Applied Geotechnical Engineering Consultants, Inc.

GEOTECHNICAL INVESTIGATION

PROPOSED CYPRESS CREDIT UNION

13709 SOUTH REDWOOD ROAD

RIVERTON, UTAH

PREPARED FOR:

CYPRESS CREDIT UNION
P.O. BOX 326
MAGNA, UTAH 84044

ATTENTION: DALE CATTEN

PROJECT NO. 1000813 **DECEMBER 1, 2000**

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EXECUTIVE SUMMARY

1. The subsurface soils encountered at the site consist of up to approximately ½ foot of fill overlying up to approximately 3 feet of clayey sand. Approximately 4½ feet of gravel with sand was encountered below the clayey sand. Silty sand and sandy silt was encountered below the gravel and extends the maximum depth investigated, approximately 13 feet.

2. Subsurface water was encountered in Test Pit TP-1 at a depth of approximately 10 feet below the surrounding ground surface when measured 7 days after excavation. No free water was encountered in Test Pit TP-2 to a depth of approximately 10 feet below the surrounding ground surface when checked 7 days after excavation.

3. The proposed building may be supported on spread footings bearing on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil. Footings bearing on the undisturbed natural soil may be designed for a net allowable bearing pressure of 1,500 pounds per square foot. Footings bearing on at least 2 feet of compacted structural fill or on at least 2 feet of undisturbed natural gravel may be designed using a net allowable bearing pressure of 2,500 pounds per square foot.

4. Geotechnical information related to foundations, subgrade preparation, pavement design and materials are included in the report.

SCOPE

This report presents the results of a geotechnical investigation for the proposed Cypress Credit Union to be constructed at 13709 South Redwood Road in Riverton, Utah. The report presents the subsurface conditions encountered, laboratory test results and recommendations for foundations and pavement. The study was conducted in general accordance with our proposal dated November 15, 2000.

Field exploration was conducted to obtain information on the subsurface conditions. Samples obtained during the field investigation were tested in the laboratory to determine physical and engineering characteristics of the on-site soil. Information obtained from the field and laboratory was used to define conditions at the site for our engineering analysis and to develop recommendations for the proposed foundations and pavement.

This report has been prepared to summarize the data obtained during the study and to present our conclusions and recommendations based on the proposed construction and subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations related to construction are included in the report.

SITE CONDITIONS

At the time of our field investigation, there were no permanent structures or pavement on the property. A local resident indicated that a single-family residence and a small barn were previously located along the western portion of the property.

The site is relatively flat with a gentle slope down to the southwest. The ground surface is vegetated with short weeds and grass. Brush and tall trees extend along the south side of the property. There is an unlined irrigation ditch which extends along the south side of the property. No water was observed in the ditch at the time of our field investigation.

Redwood Road (1700 West), which is an asphalt paved road in good condition, extends along the west side of the site. Christan Way (13700 South), which is a two-lane asphalt paved road in good condition, extends along the north side of the site. East of the site is a large two-story residential structure with several old garages. Along the southeast portion of the property, there is a large barn surrounded with a grass covered field. South of the property, beyond the barn and grass field is Bangerter Highway.

FIELD STUDY

The field study was conducted on November 20, 2000. Two test pits were excavated at the approximate locations indicated on Figure 1. The tests pits were excavated using a rubber-tired backhoe. The test pits were logged and soil samples obtained by an engineer from AGEC. Logs of the subsurface conditions encountered in the test pits are graphically shown on Figure 2.

SUBSURFACE CONDITIONS

The subsurface soils encountered at the site consist of up to approximately ½ foot of fill overlying up to approximately 3 feet of clayey sand. Approximately 4½ feet of gravel with sand was encountered below the clayey sand. Silty sand and sandy silt was encountered below the gravel and extends the maximum depth investigated, approximately 13 feet.

A description of the various soils encountered in the test pits follows:

> Fill - The fill consists of silty sand with gravel. It is moist and brown in color.
>
> Clayey Sand - The clayey sand contains occasional gravel. It is medium dense, slightly moist to moist and dark brown in color.

