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GEOTECHNICAL STUDY
EDGEWATER ESTATES
NEAR THE INTERSECTION OF
6500 EAST AND HIGHWAY 39
HUNTSVILLE, UTAH

Project No. 12-0941G

August 8, 2012

Prepared For:

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1.0 EXECUTIVE SUMMARY

This report presents the results of our geotechnical study for the Edgewater Estates subdivision located near the intersection of 6500 East and Highway 39 in Huntsville, Utah. We understand the proposed subdivision development, as currently planned, will consist predominately of residential structures with a few commercial building pads. The proposed structures will likely be one- to two-story buildings founded on spread footings with the possibility of shallow basements. We also anticipate that other improvements will be made to the site including streets to provide access to and utilities to service the structures.

For the field exploration, we excavated a total of seven test pits to depths of about 8½ to 11 feet below the existing ground surface. The subsurface soils encountered generally consisted of fill material and topsoil overlying Lean Clays (CL) with varying sand content, Silty Sand (SM), Clayey Sand (SC), and Well Graded Sand with silt and gravel (SW-SM). The fill material and topsoil should be removed beneath the entire building footprints and beneath exterior flatwork and pavement areas. Groundwater was not present in any of the test pits at the time of our investigation.

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 structures, with foundations placed entirely on uniform, undisturbed, native soils or entirely on a minimum of 18 inches of properly placed and compacted structural fill.

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 Engineering, Inc. from any liability arising from changed conditions at the site. We also strongly recommend that Earthtec Engineering, Inc. observe the building excavations to verify the adequacy of our recommendations presented herein, and that Earthtec Engineering, Inc. 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 Edgewater Estates near the intersection of 6500 East and Highway 39 in Huntsville, 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 streets.

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 subdivision development will consist predominately of residential structures with a few commercial building pads being developed on the approximately 13-acre parcel. We anticipate that the future buildings will be conventionally framed and one to two stories in height. The buildings will likely be founded on spread footings with the possibility of shallow basements. We expect structural loads for the buildings to be in the range of 1 to 3 kips per lineal foot for walls, less than 30 kips for columns, and up to 100 psf for floor slabs. 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 structures, that exterior concrete flatwork will be placed in the form of curb, gutter, and sidewalks; and that asphalt concrete paved streets will be constructed.

4.0 GENERAL SITE DESCRIPTION

The subject property is located near the intersection of 6500 East and Highway 39 in Huntsville, Utah. At the time of our subsurface investigation, the subject property was vegetated with weeds, grasses, sagebrush, and a few small. A small stream, running east to west, was located on the south central portion of the property. The subject property gradually slopes downward to the north at grades of approximately 5 to 10 percent, with an approximate elevation change of 55 feet across the property. An existing building is currently located in the southwest corner of the property. An asphalt paved street, curb, gutter, sidewalks, and utilities have been installed to the existing structure. Stockpiles of fill material (possibly from the adjacent development) and construction debris (concrete, wood, asphalt) were also prevalent in southwest corner of the subject property. The subject property is bordered on the north by Pineview Reservoir, on the east by residential development, on the south by Highway 39, and on the west by 6300 East.

5.0 SUBSURFACE EXPLORATION

Under the direction of a qualified member of our geotechnical staff, subsurface explorations were conducted at the site on July 17, 2012 by excavating seven exploratory test pits to depths of about 8½ to 11 feet below the existing ground surface using a rubber-tire backhoe. The approximate locations of the test pits are shown on Figure 2, *Aerial Photograph Showing Location of Test Pits*. Graphical representations and detailed descriptions of the soils encountered are shown on Figures 3 through 9, *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 10, *Legend.*

The subsurface soils exposed in the test pits were classified by visual examination using the guidelines of the Unified Soil Classification System (USCS). Disturbed bag samples and relatively undisturbed thin-walled "Shelby" tube samples were collected at various depths in each test pit. Samples were transported to our Ogden, Utah laboratory for further analysis. Samples will be retained in our laboratory 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 disposal date.

