Applied Geotechnical Engineering Consultants, Inc.

GEOTECHNICAL INVESTIGATION

PROPOSED RESIDENTIAL SUBDIVISION

APPROXIMATELY 11200 SOUTH 1700 EAST

SANDY, UTAH

RECEIVED
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BY:

PREPARED FOR:

WESTFIELD REAL ESTATE
5455 WEST 11000 NORTH, SUITE 202
HIGHLAND, UTAH 84003

ATTENTION: CARRIE NATE

PROJECT NO. 1040595

JULY 19, 2004

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EXECUTIVE SUMMARY

1. The subsurface materials encountered at the site consist of approximately ½ to 1 foot of topsoil in overlying sand. The sand is silty in the upper approximately 3 to 5 feet. The sand extends to the maximum depth investigated, approximately 12 feet below the ground surface.

2. No subsurface water was encountered in the test pits at the time of excavation.

3. The proposed residences may be supported on spread footings bearing on nonporous, undisturbed natural soil or on compacted structural fill extending down to nonporous, undisturbed natural soil. Spread footings bearing on the undisturbed natural soil may be designed using an allowable net bearing pressure of 1,500 pounds per square foot. Spread footings bearing on at least 2 feet of compacted structural fill may be designed using an net allowable bearing pressure of 3,000 pounds per square foot.

4. The silty sand in the upper 4 feet of Test Pit TP-2 was observed to be slightly porous. The porous soils were observed to become more compressible when wetted. Porous soils should be removed from below proposed foundation areas.

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

7/26/04
Mike, I talked to Jay McQuire about Exec. Sum. Item No. 4 to see if this was a concern relative to the road pavement. He says it is not.
Dave

SCOPE

This report presents the results of a geotechnical investigation for the proposed residential subdivision to be located at approximately 11200 South 1700 East in Sandy, 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 June 25, 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

There are several existing buildings on the site. The southeast portion of the site is occupied by a single-story, brick residence. There is a two-car garage in the southwestern portion of the site which is of masonry construction. There is a single-story, brick home in the western portion of the site and a long, single-story chicken coop along the north edge of the site.

There is an unpaved road extending through the site providing access to the house near the

There is an unpaved road extending through the site providing access to the house near the southeast corner. There is a large, corrugated metal shed/garage adjacent to the house near the southeast corner of the site.

The site is relatively flat.

Vegetation at the site consists of short grass and weeds. There are large trees along 1700 East Street and surrounding the two houses.

The site is bordered on the west by 1700 East Street which is a three-lane, asphalt-paved road. The site is surrounded by a residential development.

FIELD STUDY

The field study was conducted on July 7, 2004. Three 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 of AGEC. Logs of the subsurface conditions encountered in the test pits are graphically shown on Figure 2.

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

SUBSURFACE CONDITIONS

The subsurface materials encountered at the site consist of approximately ½ to 1 foot of topsoil in overlying sand. The sand is silty in the upper approximately 3 to 5 feet. The sand extends to the maximum depth investigated, approximately 12 feet below the ground surface.

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

Topsoil - The topsoil consists of sandy lean clay. It is moist, brown and contains roots.

Silty Sand - The sand is medium dense, slightly moist, brown and slightly porous in Test Pit TP-2.

Laboratory tests conducted on a sample of the silty sand indicate a natural moisture content of 3 percent and a natural dry density of 102 pounds per cubic foot (pcf).

A consolidation test conducted on a sample of the porous silty sand indicates that the soil will compress a small amount at its natural moisture and a moderate amount when the soil is wet under light to moderate loads. The porous material appears to become significantly more compressible when wetted. Results of the consolidation test are presented on Figure 3.

Poorly Graded Sand - The sand contains small amount of gravel. It is medium dense, moist and brown to gray.

Laboratory tests conducted on a sample of the sand indicate a natural moisture content of 3 percent and a natural dry density of 102 pcf.

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

SUBSURFACE WATER

No subsurface water was encountered in the test pits at the time of excavation to the maximum depth investigated, approximately 12 feet.

PROPOSED CONSTRUCTION

We understand that the site encompasses approximately 2 acres which will be subdivided for residential building lots. We anticipate that the residences will be one to three-story, wood-frame structures with basements. We have assumed building loads consisting of wall loads up to 3 kips per lineal foot and column loads up to 20 kips.

We anticipate that a road may extend through the subdivision. We have assumed traffic for the road consisting of 200 cars per day, 1 delivery truck per day and 2 garbage trucks per week.

