



Applied Geotechnical Engineering Consultants, P.C.

**GEOTECHNICAL INVESTIGATION
PROPOSED KYSON CREEK ESTATES
APPROXIMATELY 12774 SOUTH 4400 WEST
RIVERTON, UTAH**

PREPARED FOR:

**TODD SINKS
3894 WEST 10025 SOUTH
SOUTH JORDAN, UTAH 84095**

PROJECT NO. 1040916

OCTOBER 15, 2004

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EXECUTIVE SUMMARY

1. Approximately ½ to 1 foot of topsoil was encountered in the test pits excavated at the site. Approximately 5 feet of gravel was encountered below the topsoil in Test Pit TP-1. Lean clay was encountered below the topsoil in Test Pit TP-2 and extends to a depth of approximately 10 feet below the existing ground surface. Lean clay was encountered below the gravel in Test Pit TP-1 and extends to a depth of approximately 9 feet below the existing ground surface. Sand with small to moderate amounts of silt was encountered below the clay and extends the maximum depth investigated, approximately 13 feet.

2. No free water was encountered in the test pits at the time of excavation to the maximum depth investigated, approximately 13 feet.

3. The clay encountered in Test Pit TP-2 which extends to a depth of 10 feet below the existing ground surface was found to exhibit moisture sensitive characteristics. Samples of the clay tested in the laboratory were observed to collapse up to approximately 7 ½ percent under a constant load of 1,000 pounds per square foot when wetted. The clay was found to compress a moderate amount with the addition of light to moderate loads when wetted. Leaving the moisture sensitive soil below proposed buildings could result in significant settlement if the soil below the proposed buildings became wetted.

Ideally, the moisture sensitive soil would be removed from below proposed foundation areas or foundations extended below the moisture sensitive soil. Foundations in areas where the moisture sensitive soil was encountered and not removed from below building areas should extend to a depth of at least 5 feet below the original ground surface. Precautions, with respect to construction in the moisture sensitive soil are included in the report.

4. The proposed residences may be supported on spread footings bearing on the undisturbed non-moisture sensitive natural soil or on compacted structural fill extending down to undisturbed natural soil below the moisture sensitive soil. Footings bearing on the undisturbed natural soil which is not moisture sensitive, may be designed using an allowable net 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 an allowable net bearing pressure of 2,500 pounds per square foot.

Executive Summary Continued

5. Areas of the upper natural soil consist of lean clay. The fine-grained soil will result in construction difficulties during times when it is very moist to wet such as during the winter or spring or at times of prolonged rainfall. Care will be required to minimize disturbance of the natural soil during construction. Placement of granular fill or excavation down to granular soil will generally improve site conditions for construction in areas where the subgrade consists of very moist to wet fine-grained soil.
6. Geotechnical information related to foundations, subgrade preparation, pavement design and materials is included in the report.

This report presents the results of a geotechnical investigation for the proposed Kyson Creek Estates Subdivision to be located at approximately 12774 South 4400 West in Riverton, Utah. The report presents the subsurface conditions encountered, laboratory test results and recommendations for foundation support and pavement. The study was conducted in general accordance with our proposal dated September 21, 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 the 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

The site consists of an undeveloped field with no permanent structures or pavements. There is a high-pressure gas line easement extending across the west end of the project site. The ground surface at the site is relatively flat with a gentle slope down to the east. There is a slight drainage which extends in an east/west direction through the central portion of the site.

Vegetation at the site consists of short grasses and weeds.

There are undeveloped parcels of land fields and rural development to the north, east and south of the site.

FIELD STUDY

The field study was conducted on September 24, 2004. Two Test Pits were excavated at the approximate locations indicated on Figure 1. The test pits were excavated with a rubber-tired backhoe. The test pits were logged and soil samples obtained by an engineer from AGEC. Logs of 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

Approximately $\frac{1}{2}$ to 1 foot of topsoil was encountered in the test pits excavated at the site. Approximately 5 feet of gravel was encountered below the topsoil in Test Pit TP-1. Lean clay was encountered below the topsoil in Test Pit TP-2 and extends to a depth of approximately 10 feet below the existing ground surface. Lean clay was encountered below the gravel in Test Pit TP-1 and extends to a depth of approximately 9 feet below the existing ground surface. Sand with small to moderate amounts of silt was encountered below the clay and extends the maximum depth investigated, approximately 13 feet.

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

Topsoil - The topsoil consists of lean clay and silty sand with occasional gravel. It is slightly moist, brown and contains roots and organics.

Lean Clay - The clay contains small to moderate amounts of sand and occasional gravel. It is medium stiff to stiff, slightly moist and brown. The clay contains slight to moderate pinhole structure. Generally, the pinhole structure decreases with depth. Laboratory tests conducted on samples of the clay indicate that it has natural moisture contents ranging from 9 to 15 percent and natural dry densities ranging from 75 to 79 pounds per cubic foot (pcf).

Consolidation tests conducted on samples of the clay indicate that the clay is sensitive to moisture. The clay from Test Pit TP-2 tested in the laboratory collapsed up to approximately 7 ½ percent and becomes more compressible when wetted. The results of consolidation tests conducted on the clay are presented on Figures 3, 4 and 5.

