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GEOTECHNICAL STUDY

COTTAGES AT ~~BURROWS SUBDIVISION~~ WESTERN SPRINGS
APPROXIMATELY 12800 SOUTH SUNDAY DRIVE
RIVERTON, UTAH

Project No. 130664

June 19, 2013

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1.0 EXECUTIVE SUMMARY

This report presents the results of our geotechnical study for the proposed Burrows Subdivision located at approximately 12800 South Sunday Drive in Riverton, Utah. We understand that the proposed project, as currently planned, will consist of subdividing and constructing a residential subdivision with one- to two-story residential structures, along with a residential street to provide access to and utilities to services the residences.

For the field exploration, we excavated a total of nine (9) test pits to depths of approximately 11½ feet below the existing ground surface. Groundwater was not encountered within the depths explored. The subsurface soils encountered generally consisted of topsoil overlying alternating layers of Lean Clays (CL), Silts (ML), Sands (SM and SC) and Gravel (GP, GM, GP-GM, GP-GC). The topsoil should be removed beneath the entire building footprint, exterior flatwork and pavement areas prior to construction. The native clay soils have a negligible potential for moisture related movement under increased moisture contents and anticipated load conditions.

Based on the results of our field exploration, laboratory testing and engineering analyses, it is our opinion that the subject site is suitable for the proposed development, provided the recommendations presented herein are followed and implemented during design and construction. Conventional strip and spread footings may be used to support the structure, with foundations placed entirely on native gravel soils which extend a minimum of 18 inches below footing or entirely on 18 inches of properly placed and compacted structural fill extending to undisturbed native soils.

This executive summary provides a general synopsis of our recommendations. Details of our findings, conclusions and recommendations are provided within the body of this report. Failure to consult with Earthtec regarding any changes made during design and/or construction of the project from those discussed above in Section 3.0 relieves Earthtec from any liability arising from changed conditions at the site. We also strongly recommend that Earthtec observe the building excavations to verify the adequacy of our recommendations presented herein, and that Earthtec perform materials testing and special inspections for this project to provide consistency during construction.

2.0 INTRODUCTION

This report presents the results of our geotechnical study for the proposed Burrows Subdivision to be located at approximately 12800 South Sunday Drive in Riverton, Utah. The general location of the site is shown on Figure 1, *Vicinity Map*, at the end of this report.

The purposes of this study were to

- Evaluate the subsurface soil conditions at the site,
- Assess the engineering characteristics of the subsurface soils, and
- Provide geotechnical recommendations for general site grading and the design and construction of foundations, concrete floor slabs, miscellaneous concrete flatwork, and asphalt paved roads.

The scope of work completed for this study included field reconnaissance, subsurface exploration, field and laboratory soil testing, geotechnical engineering analysis, and the preparation of this report.

3.0 PROPOSED CONSTRUCTION

We understand that the proposed project consists of subdividing and constructing a residential subdivision on the roughly 20-acre parcel located at approximately 12800 South Sunday Drive in Riverton, Utah. We anticipate that the future homes will be conventionally framed and one to two stories in height. The homes will likely be founded on spread footings with the possibility of basements. We have based our recommendations in this report on the assumption that foundation loads for the proposed structures will not exceed 4,000 pounds per linear foot for bearing walls, 20,000 pounds for column loads, and 100 pounds per square foot for floor slabs. Asphalt paved residential streets will also be constructed to provide access to the residences. If structural loads will be greater our office should be notified so that we may review our recommendations and, if necessary, make modifications.

In addition to the construction described above, we anticipate that

- Utilities will be installed to service the proposed buildings,
- Exterior concrete flatwork will be placed in the form of curb, gutter, and sidewalks,
- And asphalt paved streets will be constructed.

4.0 GENERAL SITE DESCRIPTION

The subject property is located at approximately 12800 South Sunday Drive in Riverton, Utah. At the time of our subsurface exploration the site consisted of both developed and undeveloped parcels. The undeveloped portions of the site were vegetated with native grass and brush. The ground surface appeared to be relatively flat, thus we anticipate less than 3 feet of cut and fill may be required for site grading. Two residences and several outbuildings were observed in central and southwestern portions of the site. The lot was bounded on the north by developed residential sites, on the east by a concrete lined irrigation canal and agricultural fields, on the south by agricultural fields, and on the west by developed and undeveloped residential properties.

5.0 SUBSURFACE EXPLORATION

5.1 Soil Exploration

Under the direction of a qualified member of our geotechnical staff, subsurface explorations were conducted at the site on May 22, 2013 by excavating nine (9) exploratory test pits to depths of about 11½ feet below the existing ground surface using a track-mounted mini-excavator. The approximate locations of the test pits are shown on Figure 2, *Aerial Photograph Showing Locations of Test Pits*. Graphical representations and detailed descriptions of the soils encountered are shown on Figures 3 through 11, *Test Pit Log*, at the end of this report. The stratification lines shown on the logs represent the approximate boundary between soil units; the actual transition may be gradual. Due to potential natural variations inherent in soil deposits, care should be taken in interpolating between and extrapolating beyond exploration points. A key to the symbols and terms on the logs is presented on Figure 12, *Legend*.

Disturbed bag samples and relatively undisturbed block samples were collected at various depths in each test pit. The soil samples collected were classified by visual examination in the field following the guidelines of the Unified Soil Classification System (USCS). The samples were transported to our Orem, Utah laboratory where they will be retained for 30 days following the date of this report and then discarded, unless a written request for additional holding time is received prior to the 30 day limit.

6.0 LABORATORY TESTING

Representative soil samples collected during our field exploration were tested in the laboratory to assess pertinent engineering properties and to aid in refining field classifications, if needed. Tests performed included natural moisture content and dry density tests, liquid and plastic limits determinations, full gradation analyses, and one-dimensional consolidation tests. The following table summarizes the laboratory test results, which are also included on the attached test pit logs at the respective sample depths, on Figures 13 to 15, *Consolidation-Swell Test,* and on Figures 16 and 17, *Grain Size Distribution*

Table 1: Laboratory Test Results

Test Pit No.	Depth (ft.)	Natural Moisture (%)	Natural Dry Density (pcf)	Atterberg Limits		Grain Size Distribution (%)			Soil Type
				Liquid Limit	Plasticity Index	Gravel (+ #4)	Sand	Silt/Clay (- #200)	
TP-1	10	7	---	---	---	48	34	18	GM
TP-2	8	12	---	35	21	14	30	56	CL
TP-3	3	9	82	37	18	1	6	93	CL
TP-3	9	8	---	---	---	39	17	44	GM
TP-4	8	2	---	---	---	54	35	11	GP-GM
TP-5	7	4	---	---	---	57	33	10	GP-GM
TP-6	10	10	---	29	12	14	33	53	CL
TP-7	4	5	---	NP	NP	4	67	29	SM
TP-7	11	25	80	31	12	---	---	---	CL
TP-8	3	14	72	37	20	---	---	---	CL
TP-8	9	5	---	---	---	31	20	49	GM

* NP = Non-Plastic

As part of the consolidation test procedure, water was added to the samples to assess moisture sensitivity when the samples were loaded to an equivalent pressure of approximately 1,000 psf. This part of the consolidation test indicated a negligible potential (less than ½ percent) for moisture related movement (collapse), under increased moisture and load conditions. The clay soils tested also exhibited moderate to high compressibility.

7.0 SUBSURFACE CONDITIONS

7.1 Soil Types

On the surface of the site in most test pit locations, we encountered topsoil which we estimated to extend about 6 inches in depth. Below the topsoil we encountered alternating layers of Poorly Graded Gravel with sand (GP), Poorly Graded Gravel with silt and sand (GP-GM), Poorly Graded GRAVEL with clay (GP-GC), Silty Gravel (GM), Silty Sand (SM), Clayey Sand (SC), Silt (ML). Silty Sand (SM), and Clay (CL) extending to about 11½ feet below the existing ground surface. Based on our experience and observations during field exploration, the clay and silt soils visually ranged from medium stiff to hard in consistency and the sand and gravel soils visually had a relative density varying from medium dense to very dense. Consolidation test results indicate the clay soils are moderately to highly compressible and have a slight potential for moisture related movement.

7.2 Groundwater Conditions

Groundwater was not encountered during our field exploration to the maximum depths explored of approximately 11½ feet below the existing ground surface. Iron oxide staining, possibly indicating higher groundwater levels in the past were observed in test pits TP-1, TP-7, TP-8 and TP-9. Note that groundwater levels will fluctuate in response to the season, precipitation and snow melt, irrigation, and other on and off-site influences. Quantifying these fluctuations would require long term monitoring, which is beyond the scope of this study. The contractor should be prepared to dewater excavations as needed.