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 limit determinations, full and mechanical (partial) gradation analyses, a direct shear test, 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 11 through 12, *Consolidation-Swell Test,* and on Figure No. 13, *Direct Shear Test.*

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	5½	10	---	26	*NP	0	80	20	SM
TP-2	8	16	---	22	NP	1	76	23	SM
TP-3	3	11	104	44	26	0	1	99	CL
TP-5	4½	10	---	40	24	1	18	81	CL

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-5	10½	33	85	43	22	0	42	58	CL
TP-6	9	4	---	14	NP	24	70	6	SW-SM

* NP = Non-Plastic
**Detailed descriptions of the soils encountered are presented on the test pit logs

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 for moisture sensitivity under increased moisture and load conditions.

7.0 SUBSURFACE CONDITIONS

7.1 Soil Types

On the surface of the site, we encountered fill material and topsoil which we estimated to extend about ½ to 3 feet in depth at the test pit locations. Below the fill material and topsoil we encountered layers of Lean Clay (CL), Silty Sand (SM), Clayey Sand (SC), Lean Clay with sand (CL), Well Graded Sand with silt and gravel (SW-SM), and Sandy Lean Clay (CL) extending to the maximum depth explored of about 8½ to 11 feet below the existing ground surface. Based on our experience and observations during the field exploration, the clay soils visually appeared to be stiff to very stiff in consistency, while the sandy soils appeared to be medium dense to very dense in consistency. Consolidation test results indicate the clay soils have a negligible potential for moisture-related movement. Layers of weathered sandstone were encountered at the site as shallow as 3 feet below existing site grades. The weathered sandstone may be difficult to excavate with smaller equipment.

7.2 Groundwater Conditions

Groundwater was not encountered during our field exploration on July 17, 2012. Some iron oxide staining and mottled material, an indicator of a soils hydraulic conductivity or possible past groundwater fluctuations, was observed in some of the subsurface soils in each of the test pits at fairly shallow depths (approximately 6 feet below existing site grades). Groundwater levels will fluctuate in response to the season, precipitation and snow melt, irrigation, and other on and off-site influences. Precisely quantifying these fluctuations would require long term monitoring. The contractor should be prepared to dewater excavations as needed.

8.0 SITE GRADING

8.1 General Site Grading

Unsuitable soils and vegetation should be removed from below foundation, floor slab, and exterior concrete flatwork areas. Unsuitable soils consist of topsoil, organic soils, undocumented fill, soft, loose, or disturbed native soils, and any other inapt materials. We encountered fill material and topsoil on the surface extending from approximately ½ to 3 feet in depth at the test pit locations. The fill we encountered on the site is considered undocumented (untested). The fill material and topsoil (including soil with roots larger than about ¼ inch in diameter) should be completely removed beneath all structures and pavement, even if found to extend deeper, along with any other unsuitable soils that may be encountered.

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. 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 may include placing the fill several weeks prior to construction to allow settlement to occur.

8.2 Temporary Excavations

For temporary excavations less than 5 feet in depth into the native soils or into structural fill, slopes should not be made steeper than ½H:1V (Horizontal:Vertical). Temporary excavations extending up to 10 feet in depth should not be made steeper than 1H:1V. If unstable conditions or groundwater seepage are encountered, flatter slopes, shoring, or bracing may be required. All excavations should be conducted in accordance with all applicable OSHA requirements.

8.3 Fill Material Composition

The native clay and some of the native sand soils encountered at the site are not suitable for use as structural fill. The native, cleaner sandy soils may be used for structural fill. Excavated soils, including topsoil and clays, may be stockpiled for use as fill in landscape areas. We recommend that a professional engineer or geologist verify that the structural fill to be used on this project meets our requirements, given below.