Sand - The sand consists of poorly graded sand and silty sand and contains small to moderate amounts of silt and occasional gravel. It is medium dense to dense, slightly moist and brown.

Poorly Graded Gravel - The gravel contains small to moderate amounts of sand and is medium dense, slightly moist and brown.

Laboratory tests conducted on a sample of the gravel indicate that it has a natural moisture content of 2 percent. Results of a gradation test conducted on a sample of the gravel are presented on Figure 6.

A summary of the laboratory test results is presented on Table I. Results of the tests are included on the logs of test pits, Figure 2.

SUBSURFACE WATER

No free water was encountered in the test pits at the time of excavation to the maximum depth investigated, approximately 13 feet.

PROPOSED CONSTRUCTION

We understand that site consists of approximately 5 acres which will be subdivided into four residential building lots. We anticipate that the residences will consist of one to three-story, wood-frame structures with a potential for basements. We have assumed maximum column loads of 20 kips and maximum wall loads of 3 kips per lineal foot for the proposed residences based on typical residential construction in the area.

We understand that a private, paved road is planned to extend along the north side of the building lots. We have assumed that traffic for the private road will consist primarily of light passenger vehicles.

If the proposed construction, building loads or anticipated traffic are significantly different from those 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 minor amounts of cut and fill (less than approximately 3 feet) will be required to facilitate construction at the site.

Topsoil, organic material, unsuitable fill and other deleterious material should be removed from below proposed building and pavement areas.

1. Excavation

We anticipate that excavation at the site can be accomplished with typical excavation equipment.

2. Pavement Subgrade Preparation

Prior to placing site grading fill or base course, all organic material, topsoil, unsuitable fill, and other deleterious material should be removed.

The subgrade should be scarified to a depth of approximately 10 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 properly compacted granular fill containing less than 15 percent passing the No. 200 sieve.

Areas of the upper natural soil consist of lean clay. The fine-grained soil will result in construction difficulties during times when it is very moist to wet such as during the winter or spring or at times of prolonged rainfall. Care will be required to minimize disturbance of the natural soil during construction. Placement of granular fill or excavation down to granular soil will generally improve site conditions for construction in areas where the

subgrade consists of very moist to wet fine-grained soil. Approximately 1 ½ to 2 ½ feet of granular fill may be required to support moderately sized rubber tired construction equipment when the subgrade consists of very moist to wet fine grained soil.

3.

Materials

Listed below are materials recommended for structural fill.

Fill to Support	
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 on-site sand and gravel meeting the material recommendations given above may be used as fill to support structures. The on-site clay is not suitable for use as fill to support structures but may be used as site grading fill, in pavement areas or as utility trench backfill if the topsoil, organics, debris and other deleterious materials are removed or it may be used in landscaping areas.

The on-site soils are generally near or below the optimum moisture content and 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.

5. Drainage

The ground surface surrounding the proposed residences should be sloped away from the buildings in all directions with a slope of at least 6 inches in 10 feet for a distance of at least 10 feet away from the structure. Roof downspouts should be discharged beyond the limits of backfill.

Fill placed for the project should be frequently tested for compaction. Fill should be placed in lifts thin enough to allow for adequate compaction.

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

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

Fill to Support	Compaction
Foundations	≥ 95 %
Concrete flatwork and pavement	≥ 90 %
Landscaping	≥ 85 %
Retaining Wall Backfill	85 - 90 %

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.

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. Moisture Sensitive Soil

Moisture sensitive soil was encountered in the area of Test Pit TP-2 at depths of up to approximately 10 feet below the existing ground surface. The areal extent of moisture sensitive soil is unknown. Additional subsurface exploration would better define the extent and depth of the moisture sensitive soil.

Ideally, the moisture sensitive soil would be removed from below proposed building areas or foundations should extend below the moisture sensitive soil. We estimate approximately ½ inch of additional settlement due to wetting and collapse of the moisture sensitive soil if approximately 5 feet of moisture sensitive soil is left in place below the foundation bearing elevation. The potential for additional settlement due to moisture sensitive soil below the foundation bearing elevation may be reduced by removing additional amounts of moisture sensitive soil.

It is important to maintain little or no moisture change in the soil under and surrounding the foundations during construction and during the life of the buildings. Exterior grading should promote drainage of runoff water away from the area surrounding the buildings. Irrigation in the area surrounding the structure should be minimized.

3. Bearing Pressure

Spread footings bearing on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil may be designed using an allowable net 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 compacted structural fill extending down to the undisturbed natural soil may be designed using an allowable net bearing pressure of 2,500 psf. Footings should have a minimum width of 1 ½ feet and a minimum depth of embedment of 1 foot.

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

Structural fill placed below foundations should extend out away from the edge of footings a distance equal to the depth of fill beneath footings.

Due to the thickness of moisture sensitive soil encountered in the area of Test Pit TP-2, we recommend that the upper 5 feet of soil be removed in areas of proposed foundations or foundations be extended to a depth of at least 5 feet below the original ground surface where moisture sensitive soil is encountered.

