Applied Geotechnical Engineering Consultants, Inc.

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GEOTECHNICAL INVESTIGATION

PROPOSED SUBDIVISION

13600 SOUTH 1300 WEST

RIVERTON, UTAH

PREPARED FOR:

GOUGH CONSTRUCTION
8186 SOUTH 1300 WEST
WEST JORDAN, UTAH 84088

ATTENTION: BLAINE GOUGH

PROJECT NO. 1040185

APRIL 5, 2004

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EXECUTIVE SUMMARY

1. The subsurface materials encountered at the site consist of up to approximately 1 foot of topsoil overlying sand and gravel. The sand and gravel extend the full depth investigated, approximately 12 feet.

2. No subsurface water was encountered to the maximum depth investigated. However, the soil was very moist to wet in the lower portion of Test Pit TP-3. Thus, subsurface drains should be provided around proposed houses if the lower floor levels extend more than 6 feet below original grade or extend below the high water level of the Jordan Canal.

3. The proposed residences may be supported on spread footings bearing on the undisturbed natural soil or on compacted structural fill and 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 at least 2 feet of the natural undisturbed gravel may be designed for an allowable net bearing pressure of 2,500 pounds per square foot.

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

SCOPE

This report presents the results of a geotechnical investigation for the proposed subdivision to be located at approximately 13600 South 1300 West 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 March 3, 2004.

Field exploration was conducted to obtain information on the subsurface conditions. Samples obtained from 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 the 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 was a house and several outbuildings and greenhouses on the property. Portions of the property appear to be used for agricultural purposes. The house has a partial-depth basement.

Vegetation at the site consists of grass, weeds and some trees, particularly around the house and outbuildings.

The ground surface at the site is relatively flat and slopes gently down toward the east.

The east edge of the property is bordered by the Jordan Canal and a portion of 1300 West Street. The north edge of the property is bordered by a subdivision and there is similar ground as at the site to the south and west.

FIELD STUDY

The field study was conducted on March 12, 2004. Four test pits were excavated at the approximate locations indicated on Figure 1 using a rubber-tired backhoe. The test pits were logged and soil samples obtained by a representative from AGEC. Logs of the subsurface conditions encountered in the test pits are graphically shown on Figure 2 with legend and notes on Figure 3.

The test pits were backfilled without significant compaction. The backfill in the test pits should be properly compacted where it will support proposed buildings, floor slabs or pavement.

SUBSURFACE CONDITIONS

The subsurface materials encountered at the site consist of up to approximately 1 foot of topsoil overlying sand and gravel. The sand and gravel extend the full depth investigated, approximately 12 feet.

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

Topsoil - The topsoil consists of clayey sand with some gravel. It is very moist, dark brown and contains roots and organics.

Clayey Sand - The clayey sand has clay layers and some gravel. It is medium dense, moist and dark brown.

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 105 pounds per cubic foot (pcf).

Silty Sand - The sand contains a small to large amount of silt and some gravel. It is medium dense, moist, very moist to wet in Test Pit TP-3 and brown to grayish brown.

Laboratory tests performed on a sample of the silty sand indicate that it has a natural moisture content of 10 percent and a natural dry density of 110 pcf.

Gravel - The gravel in Test Pits TP-1 and TP-4 is interlayered with sand. The gravel is medium dense to dense, moist and brown.

Results of the laboratory tests are summarized on Table I and are included on the logs of the test pits.

SUBSURFACE WATER

No subsurface water was encountered to the maximum depth investigated, approximately 12 feet. However, the soil in the lower portion of Test Pit TP-3 was very moist to wet. Slotted PVC pipe was installed in Test Pit TP-3 and checked for water 14 days after excavation of the test pit. There was no water in the pipe to a depth of 11 feet.

With the close proximity of the site to the Jordan canal, we anticipate that the water could rise in the area when the water is turned into the canal. There was no water in the canal at

the time of our field investigation. The depth to water could be monitored to determine the potential for the rise of water level once water is placed in the canal.