8.0 SITE GRADING

8.1 General Site Grading

All surface vegetation and unsuitable soils (such as topsoil, organic soils, undocumented fill, soft, loose, or disturbed native soils, and any other inapt materials) should be removed from below foundation, floor slab, and exterior concrete flatwork. Where topsoil was encountered on the surface of the site, we estimated to extend about 6 inches below the existing ground surface. The topsoil (including soil with roots larger than about ¼ inch in diameter) should be completely removed, even if found to extend deeper, along with any other unsuitable soils that may be encountered. Over-excavations below footings and slabs will also be needed, as discussed in Section 10.0.

Fill placed over large areas, even if only a few feet in depth, can cause consolidation in the underlying native soils resulting in settlement of the fill. Because the site is relatively flat, we anticipate that less than 3 feet of grading fill will be placed. If more than 3 feet of grading fill will be placed above the existing surface (to raise site grades), Earthtec should be notified so that we may assess potential settlement and make additional recommendations if needed. Such recommendations will likely include placing the fill several weeks (or possibly more) prior to construction to allow settlement to occur.

8.2 Temporary Excavations

Temporary excavations that are less than 4 feet in depth and above groundwater should have side slopes no steeper than ½H:1V (Horizontal:Vertical). Temporary excavations where water is encountered in the upper 4 feet or that extend deeper than 4 feet below site grades should be sloped or braced in accordance with OSHA[1] requirements for Type C soils.

8.3 Fill Material Composition

The native gravel soils encountered at Test Pit 1 (TP-1) at 10 feet and Test Pit 4 (TP-4) at 8 feet appear to be suitable for use as structural fill, provided it meets the requirements for structural fill. Excavated soils, including clays, may be stockpiled for use as fill in landscape areas.

Structural fill is defined as fill material that will ultimately be subjected to any kind of structural loading, such as those imposed by footings, floor slabs, pavement, etc. We recommend that a professional engineer or geologist verify that the structural fill to be used on this project meets our requirements, given below. We recommend that structural fill consist of imported or native sandy/gravelly soils meeting the following requirements:

Table 2: Structural Fill Recommendations

Sieve Size/Other	Percent Passing (by weight)
4 inches	100
3/4 inches	70 – 100
No. 4	40 – 80
No. 40	15 – 50
No. 200	0 – 20
Liquid Limit	35 maximum
Plasticity Index	15 maximum

In some situations, particles larger than 4 inches and/or more than 30 percent coarse gravel may be acceptable, but would likely make compaction more difficult and/or significantly reduce the possibility of successful compaction testing. Consequently, more strict quality

[1] OSHA Health And Safety Standards, Final Rule, CFR 29, part 1926.

control measures than normally used may be required, such as using thinner lifts and increased or full time observation of fill placement.

We recommend that utility trenches below any structural load be backfilled using structural fill. Note that most local governments and utility companies require Type A-1-a or A-1-b (AASHTO classification) soils (which overall is stricter than our recommendation for structural fill) be used as backfill above utilities in certain areas. In other areas or situations, utility trenches may be backfilled with the native soil, but the contractor should be aware that native clayey/silty soils (as observed in the explorations) may be time consuming to compact due to potential difficulties in controlling the moisture content needed to obtain optimum compaction. All backfill soil should have a maximum particle size of 4 inches, a maximum Liquid Limit of 35 and a maximum Plasticity Index of 15.

Where needed (i.e. fill in submerged areas), we recommend that free draining granular material (clean sand and/or gravel) meet the following requirements:

Table 3: Free-Draining Fill Recommendations

Sieve Size/Other	Percent Passing (by weight)
3 inches	100
No. 10	0 – 25
No. 40	0 – 15
No. 200	0 – 5
Plasticity Index	Non-plastic

Three inch minus washed rock (sometimes called river rock or drain rock) and pea gravel materials usually meet these requirements and may be used as free draining fill. If free draining fill will be placed adjacent to soil containing a significant amount of sand or silt/clay, precautions should be taken to prevent the migration of fine soil into the free draining fill. Such precautions should include either placing a filter fabric between the free draining fill and the adjacent material, or using a well graded, clean filtering material approved by the geotechnical engineer.

8.4 Fill Placement and Compaction

Fill should be placed on level, horizontal surfaces. Where fill will be placed on existing slopes steeper than 5H:1V, the existing ground should be benched prior to placing fill. We recommend bench heights of 1 to 4 feet, with the lowest bench being a minimum 3 feet below adjacent grade and at least 10 feet wide.

The thickness of each lift should be appropriate for the compaction equipment that is used. We recommend a maximum lift thickness prior to compaction of 4 inches for hand operated equipment, 6 inches for most "trench compactors" and 8 inches for larger rollers, unless it can be demonstrated by in-place density tests that the required compaction can be obtained throughout a thicker lift. The full thickness of each lift of structural fill placed should be compacted to at least the following percentages of the maximum dry density, as determined by ASTM D-1557:

- In landscape and other areas not below structurally loaded areas: 90%
- Less than 5 feet of fill below structurally loaded areas: 95%
- Between 5 and 10 feet of fill below structurally loaded areas: 98%

Generally, placing and compacting fill at a moisture content within ±2 percent of the optimum moisture content, as determined by ASTM D-1557, will facilitate compaction. Typically, the further the moisture content is from optimum the more difficult it will be to achieve the required compaction.

Fill should be tested frequently during placement and we recommend early testing to demonstrate that placement and compaction methods are achieving the required compaction. The contractor is responsible to ensure that fill materials and compaction efforts are consistent so that tested areas are representative of the entire fill.

8.5 Stabilization Recommendations

Near surface layers of clay were encountered during our field exploration. These soils may rut and pump during grading and construction. The likelihood of rutting and/or pumping, and the depth of disturbance, is proportional to the moisture content in the soil, the load applied to the ground surface, and the frequency of the load. Consequently, rutting and pumping can be minimized by avoiding concentrated traffic, minimizing the load applied to the ground surface by using lighter equipment and/or partial loads, by working in dry times of the year, or by providing a working surface for equipment.

During grading the soil in any obvious soft spots should be removed and replaced with granular material. If rutting or pumping occurs traffic should be stopped in the area of concern. The soil in rutted areas should be removed and replaced with granular material. In areas where pumping occurs the soil should either be allowed to sit until pore pressures dissipate (several hours to several days) and the soil firms up, or be removed and replaced with granular material. Typically, we recommend removal to a minimum depth of 24 inches.

For granular material, we recommend using angular well-graded gravel, such as pit run, or crushed rock with a maximum particle size of four inches. We suggest that the initial lift be approximately 12 inches thick and be compacted with a static roller-type compactor. A finer granular material such as sand, gravelly sand, sandy gravel or road base may also be used. The more angular and coarse the material, the thinner the lift that will be required. We recommend that the fines content (percent passing the No. 200 sieve) be less than 15%, the liquid limit be less than 35, and the plasticity index be less than 15.

Using a geosynthetic fabric, such as Mirafi 600X or equivalent, may also reduce the amount of material required and avoid mixing of the granular material and the subgrade. If a fabric is used, following removal of disturbed soils and water, the fabric should be placed over the bottom and up the sides of the excavation a minimum of 24 inches. The fabric should be placed in accordance with the manufacturer's recommendations, including proper overlaps. The granular material should then be placed over the fabric in compacted lifts. Again, we suggest that the initial lift be approximately 12 inches thick and be compacted with a static roller-type compactor.

9.0 SEISMIC CONSIDERATIONS

9.1 Seismic Design

The residential structures should be designed in accordance with the International Residential Code (IRC). The IRC designates this area as a seismic design class D_1.

The site is located at approximately 40.519 degrees latitude and -111.994 degrees longitude from the approximate center of the site. The IRC site value for this property is 0.76g. The design spectral response acceleration parameters are given below in Table 4.

Table No. 4: Design Acceleration for Short Period

S_S	F_a	Site Value (S_{DS})
		2/3 S_S*F_a
1.06g	1.08	0.76g

S_S = Mapped spectral acceleration for short periods
F_a = Site coefficient from Table 1613.5.3(1)
$S_{DS} = ⅔S_{MS} = ⅔ (F_a \cdot S_s) = 5\%$ damped design spectral response acceleration for short periods

9.2 Faulting

Based upon published geologic maps[2], no active faults traverse through or immediately adjacent to the site and the site is not located within local fault study zones. The nearest mapped fault trace is the Wasatch Fault located about 8 miles east of the site.

9.3 Liquefaction Potential

According to current liquefaction maps[3] for Salt Lake County, the site is located within an area designated as "very low" in liquefaction potential. Liquefaction can occur when saturated subsurface soils below groundwater lose their intergranular strength due to an increase in soil pore water pressures during a dynamic event such as an earthquake.