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 structural fill consist of imported 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 – 15
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 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 clay 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 (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, such as a Mirafi 140N or equivalent, 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

The thickness of each lift should be appropriate for the compaction equipment that is used. We recommend a maximum lift thickness 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 areas not supporting structural loads:	90%
Less than 5 feet of fill below foundations, flatwork and pavements:	95%
Five or more feet of fill below foundations, flatwork and pavements:	98%

Generally, placing and compacting fill at a moisture content within 2% 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 early testing is recommended to demonstrate that placement and compaction methods are achieving the required compaction. It is the contractor's responsibility 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 soils 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 SLOPE STABILITY

We evaluated the overall stability of the existing slopes at the property. The properties of the native soils at the site were estimated using direct shear testing on samples recovered during our field investigation. Direct shear testing indicated the lean clay soils at the site have an internal friction angle of 36 degrees, a saturated cohesion of 810 psf, and a saturated unit weight of 125 pcf.

For the seismic (pseudostatic) analysis, a peak horizontal ground acceleration of 0.39g for the 2% probability of exceedance in 50 years was obtained for site (grid) locations of 41.251 degrees north latitude and -111.795 degrees west longitude. Typically, one-third to one-half this value is utilized in analysis. Accordingly, a value of 0.14 was used as the pseudostatic coefficient for the stability analysis. We evaluated the global stability of the site using the computer program XSTABL. This program uses a limit equilibrium (Bishop's modified) method for calculating factors of safety against sliding on an assumed failure surface and evaluates numerous potential failure surfaces, with the most critical failure surface identified as the one yielding the lowest factor of safety of those evaluated. The slope configuration analyzed consisted of a 35-foot high slope inclined at approximately 1V:4H to 1V:½H (Vertical:Horizontal). To simulate the load imposed by typical residential and light commercial construction, a load of 1,000 psf was placed near the crest of the slope. Additonally, we conservatively included a water surface was placed approximately 10 feet below the crest of the slope, at the anticipated high water level for the reservoir. Typically, the required minimum factors of safety are 1.5 for static conditions and 1.0 for seismic (pseudostatic) conditions. The results of our analyses indicate that the existing slopes meet both these requirements provided that structures are not placed beyond the crest of the slopes. The slope stability data are attached as Figures 14 and 15. Any modifications to the slope, including the construction of retaining walls, should be properly designed and engineered.

10.0 SEISMIC CONSIDERATIONS

10.1 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 41.251 degrees latitude and -111.795 degrees longitude from the approximate center of the site. The IRC site value for this property is 0.71g. 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
0.96g	1.12	0.71g

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·S_s) = 5% damped design spectral response acceleration for short periods

10.2 Faulting

Based upon published geologic maps, 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 Ogden Valley Southwestern Margin Section[1], located about 1.4 miles (2.3 kilometers) southwest of the project site.

10.3 Liquefaction Potential

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 saturation for liquefaction to occur. 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 event. Subsurface soils were composed of stiff to very stiff, unsaturated clays and medium, dense to very dense, unsaturated sands. The soils encountered are typically not liquefiable, but the liquefaction susceptibility of underlying soils (deeper than our explorations) is not known and would require deeper explorations to quantify.

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[1] Hecker, S., 1993, Quaternary Faults and Folds, Utah, Utah Geologic Survey, Bulletin 127.

11.0 FOUNDATIONS

11.1 General

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 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.

11.2 Strip/Spread Footings

We recommend that conventional strip and spread foundations be constructed entirely on non-yielding, undisturbed, uniform, native soils (clays or sands) or entirely on a minimum 18 inches of structural fill placed on undisturbed native soils. If combination soils are encountered in the foundation excavations, further excavating to reach uniform soils or the placement of structural fill will be required. For foundation design we recommend the following:

- Footings founded on non-yielding, undisturbed, uniform native soils may be designed using a maximum allowable bearing capacity of 1,500 pounds per square foot. Footings founded on a minimum 18 inches of structural fill may be designed using a maximum allowable bearing capacity of 2,000 pounds per square foot. These bearing pressures may be increased by 33 percent for transient loadings.

- 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. Generally 30 inches of cover is adequate for this site. Interior footings, not subject to frost, should extend at least 18 inches below the lowest adjacent grade.

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

- 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.

- 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.