PROPOSED CONSTRUCTION

We understand that three twin homes are to be constructed at the site. We anticipate that the houses will consist of one to two-story, wood frame structures with the possibility of basements. We have assumed building loads consisting of wall loads up to 3 kips per lineal foot and column loads up to 20 kips.

A road is planned to extend into the site. We have assumed traffic for the road will consist of passenger vehicles with occasional trucks.

If the proposed construction, building loads or traffic is significantly different from what is described above, we should be notified so that we can reevaluate our recommendations.

RECOMMENDATIONS

Based on the subsurface conditions encountered, 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 development will result in less than 3 feet of grade change.

1. Subgrade Preparation

   Prior to placing grading fill or base course, the organic material, existing fill and other deleterious material should be removed.

The subgrade in proposed pavement areas should be scarified to a depth of approximately 8 inches, the moisture adjusted to within 2 percent of optimum and the subgrade compacted to at least 90 percent of the maximum dry density as determined by ASTM D-1557. The subgrade should be proof-rolled to identify soft areas. Soft areas should be removed and replaced with granular fill compacted as indicated above.

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 proposed buildings and pavement. Consideration should be given to using excavation equipment with a smooth cutting edge when excavating for building foundations to minimize disturbance of the natural soil.

3. Materials

Listed below are materials recommended for imported structural fill.

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

The natural soil is suitable for use as structural fill if it meets the recommendations for imported structural fill given above or it may be used as

grading fill, trench backfill or wall backfill. Topsoil, organics and other deleterious materials should be removed prior to use as fill. The natural soil may require moisture conditioning (wetting or drying) if used as fill. Drying of the soil may not be practical during cold or wet times of the year.

4. Compaction

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 Flatwork and Pavement	≥ 90%
Landscaping	≥ 85%
Retaining Wall Backfill	85 to 90%

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

The 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 proposed buildings should be sloped away from the buildings in all directions. Roof down spouts and drains should discharge beyond the limits of backfill.

4. Settlement

We estimate that total and differential settlement will be less than 1 and ¾ inch, respectively, for footings designed as indicated above.

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 footing 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 undisturbed natural soil.

Topsoil, existing fill, organics and other deleterious materials should be removed from below proposed floor slabs.

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 to facilitate construction and allow even curing of the slab concrete.

D. Lateral Earth Pressures

1. Lateral Resistance for Footings

Lateral resistance for spread footings placed on the natural soil or on compacted structural fill is controlled by sliding resistance between the footing and the foundation soils. A friction value of 0.45 may be used in design for ultimate lateral resistance.

2. Subgrade Walls and Retaining Structures

The following equivalent fluid weights 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 below assume a horizontal surface adjacent the wall.

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

3. Seismic Conditions

Under seismic conditions, the equivalent fluid weight should be increased by 29 pcf for active and at-rest conditions and decreased by 29 pcf for the passive condition. This assumes a short period spectral response acceleration of 1.26g which represents a 2 percent probability of exceedance in a 50-year period (IBC 2000).

4. Safety Factors

The values recommended above for active and passive pressures assume mobilization of the soil to achieve the assumed 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" potential for liquefaction (Salt Lake County, 1995). Based on subsurface conditions encountered and our understanding of the geology in the area, liquefaction should not be a significant hazard at the site.

Listed below is a summary of the site parameters for the 2000 International Building Code.

a.	Site Class	D
b.	Short Period Spectral Response Acceleration, S_s	1.26g
c.	One Second Period Spectral Response Acceleration, S_1	0.54g

The closest mapped active fault to the site is the Wasatch Fault, mapped as extending approximately 4½ miles to the east of the site (Salt Lake County, 1995).

F. Subsurface Drains

If the lowest floor level of a residence is more than 6 feet below grade or below the high water level of the Jordan Canal, the subgrade floor portion of the residence should be protected with a perimeter drain system. The perimeter drain system should consist of at least the following items.

