Applied Geotechnical Engineering Consultants, Inc.

GEOTECHNICAL INVESTIGATION

CHALLENGER SCHOOL

APPROXIMATELY 11900 SOUTH 4000 WEST

RIVERTON, UTAH

PREPARED FOR:

ASWN
5151 SOUTH 900 EAST, SUITE 200
MURRAY, UTAH 84117

ATTENTION: SCOTT WILKINSON

PROJECT NO. 1071011

OCTOBER 29, 2007

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EXECUTIVE SUMMARY

1. The subsurface soils encountered at the site generally consist of approximately 1 foot of topsoil overlying lean clay. Occasional gravel layers were encountered in the clay with significant gravel being encountered in the upper portion of Test Pit TP-3. Gravel was encountered below the clay at a depth of approximately 13 feet below the ground surface in Boring B-1 and 12 feet below the ground surface in Test Pit TP-7. The gravel extended to a depth of approximately 22 feet below the ground surface in Boring B-1 with interlayered clay and gravel encountered below this depth to the full depth investigated, approximately 26 feet.

2. No subsurface water was encountered in the test pits or borings at the time of drilling/excavation.

3. The natural clay is slightly porous. Laboratory tests conducted on samples of the porous soil indicate that the material is moisture-sensitive becoming more compressible when wetted. The moisture-sensitive soil generally extends down to the gravel to a depth on the order of 13 feet below the ground surface. The moisture-sensitivity of the clay appears to decrease significantly below a depth of approximately 10 feet. The proposed building may be supported on spread footings supported at or below a depth of approximately 10 feet below the original ground surface or the moisture-sensitive soils to this depth may be removed from below footing areas and replaced with compacted structural fill. Structural fill should extend out away from the edge of the footings at least a distance equal to ½ the depth of structural fill below the footing. Foundation support may be extended below the moisture-sensitive soil by using drilled piers, helical piers, Geopiers or similar foundation systems extending down to the gravel. The on-site soils may be considered for use as structural fill if properly moisture conditioned and compacted.

4. Spread footings bearing on the undisturbed natural soil at or below a depth of approximately 10 feet below the original ground surface may be designed using an allowable net bearing pressure of 1,200 pounds per square foot. Spread footings bearing on at least 2 feet of compacted structural fill may be designed using an allowable net bearing pressure of 2,500 pounds per square foot.

Executive Summary (continued)

5. The upper soil consists predominantly of clay. Construction access difficulties may be encountered for rubber-tired construction equipment during periods when the upper soil is very moist to wet. Placement of granular fill may be needed to provide equipment access and to facilitate construction of the pavement when the upper soil is very moist to wet.

6. 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 Challenger School to be located at approximately 11900 South 4000 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 August 1, 2007 with additional subsurface exploration and laboratory testing as discussed in our letter dated October 9, 2007.

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 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 a cultivated field. There are no structures or pavement on the site.

The ground surface is relatively flat with a gentle slope down to the east/northeast.

Vegetation at the site consists of a cut alfalfa crop with some other grass and weeds.

There are residences to the north and south of the site. The site is bordered on the west by 4000 West Street which is a two-lane, asphalt-paved road. The site is bordered on the east by Bangerter Highway, an eight-lane wide concrete-paved highway.

FIELD STUDY

The field study was conducted on August 20, September 23 and October 9, 2007. Seven test pits were excavated and two borings drilled at the approximate locations indicated on Figure 1. The test pits were excavated with a rubber-tired backhoe. The borings were drilled with 8-inch diameter hollow-stem auger powered by a truck-mounted drill rig. The test pits and borings were logged and soil samples obtained by an engineer from AGEC. Logs of the subsurface conditions encountered in the test pits and borings are graphically shown on Figures 2 and 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 soils encountered at the site generally consist of approximately 1 foot of topsoil overlying lean clay. Occasional gravel layers were encountered in the clay with significant gravel being encountered in the upper portion of Test Pit TP-3. Gravel was encountered below the clay at a depth of approximately 13 feet below the ground surface in Boring B-1 and 12 feet below the ground surface in Test Pit TP-7. The gravel extended to a depth of approximately 22 feet below the ground surface in Boring B-1 with interlayered clay and gravel encountered below this depth to the full depth investigated, approximately 26 feet.

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

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

Lean Clay - The clay contains small to moderate amounts of sand. The clay is slightly porous, medium stiff to stiff, moist to very moist and gray.

Laboratory tests conducted on samples of the clay indicate natural moisture contents range from 15 to 29 percent and natural dry densities range from 72 to 100 pounds per cubic foot (pcf).

Unconfined compressive strengths of 1,525 and 1,665 pounds per square foot (psf) were measured for samples of the clay tested in the laboratory.

Consolidation tests conducted on samples of the clay indicate that the clay will compress a small to moderate amount under light to moderate loads prior to wetting and a moderate to large amount after wetting. Up to approximately 7 percent collapse was measured when samples were wetted under a constant pressure of 1,000 psf. Samples from below depths of approximately 10 feet below the ground surface appear to be significantly less moisture-sensitive than the upper materials tested. Results of the tests are presented on Figures 4 through 11.

Clayey Gravel with Sand and Lean Clay - The gravel and clay are interlayered. The interlayered soil is dense, stiff, very moist and brown to reddish brown.

Clayey Gravel with Sand - The gravel is medium dense, moist and brown.

Poorly-Graded Gravel with Clay and Sand - The gravel contains possible cobbles. It is dense, moist and brown.

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

SUBSURFACE WATER

No subsurface water was encountered in the test pits or borings to the maximum depth investigated, approximately 26 feet.

PERCOLATION TEST

A percolation test was conducted in Test Pit TP-7 at a depth of approximately 4 feet below the ground surface. The percolation test was conducted by excavating a test hole approximately 6 inches in diameter to a depth of approximately 1 foot. Water was introduced into the test hole on the day before the percolation test was conducted. Water was again placed in the test hole on the day of the test and the drop in the water level was measured over 30 minute intervals. Water was replaced to the original level at the beginning of each 30 minute interval. A percolation rate of 19 minutes per inch was measured.

PROPOSED CONSTRUCTION

We understand that the proposed building will consist of a two-story, wood-frame structure with the main level being slab-on-grade. We understand that the footprint area of the building is approximately 26,000 square feet.

The structural engineer indicates that wall loads will be up to 6 kips per lineal foot with one-half of this load being live load. The structural engineer indicates that column loads will be up to 36 kips with approximately 60 percent of this load being live load.

Pavement is planned for portions of the property surrounding the building. We have assumed traffic for paved areas consisting of passenger vehicles with occasional delivery trucks and two garbage trucks per week.

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 the recommendations given.

RECOMMENDATIONS

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

A. Site Grading

We anticipate that there will be relatively small amounts of cut and fill for the proposed development. We have assumed that the finished floor level of the building will be within approximately 3 feet of the existing ground surface. If the building area is raised more than 3 feet above the existing ground surface, we should be notified so that we can reevaluate our recommendations.

1. Pavement Subgrade Preparation

   Prior to placing grading fill or base course, the topsoil, organics, 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 be proof-rolled to identify soft areas. Soft areas should be removed and replaced with properly compacted granular fill.