11.3 Estimated Settlements

If the proposed foundations are properly designed and constructed using the parameters provided above, we estimate that total settlements will not exceed one inch and differential settlements will be one-half of the total settlement over a 25-foot length of 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.

11.4 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 either static or seismic conditions the resultant forces occur at about 1/3 the height of the wall, 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 120 pcf.

Table 5: Lateral Earth Pressures

Condition	Case	Lateral Pressure Coefficient	Equivalent Fluid Pressure (pcf)*
Active	Static	0.31	37
	Seismic	0.42	50
At-Rest (Rankine)	Static	0.47	56
	Seismic	0.66	79
Passive (Rankine)	Static	3.25	391
	Seismic	4.84	581

*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.

Resistance to sliding may incorporate the friction acting along the base of foundations, which may be computed using a coefficient of friction of 0.45 for native soils and 0.70 for structural fill meeting the recommendations presented herein. These values may be increased by one-third for transient wind and seismic loads.

The friction and lateral earth pressure values given above are ultimate, and appropriate factors of safety should be applied, particularly when utilizing both the coefficient of friction and passive earth pressure to resist sliding.

12.0 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 4 inches of roadbase material or free-draining fill. 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 120 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.

13.0 DRAINAGE

13.1 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 8 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 5 feet from foundation walls. Sprinkler systems should be well maintained, checked for leaks frequently, and repaired promptly. Over-watering at any time should be avoided.
- Any additional precautions which may become evident during construction.

13.2 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 majority of the native soils encountered in the explorations (CL and SC) were not Group 1 soils. 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.

14.0 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 were composed of predominately clays. We estimate that a California Bearing Ratio (CBR) value of 3 is appropriate to account for this material.

We anticipate the traffic volume will be about 500 vehicles a day or less for, 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 6: Pavement Section Recommendations

Asphalt Thickness (in)	Compacted Roadbase Thickness (in)	Compacted Subbase Thickness (in)
3	5	5
3	8	---

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 should meet local or UDOT requirements.
- Aggregate base and sub-base is compacted to local 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 Marshal density (ASTM D 6927).

15.0 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.