With the proposed construction and the subsurface conditions encountered, the proposed residences may be supported on the undisturbed non-moisture sensitive natural soil or on compacted structural fill extending below any moisture sensitive soil.

2. Bearing Material

4. Settlement
- We estimate that settlement will be on the order of 1 inch for foundations bearing on the undisturbed non-moisture sensitive natural soil or on compacted structural fill extending down to the undisturbed natural soil as indicated above.
- The estimated total and differential settlement for the proposed residences to be constructed in the area of Test Pit TP-2 and for a foundation bearing elevation extending at least 5 feet below the existing ground surface is estimated to be on the order of ½ inch if the supporting soil becomes wetted. This additional settlement would be differential and could occur over relatively small distances.
5. Temporary Loading Conditions
- The allowable bearing pressure may be increased by one-half for temporary loading conditions such as wind or seismic loads
6. Frost Depth
- Exterior footings and footings beneath unheated areas should be placed at least 30 inches below grade for frost protection.
7. Foundation Base
- The base of foundation excavations should be cleared of loose or deleterious material prior to fill or concrete placement.
8. Construction Observation and Testing
- A representative of the geotechnical engineer should observe all footing excavations and subgrade areas prior to structural fill or concrete placement. This is particularly important since moisture sensitive soils were encountered at the site.

Fill and pavement materials placed for the project should be frequently tested for compaction. To facilitate the compaction process, fill should be properly moisture conditioned.

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.

We anticipate that removal of moisture sensitive soil from below foundation areas will likely result in removal of the moisture sensitive soil from below floor slabs.

Topsoil, organic materials, unsuitable fill and other deleterious material should be removed from below proposed slab areas.

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 floor slab for ease of construction and to promote even curing of the floor 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 0.35 may be used in design for ultimate lateral resistance.

E. Seismicity, Faulting and Liquefaction

1. Seismicity
Listed below is a summary of the site parameters for the 2003 International Building Code.

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.

3. Seismic Conditions
Under seismic conditions, the equivalent fluid weight should be increased by 28 pcf for active and at-rest conditions and decreased by 28 pcf for the passive condition. This assumes a short period spectral response acceleration of 1.168g which represents a 2 percent probability of exceedance in a 50-year period. (IBC, 2003).

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

2. Foundation 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 assume a horizontal surface adjacent each side of the wall.

a.	Site Class	D
b.	Short Period Spectral Response Acceleration, S_s	1.168g
c.	One Second Period Spectral Response Acceleration, S_1	0.42g

2. Faulting

There are no mapped active faults extending through the subject property. The closest mapped active fault, which is considered active, is the Wasatch Fault located approximately 8 miles east of the site (Salt Lake County, 1995)

3. Liquefaction

The area proposed for construction is mapped as having a "very low" potential for liquefaction (Salt Lake County, 1995). Research indicates that the soil type most susceptible to liquefaction during a large magnitude earthquake is loose, clean sand. In order for liquefaction to occur the soil must be saturated. The liquefaction potential for soil tends to decrease with an increase in fines content and density.

Based on the subsurface conditions encountered to the depth investigated at the site and our understanding of geologic conditions in the area, it is our professional opinion that liquefaction is not a concern for the project.

F. **Water Soluble Sulfates**

One sample of the natural soil was tested in the laboratory for water soluble sulfate content. The test results 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. The concentration of water soluble sulfates present in the soil at the site indicates that sulfate resistant cement is not needed for concrete placed in contact with the

natural soil. Other conditions may dictate the type of cement to be used for the project.

G. Pavement

Based on the subsurface conditions encountered, laboratory test results and the assumed traffic as indicated in the Proposed Construction section of the report, the following pavement support recommendations are given:

1. Subgrade Support

The near-surface soil consists of lean clay and gravel. A California Bearing Ratio (CBR) value of 3 percent was used in the analysis, which assumes a clay 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 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 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 pavement thickness assumes that the pavement will have aggregate interlock joints and that a concrete shoulder or curb will be provided.

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 the site plan and the data obtained from laboratory testing. Variations in the subsurface conditions may not become evident until additional excavation is conducted. If the subsurface conditions or groundwater level are found to be significantly different from those described above, we should be notified to reevaluate our recommendations.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, P.C.