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

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 there will be less than 3 feet of grade change.

1. Subgrade Preparation

Prior to placing grading fill or base course, the topsoil, organic material, existing fill and other deleterious material should be removed. The subgrade should be scarified to a depth of approximately 8 inches, the moisture adjusted to within 2 percent of the optimum moisture content and the subgrade compacted to at least 90 percent of the maximum dry density as determined by ASTM D-1557. The subgrade should then be proof-rolled to identify soft areas. Soft areas should be removed and replaced with granular fill comprised predominantly of gravel and having 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.

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, fill for proposed pavement areas and utility trench backfill if topsoil, organics, debris and other deleterious materials are removed or it may be used in landscaping areas. The use of on-site soil may require moisture conditioning (wetting or drying) prior to compaction. 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.

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. Fill should be placed in thin enough lifts to allow for proper 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.

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 residences may be supported on spread footings bearing on nonporous, undisturbed natural soil or on compacted structural fill extending down to nonporous, undisturbed natural soil. Structural fill placed below footings should extend out away from the footings at least a distance equal to the depth of fill beneath footings.

Topsoil, unsuitable fill, porous soils, such as was encountered in the upper approximately 4 feet in Test Pit TP-2, and other deleterious material should be removed from below proposed foundation areas.

2. Bearing Pressure

Footings bearing on the undisturbed natural soil may be designed for a net allowable bearing pressure of 1,500 psf. Footings bearing on at least 2 feet of compacted structural fill may be designed for a net allowable bearing pressure of 3,000 psf. Footings should have a width of at least 18 inches and a depth of embedment of at least 10 inches.

3. Temporary Loading Conditions

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

4. Settlement

We estimate that total and differential settlement will be less than ½ of an inch. Care will be required to avoid disturbing the natural soil to remain below proposed footings to maintain settlement 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 footing excavations should be cleared of loose or deleterious material prior to structural fill or concrete placement.

The subgrade should not be scarified prior to structural fill 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. The natural poorly-graded sand may meet this criteria.

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 top and bottom of 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 36 pcf for active and at-rest conditions and decreased by 36 pcf for the

passive condition. This assumes a short period spectral response acceleration of 1.55g for a 2 percent probability of exceedance in a 50-year period (IBC 2000 and 2003).

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. Liquefaction, Seismicity and Faulting

The site is located in an area mapped as having a "very low" liquefaction potential (Salt Lake County, 1995). This represents a less than 5 percent probability that the soil may be subjected to ground shaking sufficient to cause liquefaction during a 100 year time period. Based on the subsurface conditions encountered to the depth investigated, the site conditions are consistent with a "very low" liquefaction potential. Based on the liquefaction hazard map and our understanding of the geology of the area, liquefaction is not considered to be a potential hazard for the development.

Listed below is a summary of the site parameters for the 2000 and 2003 International Building Code.

a.	Site Class	D
b.	Short Period Spectral Response Acceleration, S_S	1.55g
c.	One Second Period Spectral Response Acceleration, S_1	0.75g

There are no mapped active faults extending through the property. The closest mapped active fault to the site is the Wasatch Fault located approximately 1 ½ miles to the southeast (Salt Lake County, 1995).

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 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.

G. 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 sand. A California Bearing Ratio (CBR) of 5 percent was used in the analysis which assumes a silty 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 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.

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 Figure 1 and the data obtained from 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 in the report, we should be notified to re-evaluate our recommendations.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, P.C.



Jay R. McQuivey, P.E.

Reviewed by Christopher J. Beckman, P.E.

JRM/dc

REFERENCES CITED

International Building Code, 2000 and 2003; 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.



