

**GEOTECHNICAL REPORT
REEMS ROAD CHANNEL AND BASIN
HALF-MILE SOUTH OF OLIVE AVENUE TO
PEORIA AVENUE
MARICOPA COUNTY, ARIZONA**



KLEINFELDER
An employee owned company

**GEOTECHNICAL REPORT
REEMS ROAD CHANNEL AND BASIN
HALF-MILE SOUTH OF OLIVE AVENUE TO
PEORIA AVENUE
MARICOPA COUNTY, ARIZONA**

Project Number: 47724 (1)

Kleinfelder, Inc.
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September 2004

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September 22, 2004
File No.: 47724 (001)

Mr. Warren Rosebraugh, P.E.
Flood Control District of Maricopa County
2801 West Durango
Phoenix, Arizona 85009

**SUBJECT: Geotechnical Report
Reems Road Channel and Basin
Half-mile South of Olive Avenue to Peoria Avenue
Maricopa County, Arizona**

Dear Mr. Rosebraugh:

Kleinfelder, Inc. (Kleinfelder) is pleased to present this final geotechnical report to Aztec Engineering, Inc. (Aztec) for the proposed construction of the new Reems Road Channel and Basin, which will extend from roughly ½-mile south of Olive Avenue, northward to Peoria Avenue, west of the town of El Mirage, Maricopa County, Arizona. The purpose of our study was to explore and evaluate the subsurface conditions in order to develop geotechnical engineering recommendations for design and construction of the channels, culverts, pipes, and related elements.

Based on the results of our study, the site may be developed as planned using conventional grading and construction techniques. Recommendations regarding the geotechnical aspects of project design and construction are presented in the following report.

Recommendations provided herein are contingent on the provisions outlined in the "Additional Services" and "Limitations" sections of this report. The project Owner should become familiar with these provisions in order to assess further involvement by Kleinfelder and other potential impacts to the proposed project.

We appreciate the opportunity of providing our services for this project. If you have questions regarding this report or if we may be of further assistance, please contact the undersigned.

Sincerely,

KLEINFELDER, INC.



Steven A. Haire, P.E.
Senior Geotechnical Engineer

Reviewed By:

Charles E. Reynolds, G.I.T.
Geotechnical Department Manager

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Plate 1 Site Plan

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1.0 INTRODUCTION

1.1 General

In this report we present the results of our geotechnical study for the proposed Reems Road Channel and Basin, which will extend from roughly ½-mile south of Olive Avenue, northward to Peoria Avenue, Maricopa County, Arizona. This site is located west of the town of El Mirage and north of Luke Air Force Base, in the western part of the Phoenix Basin. The project limits are shown on Figure 1. The purpose of the study was to explore and evaluate the subsurface conditions at various locations on the site in order to develop geotechnical engineering recommendations for project design and construction.

Our study included a site reconnaissance, subsurface exploration, representative soil sampling, field and laboratory testing, engineering analyses, and preparation of this report. This report presents recommendations for design and construction of box culverts, stability of channel and basin slopes, earthwork shrink/swell factors, soil corrosivity for pipeline design, and agronomy testing and recommendations for topsoil. The recommendations contained in this report are subject to the limitations presented in the "Limitations" section of this report.

1.2 Project Description

We understand that the proposed construction will include the construction of approximately 7,900 linear feet of trapezoidal open channel and pipe section, along with a retention basin and three box culverts to convey storm water below Peoria Avenue, below Olive Avenue and the adjacent railroad, and below Reems Road at the south end of the project. The preliminary conceptual layout of the project features are shown on the Site Plan, Figure 1.

2.0 FIELD EXPLORATION

The field exploration consisted of drilling test borings to obtain the geotechnical soil profile and excavating by hand at two locations at the edge of the existing Reems Road pavement to observe the existing pavement structure.

2.1 Drilling and Sampling

The drilling and sampling program was performed on August 2 and August 3, 2004, and consisted of drilling ten borings along the project alignment and/or within the retention basin area. The boring locations are shown on the Site Plan, Figure 1. The locations of the borings were estimated by our staff professional based on rough measurements from the limits of existing landmarks; therefore, the locations of the borings shown on the attached Site Plan should be considered approximate. The approximate Latitude and Longitude of each boring was measured in the field using a GPS unit, and coordinates are noted on the test boring logs presented in Appendix A.

The borings were drilled using a truck-mounted drill rig equipped with 6 5/8-inch hollow-stem auger to depths of about 20 feet below the existing ground surface. Geomechanics Southwest Inc. of Phoenix, Arizona was subcontracted to drill these borings. A Kleinfelder, Inc. (Kleinfelder) staff professional observed the drilling operation, classified the encountered soils, prepared boring logs, and collected soil samples for laboratory examination and testing.

Prior to the start of drilling, the Arizona Bluestake Center was contacted to locate existing utilities at the boring locations. Upon completion of the borings, the boreholes were backfilled with soil cuttings.

Relatively undisturbed samples were obtained using a California sampler with a 2.5-inch inside diameter and a 3.0-inch outside diameter. Disturbed samples were obtained using a Standard Penetration/Split-Spoon Sampler (SPT) with a 1.5-inch inside diameter and 2.0-inch outside diameter. The SPT samplers were driven a maximum of 18 inches using a 140-pound hammer

falling 30 inches, and blow counts for successive 6-inch penetration intervals were recorded. California samplers were driven a maximum of 12 inches. Bulk (bag) samples of shallow soils were obtained from the auger cuttings at selected locations.

Soil classifications made in the field from auger cuttings and samples were re-evaluated in the laboratory after further examination and testing. The soils were classified in accordance with the Unified Soil Classification System presented on A-1 in Appendix A. Sample classifications, blow counts recorded during sampling, and other related information was recorded on the soil boring logs, which are presented in Appendix A.

2.2 Pavement Thickness Measurement

The pavement structure Reems Road was measured at two locations along Reems Road by hand excavating at the edge of the existing pavement at two locations, adjacent to borings B-3 and B-6. At both locations, the pavement thickness at the shoulder included 2.5-inches of asphalt concrete over about 6 inches aggregate base.

3.0 LABORATORY TESTING

Laboratory testing performed on selected samples obtained during the field exploration for the project included:

- Moisture Content
- Sieve Analysis
- Plasticity Index
- Direct Shear
- Consolidation
- Density
- pH & Resistivity
- Sulfate & Chloride Content
- R-Value

- Moisture-Density Relationship (Standard Proctor)
- Agronomy Testing for Top Soil

The results of the laboratory testing are presented in Appendix B. Included in the agronomy test results are specific recommendations for soil amendments in lbs / 1000 square feet.

4.0 SITE CONDITIONS

4.1 Geologic Setting

The project site is located in the Basin and Range Physiographic Province (Basin and Range) of central Arizona. The Basin and Range is characterized by isolated fault-bounded mountain ranges of igneous, metamorphic, deformed sedimentary, and volcanic rock separated by broad alluvium-filled valleys. The rock units are generally of Precambrian age, with erosional remnants of Paleozoic age rocks and local Cenozoic age volcanics and sediments. Bedrock is not exposed in the project vicinity.

4.2 Site Surface Conditions

The site is currently cultivated agricultural land, and Reems Road is a two-lane asphalt concrete paved road. The existing ground surface is relatively flat, sloping gently down to the southeast with a slope of about 30 feet per mile.

4.3 Soil Conditions

Soils encountered in the upper 5 to 10 feet at the test boring locations consisted primarily of stratified deposits of low to medium plasticity sandy clays and clayey sands (CL and SC). Underlying soils, below about 5 to 10 feet and extending to the depth explored (about 22 feet), consisted of stratified deposits of non-plastic to low plasticity sands and silty sands (SP, SP-SM, and SM), along with low to medium plasticity sandy clays and clayey sands (CL and SC). Soil consistencies of the clayey and silty soils generally ranged from soft to very firm, while the sands

were generally medium dense. Detailed descriptions of the soils encountered at the boring locations are presented on the boring logs in Appendix A.

4.4 Soil Moisture and Groundwater Conditions

Neither regional nor perched groundwater was encountered within any of the borings drilled (to depths of about 22 feet) at the site. Soil moisture contents at the boring locations were described as slightly moist. It should be noted that soil moisture conditions across the site may vary depending on rainfall and/or runoff conditions and may be affected by irrigation in agricultural areas. Groundwater is expected to be encountered at depths generally ranging from about 400 to 500 feet below existing grade, according to regional well information provided by the Arizona Department of Water Resources.

5.0 DISCUSSION AND RECOMMENDATIONS

5.1 General

Based on the results of our study, the site may be developed as planned using conventional grading and construction techniques. Recommendations regarding the geotechnical aspects of project design and construction are presented in the following sections.

5.2 Slopes

5.2.1 General

Excavations in the site soils can most likely be made by conventional earth moving equipment. All excavations must comply with applicable local, state, and federal safety regulations, including the current Occupational Safety Health Association (OSHA) Excavation and Trench Safety Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. We are providing the information below solely as a service to our client. Under no

circumstances should the information provided be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

5.2.2 Permanent Channel Slopes

We recommend that permanent unprotected cut and fill channel slopes subjected to flowing water be constructed at a gradient no steeper than 2.5H:1V (horizontal to vertical). For cut and fill slopes with concrete slope paving, we recommend they be constructed at a gradient no steeper than 2.0H:1V. To reduce the potential for surface erosion, a berm or "V" ditch should be located at the top of slopes subject to significant overland water flows in order to intercept and redirect surface runoff. To minimize erosion of the slope face due to flowing water, vegetation or gravel surfacing should be considered. Consultation with a landscape architect is recommended to establish the design slope for vegetated channels, and slopes as flat as 3H:1V may be desirable to aid in establishing and maintaining plant growth.

5.2.3 Temporary Excavations

Soils encountered at the boring locations consisted predominately sandy clays and clayey sands in the upper 5 to 10 feet. These soils would be considered Type B soil when applying the OSHA regulations. For these soil types, OSHA recommends a maximum slope inclination of 1H:1V or flatter. Steeper cut slopes may be utilized for excavations less than five feet deep depending on the strength, moisture content, and homogeneity of the soils as observed in the field.

Underlying soils, below about 5 to 10 feet and extending to the depth explored (about 22 feet), consisted of stratified deposits of non-plastic to low plasticity sands and silty sands (SP, SP-SM, and SM), along with low to medium plasticity sandy clays and clayey sands (CL and SC). The silty sands and sands would be considered Type C soil when applying the OSHA regulations. For these soil types, OSHA recommends a maximum slope inclination of 1.5H:1V or flatter for excavation less than 20 feet deep.

The Contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

5.2.4 Construction Considerations

Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within $1/3$ the slope height from the top of any excavation. Where the stability of adjoining walls or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning may be required to provide structural stability and to protect personnel working within the excavation. A professional engineer registered in the State of Arizona should design shoring, bracing, or underpinning required for the project (if any).

Earthen berms or other methods should be used to prevent runoff water from entering all excavations. All runoff water should be collected and disposed of outside the construction limits.

5.3 Structural Backfill

Structural backfill should be used against concrete structures designed to resist earth loads, such as box culverts, wingwalls and retaining walls. All structural backfill should meet the material requirements of Section 701.2.1 Crushed Rock, and the gradation requirements for Select Material, Type A or B in Table 702-1, both of the M.A.G. Uniform Standard Specifications.

5.4 Trench and Pipe Bedding Material

Pipe bedding backfill (i.e., material from the bottom of the pipe to the springline of the pipe) should consist of ½ Sack or 1 Sack Controlled Low Strength Material (CLSM) slurry backfill in accordance with M.A.G. Section 728 and placement per M.A.G. Section 604.

Trench zone backfill (i.e., material placed between the pipe springline and finished subgrade) may consist of native soil from areas of on-site excavation. Compaction of trench backfill above the CLSM pipe bedding material shall be in accordance with the requirements of Section 601.4.4 of the M.A.G. Specifications. Within pavement areas, trench backfill should be compacted to at least 100 percent relative compaction within two feet of finished subgrade. Mechanical compaction is recommended; ponding or jetting should not be allowed, especially in areas supporting structural loads or beneath concrete slabs supported-on-grade, pavements, or other improvements.

Recommendations provided above for pipe zone backfill are minimum requirements only. More stringent material specifications may be required to fulfill local codes and/or bedding requirements for specific types of pipes. We recommend the project Civil Engineer develop these material specifications based on planned pipe types, bedding conditions, and other factors beyond the scope of this study.

5.5 Shrink/Swell Earthwork Factors

For soils excavated on-site and then placed in compacted embankment or trench fills, earthwork shrink/swell factors (volume change) were estimated as part of our study. The estimated shrink/swell factors presented below were based primarily on comparison between in-situ densities from driven ring samples and laboratory compaction tests, and engineering judgment based on detailed boring logs. Estimated earthwork factors vary depending on the degree of compaction, as presented below:

| Relative Compaction Based on Percentage of AASHTO T-99 (Standard Proctor) Maximum Density | Approximate Earthwork Shrinkage |
|---|------------------------------------|
| 85% | 5% swell |
| 90% | 0% shrink |
| 95% | 5% shrink |
| 100% | 10% shrink |

5.6 Corrosion Potential

Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. As soil's resistivity decreases, its corrosivity increases. A commonly accepted correlation between soil resistivity and corrosivity towards ferrous metals is provided below:

Resistivity in ohm-centimeters

0 to 1,000
 1,000 to 2,000
 2,000 to 10,000
 Over 10,000

Corrosivity Category

Severely Corrosive
 Corrosive
 Moderately Corrosive
 Mildly Corrosive

Results of the laboratory testing for pH, resistivity, soluble sulfates, and soluble chlorides are presented in the following table:

| Location | Depth (ft) | pH | Resistivity (ohm-cm) | Soluble Sulfates (ppm) | Soluble Chlorides (ppm) |
|----------|------------|-----|-------------------------|------------------------------|-------------------------------|
| B-1 | 3-10 | 8.0 | 903 | 49 | 45 |
| B-3 | 3-10 | 7.9 | 1966 | | |
| B-5 | 3-10 | 8.1 | 1550 | 27 | 13 |
| B-6 | 3-10 | 7.9 | 848 | | |
| B-8 | 3-10 | 8.0 | 1074 | 46 | 38 |

Based on laboratory testing, minimum resistivities of between 848 and 1966 ohm-cm indicate that on-site soils would be categorized as corrosive to severely corrosive toward ferrous metals.

Arizona Department of Transportation has established design criteria based on soil resistivity and pH for determining the life of corrugated steel pipe. Based on the resistivity of 848 ohms-cm and a pH of 7.9, a life of 23 years for corrugated 18-gage galvanized steel pipe for dry soil conditions is predicted by the ADOT design criteria. This predicted life will be reduced for moist soil conditions, which may develop due to irrigation and runoff.

Protection from corrosion may be necessary for metallic conduits. While in dry field conditions of our arid environment, these soils may not contribute to significant corrosion; however, increases in soil moisture may result in reduced resistivities, and thus, could increase the potential for corrosion. According to ADOT's MPE&D Manual the following types of culvert pipe may be used for various resistivity ranges:

- For resistivities greater than 2000 ohm-cm, galvanized-coated steel AASHTO M-36, aluminum coated steel AASHTO M-36, aluminum alloy AASHTO M-196 or bituminous-coated AASHTO M-190 pipe should be used.
- For resistivities between 500 and 1999 ohm-cm, aluminum alloy AASHTO M-196 or bituminous-coated AASHTO M-190 pipe should be used.
- For resistivities less than 500 ohm-cm, bituminous coated AASHTO M-190 pipe should be used.

The above-recommended culvert types are applicable for soils with a pH in the range of 5.0 to 9.0.

- Regardless of resistivity, for pH greater than 7.2, bituminous-coated AASHTO M-190 pipe may be used.

Laboratory tests indicate pH values vary between 7.9 and 8.1. Laboratory tests show chloride contents between 13 ppm and 45 ppm, indicating a negligible corrosion potential to concrete reinforcing steel.

Based on laboratory results, sulfate (SO₄) contents vary between 27 ppm and 49 ppm. Therefore, special precautions are not expected to be necessary to protect concrete, and Type II cement may be used for concrete in contact with soil.

5.7 Channels and Basins

Site soils are acceptable for placement of conventional concrete linings. Overexcavation recommended for placement of embankment fills is not necessary for concrete channel linings; however, soil near the existing ground surface should be moisture conditioned and compacted in accordance with the Standard Specifications. Cutoffs for channel linings should extend a minimum of 2.0 feet below the top of the channel lining where no overland flow is expected. Where flow is expected to be directed over the top of the lining, cutoffs should extend a minimum of 4.0 feet below the top of the channel lining.

Cutoff walls for inlet structures adjacent to concrete linings should extend a minimum of five feet below the invert elevation of the inlet structure.

5.8 Topsoil Characteristics

The results of the laboratory testing are presented in Appendix B. Included in the agronomy test results are specific recommendations for soil amendments in lbs / 1000 square feet for the growth of grass (turf).

5.9 Box Culverts

As shown on the Site Plan, box culverts will be used to convey storm water below Peoria Avenue, below Olive Avenue and the adjacent railroad, and below Reems Road at the south end of the project. Foundation and earth pressure recommendations are presented in the following sections.

5.9.1 Box Culvert Foundations

For box culverts bearing on undisturbed native soils or compacted structure backfill, an allowable bearing pressure of 2500 pounds per square foot is recommended for pipe or box structures at a depth of three feet or more below finished grade.

5.9.2 Passive Lateral Resistance and Base Friction

A passive soil resistance of 350 psf per foot of depth is recommended against the edges of footings or box culverts in contact with properly compacted structure backfill.

A coefficient of friction of 0.35 is recommended for computing the lateral resistance between the bases of footings and slabs and the soils when analyzing lateral loads. Should a key be utilized beneath the footing, the coefficient of friction can be increased to 0.60.

5.9.3 Earth Pressures Acting on Box Culvert Walls

Rigid foundation elements that will not experience any lateral movement or rotation will be subjected to at-rest earth pressures represented by a triangular hydrostatic diagram of 55 pcf per foot of depth for level backfill. Foundation elements, which are not restrained, will be subjected to active state earth pressures represented by a triangular pressure diagram equivalent to 35 psf per foot of depth for level backfill.

