2	10.9	9.8	1.1	0.0074	0.0078	0.0076	0.0010	10,338
			4	136.9	123.9	13.0	10.9	9.9	1.0	0.0074	0.0079	0.0077	0.0010	10,350
			5	135.9	122.8	13.1	10.9	9.8	1.0	0.0074	0.0079	0.0077	0.0010	10,276
	COLUMN AVERAGE		136.4	123.2	13.1	10.9	9.9	1.0	0.0074	0.0079	0.0077	0.0010	10,327	
	STANDARD DEV.		0.6	0.6	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	44	

BURGESS ENGINEERING AND TESTING, INC.

MR4-1-A

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 11	2.00	2.00	1	25.3	22.8	2.5	2.0	1.8	0.2	0.00060	0.00070	0.00065	0.00008	22,629
			2	25.6	22.7	2.9	2.1	1.8	0.2	0.00070	0.00070	0.00070	0.00009	21,011
			3	26.0	23.4	2.7	2.1	1.9	0.2	0.00070	0.00070	0.00070	0.00009	20,990
			4	24.7	21.7	2.9	2.0	1.7	0.2	0.00060	0.00070	0.00065	0.00008	21,842
			5	24.0	21.1	3.0	1.9	1.7	0.2	0.00060	0.00060	0.00060	0.00008	22,142
	COLUMN AVERAGE		25.1	22.3	2.8	2.0	1.8	0.2	0.00060	0.00070	0.00065	0.00008	21,723	
	STANDARD DEV.		0.8	0.9	0.2	0.1	0.1	0.0	0.00010	0.00000	0.00005	0.00001	717	
Sequence 12	2.00	4.00	1	54.1	49.7	4.4	4.3	4.0	0.4	0.00230	0.00250	0.00240	0.00030	13,234
			2	53.6	49.3	4.3	4.3	3.9	0.3	0.00230	0.00240	0.00235	0.00029	13,441
			3	51.3	46.6	4.7	4.1	3.7	0.4	0.00220	0.00230	0.00225	0.00028	13,129
			4	56.7	52.3	4.4	4.5	4.2	0.4	0.00240	0.00250	0.00245	0.00031	13,584
			5	51.9	47.3	4.7	4.2	3.8	0.4	0.00220	0.00230	0.00225	0.00029	13,206
	COLUMN AVERAGE		53.5	49.0	4.5	4.3	3.9	0.4	0.00230	0.00240	0.00235	0.00029	13,319	
	STANDARD DEV.		2.1	2.2	0.2	0.2	0.2	0.0	0.00010	0.00010	0.00010	0.00001	188	
Sequence 13	2.00	6.00	1	81.7	74.9	6.8	6.5	6.0	0.5	0.00400	0.00420	0.00410	0.00052	11,596
			2	81.6	74.7	6.8	6.5	6.0	0.5	0.00400	0.00430	0.00415	0.00052	11,489
			3	81.7	74.8	6.9	6.5	6.0	0.6	0.00400	0.00420	0.00410	0.00052	11,578
			4	81.8	75.0	6.9	6.5	6.0	0.6	0.00400	0.00430	0.00415	0.00052	11,594
			5	82.1	75.3	6.9	6.6	6.0	0.5	0.00410	0.00430	0.00420	0.00052	11,558
	COLUMN AVERAGE		81.8	74.9	6.9	6.5	6.0	0.5	0.00400	0.00430	0.00415	0.00052	11,563	
	STANDARD DEV.		0.2	0.2	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	44	
Sequence 14	2.00	8.00	1	106.2	95.8	10.4	8.5	7.7	0.8	0.00540	0.00570	0.00555	0.00069	11,052
			2	106.8	96.4	10.4	8.5	7.7	0.8	0.00540	0.00580	0.00560	0.00070	11,076
			3	106.8	96.4	10.4	8.5	7.7	0.8	0.00550	0.00570	0.00560	0.00070	10,984
			4	106.9	96.5	10.4	8.5	7.7	0.8	0.00540	0.00570	0.00555	0.00069	11,114
			5	106.4	96.0	10.4	8.5	7.7	0.8	0.00550	0.00580	0.00565	0.00070	10,941
	COLUMN AVERAGE		106.6	96.2	10.4	8.5	7.7	0.8	0.00540	0.00570	0.00555	0.00070	11,033	
	STANDARD DEV.		0.3	0.3	0.0	0.0	0.0	0.0	0.00010	0.00000	0.00005	0.00000	70	
Sequence 15	2.00	10.00	1	137.9	124.9	13.0	11.0	10.0	1.0	0.00720	0.00760	0.00740	0.00092	10,802
			2	138.3	125.2	13.1	11.1	10.0	1.0	0.00730	0.00760	0.00745	0.00093	10,743
			3	138.8	125.6	13.1	11.1	10.0	1.0	0.00720	0.00750	0.00735	0.00092	10,891
			4	138.2	125.1	13.1	11.1	10.0	1.0	0.00730	0.00750	0.00740	0.00092	10,818
			5	138.2	125.1	13.1	11.1	10.0	1.0	0.00720	0.00760	0.00740	0.00092	10,833
	COLUMN AVERAGE		138.3	125.2	13.1	11.1	10.0	1.0	0.00720	0.00760	0.00740	0.00093	10,817	
	STANDARD DEV.		0.3	0.3	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	54	