The upper natural soil consists of lean clay. The clay will be easily disturbed by construction traffic when it is very moist to wet, such as in the winter and spring or at times of prolonged rainfall. Under these conditions, consideration may be given to not scarifying and recompacting the subgrade, but cutting the subgrade to undisturbed natural soil below the topsoil and placing a sufficient thickness of granular fill to provide construction equipment access. Placement of approximately 1 ½ to 2 feet of granular fill will generally provide limited support for moderately loaded rubber-tired construction equipment when the upper soil is very moist to wet.

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	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 on-site soil may be considered for use as structural fill, fill below pavement areas or as utility trench or wall backfill if the topsoil, organics, debris and other deleterious materials are removed.

The soil will 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. 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 Slabs and Pavement	≥ 90%
Landscaping	≥ 85%
Retaining Wall Backfill	85 - 90%

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 at a moisture content within 2 percent of the optimum.

Fill and pavement materials should be frequently tested during construction for compaction.

Full-time observation and testing is recommended if the clay is used as fill below the proposed building.

5. Drainage

The ground surface surrounding the proposed building should be sloped 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 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 at least 10 feet below the original ground surface or the building may be supported on spread footings bearing on structural fill which extends to at least 10 feet below the original ground surface.

Structural fill should extend down to the undisturbed natural soil and out away from the edge of the footings at least a distance equal to ½ the depth of fill beneath footings.

Topsoil, organics, unsuitable fill and other deleterious material should be removed from proposed foundation areas.

An alternative to extending foundation support to a depth of at least 10 feet or over-excavation and replacement of the upper 10 feet below the footings, would be to support the structure on drilled piers, helical piers, Geopiers, minipiles or other systems to extend support down to the natural gravel.

2. Bearing Pressures

Spread footings bearing on the undisturbed natural soil or on compacted structural fill may be designed using an allowable net bearing pressure of 1,200 psf. Spread footings bearing on at least 2 feet of compacted structural fill may be designed using an allowable net bearing pressure of 2,500 psf. Footings should have a width of at least 1½ feet and a depth of embedment of at least 1 foot.

3. <u>Temporary Loading Conditions</u>

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

4. <u>Settlement</u>

We estimate that total settlement will be on the order of 1 inch for footings designed as indicated above. Differential settlement is estimated to be on the order of ¾ of an inch.

5. <u>Frost Depth</u>

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

6. <u>Foundation Base</u>

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

7. <u>Construction Observation</u>

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

C. Concrete Slab-on-Grade

1. <u>Slab Support</u>

Concrete slabs may be supported on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil. We estimate that there is a potential for settlement on the order of 1 inch for floor slabs supported above the moisture-sensitive soils, if the supporting soils were to become wet.

2. Underslab Sand and/or Gravel

A 4-inch layer of free-draining sand and/or gravel with less than 5 percent passing the No. 200 sieve should be placed below the concrete slabs for ease of construction and to promote even curing of the slab concrete.

3. Vapor Barrier

A vapor barrier should be placed under the concrete floor if the floor will receive an impermeable floor covering. The barrier will reduce the amount of water vapor passing from below the slab to the floor covering.

D. Lateral Earth Pressures

1. Lateral Resistance for Footings

Lateral resistance for 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.

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 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 equivalent fluid weight should be increased by 27 pcf for active and at-rest conditions and decreased by 27 pcf for the passive condition. This assumes a short period spectral response acceleration of 1.09g for a 2 percent probability of exceedance in a 50-year period (IBC 2006).

4. Safety Factors

The values recommended above for passive and active conditions 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

1. Liquefaction

The site is located in an area mapped as having a "very low" liquefaction potential (Salt Lake County, 1995). Based on our understanding of the geology in the area and the subsurface conditions encountered at the site, liquefaction is not considered a hazard for the proposed development.

2. Seismicity

Listed below is a summary of the site parameters for the 2006 International Building Code.

a.	Site Class	D
b.	Short Period Spectral Response Acceleration, S_S	1.09g
c.	One Second Period Spectral Response Acceleration, S_1	0.43g

3. Faulting

There are no mapped active faults extending near or through the site. The closest mapped active fault considered to be active is the Wasatch Fault located approximately 7½ miles to the east of the site (Salt Lake County, 1995).

F. Water Soluble Sulfates

One sample of the natural soil was tested in the laboratory for water soluble sulfate content. Test results indicate that there is less than 0.1 percent water soluble sulfate in the sample tested. Based on the test results and published literature, the natural soil possesses a negligible sulfate attack potential for 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

Provide a pavement design recommendation for 26,000 ADT on 40th West. This is a repeat comment.

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

1. Subgrade Support

We anticipate that the subgrade will consist of clay. We have assumed a California Bearing Ratio (CBR) value of 3 percent which assumes a clay subgrade. We estimate that there is a potential for approximately 1 inch of settlement if the underlying soil below the pavement becomes wet.

2. Pavement Thickness

Based on the subsurface soil conditions, anticipated 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 pavement section consisting of 3 inches of asphaltic concrete overlying 6 inches of base course is calculated. Alternatively, a Portland cement concrete pavement section consisting of 5 inches of Portland cement concrete may be used.

Granular borrow may be needed to facilitate pavement construction where the subgrade consists of clay and becomes very moist to wet as discussed in the Subgrade Preparation section of the report.

3. Pavement Materials and Construction

a. Flexible Pavement (Asphaltic Concrete)

The pavement materials should meet the material specifications for the applicable jurisdiction. 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 design assumes that a concrete shoulder or curb will be placed at the edge of the pavement and that the concrete will have aggregate interlock joints.

The pavement materials should meet the material specifications for the applicable jurisdiction. The pavement thicknesses indicated above assume 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 borings drilled and 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 exploration or excavation is conducted. If the subsurface soil or groundwater conditions are found to be significantly different from those described above, we should be notified to reevaluate the recommendations given.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

Jay R. McQuivey, P.E.