6.0 CLOSURE

6.1 Limitations

The recommendations contained in this report are based on our field explorations, laboratory tests, and our understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the borings drilled during the field study. It is anticipated that some variations in the soil conditions will exist between the points explored. The

nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, our firm should be immediately notified so that we may make any necessary revisions to the recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, our firm should also be notified. This report was prepared in accordance with the generally accepted standard of practice in Arizona at the time the report was written. No warranty, expressed or implied, is made. It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on- and off-site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

6.2 Additional Services

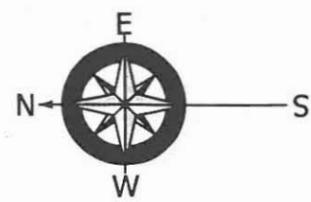
The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be performed during the construction to verify compliance with these recommendations. These tests and observations should include, but are not necessarily limited to observations and testing during site preparation and earthwork and consultation as may be required during construction.

We also recommend that we review project plans and specifications to verify compatibility with our conclusions and recommendations. Additional information concerning the scope and cost of these services can be obtained from our office.

FIGURES



PHOTO DATE: DECEMBER 2002
 PREPARED: 24 FEBRUARY 2004

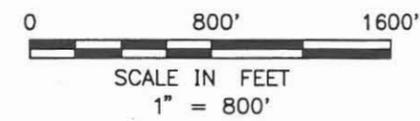


LEGEND

⊙ B-1 = TEST BORING LOCATION

NOTES

BASE PLAN PROVIDED BY
 F.C.D.M.C., SEPTEMBER 2004



F.C.D.M.C.
 REEMS ROAD CHANNEL AND BASIN

SITE PLAN

PLATE
1

KLEINFELDER, Inc.
 PROJECT NO. : 47724

SEPTEMBER 2004

APPENDIX A

Field Study

UNIFIED SOIL CLASSIFICATION SYSTEM

| | MAJOR DIVISIONS | | USCS SYMBOL | TYPICAL DESCRIPTIONS |
|---|---|--|--|---|
| COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve) | GRAVELS (More than half of coarse fraction is larger than the #4 sieve) | CLEAN GRAVELS WITH LESS THAN 5% PASSING NO. 200 SIEVE |  GW | WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES |
| | | GRAVELS WITH OVER 12% PASSING NO. 200 SIEVE |  GP | POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES |
| | | GRAVELS WITH OVER 12% PASSING NO. 200 SIEVE |  GM | SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES |
| | | GRAVELS WITH OVER 12% PASSING NO. 200 SIEVE |  GC | CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES |
| | SANDS (More than half of coarse fraction is smaller than the #4 sieve) | CLEAN SANDS WITH LESS THAN 5% PASSING NO. 200 SIEVE |  SW | WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES |
| | | SANDS WITH OVER 5% PASSING NO. 200 SIEVE |  SP | POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES |
| | | SANDS WITH OVER 12% PASSING NO. 200 SIEVE |  SM | SILTY SANDS, SAND-GRAVEL-SILT MIXTURES |
| | | SANDS WITH OVER 12% PASSING NO. 200 SIEVE |  SC | CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES |
| FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve) | SILTS AND CLAYS (Liquid limit less than 50) |  ML | INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY | |
| | |  CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS | |
| | |  OL | ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY | |
| | SILTS AND CLAYS (Liquid limit greater than 50) |  MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT | |
| | |  CH | INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS | |
| | |  OH | ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY | |

Note: Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing No. 200 sieve require dual USCS symbols. (See KEY A-3 if provided)



UNIFIED SOIL CLASSIFICATION SYSTEM

Reems Road Channel and Basin
 Flood Control District of Maricopa County
 Half-mile South of Olive Avenue to Peoria Avenue
 Maricopa County, Arizona

KEY

A-1

Drafted By: RGP
 Date: September, 2004

Project Number:
 47724

LOG SYMBOLS

| | | | |
|---|--|---|--|
|  | BULK / GRAB SAMPLE |  | NON-STANDARD PENETRATION SPLIT SPOON SAMPLER (1.5-inch O.D. X 0.9-inch I.D.) |
|  | MODIFIED CALIFORNIA SAMPLER (2 inch inside diameter) |  | BDBGM SIZE CORE BARREL (1.65-inch I.D.) |
|  | RING (PORTER) SAMPLER (2.4 - inch inside diameter) |  | BW44 SIZE CORE BARREL (1.75-inch I.D.) |
|  | STANDARD PENETRATION SPLIT SPOON SAMPLER (2.0-inch O.D. X 1.4-inch I.D.) |  | HQ-3 SIZE CORE BARREL (2.4-inch I.D.) |
|  | SHELBY TUBE (3 inch outside diameter) |  | NON-STANDARD PENETRATION SPLIT SPOON SAMPLER (2.5-inch O.D. X 2.0-inch I.D.) |
| | |  | WATER LEVEL (level after completion) |
| | |  | WATER LEVEL (level where first encountered) |

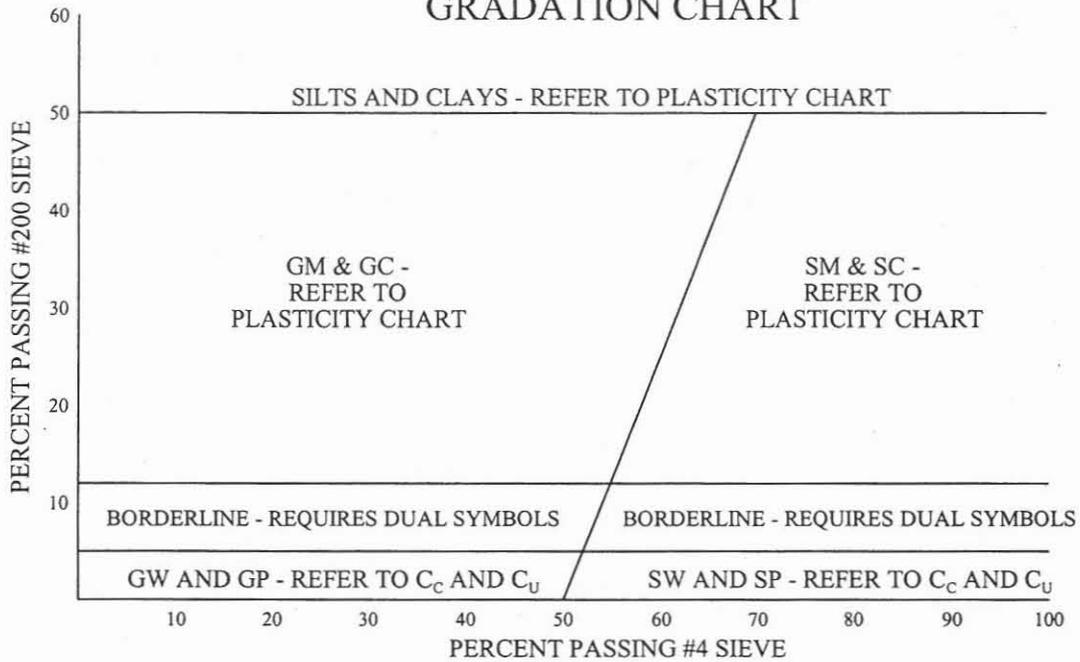
GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
3. Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
4. In general, the Unified Soil Classification designations presented on the logs were based on visual classification in the field, modified where appropriate by visual classifications in the office, and/or laboratory gradation and index testing.
5. NA = Not Analyzed

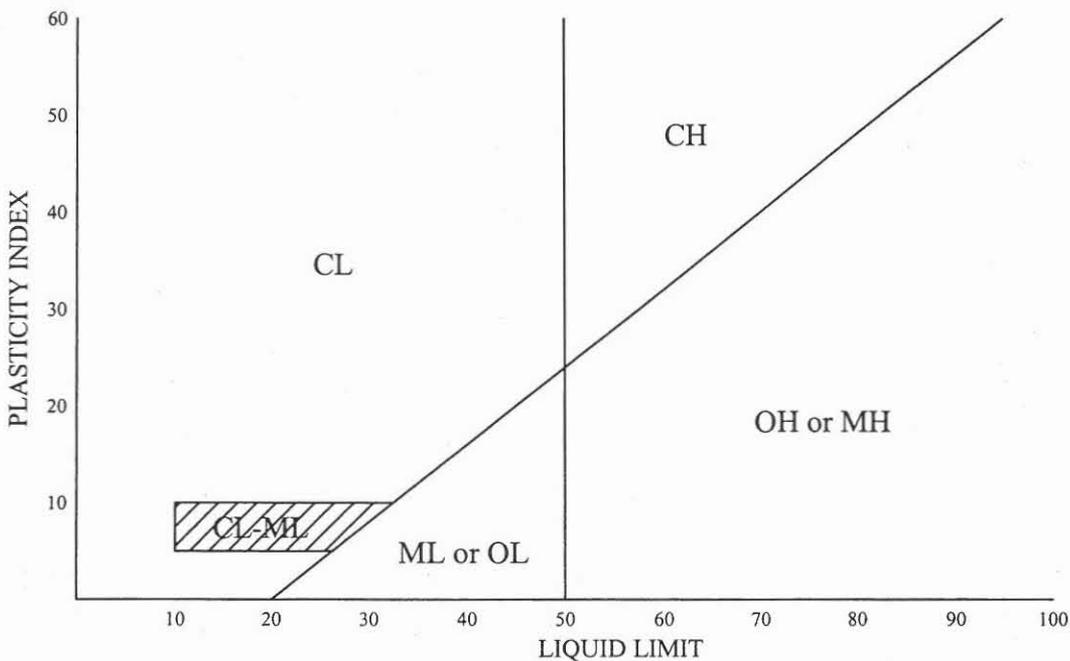
GEO-KEY_A2_LOG_47724.GPJ 09/02/2004

| | | |
|--|---|-----------------------|
|  KLEINFELDER | LOG KEY Reems Road Channel and Basin Flood Control District of Maricopa County Half-mile South of Olive Avenue to Peoria Avenue Maricopa County, Arizona | KEY A-2 |
| Drafted By: RGP Date: September, 2004 | Project Number: 47724 | |

GRADATION CHART



PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

| SOIL FRACTION | PARTICLE SIZE RANGE |
|---------------|-------------------------------|
| Boulders | Greater than 300mm (12in.) |
| Cobbles | 300mm to 75mm (12in. to 3in.) |
| Coarse Gravel | 75mm to 19mm (3in. to 3/4in.) |
| Fine Gravel | 19mm (3/4in.) to No. 4 sieve |
| Coarse Sand | No. 4 sieve to No. 10 sieve |
| Medium Sand | No. 10 sieve to No. 40 sieve |
| Fine Sand | No. 40 sieve to No. 200 sieve |
| Fines | less than No. 200 sieve |



CHARTS & DEFINITIONS

Reems Road Channel and Basin
 Flood Control District of Maricopa County
 Half-mile South of Olive Avenue to Peoria Avenue
 Maricopa County, Arizona

KEY

A-3

Drafted By: RGP
 Date: September, 2004

Project Number:
 47724

TERMINOLOGY USED ON THE BORING LOGS TO DESCRIBE THE FIRMNESS, DENSITY, OR CONSISTENCY OF SOILS

The standard penetration resistance (N) in blows per foot is obtained by the ASTM D1586 procedure using 2" O.D., 1 3/8" I.D. samplers.

- Terms for description of partially saturated and/or cemented soils including clays, cemented granular materials, silts and silty and clayey granular soils.

| N | Relative Firmness |
|---------|-------------------|
| 0 - 4 | Very soft |
| 5 - 8 | soft |
| 9 - 15 | Moderately firm |
| 16 - 30 | Firm |
| 31 - 50 | Very firm |
| 51+ | Hard |

- Terms for description of cohesionless, uncemented sands and sand-gravel mixtures.

| N | Relative Density |
|---------|------------------|
| 0 - 4 | Very loose |
| 5 - 10 | Loose |
| 11 - 30 | Medium dense |
| 31 - 50 | Dense |
| 51+ | Very dense |

- Terms for description of clays which are saturated or near saturation.

| N | Relative Consistency |
|---------|----------------------|
| 0 - 2 | Very soft |
| 3 - 4 | soft |
| 5 - 8 | Moderately stiff |
| 9 - 15 | Stiff |
| 16 - 30 | Very Stiff |
| 31+ | Hard |

GEO-KEY_A4_SOIL-TERMINOLOGY 47724.GPJ 09/02/2004



Drafted By: RGP
Date: September, 2004

Project Number:
47724

TERMINOLOGY USED TO DESCRIBE SOILS
Reems Road Channel and Basin
Flood Control District of Maricopa County
Half-mile South of Olive Avenue to Peoria Avenue
Maricopa County, Arizona

KEY

A-4

Northing and Easting: N33 deg. 34.807' W112 deg. 23.629'
 Groundwater (ft): No Free Groundwater Encountered
 Drilling Company: GSI Equipment: CME-75
 Hole Diameter (in): 6 5/8 Drilling Method: Hollow Stem Auger
 Hammer Type: Automatic

Date Started: 8/2/2004
 Date Completed: 8/2/2004
 Logged By: Kevin Brooks
 Total Depth (ft): 21.5

| ELEVATION (ft) | DEPTH (ft) | FIELD | | | LABORATORY | | | | | | Graphical Log | USCS Classification | DESCRIPTION | |
|----------------|------------|-----------------|-----------------------------|----------------------------------|-------------------|----------------------|--------------|------------------|----------------------|------------------------|---------------|---------------------|-------------|---|
| | | Sample Interval | Blow Counts per 6" Interval | Continuous Pen. Resistance (bpf) | Dry Density (pcf) | Moisture Content (%) | Liquid Limit | Plasticity Index | Passing #4 Sieve (%) | Passing #200 Sieve (%) | | | Other Tests | 0.0 to 21.5 feet |
| | | | 7 13 10 | | | | 27 | 11 | 99 | 64 | | | | Surface Condition: Sparse vegetation |
| | 5 | | 31/12 | | 119 | 9.1 | | | | | | | CL | Sandy Clay , with gravel, brown, slightly moist, firm, low plasticity, moderate cementation |
| | 10 | | 12 11 12 | | | | | | | | | | SC | Clayey Sand , fine grained sand, brown, slightly moist, firm, low plasticity, moderate cementation |
| | 15 | | 9 11 10 | | | | 37 | 21 | 98 | 52 | | | CL | Sandy Clay , trace gravel, brown, slightly moist, firm, medium plasticity, moderate cementation |
| | 20 | | 7 7 6 | | | | | | | | | | SP-SM | Sand , some silt, medium to coarse grained sand, brown, slightly moist, medium dense, nonplastic |
| | 25 | | | | | | | | | | | | | Boring terminated at 21.5 feet Sampling stopped at 21.5 feet Caved to 11.0 feet |

pH=8.0
Resistivity=903 ohm-cm

GEO_ADOT_EW/EL 47724.GPJ 09/08/2004



LOG OF BORING B-1
 Reems Road Channel and Basin
 Flood Control District of Maricopa County
 Half-mile South of Olive Avenue to Peoria Avenue
 Maricopa County, Arizona

BORING
B-1

Drafted By: RGP
 Date: September, 2004

Project Number:
47724

Northing and Easting: N33 deg. 34.629' W112 deg. 23.627'
 Groundwater (ft): No Free Groundwater Encountered
 Drilling Company: GSI Equipment: CME-75
 Hole Diameter (in): 6 5/8 Drilling Method: Hollow Stem Auger
 Hammer Type: Automatic

Date Started: 8/2/2004
 Date Completed: 8/2/2004
 Logged By: Kevin Brooks
 Total Depth (ft): 21.5

| ELEVATION (ft) | DEPTH (ft) | FIELD | | | LABORATORY | | | | | | Graphical Log | USCS Classification | DESCRIPTION 0.0 to 21.5 feet |
|----------------|------------|-----------------|-----------------------------|----------------------------------|-------------------|----------------------|--------------|------------------|----------------------|------------------------|---------------|---------------------|---|
| | | Sample Interval | Blow Counts per 6" Interval | Continuous Pen. Resistance (bpf) | Dry Density (pcf) | Moisture Content (%) | Liquid Limit | Plasticity Index | Passing #4 Sieve (%) | Passing #200 Sieve (%) | | | |
| | 0 | | | | | | | | | | | CL | Sandy Clay , some gravel, brown, slightly moist, moderately firm, low to medium plasticity, moderate cementation |
| | 5 | 6 8 5 | | | 112 | 3.9 | | | | | | SC | Clayey Sand , medium to coarse grained sand, brown, slightly moist, very firm, low plasticity |
| | 10 | 10 15 24 | | | 106 | 5.9 | | | | Direct Shear | | SP | Sand , trace clay, coarse grained sand, light brown, slightly moist, dense, nonplastic |
| | 15 | 33/12 | | | | | 22 | 10 | 95 | 17 | | SC | Clayey Sand , trace gravel, predominately medium grained sand, brown, slightly moist, very firm, low plasticity |
| | 20 | 14 19 19 | | | | | | | | | | CL | Sandy Clay , brown, slightly moist, very firm, low to medium plasticity |
| | 25 | 12 16 17 | | | | | | | | | | | Boring terminated at 21.5 feet Sampling stopped at 21.5 feet Caved to 12.5 feet |

GEO_ADOT_EW/EL_47724.GPJ 09/08/2004



KLEINFELDER

LOG OF BORING B-2

Reems Road Channel and Basin
 Flood Control District of Maricopa County
 Half-mile South of Olive Avenue to Peoria Avenue
 Maricopa County, Arizona

BORING

B-2

Drafted By: RGP
 Date: September, 2004

Project Number:
47724

Northing and Easting: N33 deg. 34.418' W112 deg. 23.626'
 Groundwater (ft): No Free Groundwater Encountered
 Drilling Company: GSI Equipment: CME-75
 Hole Diameter (in): 6 5/8 Drilling Method: Hollow Stem Auger
 Hammer Type: Automatic