BURGESS ENGINEERING AND TESTING, INC.
SUMMARY OF RESILIENT MODULUS TESTING
FOR PEDEOLOGICAL SOIL SURVEY

Project Location: U.S. Highway 77 Improvement South of Tonkawa

Project No.: SSP-136C(101)SS

Job Piece No: 21854(04)

Surveyed by: Jim Nevels

County: Kay County

Date Surveyed: October 2, 2010

Lab No.: S10632

Burgess Job No.: 731-10119

Soil Series: **Lela Soil Series Composite B**

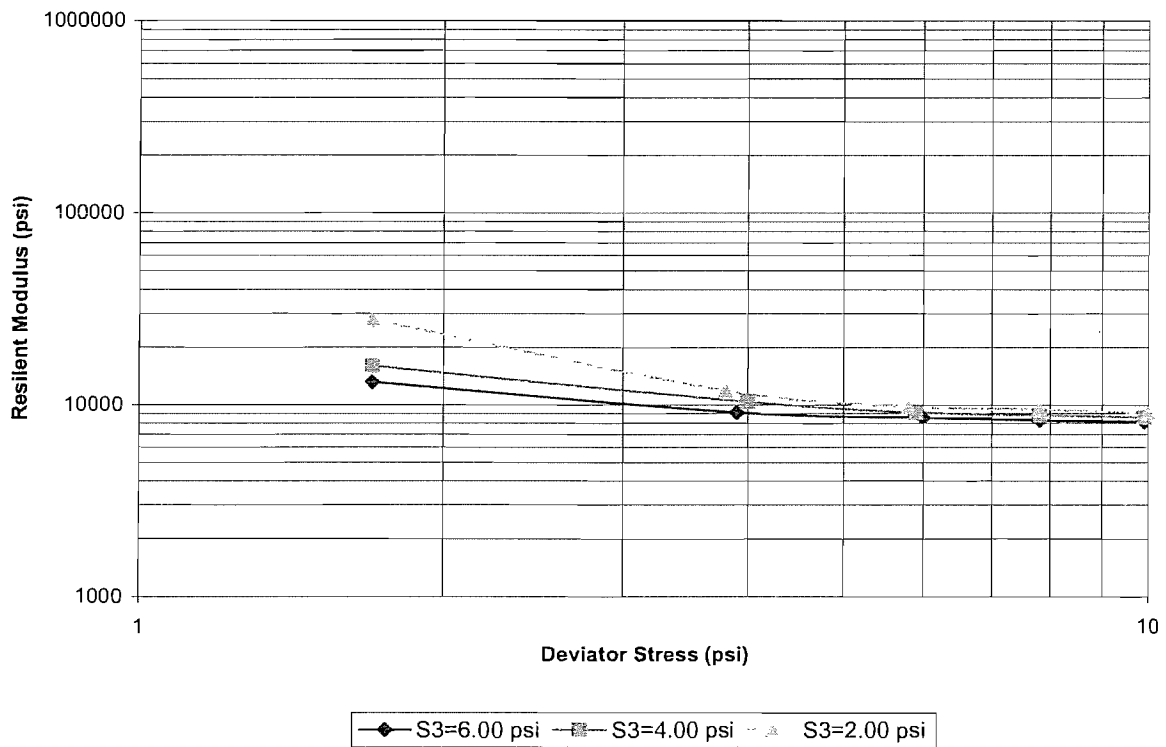
Desired Moisture Content: 23 %

Desired Dry Density: 99.3 pcf

Sample I.D.	Chamber Pressure (psi)	Axial Stress (psi)	Moisture Content (%)	Dry Density (pcf)	Resilient Strain (in/in)	Resilient Modulus (psi)	Standard Deviation for M_R
MR4-1-B	6.0	1.7	23.4	99.9	0.00013	13128.0	378.7
		3.9			0.00042	9119.3	120.8
		6.0			0.00070	8576.4	43.6
		7.8			0.00093	8312.2	39.3
		9.9			0.00122	8133.0	20.5
	4.0	1.7			0.00010	15928.6	230.0
		4.0			0.00038	10394.9	134.3
		5.9			0.00065	9085.5	61.6
		7.8			0.00089	8786.5	20.6
		9.9			0.00115	8607.8	10.9
	2.0	1.7			0.00006	27621.8	1441.9
		3.8			0.00032	11847.5	52.7
		5.8			0.00059	9840.6	99.2
		7.8			0.00082	9443.0	63.2
		10.0			0.00111	9069.5	32.9

RESILIENT MODULUS TESTING - AASHTO T307-99

MR4-1-B @ Opt. Moisture + 2%



LOCATION		DESCRIPTION	
Project Location: U.S. Highway 77 Improvement		MR4-1-B	
Project No.: SSP-136C(101)SS		RM=a(S _d) ^b	
Soil Series: Lela Soil Series Composite B		Values for S _d are:	
Sample by: Jim Nevels		S3=6.00psi: 1.7, 3.9, 6.0, 7.8, 9.9 psi	
Sample Date: October 2, 2010		S3=4.00psi: 1.7, 4.0, 5.9, 7.8, 9.9 psi	
Burgess Job No.: 731-10119		S3=2.00psi: 1.7, 3.8, 5.8, 7.8, 10.0 psi	
Sample No. MR4-1-B		Calculated units of values for RM are in psi	
S ₃	6.00 psi	4.00 psi	2.00 psi
R ²	0.9107	0.9393	0.8910
a	14391	18313	33574
b	-0.2721	-0.3603	-0.6317
RESILIENT MODULUS TESTING AASHTO T307-99		BURGESS ENGINEERING AND TESTING, INC.	