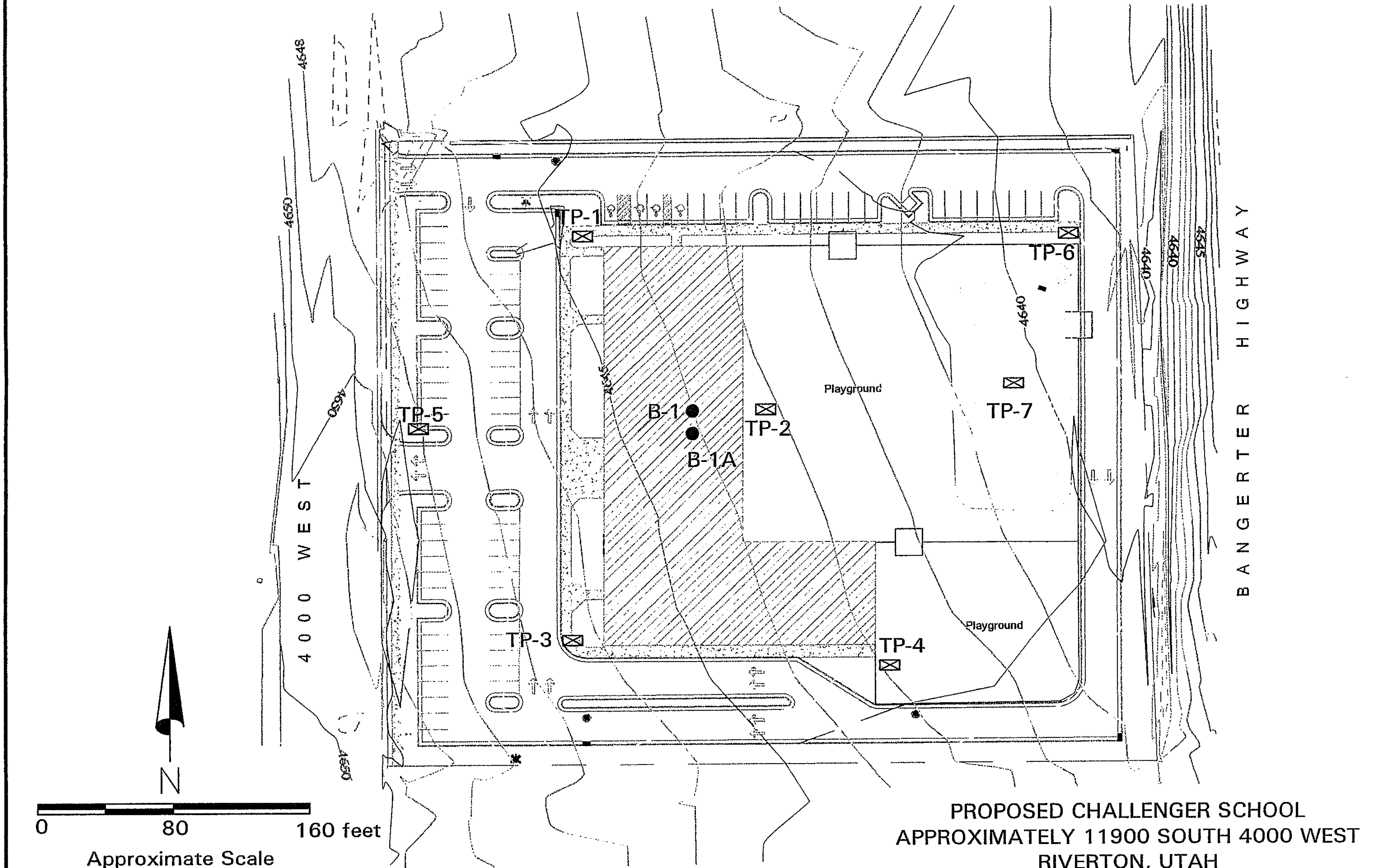
Reviewed by Douglas R. Hawkes, P.E., P.G.

JRM/dc

REFERENCES

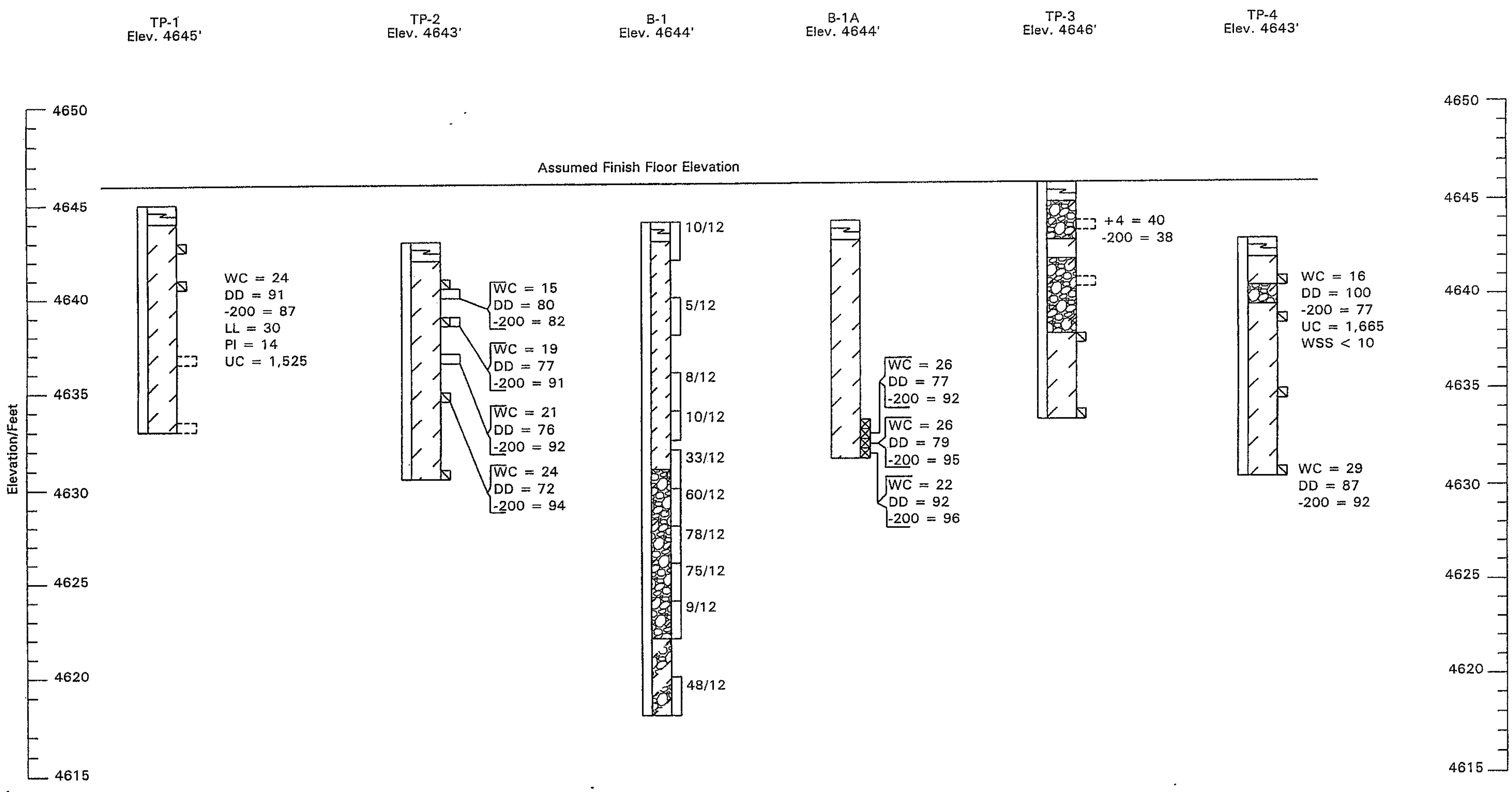
International Building Code, 2006; International Code Council, Inc., Falls Church, Virginia.