Date Started: 8/2/2004
 Date Completed: 8/2/2004
 Logged By: Kevin Brooks
 Total Depth (ft): 21.5

| ELEVATION (ft) | DEPTH (ft) | FIELD | | | LABORATORY | | | | | | Graphical Log | USCS Classification | DESCRIPTION |
|----------------|------------|-----------------|-----------------------------|----------------------------------|-------------------|----------------------|--------------|------------------|----------------------|------------------------|---------------|---------------------|--|
| | | Sample Interval | Blow Counts per 6" Interval | Continuous Pen. Resistance (bpf) | Dry Density (pcf) | Moisture Content (%) | Liquid Limit | Plasticity Index | Passing #4 Sieve (%) | Passing #200 Sieve (%) | | | Other Tests |
| | 12 | | | | | | | | | | | CL | Sandy Clay , with gravel, brown, slightly moist, firm to moderately firm, low to medium plasticity Note: same as above except fine grained sand and nonplastic at 5' |
| | 11 | | | | | | | | | | | | |
| | 9 | | | | | | | | | | | | |
| | 5 | | 4 | | | | | | | | | | |
| | 3 | | 3 | | | | | | | | | | |
| | 9 | | 9 | | | | | | | | | | |
| | 10 | | 13 | | | | | | | | | SP | Sand , trace clay, with gravel, coarse grained sand, light brown, slightly moist, dense, nonplastic |
| | 11 | | 11 | | | | | | | | | | |
| | 9 | | 9 | | | | | | | | | | |
| | 15 | | 24/12 | | 125 | * | 37 | 19 | 98 | 56 | | CL | Sandy Clay , light brown, slightly moist, firm, low to medium plasticity |
| | 13 | | | | | | | | | | | | |
| | 20 | | 9 | | | | | | | | | | |
| | 14 | | 14 | | | | | | | | | | |
| | 13 | | 13 | | | | | | | | | | |
| | 25 | | | | | | | | | | | | Boring terminated at 21.5 feet Sampling stopped at 21.5 feet Caved to 13.0 feet |

GEO_ADOT_EWIEL_47724.GPJ_09/08/2004



LOG OF BORING B-3
 Reems Road Channel and Basin
 Flood Control District of Maricopa County
 Half-mile South of Olive Avenue to Peoria Avenue
 Maricopa County, Arizona

Drafted By: RGP
 Date: September, 2004

Project Number:
47724

BORING
B-3

Northing and Easting: N33 deg. 34.237' W112 deg. 23.624'
 Groundwater (ft): No Free Groundwater Encountered
 Drilling Company: GSI Equipment: CME-75
 Hole Diameter (in): 6 5/8 Drilling Method: Hollow Stem Auger
 Hammer Type: Automatic

Date Started: 8/2/2004
 Date Completed: 8/2/2004
 Logged By: Kevin Brooks
 Total Depth (ft): 21.5

| ELEVATION (ft) | DEPTH (ft) | FIELD | | | LABORATORY | | | | | Graphical Log | USCS Classification | DESCRIPTION | |
|----------------|------------|-----------------|-----------------------------|----------------------------------|-------------------|----------------------|--------------|------------------|----------------------|---------------|---|------------------------|--|
| | | Sample Interval | Blow Counts per 6" Interval | Continuous Pen. Resistance (bpf) | Dry Density (pcf) | Moisture Content (%) | Liquid Limit | Plasticity Index | Passing #4 Sieve (%) | | | Passing #200 Sieve (%) | Other Tests |
| | 8 | | | | | | | | | | | | |
| | 10 | | | | | | | | | | | | |
| | 9 | | | | | | | | | | | | |
| | 5 | | 40/12 | | 99 | 15.2 | | | | | Direct Shear | CL | Sandy Clay, light brown, slightly moist, firm to very firm, low to medium plasticity |
| | 10 | | | | | | | | | | | SC | Clayey Sand, fine grained sand, light brown, slightly moist, firm, low plasticity |
| | 15 | | | | | | | | | | | CL | Sandy Clay, trace gravel, light brown, slightly moist, firm, medium plasticity |
| | 20 | | | | | | | | | | | | |
| | 11 | | | | | | | | | | | | |
| | 26 | | | | | | | | | | | | |
| | 28 | | | | | | | | | | | | |
| | 25 | | | | | | | | | | | | |
| | | | | | | | | | | | Boring terminated at 21.5 feet Sampling stopped at 21.5 feet Caved to 13.5 feet | | |

GEO_ADOT_EWEL 47724.GPJ 09/08/2004



LOG OF BORING B-4
 Reems Road Channel and Basin
 Flood Control District of Maricopa County
 Half-mile South of Olive Avenue to Peoria Avenue
 Maricopa County, Arizona

BORING
B-4

Drafted By: RGP
 Date: September, 2004

Project Number:
 47724

Northing and Easting: N33 deg. 33.988' W112 deg. 23.622'
 Groundwater (ft): No Free Groundwater Encountered
 Drilling Company: GSI Equipment: CME-75
 Hole Diameter (in): 6 5/8 Drilling Method: Hollow Stem Auger
 Hammer Type: Automatic

Date Started: 8/2/2004
 Date Completed: 8/2/2004
 Logged By: Kevin Brooks
 Total Depth (ft): 21.5

| ELEVATION (ft) | DEPTH (ft) | FIELD | | LABORATORY | | | | | | Graphical Log | USCS Classification | DESCRIPTION | | |
|----------------|------------|-----------------|-----------------------------|----------------------------------|-------------------|----------------------|--------------|------------------|----------------------|---------------|---------------------|------------------------|-------------|---|
| | | Sample Interval | Blow Counts per 6" Interval | Continuous Pen. Resistance (bpf) | Dry Density (pcf) | Moisture Content (%) | Liquid Limit | Plasticity Index | Passing #4 Sieve (%) | | | Passing #200 Sieve (%) | Other Tests | 0.0 to 21.5 feet |
| | | | 7 14 16 | | | | 24 | 6 | 100 | 59 | | | CL-ML | Sandy Silty Clay, with gravel, fine to medium grained sand, light brown, slightly moist, firm to soft, low plasticity |
| | 5 | | 5 3 3 | | | | | | | | | | | Note: no gravel at 5' |
| | 10 | | 16/12 | | 115 | 6.0 | NV | NP | 81 | 10 | | | SP-SM | Sand, some silt, fine to medium grained sand, brown, slightly moist, medium dense, nonplastic |
| | 15 | | 5 6 7 | | | | | | | | | | | Note: trace gravel and fine to coarse grained sand at 15' |
| | 20 | | 9 12 15 | | | | | | | | | | | Note: weak cementation at 20' |
| | 25 | | | | | | | | | | | | | Boring terminated at 21.5 feet Sampling stopped at 21.5 feet Caved to 14.0 feet |

pH=8.1
Resistivity=1550 ohm-cm

GEO_ADOT_EWIEL_47724.GPJ 09/21/2004



LOG OF BORING B-5
 Reems Road Channel and Basin
 Flood Control District of Maricopa County
 Half-mile South of Olive Avenue to Peoria Avenue
 Maricopa County, Arizona

BORING
B-5

Drafted By: RGP Project Number: 47724
 Date: September, 2004

Northing and Easting: N33 deg. 33.852' W112 deg. 23.662'
 Groundwater (ft): No Free Groundwater Encountered
 Drilling Company: GSI Equipment: CME-75
 Hole Diameter (in): 6 5/8 Drilling Method: Hollow Stem Auger
 Hammer Type: Automatic

Date Started: 8/2/2004
 Date Completed: 8/2/2004
 Logged By: Kevin Brooks
 Total Depth (ft): 21.5

| ELEVATION (ft) | DEPTH (ft) | FIELD | | | | LABORATORY | | | | Graphical Log | USCS Classification | DESCRIPTION | |
|----------------|------------|-----------------|-----------------------------|----------------------------------|-------------------|----------------------|--------------|------------------|----------------------|---------------|---------------------|------------------------|--|
| | | Sample Interval | Blow Counts per 6" Interval | Continuous Pen. Resistance (bpf) | Dry Density (pcf) | Moisture Content (%) | Liquid Limit | Plasticity Index | Passing #4 Sieve (%) | | | Passing #200 Sieve (%) | Other Tests |
| | | | 3 6 12 | | | | 28 | 14 | 93 | 61 | | CL | Surface Condition: Sparse vegetation Sandy Clay , brown, slightly moist, moderately firm to firm, low plasticity |
| | 5 | | 4 4 9 | | | | 31 | 9 | 99 | 57 | | | pH=7.9 Resistivity=848 ohm-cm |
| | 10 | | 5 4 4 | | | | | | | | | SP-SM | Sand , some silt, fine to medium grained sand, brown, slightly moist, loose, nonplastic |
| | 15 | | 19/12 | | 110 | 6.3 | | | | | | SM | Silty Sand , with gravel, light brown, slightly moist, firm to very firm, low to medium plasticity, medium cementation |
| | 20 | | 15 20 14 | | | | | | | | | | Direct Shear |
| | 25 | | | | | | | | | | | | Boring terminated at 21.5 feet Sampling stopped at 21.5 feet Caved to 12.5 feet |

GEO_ADOT_EWEL_47724.GPJ 09/08/2004



LOG OF BORING B-6

Reems Road Channel and Basin
 Flood Control District of Maricopa County
 Half-mile South of Olive Avenue to Peoria Avenue
 Maricopa County, Arizona

BORING

B-6

Page 1 of 1

Drafted By: RGP
 Date: September, 2004

Project Number:
 47724

Northing and Easting: N33 deg. 33.708' W112 deg. 23.622'
 Groundwater (ft): No Free Groundwater Encountered
 Drilling Company: GSI Equipment: CME-75
 Hole Diameter (in): 6 5/8 Drilling Method: Hollow Stem Auger
 Hammer Type: Automatic

Date Started: 8/2/2004
 Date Completed: 8/2/2004
 Logged By: Kevin Brooks
 Total Depth (ft): 21.5

| ELEVATION (ft) | DEPTH (ft) | FIELD | | | LABORATORY | | | | | | Graphical Log | USCS Classification | DESCRIPTION |
|----------------|------------|-----------------|-----------------------------|----------------------------------|-------------------|----------------------|--------------|------------------|----------------------|------------------------|---------------|---------------------|---|
| | | Sample Interval | Blow Counts per 6" Interval | Continuous Pen. Resistance (bpf) | Dry Density (pcf) | Moisture Content (%) | Liquid Limit | Plasticity Index | Passing #4 Sieve (%) | Passing #200 Sieve (%) | | | Other Tests |
| | | | 4 | | | | | | | | | CL | Sandy Clay, with gravel, light brown, slightly moist, moderately firm to soft, low plasticity |
| | | | 4 | | | | | | | | | | |
| | | | 9 | | | | | | | | | | |
| | 5 | | 3 | | | | 38 | 18 | 100 | 64 | | | |
| | | | 5 | | | | | | | | | | |
| | | | 5 | | | | | | | | | | |
| | 10 | | 6 | | | | | | | | | | |
| | | | 6 | | | | | | | | | | |
| | | | 7 | | | | | | | | | | |
| | 15 | | 5 | | 8.5 | | | | | | | SM | Silty Sand, medium to coarse grained sand, brown, slightly moist, moderately firm, low plasticity |
| | | | 6 | | | | | | | | | | |
| | | | 8 | | | | | | | | | | |
| | 20 | | 6 | | | | | | | | | SP-SM | Sand, some silt, coarse to medium grained sand, brown, slightly moist, medium dense, nonplastic |
| | | | 6 | | | | | | | | | | |
| | | | 5 | | | | | | | | | | |
| | 25 | | | | | | | | | | | | Boring terminated at 21.5 feet Sampling stopped at 21.5 feet Caved to 12.0 feet |

GEO_ADOT_EW/EL 47724.GPJ 09/08/2004



LOG OF BORING B-7

Reems Road Channel and Basin
 Flood Control District of Maricopa County
 Half-mile South of Olive Avenue to Peoria Avenue
 Maricopa County, Arizona

BORING

B-7

Drafted By: RGP
 Date: September, 2004

Project Number:
 47724

Northing and Easting: N33 deg. 33.543' W112 deg. 23.260'
 Groundwater (ft): No Free Groundwater Encountered
 Drilling Company: GSI Equipment: CME-75
 Hole Diameter (in): 6 5/8 Drilling Method: Hollow Stem Auger
 Hammer Type: Automatic

Date Started: 8/2/2004
 Date Completed: 8/2/2004
 Logged By: Kevin Brooks
 Total Depth (ft): 21.5

| ELEVATION (ft) | DEPTH (ft) | FIELD | | LABORATORY | | | | | | Graphical Log | USCS Classification | DESCRIPTION | |
|----------------|------------|-----------------|-----------------------------|----------------------------------|-------------------|----------------------|--------------|------------------|----------------------|---------------|---|------------------------|---|
| | | Sample Interval | Blow Counts per 6" Interval | Continuous Pen. Resistance (bpf) | Dry Density (pcf) | Moisture Content (%) | Liquid Limit | Plasticity Index | Passing #4 Sieve (%) | | | Passing #200 Sieve (%) | Other Tests |
| | | | 4 6 5 | | | | | | | | | CL | Sandy Clay, light brown, slightly moist, moderately firm, low plasticity |
| | 5 | | 5 3 5 | | | | 26 | 14 | 99 | 44 | | SC | Clayey Sand, predominately medium grained sand, red-brown, slightly moist, soft, low plasticity |
| | 10 | | 6 8 8 | | 13.3 | | | | | | | SM | Silty Sand, fine grained sand, brown, slightly moist, firm, low plasticity |
| | 15 | | 4 5 7 | | | | | | | | | CL | Sandy Clay, brown, slightly moist, firm, low to medium plasticity |
| | 20 | | 6 14 13 | | | | | | | | | | |
| | 25 | | | | | | | | | | | | |
| | | | | | | | | | | | pH=8.0 Resistivity=1074 ohm-cm | | |
| | | | | | | | | | | | Boring terminated at 21.5 feet Sampling stopped at 21.5 feet Caved to 13.0 feet | | |

GEO_ADOT_EW/EL_47724.GPJ 09/08/2004



LOG OF BORING B-8

Reems Road Channel and Basin
 Flood Control District of Maricopa County
 Half-mile South of Olive Avenue to Peoria Avenue
 Maricopa County, Arizona

BORING

B-8

Page 1 of 1

Drafted By: RGP
 Date: September, 2004

Project Number:
 47724

Northing and Easting: N33 deg. 34.404' W112 deg. 23.839'
 Groundwater (ft): No Free Groundwater Encountered
 Drilling Company: GSI Equipment: CME-75
 Hole Diameter (in): 6 5/8 Drilling Method: Hollow Stem Auger
 Hammer Type: Automatic

Date Started: 8/3/2004
 Date Completed: 8/3/2004
 Logged By: Kevin Brooks
 Total Depth (ft): 21.5

| ELEVATION (ft) | DEPTH (ft) | FIELD | | | LABORATORY | | | | | | Graphical Log | USCS Classification | DESCRIPTION |
|----------------|------------|-----------------|-----------------------------|----------------------------------|-------------------|----------------------|--------------|------------------|----------------------|------------------------|---------------|---------------------|--|
| | | Sample Interval | Blow Counts per 6" Interval | Continuous Pen. Resistance (bpf) | Dry Density (pcf) | Moisture Content (%) | Liquid Limit | Plasticity Index | Passing #4 Sieve (%) | Passing #200 Sieve (%) | | | |
| | | | | | | | | | | | | | 0.0 to 21.5 feet |
| | | | | | | | | | | | | | Surface Condition: Sparse vegetation |
| | 5 | 5 5 3 | | | | | 41 | 26 | 97 | 60 | | CL | Sandy Clay, light brown, slightly moist, soft, low plasticity |
| | 5 | 20/12 | | 109 | 8.8 | 28 | 11 | 97 | 47 | Direct Shear | | SC | Clayey Sand, fine grained sand, brown, slightly moist, firm, low plasticity |
| | 10 | 7 9 10 | | | | | | | | | | CL | Sandy Clay, brown, slightly moist, firm, low plasticity |
| | 15 | 7 9 10 | | | | | | | | | | SP | Sand, trace clay, predominately fine grained sand, brown, slightly moist, medium dense, nonplastic |
| | 20 | 5 9 9 | | | | | | | | | | CL | Sandy Clay, brown, slightly moist, firm, low plasticity |
| | 25 | | | | | | | | | | | | Boring terminated at 21.5 feet Sampling stopped at 21.5 feet Caved to 15.0 feet |

GEO_ADOT_EW/EL 47724.GPJ 09/08/2004



LOG OF BORING B-9
 Reems Road Channel and Basin
 Flood Control District of Maricopa County
 Half-mile South of Olive Avenue to Peoria Avenue
 Maricopa County, Arizona

BORING

B-9

Drafted By: RGP
 Date: September, 2004

Project Number:
47724

Northing and Easting: N33 deg. 34.226' W112 deg. 23.880'
 Groundwater (ft): No Free Groundwater Encountered
 Drilling Company: GSI Equipment: CME-75
 Hole Diameter (in): 6 5/8 Drilling Method: Hollow Stem Auger
 Hammer Type: Automatic

Date Started: 8/3/2004
 Date Completed: 8/3/2004
 Logged By: Kevin Brooks
 Total Depth (ft): 21.5

| ELEVATION (ft) | DEPTH (ft) | FIELD | | | LABORATORY | | | | | | Graphical Log | USCS Classification | DESCRIPTION | |
|----------------|------------|-----------------|-----------------------------|----------------------------------|-------------------|----------------------|--------------|------------------|----------------------|------------------------|---------------|---------------------|--|---|
| | | Sample Interval | Blow Counts per 6" Interval | Continuous Pen. Resistance (bpf) | Dry Density (pcf) | Moisture Content (%) | Liquid Limit | Plasticity Index | Passing #4 Sieve (%) | Passing #200 Sieve (%) | | | Other Tests | 0.0 to 21.5 feet |
| | | | | | | | | | | | | | | Surface Condition: Sparse vegetation |
| | 5 | | 3 2 5 | | | | | | | | | CL | Sandy Clay, light brown, slightly moist, moderately firm to soft, low plasticity | |
| | 10 | | 16/12 | | 117 | 6.7 | | | | Direct Shear | | SP | Sand, trace clay, with gravel, coarse grained sand, light brown, slightly moist, medium dense, nonplastic | |
| | 15 | | 5 14 10 | | | | | | | | | SP | Sand, trace clay, with gravel, coarse grained sand, light brown, slightly moist, medium dense, nonplastic | |
| | 20 | | 5 8 7 | | | | | | | | | SP-SM | Sand, some silt, with gravel, coarse to medium grained sand, brown, slightly moist, medium dense, nonplastic | |
| | 25 | | | | | | | | | | | | | Boring terminated at 21.5 feet Sampling stopped at 21.5 feet Caved to 14.5 feet |

GEO_ADOT_EWEL_47724.GPJ_09/08/2004



LOG OF BORING B-10

Reems Road Channel and Basin
 Flood Control District of Maricopa County
 Half-mile South of Olive Avenue to Peoria Avenue
 Maricopa County, Arizona

BORING

B-10

Page 1 of 1

Drafted By: RGP
 Date: September, 2004

Project Number:
47724

APPENDIX B

Laboratory Testing

APPENDIX B LABORATORY TESTING

LABORATORY TESTS

Laboratory tests were performed on selected samples to aid in soil classification and to evaluate physical properties of the soils, which may affect the geotechnical aspects of project design and construction. A description of the geotechnical laboratory testing program is presented below.