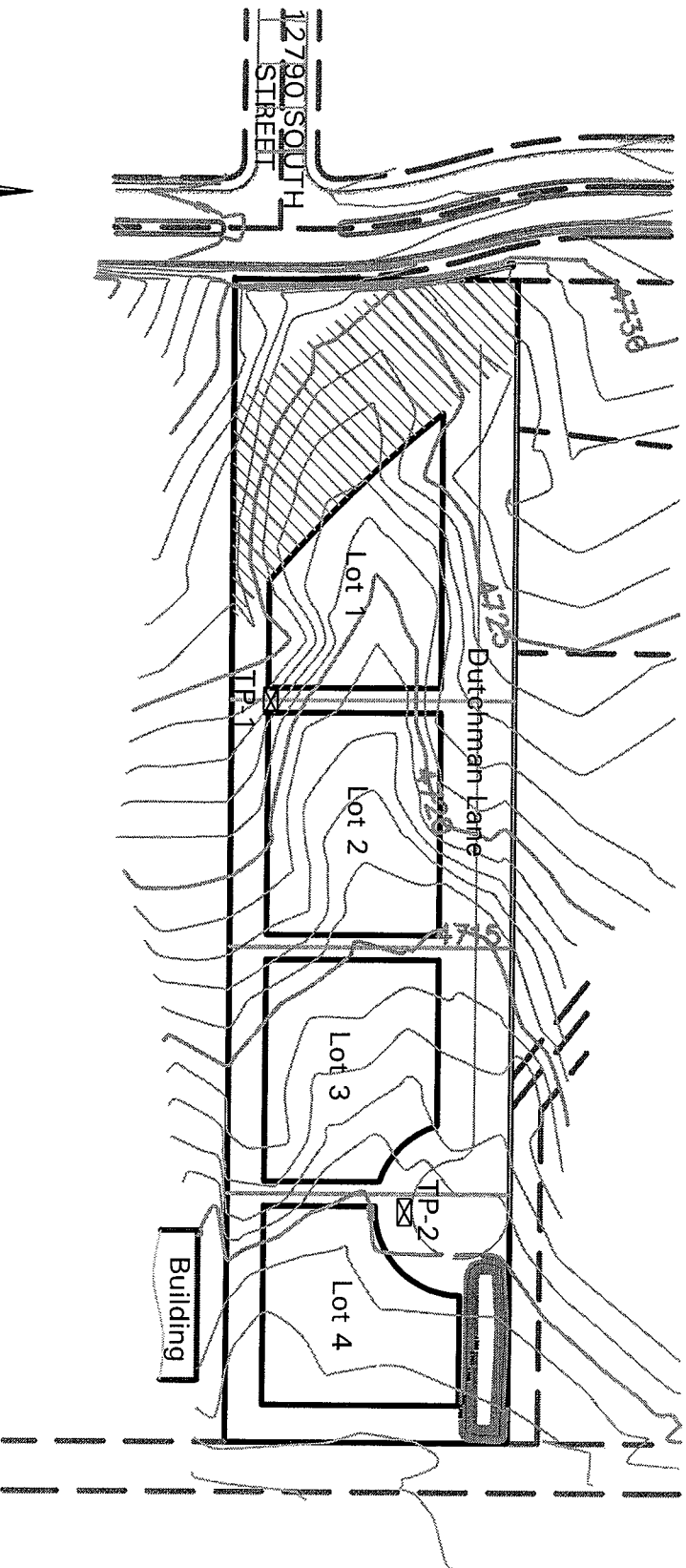
Christopher J. Beckman, P.E.

Reviewed by Douglas R. Hawkes, P.E., P.G.
Douglas R. Hawkes

CJB/dc

REFERENCES

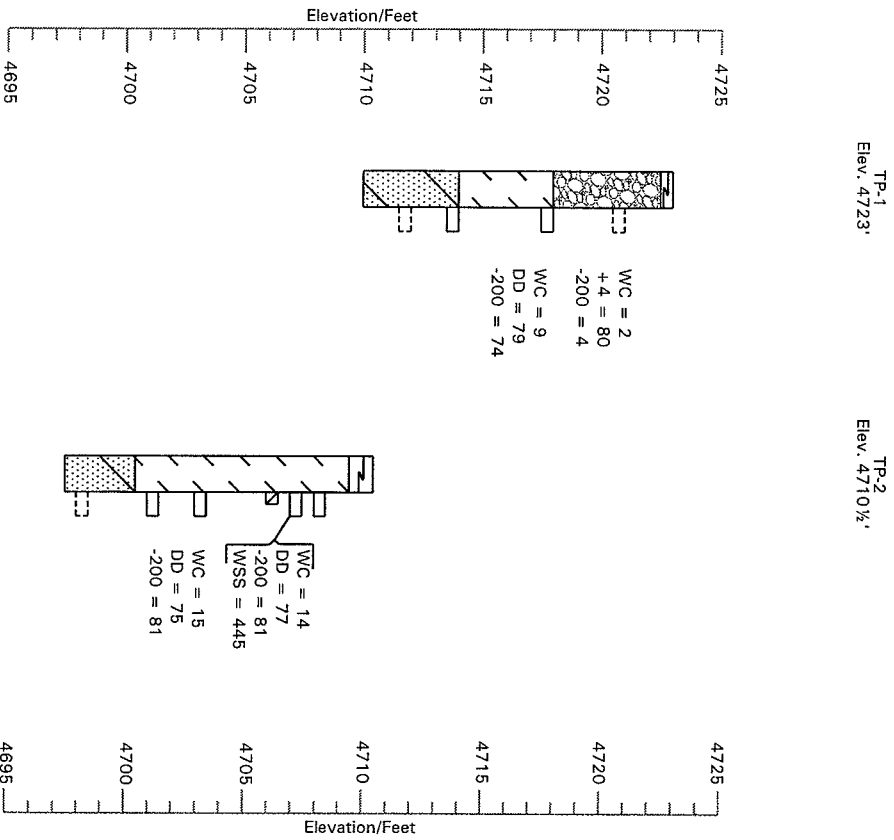
International Building Code, 2003; International Code Council, Inc., Falls Church, Virginia.
Salt Lake County, 1995; Surface Rupture and Liquefaction Potential Special Study Areas Map, Salt Lake County, Utah, adopted March 31, 1989, revised March 1995, Salt Lake County Public Works - Planning Division, 2001 South State Street, Salt Lake City, Utah.