BURGESS ENGINEERING AND TESTING, INC.

Resilient Modulus Testing - AASHTO T307-99

Date: 10/08/2010

Client:
Smith Roberts Baldischwiler, LLC.
 Attn: Mr. Gary Noland, P.E.
 104 S 2nd Street
 Chickasha, OK 73018

Project: U.S. Highway 77 Improvement South of
 Tonkawa
 Project Description: Resilient Modulus Test

AASHTO T307-99
 BETI Project No.: 731-10119
 Soil Series: Lela Soil Series Composite B

Sample Information

Sample ID: MR4-1-B	Sample Diameter, in.: 4	Sample M.C., %: 23.4
Sample Type: Opt. Moisture + 2%	Sample Height, in.: 8	Sample Dry Den., pcf: 99.9
Test Date: 10/08/10	Desired M.C., %: 23.0	Failed in Shear?:
Remarks:	Dry Den., pcf: 99.3	Triaxial Shear Strength, psi:

COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
PARAMETER	Chamber Confining Pressure	Nominal Maximum Axial Stress	Cycle No.	Actual Applied Max. Axial Load	Actual Applied Cyclic Load	Actual Applied Contact Load	Actual Applied Max. Axial Stress	Actual Applied Cyclic Stress	Actual Applied Contact Stress	Recov. Def. LVDT #1 Reading	Recov. Def. LVDT #2 Reading	Average Recov. Def. LVDT 1 and 2	Resilient Strain	Resilient Modulus
DESIGNATION	S3	Scyclic	cl	Pmax	Pcyclic	Pcontact	Smax	Scyclic	Scontact	H1	H2	Havg	Er	Mr
UNIT	psi	psi	---	lbf	lbf	lbf	psi	psi	psi	in	in	in	in/in	psi
PRECISION	---	---	-	---	---	---	---	---	---	---	---	---	---	---
Sequence 1	6.00	2.00	1	24.7	21.4	3.3	2.0	1.7	0.3	0.00100	0.00110	0.00105	0.000130	12,997
			2	25.8	22.9	2.9	2.1	1.8	0.2	0.00110	0.00120	0.00115	0.000140	12,722
			3	23.8	20.7	3.1	1.9	1.7	0.2	0.00100	0.00100	0.00100	0.000130	13,249
			4	24.1	21.1	3.1	1.9	1.7	0.2	0.00100	0.00110	0.00105	0.000130	12,955
			5	23.4	20.3	3.2	1.9	1.6	0.3	0.00100	0.00090	0.00095	0.000120	13,717
	COLUMN AVERAGE			24.4	21.3	3.1	2.0	1.7	0.2	0.00100	0.00110	0.00105	0.000130	13,128
	STANDARD DEV.			0.9	1.0	0.2	0.1	0.1	0.0	0.00010	0.00010	0.00010	0.000010	379

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COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 2	6.00	4.00	1	54.5	48.8	5.6	4.4	3.9	0.5	0.00340	0.00340	0.00340	0.00042	9,191
			2	54.9	49.3	5.7	4.4	3.9	0.5	0.00340	0.00340	0.00340	0.00042	9,284
			3	53.8	48.1	5.7	4.3	3.8	0.5	0.00340	0.00340	0.00340	0.00042	9,073
			4	53.5	47.7	5.7	4.3	3.8	0.5	0.00340	0.00340	0.00340	0.00042	9,081
			5	53.2	47.4	5.8	4.3	3.8	0.5	0.00340	0.00340	0.00340	0.00042	8,969
	COLUMN AVERAGE		54.0	48.3	5.7	4.3	3.9	0.5	0.00340	0.00340	0.00340	0.00042	9,119	
	STANDARD DEV.		0.7	0.8	0.0	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	121	
Sequence 3	6.00	6.00	1	82.4	74.4	8.0	6.6	6.0	0.6	0.00550	0.00560	0.00555	0.00069	8,565
			2	82.7	74.8	7.9	6.6	6.0	0.6	0.00550	0.00560	0.00555	0.00070	8,590
			3	83.3	75.3	8.0	6.7	6.0	0.6	0.00550	0.00560	0.00555	0.00070	8,641
			4	82.5	74.3	8.2	6.6	5.9	0.7	0.00550	0.00560	0.00555	0.00069	8,562
			5	82.7	74.7	8.0	6.6	6.0	0.6	0.00560	0.00560	0.00560	0.00070	8,523
	COLUMN AVERAGE		82.7	74.7	8.0	6.6	6.0	0.6	0.00550	0.00560	0.00555	0.00070	8,576	
	STANDARD DEV.		0.3	0.4	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	44	
Sequence 4	6.00	8.00	1	108.0	97.4	10.6	8.6	7.8	0.8	0.00730	0.00760	0.00745	0.00094	8,321
			2	106.5	95.8	10.6	8.5	7.7	0.9	0.00730	0.00750	0.00740	0.00093	8,255
			3	107.0	96.5	10.5	8.6	7.7	0.8	0.00730	0.00760	0.00745	0.00093	8,292
			4	108.5	97.8	10.7	8.7	7.8	0.9	0.00740	0.00760	0.00750	0.00094	8,355
			5	107.8	97.2	10.6	8.6	7.8	0.8	0.00740	0.00760	0.00750	0.00093	8,338
	COLUMN AVERAGE		107.6	97.0	10.6	8.6	7.8	0.8	0.00740	0.00760	0.00750	0.00093	8,312	
	STANDARD DEV.		0.8	0.8	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	39	
Sequence 5	6.00	10.00	1	137.6	124.4	13.1	11.0	10.0	1.1	0.00970	0.00990	0.00980	0.00122	8,125
			2	137.3	124.0	13.3	11.0	9.9	1.1	0.00970	0.00990	0.00980	0.00122	8,111
			3	137.6	124.4	13.2	11.0	9.9	1.1	0.00960	0.00990	0.00975	0.00122	8,163
			4	137.2	124.1	13.1	11.0	9.9	1.0	0.00960	0.00990	0.00975	0.00122	8,144
			5	136.5	123.2	13.2	10.9	9.9	1.1	0.00960	0.00980	0.00970	0.00121	8,122
	COLUMN AVERAGE		137.2	124.0	13.2	11.0	9.9	1.1	0.00960	0.00990	0.00975	0.00122	8,133	
	STANDARD DEV.		0.5	0.5	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	21	

