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GEOTECHNICAL STUDY
ILIFF'S COLLEGE TOWNHOMES
31ST STREET AND VANBUREN
OGDEN, UTAH

PREPARED FOR:

CACHE-LANDMARK ENGINEERING
666 NORTH MAIN STREET, SUITE 303
LOGAN, UT 84321

ETE JOB NO.: 03E-113

MARCH 14, 2003

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TABLES

1.0 INTRODUCTION

We understand that a townhome development is planned for a parcel of land located at approximately 31st Street and Van Buren Ave. in Ogden, Utah as shown on the Vicinity Map, Figure 1.

This study was made to assist in evaluating the subsurface conditions and engineering characteristics of the foundation soils and in developing our opinions and recommendations concerning appropriate foundation types, floor slabs, and pavements. This report presents the results of our geotechnical investigation including field exploration, laboratory testing, engineering analysis, and our opinions and recommendations. Data from the study is summarized on Figures 3 through 11 and Table 2.

2.0 CONCLUSIONS

1. Based upon the five test holes drilled for this study, the native soils at the site generally consist of medium stiff to stiff lean clay (CL) with lenses and layers of loose to medium dense silt with sand (ML) and silty sand (SM) extending beyond the maximum depth investigated of 46 ½ feet. It appears the site has been graded in the past and uncontrolled fill was found on the northeast corner. We expect fill encountered will range from nominal to as deep as 50 feet. Groundwater was encountered at depths of 6 to 7 feet below existing site grades on the southeast portion of the site, at ground surface on the western side of the property and at 35 feet on the northwest portion.

2. The structures may be supported with lightly loaded spread footings founded on native, undisturbed soils where dry conditions are encountered at footing level. Where wet conditions are encountered at footing level, the footings should be overexcavated by at least 18 inches and underlain by a crushed gravel fill. A maximum allowable bearing capacity of 1700 psf should be used for footing design.

3. Due to shallow groundwater and the possibility of perched groundwater areas at this site, basements where floors are more than 3 feet below existing site grades should have foundation drains installed. The drain recommendations are presented in Section 13.0.

4. Pavements should consist of 3 inches of asphalt and 9 inches of untreated aggregate base placed on proof-rolled native subgrade.

3.0 PROPOSED CONSTRUCTION

We understand that the planned development will consist of attached townhomes with associated access roads. The structures will be two stories in height with walkout basements set into the slopes. For design purposes, it was assumed that wall loads of the structures would be on the order of 3 to 4 klf. For pavement design, we assumed a Daily Traffic Number (equivalent 18-k loading) of 5 which is a typical traffic load for residential non-collector streets. If wall loads or traffic conditions are different than those assumed, we should be notified and allowed to reevaluate our recommendations.

4.0 SITE CONDITIONS

The subject site is an irregularly shaped parcel of undeveloped land. The site is primarily vegetated with grasses and weeds but supports pockets of trees particularly along the east boundary. The topography undulates but in general the site had a downward grade to the southwest. Uncontrolled fill has been placed east of the property and west of Brinker Avenue. At the east property line, the existing ground drops sharply to the west, dropping about 10 to 25 feet with slope grades of 30 to 70 percent. The property then slopes down to the southwest with an overall grade of about 8 percent. The northeast corner of the property has been graded in the past with the south edge of the grade (approximately 125 feet south of north property line) being about 6 feet above the grade of the adjacent Brinker Avenue. We estimate fill on this graded section could be up to 15 feet deep. A large ravine runs from east to the west across the north portion of the property just north of the extension of 31st Street. The east end of the ravine has been filled with uncontrolled fill containing large concrete pieces and other debris. We estimate this fill to be 30 to 40 feet deep. A road grade, which is an extension of 31st Street, has been constructed south of the large ravine with fills estimated up to 10 feet deep. A small drainage ditch is located south of this road grade had a small flow at the time of the investigation. There is a drainage pipe at the head of this small ditch and a spring area was identified about 100 feet east of Van Buren Avenue. Water was ponding at the base of this drainage adjacent to Van Buren Avenue. Another small drainage ditch is located on the south side of the property and was flowing a small amount of water at the time of this study. This drainage ditch had a drain pipe at the head and it appears a small flowing spring is also located at that point. The ditch terminates at about the location of the proposed intersection of Healy Drive and Van Buren Avenue. At this point a small water pond had developed. There are fill piles, some containing significant debris, throughout the property.

The site is bound by residential homes and apartments to the north and south; a small commercial building to the northeast, undeveloped land and a larger commercial building (former Smiths Food King) to the east; and apartments to the west. The structures in the area appear to generally be performing satisfactorily from a foundation viewpoint, based upon a limited exterior visual inspection. Several poorly designed retaining walls in the neighborhood are bulging and/or collapsing.

5.0 FIELD INVESTIGATION

The field investigation consisted of drilling five test holes to depths of between 11 and 46 ½ feet below current site grades at the approximate locations shown on Figure 2. The soils encountered at the site were continuously logged by the undersigned engineer. Undisturbed and disturbed samples were obtained and returned to our laboratory for testing. Test hole TH-1 was terminated at 11 feet due to drill refusal on a large rock or piece of concrete.

6.0 LABORATORY TESTING

The samples obtained during the field investigation were sealed and returned to our laboratory where each one was inspected to select representative samples for laboratory testing. Laboratory tests included natural moisture and density determinations, consolidation tests, Atterberg Limits tests, Torvane shear, and grain size distribution analyses. The results of these tests are shown on Figures 3 through 11 and in Table 2, attached.

Samples will be retained in our Ogden laboratory for 30 days following the date of this report at which time they will be disposed of unless a written request for additional holding time is received prior to the disposal date.

7.0 SUBSURFACE CONDITIONS

Based upon the five test holes drilled for this study, the native soils at the site generally consist of medium stiff to stiff lean clay (CL) with lenses and layers of loose to medium dense silt with sand (ML) and silty sand (SM) extending beyond the maximum depth investigated of 46 ½ feet. It appears the site has been graded in the past and uncontrolled fill was found on the northeast corner which exceeded 11 feet in depth, in the ravine on the northeast potion of the site which could reach 40 feet deep and in isolated areas at the center and south sides of the site that are expected to 3 to 10 feet deep. There may also be pockets that have been filled in the past which are not viable at this time.

Groundwater was encountered at depths of 6 to 7 feet below existing site grades on the southeast portion of the site, at the ground surface on the western side of the property and at 35 feet below grade on the northwest portion. Graphical representations of the soil and groundwater conditions encountered are shown on the Drill Hole Logs, Figures 3 through 7. A key to the symbols used on the drill hole logs is shown on Figure 8.