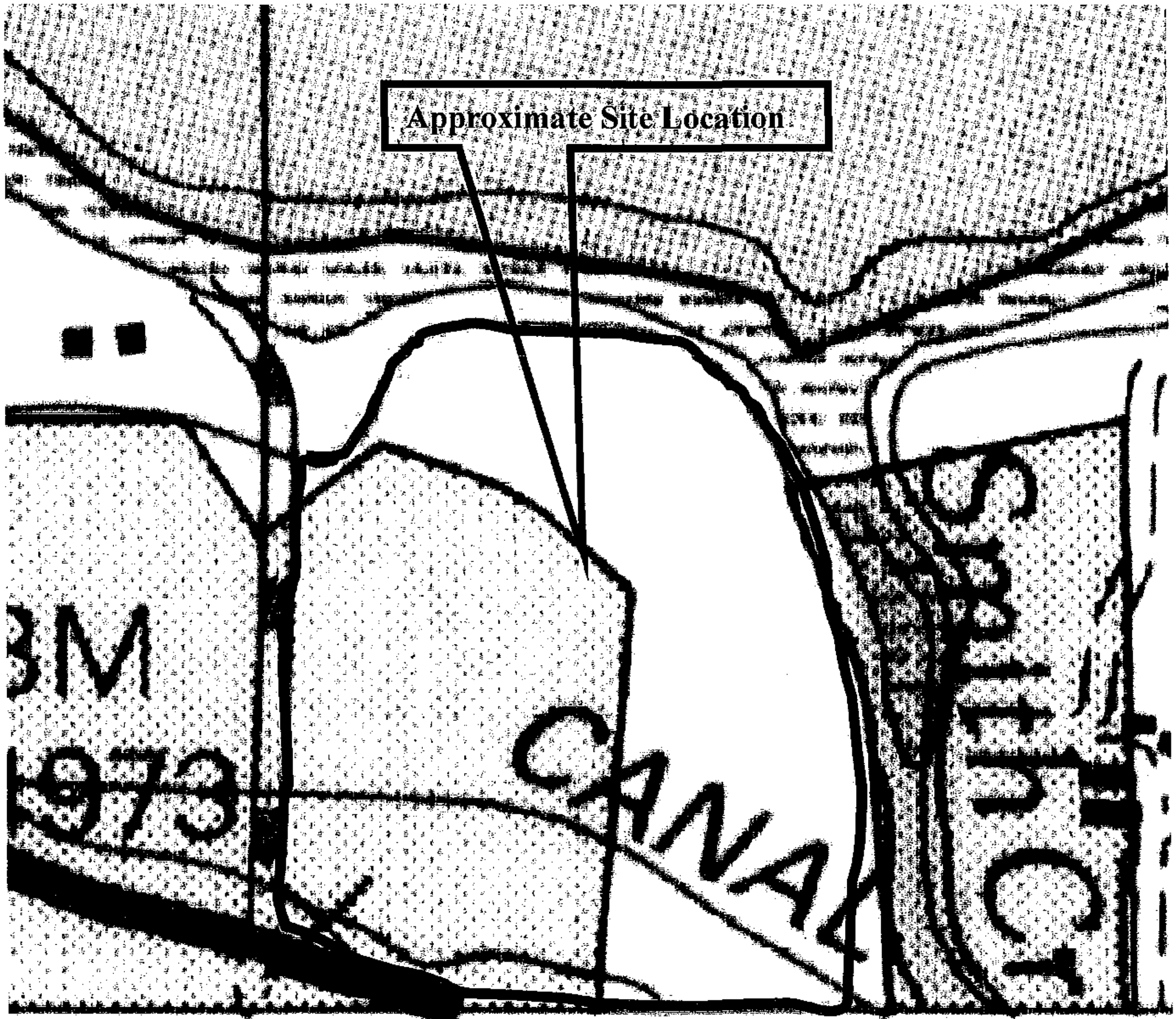
The findings and recommendations presented in this geotechnical report were prepared in accordance with generally accepted geotechnical engineering principles and practice in this area of Utah at this time. No other warranty or representation, either expressed or implied, is intended in our proposals,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