Moisture Content and Dry Unit Weight

Moisture content and dry unit weight tests were performed to evaluate moisture-conditioning requirements during site preparation and earthwork grading; soil overburden, and active and passive earth pressures; and relative soil strength and compressibility. Moisture content was evaluated in general accordance with ASTM Test Method D 2216; dry unit weight was evaluated using procedures similar to ASTM Test Method D 2937.

Sieve Analysis

Sieve analyses were performed to evaluate the gradational characteristics of the material and to aid in soil classification. Tests were performed in general accordance with ARIZ 201b.

Atterberg Limits

Atterberg Limits tests were performed to aid in soil classification and to evaluate the plasticity characteristics of the material. Additionally, test results were correlated to published data to evaluate the shrink/swell potential of near-surface site soils. Tests were performed in general accordance with AASHTO T 90.

Moisture/Density Relationship

Standard proctor tests were performed on bulk soil samples to evaluate maximum compacted dry density and optimum moisture content. Test procedures were in general accordance with ARIZ 225.

Direct Shear

Direct shear tests were performed on selected undisturbed soil samples to evaluate the strength parameters of the site soils. The direct shear tests were performed over the range of expected normal loading.

Resistivity and pH

Resistivity and pH tests were performed to evaluate the corrosive potential of the site soils. Tests were performed in general accordance with ADOT Test Method 236.

Sulfate and Chloride

Sulfate and Chloride tests were performed to evaluate the corrosive potential of site soils toward Portland cement concrete. Tests were performed in general accordance with California Test Methods 417 and 422 (sulfate and chloride, respectively).

Consolidation

Consolidation tests were performed on selected undisturbed samples to evaluate the settlement potential of the site soils when subjected to typical foundation loads and wetting.

Agronomy

Agronomy testing for topsoil was performed on selected bulk samples to determine amendments recommended for growth of grasses in channels and basins.



PROJECT: REEMS ROAD CHANNEL & BASIN
 LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
 REVIEWED BY: M. CONNOLLY

PROJECT NO: 47724
 WORK ORDER NO: 04235
 DATE SAMPLED: 8/2 & 8/3/04

MECHANICAL SIEVE ANALYSIS
 GROUP SYMBOL, USCS (ASTM D-2487)

SIEVE SIZES

| Location & Depth | USCS | LL | PL | PI | COBBLES | | GRAVEL | | | | | | | | SAND | | | | | | | Silt or Clay | Lab # |
|------------------|------|----|----|----|---------|----|--------|----|------|------|------|------|----|----|--------|-----|--------|-----|-----|------|------|--------------|-------|
| | | | | | 6" | 4" | Coarse | | | | Fine | | | | Coarse | | Medium | | | Fine | | | |
| | | | | | 3" | 2" | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | 1/4" | #4 | #8 | #10 | #16 | #30 | #40 | #50 | #100 | #200 | | |

PERCENT PASSING BY WEIGHT

| Location & Depth | USCS | LL | PL | PI | 6" | 4" | 3" | 2" | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | 1/4" | #4 | #8 | #10 | #16 | #30 | #40 | #50 | #100 | #200 | Lab # |
|------------------|-------|----|----|----|-----|-----|-----|-----|--------|-----|------|------|------|------|-----|----|-----|-----|-----|-----|-----|------|------|-------|
| B-1 @ 0-1.5 | CL | 27 | 16 | 11 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 99 | 97 | 96 | 93 | 87 | 83 | 79 | 72 | 64 | 1 |
| B-1 @ 15-16.5 | CL | 37 | 16 | 21 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 98 | 95 | 94 | 90 | 82 | 76 | 70 | 60 | 52 | 4 |
| B-2 @ 15-16.5 | SC | 22 | 12 | 10 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 97 | 95 | 87 | 83 | 70 | 49 | 40 | 32 | 22 | 17 | 9 |
| B-3 @ 15-16 | CL | 37 | 18 | 19 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 99 | 98 | 96 | 95 | 93 | 86 | 82 | 76 | 66 | 56 | 14 |
| B-4 @ 0-1.5 | CL | 29 | 15 | 14 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 98 | 97 | 93 | 90 | 87 | 82 | 74 | 16 |
| B-4 @ 15-16.5 | CL | 36 | 19 | 17 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 98 | 96 | 95 | 93 | 86 | 81 | 76 | 66 | 56 | 19 |
| B-5 @ 0-1.5 | CL-ML | 24 | 18 | 6 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 98 | 98 | 95 | 90 | 98 | 82 | 72 | 59 | 21 |
| B-5 @ 10-11 | SP-SM | NV | NP | NP | 100 | 100 | 100 | 100 | 100 | 100 | 97 | 93 | 89 | 84 | 81 | 72 | 69 | 62 | 47 | 39 | 29 | 15 | 10 | 23 |
| B-6 @ 5-6.5 | CL | 31 | 22 | 9 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 99 | 96 | 95 | 92 | 87 | 84 | 80 | 70 | 57 | 27 |
| B-7 @ 5-6.5 | CL | 38 | 20 | 18 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 99 | 98 | 93 | 90 | 86 | 77 | 64 | 32 |



PROJECT: REEMS ROAD CHANNEL & BASIN
 LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
 REVIEWED BY: M. CONNOLLY

PROJECT NO: 47724
 WORK ORDER NO: 04235
 DATE SAMPLED: 8/2 & 8/3/04

MECHANICAL SIEVE ANALYSIS
 GROUP SYMBOL, USCS (ASTM D-2487)

SIEVE SIZES

| Location & Depth | USCS | LL | PL | PI | COBBLES | | GRAVEL | | | | | | | SAND | | | | | | | Silt or Clay | Lab # |
|------------------|------|----|----|----|---------|----|--------|----|--------|------|------|------|------|--------|----|--------|-----|-----|------|-----|--------------|-------|
| | | | | | 6" | 4" | Coarse | | | Fine | | | | Coarse | | Medium | | | Fine | | | |
| | | | | | | | 3" | 2" | 1 1/2" | 1" | 3/4" | 1/2" | 3/8" | 1/4" | #4 | #8 | #10 | #16 | #30 | #40 | | |

PERCENT PASSING BY WEIGHT

| | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|----|----|----|----|----|----|----|----|
| B-8 @ 5-6.5 | SC | 26 | 12 | 14 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 96 | 95 | 91 | 79 | 70 | 63 | 53 | 44 | 37 |
| B-9 @ 5-6 | SC | 28 | 17 | 11 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 98 | 97 | 93 | 92 | 87 | 80 | 76 | 70 | 59 | 47 | 42 | |
| B-6 @ 0-3 | CL | 28 | 14 | 14 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 98 | 95 | 93 | 91 | 90 | 86 | 80 | 77 | 73 | 67 | 61 | 56 | |
| B-9 @ 3-10 | CL | 41 | 15 | 26 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 99 | 98 | 97 | 95 | 94 | 91 | 85 | 81 | 77 | 68 | 60 | 69 |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | |



PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SOIL SAMPLES
SAMPLE SOURCE: SEE BELOW

PROJECT NO: 47724
WORK ORDER NO: 04235
LAB NO: SEE BELOW
DATE SAMPLED: 8/2 & 8/3/04
REVIEWED BY: M. CONNOLLY

MOISTURE CONTENT OF SOIL (ASTM D2216)

| LAB # | BORING | DEPTH RANGE | USCS | WET WT. (gram) | DRY WT. (gram) | MOISTURE CONTENT |
|-------|--------|-------------|--------------|----------------|----------------|------------------|
| 34 | B-7 | 15-16.5 | Soil Samples | 324.9 | 299.4 | 8.5% |
| 38 | B-8 | 10-11.5 | Soil Samples | 307.3 | 271.3 | 13.3% |



PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SOIL SAMPLES
SAMPLE SOURCE: SEE BELOW

PROJECT NO: 47724
WORK ORDER NO: 04235
LAB NO: SEE BELOW
DATE SAMPLED: 8/2 & 8/3/04
REVIEWED BY: M. CONNOLLY

DENSITY OF SOIL IN PLACE BY THE DRIVE-CYLINDER METHOD(ASTM D2937)

| LAB # | BORING | USCS | MOISTURE | | | NUMBER OF RINGS | WET WGT. + RINGS (g) | WEIGHT OF RINGS (g) | DRY DENSITY (pcf) |
|-------|--------------|-------------|----------------|----------------|---------------------|--------------------|----------------------------|---------------------------|-------------------------|
| | | | WET WT. (g) | DRY WT. (g) | MOISTURE CONTENT | | | | |
| 2 | B-1 @ 5-6 | Soil Sample | 803.3 | 736.2 | 9.1% | 5.0 | 1,010.6 | 224.3 | 119.3 |
| 8 | B-2 @ 10-11 | Soil Sample | 460.9 | 443.5 | 3.9% | 5.0 | 932.6 | 231.2 | 111.8 |
| 14 | B-3 @ 15-16 | CL | 379.2 | 379.2 | 0.0% | 5.0 | 977.5 | 224.9 | 124.6 |
| 17 | B-4 @ 5-6 | Soil Sample | 306.1 | 265.8 | 15.2% | 5.0 | 914.8 | 226.2 | 99.0 |
| 23 | B-5 @ 10-11 | SP-SM | 312.6 | 294.9 | 6.0% | 5.0 | 949.8 | 215.8 | 114.7 |
| 29 | B-6 @ 15-16 | Soil Sample | 474.1 | 446.1 | 6.3% | 6.0 | 1,119.6 | 273.4 | 109.9 |
| 42 | B-9 @ 5-6 | SC | 429.7 | 395.1 | 8.8% | 5.0 | 945.3 | 226.8 | 109.4 |
| 48 | B-10 @ 10-11 | Soil Sample | 517.9 | 485.6 | 6.7% | 6.0 | 1,170.0 | 268.5 | 116.6 |



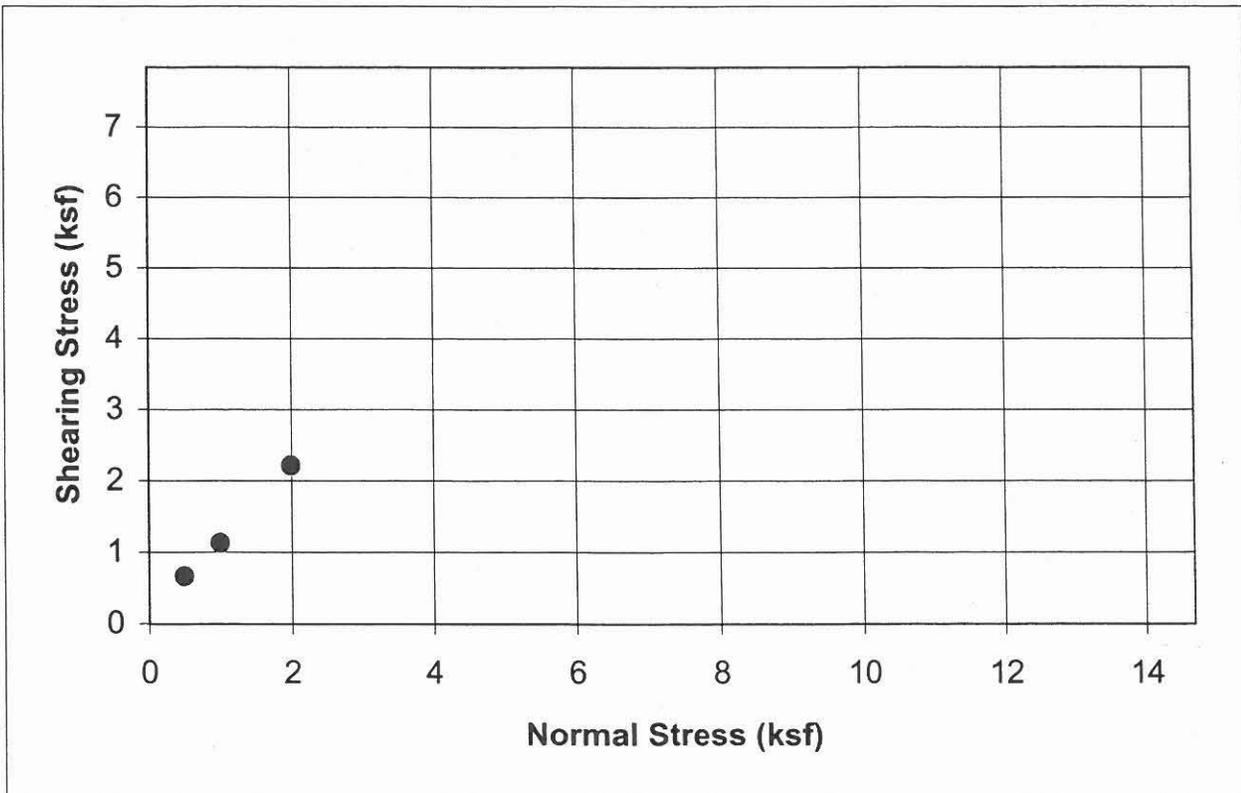
PROJECT: REEMS ROAD CHANNEL & BASIN
 LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
 MATERIAL: SOIL SAMPLES
 SAMPLE SOURCE: B-2 @ 10-11
 SAMPLE PREP.: SATURATED
 TARGET: N/A

JOB NO: 47724
 W.O. NUMBER: 04235
 LAB NO: 8
 DATE SAMPLED: 8/2 & 8/3/04

Joe

DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS(ASTM D3080)

| | | | |
|--|--|--------|--------|
| Initial thickness of specimen (in.): | 1.00 | | |
| Initial diameter of specimen (in.): | 2.42 | | |
| Shearing device used: | Created by DigiShear Version 1.2; Copyright 2000, GEOTAC | | |
| Rate of deformation (in/min): | 0.008 | | |
| Direct shear point: | 1 | 2 | 3 |
| Dry mass of specimen (g): | 124.8 | 131.6 | 126.9 |
| Initial Moisture Content: | 6.3% | 5.1% | 6.2% |
| Initial Wet Density (lb per cu.ft): | 109.8 | 114.5 | 111.6 |
| Initial Dry Density (lb per cu.ft): | 103.3 | 109.0 | 105.1 |
| Final Moisture Content: | 18.7% | 17.5% | 17.5% |
| Final Wet Density (lb per cu.ft): | 123.5 | 128.1 | 124.2 |
| Final Dry Density (lb per cu.ft): | 104.1 | 109.7 | 105.9 |
| Normal Stress (kips per sq. ft): | 0.50 | 1.00 | 2.00 |
| Maximum Shearing Stress (kips per sq. ft): | 0.66 | 1.13 | 2.21 |
| Vertical Deformation @ Max Shear (in): | -0.007 | -0.001 | -0.006 |
| Horizontal Deformation @ Max Shear (in): | 0.449 | 0.483 | 0.326 |



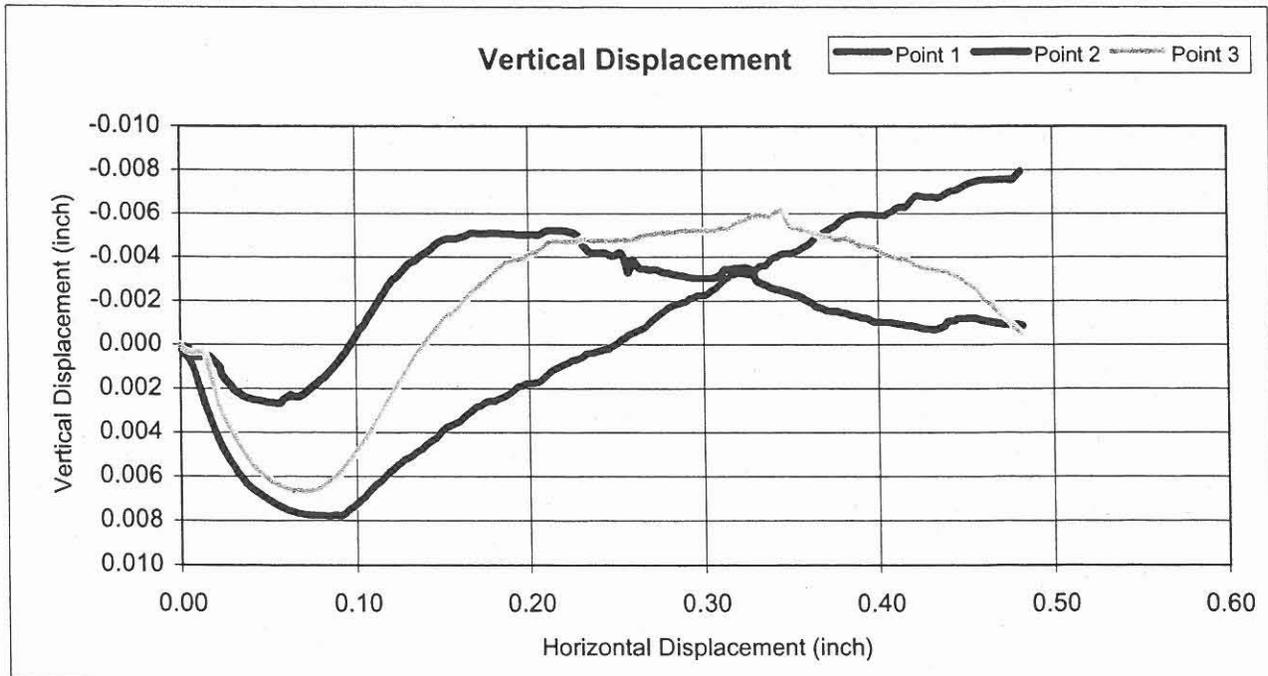
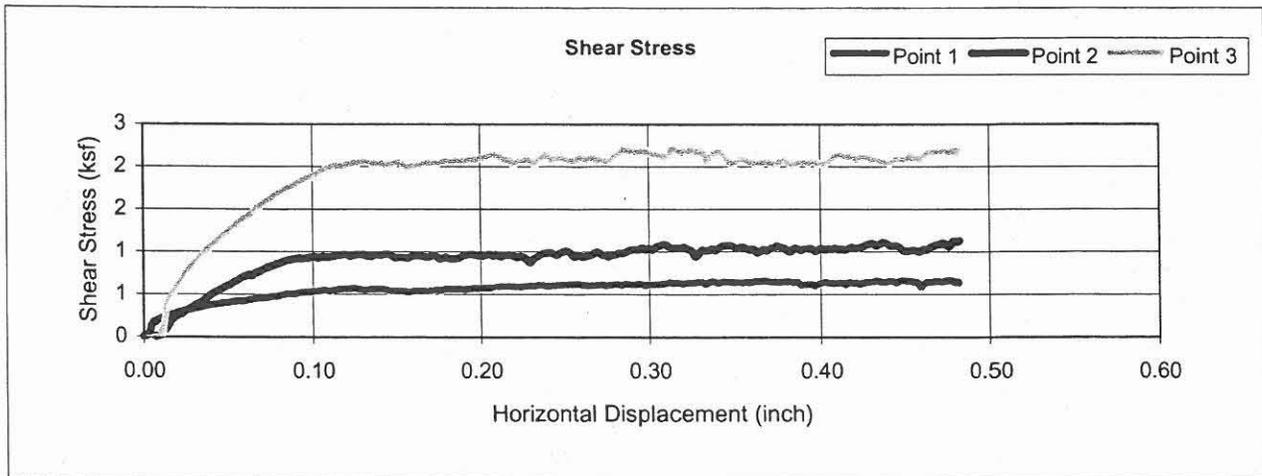