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COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 6	4.00	2.00	1	24.8	21.5	3.3	2.0	1.7	0.3	0.0009	0.0008	0.0009	0.0001	16,057
			2	24.2	20.9	3.3	1.9	1.7	0.3	0.0008	0.0009	0.0009	0.0001	16,024
			3	23.5	20.2	3.3	1.9	1.6	0.3	0.0009	0.0008	0.0009	0.0001	15,624
			4	23.9	20.6	3.3	1.9	1.6	0.3	0.0008	0.0009	0.0009	0.0001	15,756
			5	24.4	21.2	3.2	1.9	1.7	0.3	0.0008	0.0009	0.0009	0.0001	16,181
	COLUMN AVERAGE		24.2	20.9	3.3	1.9	1.7	0.3	0.0008	0.0008	0.0008	0.0001	15,929	
	STANDARD DEV.		0.5	0.5	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	230	
Sequence 7	4.00	4.00	1	55.6	50.1	5.5	4.4	4.0	0.4	0.0031	0.0031	0.0031	0.0004	10,395
			2	56.0	50.7	5.4	4.5	4.1	0.4	0.0031	0.0031	0.0031	0.0004	10,552
			3	56.1	50.6	5.5	4.5	4.0	0.4	0.0031	0.0031	0.0031	0.0004	10,489
			4	53.9	48.3	5.6	4.3	3.9	0.4	0.0030	0.0030	0.0030	0.0004	10,208
			5	54.2	48.7	5.5	4.3	3.9	0.4	0.0030	0.0030	0.0030	0.0004	10,332
	COLUMN AVERAGE		55.2	49.7	5.5	4.4	4.0	0.4	0.0031	0.0031	0.0031	0.0004	10,395	
	STANDARD DEV.		1.1	1.1	0.1	0.1	0.1	0.0	0.0000	0.0000	0.0000	0.0000	134	
Sequence 8	4.00	6.00	1	81.7	73.9	7.9	6.5	5.9	0.6	0.0051	0.0052	0.0052	0.0007	9,116
			2	81.5	73.7	7.8	6.5	5.9	0.6	0.0051	0.0052	0.0052	0.0007	9,081
			3	80.8	72.9	7.9	6.5	5.8	0.6	0.0051	0.0052	0.0052	0.0006	9,049
			4	81.9	74.2	7.7	6.6	5.9	0.6	0.0051	0.0053	0.0052	0.0007	9,171
			5	80.8	73.0	7.8	6.5	5.8	0.6	0.0051	0.0053	0.0052	0.0007	9,011
	COLUMN AVERAGE		81.4	73.5	7.8	6.5	5.9	0.6	0.0051	0.0052	0.0052	0.0007	9,086	
	STANDARD DEV.		0.5	0.6	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	62	
Sequence 9	4.00	8.00	1	107.8	97.6	10.2	8.6	7.8	0.8	0.0070	0.0072	0.0071	0.0009	8,784
			2	107.8	97.7	10.1	8.6	7.8	0.8	0.0070	0.0072	0.0071	0.0009	8,820
			3	107.9	97.9	10.0	8.6	7.8	0.8	0.0070	0.0072	0.0071	0.0009	8,789
			4	107.4	97.2	10.2	8.6	7.8	0.8	0.0070	0.0072	0.0071	0.0009	8,773
			5	107.2	97.1	10.0	8.6	7.8	0.8	0.0070	0.0072	0.0071	0.0009	8,767
	COLUMN AVERAGE		107.6	97.5	10.1	8.6	7.8	0.8	0.0070	0.0072	0.0071	0.0009	8,787	
	STANDARD DEV.		0.3	0.3	0.1	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	21	
Sequence 10	4.00	10.00	1	137.1	124.4	12.6	11.0	10.0	1.0	0.0092	0.0093	0.0093	0.0012	8,600
			2	136.5	123.8	12.6	10.9	9.9	1.0	0.0091	0.0093	0.0092	0.0012	8,592
			3	136.6	123.8	12.7	10.9	9.9	1.0	0.0091	0.0093	0.0092	0.0012	8,615
			4	137.4	124.8	12.6	11.0	10.0	1.0	0.0092	0.0094	0.0093	0.0012	8,615
			5	136.9	124.3	12.6	11.0	9.9	1.0	0.0092	0.0093	0.0093	0.0012	8,616
	COLUMN AVERAGE		136.9	124.2	12.6	10.9	9.9	1.0	0.0091	0.0093	0.0092	0.0012	8,608	
	STANDARD DEV.		0.4	0.4	0.0	0.0	0.0	0.0	0.0000	0.0000	0.0000	0.0000	11	