1. The underdrain system should consist of a perforated pipe installed in a free-draining gravel filled trench around the perimeter of the below grade floor portion of the building.

2. The flow line of the pipe should be placed at least 18 inches below the finished floor level and should slope to a sump or outlet where water can be removed by pumping or by gravity flow.

3. If placing the gravel and drain pipe requires excavation below the bearing level of the footing, the excavation for the drain pipe and gravel should have a slope no steeper than 1:1 (horizontal to vertical) away from the edge of the footing to avoid disturbing the soil below the footing.

4. A filter fabric should be placed between the natural soil and the drain gravel. This will help reduce the potential for fine-grained materials filling in the void spaces of the gravel.

5. The subgrade floor slab should have at least 6 inches of free draining gravel placed below it and the under slab gravel should connect to the perimeter drain.

6. Consideration should be given to installing cleanouts to allow access into the perimeter drain, should cleaning of the pipe be required in the future.

G. Water Soluble Sulfates

One sample of the natural soil was tested in the laboratory for water soluble sulfate content. Results of the test indicate 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 possesses 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 used in concrete for the project.

H. Pavement

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

1. Subgrade Support

The near surface soil consists of silty to clayey sand. A California Bearing Ratio (CBR) of 5 percent was used in the analysis which assumes a clayey sand subgrade.

2. Pavement Thickness

Based on the subsoil conditions, assumed traffic, a design life of 20 years for flexible pavement 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 placed on a prepared subgrade may be used.

3. Pavement Materials and Construction

a. Flexible Pavement (Asphaltic Concrete)

The 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 pavement thickness indicated assumes that the pavement will have aggregate interlock joints and that a concrete shoulder or curb will be provided.

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 psi. 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.

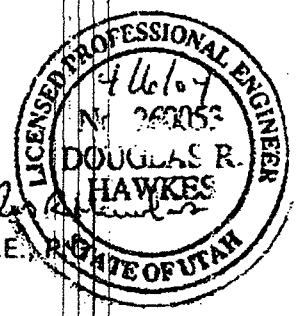
4. Jointing

Joints for concrete pavement should be laid out in a square or rectangular pattern. Joint spacings 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-fourth of the slab thickness.

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the test pits excavated at the approximate locations indicated on the site plan and the results of laboratory testing. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface conditions or groundwater level is found to be significantly different from what is described above, we should be notified to reevaluate our recommendations.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.



Douglas R. Hawkes, P.E.