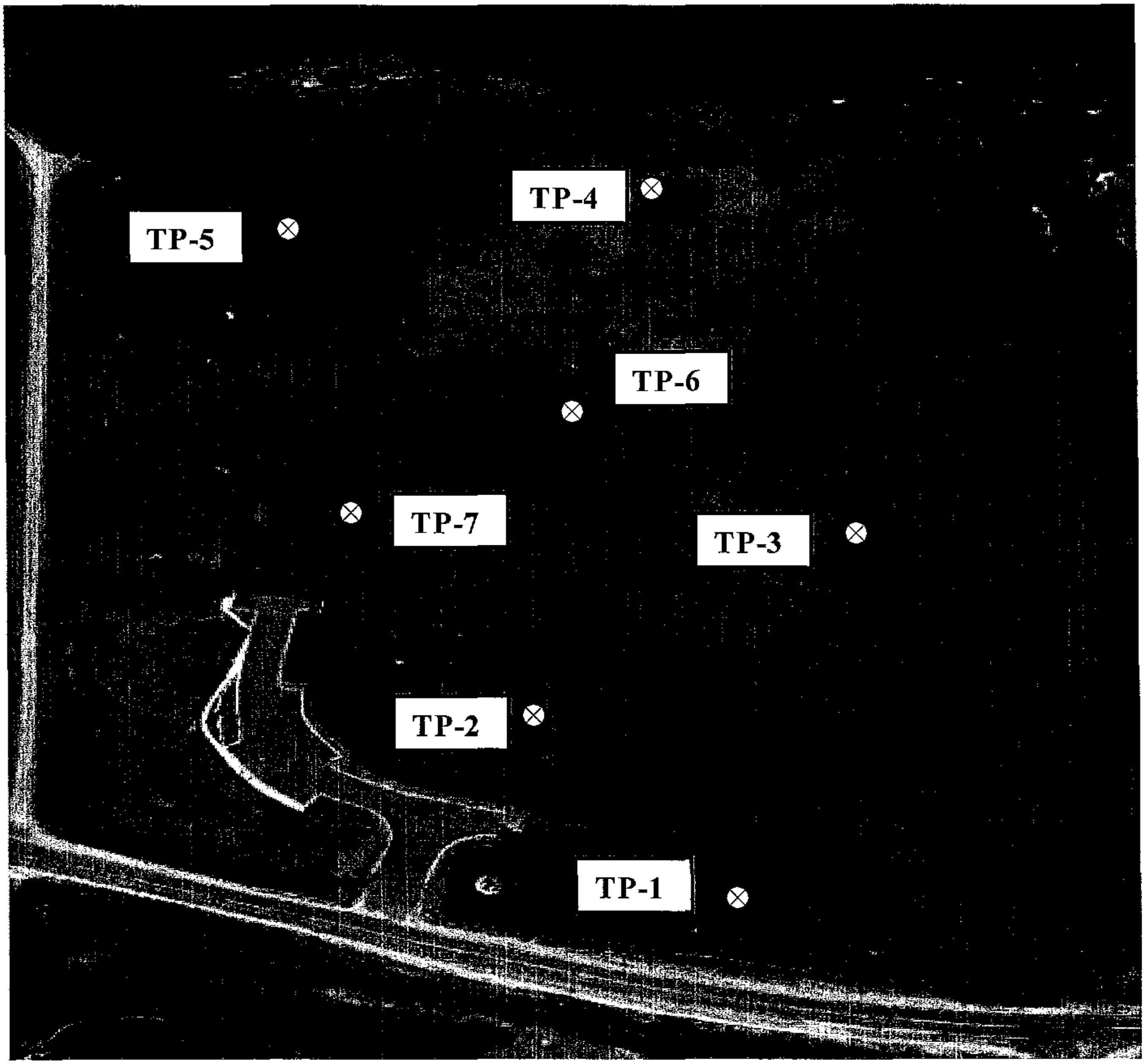


(cida.usgs.gov)

PROJECT NO.: 12-0941G	Earthtec Engineering Inc.	**FIGURE NO.:** 1

AERIAL PHOTOGRAPH SHOWING LOCATION OF TEST PITS

EDGEWATER ESTATES, HUNTSVILLE, UT



⊗ **Approximate Location of Test Pits (Google Earth)**

PROJECT NO.: 12-0941G	Earthtec Engineering Inc.	**FIGURE NO.:** 2

TEST PIT LOG

NO.: TP-1

PROJECT: Edgewater Estates
CLIENT: Bertoldi Architects
LOCATION: See Figure 2
OPERATOR: C.E. Butter Construction
EQUIPMENT: Rubber-tire backhoe
DEPTH TO WATER; INITIAL ▽ **:**

PROJECT NO.: 12-0941G
DATE: 07/17/12 - 07/17/12
ELEVATION: Not Measured
LOGGED BY: SAS
AT COMPLETION ▼ **:**

Depth (Ft.)	Graphic Log	USCS	Description	Samples	TEST RESULTS							
					Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0			Topsoil, very dry, black to dark brown, organic rich									
1												
2		TOPSOIL										
3				☒								
4		CL	Lean Clay (CL), very stiff (estimated), dry to slightly moist, dark brown to brown, minor thin organic rooting to 4 feet, moderate pinhole texture									
5												
6		SM	Silty Sand, dense (estimated), moist, brown	☒	10		26	NP	0	80	20	
7			Lean Clay with sand, stiff (estimated), moist, light brown, minor pinhole texture									
8				▥								
9		CL										
10												
11			cobbles up to 4 inches in diameter below 10 feet									
12			MAXIMUM DEPTH EXPLORED 11 FEET									
13												
14												

Notes: No groundwater encountered.

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

LOG OF TESTPIT 12-0941G.GPJ EARTHTEC.GDT 8/6/12

PROJECT NO.: 12-0941G

Earthtec Engineering Inc.