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COLUMN #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sequence 11	2.00	2.00	1	23.3	21.2	2.1	1.9	1.7	0.2	0.00050	0.00040	0.00045	0.00006	28,223
			2	25.3	23.2	2.1	2.0	1.9	0.2	0.00050	0.00050	0.00050	0.00007	28,183
			3	24.4	22.0	2.3	1.9	1.8	0.2	0.00050	0.00060	0.00055	0.00007	25,833
			4	23.3	20.7	2.6	1.9	1.7	0.2	0.00050	0.00050	0.00050	0.00006	26,479
			5	23.1	20.5	2.6	1.9	1.6	0.2	0.00040	0.00040	0.00040	0.00006	29,392
	COLUMN AVERAGE		23.9	21.5	2.3	1.9	1.7	0.2	0.00050	0.00050	0.00050	0.00006	27,622	
	STANDARD DEV.		0.9	1.1	0.3	0.1	0.1	0.0	0.00000	0.00010	0.00005	0.00000	1,442	
Sequence 12	2.00	4.00	1	53.9	47.8	6.1	4.3	3.8	0.5	0.00260	0.00260	0.00260	0.00032	11,875
			2	53.6	47.6	6.0	4.3	3.8	0.5	0.00250	0.00260	0.00255	0.00032	11,848
			3	53.5	47.5	6.0	4.3	3.8	0.5	0.00260	0.00260	0.00260	0.00032	11,797
			4	54.1	48.1	6.0	4.3	3.9	0.5	0.00260	0.00260	0.00260	0.00032	11,920
			5	53.6	47.6	6.1	4.3	3.8	0.5	0.00260	0.00260	0.00260	0.00032	11,797
	COLUMN AVERAGE		53.7	47.7	6.0	4.3	3.8	0.5	0.00260	0.00260	0.00260	0.00032	11,848	
	STANDARD DEV.		0.3	0.3	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	53	
Sequence 13	2.00	6.00	1	80.9	73.3	7.6	6.5	5.9	0.6	0.00460	0.00480	0.00470	0.00059	9,962
			2	79.2	71.6	7.6	6.3	5.7	0.6	0.00470	0.00480	0.00475	0.00059	9,693
			3	80.1	72.3	7.8	6.4	5.8	0.6	0.00460	0.00480	0.00470	0.00059	9,822
			4	79.9	72.2	7.6	6.4	5.8	0.6	0.00460	0.00480	0.00470	0.00059	9,835
			5	80.6	73.0	7.6	6.4	5.8	0.6	0.00460	0.00480	0.00470	0.00059	9,891
	COLUMN AVERAGE		80.1	72.5	7.6	6.4	5.8	0.6	0.00460	0.00480	0.00470	0.00059	9,841	
	STANDARD DEV.		0.7	0.7	0.1	0.1	0.1	0.0	0.00000	0.00000	0.00000	0.00000	99	
Sequence 14	2.00	8.00	1	107.3	97.2	10.0	8.6	7.8	0.8	0.00650	0.00670	0.00660	0.00083	9,390
			2	107.6	97.5	10.1	8.6	7.8	0.8	0.00650	0.00670	0.00660	0.00082	9,490
			3	107.3	97.2	10.1	8.6	7.8	0.8	0.00650	0.00670	0.00660	0.00083	9,414
			4	107.3	97.2	10.1	8.6	7.8	0.8	0.00650	0.00670	0.00660	0.00083	9,391
			5	107.9	97.8	10.1	8.6	7.8	0.8	0.00650	0.00670	0.00660	0.00082	9,529
	COLUMN AVERAGE		107.5	97.4	10.1	8.6	7.8	0.8	0.00650	0.00670	0.00660	0.00082	9,443	
	STANDARD DEV.		0.3	0.3	0.0	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	63	
Sequence 15	2.00	10.00	1	137.6	125.0	12.6	11.0	10.0	1.0	0.00870	0.00890	0.00880	0.00110	9,060
			2	138.0	125.5	12.5	11.0	10.0	1.0	0.00880	0.00890	0.00885	0.00111	9,070
			3	138.1	125.6	12.5	11.0	10.0	1.0	0.00880	0.00900	0.00890	0.00111	9,077
			4	138.8	126.2	12.5	11.1	10.1	1.0	0.00880	0.00890	0.00885	0.00111	9,116
			5	138.2	125.6	12.6	11.1	10.0	1.0	0.00880	0.00900	0.00890	0.00111	9,024
	COLUMN AVERAGE		138.1	125.6	12.5	11.0	10.0	1.0	0.00880	0.00900	0.00890	0.00111	9,070	
	STANDARD DEV.		0.4	0.4	0.1	0.0	0.0	0.0	0.00000	0.00000	0.00000	0.00000	33	