KLEINFELDER

PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SOIL SAMPLES
SAMPLE SOURCE: B-2 @ 10-11
SAMPLE PREP.: SATURATED
NORMAL LOADS (ksf): 0.5 1 2

JOB NO: 47724
WORK ORDER NO: 04235
LAB NO: 8
DATE SAMPLED: 8/2 & 8/3/04

DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS (ASTM D3080)





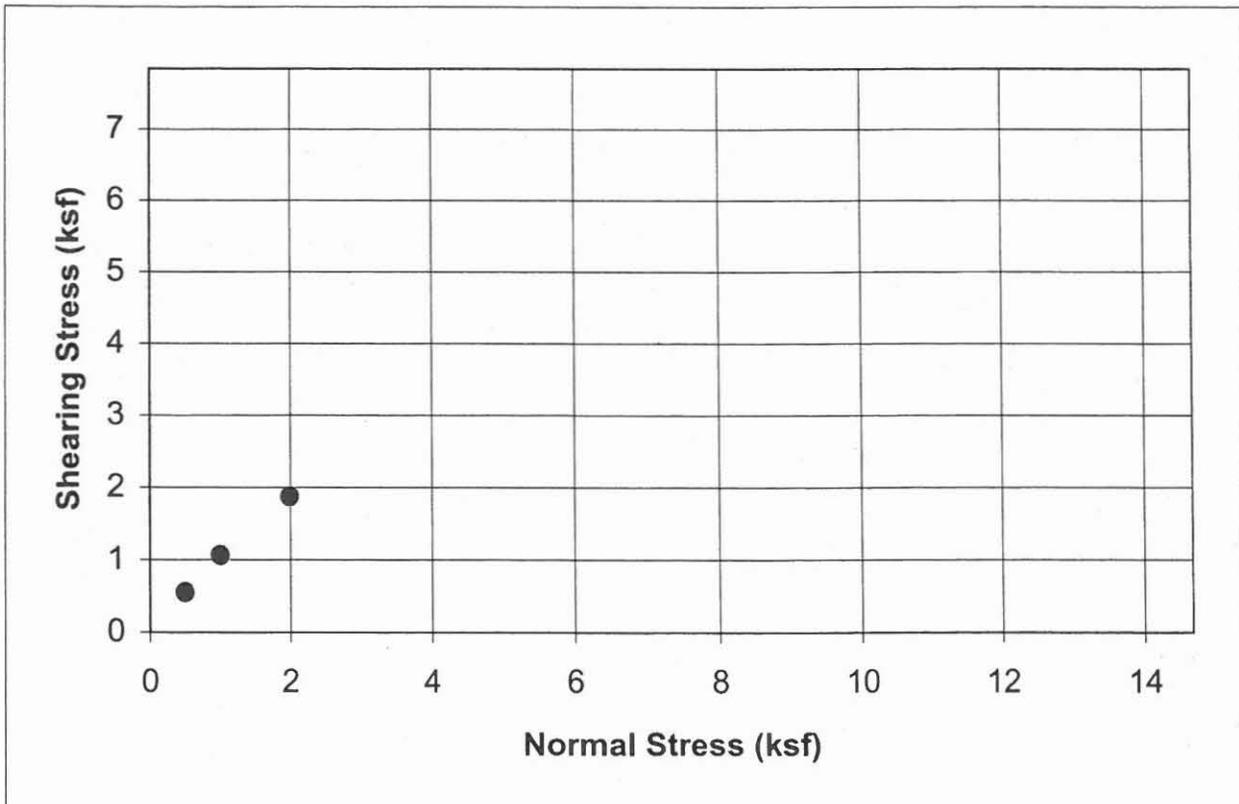
KLEINFELDER

PROJECT: REEMS ROAD CHANNEL & BASIN
 LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
 MATERIAL: SOIL SAMPLES
 SAMPLE SOURCE: B-4 @ 5-6
 SAMPLE PREP.: SATURATED
 TARGET: N/A

JOB NO: 47724
 W.O. NUMBER: 04235
 LAB NO: 17
 DATE SAMPLED: 8/2 & 8/3/04

DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS(ASTM D3080)

| | | | |
|--|--|-------|-------|
| Initial thickness of specimen (in.): | 1.00 | | |
| Initial diameter of specimen (in.): | 2.42 | | |
| Shearing device used: | Created by DigiShear Version 1.2; Copyright 2000, GEOTAC | | |
| Rate of deformation (in/min): | 0.008 | | |
| Direct shear point: | 1 | 2 | 3 |
| Dry mass of specimen (g): | 112.9 | 110.9 | 113.8 |
| Initial Moisture Content: | 13.5% | 16.1% | 16.3% |
| Initial Wet Density (lb per cu.ft): | 106.1 | 106.6 | 109.6 |
| Initial Dry Density (lb per cu.ft): | 93.5 | 91.9 | 94.3 |
| Final Moisture Content: | 29.4% | 31.0% | 28.2% |
| Final Wet Density (lb per cu.ft): | 119.9 | 119.1 | 119.8 |
| Final Dry Density (lb per cu.ft): | 92.7 | 91.1 | 93.5 |
| Normal Stress (kips per sq. ft): | 0.50 | 1.00 | 2.00 |
| Maximum Shearing Stress (kips per sq. ft): | 0.55 | 1.06 | 1.87 |
| Vertical Deformation @ Max Shear (in): | 0.008 | 0.010 | 0.009 |
| Horizontal Deformation @ Max Shear (in): | 0.098 | 0.101 | 0.087 |



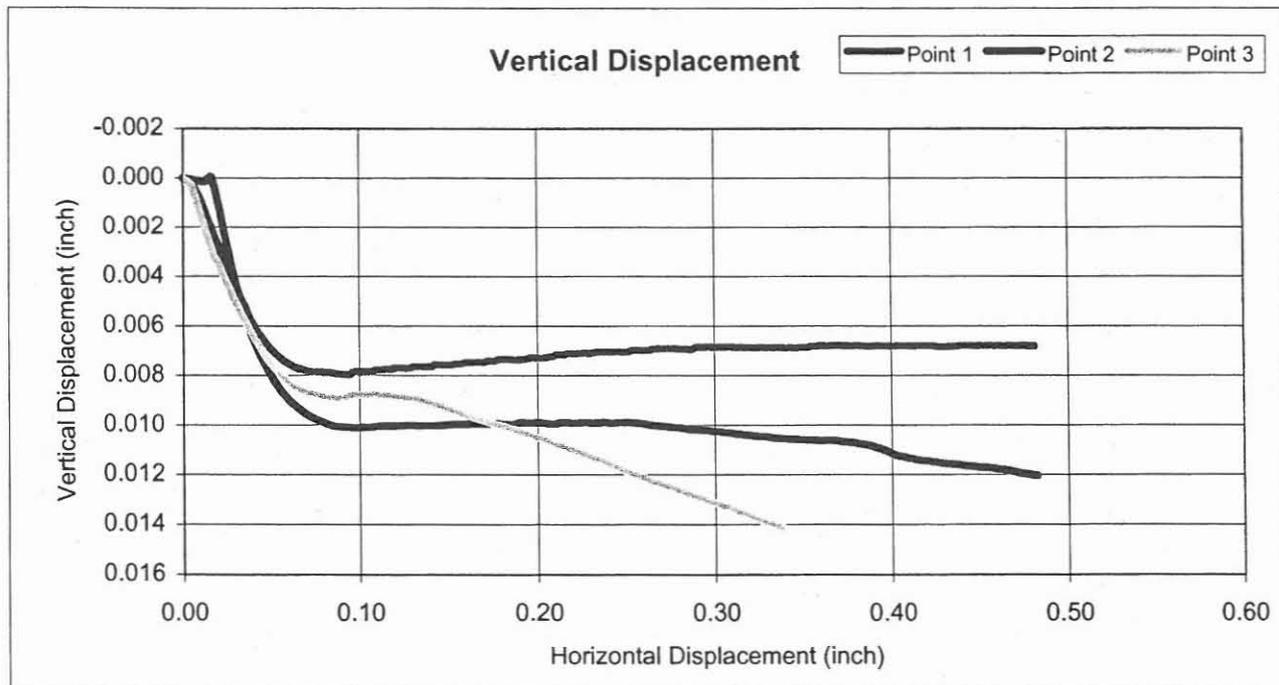
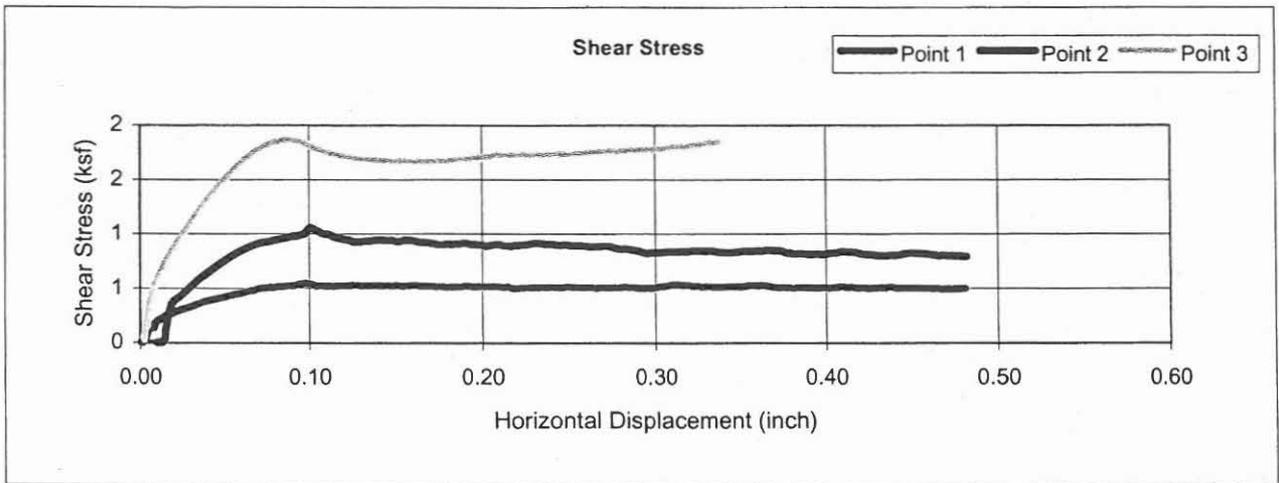


KLEINFELDER

PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SOIL SAMPLES
SAMPLE SOURCE: B-4 @ 5-6
SAMPLE PREP.: SATURATED
NORMAL LOADS (ksf): 0.5 1 2

JOB NO: 47724
WORK ORDER NO: 04235
LAB NO: 17
DATE SAMPLED: 8/2 & 8/3/04

DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS (ASTM D3080)



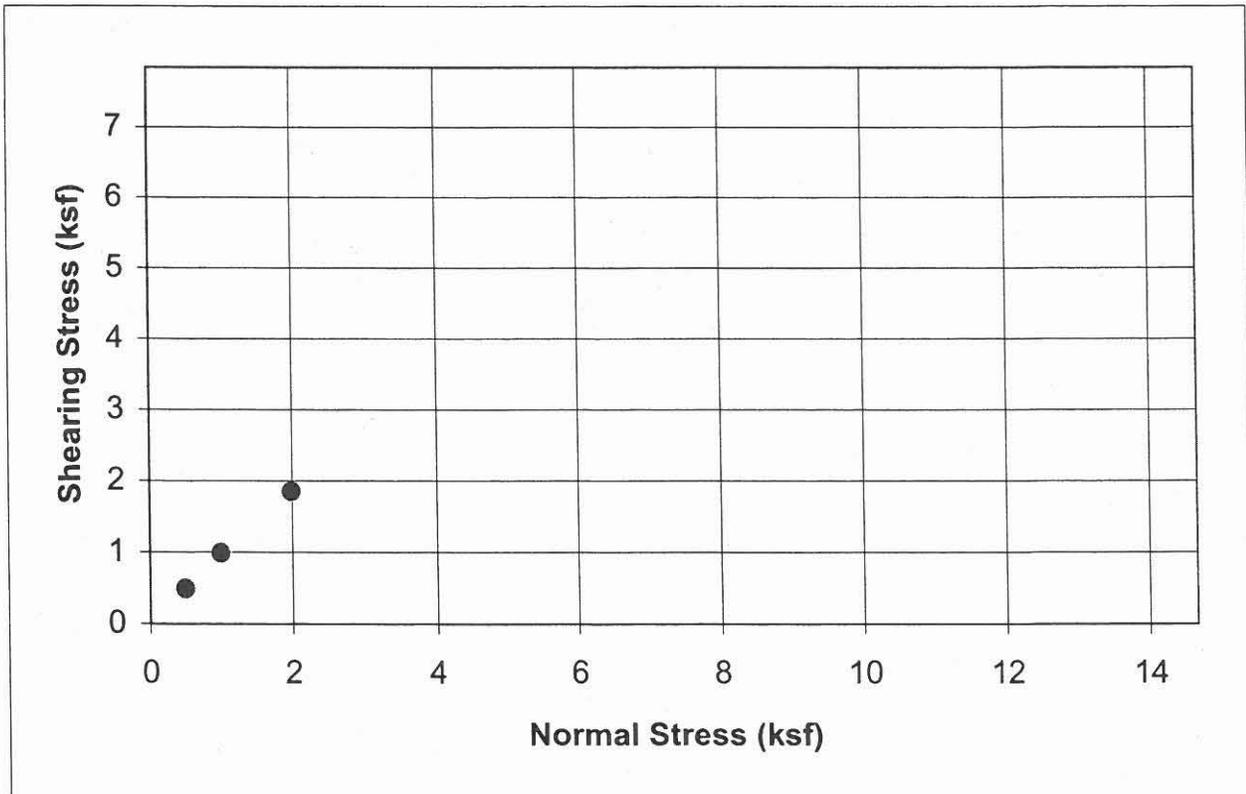


PROJECT: REEMS ROAD CHANNEL & BASIN
 LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
 MATERIAL: SOIL SAMPLES
 SAMPLE SOURCE: B-6 @ 15-16
 SAMPLE PREP.: SATURATED
 TARGET: N/A

JOB NO: 47724
 W.O. NUMBER: 04235
 LAB NO: 29
 DATE SAMPLED: 8/2 & 8/3/04

DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS(ASTM D3080)

| | | | |
|--|--|-------|-------|
| Initial thickness of specimen (in.): | 1.00 | | |
| Initial diameter of specimen (in.): | 2.42 | | |
| Shearing device used: | Created by DigiShear Version 1.2; Copyright 2000, GEOTAC | | |
| Rate of deformation (in/min): | 0.008 | | |
| Direct shear point: | 1 | 2 | 3 |
| Dry mass of specimen (g): | 126.6 | 126.2 | 128.0 |
| Initial Moisture Content: | 7.9% | 9.4% | 7.6% |
| Initial Wet Density (lb per cu.ft): | 113.1 | 114.3 | 114.1 |
| Initial Dry Density (lb per cu.ft): | 104.9 | 104.5 | 106.0 |
| Final Moisture Content: | 18.9% | 22.6% | 23.1% |
| Final Wet Density (lb per cu.ft): | 124.3 | 126.9 | 127.0 |
| Final Dry Density (lb per cu.ft): | 104.5 | 104.2 | 105.7 |
| Normal Stress (kips per sq. ft): | 0.50 | 1.00 | 2.00 |
| Maximum Shearing Stress (kips per sq. ft): | 0.48 | 0.99 | 1.84 |
| Vertical Deformation @ Max Shear (in): | 0.003 | 0.009 | 0.027 |
| Horizontal Deformation @ Max Shear (in): | 0.399 | 0.431 | 0.476 |