Loose, saturated sands are most susceptible to liquefaction, but some loose, saturated gravels and relatively sensitive silt to low-plasticity silty clay soils can also liquefy during a seismic

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[2] U.S. Geological Survey, Quaternary Fault and Fold Database of the United States, November 3, 2010
[3] Salt Lake County Public Works, Surface Rupture and Liquefaction Potential Special Study Areas, Salt Lake County, Utah, May 31, 1989

event. Subsurface soils were composed of unsaturated clays, silts, sands and gravels. The soils encountered do not appear liquefiable, but the liquefaction susceptibility of underlying soils (deeper than our explorations) is not known and would require deeper explorations to quantify.

10.0 FOUNDATIONS

10.1 <u>General</u>

The foundation recommendations presented in this report are based on the soil conditions encountered during our field exploration, the results of laboratory testing of samples of the native soils, the site grading recommendations presented in this report, and the foundation loading conditions presented in Section 3.0, *Proposed Construction*, of this report. If loading conditions and assumptions related to foundations are significantly different, Earthtec should be notified so that we can re-evaluate our design parameters and estimates (higher loads may cause more settlement), and to provide additional recommendations if necessary.

Conventional strip and spread footings may be used to support the proposed residences after appropriate removals as outlined in Section 8.1. Foundations should not be installed on topsoil, undocumented fill, debris, combination soils, organic soils, frozen soil, or in ponded water. If foundation soils become disturbed during construction they should be removed or recompacted.

10.2 <u>Strip/Spread Footings</u>

We recommend that conventional strip and spread foundations be constructed <u>entirely</u> on undisturbed, <u>uniform</u> gravel soils which extend a minimum of 18 inches below footings, or <u>entirely</u> on a minimum 18 inches of structural fill placed on undisturbed native soils. For foundation design we recommend the following:

- Footings founded on a minimum 18 inches of native gravel soils may be designed using a maximum allowable bearing capacity of 1,800 pounds per square foot. Footings founded on a minimum 18 inches of structural fill may also be designed using a maximum allowable bearing capacity of 1,800 pounds per square foot. The values for vertical foundation pressure can be increased by one-third for wind and seismic conditions per Section 1806.1 when used with the Alternative Basic Load Combinations found in Section 1605.3.2 of the 2009 International Building Code.

- Continuous and spot footings should be uniformly loaded and should have a minimum width of 20 and 30 inches, respectively.

- Exterior footings should be placed below frost depth which is determined by local building codes. In general 30 inches of cover is adequate for most sites; however local code should be verified by the end design professional. Interior footings, not subject to frost (heated structures), should extend at least 18 inches below the lowest adjacent grade.

- Foundation walls and footings should be properly reinforced to resist all vertical and lateral loads and differential settlement.

- The bottom of footing excavations should be compacted with at least 4 passes of an approved non-vibratory roller prior to erection of forms or placement of structural fill to densify soils that may have been loosened during excavation and to identify soft spots. If soft areas are encountered, they should be stabilized as recommended in Section 8.5.

- Footing excavations should be observed by the geotechnical engineer prior to beginning footing construction to evaluate whether suitable bearing soils have been exposed and whether excavation bottoms are free of loose or disturbed soils.

- Due to shallow groundwater encountered at the site, basement floor slab depths should be limited to 2 feet below existing site grades. This is intended to provide a minimum of 2 feet of separation between the observed groundwater condition and the bottom of the floor slab.

- Structural fill used below foundations should extend laterally a minimum of 6 inches for every 12 vertical inches of structural fill placed. For example, if 18 inches of structural fill are required to bring the excavation to footing grade, the structural fill should extend laterally a minimum of 9 inches beyond the edge of the footings on both sides.

10.3 Estimated Settlements

If the proposed foundations are properly designed and constructed using the parameters provided above, we estimate that total settlements should not exceed one inch and differential settlements should be one-half of the total settlement over a 25-foot length of continuous foundation, for non-earthquake conditions. Additional settlement could occur during an earthquake due to ground shaking, if more than 3 feet of grading fill is placed above the existing ground surface, and/or if foundation soils are allowed to become wetted.

10.4 Lateral Earth Pressures

Below grade walls act as soil retaining structures and 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. Most retaining walls that can rotate or move slightly will develop an active lateral earth pressure condition. Structures that are not allowed to rotate or move laterally, such as subgrade basement walls, will 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. For static conditions the resultant forces is applied at about one-third the wall height (measured from bottom of wall). For seismic conditions, the resultant forces are applied at about two-third times the height of the wall both measured from the bottom of the wall. The lateral pressures presented in the table below are based on drained, horizontally placed structural fill (as outlined in this report) soils as backfill material using a 32° friction angle and a dry unit weight of 135 pcf.

Table No. 6: Lateral Earth Pressures (Static and Dynamic)

Condition	Case	Lateral Pressure Coefficient	Equivalent Fluid Pressure (pcf)
Active	Static	0.31	41
	Seismic	0.44	59
At-Rest	Static	0.47	63
	Seismic	0.67	91
Passive	Static	3.25	439
	Seismic	4.74	640

*Seismic values combine the static and dynamic values

These pressure values do not include any surcharge, and are based on a relatively level ground surface at the top of the wall and drained conditions behind the wall. It is important that water is not allowed to build up (hydrostatic pressures) behind retaining structures. Retaining walls should incorporate drainage behind the walls as appropriate, and surface water should be directed away from the top and bottom of the walls.

Lateral loads are typically resisted by friction between the underlying soil and footing bottoms. Resistance to sliding may incorporate the friction acting along the base of foundations, which may be computed using a coefficient of friction of soils against concrete of 0.40 for native sands, and 0.55 for native gravels/structural fill meeting the recommendations presented herein. For allowable stress design, the lateral resistance may be computed using section 1806 of the 2009 International Building Code and all sections referenced therein. Retaining wall lateral resistance design should further reference Section 1807.2. for reference of Safety Factors. Retaining systems are assumed to be founded upon and backfilled with granular structural fill. Resistances can be calculated assuming Class 3 material in Table 1806.2, which is sandy gravel and/or gravel, provided clay or silt is not used immediately below the foundation, or as backfill material. If backfilling with clay or silt, it is required to contact Earthtec Engineering prior to construction for further review and recommendations. The values for lateral foundation pressure can be increased by one-third for wind and seismic conditions per Section 1806.1 when used with the Alternative Basic Load Combinations found in Section 1605.3.2 of the 2009 International Building Code.

The pressure and coefficient values presented above are ultimate; therefore an appropriate factor of safety may need to be applied to these values for design purposes. The appropriate factor of safety will depend on the design condition and should be determined by the project structural engineer.

11.0 FLOOR SLABS AND FLATWORK

Concrete floor slabs and exterior flatwork may be supported on native soils after appropriate removals and grading as outlined in Section 8.1 are completed. We recommend placing a minimum 4 inches of free-draining fill material (see Section 8.3) beneath floor slabs to facilitate construction, act as a capillary break, and aid in distributing floor loads. For flatwork, we recommend placing a minimum 12 inches of roadbase material. Prior to placing the free-draining fill or roadbase materials, the native subgrade should be proof-rolled to identify soft spots, which should be stabilized as discussed above in Section 8.5.

For slab design, we recommend using a modulus of subgrade reaction of 100 pounds per cubic inch. To help control normal shrinkage and stress cracking, we recommend that floor slabs have adequate reinforcement for the anticipated floor loads with the reinforcement continuous through interior floor joints, frequent crack control joints, and non-rigid attachment of the slabs to foundation and bearing walls. Special precautions should be taken during placement and curing of all 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.

12.0 DRAINAGE

12.1 Surface Drainage

As part of good construction practice, precautions should be taken during and after construction to reduce the potential for water to collect near foundation walls. Accordingly, we recommend the following:

- Adequate compaction of foundation backfill should be provided i.e. a minimum of 90% of ASTM D-1557. **Water consolidation methods should not be used.**
- The ground surface should be graded to drain away from the building in all directions. We recommend a minimum fall of 6 inches in the first 10 feet.

- Roof runoff should be collected in rain gutters with downspouts designed to discharge well outside of the backfill limits, or at least 10 feet from foundations, whichever is greater.

- Sprinklers should be aimed away, and all sprinkler components (valves, lines, sprinkler heads) should be placed at least 2 feet from foundation walls. Sprinkler systems should be well maintained, checked for leaks frequently, and repaired promptly. Overwatering at any time should be avoided.

- Any additional precautions which may become evident during construction.

12.2 Subsurface Drainage

Section R405.1 of the 2009 International Residential Code states, "Drains shall be provided around all concrete and masonry foundations that retain earth and enclose habitable or usable spaces located below grade." An exception is allowed when the foundation is installed on well drained ground consisting of Group 1 soils, which include those defined by the Unified Soil Classification System as GW, GP, SW, SP, GM, and SM. The native soils encountered in the explorations consisted of both Group 1 soils and soils that were not Group 1 soils (CL, CL-ML and ML). As such, we recommend that foundation drains be constructed for the residences within the proposed development. The recommendations presented below should be followed during design and construction of the foundation drains:

- A perforated 4-inch minimum diameter pipe should be enveloped in at least 12 inches of free-draining gravel and placed adjacent to the perimeter footings. The perforations should be oriented such that they are not located on the bottom side of the pipe, as much as possible. The free-draining gravel should consist of primarily ¾- to 2-inch size gravel having less than 5 percent passing the No. 4 sieve, and should be wrapped with a separation fabric such as Mirafi 140N or equivalent.