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 CHALLENGER SCHOOL
APPROXIMATELY 11900 SOUTH 4000 WEST
RIVERTON, UTAH

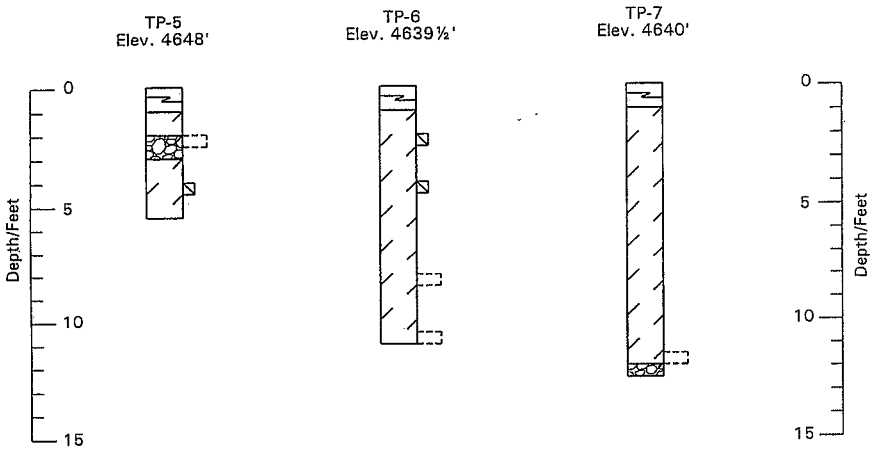
1071011	AGEC	Locations of Test Pits and Borings	Figure 1



Approximate Vertical Scale 1" = 8'

See Figure 3 for Legend and Notes

1071011	AGEC	Logs of Test Pits and Borings	Figure 2



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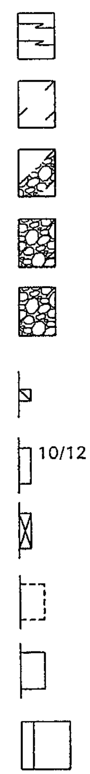

Topsoil; lean clay with sand, slightly moist to moist, brown, roots and organics.

Lean Clay (CL); small to moderate amount of sand, slightly porous, medium stiff to stiff, moist to very moist, gray.

Clayey Gravel with Sand and Lean Clay (GC/CL); interlayered, dense, stiff, very moist, brown to reddish brown.

Clayey Gravel with Sand (GC); medium dense, moist, brown.

Poorly-Graded Gravel with Clay and Sand (GP-GC); possible cobbles, dense, moist, brown.

Indicates relatively undisturbed hand drive sample taken.

California Drive sample taken. The symbol 10/12 indicates that 10 blows from a 140 pound automatic hammer falling 30 inches were required to drive the sampler 12 inches.

Indicates Shelby tube sample taken.

Indicates disturbed sample taken.

Indicates relatively undisturbed block sample taken.

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

NOTES:

1. Test pits were excavated on August 20 and September 23, 2007, with a rubber-tired backhoe. The borings were drilled on October 9, 2007, with a 8-inch hollowsteam auger.
2. Locations of test pits and borings were measured approximately by pacing from features shown on the site plan provided.
3. Elevations of test pits and borings were determined by interpolating between contours shown on the site plan provided.
4. The test pit and boring 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 and boring logs represent the approximate boundaries between material types and the transitions may be gradual.
6. No free water was encountered in the test pits or borings at the time of excavation/ drilling.
7. WC = Water Content (%);
   DD = Dry Density (pcf);
   -200 = Percent Passing No. 200 Sieve;
   LL = Liquid Limit (%);
   PI = Plasticity Index (%);
   UC = Unconfined Compressive Strength (psf);
   WSS = Water Soluble Sulfates (ppm).

Approximate Vertical Scale 1" = 8'