8.0 SITE GRADING

8.1 General Site Grading

Topsoil, man-made fill, and soils loosened by construction activities should be removed (stripped) from building pads, pavement areas, and concrete flatwork areas prior to foundation excavation and placement of site grading fills. Following stripping and any additional excavation required to achieve design grades, the subgrade should be proof rolled to a firm, non-yielding surface. Soft areas detected during the proof-rolling operation, should be removed and replaced with structural fill. If the soft soils extend more than 18 inches deep, stabilization may be considered. The use of stabilization should be approved by the geotechnical engineer and would likely consist of over excavating the area by at least 18 inches, placing a geofabric, such as Mirafi 600X, at the bottom of the excavation over which a stabilizing fill consisting of angular coarse gravel with cobbles is placed up to the design subgrade.

8.2 Structural Fill and Compaction

All fill placed below the buildings, pavements, and concrete flatwork should be structural fill. All other fills should be considered as backfill. Structural fill should be imported to the site and consist of well-graded sandy gravels with a maximum particle size of 3 inches and 5 to 15 percent fines (materials passing the No. 200 sieve). The liquid limit of the fines should not exceed 35 and the plasticity index should be below 15. Where fill is placed in wet conditions the structural fill material may be replaced with a crushed 2-inch minus, clean gravel. All fill soils should be free from topsoils, highly organic material, frozen soil, and other deleterious materials. Structural fill should be placed in maximum 8-inch thick loose lifts at a moisture content within 2 percent of optimum and compacted to at least 95 percent of maximum density (ASTM D 1557) under the buildings and 90 percent under pavements and concrete flatwork. Where clean crushed gravel is used no specific density is required but it should be placed in maximum 12 inch thick lifts with each lift consolidated by 4 passes of an approved vibratory plate compactor. The clean gravel fill should be underlain by a geofabric such as Mirafi 600X, or equivalent.

8.3 Backfill

The native soils may be used as backfill in utility trenches and against outside foundation walls. Backfill should be placed in lift heights suitable to the compaction equipment used and compacted to at least 90 percent of the maximum dry density(ASTM D 1557). Soils removed below water level should not be used as backfill unless it is dried back to a moisture content which will allow the recommended compaction.

8.4 Excavations

Temporary construction excavations at the site which are less than five feet deep should have slopes no steeper than ½ to1 (horizontal to vertical). All excavations which are advanced deeper than five feet below site grades should be sloped or braced in accordance with OSHA[1] Health and Safety Standards for type C soils.

9.0 SEISMIC CONSIDERATIONS

9.1 Faulting

Based on published data, no active faults are known to traverse the site and no faulting was indicated during our field investigation. The nearest known active fault is the Wasatch Fault which is located about two miles east of the property[2].

9.2 Seismic Design Criteria

The structures should be designed in accordance with IRC[3] building codes. Based on section R301.2.2 of the IRC, this site is in a general area classified as a Site Class E.

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[1] Occupational Safety and Health Administration, "Occupational Safety and Health Standards - Excavations" Final Rule, 29 CFR part 1926.

[2] Utah Geologic Survey, Selected Critical Facilities and Geologic Hazards, Davis County, Utah

[3] International Residential Code 2000

9.3 Liquefaction

Liquefaction is a phenomenon where soils lose their intergranular strength due to an increase of pore pressures during a dynamic event such as an earthquake. The potential for liquefaction is based on several factors, including 1) the grain size distribution of the soil, 2) the plasticity of the fine fraction of the soil (material passing the No. 200 sieve), 3) relative density of the soil, 4) earthquake strength (magnitude) and duration, and 5) overburden pressures. In addition, the soils must be near saturated for liquefaction to occur. According to the Utah Geologic Survey liquefaction map, this site is in an area classified as having low to moderate potential for liquefaction[2]. Our investigation showed that the majority of the site soils are clays which have a low potential for liquefaction. Some of the sand lenses could liquefy which would cause some additional settlement and lateral spreading if a strong, long duration earthquake event occurred.

10.0 FOUNDATIONS

10.1 Footing Design

The structures at this site may be supported with lightly loaded spread footings bearing directly on the native, undisturbed soils where dry conditions are encountered in the footing excavations. Where wet conditions are encountered at footing level, we recommend supporting the structures with spread footings founded on at least 18 inches of properly placed, angular gravel fill. The recommendations presented below should be utilized during design and construction of this project:

1. Spread footings founded on firm native soils or 18 inches of properly placed angular gravel fill should be designed for a maximum allowable soil bearing capacity of 1700 psf. A one-third increase is allowed for short term transient loads such as wind and seismic events. Footings should be uniformly loaded.

2. Continuous footings should have minimum widths of 20 inches.

3. Exterior footings should be placed below frost depth which is determined by local building codes. Generally 30 inches is adequate in this area. Interior footings, not subject to frost, should extend at least 18 inches below the lowest adjacent grade.

4. Foundation walls on continuous footings should be well reinforced both top and bottom. We suggest a minimum amount of steel equivalent to that required for a simply supported span of 12 feet.

5. The bottom of footing excavations should be cleaned to remove soils loosened during foundation excavation. The bottom of the excavation should be test rolled with non-vibratory equipment (i.e. static compactor, backhoe or trackhoe bucket) to identify soft spots. If soft areas are encountered, they should be stabilized as recommended in Section 8.1.

6. Footing excavations should be observed by the geotechnical engineer prior to placement of structural fill and construction of footings to evaluate whether suitable bearing soils have been exposed and verify that excavation bottoms are free of loose or disturbed soils.

10.2 Estimated Settlement

If footings are designed and constructed in accordance with the recommendations presented above, the risk of total settlement exceeding 1 inch and differential settlement exceeding 0.5 inch for a 25-foot span will be low. Additional settlement should be expected during a strong seismic event.

11.0 LATERAL EARTH PRESSURES

Resistance to lateral loads (including those due to wind or seismic loads) on foundations may be achieved by frictional resistance between the foundations and underlying soils, and by passive earth pressures of backfill soils placed against the sides of foundations. Retaining walls and below grade walls acting as soil retaining structures should be designed to resist pressures induced by the backfill soils.

The lateral pressures imposed on a retaining structure are dependant on the rigidity of the structure and its ability to resist rotation. Retaining walls which are free to rotate slightly, develop an active lateral soil pressure condition. Structures that are not allowed to rotate or move laterally, such as subgrade basement walls, develop an at-rest lateral earth pressure condition. Lateral pressures applied to structures may be computed by multiplying the vertical depth of backfill material by the appropriate equivalent fluid density. Any surcharge loads in excess of the soil weight applied to the backfill should be multiplied by the appropriate lateral pressure coefficient and added to the soil pressure. The lateral pressures presented in Table 1, *Lateral Earth Pressures* below, are based on drained, horizontally placed soils as backfill material. For computing lateral forces we recommend the following equivalent fluid densities:

Table 1: Lateral Earth Pressures

Condition	Static Lateral Pressure Coefficient	Static Equivalent Fluid Pressure (pcf)
Active	0.36	43
At-Rest	0.55	66
Passive	2.77	305

The friction acting along the base of foundations may be computed by using a coefficient of friction of 0.25 for the native soils. These values may be increased by one-third for transient wind and seismic loads.