Laboratory tests performed on a sample of the clayey sand indicate that it has a natural moisture content of 14 percent and a natural dry density of 104 pounds per cubic foot (pcf).

Results of a consolidation test conducted on a sample of the clayey sand indicate that the sample will compress a small to moderate amount with the addition of light to moderate loads. Results of the consolidation test are presented on Figure 3.

Silty Sand - The silty sand grades to sandy silt. It is medium dense, moist to wet and brown in color with iron oxide staining.

Gravel - The gravel contains moderate to large amounts of sand. It is medium dense, slightly moist and brown in color with slight iron oxide staining.

Laboratory tests conducted on a sample of the sand and gravel indicate that it has a natural moisture content of 2 percent. Results of a gradation test conducted on a sample of the sand and gravel are presented on Figure 4.

A Summary of the Laboratory Test Results is presented on Table I and on the Logs of the Exploratory Test Pits, Figure 2.

SUBSURFACE WATER

Subsurface water was encountered at a depth of approximately 10 feet below the surrounding ground surface in Test Pit TP-1 when measured 7 days after excavation. No free water was encountered in PVC pipe installed in Test Pit TP-2 to a depth of approximately 10 feet below the surrounding ground surface when checked 7 days after excavation.

Slotted PVC pipe was installed in the test pits to facilitate future measurement of the water level. Fluctuations in the water level may occur with time. Typically the groundwater level is highest in the spring and summer and lowest in the fall and winter months. An evaluation of fluctuations in the subsurface water level is beyond the scope of this report.

PROPOSED CONSTRUCTION

We understand that the proposed building will be approximately 4,225 square feet in size. The proposed building will be a single-story structure with slab-on-grade floor. The structural engineer indicates building loads will consist of column loads of less than 40 kips and wall loads of less than 4 kips per lineal foot.

We anticipate that pavement will be provided for the proposed structure. A drive-thru canopy area is planned for the north side of the proposed credit union building. We anticipate that traffic will consist primarily of light passenger vehicles. We have assumed traffic for pavement areas consisting of 500 cars and 2 delivery trucks per day and 1 garbage truck per week.

If the proposed construction, building loads or traffic are significantly different from those described above, we should be notified so that we can re-evaluate the recommendations given.

RECOMMENDATIONS

Based on the subsoil conditions encountered, the laboratory test results and the proposed construction, the following recommendations are given:

A. Site Grading

Final site grading plans were not available at the time of our investigation. We anticipate that there will be only minor amounts of cut and fill required for the proposed development.

1. Subgrade Preparation

Prior to placing grading fill or base course, all topsoil, organics, unsuitable fill, debris and other deleterious material should be removed. The subgrade should be proof-rolled to identify soft areas. Soft areas should be removed and replaced with granular fill containing less than 15 percent passing the No. 200 sieve.

2. Excavation

We anticipate that excavation at the site can be accomplished with typical excavation equipment. Care should be taken not to disturb the natural soil to remain below the proposed building area.

3. Materials

Listed below are the materials recommended for imported structural fill.

Fill to Support	Recommendations
Footings	Non-expansive granular soil Passing No. 200 Sieve < 35% Liquid Limit < 30% Maximum size 4 inches
Floor Slab (Upper 4 inches)	Sand and/or Gravel Passing No. 200 Sieve < 5% Maximum size 2 inches
Slab Support	Non-expansive granular soil Passing No. 200 Sieve < 50% Liquid Limit < 30% Maximum size 6 inches

The upper natural soil consists of clayey sand overlying sand and gravel. The existing fill and clayey sand is generally not suitable for use as structural fill below the proposed footings, but may be used below floor slabs, as site grading fill or utility trench backfill, if the organics, debris and other deleterious materials are removed, or it may be used in landscape areas. The sand and gravel is suitable for use as structural fill, as site grading fill, and as utility trench backfill, if the organics, over sized material, debris and other deleterious materials are removed or it may be used in landscaped areas.