1071011	AGEC	Logs of Test Pits and Legend and Notes of Test Pits and Borings	Figure 3

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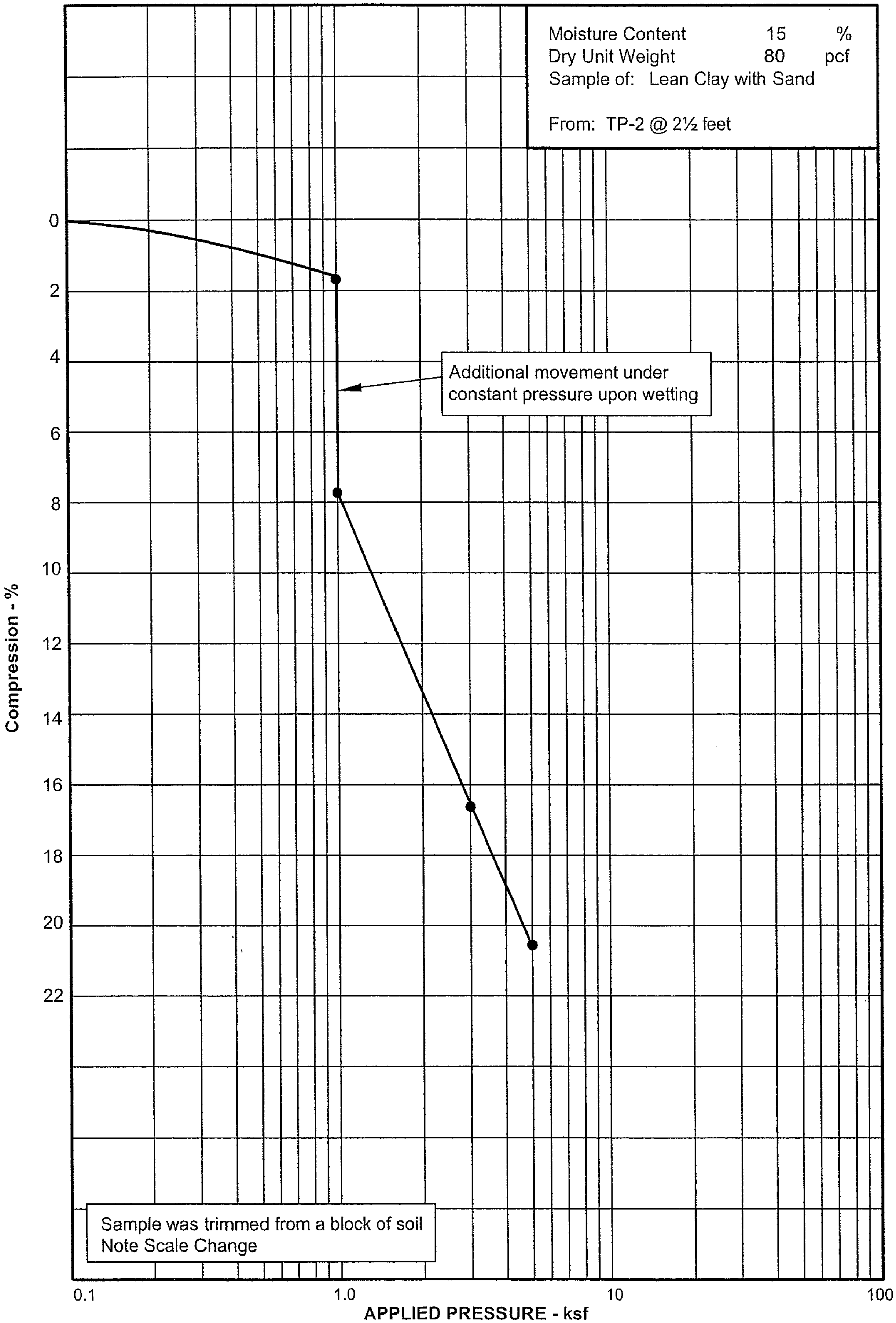
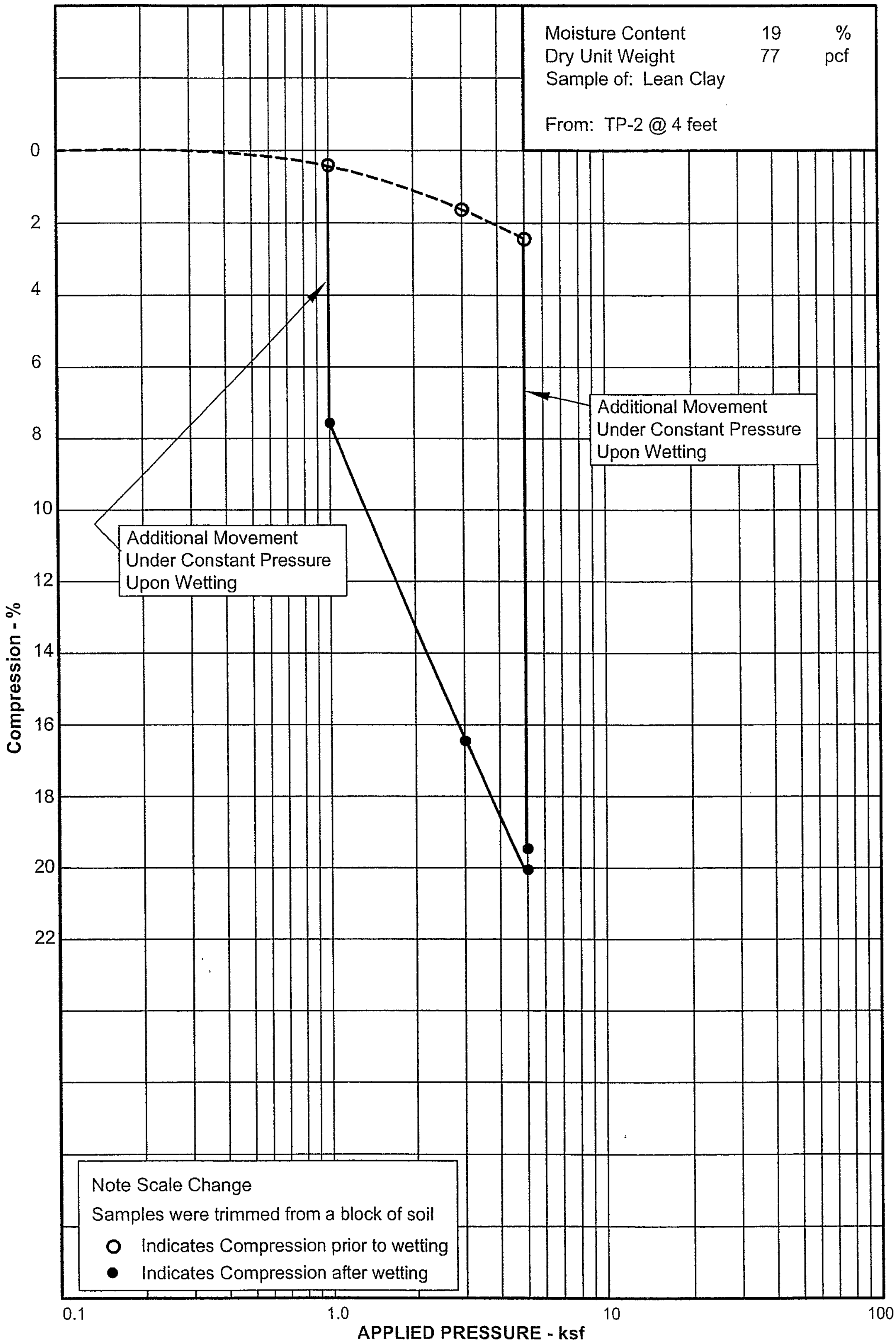


Project No. 1071011 **CONSOLIDATION TEST RESULTS** **Figure 4**

Applied Geotechnical Engineering Consultants, Inc.



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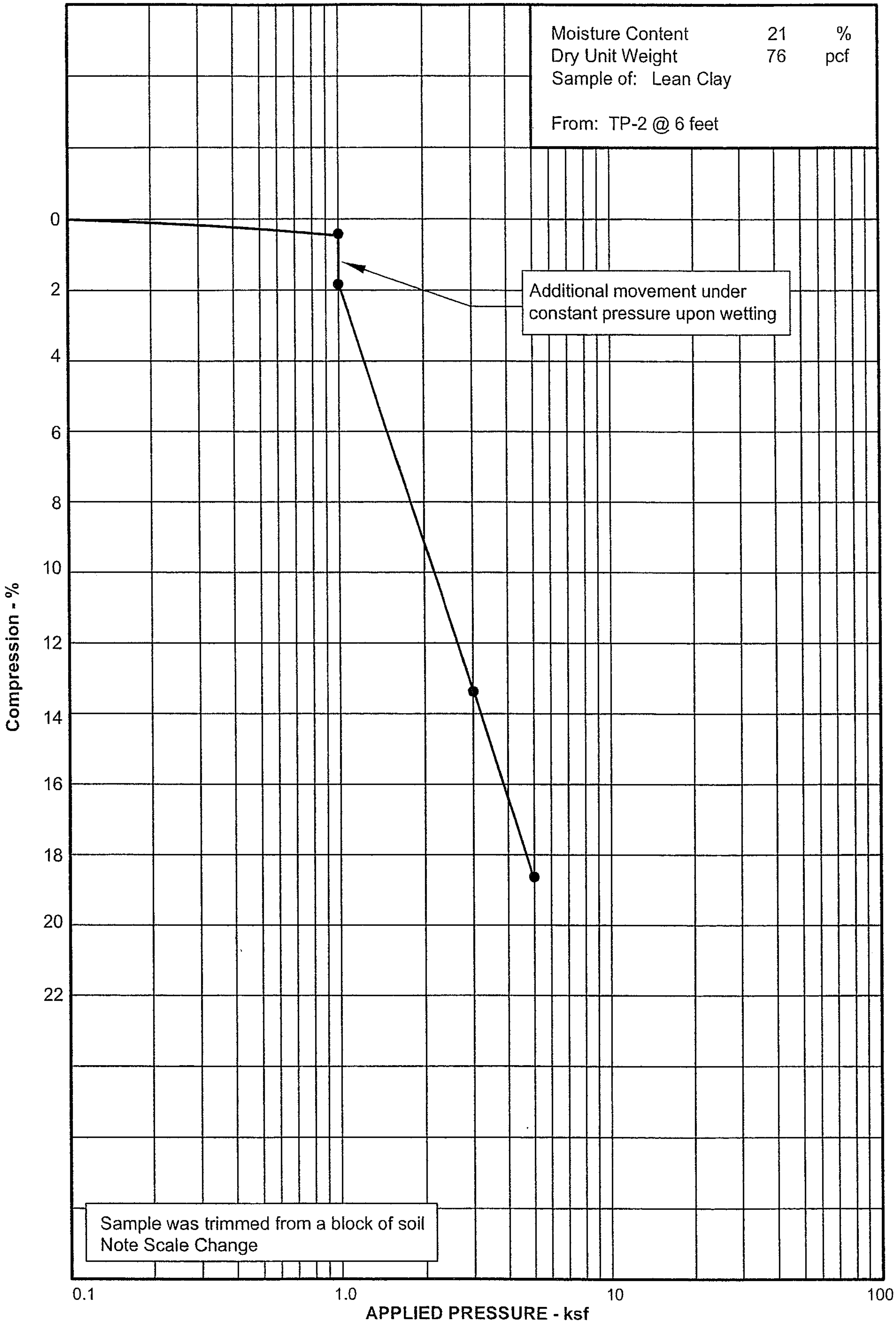