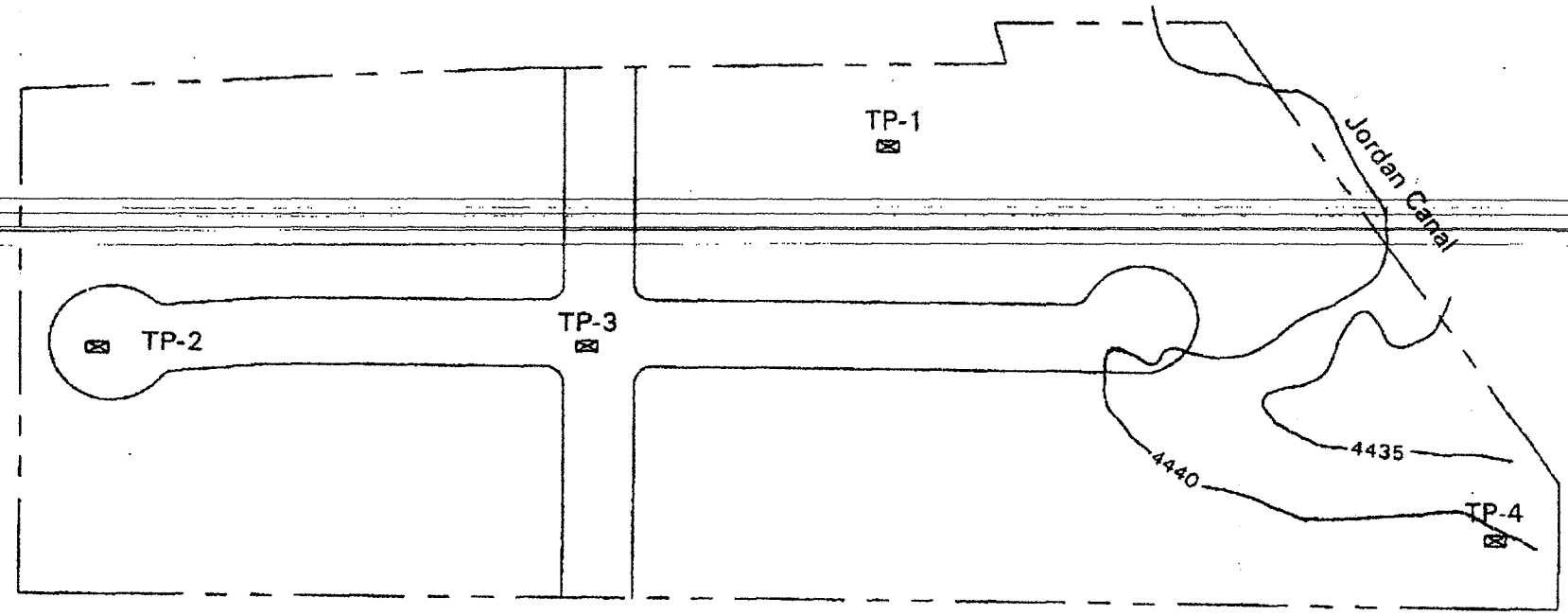
Reviewed by Jay R. McQuivey, P.E.

DRH/dc

REFERENCES CITED

International Building Code, 2000; International Code Council, Inc., Falls Church, Virginia.

Salt Lake County, 1995; Surface Rupture and Liquefaction Potential Special Study Areas Map, Salt Lake County, Utah, adopted March 31, 1989, revised 1995, Salt Lake County Public Works - Planning Division, 2001 South State Street, Salt Lake City, Utah.