The existing fill and natural soils may require moisture conditioning (wetting or drying) prior to use as fill. Drying of the soil may not be practical during cold or wet times of the year.

4. <u>Compaction</u>

Compaction of materials placed at the site should equal or exceed the minimum densities as indicated below when compared to the maximum dry density as determined by ASTM D-1557.

Fill To Support	Compaction
Foundations	≥ 95%
Concrete Slabs and Pavement	≥ 90%
Landscaping	≥ 85%
Retaining Wall Backfill	85 - 90%

To facilitate the compaction process, the fill should be compacted at a moisture content within 2 percent of the optimum moisture content.

Base course should be compacted to at least 95 percent of the maximum dry density as determined by ASTM D-1557.

Fill and pavement materials placed for the project should be frequently tested for compaction.

5. Drainage

The ground surface surrounding the building should be sloped to drain away from the building in all directions. Roof downspouts and drains should discharge beyond the limits of backfill.

The collection and diversion of drainage away from the pavement surface is important to the satisfactory performance of the pavement section. Proper drainage should be provided.

B. Foundations

1. Bearing Material

With the proposed construction and the subsurface conditions encountered, the building may be supported on spread footings bearing on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil. Structural fill placed below footings should extend out away from the edge of footings a distance equal to the depth of fill beneath footings.

All topsoil, unsuitable fill, debris and other deleterious material should be removed from below foundation areas.

2. Bearing Pressures

Spread footings bearing on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil may be designed for a net allowable bearing pressure of 1,500 pounds per square foot (psf). Footings bearing on at least 2 feet of undisturbed natural gravel or on at least 2 feet of properly compacted structural fill may be designed for a net allowable bearing pressure of 2,500 psf.

Footings should have a minimum width of 1½ feet and a minimum depth of embedment of 1 foot.

3. Temporary Loading Conditions

The allowable bearing pressure may be increased by one-half for temporary loading conditions such as for wind and seismic loads.

4. Settlement

We estimate that total settlement will be on the order of ¾ inch for footings designed as indicated above. Differential settlement is estimated to be on the order of ½ inch for footings designed as indicated above.

Disturbance of the soil below foundations can result in greater settlement. Care should be taken to minimize disturbance of the natural soil at the base of foundation excavations so that settlement can be maintained within tolerable limits.

5. Frost Depth

Exterior footings and footings beneath unheated areas should be placed at least 30 inches below grade for frost protection.

6. Foundation Base

The base of foundation excavations should be cleared of loose or deleterious material prior to structural fill or concrete placement.

7. Construction Observation

A representative of the geotechnical engineer should observe footing excavations prior to structural fill or concrete placement.

C. Concrete Slab-on-Grade

1. Slab Support

Concrete slabs may be supported on the undisturbed natural soil or on compacted structural fill extending down to the natural soil.

2. Underslab Sand and/or Gravel

A 4-inch layer of free draining sand and/or gravel (less than 5 percent passing the No. 200 sieve) should be placed below the concrete slabs. The natural sand and gravel may meet this criteria.

3. Vapor Barrier

A vapor barrier should be placed under the concrete floor, if the floor will receive an impermeable floor covering. The vapor barrier will prevent water vapor from passing below the slab to the floor covering. Free draining material should be provided between the concrete and the vapor barrier.

D. Lateral Earth Pressures

1. Lateral Resistance for Footings

Lateral resistance for spread footings placed on the natural soils or on compacted structural fill is controlled by sliding resistance between the footing and the foundation soils. A friction value of 0.35 may be used in the design for ultimate lateral resistance.

2. Subgrade Walls and Retaining Structures

The following lateral earth pressures are given for design of subgrade walls and retaining structures. The active condition is where the wall moves away from the soil. The passive condition is where the wall moves into the soil and the at-rest condition is where the wall does not move. The values listed are equivalent fluid weights and assume a horizontal surface adjacent the wall.