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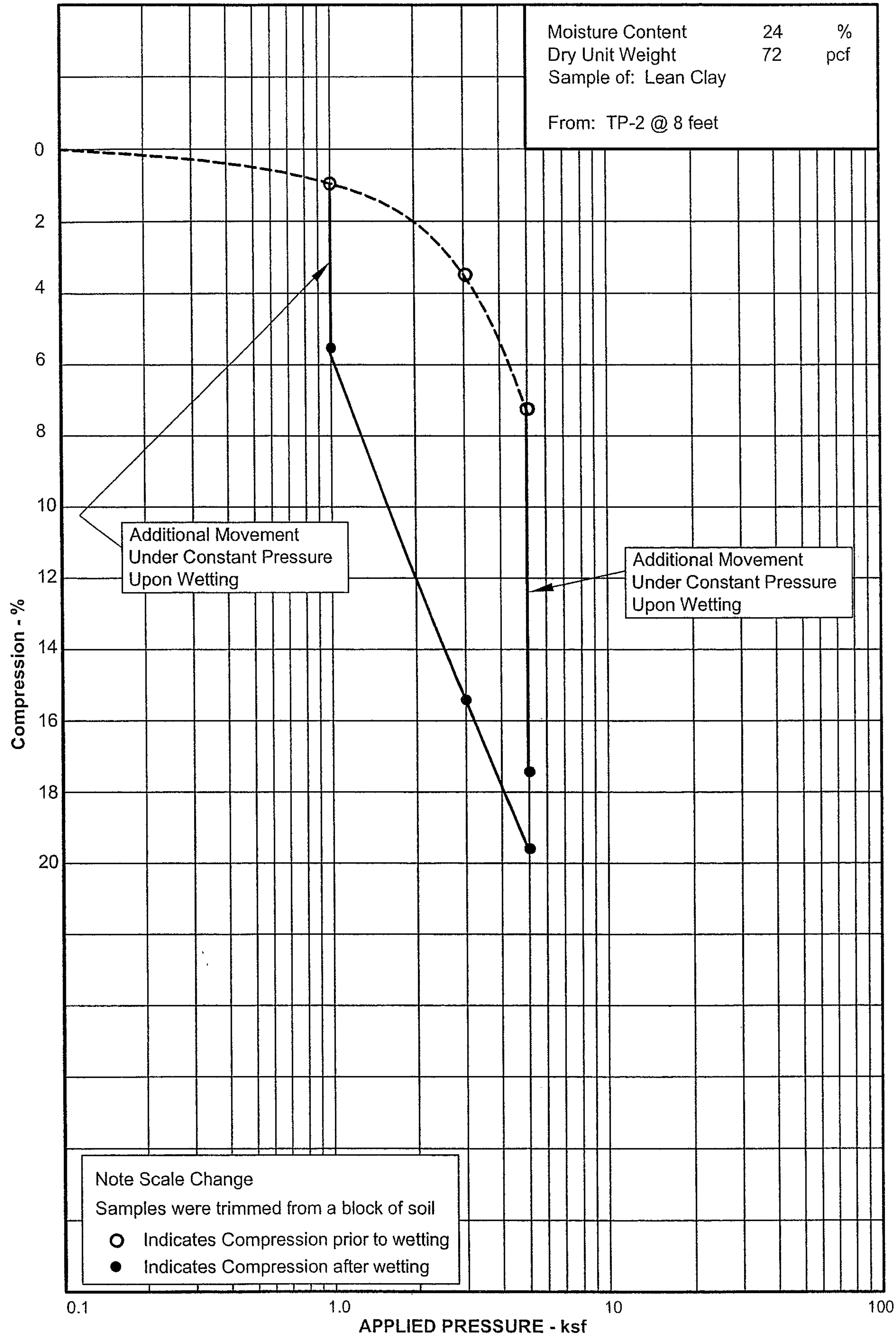
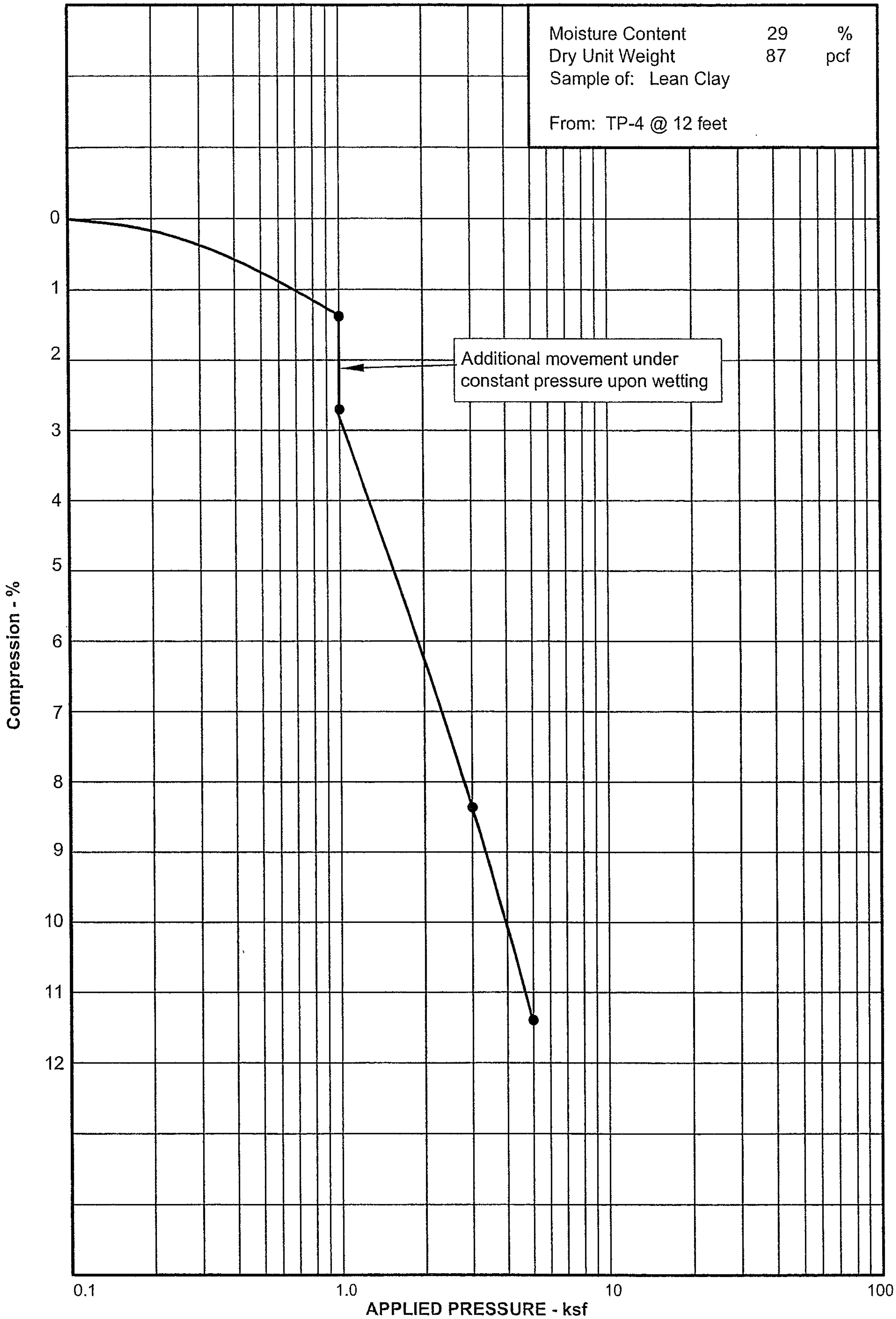