APPENDIX D

Abrasion and Corrosion Rating Table

CORRUGATED GALVANIZED STEEL PIPE CORROSION STRESS MAP

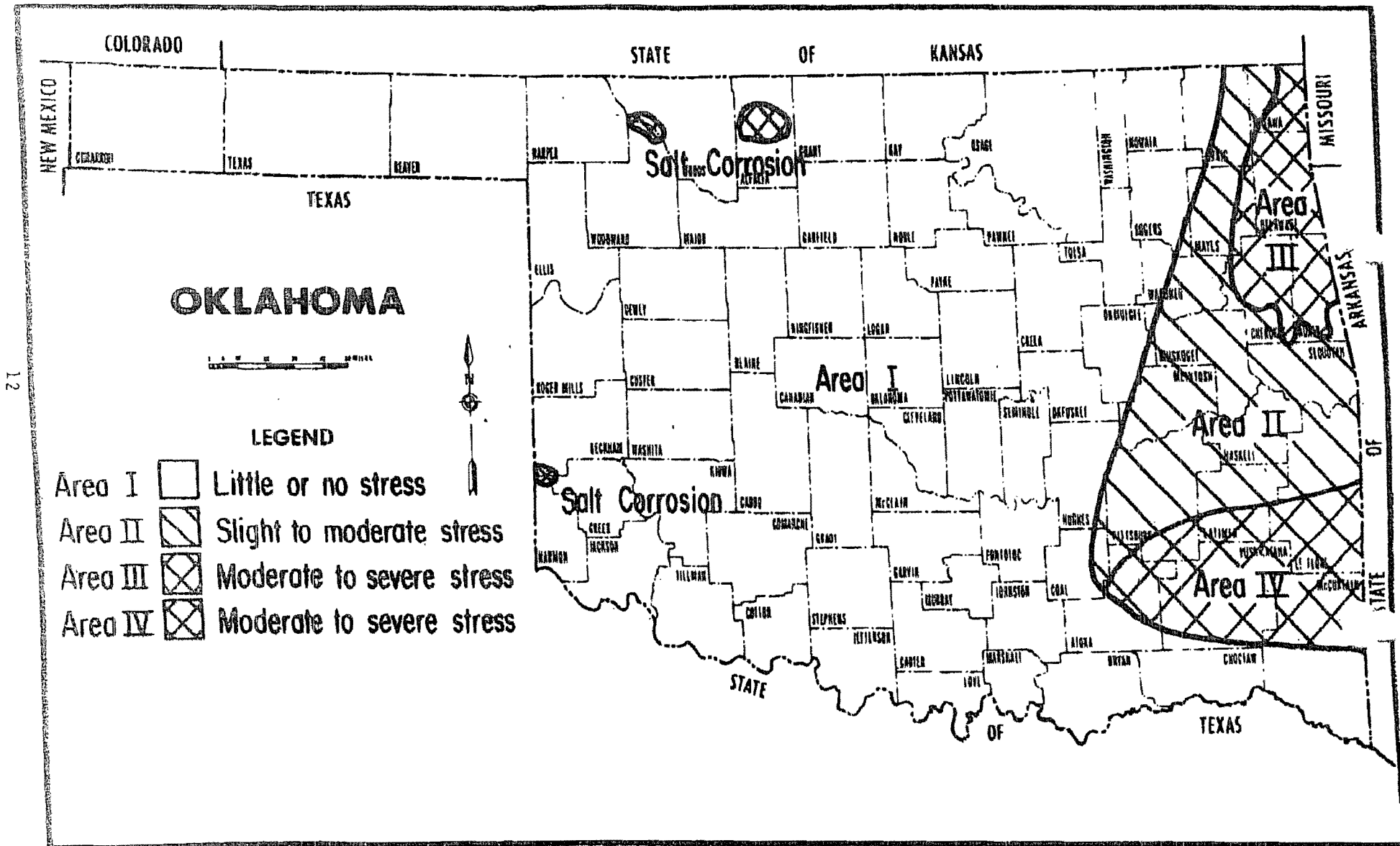


Figure 1. Map showing areas in Oklahoma where potential steel pipe culvert corrosion exists.