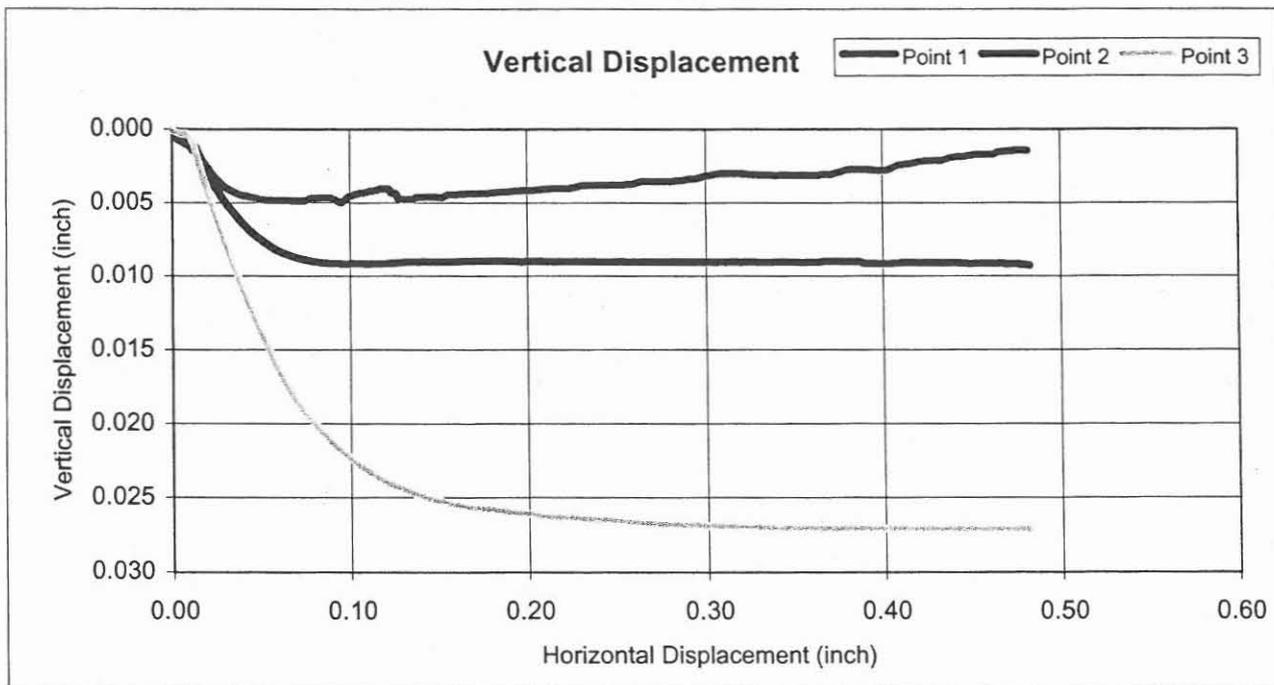
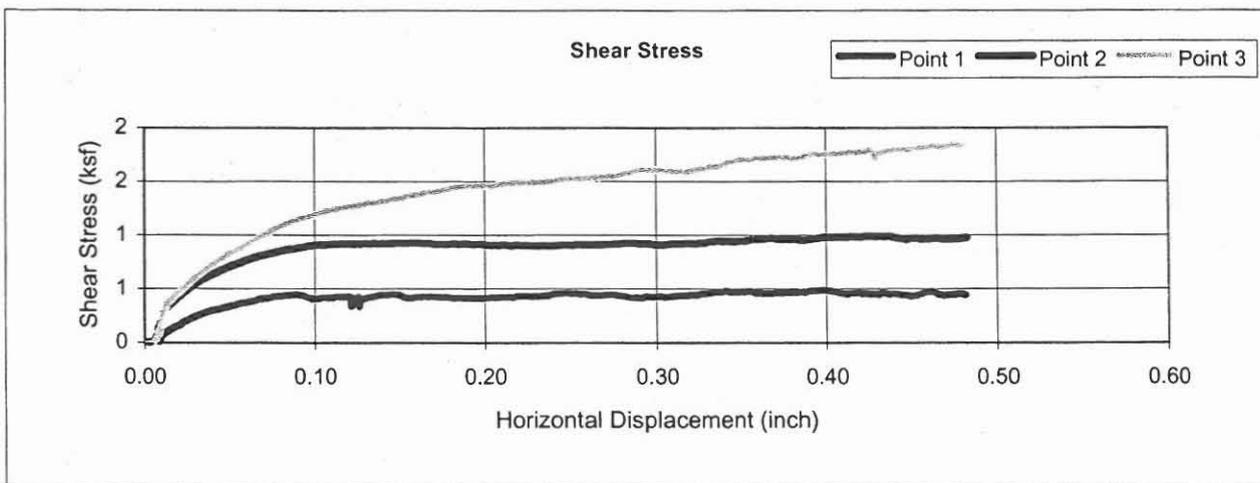


KLEINFELDER

PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SOIL SAMPLES
SAMPLE SOURCE: B-6 @ 15-16
SAMPLE PREP.: SATURATED
NORMAL LOADS (ksf): 0.5 1 2

JOB NO: 47724
WORK ORDER NO: 04235
LAB NO: 29
DATE SAMPLED: 8/2 & 8/3/04

DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS (ASTM D3080)





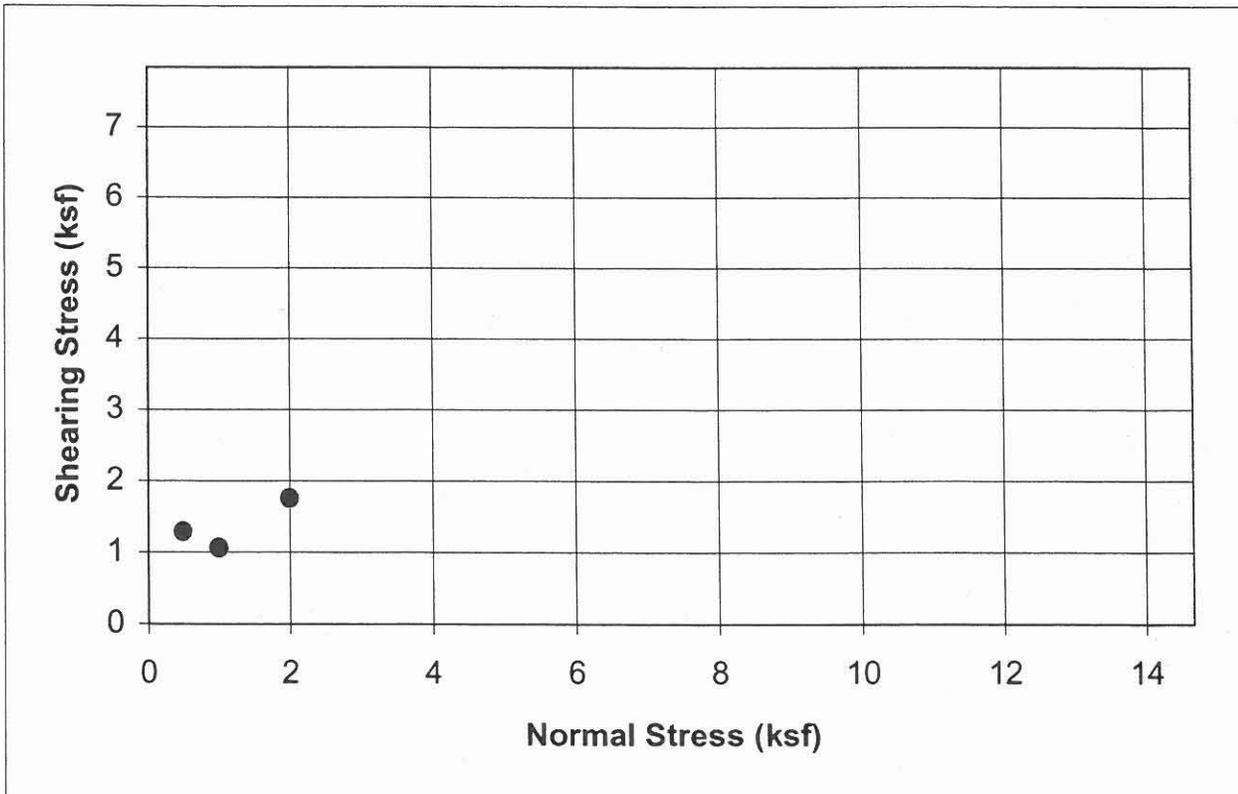
KLEINFELDER

PROJECT: REEMS ROAD CHANNEL & BASIN
 LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
 MATERIAL: SC
 SAMPLE SOURCE: B-9 @ 5-6
 SAMPLE PREP.: SATURATED
 TARGET: N/A

JOB NO: 47724
 W.O. NUMBER: 04235
 LAB NO: 42
 DATE SAMPLED: 8/2 & 8/3/04

DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS(ASTM D3080)

| | | | |
|--|--|-------|-------|
| Initial thickness of specimen (in.): | 1.00 | | |
| Initial diameter of specimen (in.): | 2.42 | | |
| Shearing device used: | Created by DigiShear Version 1.2; Copyright 2000, GEOTAC | | |
| Rate of deformation (in/min): | 0.008 | | |
| Direct shear point: | 1 | 2 | 3 |
| Dry mass of specimen (g): | 132.8 | 115.9 | 105.8 |
| Initial Moisture Content: | 13.1% | 16.3% | 17.5% |
| Initial Wet Density (lb per cu.ft): | 124.3 | 111.5 | 102.9 |
| Initial Dry Density (lb per cu.ft): | 110.0 | 96.0 | 87.6 |
| Final Moisture Content: | 23.0% | 29.0% | 33.8% |
| Final Wet Density (lb per cu.ft): | 137.4 | 123.4 | 114.3 |
| Final Dry Density (lb per cu.ft): | 111.7 | 97.4 | 89.0 |
| Normal Stress (kips per sq. ft): | 0.50 | 1.00 | 2.00 |
| Maximum Shearing Stress (kips per sq. ft): | 1.28 | 1.06 | 1.75 |
| Vertical Deformation @ Max Shear (in): | -0.016 | 0.003 | 0.025 |
| Horizontal Deformation @ Max Shear (in): | 0.054 | 0.115 | 0.457 |



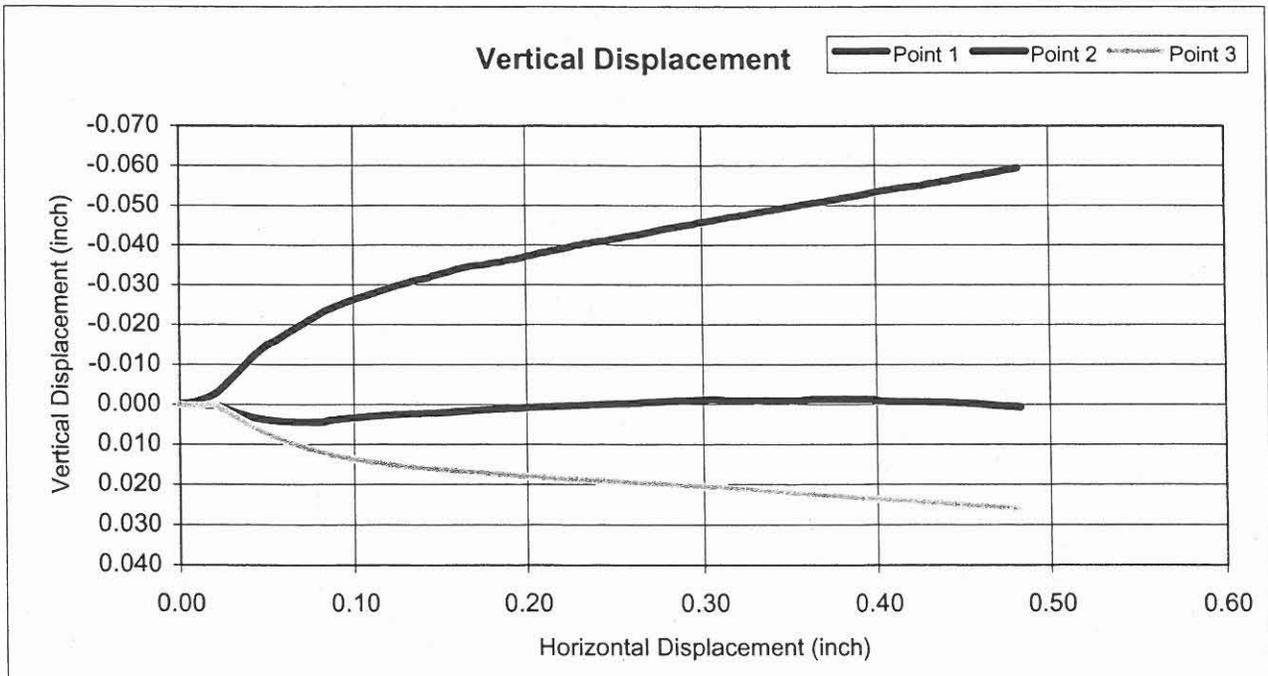
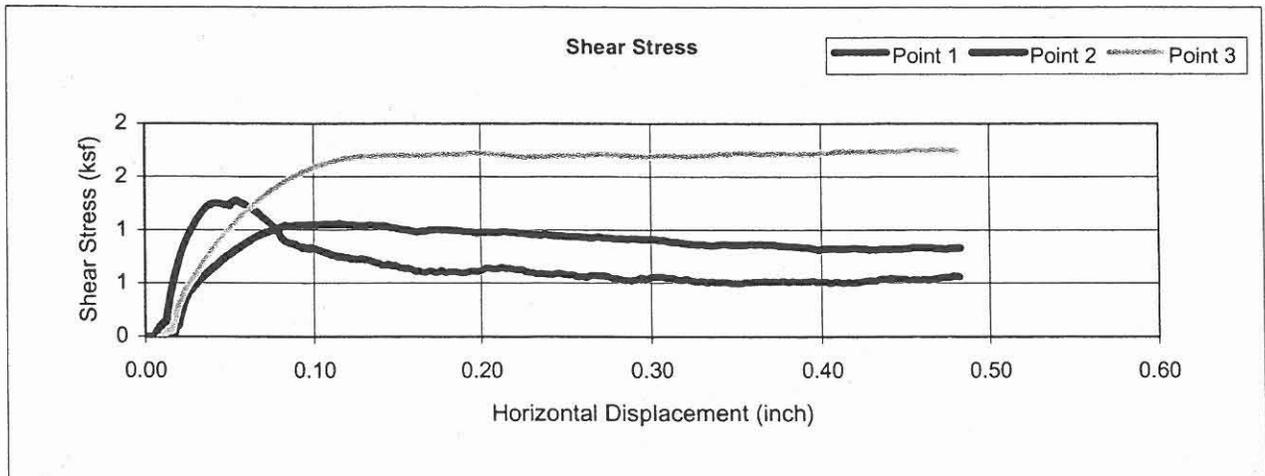


KLEINFELDER

PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SC
SAMPLE SOURCE: B-9 @ 5-6
SAMPLE PREP.: SATURATED
NORMAL LOADS (ksf): 0.5 1 2

JOB NO: 47724
WORK ORDER NO: 04235
LAB NO: 42
DATE SAMPLED: 8/2 & 8/3/04

DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS(ASTM D3080)





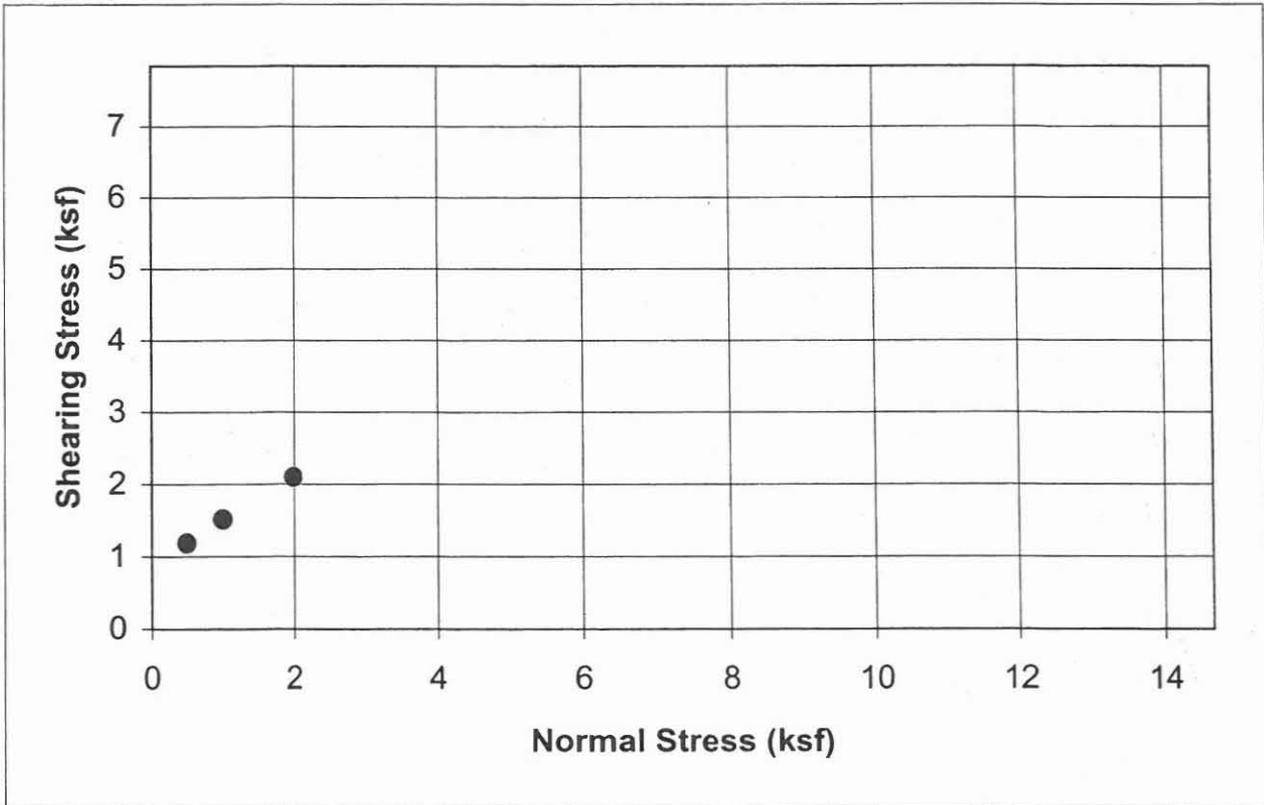
KLEINFELDER

PROJECT: REEMS ROAD CHANNEL & BASIN
 LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
 MATERIAL: SOIL SAMPLES
 SAMPLE SOURCE: B-10 @ 10-11
 SAMPLE PREP.: SATURATED
 TARGET: N/A