N

0 100 200 300 feet

Approximate Scale

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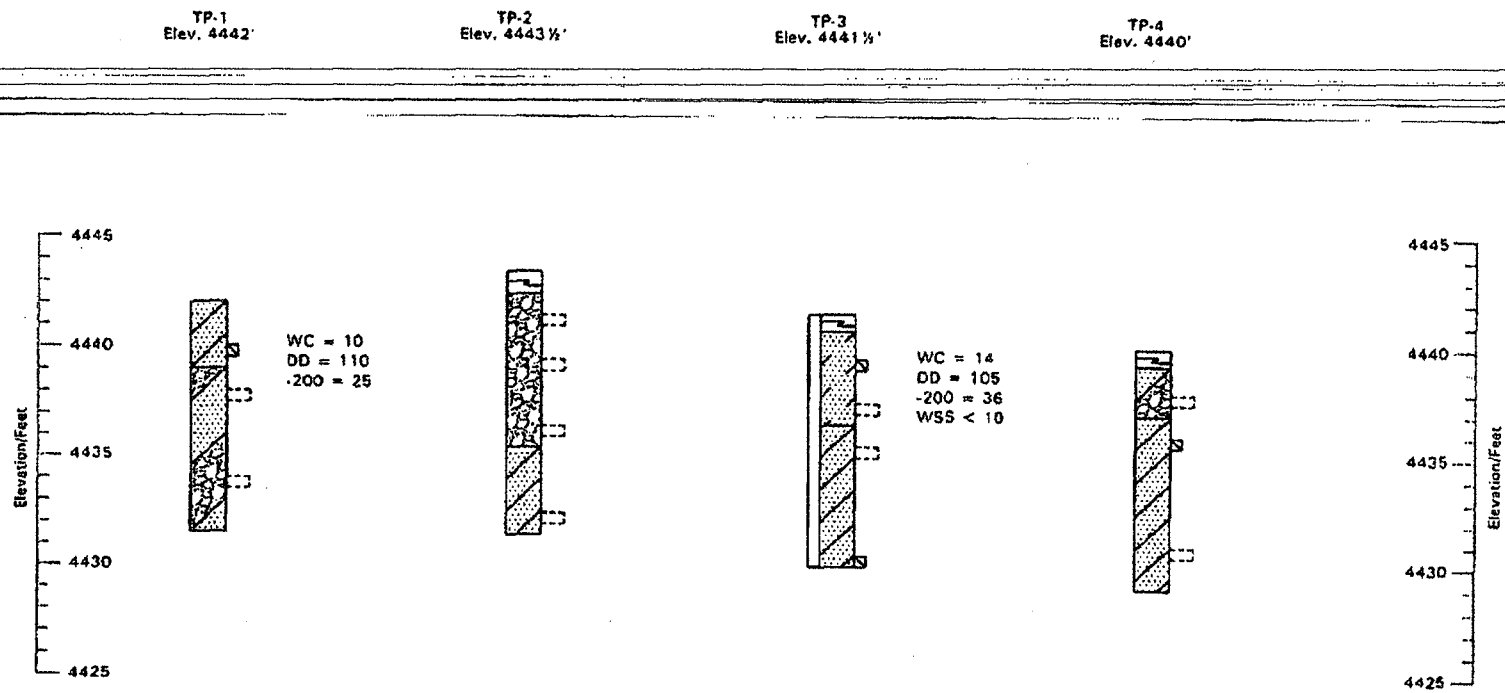
13600 SOUTH 1300 WEST
RIVERTON, UTAH

1040185 AGEC Locations of Test Pits Figure 1



Approximate Vertical Scale 1" = 8'

See Figure 3 for Legend and Notes

1040185 | AGS | Logs of Test Pits

LEGEND:

Topsoil; clayey sand, some gravel, very moist, dark brown, roots, organics.

Clayey Sand (SC); clay layers, some gravel, medium dense, moist, dark brown.

Silty Sand (SM); small to large amount of silt, some gravels, medium dense, moist, very moist to wet in Test Pit TP-3, brown to grayish brown.

Poorly-graded Gravel with Sand (GP); dense, moist, brown.

Interlayered Sand and Gravel (SP/GP); small amount of silt, medium dense to dense, moist, brown.

Indicates relatively undisturbed hand drive sample taken.