- The highest point of the perforated pipe bottom should be equal to the bottom elevation of the footings. The pipe should be uniformly graded to drain to an appropriate outlet (storm drain, land drain, other gravity outlet, etc.) or to one or more sumps where water can be removed by pumping.

- To facilitate drainage beneath basement floor slabs we recommend that the minimum thickness of free-draining fill beneath the slabs be increased to at least 10 inches (approximately equal to the bottom of footing elevations). A separation fabric such as Mirafi 140N or equivalent should be placed beneath the free-draining gravel.

Connections should be made to allow any water beneath the slabs to reach the perimeter foundation drain (i.e. placing at least 10 inches of free-draining fill beneath footings).

- The drain system should be periodically inspected and clean-outs should be installed for the foundation drain to allow occasional cleaning/purging, as needed. Proper drain operation depends on proper construction and maintenance.

13.0 PAVEMENT RECOMMENDATIONS

We understand that asphalt paved residential streets will be constructed as part of the development. The native soils encountered beneath the topsoil during our field exploration varied. We estimate that a California Bearing Ratio (CBR) value of 3 is appropriate for these soils.

We anticipate the traffic volume will be about 1200 vehicles a day or less for the parking lot, consisting of mostly cars and pickup trucks, with a daily delivery truck and a weekly garbage truck. Based on these traffic parameters, the estimated CBR given above, and the procedures and typical design inputs outlined in the UDOT Pavement Design Manual (1998), we recommend the minimum asphalt pavement section presented in the table below.

Table 7: Pavement Section Recommendations

Asphalt Thickness (in)	Compacted Roadbase Thickness (in)	Compacted Subbase Thickness (in)
3	10	12*
4	6	10*

* Stabilization may be required

If the pavement will be required to support construction traffic, more than an occasional semi-tractor or fire truck, or more traffic than listed above, our office should be notified so that we can re-evaluate the pavement section recommendations. The following also apply:

- The subgrade should be prepared by proof rolling to a firm, non-yielding surface, with any identified soft areas stabilized as discussed above in Section 8.5.

- Site grading fills below the pavements should meet structural fill composition and placement recommendations per Sections 8.3 and 8.4 herein.
- Asphaltic concrete, aggregate base and sub-base material composition should meet local, APWA or UDOT requirements.
- Aggregate base and sub-base is compacted to local, APWA, or UDOT requirements, or to at least 95 percent of maximum dry density (ASTM D 1557).
- Asphaltic concrete is compacted to local or UDOT requirements, or to at least 96 percent of the laboratory Marshall density (ASTM D 6927).

14.0 GENERAL CONDITIONS

The exploratory data presented in this report was collected to provide geotechnical design recommendations for this project. The test pits may not be indicative of subsurface conditions outside the study area or between points explored and thus have a limited value in depicting subsurface conditions for contractor bidding. Variations from the conditions portrayed in the test pits may occur and which may be sufficient to require modifications in the design. If during construction, conditions are different than presented in this report, please advise us so that the appropriate modifications can be made.

The findings and recommendations presented in this geotechnical report were prepared in accordance with generally accepted geotechnical engineering principles and practice in this area of Utah at this time. No warranty or representation, either expressed or implied, is intended in our proposals, contracts or reports.

This geotechnical report is based on relatively limited subsurface explorations and laboratory testing. Subsurface conditions may differ in some locations of the site from those described herein, which may require additional analyses and possibly modified recommendations. Thus we strongly recommend consulting with Earthtec Engineering, Inc. regarding any changes made during design and construction of the project from those discussed above in

Section 3.0. Failure to consult with Earthtec regarding any such changes relieves Earthtec from any liability arising from changed conditions at the site.

For consistency, Earthtec Engineering Inc. should also perform materials testing and special inspections for this project. The recommendations presented herein are based on the assumption that an adequate program of tests and observations will be followed during construction to verify compliance with our recommendations. We also assume that we will review the project plans and specifications to verify that our conclusions and recommendations are incorporated and remain appropriate (based on the actual design). Earthtec Engineering, Inc. should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Earthtec Engineering, Inc. also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

We appreciate the opportunity of providing our services on this project. If we can answer questions or be of further service, please contact Earthtec at your convenience.

VICINITY MAP

BURROWS SUBDIVISION
APPROXIMATELY 12800 SOUTH SUNDAY DRIVE
RIVERTON, UTAH

Not to Scale

PROJECT NO.: 130664		**FIGURE NO.:** 1

AERIAL PHOTOGRAPH SHOWING LOCATIONS OF TEST PITS

BURROWS SUBDIVISION
APPROXIMATELY 12800 SOUTH SUNDAY DRIVE
RIVERTON, UTAH

Approximate Test Pit Location

N

Not to Scale

PROJECT NO.: 130664	Earthtec Engineering Inc.	**FIGURE NO.:** 2

TEST PIT LOG
NO.: TP-1

PROJECT: Burrows Subdivision
PROJECT NO.: 130664
CLIENT: Brighton Homes Utah, LLC
DATE: 05/22/13
LOCATION: See Figure 2.
ELEVATION:
OPERATOR: JSI Excavation
LOGGED BY: Caleb Allred
EQUIPMENT: Track Mounted Mini- Excavator
DEPTH TO WATER; INITIAL ∇ :
AT COMPLETION ▼ :

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0			TOPSOIL, consisting of clay with gravel, slightly moist, dark brown.									
1–2		GM	Silty GRAVEL, medium dense (estimated), slightly moist, brown.	☒								
2–5		GP-GM	Poorly Graded GRAVEL with silt and sand, medium dense (estimated), slightly moist, brown.	☒								
5–6		ML	SILT with sand, medium stiff (estimated), light brown, minor pinhole texture.	■								
6–8		SM	Silty SAND, medium dense (estimated), moist, brown.	☒								
8–9		SC	Clayey SAND, medium dense (estimated), moist, brown.	☒								
9–11.5		GM	Silty GRAVEL with sand, dense to very dense (estimated), moist, brown, iron oxide staining from approximately 9 to 11.5 feet.	☒	7				48	34	18	
11.5			End exploration at approximately 11.5 feet.									

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Notes: Groundwater was not observed in test pit.

Tests Key
CBR = California Bearing Ratio
C = Consolidation
R = Resistivity
DS = Direct Shear
SS = Soluble Sulfates
UC = Unconfined Compressive Strength

LOG OF TESTPIT TEST PIT LOGS.GPJ EARTHTEC.GDT 6/19/13

PROJECT NO.: 130664

Earthtec Engineering Inc.

FIGURE NO.: 3

TEST PIT LOG

NO.: TP-2

PROJECT: Burrows Subdivision
CLIENT: Brighton Homes Utah, LLC
LOCATION: See Figure 2.
OPERATOR: JSI Excavation
EQUIPMENT: Track Mounted Mini- Excavator
DEPTH TO WATER; INITIAL ▽ :

PROJECT NO.: 130664
DATE: 05/22/13
ELEVATION:
LOGGED BY: Caleb Allred
AT COMPLETION ▼ :

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Pocket Penet. (tsf)	Other Tests
0–0.5			TOPSOIL, consisting of clay and silt, slightly moist, brown.										
0.5–2.5		CL	Lean CLAY, stiff (estimated), slightly moist, light brown, minor pinhole texture.	■ (1.5–2.5)									
2.5–5		ML	SILT, very stiff (estimated), light brown.	☒ (4–5)								3.5	
5–7		SM	Silty SAND, medium dense (estimated), moist, light brown.	☒ (6–7)									
7–11.5		CL	Sandy LEAN CLAY, stiff (estimated), moist, brown, pinholes in silt matrix.	☒ (8–9)	12		35	21	14	30	56		
				☒ (10–11)									
11.5			End exploration at approximately 11.5 feet.										

Notes: Groundwater was not observed in test pit.