JOB NO: 47724
 W.O. NUMBER: 04235
 LAB NO: 48
 DATE SAMPLED: 8/2 & 8/3/04

DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS (ASTM D3080)

| | | | |
|--|--|--------|-------|
| Initial thickness of specimen (in.): | 1.00 | | |
| Initial diameter of specimen (in.): | 2.42 | | |
| Shearing device used: | Created by DigiShear Version 1.2; Copyright 2000, GEOTAC | | |
| Rate of deformation (in/min): | 0.008 | | |
| Direct shear point: | 1 | 2 | 3 |
| Dry mass of specimen (g): | 128.9 | 130.8 | 135.8 |
| Initial Moisture Content: | 9.6% | 11.3% | 10.0% |
| Initial Wet Density (lb per cu.ft): | 117.0 | 120.5 | 123.6 |
| Initial Dry Density (lb per cu.ft): | 106.8 | 108.3 | 112.5 |
| Final Moisture Content: | 9.6% | 22.2% | 20.1% |
| Final Wet Density (lb per cu.ft): | 118.0 | 134.8 | 135.0 |
| Final Dry Density (lb per cu.ft): | 107.6 | 109.2 | 113.4 |
| Normal Stress (kips per sq. ft): | 0.50 | 1.00 | 2.00 |
| Maximum Shearing Stress (kips per sq. ft): | 1.18 | 1.51 | 2.09 |
| Vertical Deformation @ Max Shear (in): | -0.008 | -0.019 | 0.001 |
| Horizontal Deformation @ Max Shear (in): | 0.119 | 0.339 | 0.080 |



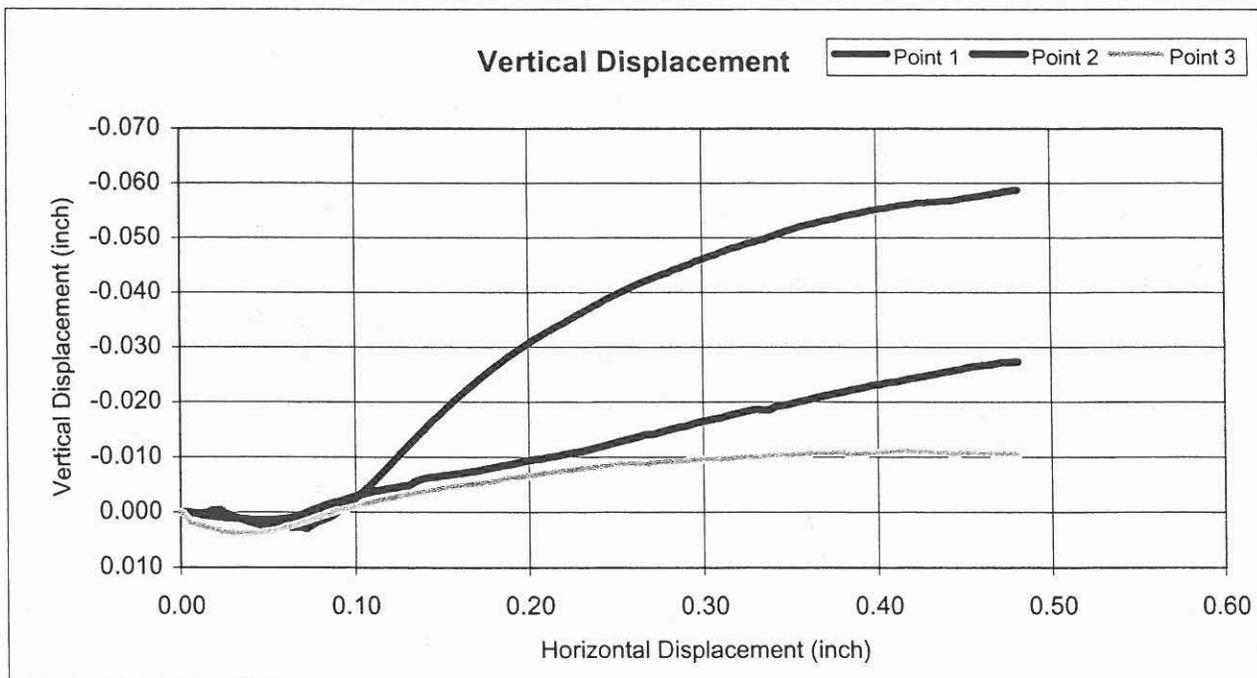
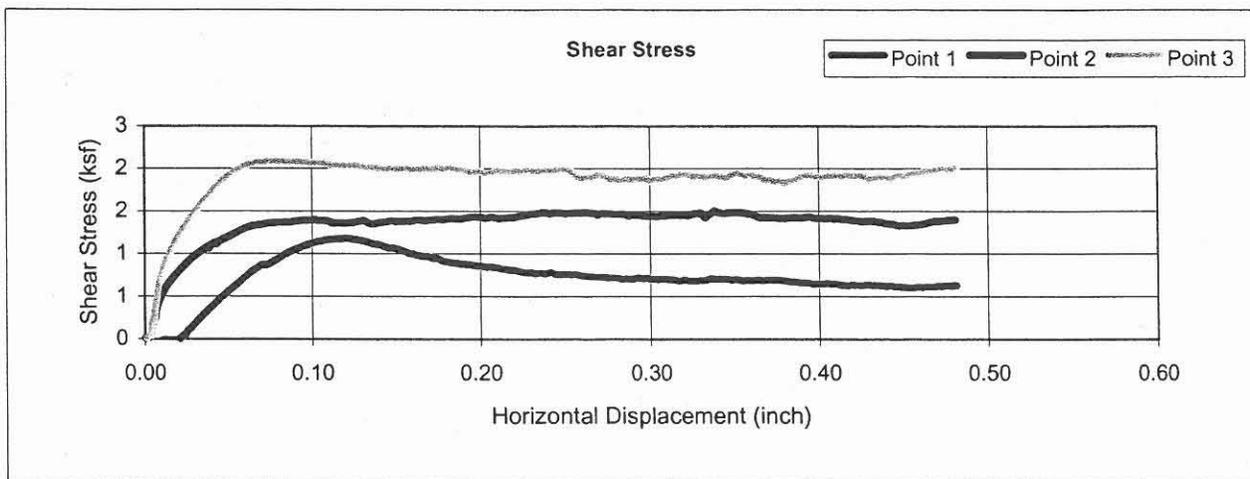


KLEINFELDER

PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SOIL SAMPLES
SAMPLE SOURCE: B-10 @ 10-11
SAMPLE PREP.: SATURATED
NORMAL LOADS (ksf): 0.5 1 2

JOB NO: 47724
WORK ORDER NO: 04235
LAB NO: 48
DATE SAMPLED: 8/2 & 8/3/04

DIRECT SHEAR TEST OF SOILS UNDER CONSOLIDATED DRAINED CONDITIONS (ASTM D3080)



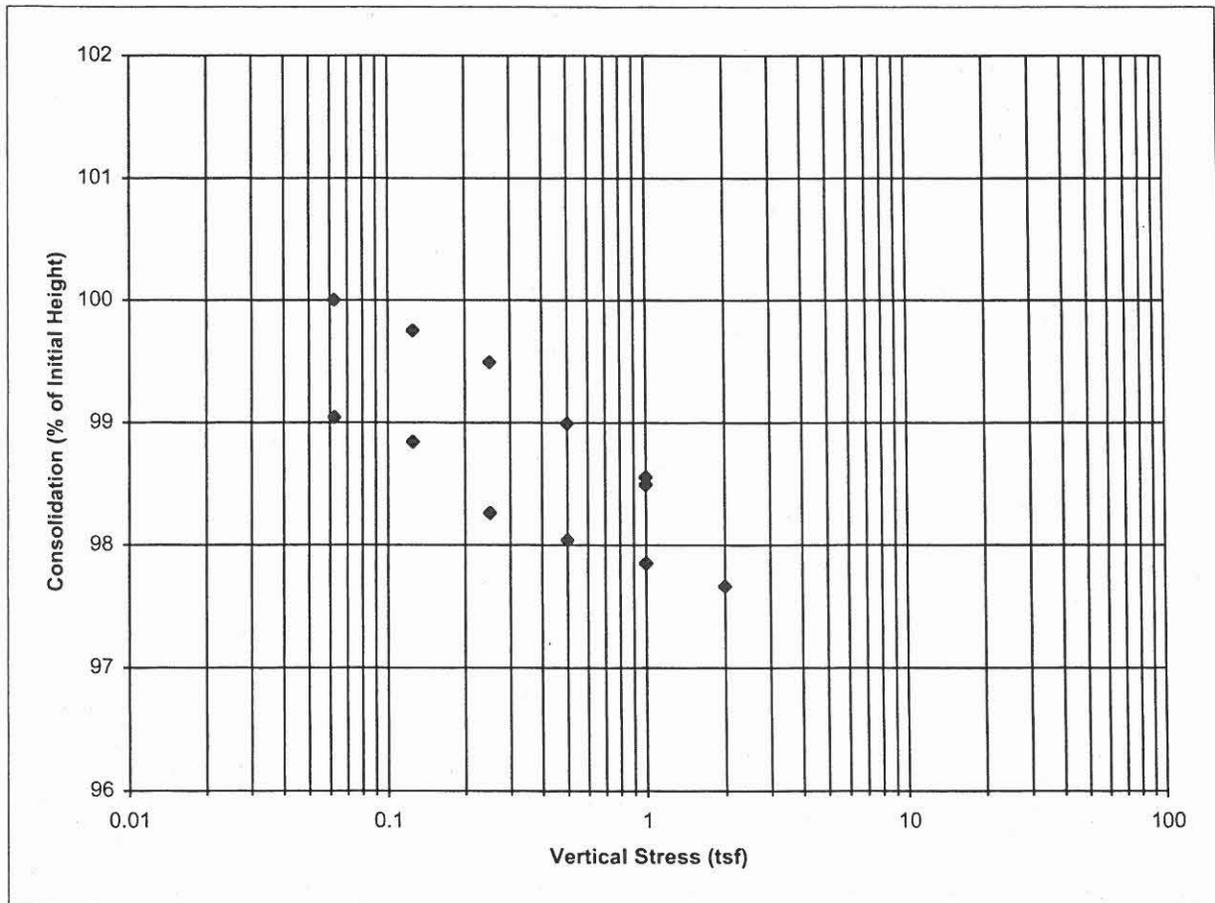


PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SOIL SAMPLES
SAMPLE SOURCE: B-1 @ 5-6
REVIEWED BY: M. CONNOLLY

PROJECT NO: 47724
WORK ORDER NO 04235
LAB NO: 2
DATE SAMPLED: 8/2 & 8/3/04

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

| | | | |
|------------------------------|-------|----------------------------|-------|
| INITIAL VOLUME (cu.in) | 4.60 | FINAL VOLUME (cu.in) | 4.50 |
| INITIAL MOISTURE CONTENT | 9.5% | FINAL MOISTURE CONTENT | 14.8% |
| INITIAL DRY DENSITY(pcf) | 118.5 | FINAL DRY DENSITY(pcf) | 120.7 |
| INITIAL DEGREE OF SATURATION | 60% | FINAL DEGREE OF SATURATION | 101% |
| INITIAL VOID RATIO | 0.4 | FINAL VOID RATIO | 0.4 |
| ESTIMATED SPECIFIC GRAVITY | 2.700 | SATURATED AT | 1tsf |



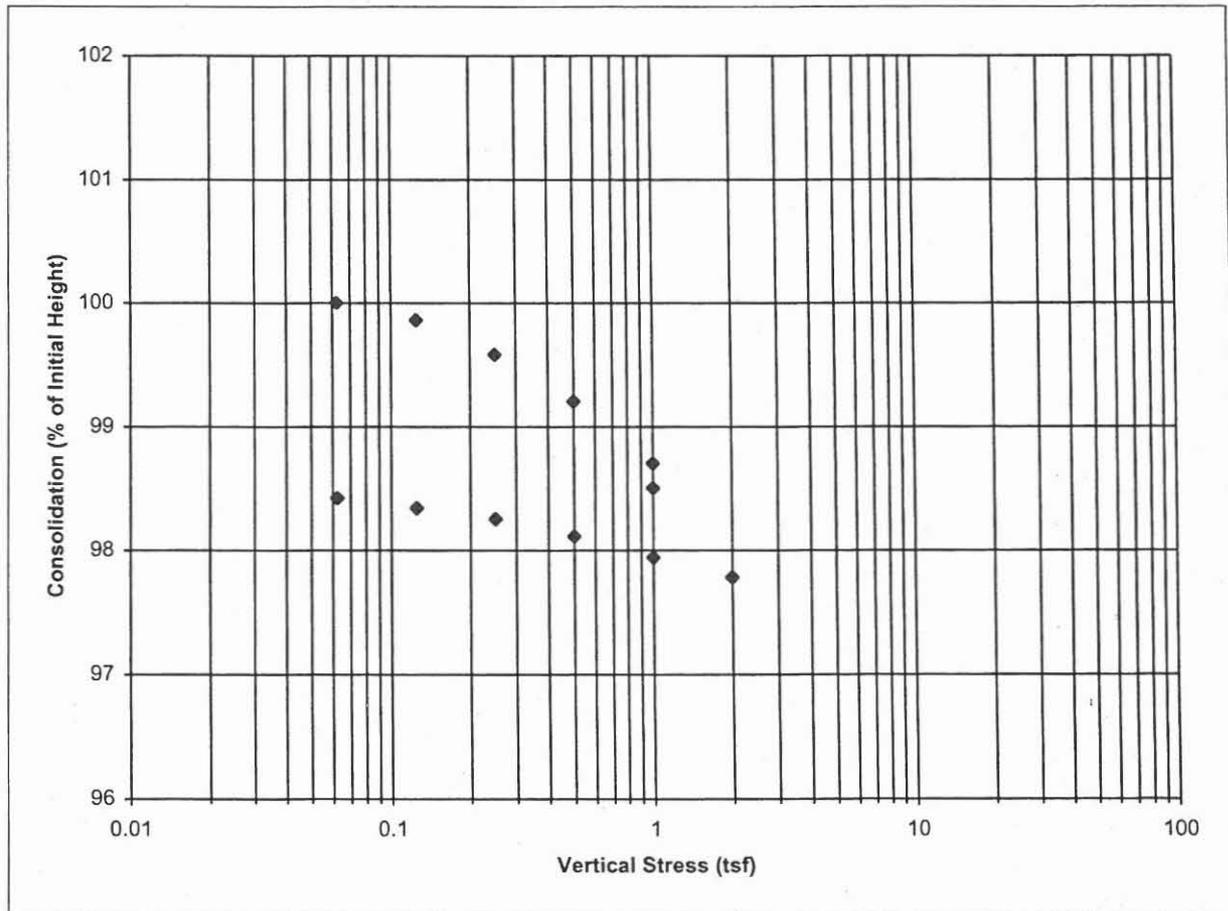


PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SOIL SAMPLES
SAMPLE SOURCE: B-5 @ 10-11
REVIEWED BY: M. CONNOLLY

PROJECT NO: 47724
WORK ORDER NO 04235
LAB NO: 23
DATE SAMPLED: 8/2 & 8/3/04

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES OF SOILS (ASTM D2435)

| | | | |
|------------------------------|-------|----------------------------|-------|
| INITIAL VOLUME (cu.in) | 4.60 | FINAL VOLUME (cu.in) | 4.50 |
| INITIAL MOISTURE CONTENT | 6.8% | FINAL MOISTURE CONTENT | 15.9% |
| INITIAL DRY DENSITY(pcf) | 108.9 | FINAL DRY DENSITY(pcf) | 110.8 |
| INITIAL DEGREE OF SATURATION | 39% | FINAL DEGREE OF SATURATION | 98% |
| INITIAL VOID RATIO | 0.4 | FINAL VOID RATIO | 0.4 |
| ESTIMATED SPECIFIC GRAVITY | 2.500 | SATURATED AT | 1tsf |



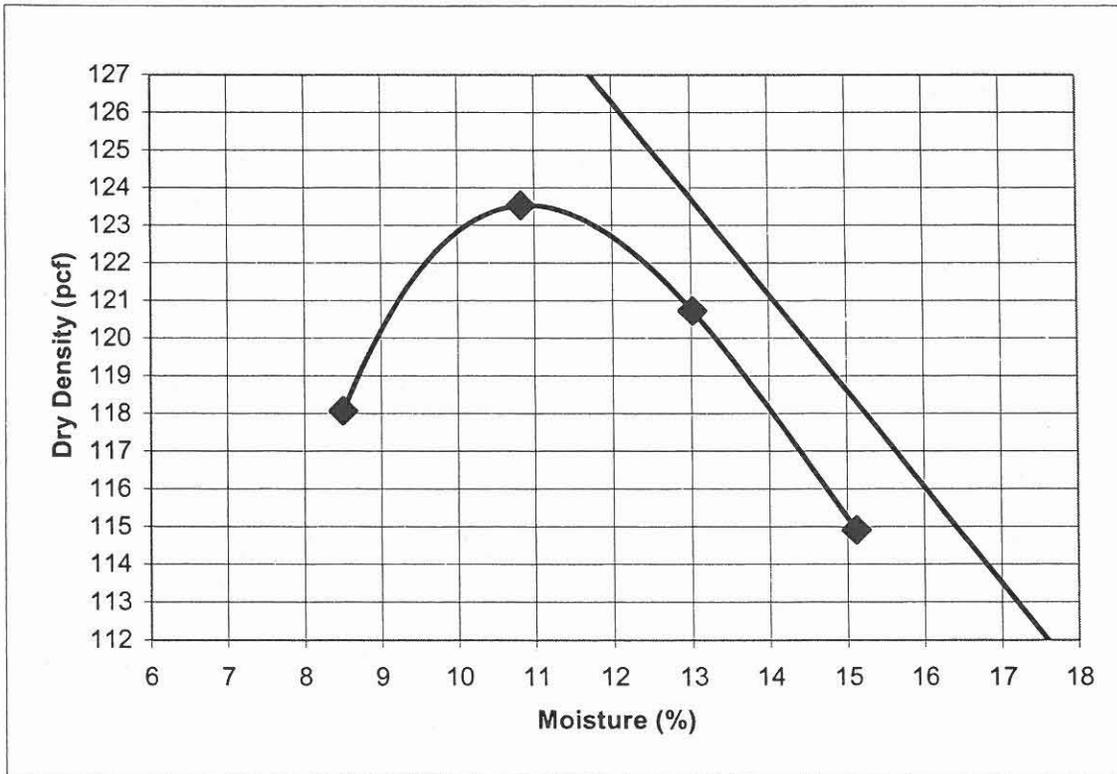
PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SOIL SAMPLES
SAMPLE SOURCE: B-1 @ 3-10

JOB NO: 47724
WORK ORDER NO: 04235
LAB NO: 61
SAMPLE DATE: 8/2 & 8/3/04

**LABORATORY COMPACTION CHARACTERISTICS OF SOILS USING
 STANDARD EFFORTS (12,400ft-lb-ft/cu.ft) (ASTMD698A)**

CURVE: 04235-61
Maximum dry density:
Optimum moisture (%):

| English (pcf) | Metric (kg/ cu.m.) |
|------------------|-----------------------|
| 123.5 | 1979 |
| 10.9 | 10.9 |



NOTES:

- The zero air void curve represents a specific gravity of: 2.65 (assumed).
- This is a summarized report of the referenced procedures and does not include all reporting requirements. Additional data can be provided at clients request.