PROPOSED KYSON CREEK ESTATES
 APPROXIMATELY 12774 SOUTH 4400 WEST
 RIVERTON, UTAH



Approximate Vertical Scale 1" = 8'

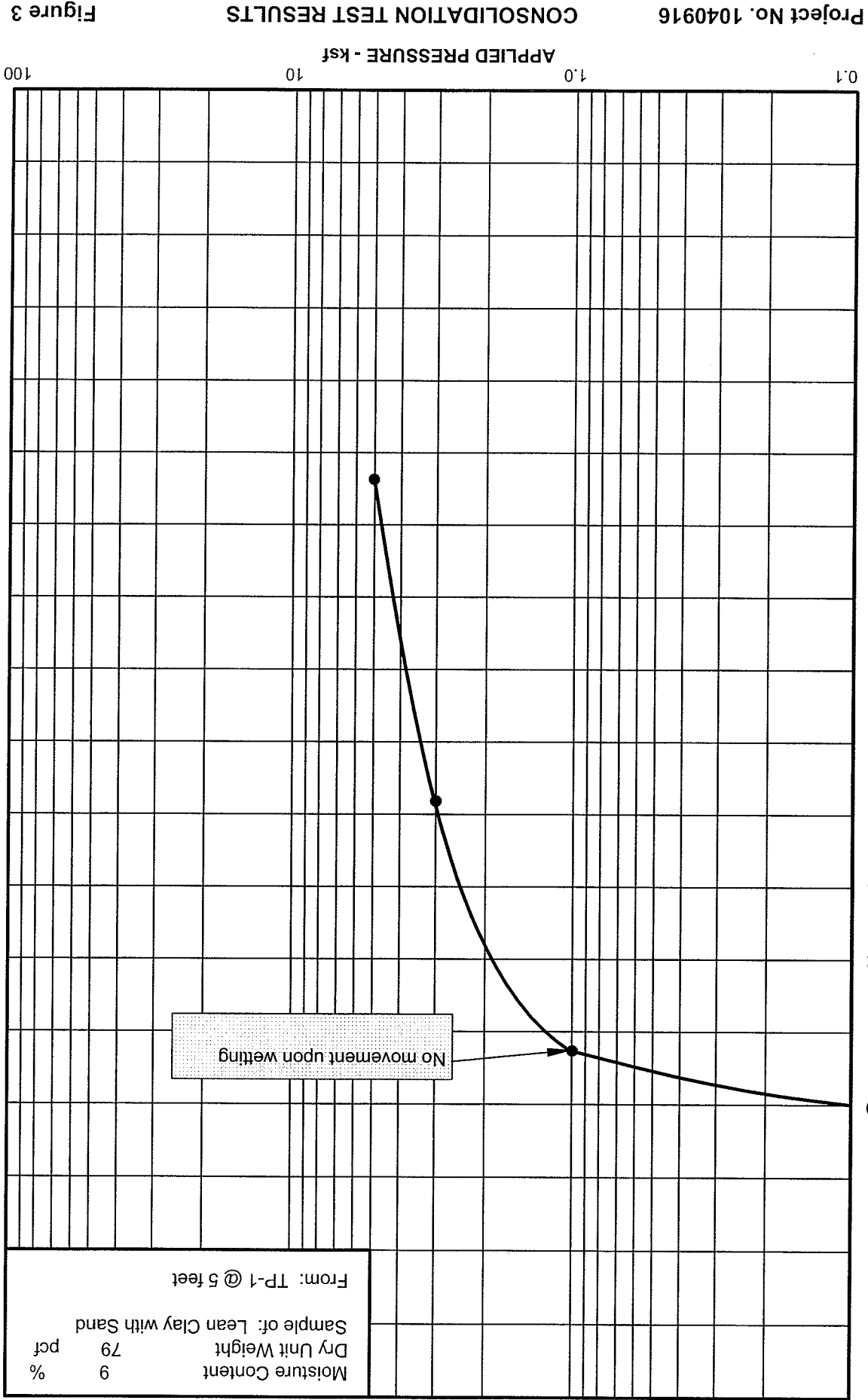


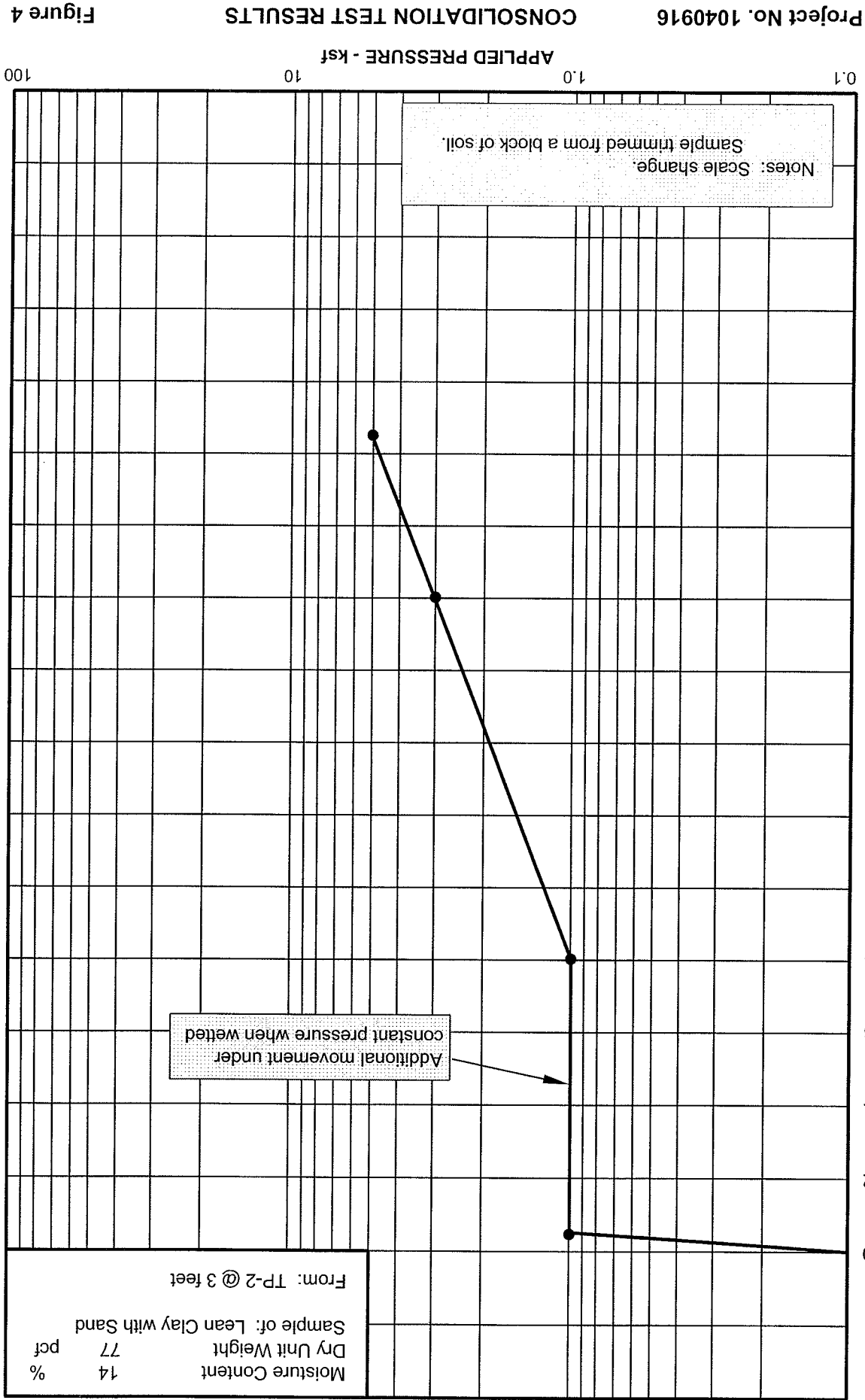
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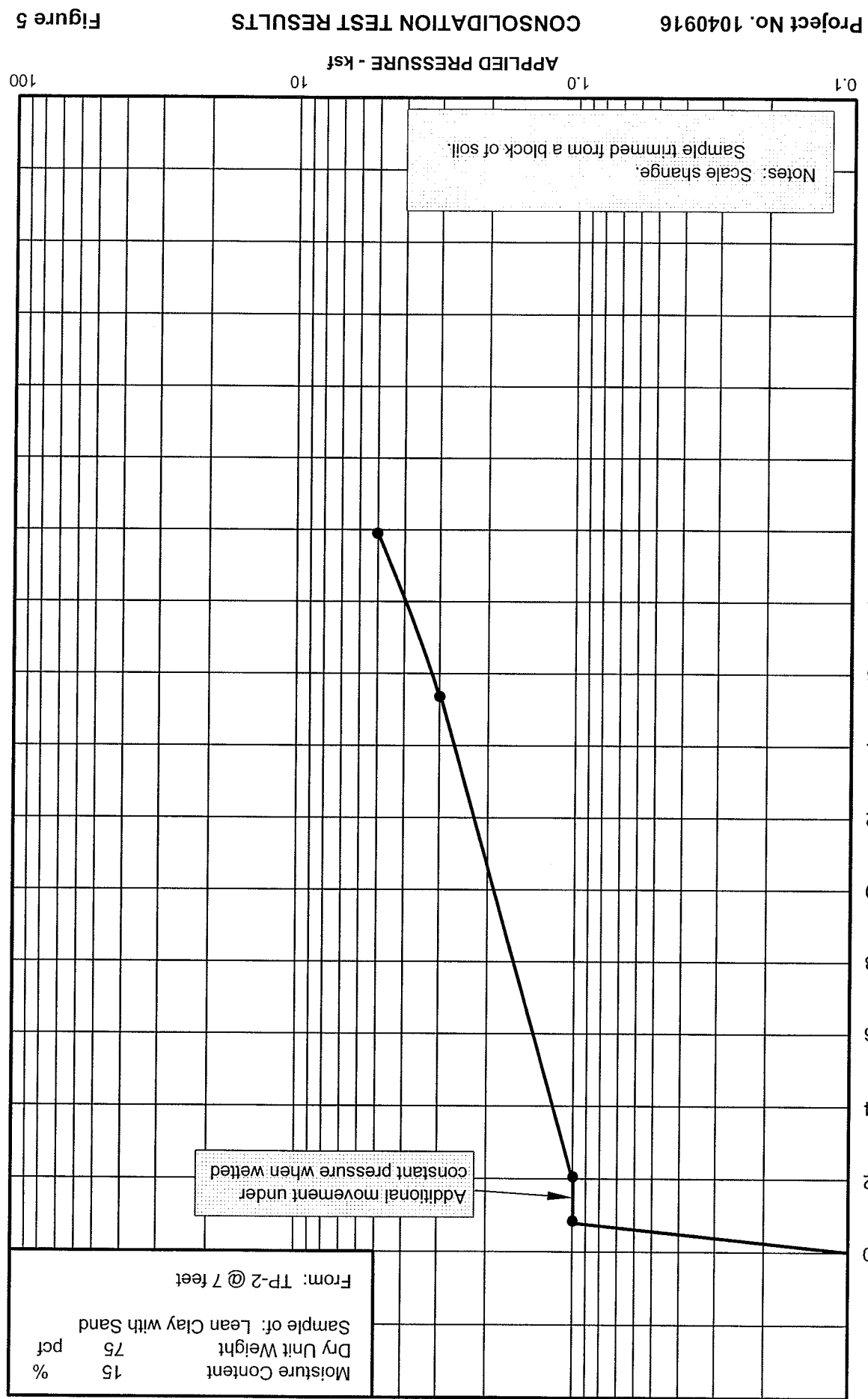
- Topsoil: lean clay and silty sand, occasional gravel, slightly moist, brown, roots and organics.
- Lean Clay (CL): small to moderate amounts of sand, occasional gravel, medium stiff to stiff, slightly moist, brown, slight to moderate pinhole structure.
- Poorly Graded Sand and Silty Sand (SP/SM): small to moderate amounts of silt, occasional gravel, medium dense to dense, slightly moist, brown.
- Poorly Graded Gravel with sand (GP): medium dense, slightly moist, brown.
- Indicates relatively undisturbed hand drive sample taken.
- Indicates disturbed sample taken.
- Indicates relatively undisturbed block sample taken.