Tests Key
CBR = California Bearing Ratio
C = Consolidation
R = Resistivity
DS = Direct Shear
SS = Soluble Sulfates
UC = Unconfined Compressive Strength

LOG OF TESTPIT TEST PIT LOGS.GPJ EARTHTEC.GDT 6/19/13

TEST PIT LOG

NO.: TP-3

PROJECT: Burrows Subdivision
CLIENT: Brighton Homes Utah, LLC
LOCATION: See Figure 2.
OPERATOR: JSI Excavation
EQUIPMENT: Track Mounted Mini- Excavator
DEPTH TO WATER; INITIAL ∇ :

PROJECT NO.: 130664
DATE: 05/22/13
ELEVATION:
LOGGED BY: Caleb Allred
AT COMPLETION ▼ :

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Pocket Penet. (tsf)	Other Tests
0–1			TOPSOIL, consisting of clay and silt, slightly mosit, brown.										
1–6		CL	CLAY with sand and gravel, slightly moist, hard (estimated), light brown.										
3–4					9	82	37	18	1	6	93	4.5+	C
6–8		SM	Silty SAND, dense (estimated), moist, brown.										
8–11.5		GM	Silty GRAVEL with sand, very dense (estimated), moist, brown.										
9–10					8				39	17	44		
11.5			End of exploration at approximately 11.5 feet.										

Notes: Groundwater was not observed in test pit.

Tests Key
CBR = California Bearing Ratio
C = Consolidation
R = Resistivity
DS = Direct Shear
SS = Soluble Sulfates
UC = Unconfined Compressive Strength

PROJECT NO.: 130664

FIGURE NO.: 5

LOG OF TESTPIT TEST PIT LOGS.GPJ EARTHTEC.GDT 6/19/13

TEST PIT LOG

NO.: TP-4

PROJECT: Burrows Subdivision
CLIENT: Brighton Homes Utah, LLC
LOCATION: See Figure 2.
OPERATOR: JSI Excavation
EQUIPMENT: Track Mounted Mini- Excavator
DEPTH TO WATER; INITIAL ▽ :

PROJECT NO.: 130664
DATE: 05/22/13
ELEVATION:
LOGGED BY: Caleb Allred
AT COMPLETION ▼ :

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Pocket Penet. (tsf)	Other Tests
0			TOPSOIL, consisting of clay and silt, slightly moist, brown.										
1–4		SM	Silty SAND, medium dense (estimated), moist, brown.	X (3–4 ft)									
4–4.5		ML	SILT, very stiff (estimated), slightly moist, white, moderate pinhole texture.	■ (4–5 ft)								3.0	
4.5–9		GP-GM	Poorly Graded GRAVEL with silt and sand, dense (estimated), slightly moist, light brown.	X (8–9 ft)	2				54	35	11		
9–11.5		GM	Sitly GRAVEL with sand, very dense (estimated), slightly moist, brown.										
11.5			End of exploration at approximately 11.5 feet.										

Notes: Groundwater was not observed in test pit.

Tests Key
CBR = California Bearing Ratio
C = Consolidation
R = Resistivity
DS = Direct Shear
SS = Soluble Sulfates
UC = Unconfined Compressive Strength

PROJECT NO.: 130664

Earthtec Engineering Inc.

FIGURE NO.: 6

TEST PIT LOG

NO.: TP-5

PROJECT:	Burrows Subdivision	**PROJECT NO.:**	130664
CLIENT:	Brighton Homes Utah, LLC	**DATE:**	05/22/13
LOCATION:	See Figure 2.	**ELEVATION:**	
OPERATOR:	JSI Excavation	**LOGGED BY:**	Caleb Allred
EQUIPMENT:	Track Mounted Mini- Excavator		
DEPTH TO WATER; INITIAL ▽ :		**AT COMPLETION ▼ :**	

Depth (Ft.)	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Pocket Penet. (tsf)	Other Tests
0–0.5		TOPSOIL, consisting of clay with roots.										
0.5–3	SM	Silty SAND, medium dense (estimated), slightly moist, light brown.	X (approx. 2–3 ft)									
3–6	ML	Sandy SILT, stiff (estimated), slightly moist, light brown.	■ (approx. 3.5–4.5 ft)								3.0	
6–9	GP-GM	Poorly Graded GRAVELwith silt and sand, dense (estimated), moist, brown.	X (approx. 7–8 ft)	4				57	33	10		
9–11.5	GP-GC	Poorly Graded GRAVEL with clay, dense (estimated), moist, brown.	X (approx. 10.5–11.5 ft)									
11.5		End of exploration at approximatly 11.5 feet.										

Notes: Groundwater was not observed in test pit.

Tests Key

- CBR = California Bearing Ratio
- C = Consolidation
- R = Resistivity
- DS = Direct Shear
- SS = Soluble Sulfates
- UC = Unconfined Compressive Strength

TEST PIT LOG

NO.: TP-6

PROJECT: Burrows Subdivision
CLIENT: Brighton Homes Utah, LLC
LOCATION: See Figure 2.
OPERATOR: JSI Excavation
EQUIPMENT: Track Mounted Mini- Excavator
DEPTH TO WATER; INITIAL ▽ :

PROJECT NO.: 130664
DATE: 05/22/13
ELEVATION:
LOGGED BY: Caleb Allred
AT COMPLETION ▼ :

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0–4		GM	Silty GRAVEL with sand, medium dense (estimated), slightly moist, brown.	X								
4–5		SM	Silty SAND, medium dense (estimated), slightly moist, brown.	X								
5–10		GP-GM	Poorly Graded GRAVEL with silt and sand, medium dense (estimated) slightly moist, light brown.	X								
10–11		CL	Sandy Lean CLAY, medium stiff (estimated), moist, light brown.	X	10		29	12	14	33	53	
11–11.5		ML	SILT, medium stiff (estimated), slightly moist, light brown.	▮								
			End of exploration at approximately 11.5 feet.									

Notes: Groundwater was not observed in test pit.

Tests Key
CBR = California Bearing Ratio
C = Consolidation
R = Resistivity
DS = Direct Shear
SS = Soluble Sulfates
UC = Unconfined Compressive Strength

PROJECT NO.: 130664

Earthtec Engineering Inc.

FIGURE NO.: 8

TEST PIT LOG
NO.: TP-7

PROJECT: Burrows Subdivision
CLIENT: Brighton Homes Utah, LLC
LOCATION: See Figure 2.
OPERATOR: JSI Excavation
EQUIPMENT: Track Mounted Mini- Excavator
DEPTH TO WATER; INITIAL ▽ **:**

PROJECT NO.: 130664
DATE: 05/22/13
ELEVATION:
LOGGED BY: Caleb Allred
AT COMPLETION ▼ **:**

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Pocket Penet. (tsf)	Other Tests
0–4		ML	SILT with gravel, medium stiff (estimated), slightly moist, brown.										
4–8		SM	Silty SAND, medium dense (estimated), moist, brown.		5		NP	NP	4	67	29		
8–10		ML	SILT, hard (estimated), dry, light brown.									4.5	
10–11		SM	Silty SAND, medium dense (estimated), moist, brown, iron oxide stining throughout.										
11–11.5		CL	Lean CLAY with sand, medium stiff (estimated), moist, gray-brown, iron oxide staining.		25	80	31	12				1.0	C
			End of exploration at approximately 11.5 feet.										

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

TEST RESULTS

Notes: Groundwater was not observed in test pit.

Tests Key
CBR = California Bearing Ratio
C = Consolidation
R = Resistivity
DS = Direct Shear
SS = Soluble Sulfates
UC = Unconfined Compressive Strength

PROJECT NO.: 130664

Earthtec Engineering Inc.

FIGURE NO.: 9

LOG OF TESTPIT TEST PIT LOGS.GPJ EARTHTEC.GDT 6/19/13

TEST PIT LOG

NO.: TP-8

PROJECT:	Burrows Subdivision	**PROJECT NO.:**	130664
CLIENT:	Brighton Homes Utah, LLC	**DATE:**	05/22/13
LOCATION:	See Figure 2.	**ELEVATION:**	
OPERATOR:	JSI Excavation	**LOGGED BY:**	Caleb Allred
EQUIPMENT:	Track Mounted Mini- Excavator		
DEPTH TO WATER; INITIAL ▽ :		**AT COMPLETION ▼ :**	

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Pocket Penet. (tsf)	Other Tests
0			TOPSOIL, consisting of silt with roots.										
1–8		CL	Lean CLAY with sand, very stiff (estimated), slightly moist, brown, moderate pinhole texture.										
~3.5				■	14	72	37	20				2.5	C
8–11.5		GM	Silty GRAVEL with sand, medium dense (estimated), moist, brown, iron oxide staining throughout.										
~10				☒	5				31	20	49		
11.5			End of exploration at approximately 11.5 feet.										

Notes: Groundwater was not observed in test pit.