The values presented above are based on drained conditions and are ultimate, therefore, an appropriate factor of safety (minimum of 2.0) should be applied to these values for design purposes.

12.0 FLOOR SLABS

The native soils below floor slabs should be proof rolled and a minimum 4 inch thick layer of free-draining gravel should be placed immediately below the floor slab to help distribute floor loads, break the rise of capillary water, and aid in the concrete curing process. If the floor is a basement floor which is deeper than 3 feet below existing site grade or where wet conditions are encountered within 3 feet of the floor level, the gravel should be thickened to a minimum of 10 inches, and provisions provided to allow drainage to a free gravity outfall. For slab design, we recommend a modulus of subgrade reaction of 100 psi/in be used. To help control normal shrinkage and stress cracking, the floor slabs should have adequate reinforcement for the anticipated floor loads with the reinforcement continuous through interior floor joints and frequent crack control joints.

Special precautions should be taken during placement and curing of concrete slabs and flatwork. Excessive slump (high water-cement ratios) of the concrete and/or improper finishing and curing procedures used during hot or cold weather conditions may lead to excessive shrinkage, cracking, spalling, or curling of slabs. We recommend all concrete placement and curing operations be performed in accordance with American Concrete Institute (ACI) codes and practices.

13.0 SUBSURFACE DRAINAGE

13.1 Foundation and Basement Drains

For basements to be constructed within this subdivision with floor slab elevations deeper than 3 feet below existing site grades, foundation drains should be installed. Underfloor drains should be installed whenever wet conditions are encountered within 3 feet of the floor level during construction (as discussed in Section 12). The recommendations presented below should be followed during design and construction of basements in the development:

1. The foundation drain should consist of a 4 inch diameter, slotted pipe encased in at least 12 inches of free draining gravel. The gravel should extend up the foundation wall to within 2 feet of the final ground surface and a filter fabric should separate the gravel from the native soils. The pipe should be graded to drain to a storm drain or other free gravity outfall unless provisions for pumped sumps are made. Gravel extending up the walls may be replaced by a fabricated drain panel such as Mirafi Micro drain or equivalent.

2. The highest point of the 4 inch perforated pipe within the foundation drain should be placed at least 8 inches below the floor slab. The pipe should be graded to drain (minimum 2 percent grade) to a storm sewer or other free gravity outlet.

3. To facilitate basement drainage, clean gravel placed below the basement floor slabs which are more than 3 feet below existing grades should be at least 10 inches thick.

4. Connections through the foundation should be made between the subfloor gravel and the foundation drain. The connections should be made in such a way to allow any water collected below the floor slabs to gravity flow to the foundation drains.

5. Clean outs should be installed so that the foundation drains may be cleaned as necessary.

13.2 Area Drains

As discussed in Section 4.0 of this report there are two springs and two areas where water ponding has developed on this site. We recommend that these areas be mitigated by placing at least 3 feet of drain gravel below final grade. A slotted 4 inch diameter perforated pipe should be installed in each area to collect the water and channel it to a storm drain or other free gravity outlet.

13.3 General Drain Maintenance

Drain operation is contingent upon proper drain construction and maintenance. Drains should be periodically inspected to verify that drains are clear of blockages and operating as envisioned.

14.0 SURFACE DRAINAGE

Wetting of the foundation soils will likely cause some degree of volume change within the soil and should be prevented both during and after construction. We recommend that the following precautions be taken at this site:

1. The ground surface should be graded to drain away from the structures in all directions. We recommend a minimum fall of 8 inches in the first 10 feet.
2. Roof runoff should be collected in rain gutters with down spouts designed to discharge well outside of the backfill limits.
3. Sprinkler heads, should be aimed away and kept at least 12 inches from foundation walls.
4. Provide adequate compaction of foundation backfill i.e. a minimum of 90% of ASTM D 1557. Water consolidation methods should not be used.
5. Other precautions which may become evident during design and construction should be taken.

15.0 PAVEMENTS

We understand that a flexible pavement is desired for the residential access roads in this development. Unless a more stringent local code is required, we recommend a pavement section consisting of 3 inches of asphaltic concrete over 9 inches of untreated aggregate road base. The pavement design recommendations were developed using an estimated CBR value of 3%, the PAS computer program which uses the AASHTO 1993 design method, and the following assumptions:

1. The subgrade is proof rolled to a firm non-yielding condition and soft areas are stabilized, as discussed in Section 8.1;
2. Grading fills below the pavements meet imported structural fill material and placement requirements as defined in Section 8.2 of this report;
3. Asphaltic concrete and aggregate base meet UDOT specification requirements;
4. Aggregate base is compacted to at least 95 percent of maximum dry density (ASTM D 1557);
5. Asphaltic concrete is compacted to at least 95 percent of the laboratory Marshal mix design density (ASTM D 1559);
6. Traffic loads are typical for residential traffic as discussed in Section 3.0 of this report; and
7. Pavement design life of 20 years.

16.0 GENERAL CONDITIONS

The exploratory data presented in this report were collected to provide geotechnical design recommendations for this project. Test holes were widely spaced and may not be indicative of subsurface conditions between the test holes or outside the study area and thus have limited value in depicting subsurface conditions for contractor bidding. If it is necessary to define subsurface conditions in sufficient detail to allow accurate bidding we recommend an additional study be conducted which is designed for that purpose.

Variations from the conditions portrayed in the test pits often occur which are sometimes sufficient to require modifications in the design. If during construction, conditions are found to be different than those presented in this report, please advise us so that the appropriate modifications can be made. An experienced geotechnical engineer or technician should observe fill placement and conduct testing as required to confirm the use of proper structural fill materials and placement procedures.

The geotechnical study as presented in this report was conducted within the limits prescribed by our client, with the usual thoroughness and competence of the engineering profession in the area. No other warranty or representation, either expressed or implied, is intended in our proposals, contracts or reports.

We appreciate the opportunity of providing our services on this project. If we can answer questions or be of further service, please call.

Respectfully;
EARTHTEC ENGINEERING, P.C.