Soil Type	Active	At-Rest	Passive
Clay & Silt	50 pcf	65 pcf	250 pcf
Sand & Gravel	40 pcf	55 pcf	300 pcf

3. Seismic Conditions

Under seismic conditions, the lateral earth pressure should be increased by 20 pcf for active and at rest conditions and decreased by 20 pcf for the passive condition. This assumes a horizontal ground acceleration of 0.23g which represented a 10 percent probability of exceedance in a 50 year period (Frankel and others, 1996).

4. Safety Factors

The values recommended above for active and passive conditions assume mobilization of the soils to achieve the soil strength. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

E. Seismicity and Liquefaction

The site is located in an area mapped as having a "very low" liquefaction potential. (Salt Lake County Planning Department, 1997). Research indicates that the soil type most susceptible to liquefaction during a large magnitude earthquake is loose clean sand. The liquefaction potential for soil tends to decrease with an increase in fines content and density.

Subsurface water was encountered at a depth of approximately 10 feet below the surrounding ground surface. The soils above the subsurface water level are not susceptible to liquefaction. The silt and sand encountered at depth may be susceptible to liquefaction. An investigation to a depth of 30 feet would be needed to more fully investigate the liquefaction potential for the site. Such a study is beyond the scope of this report.

Based on the location of the site, we recommend that the building be designed and constructed to at least meet the Uniform Building Code Seismic Zone 3 criteria using a soil profile type of "S_D".

The closest mapped trace of the Wasatch Fault, which is considered active, is located approximately 5.4 miles east of the site (Salt Lake County Planning Department, 1997).

F. Water Soluble Sulfates

One sample of the natural soil was tested in the laboratory for water soluble sulfate content. Results of the test indicate that there is less than 0.1 percent water soluble sulfate in the sample tested. Based on the results of the test and published literature, the natural soil possess negligible sulfate attack potential on concrete. No special cement type is required for concrete placed in contact with the natural soil. Other conditions may dictate the type of cement to be use in concrete for the project.

G. Pavement

Based on the subsoil conditions encountered, laboratory test results and the assumed traffic, the following pavement support recommendations are given.

1. <u>Subgrade Support</u>

   The near surface soil consists of clayey sand. A California Bearing Ratio (CBR) of 8 percent was used in the analysis which assumes a clayey sand subgrade.

2. Pavement Thickness

Based on the subsoil conditions, assumed traffic as described in the Proposed Construction section of the report, a design life of 20 years for flexible and 30 years for rigid pavement, and methods presented by the Utah Department of Transportation, a flexible pavement section consisting of 3 inches of asphaltic concrete overlying 6 inches of high quality base course is calculated. Alternatively, a rigid pavement section consisting of 5 inches of Portland cement concrete may be used.

3. Pavement Materials and Construction

a. Flexible Pavement (Asphaltic Concrete)