Tests Key
- CBR = California Bearing Ratio
- C = Consolidation
- R = Resistivity
- DS = Direct Shear
- SS = Soluble Sulfates
- UC = Unconfined Compressive Strength

TEST PIT LOG
NO.: TP-9

PROJECT: Burrows Subdivision
CLIENT: Brighton Homes Utah, LLC
LOCATION: See Figure 2.
OPERATOR: JSI Excavation
EQUIPMENT: Track Mounted Mini- Excavator
DEPTH TO WATER; INITIAL ▽ :

PROJECT NO.: 130664
DATE: 05/22/13
ELEVATION:
LOGGED BY: Caleb Allred
AT COMPLETION ▼ :

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Pocket Penet. (tsf)	Other Tests
0–6		CL	Lean CLAY with sand, stiff (estimated), moist, brown.										
2–3				■								2.0	
4–5				■									
6–6.5		SM	Silty SAND, medium dense (estimated), moist, orange-brown, iron oxide staining throughout.										
6.5–9.5		GP-GM	Poorly Graded GRAVEL with silt and sand, very dense (estimated), mpist, brown.										
7–8				X									
9.5–11.5		GP	Poorly Graded GRAVEL with sand, very dense (estimated), moist, brown.										
11.5			End of exploration at approximately 11.5 feet.										

Notes: Groundwater was not observed in test pit.

Tests Key
CBR = California Bearing Ratio
C = Consolidation
R = Resistivity
DS = Direct Shear
SS = Soluble Sulfates
UC = Unconfined Compressive Strength

PROJECT NO.: 130664

Earthtec Engineering Inc.

FIGURE NO.: 11

LEGEND

PROJECT: Burrows Subdivision
CLIENT: Brighton Homes Utah, LLC
DATE: 05/22/13
LOGGED BY: Caleb Allred

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR SOIL DIVISIONS			USCS SYMBOL	TYPICAL SOIL DESCRIPTIONS
COARSE GRAINED SOILS (More than 50% retaining on No. 200 Sieve)	GRAVELS (More than 50% of coarse fraction retained on No. 4 Sieve)	CLEAN GRAVELS (Less than 5% fines)	GW	Well Graded Gravel, May Contain Sand, Very Little Fines
			GP	Poorly Graded Gravel, May Contain Sand, Very Little Fines
		GRAVELS WITH FINES (More than 12% fines)	GM	Silty Gravel, May Contain Sand
			GC	Clayey Gravel, May Contain Sand
	SANDS (50% or more of coarse fraction passes No. 4 Sieve)	CLEAN SANDS (Less than 5% fines)	SW	Well Graded Sand, May Contain Gravel, Very Little Fines
			SP	Poorly Graded Sand, May Contain Gravel, Very Little Fines
		SANDS WITH FINES (More than 12% fines)	SM	Silty Sand, May Contain Gravel
			SC	Clayey Sand, May Contain Gravel
FINE GRAINED SOILS (More than 50% passing No. 200 Sieve)	SILTS AND CLAYS (Liquid Limit less than 50)		CL	Lean Clay, Inorganic, May Contain Gravel and/or Sand
			ML	Silt, Inorganic, May Contain Gravel and/or Sand
			OL	Organic Silt or Clay, May Contain Gravel and/or Sand
	SILTS AND CLAYS (Liquid Limit Greater than 50)		CH	Fat Clay, Inorganic, May Contain Gravel and/or Sand
			MH	Elastic Silt, Inorganic, May Contain Gravel and/or Sand
			OH	Organic Clay or Silt, May Contain Gravel and/or Sand
HIGHLY ORGANIC SOILS			PT	Peat, Primarily Organic Matter

SAMPLER DESCRIPTIONS

- SPLIT SPOON SAMPLER (1 3/8 inch inside diameter)
- MODIFIED CALIFORNIA SAMPLER (2 inch outside diameter)
- SHELBY TUBE (3 inch outside diameter)
- BLOCK SAMPLE
- BAG/BULK SAMPLE

WATER SYMBOLS

- ∇ Water level encountered during field exploration
- ▼ Water level encountered at completion of field exploration

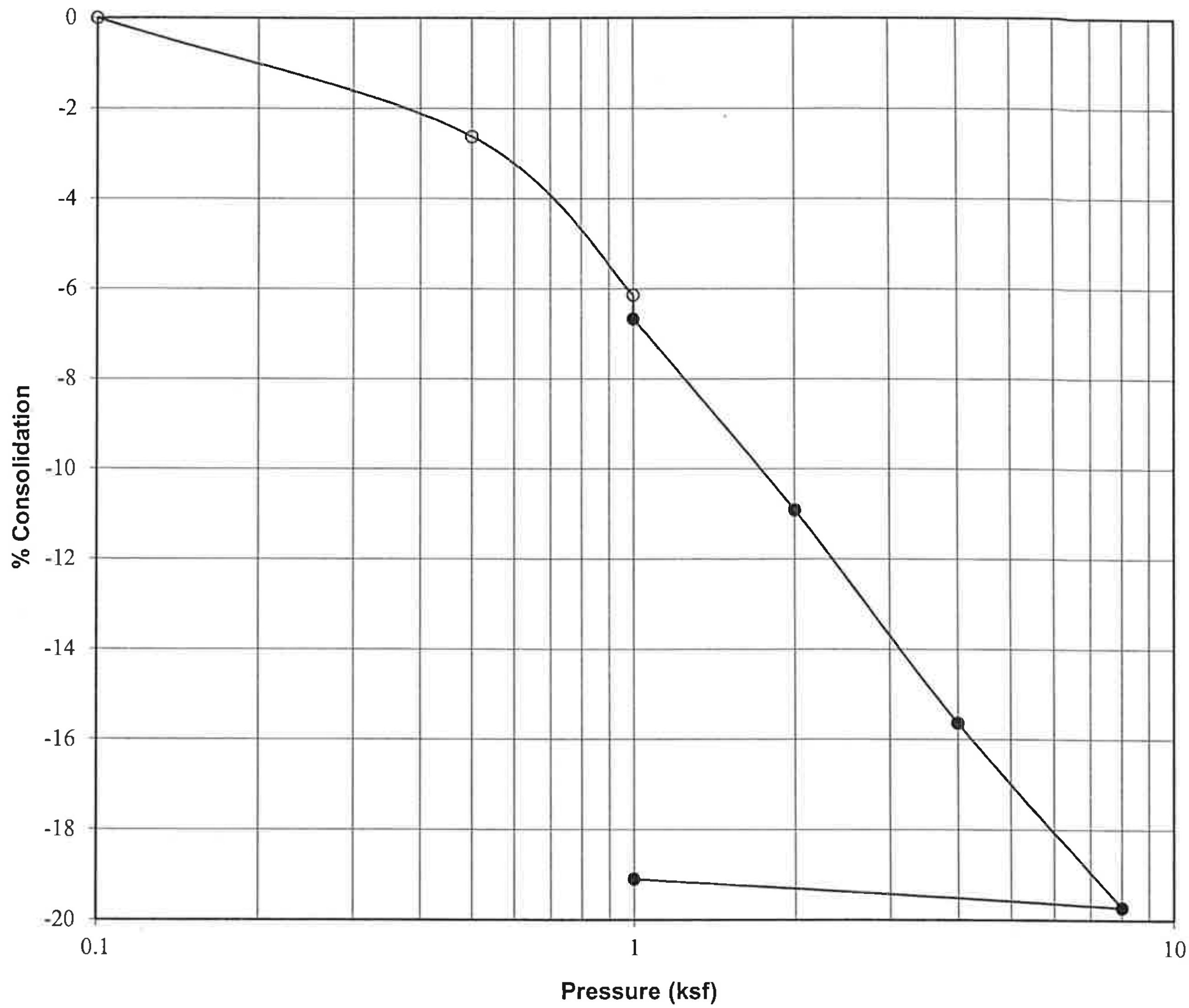
NOTES:
1. The logs are subject to the limitations, conclusions, and recommendations in this report.
2. Results of tests conducted on samples recovered are reported on the logs and any applicable graphs.
3. Strata lines on the logs represent approximate boundaries only. Actual transitions may be gradual.
4. In general, USCS symbols shown on the logs are based on visual methods only: actual designations (based on laboratory tests) may vary.

PROJECT NO.: 130664

Earthtec Engineering Inc.