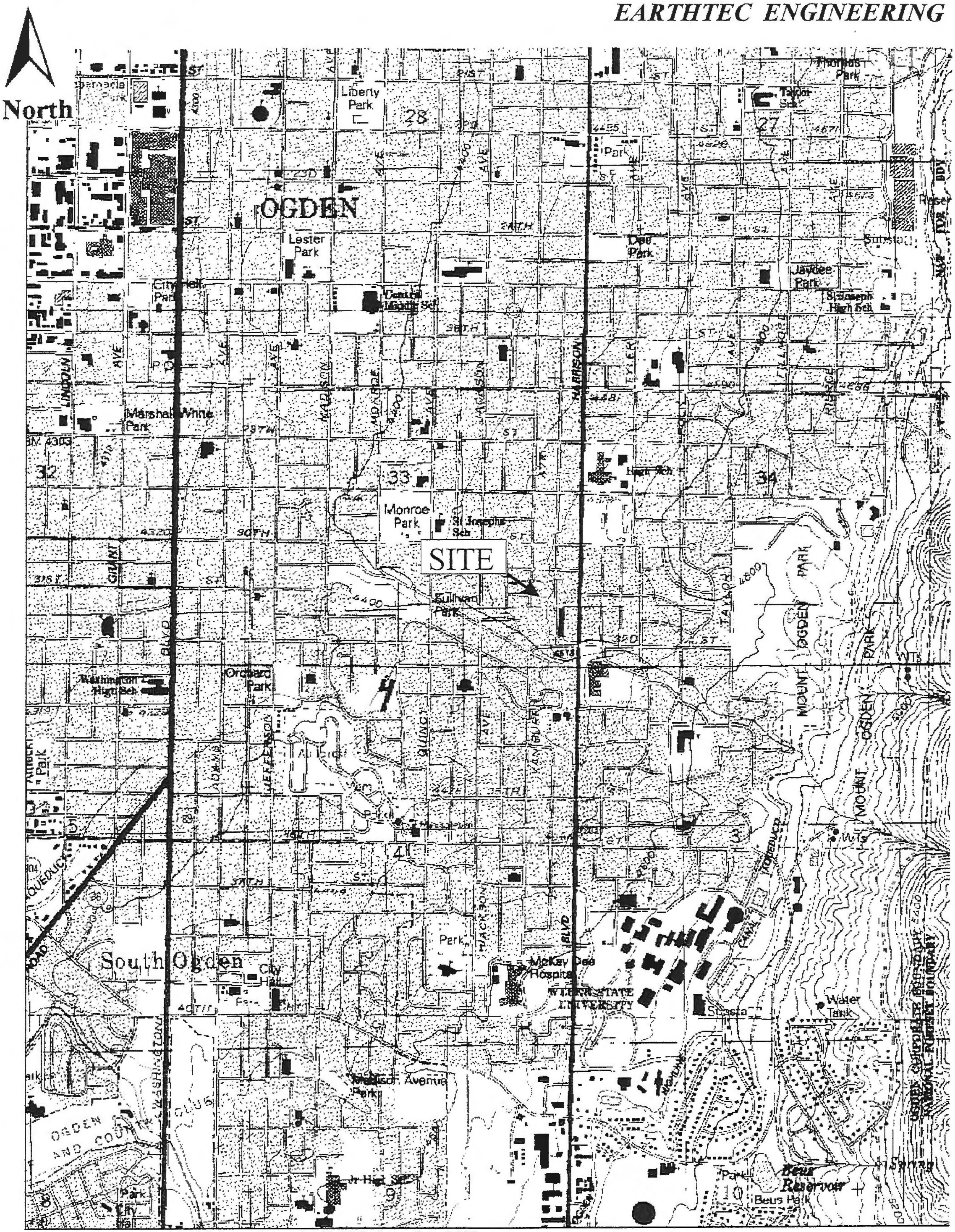
REGISTERED PROFESSIONAL ENGINEER
168431
ROBERT E.
BARTON
3-14-03
STATE OF UTAH

Robert E. Barton, P.E.
Principal Geotechnical Engineer

2 copies sent

1cc: Ogden City - John Mayer

EARTHTEC ENGINEERING

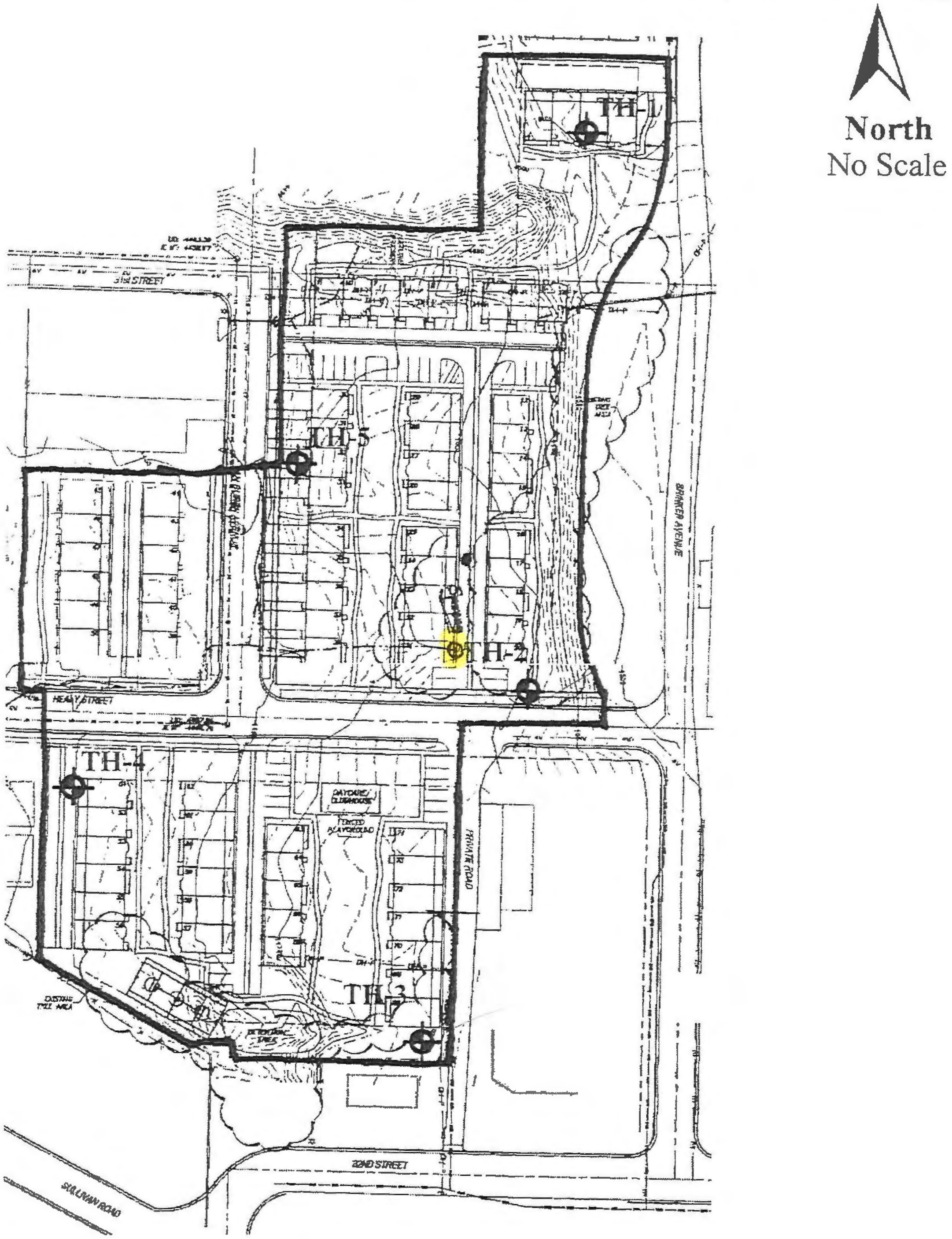


3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS

693 ft Scale: 1 : 24,000 Detail: 13-0 Datum: WGS84

ETE Job No. 03E-113 **VICINITY MAP** **Figure 1**

EARTHTEC ENGINEERING



BASE MAP PROVIDED BY
CACHE-LANDMARK
ENGINEERING

ETE Job No. 03E-113 **SITE PLAN** **Figure 2**

DRILL HOLE LOG

BORING NO.: TH-1

PROJECT: Townhome Project - Ogden
CLIENT: Cache-Landmark Engineers
LOCATION: See Figure 2
DRILLER: All Season's Drilling
DRILL RIG: CME-55
DEPTH TO WATER > INITIAL ▽ : none ft. **AT COMPLETION** ▼ :

PROJECT NO.: 03E-113
DATE: 3-4-03
ELEVATION: NM
LOGGED BY: Bruce Nielsen

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Blow Count	TEST RESULTS PL ├──┤ LL Water Con.- ● Blows - ▨ 10 20 30 40 50	Dry Dens. pcf	Water Cont. %	Gravel %	Sand %	Fines %	Torvane Cohesion (psf)	Other Tests
	▨	FILL	Fill; Silty Sand with Gravel - dense, slightly moist, dark brown	◩	68	▨ 68 →							
				◩	34	● ▨		4.5	15	47	38		
	▨	FILL	Fill; Silty Gravel with sand - dense, dry, medium brown	◩	45	▨							
10				◩	50	▨							
			Refusal at 11 feet on rock										
20													
30													