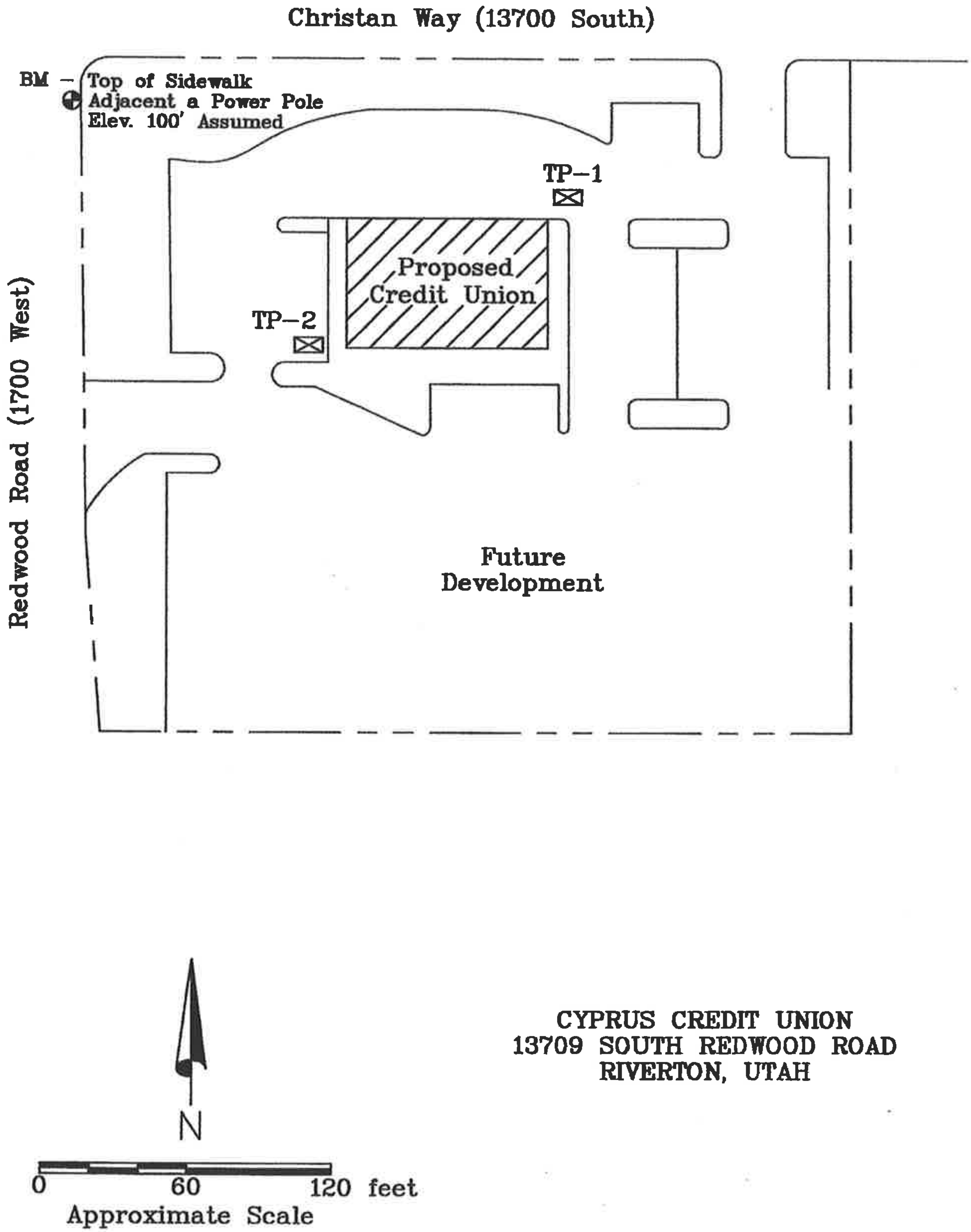
Pavement Materials should meet the Utah Department of Transportation Specifications for gradation and quality. Other materials may be considered for use in the pavement section. The use of other materials may result in the need for different pavement material thicknesses.

b. Rigid Pavement (Portland Cement Concrete)

The rigid pavement thickness assumes that a concrete shoulder will be placed at the edge of the pavement and that the concrete will have aggregate interlock joints.

The pavement materials should meet the Utah Department of Transportation Specifications. The pavement thickness indicated above assumes that the concrete will have a 28-day compressive strength of 4,000 pounds per square inch. Concrete should be air entrained with approximately 6 percent air. Maximum allowable slump will depend on the method of placement, but should not exceed 4 inches.

Joints for concrete pavement should be laid out in a square or rectangular pattern. Joint spacing should not exceed 30 times the thickness of the slab. The joint spacings indicated should accommodate the contraction of the concrete and under these conditions steel reinforcing will not be required. The depth of joints should be approximately one-quarter of the slab thickness.