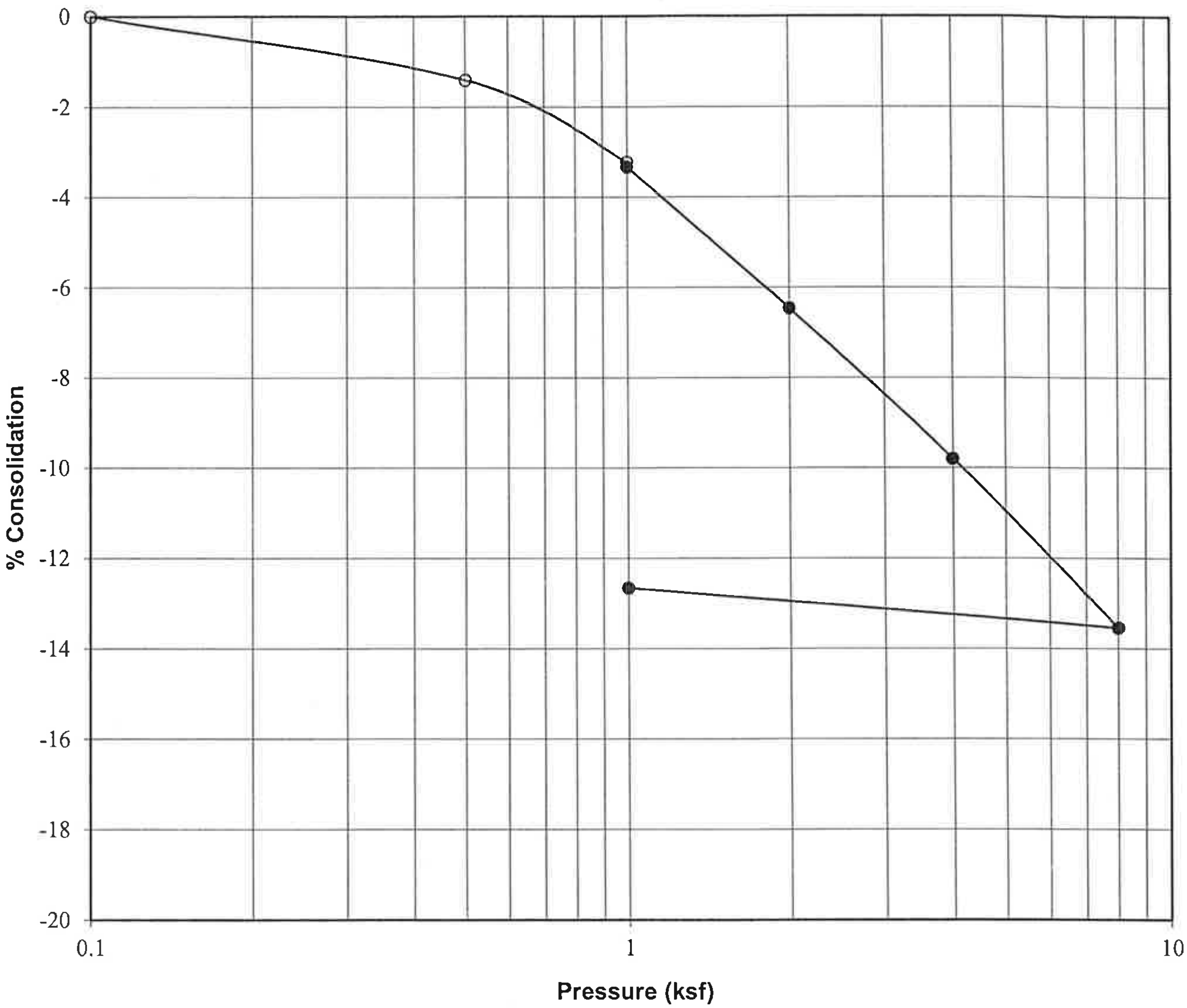
FIGURE NO.: 12

CONSOLIDATION - SWELL TEST



Project:	Burrows Subdivison
Location:	TP-8
Sample Depth, ft:	3
Description:	Shelby
Soil Type:	SILTY CLAY (CL-ML)
Natural Moisture, %:	14
Dry Density, pcf:	72
Liquid Limit:	37
Plasticity Index:	20
Water Added at:	1 ksf
Percent Collapse:	0.5

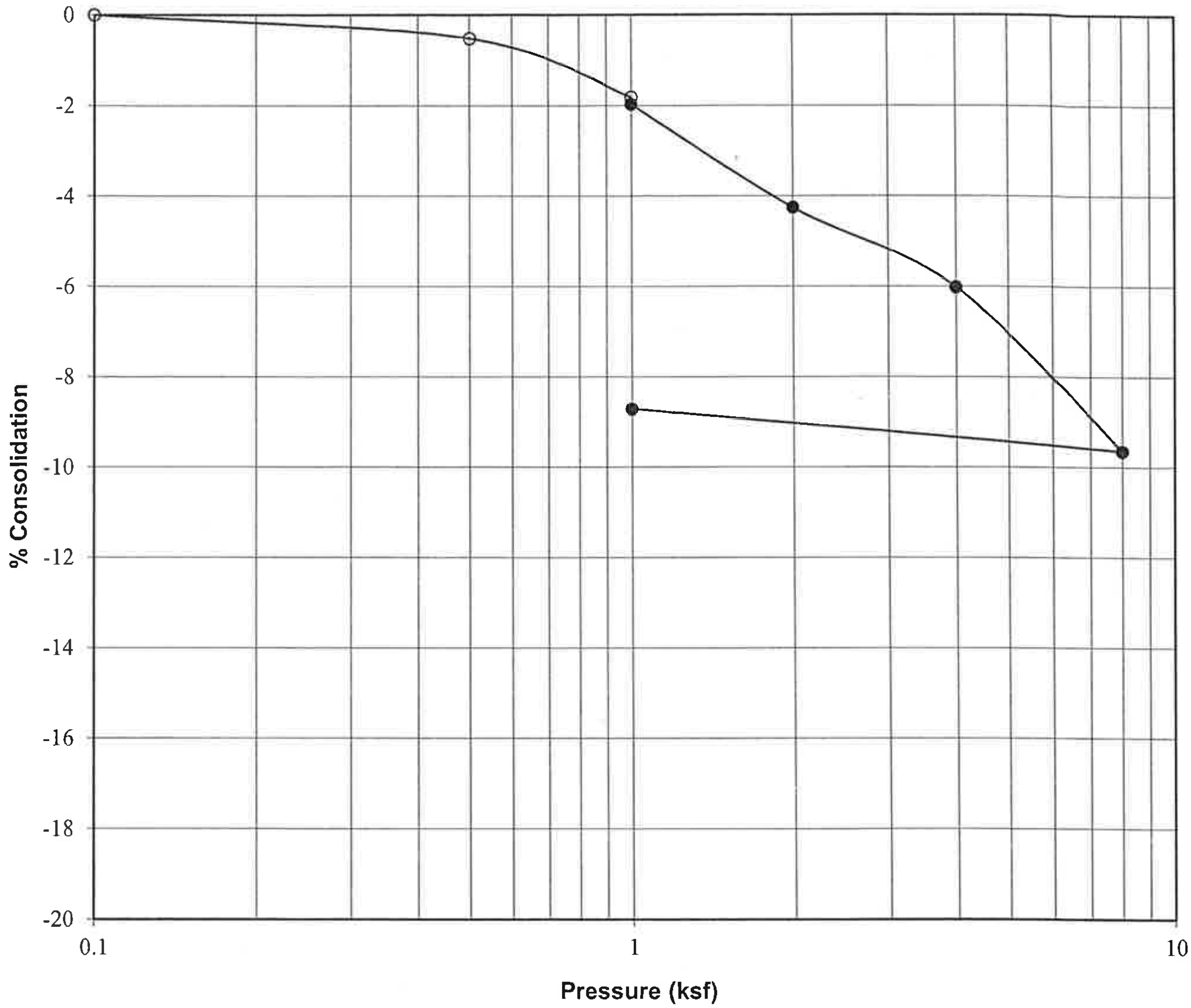
CONSOLIDATION - SWELL TEST



Project:	Burrows Subdivison
Location:	TP-3
Sample Depth, ft:	3
Description:	Shelby
Soil Type:	LEAN CLAY (CL)
Natural Moisture, %:	9
Dry Density, pcf:	82
Liquid Limit:	37
Plasticity Index:	18
Water Added at:	1 ksf
Percent Collapse:	0.1