40													
50													
60													

Notes:

Tests Key:
A = Atterberg Limits
C = Consolidation
G = Gradation
DS = Direct Shear
SO = Solubility
UC = Unconf. Compress. Strength

PROJECT NO. 03E-113

EARTHTEC ENGINEERING, P.C.

FIGURE NO.: 3

DRILL HOLE LOG

BORING NO.: TH-2

PROJECT: Townhome Project - Ogden
CLIENT: Cache-Landmark Engineers
LOCATION: See Figure 2
DRILLER: All Season's Drilling
DRILL RIG: CME-55
DEPTH TO WATER > INITIAL ∇ : 7 ft. **AT COMPLETION** ▼ :

PROJECT NO.: 03E-113
DATE: 3-4-03
ELEVATION: NM
LOGGED BY: Bruce Nielsen

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Blow Count	TEST RESULTS: PL ├──┤ LL, Water Con.- ●, Blows - ▨ (10 20 30 40 50)	Dry Dens. pcf	Water Cont. %	Gravel %	Sand %	Fines %	Torvane Cohesion (psf)	Other Tests
	▨	CL	Lean Clay - medium stiff, slightly moist, reddish brown	◩	8	▨							
			moist below 5 feet	☐		├●┤	101.3	23.0	0	14	86		C
		ML ∇	Sandy Silt - medium stiff, moist, reddish brown	◩	8	▨							
10		ML	Sandy Silt - loose, wet, medium brown, iron oxide staining	◩	9	▨ ●		26.4	0	15	85		
		SM	Silty Sand - loose, wet, gray	◩	6	▨							
20													
30													
40													
50													
60													

Notes:

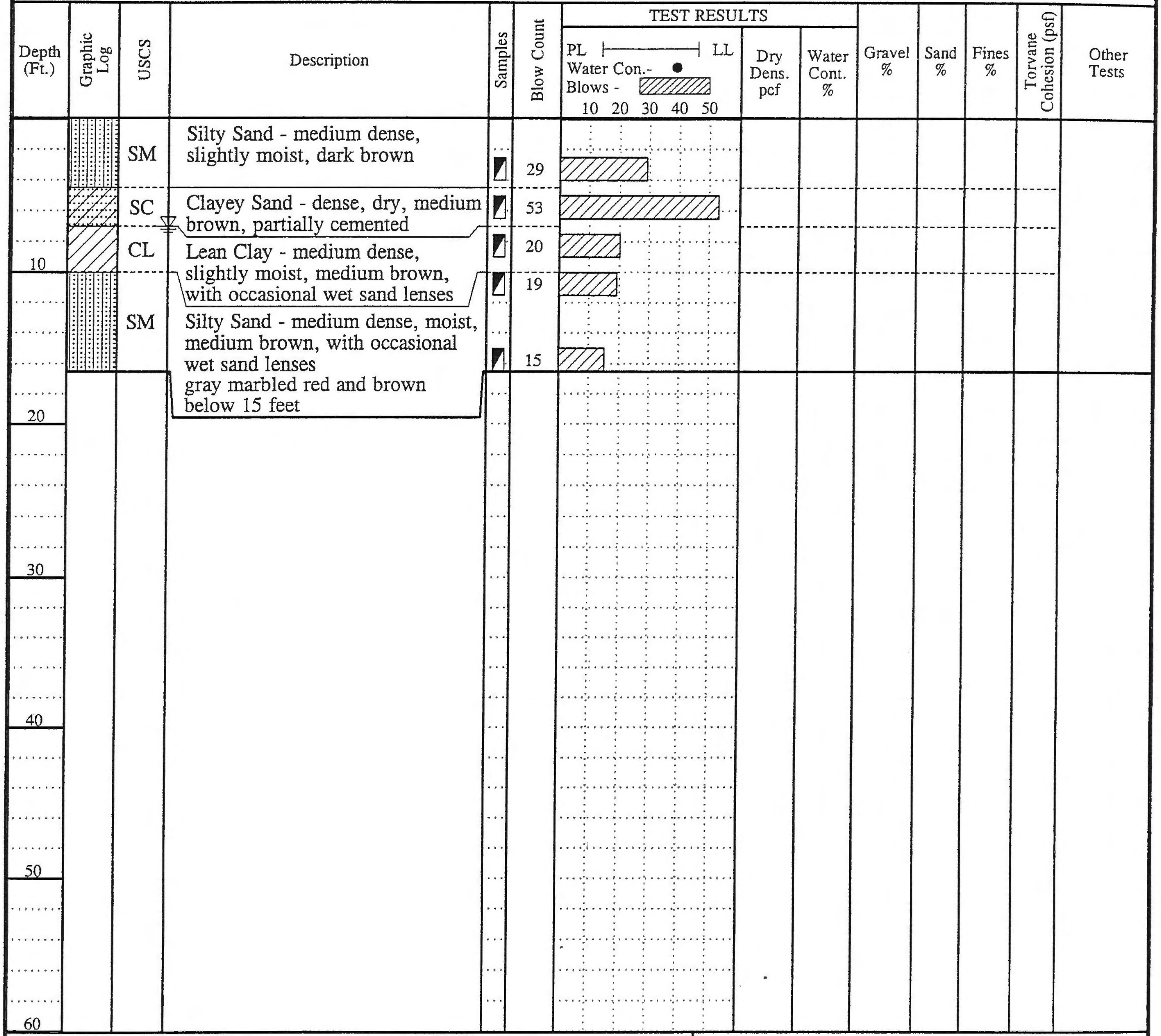
Tests Key:
A = Atterberg Limits
C = Consolidation
G = Gradation
DS = Direct Shear
SO = Solubility
UC = Unconf. Compress. Strength