Table 1 – Typical Soil Resistivities

Classification	Resistivity Ohm-cm
Clay	750 - 2000
Loam	2000 - 10000
Gravel	10000 - 30000
Sand	30000 - 50000
Rock	50000 - Infinity*

* Theoretical

Table 2 – Corrosiveness of Soils

Soil Type	Description of Soil	Aeration	Drainage	Color	Water Table
I - Lightly Corrosive	1. Sands or Sandy Loams 2. Light Textured Silt Loams 3. Porus Loams or Clay Loams Thoroughly Oxidized to Great Depths	Good	Good	Uniform Color	Very Low
II - Moderately Corrosive	1. Sandy Loams 2. Silt Loams 3. Clay Loams	Fair	Fair	Slight Mottling	Water Table
III - Badly Corrosive	1. Clay Loams 2. Clays	Poor	Poor	Heavy Texture Moderate Mottling	Water Table
IV - Unusually Corrosive	1. Muck 2. Peat 3. Tidal Marsh 4. Clays and Organic Soils	Very Poor	Very Poor	Bluish-Gray Mottling	Water Table

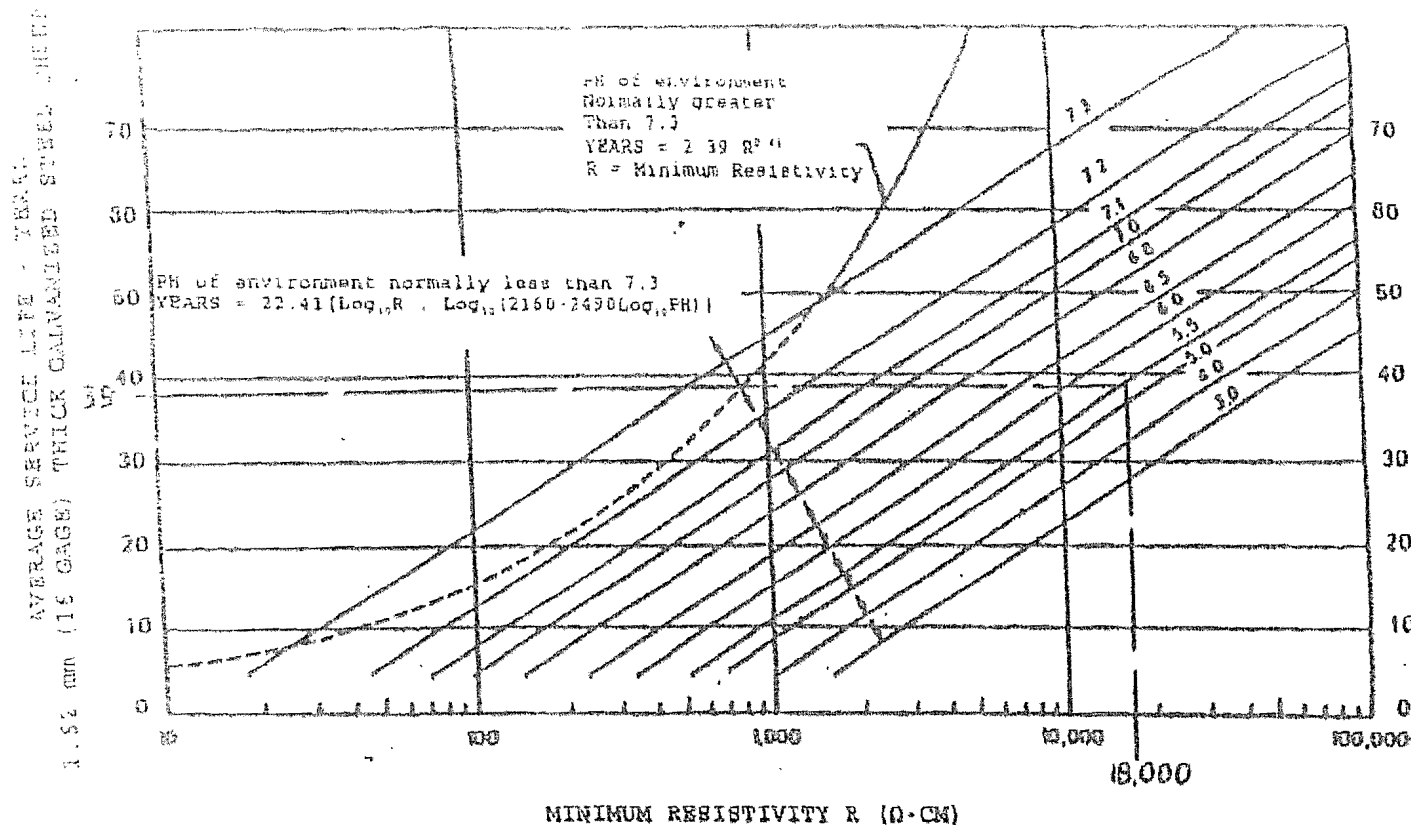


FIGURE 1 - FOR ESTIMATING AVERAGE SERVICE LIFE OF PLAIN GALVANIZED CULVERTS

FIGURE 1

Thickness, mm	.321	1.62	2.00	2.77	3.50	4.27
Thickness, in	0.052	0.064	0.079	0.109	0.138	0.168
Gage	18	16	14	12	10	8
Factor*	0.8	1.0	1.2	1.7	2.2	2.6

11-16-61

The curves in this graph are based on the data in FHWA-FLE-91-006 which uses the factors in California Test 643, "Method for Estimating the Service Life of Steel Culverts". These factors increased the estimated service life by 25% after first perforation.

The graph has also been modified to reflect a minimum metal thickness of 1.62 mm (16 gage).