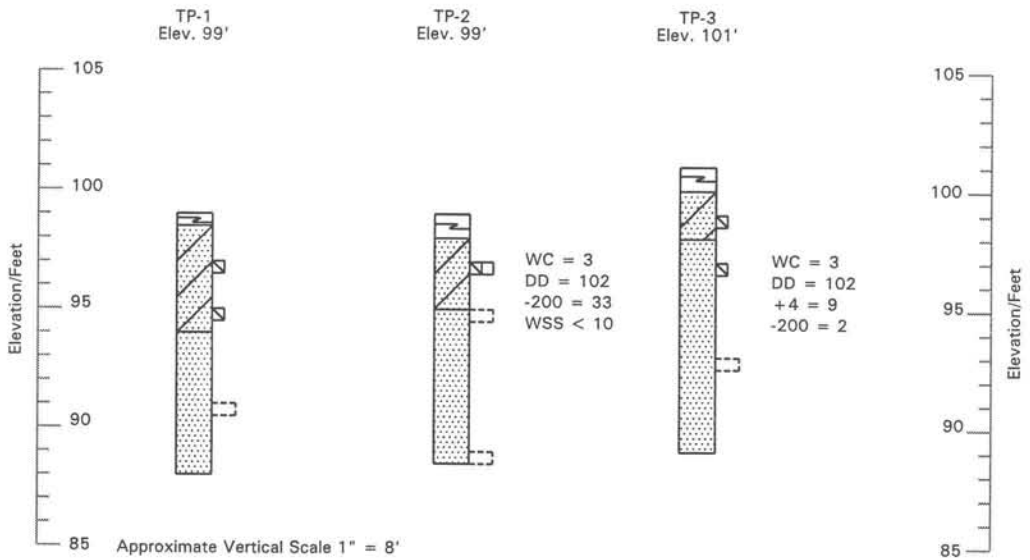
From USGS Draper Ortho (1997)
and GDT Dynamap (January 2000)

N

Approximate Scale
1 inch = 300 feet

PROPOSED RESIDENTIAL SUBDIVISION
APPROXIMATELY 11200 SOUTH 1700 EAST
SANDY, UTAH

1040595	AGEC	Locations of Test Pits	Figure 1



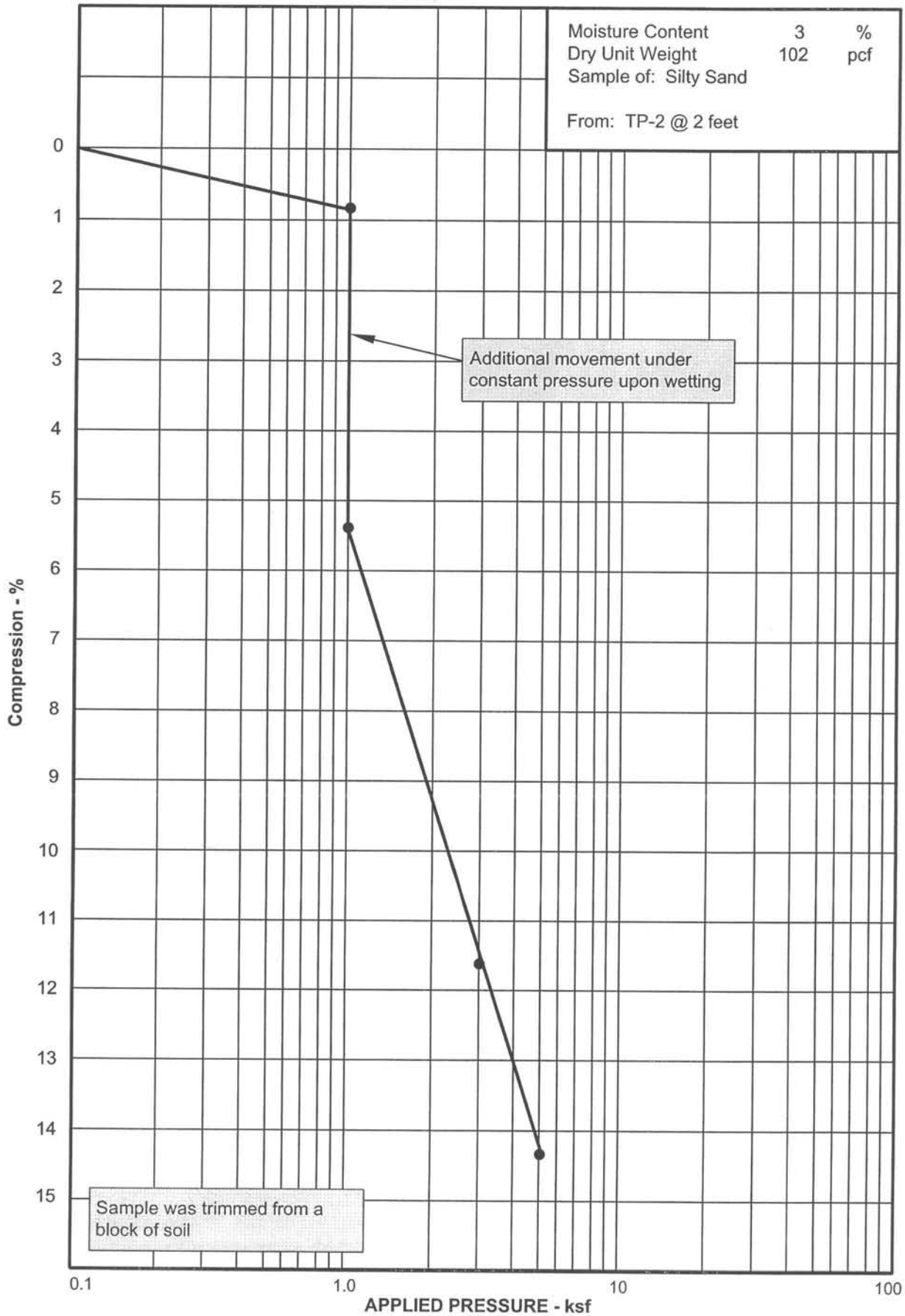
LEGEND:

- Topsoil; sandy lean clay, moist, brown, roots.
- Silty Sand (SM); medium dense, slightly moist, brown, slightly porous in Test Pit TP-2.
- Poorly-graded Sand (SP); small amount of gravel, medium dense, moist, brown to gray.
- Indicates relatively undisturbed hand drive sample taken.
- Indicates disturbed sample taken.
- Indicates realtively undisturbed block sample taken.

NOTES:

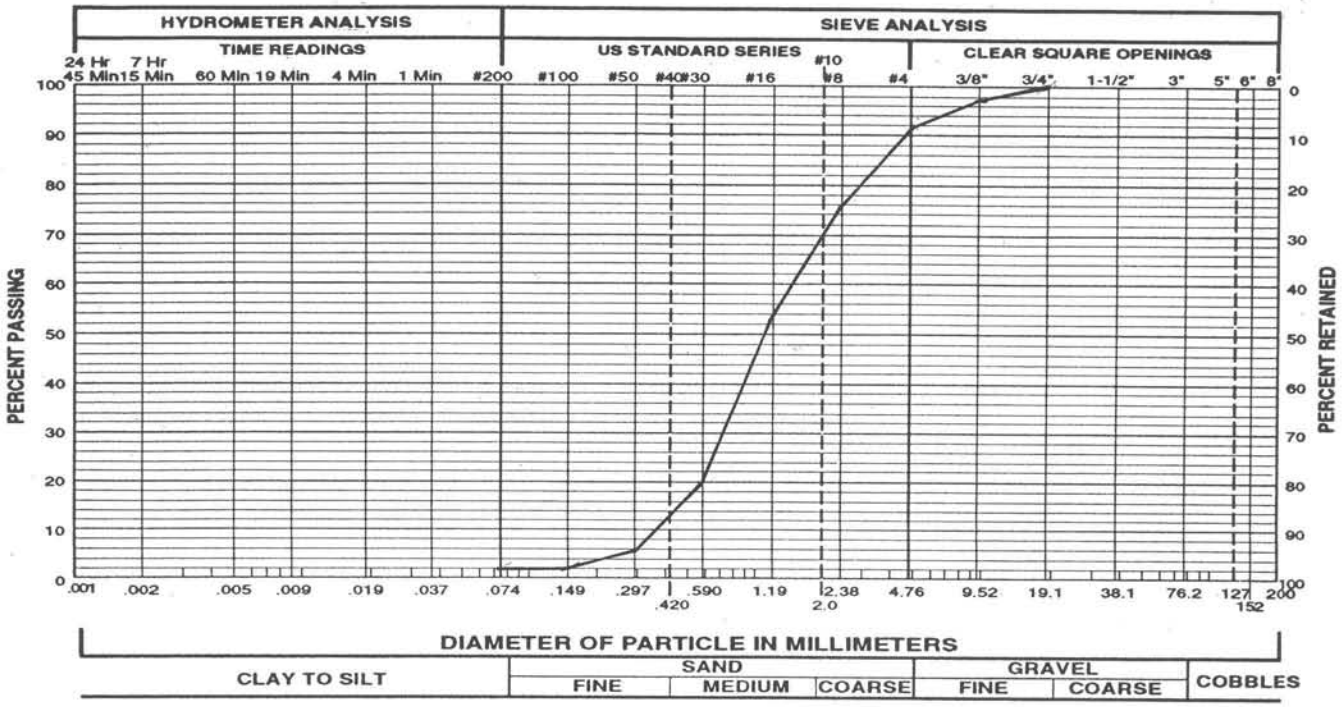
1. Test pits were excavated on July 7, 2004 with a rubber-tired backhoe.
2. Locations of test pits were measured approximately by pacing from features shown on the site plan provided.
3. Elevations of test pits were measured by hand level and refer to the bench mark shown on Figure 1.
4. The test pit 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 subsurface water was encountered in test pits at time of excavation.
7. WC = Water Content (%);
   DD = Dry Density (pcf);
   +4 = Percent Retained on No. 4 Sieve;
   -200 = Percent Passing No. 200 Sieve;
   WSS = Water Soluble Sulfates (ppm).