DRILL HOLE LOG

BORING NO.: TH-3

PROJECT: Townhome Project - Ogden
CLIENT: Cache-Landmark Engineers
LOCATION: See Figure 2
DRILLER: All Season's Drilling
DRILL RIG: CME-55
DEPTH TO WATER> INITIAL ⊽ : 7 ft. **AT COMPLETION** ▼ :

PROJECT NO.: 03E-113
DATE: 3-4-03
ELEVATION: NM
LOGGED BY: Bruce Nielsen



SM — Silty Sand - medium dense, slightly moist, dark brown

SC — Clayey Sand - dense, dry, medium brown, partially cemented

CL — Lean Clay - medium dense, slightly moist, medium brown, with occasional wet sand lenses

SM — Silty Sand - medium dense, moist, medium brown, with occasional wet sand lenses gray marbled red and brown below 15 feet

Notes:

Tests Key:
A = Atterberg Limits
C = Consolidation
G = Gradation
DS = Direct Shear
SO = Solubility
UC = Unconf. Compress. Strength

DRILL HOLE LOG

BORING NO.: TH-4

PROJECT: Townhome Project - Ogden
CLIENT: Cache-Landmark Engineers
LOCATION: See Figure 2
DRILLER: All Season's Drilling
DRILL RIG: CME-55

PROJECT NO.: 03E-113
DATE: 3-4-03
ELEVATION: NM
LOGGED BY: Bruce Nielsen

DEPTH TO WATER > INITIAL ▽ : none ft. **AT COMPLETION** ▼ :

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Blow Count	TEST RESULTS: PL ├──┤ LL, Water Con.- ●, Blows - ▨ (10 20 30 40 50)	Dry Dens. pcf	Water Cont. %	Gravel %	Sand %	Fines %	Torvane Cohesion (psf)	Other Tests
	▨	CL	Lean Clay - medium dense, slightly moist, light brown	☐ ◩	12	▨							
10	▨	CL	Lean Clay - very stiff, moist, gray marbled red and brown	☐ ◩	16	●├─┤ ▨	102.0	22.2	0	0	100		C
			stiff and medium brown below 15 feet	◩	13	▨							
20													
30													
40													
50													
60													

Notes:

Tests Key:
A = Atterberg Limits
C = Consolidation
G = Gradation
DS = Direct Shear
SO = Solubility
UC = Unconf. Compress. Strength

DRILL HOLE LOG

BORING NO.: TH-5

PROJECT: Townhome Project - Ogden
CLIENT: Cache-Landmark Engineers
LOCATION: See Figure 2
DRILLER: All Season's Drilling
DRILL RIG: CME-55
DEPTH TO WATER> INITIAL ▽ : 35 ft. **AT COMPLETION** ▼ : 0

PROJECT NO.: 03E-113
DATE: 3-4-03
ELEVATION: NM
LOGGED BY: Bruce Nielsen

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Blow Count	TEST RESULTS: PL ⊢⊣ LL, Water Con.- ●, Blows - ▨ (10 20 30 40 50)	Dry Dens. pcf	Water Cont. %	Gravel %	Sand %	Fines %	Torvane Cohesion (psf)	Other Tests
	▨	CL	Lean Clay - medium stiff, slightly moist, red brown	◪	8	▨							
	▨		marbled gray with occasional sand lenses below 5 feet	☐ ◪	10	●⊢⊣ ▨	103.3	22.2	0	10	90		C
10	▨		stiff, red brown with occasional sand lenses below 10 feet	☐									
	▨		very stiff, red brown marbed brown and gray with frequent sand lenses below 15 feet	◪	17	▨							
20	▨		stiff, brown marbled gray with frequent sand and silt seams below 20 feet	◪	14	▨							
	▨	CL	Sandy Clay - medium stiff, slightly moist, gray	◪	7	▨							
30	▨		stiff and moist below 30 feet	◪	10	▨							
	▨	▽	medium stiff and wet below 35 feet	◪	7	▨							
40	▨			◪	8	▨							
	▨		stiff below 45 feet	◪	9	▨							
50													
60													

Notes:

Tests Key:
A = Atterberg Limits
C = Consolidation
G = Gradation
DS = Direct Shear
SO = Solubility
UC = Unconf. Compress. Strength