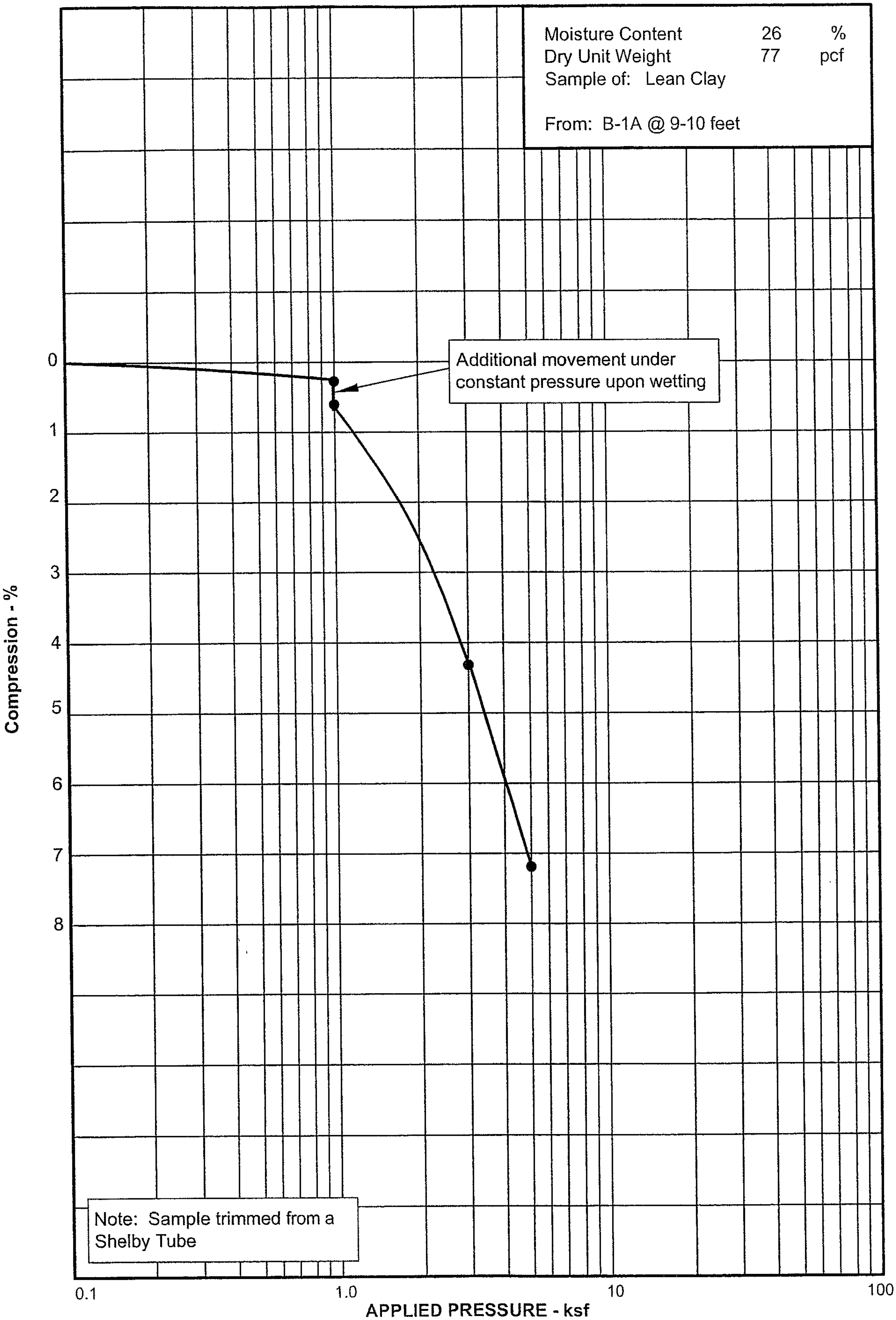
Project No. 1071011 **CONSOLIDATION TEST RESULTS** **Figure 7**

Applied Geotechnical Engineering Consultants, Inc.