Under conditions with S-PH-3, and R=1500 Ω-cm, the average service life determined for plain galvanized culverts should be multiplied by 2.0 for aluminized type II.

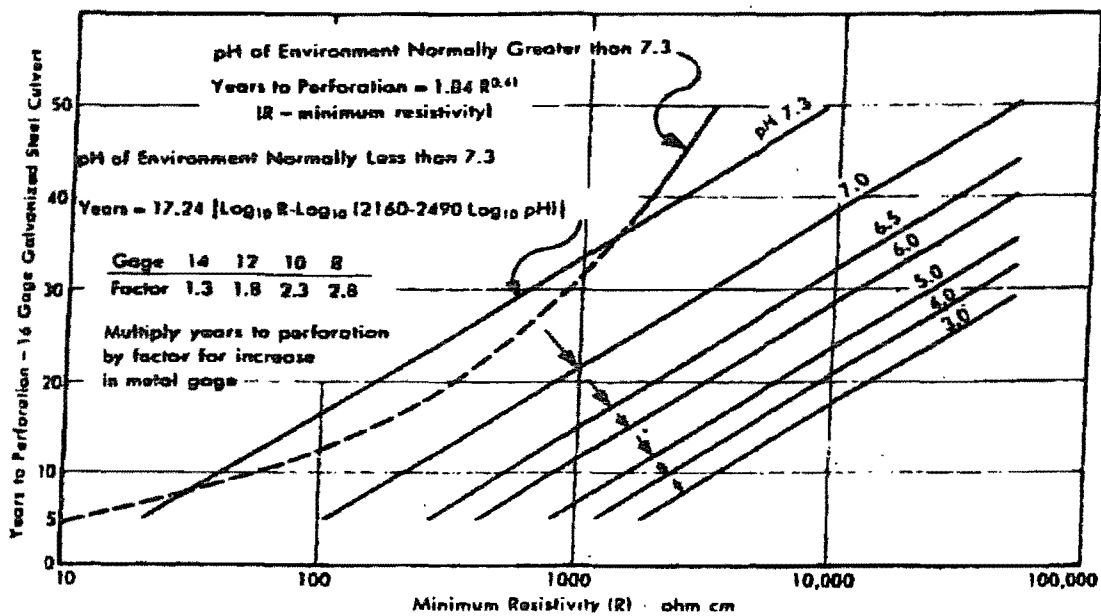
- The following procedure should be used when determining the types of pipe allowed for each use:
- (1) Evaluate a) Soil type at the structure, b) Abrasion characteristics of the stream bed, c) Area of the state for Corrosion Regions
 - (2) Enter the Abrasion / Corrosion Rating Chart with this data and pick the rating which best depicts the site conditions.
(Note: When (a) and (c) are in conflict, use the more conservative ratings)
 - (3) Enter the Allowable Pipe Types Chart and obtain the types of pipes allowed for each category of the Abrasion / Corrosion Rating.
 - (4) When more than one type of pipe is allowable, show these structures as one type but include payitem notes stating which other types may be substituted and the special requirements for such a substitution. Example note: "corrugated Polyethylene Pipe may be substituted for Reinforced Concrete Pipe. Construction shall be in accordance with the 'Flexible Pipe Installation' detail sheet."

ABRASION / CORROSION RATING

		SITE ABRASION CHARACTERISTICS					
		NONABRASIVE	LOW ABRASIVE	MODERATELY ABRASIVE	SEVERELY ABRASIVE		
		V = VERY LOW NO BED LOAD	V < 5 F.P.S. MINOR BED LOADS OF SAND	V = 5 - 15 F.P.S. MODERATE BED LOADS OF SAND OR GRAVEL	V > 15 F.P.S. HEAVY BED LOADS OF SAND, GRAVEL, OR ROCK		
SOIL TYPE	(RESISTIVITY > 6,000 Ω /CM) LITTLE OR NO CORROSION 1) SANDS OR SANDY LOAMS 2) LIGHT TEXTURED SILT LOAMS 3) POROUS OR CLAY LOAMS (OXIDIZED) W/GOOD DRAINAGE CHARACTERISTICS	1	2	3	4	AREA I	CORROSION REGION AS DEPICTED IN FIGURE 1a OF TECH MANUAL)
	(RESIST. = 4,500 Ω /CM - 6,000 Ω /CM) SLIGHT CORROSION 1) SANDY LOAMS 2) SILT LOAMS 3) CLAY LOAMS W/FAIR DRAINAGE CHARACTERISTICS	5	6	7	8	AREA II	
	(RESIST. = 2,000 Ω /CM - 4,500 Ω /CM) MODERATE CORROSION 1) CLAY LOAMS 2) CLAYS W/POOR DRAINAGE CHARACTERISTICS	9	10	11	12	AREA III & IV	
	(RESISTIVITY < 2,000 Ω /CM) SEVERE CORROSION 1) MUCK 2) PEAT 3) CLAYS & ORGANIC SOILS W/VERY POOR DRAINAGE CHARACTERISTICS	13	14	15	16		

PIPE ALTERNATIVES

CALIFORNIA PIPE LIFE CHART



Method of estimating service life of steel pipe as developed by California Division of Highways. This correlates pH with electrical resistivity of soils to determine years to perforate a steel sheet. Local durability records are used for confirmation or control.