Reviewed by: _____



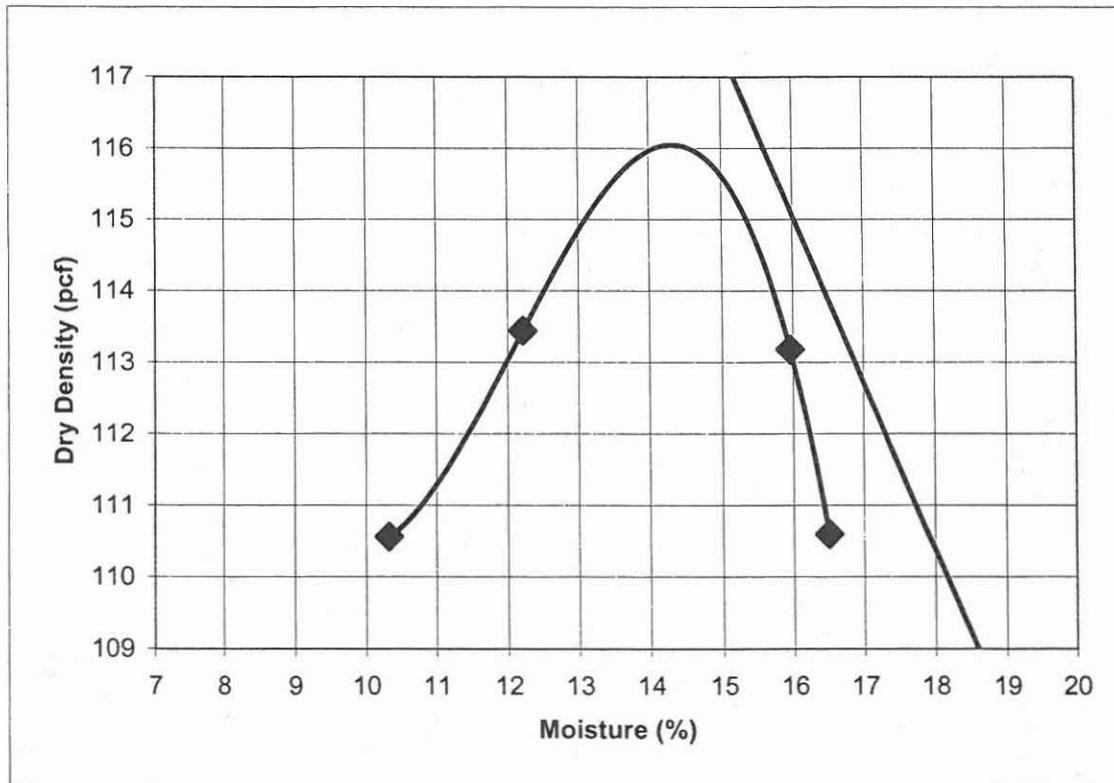
PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SOIL SAMPLES
SAMPLE SOURCE: B-4 @ 3-10

JOB NO: 47724
WORK ORDER NO: 04235
LAB NO: 64
SAMPLE DATE: 8/2 & 8/3/04

**LABORATORY COMPACTION CHARACTERISTICS OF SOILS USING
 STANDARD EFFORTS (12,400ft-lb-ft/cu.ft) (ASTMD698A)**

CURVE: 04235-64
Maximum dry density:
Optimum moisture (%):

| English (pcf) | Metric (kg/ cu.m.) |
|------------------|-----------------------|
| 116.1 | 1859 |
| 14.3 | 14.3 |



NOTES:

- The zero air void curve represents a specific gravity of: 2.6 (assumed).
- This is a summarized report of the referenced procedures and does not include all reporting requirements. Additional data can be provided at clients request.

Reviewed by: _____ 

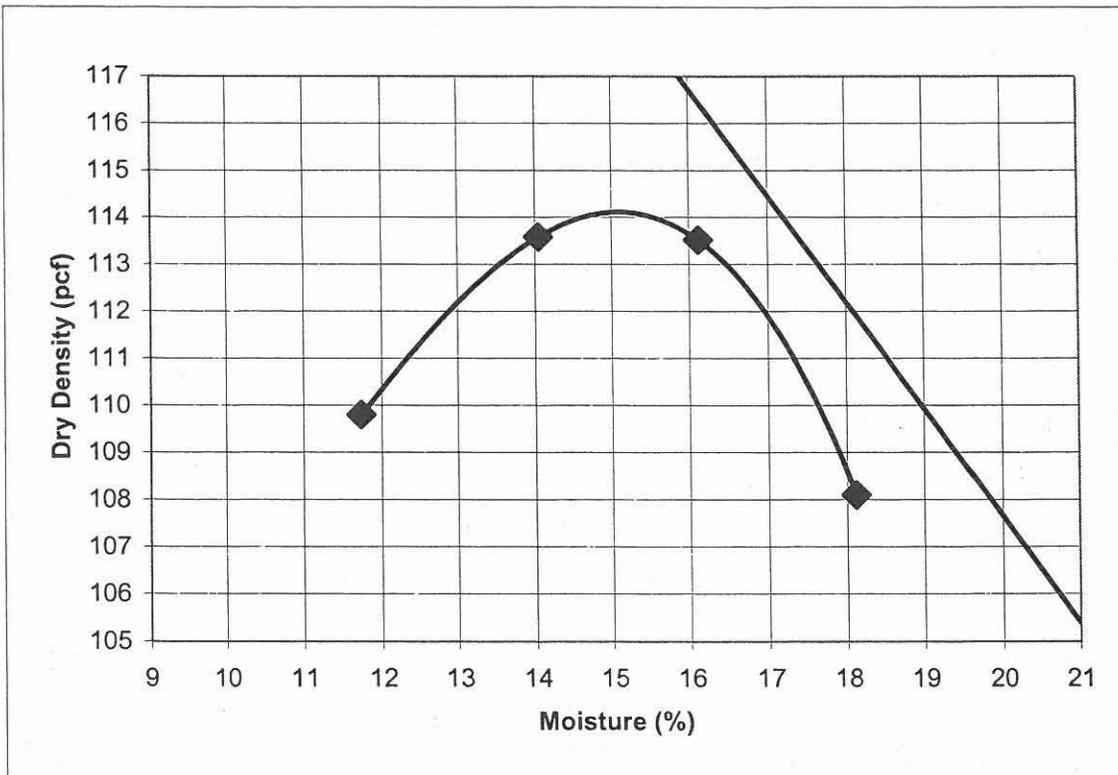
PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: CL
SAMPLE SOURCE: B-9 @ 3-10

JOB NO: 47724
WORK ORDER NO: 04235
LAB NO: 69
SAMPLE DATE: 8/2 & 8/3/04

**LABORATORY COMPACTION CHARACTERISTICS OF SOILS USING
 STANDARD EFFORTS (12,400ft-lb-ft/cu.ft) (ASTMD698A)**

CURVE: 04235-69
Maximum dry density:
Optimum moisture (%):

| English (pcf) | Metric (kg/ cu.m.) |
|------------------|-----------------------|
| 114.1 | 1828 |
| 15.1 | 15.1 |



NOTES:

- The zero air void curve represents a specific gravity of: 2.65 (assumed).
- This is a summarized report of the referenced procedures and does not include all reporting requirements. Additional data can be provided at clients request.

Reviewed by: _____



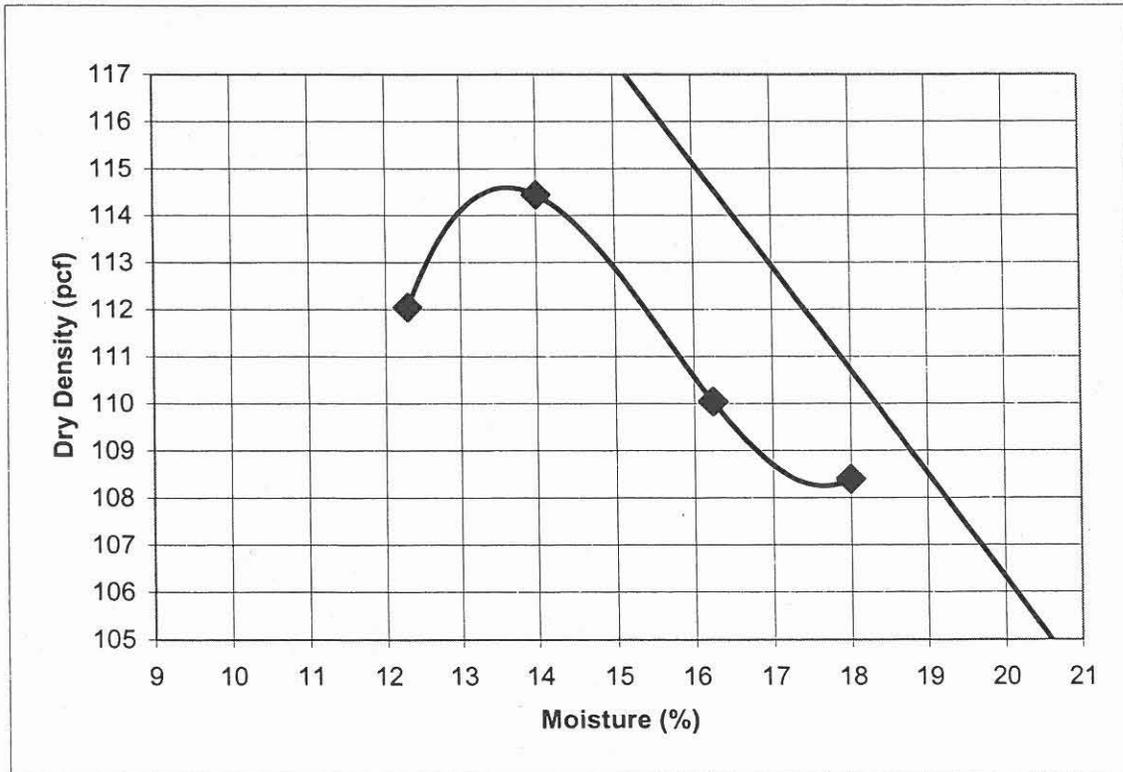
PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SOIL SAMPLES
SAMPLE SOURCE: B-10 @ 3-10

JOB NO: 47724
WORK ORDER NO: 04235
LAB NO: 70
SAMPLE DATE: 8/2 & 8/3/04

**LABORATORY COMPACTION CHARACTERISTICS OF SOILS USING
 STANDARD EFFORTS (12,400ft-lb-ft/cu.ft) (ASTMD698A)**

CURVE: 04235-70
Maximum dry density:
Optimum moisture (%):

| English (pcf) | Metric (kg/ cu.m.) |
|------------------|-----------------------|
| 114.6 | 1836 |
| 13.6 | 13.6 |



NOTES:

- The zero air void curve represents a specific gravity of: 2.6 (assumed).
- This is a summarized report of the referenced procedures and does not include all reporting requirements. Additional data can be provided at clients request.

Reviewed by: _____ *[Signature]*



PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SEE BELOW
SAMPLE SOURCE: SEE BELOW

PROJECT NO: 47724
WORK ORDER NO: 04235
LAB NO: SEE BELOW
DATE SAMPLED: 8/2 & 8/3/04
REVIEWED BY: M. CONNOLLY

Laboratory Compaction Characteristics of Soils using the One-Point method
AASHTO T 272-86 (2000)

| LAB NO | SAMPLE SOURCE | MATERIAL | Maximum Dry Density (pcf) | Optimum Moisture (%) |
|--------|---------------|--------------|---------------------------|----------------------|
| 62 | B-2 @ 3-10 | SOIL SAMPLES | 139.7 | 10.1 |
| 66 | B-6 @ 3-10 | SOIL SAMPLES | 138.2 | 11.8 |



PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: SEE BELOW
SAMPLE SOURCE: SEE BELOW

PROJECT NO: 47724
WORK ORDER NO: 04235
LAB NO: SEE BELOW
DATE SAMPLED: 8/2 & 8/3/04
REVIEWED BY: M. CONNOLLY

PH & RESISTIVITY (AZ 236)

| LAB NO | SAMPLE SOURCE | MATERIAL | RESISTIVITY (Ohm-cm) | pH |
|--------|---------------|--------------|-------------------------|-----|
| 61 | B-1 @ 3-10 | SOIL SAMPLES | 903 | 8.0 |
| 63 | B-3 @ 3-10 | SOIL SAMPLES | 1,966 | 7.9 |
| 65 | B-5 @ 3-10 | SOIL SAMPLES | 1,550 | 8.1 |
| 66 | B-6 @ 3-10 | SOIL SAMPLES | 848 | 7.9 |
| 68 | B-8 @ 3-10 | SOIL SAMPLES | 1,074 | 8.0 |



PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: Soil Samples
SAMPLE SOURCE: B-1 DEPTH: 3-10

JOB NO: 47724
WORK ORDER NO: 04235
LAB NO: 61
TESTED BY: IAS LABORATORIES

ANALYSES RESULTS

| ANALYSIS | RESULTS | UNITS |
|----------|---------|-------|
| SULFATE | 49 | ppm |
| CHLORIDE | 45 | ppm |



PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: Soil Samples
SAMPLE SOURCE: B-5 DEPTH: 3-10

JOB NO: 47724
WORK ORDER NO: 04235
LAB NO: 65
TESTED BY: IAS LABORATORIES

ANALYSES RESULTS

| ANALYSIS | RESULTS | UNITS |
|----------|---------|-------|
| SULFATE | 27 | ppm |
| CHLORIDE | 13 | ppm |



KLEINFELDER

PROJECT: REEMS ROAD CHANNEL & BASIN
LOCATION: 1/2 MILE SOUTH OF OLIVE TO PEORIA
MATERIAL: Soil Samples
SAMPLE SOURCE: B-8

DEPTH: 3-10

JOB NO: 47724
WORK ORDER NO: 04235
LAB NO: 68
TESTED BY: IAS LABORATORIES

ANALYSES RESULTS

| ANALYSIS | RESULTS | UNITS |
|----------|---------|-------|
| SULFATE | 46 | ppm |
| CHLORIDE | 38 | ppm |



IAS Laboratories

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Phoenix, Arizona 85034
(602) 273-7248

SOIL ANALYSIS REPORT

Page 1

Today's Date: 8/17/2004
Grower: 47724-04235 FCD
Submitted By: Sabine Guedamour
Send Report To: KLEINFELDER
Report Number: 6624231
Crop: No Interpretive Levels
Date Received: 8/12/2004

VL = Very Low
L = Low
M = Medium
H = High
VH = Very High

| Sender Sample Id | Depth | Lab # | pH | Calcium (Ca) PPM | Magnesium (Mg) PPM | Sodium (Na) PPM | Potash (K) PPM | Iron (Fe) PPM | Zinc (Zn) PPM | Manganese (Mn) PPM | Copper (Cu) PPM | Salinity (EC x K) dS/m | Nitrate Nitrogen (NO3-N) PPM | Phosphorus (Bicarb - Soluble P) PPM | Computed % Sodium (ESP) | Sulfur (SO4-S) PPM | Boron (B) PPM | Free Lime Level |
|------------------|-------|-------|-----|---------------------|-----------------------|--------------------|-------------------|------------------|------------------|-----------------------|--------------------|---------------------------|---------------------------------|--|-------------------------|-----------------------|------------------|-----------------|
| B6 | 0-3 | 399 | 7.9 | 5600 VH | 430 VH | 270 H | 350 VH | 15.0 VH | 1.00 M | 9.0 VH | 2.1 VH | 5.4 VH | 300.0 VH | 12.0 M | 3.5 | 150 VH | .47 L | High |
| B9 | 3-10 | 400 | 8.6 | 7500 VH | 370 VH | 170 M | 190 H | 49.0 VH | .31 L | 32.0 VH | 1.1 VH | 1.0 L | 23.0 H | 7.4 L | 1.8 | 49 VH | .23 VL | High |



IAS Laboratories

2515 East University Drive
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SOIL FERTILITY RECOMMENDATIONS

Lb/1000 Sq Ft

Grower: 47724-04235 FCD

Send To: KLEINFELDER

Report No: 6624231

Date: 8/12/2004

Page: 2

| Sender Number | Crop | Nitrogen N | Phosphate P2O5 | Potash K2O | Magnesium Mg | Sulfur S | Iron Fe | Zinc Zn | Manganese Mn | Copper Cu | Boron B | AMENDMENTS | | | Leaching of Excess Salts |
|---------------|------------------------|------------|----------------|------------|--------------|----------|---------|---------|--------------|-----------|---------|------------------|--------|------|--------------------------|
| | | | | | | | | | | | | Elemental Sulfur | Gypsum | Lime | |
| B1 | No Interpretive Levels | | | | | | | | | | | | | | |
| B5 | No Interpretive Levels | | | | | | | | | | | | | | |
| B8 | No Interpretive Levels | | | | | | | | | | | | | | |
| B6 | Turf | excess | 1 b | | | | | | | | h | | | | yes* |
| B9 | Turf | 1 a | 2 b | | | | | | excess | | h | 20** | | | |

*Total salinity (EC) levels are high enough to deter turfgrass growth. Leach to remove excess salts.

**Till sulfur into the soil to reduce pH. When turf is already established about the best you can do is to work it in when verticutting or aerating. Disposul, a 95 sulfur product, dissolves readily and can be used. After sulfur addition, Leach by irrigating with large amounts of water to push sodium below rootzone.

a. Currently adequate. Apply this amount about every 4 weeks. The B6 sample has excessive N and will reduce growth due to salinity.

b Apply phosphorus as a blend or as triple superphosphate or as MAP. Phosphorus is most efficient when applied following aerating to work the P into the soil near the plant roots.

The Mn level is very high on the B9 sample and could reduce growth of turf.

h. Irrigation should give enough B for turf. However, it wouldn't hurt to test the water to be sure.