PROJECT NO.: 130664	Earthtec Engineering Inc.	**FIGURE NO.:** 14

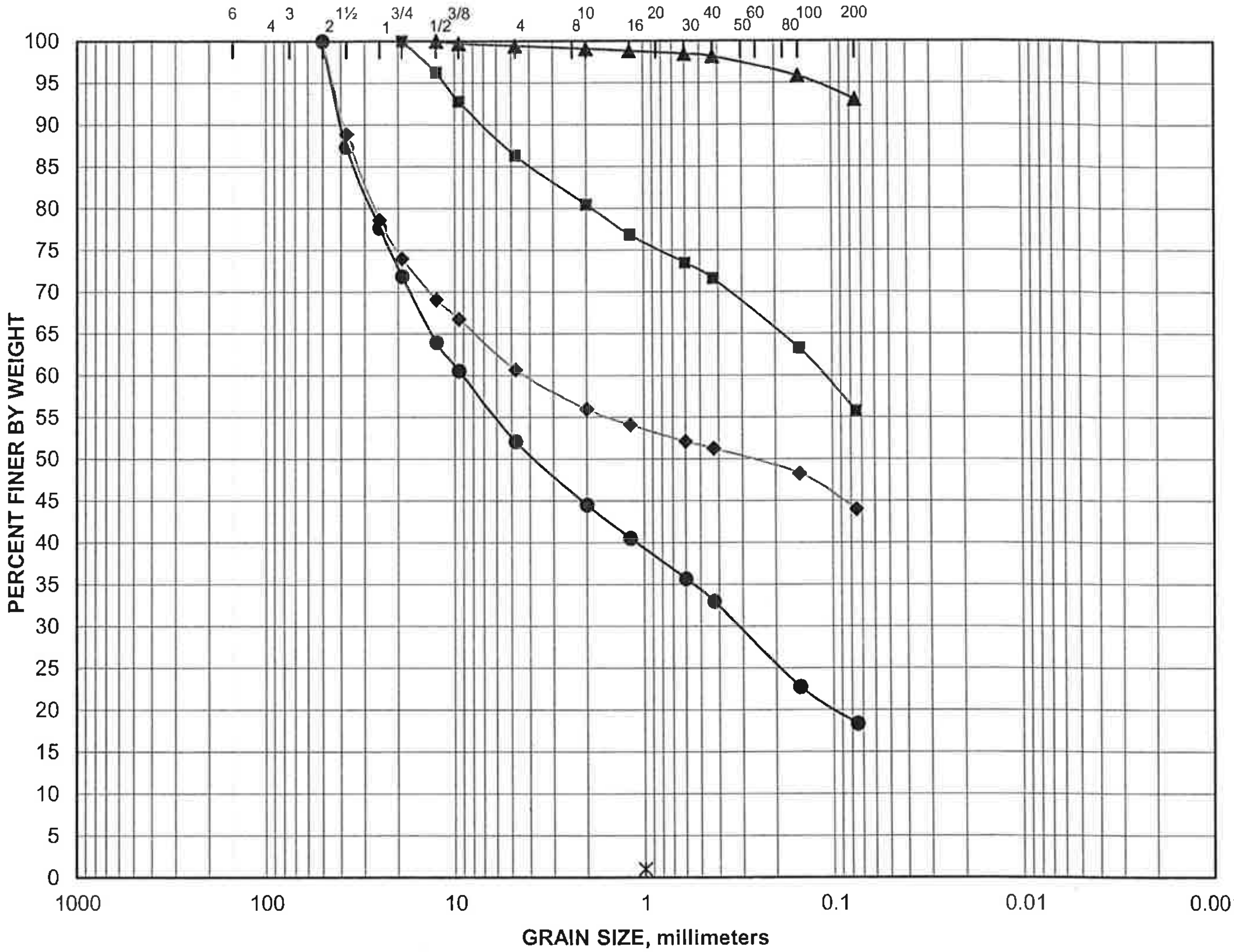
CONSOLIDATION - SWELL TEST



Project:	Burrows Subdivison
Location:	TH-7
Sample Depth, ft:	11
Description:	Shelby
Soil Type:	LEAN CLAY (CL)
Natural Moisture, %:	25
Dry Density, pcf:	80
Liquid Limit:	31
Plasticity Index:	12
Water Added at:	1 ksf
Percent Collapse:	0.2

PROJECT NO.: 130664	Earthtec Engineering Inc.	**FIGURE NO.:** 15

GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	**TP-1 @ 10 ft.**	**Silty GRAVEL with sand (GM)**	**7**					
■	**TP-2 @ 8 ft.**	**Sandy Lean CLAY (CL)**	**12**	**35**	**14**	**21**		
▲	**TP-3 @ 3 ft.**	**Lean CLAY (CL)**	**9**	**37**	**19**	**18**		
◆	**TP-3 @ 9 ft.**	**Silty GRAVEL with sand (GM)**	**8**					

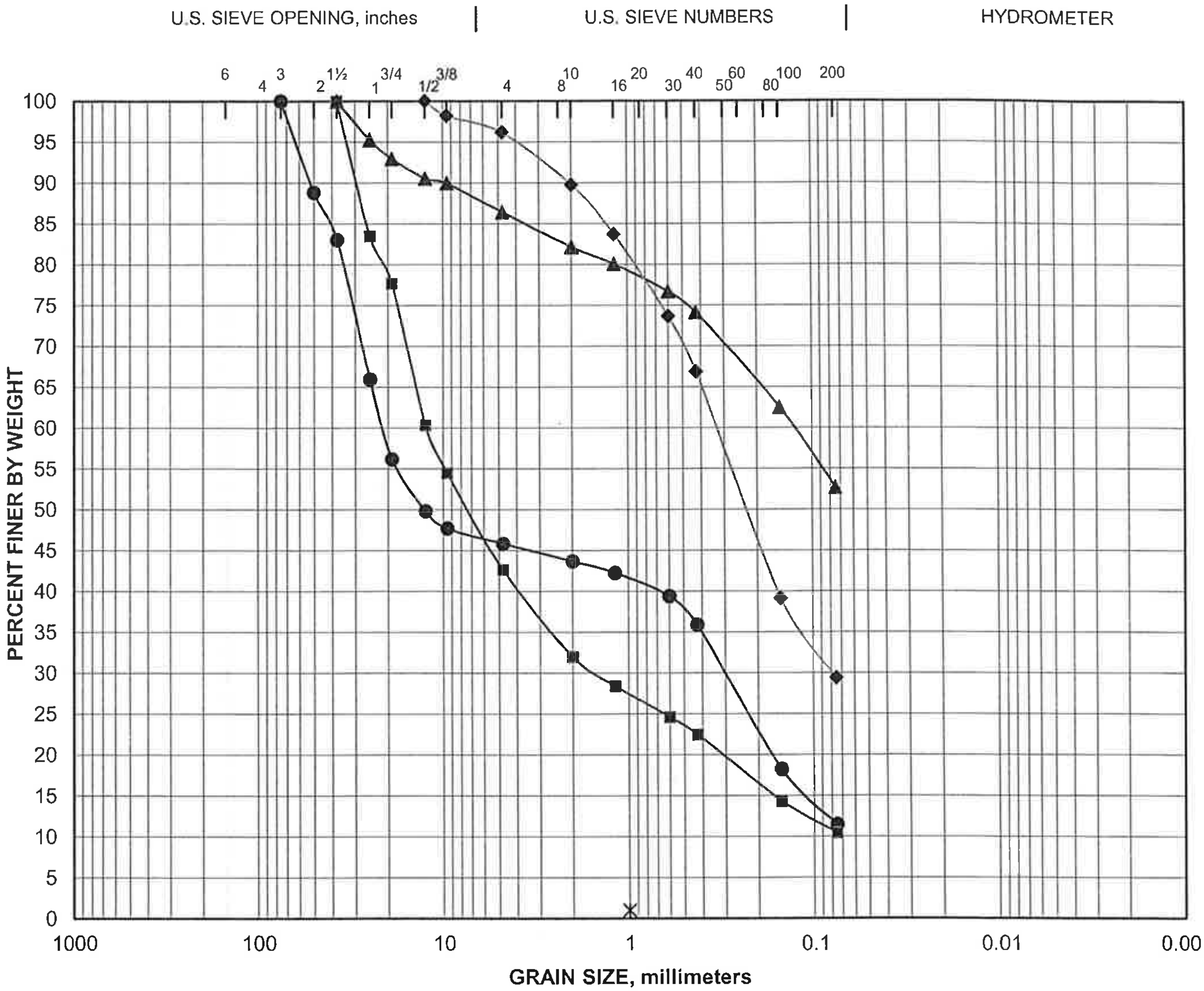
	Specimen Identification	D100	D85	D60	D30	D15	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP-1 @ 10 ft.**	**50.0**	**34.0**	**9.08**	**0.314**			**48**	**34**	**18**	
■	**TP-2 @ 8 ft.**	**19.0**	**3.91**	**0.100**				**14**	**30**	**56**	
▲	**TP-3 @ 3 ft.**	**12.5**						**1**	**6**	**93**	
◆	**TP-3 @ 9 ft.**	**50.0**	**32.2**	**4.19**				**39**	**17**	**44**	

PROJECT NO.: 130878

Earthtec Engineering, Inc.

FIGURE NO.: 16

GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
●	TP-4 @ 8 ft	Poorly Graded GRAVEL with silt and sand (GP-GM)	2				0.1	328
■	TP-5 @ 7 ft	Poorly Gaded GRAVEL with clay (GP-GC)	4				2.6	178
▲	TP-6 @ 10	Sandy Lean CLAY (CL)	10					
◆	TP-7 @ 4 ft.	Silty SAND (SM)	5					

	Specimen Identification	D100	D85	D60	D30	D15	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-4 @ 8 ft	75.0	41.3	21.1	0.300	0.124		54	35	11	
■	TP-5 @ 7 ft	37.5	25.9	12.3	1.50	0.163		57	33	10	
▲	TP-6 @ 10	37.5	3.55	0.119				14	33	53	
◆	TP-7 @ 4 ft.	12.5	1.32	0.328	0.106			4	67	29	

PROJECT NO.: 130664

Earthtec Engineering Inc.

FIGURE NO.: 17