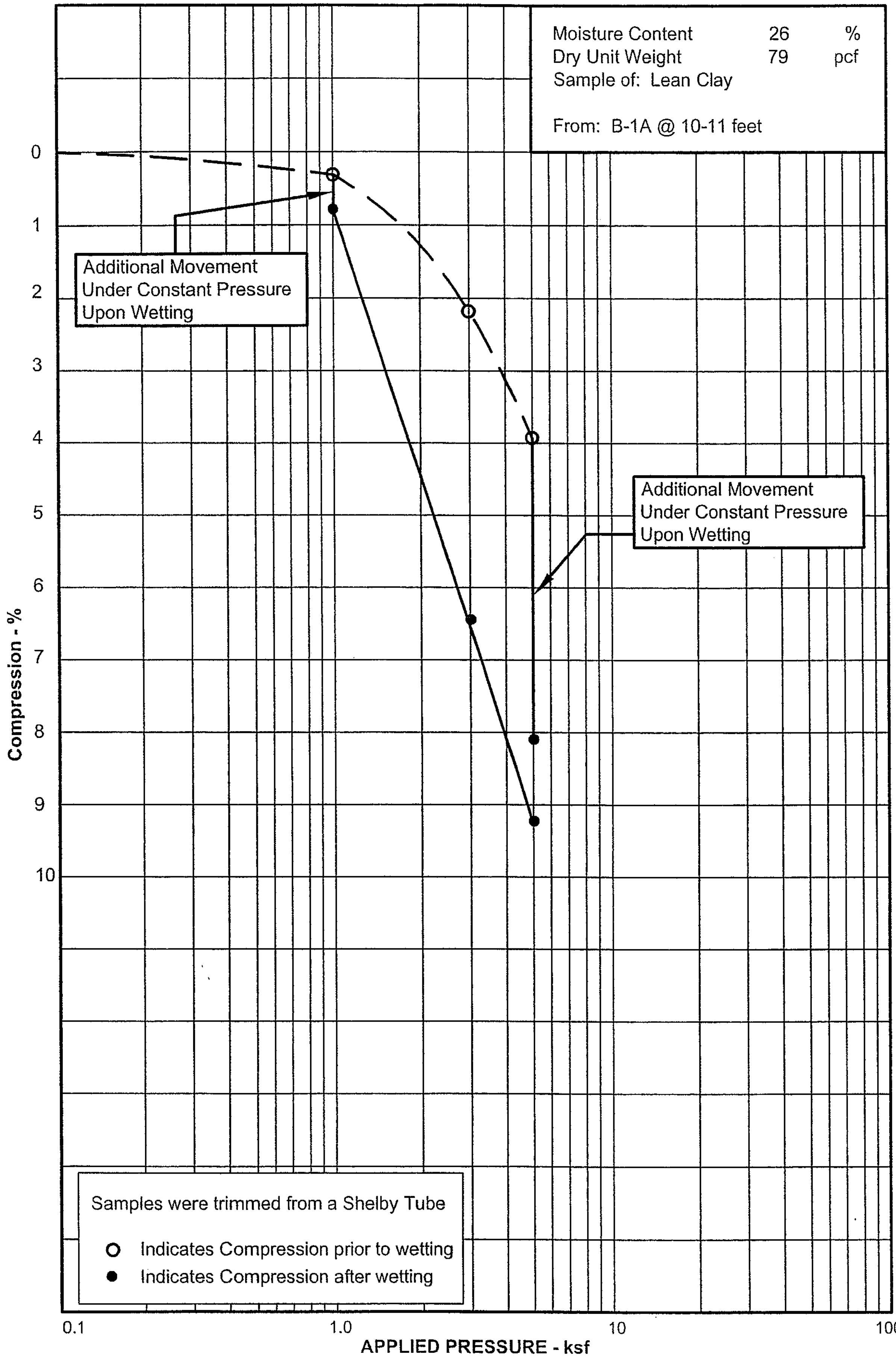
Project No. 1071011 **CONSOLIDATION TEST RESULTS** **Figure 8**

Applied Geotechnical Engineering Consultants, Inc.



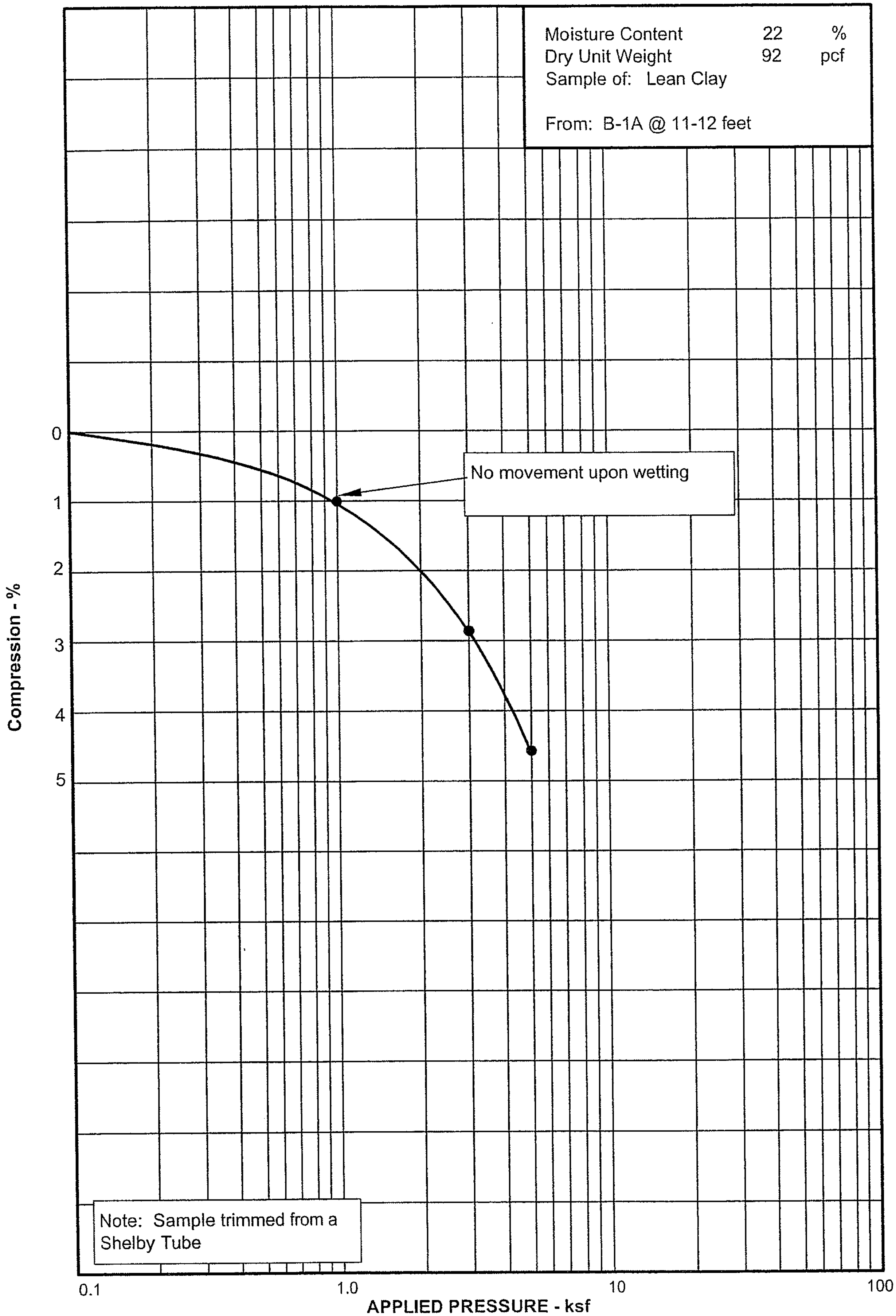
Project No. 1071011 CONSOLIDATION TEST RESULTS Figure 9

Applied Geotechnical Engineering Consultants, Inc.



Project No. 1071011 CONSOLIDATION TEST RESULTS Figure 10

Applied Geotechnical Engineering Consultants, Inc.



Project No. 1071011 CONSOLIDATION TEST RESULTS Figure 11

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER 1071011

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (PCF)	GRADATION			ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	WATER SOLUBLE SULFATE (ppm)	SAMPLE CLASSIFICATION
BORING/ TEST PIT	DEPTH (FEET)			GRAVEL (%)	SAND (%)	SILT/ CLAY (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)			
TP-1	4	24	91			87	30	14	1,525		Lean Clay
TP-2	2½	15	80			82					Lean Clay with Sand
	4	19	77			91					Lean Clay
	6	21	76			92					Lean Clay
	8	24	72			94					Lean Clay
B-1A	9-10	26	77			92					Lean Clay
	10-11	26	79			95					Lean Clay
	11-12	22	92			96					Lean Clay
TP-3	2			40	22	38					Clayey Gravel with Sand
TP-4	2	16	100			77			1,665	<10	Lean Clay with Sand
	12	29	87			92					Lean Clay