PROJECT NO. 03E-113 | EARTHTEC ENGINEERING, P.C. | **FIGURE NO.: 7**

KEY TO SYMBOLS USED ON DRILL HOLE LOGS

Symbol	Description

Strata symbols

▩	Fill
▨	Low plasticity clay
▥	Silt
▥	Silty sand
▨	Clayey sand

Misc. Symbols

▽	Water table during drilling
▼	Water table at boring completion

Soil Samplers

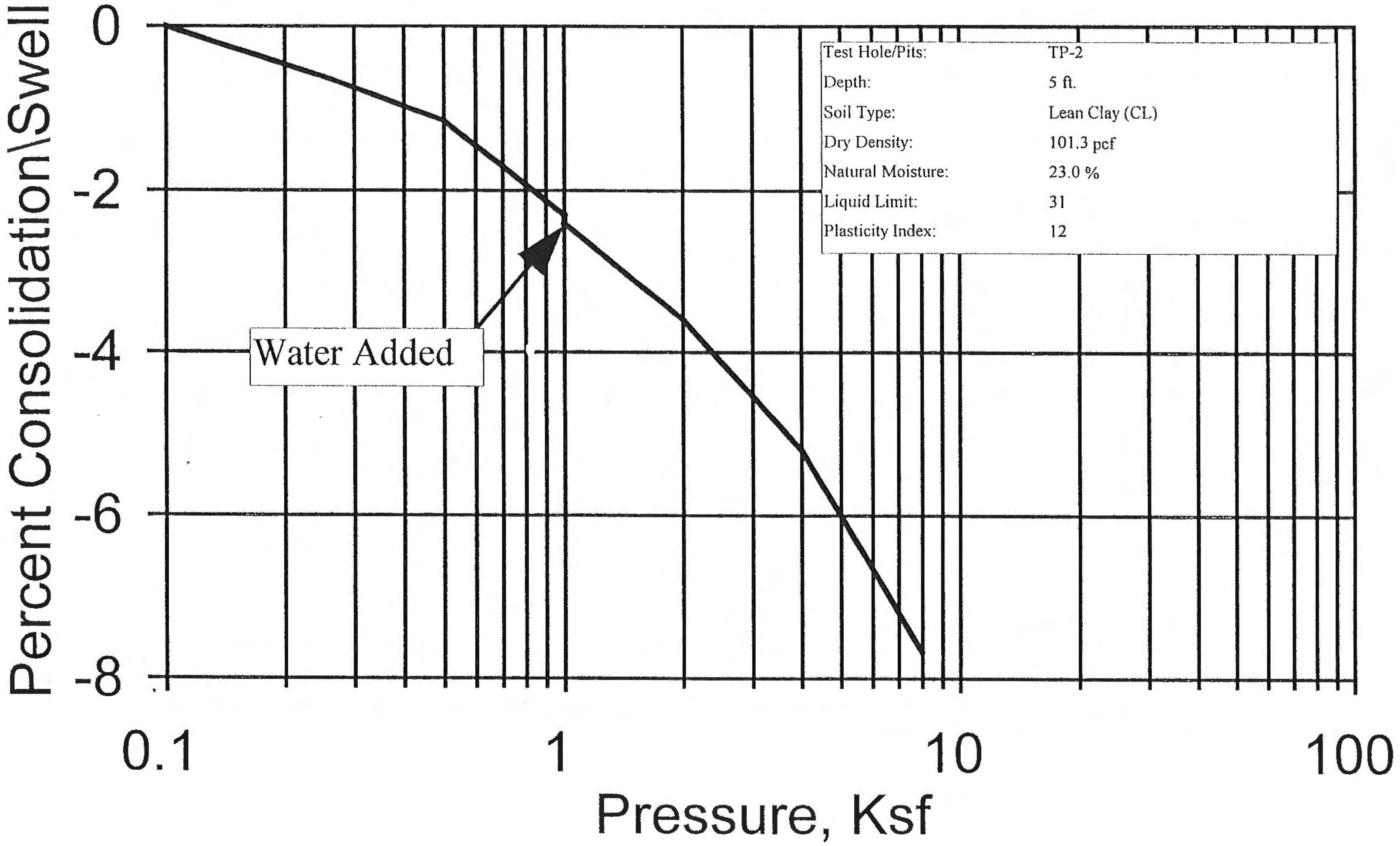
◩	Standard penetration test
▯	Undisturbed thin wall Shelby tube

Notes:

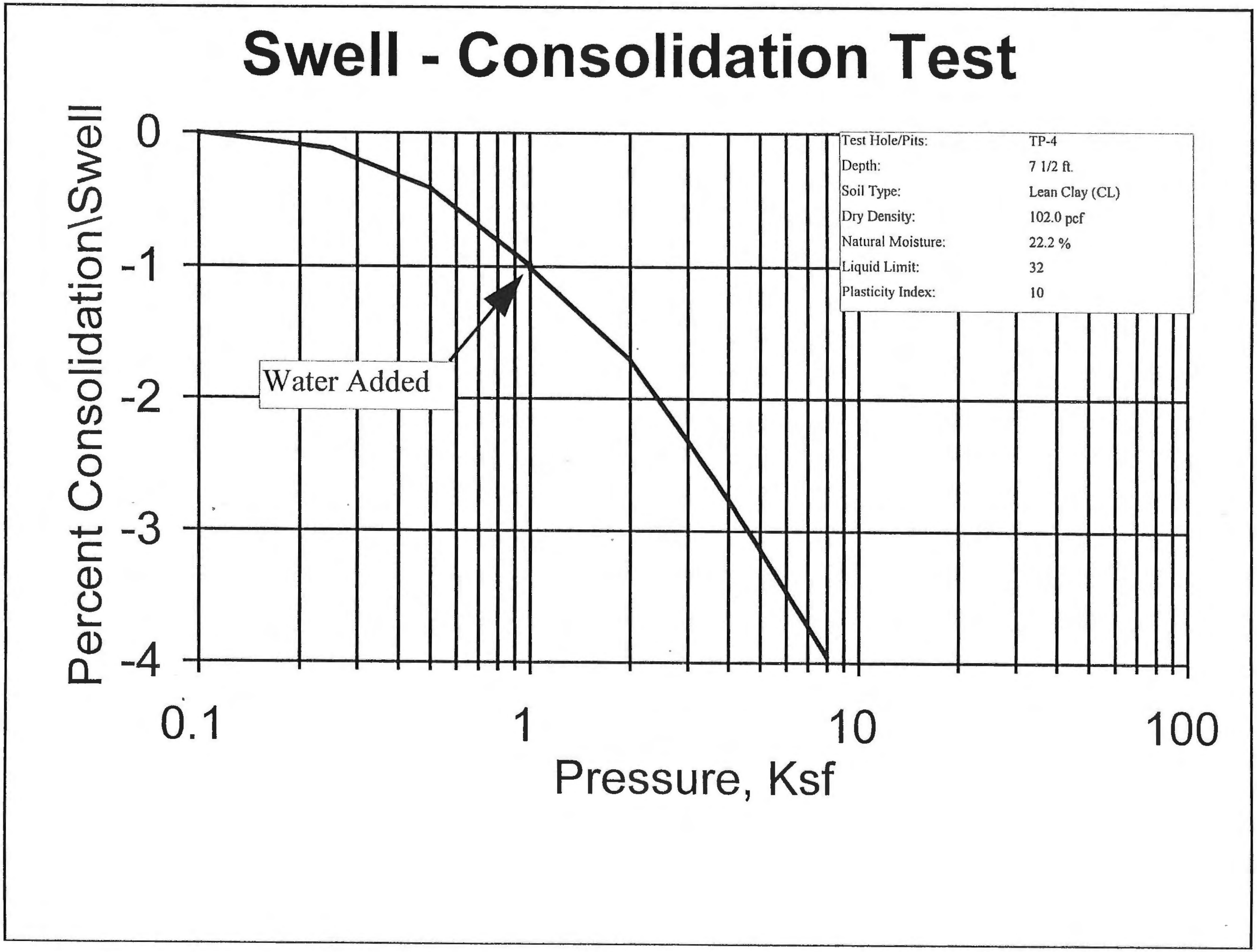
1. Exploratory borings were drilled on March 4, 2003 using a 6-inch diameter hollow stem auger powered by a CME-55 truck mounted drill rig.
2. Free water was encountered at the time of this investigation and measurements are shown on the logs.
3. Hole locations were estimated from existing features shown on the site plan provided for this project.
4. These logs are subject to the limitations, conclusions, and recommendations presented in this report.
5. Results of laboratory tests conducted on samples recovered are reported on the logs and in Table 1.