1000813	AGEC	Locations of Test Pits	Figure 1

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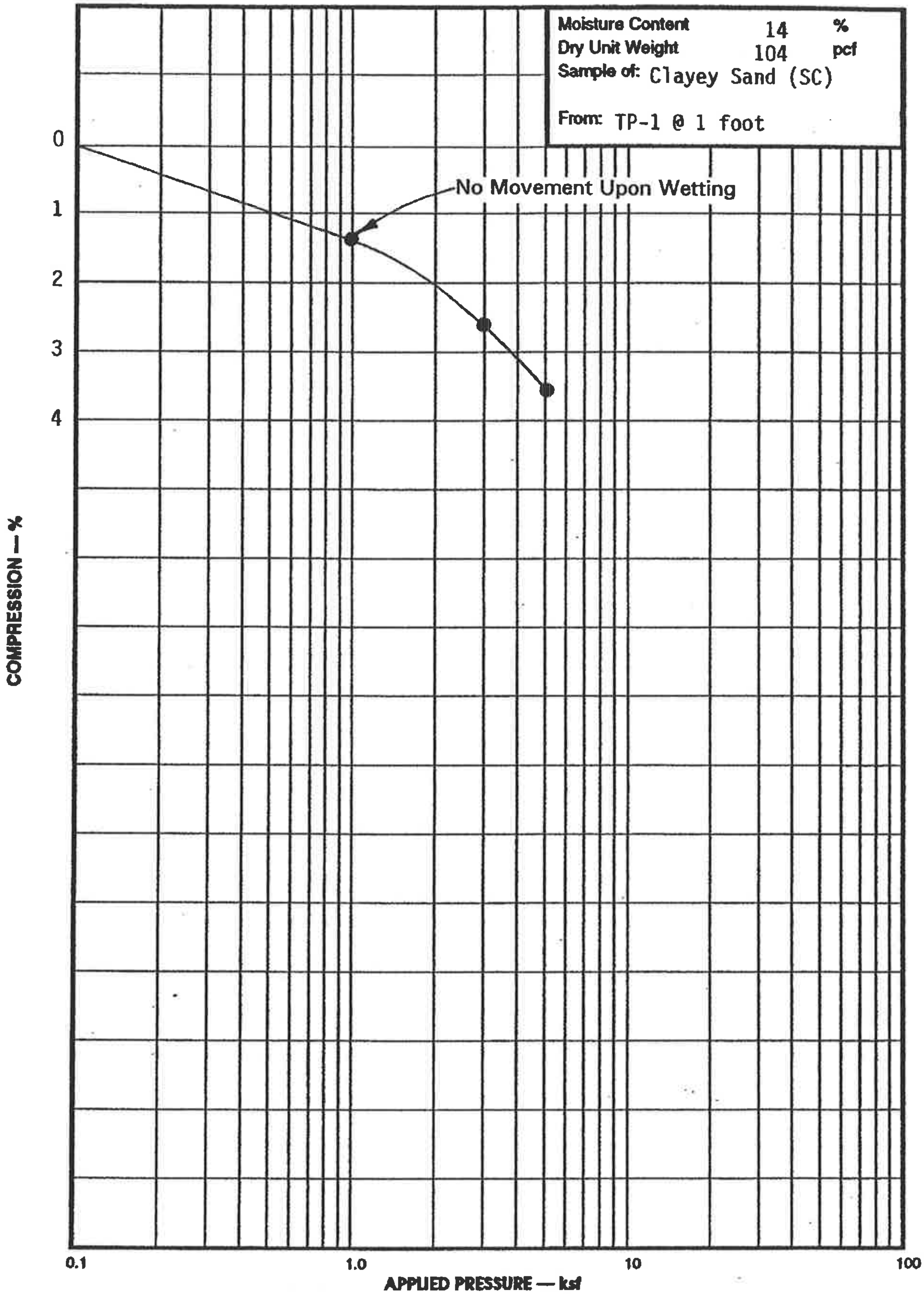

Project No. 1000813 **CONSOLIDATION TEST RESULTS** Figure 3

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TABLE I

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER 1000813

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (PCF)	GRADATION			ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	WATER SOLUBLE SULFATE (ppm)	SAMPLE CLASSIFICATION
TEST PIT	DEPTH (FEET)			GRAVEL (%)	SAND (%)	SILT/ CLAY (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)			
TP-1	1	14	104			42				<10	Clayey Sand (SC)
	12½					50					Sandy Silt (ML)
TP-2	3	2		47	52	1					Well Graded Sand with Gravel (SW)