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Project No. 1040595 CONSOLIDATION TEST RESULTS Figure 3

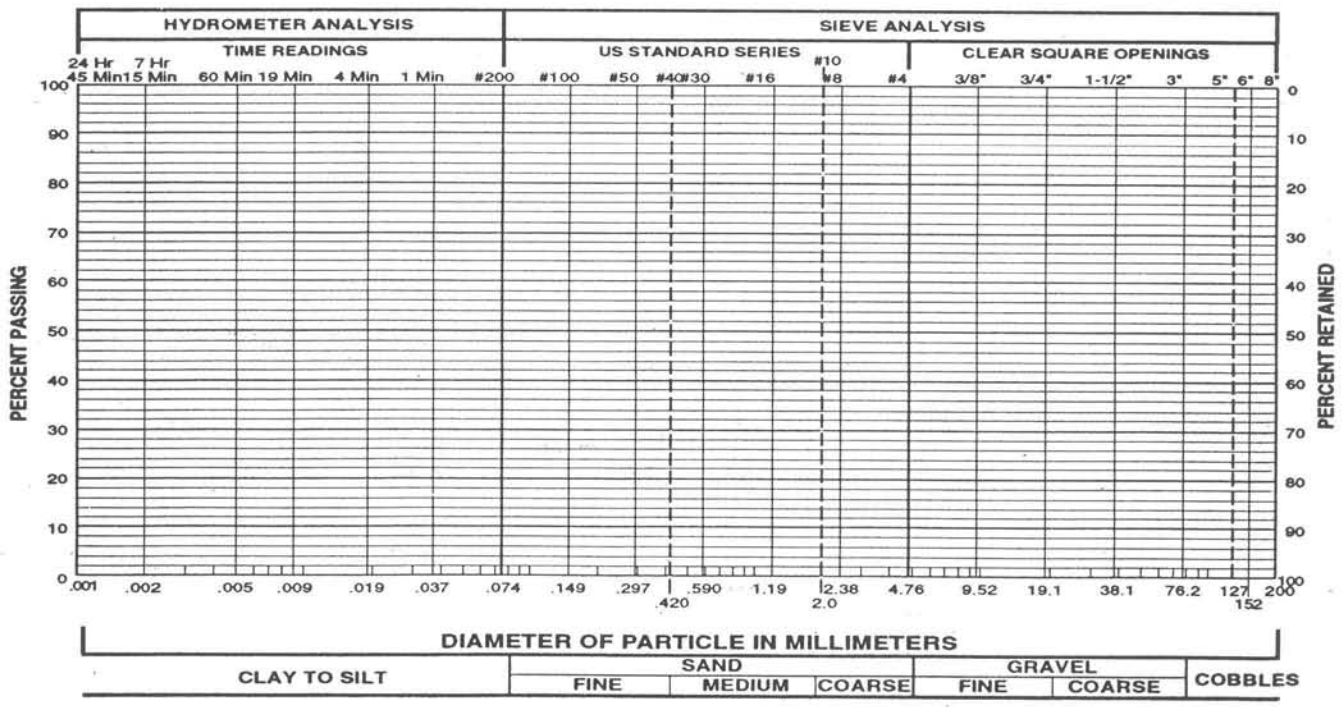
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Gravel 9 % Sand 89 % Silt and Clay 2 %

Liquid Limit _____ % Plasticity Index _____ %

Sample of Poorly-graded Sand From TP-3 @ 4'



Gravel _____ % Sand _____ % Silt and Clay _____ %

Liquid Limit _____ % Plasticity Index _____ %

Sample of _____ From _____

Project No. 1040595 **GRADATION TEST RESULTS** Figure 4

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, P.C.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER 1040595

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-2	2	2	102			33				<10	Silty Sand
TP-3	4	3	102	9	89	2					Poorly-graded Sand