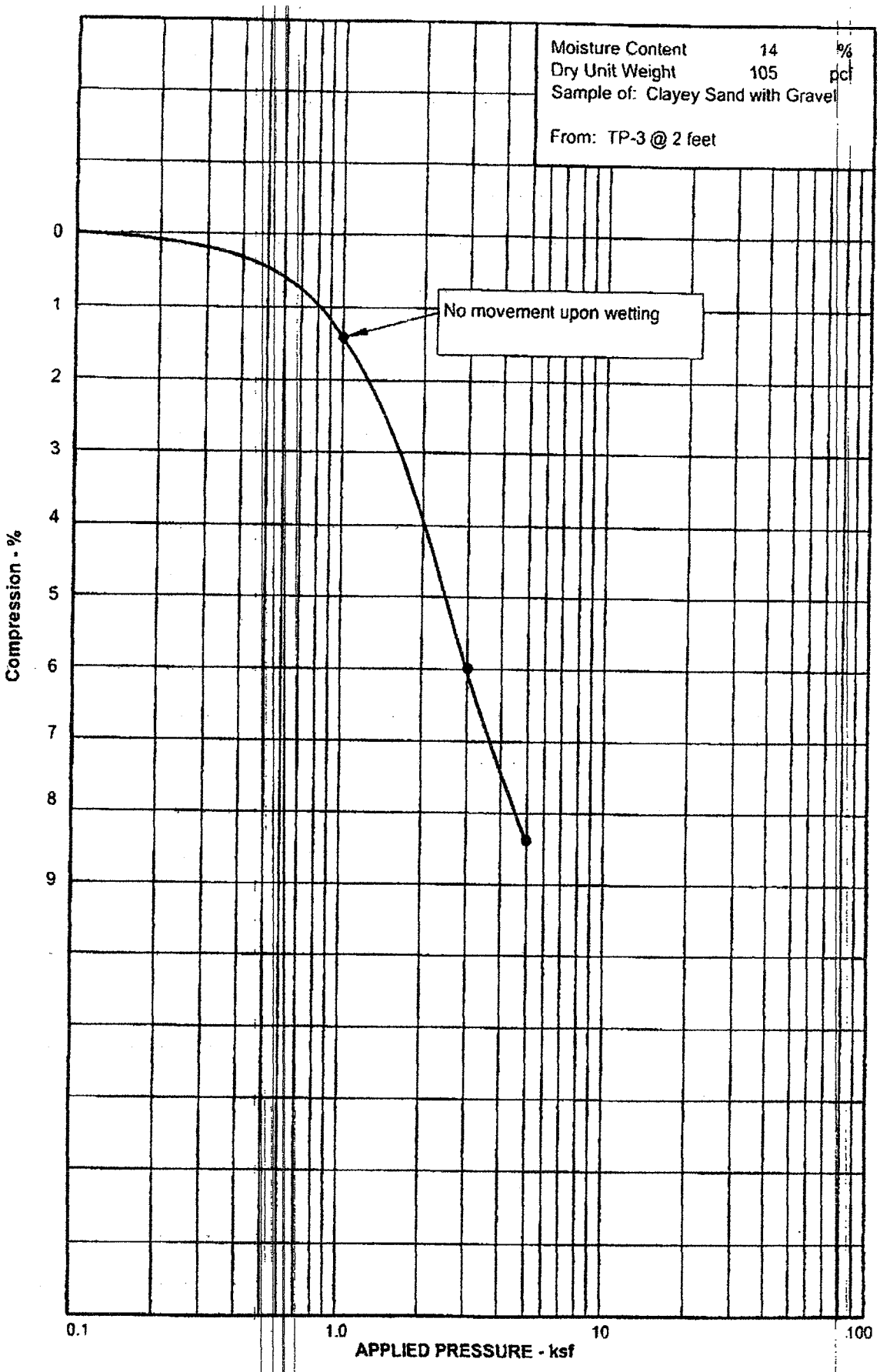
Indicates disturbed sample taken.

Indicates slotted 1½ inch PVC pipe installed in the test pit to the depth shown.

NOTES:

1. Test pits were excavated on March 12, 2004 with a rubber-tired backhoe.
2. Locations of test pits were measured approximately by pacing from features shown on the site plan provided.
3. Elevations of test pits were determined by interpolating between contours shown on the site plan provided.
4. The test pit locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between the materials shown on the test pit logs represent the approximate boundaries between material types and the transitions may be gradual.
6. No water was encountered in the test pit at the time of excavation.
7. WC = Water Content (%);
   DD = Dry Density (pcf);
   -200 = Percent Passing No. 200 Sieve;
   WSS = Water Soluble Sulfates (ppm).

1040186	AGES	Legend and Notes of Test Pits	Figure 3



Project No. 1040185 CONSOLIDATION TEST RESULTS Figure 4

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TABLE I
SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER 1

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (PCF)	GRADATION			ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	WATER SOLUBLE SULFATE (ppm)	SAMPLE CLASSIFICAT
TEST PIT	DEPTH (FEET)			GRAVEL (%)	SAND (%)	SILT/ CLAY (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)			
TP-1	2	10	110			25					Silty Sand
TP-3	2	14	105			36				< 10	Clayey Sand with