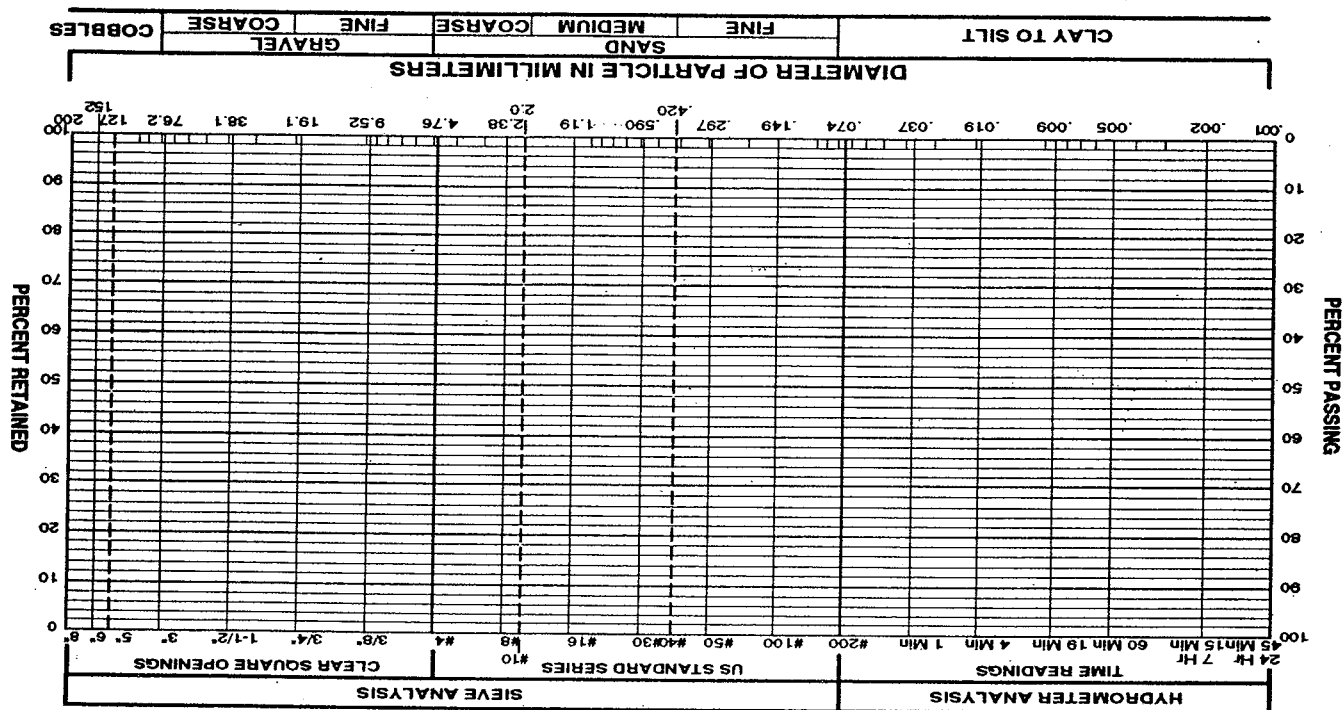
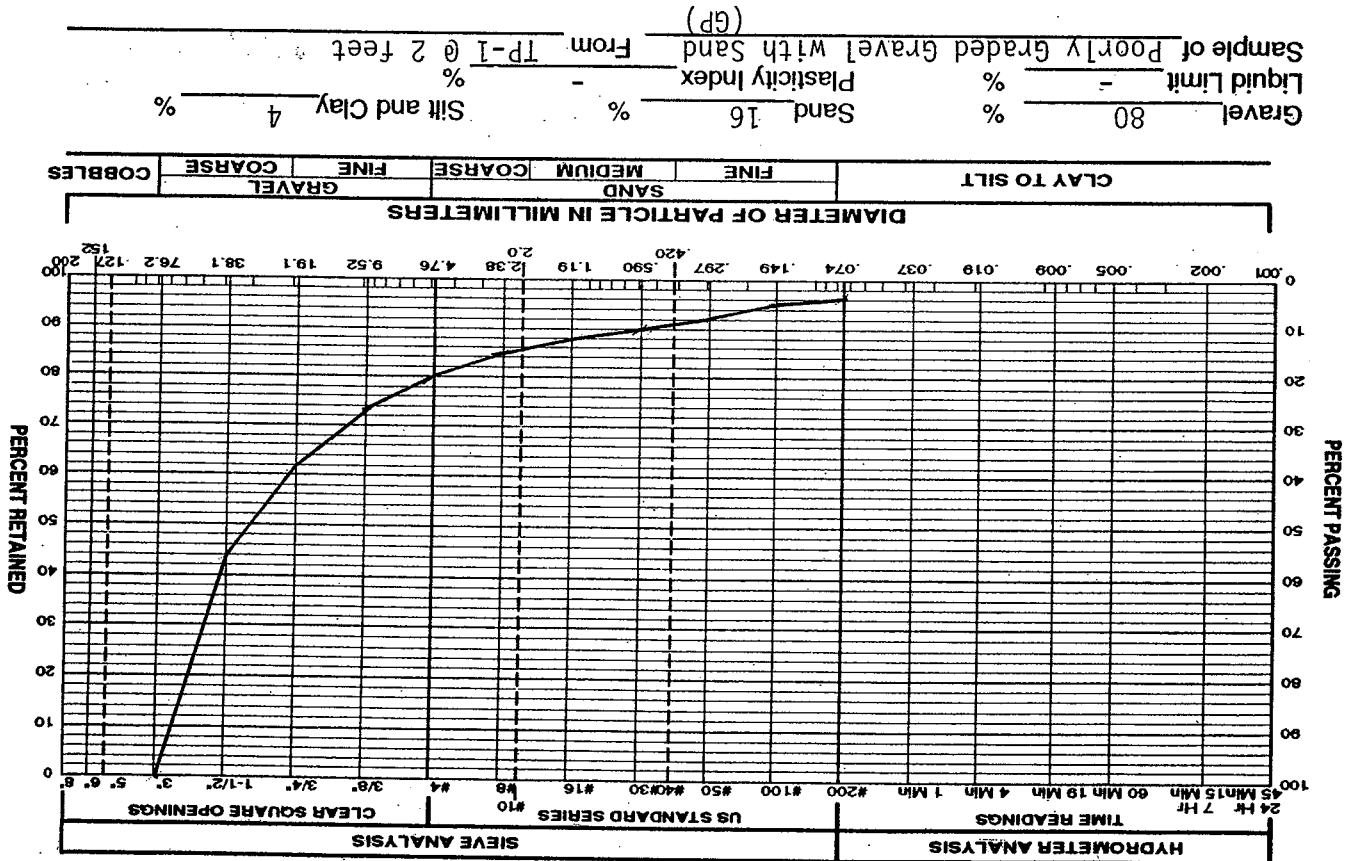
NOTES:

1. Test pits were excavated on September 24, 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 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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TABLE I

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER 1040916

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