PROJECT NO. 03E-113	EARTHTEC ENGINEERING	FIGURE NO.: 8

Swell - Consolidation Test



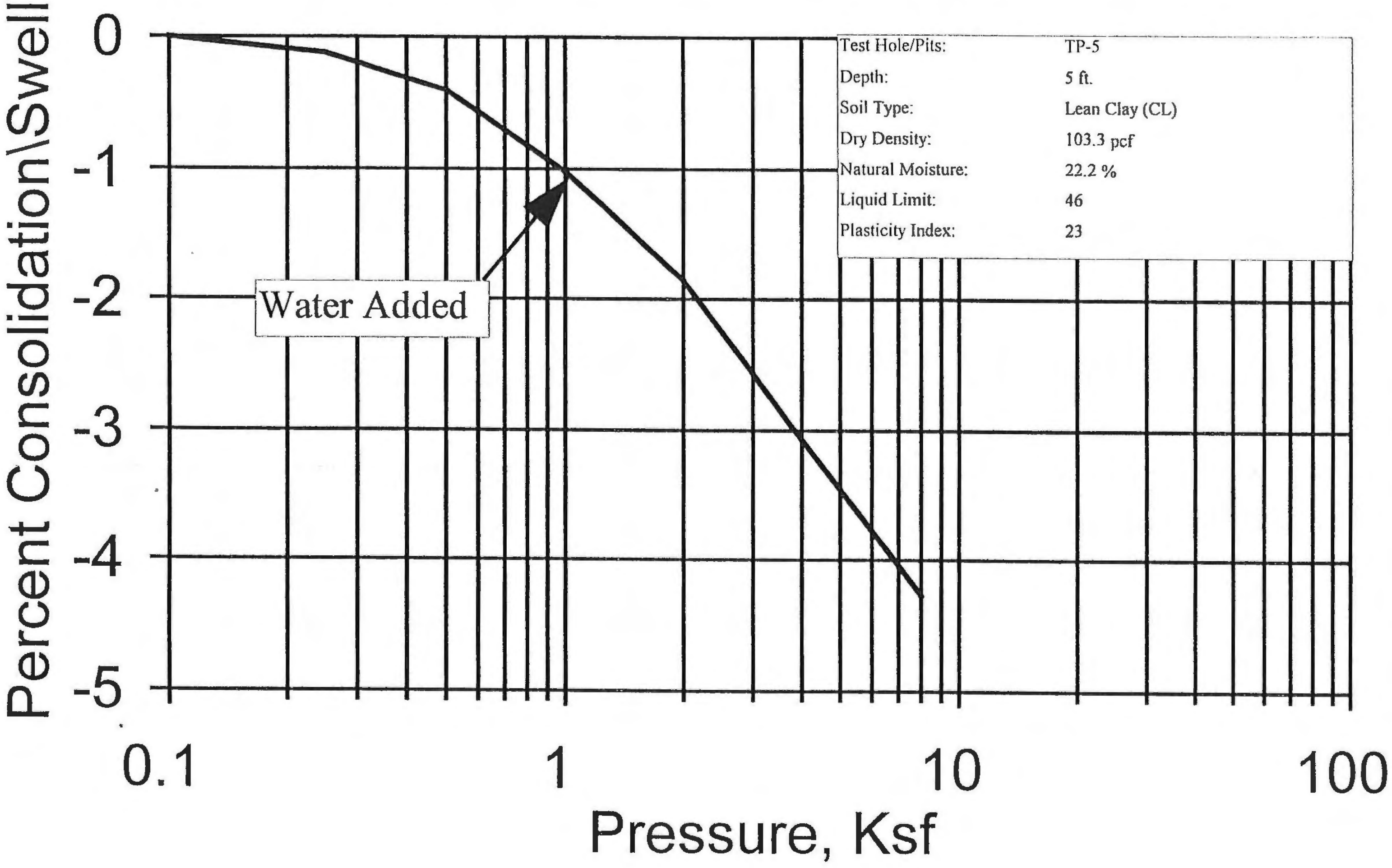
Test Hole/Pits:	TP-2
Depth:	5 ft.
Soil Type:	Lean Clay (CL)
Dry Density:	101.3 pcf
Natural Moisture:	23.0 %
Liquid Limit:	31
Plasticity Index:	12



Test Hole/Pits:	TP-4
Depth:	7 1/2 ft.
Soil Type:	Lean Clay (CL)
Dry Density:	102.0 pcf
Natural Moisture:	22.2 %
Liquid Limit:	32
Plasticity Index:	10

Figure 10

Swell - Consolidation Test



Test Hole/Pits:	TP-5
Depth:	5 ft.
Soil Type:	Lean Clay (CL)
Dry Density:	103.3 pcf
Natural Moisture:	22.2 %
Liquid Limit:	46
Plasticity Index:	23

Figure 11

TABLE 2
SUMMARY OF LABORATORY DATA

Iliff's Collage Townhomes **ETE Project No. 03E-113**

TEST HOLE	DEPTH (FT)	DENSIT (PCF)	MOISTURE (%)	(%) GRADATION			ATTERBERG LIMITS		TORVANE (PSF)	SOIL TYPE
				GRAVEL	SAND	SILT/CLA	LIQUID LIMIT	PI		
TH-1	5		4.5	15.0	46.8	38.2				Silty Sand w/ gravel (SM)
TH-2	5	101.3	23.0	0.0	14.0	86.0	31	12		Lean Clay (CL)
TH-2	10		26.4	0.0	14.7	85.3				Lean Clay (CL)
TH-4	7 1/2	102.0	22.2	0.0	0.0	100.0	32	10		Lean Clay (CL)
TH-5	5	103.3	22.2	0.0	10.2	89.8	46	23		Lean Clay (CL)