FIGURE NO.: 3

TEST PIT LOG
NO.: TP-2

PROJECT: Edgewater Estates
CLIENT: Bertoldi Architects
LOCATION: See Figure 2
OPERATOR: C.E. Butter Construction
EQUIPMENT: Rubber-tire backhoe
DEPTH TO WATER; INITIAL ∇ :

PROJECT NO.: 12-0941G
DATE: 07/17/12 - 07/17/12
ELEVATION: Not Measured
LOGGED BY: SAS
AT COMPLETION ▼ :

					TEST RESULTS							
Depth (Ft.)	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0	▩	FILL	Fill: comprised of sand and gravels, slightly moist, light brown									
1		TOPSOIL	Topsoil, dry, black to dark brown, organic rich									
2	▨	CL	Lean Clay, very stiff (estimated), dry, dark brown to brown, minor pinhole texture, minor thin organics									
3	▨			▥								
4	▨											
5	▨		becoming orange-brown from 4.5 to 6 feet	☒								
6	░	SM	Silty Sand, medium dense (estimated), dry to slightly moist, olive, some gravel, minor to moderate iron oxide staining									
7	░											
8	░			☒	16		22	NP	1	76	23	
9	░											
10	░											
11			MAXIMUM DEPTH EXPLORED 10.5 FEET									
12												
13												
14												

Notes: No groundwater encountered.

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

PROJECT NO.: 12-0941G

Earthtec Engineering Inc.

FIGURE NO.: 4

TEST PIT LOG
NO.: TP-3

PROJECT: Edgewater Estates
CLIENT: Bertoldi Architects
LOCATION: See Figure 2
OPERATOR: C.E. Butter Construction
EQUIPMENT: Rubber-tire backhoe
DEPTH TO WATER; INITIAL ▽ :

PROJECT NO.: 12-0941G
DATE: 07/17/12 - 07/17/12
ELEVATION: Not Measured
LOGGED BY: SAS
AT COMPLETION ▼ :

Depth (Ft.) 0	Graphic Log	USCS	Description	Samples	TEST RESULTS Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
1	▩	TOPSOIL	Topsoil, dry, dark brown, organic rich									
2	▨		Lean Clay, very stiff (estimated), dry, dark brown to brown, some fissures up to 1/4 inch wide in material from 1 to 4 feet									
3	▨	CL		▥	11	104	44	26	0	1	99	C
4	▨		orange-brown from 4 to 5 feet	☒								
5	▨		Clayey Sand, very dense (estimated), light brown, moderate pinhole texture, contains moderate weathered sandstone									
6	▨			☒								
7	▨	SC										
8	▨											
9	▨											
10			MAXIMUM DEPTH EXPLORED 9.5 FEET									
11												
12												
13												
14												

Notes: No groundwater encountered.

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

PROJECT NO.: 12-0941G

Earthtec Engineering Inc.

FIGURE NO.: 5

TEST PIT LOG
NO.: TP-4

PROJECT: Edgewater Estates
CLIENT: Bertoldi Architects
LOCATION: See Figure 2
OPERATOR: C.E. Butter Construction
EQUIPMENT: Rubber-tire backhoe
DEPTH TO WATER; INITIAL ∇ :

PROJECT NO.: 12-0941G
DATE: 07/17/12 - 07/17/12
ELEVATION: Not Measured
LOGGED BY: SAS
AT COMPLETION ▼ :

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0		TOPSOIL	TOPSOIL, dry, brown, organic rich									
1		CL	Lean Clay with gravels and cobbles, gravels and cobbles in matrix, stiff (estimated), slightly moist to moist, brown									
2												
3												
4				☒								
5												
6												
7				☒								
8		SANDSTONE	Weathered Sandstone, slightly moist, olive									
9			MAXIMUM DEPTH EXPLORED 8.5 FEET									
10												
11												
12												
13												
14												

Notes: No groundwater encountered.

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

PROJECT NO.: 12-0941G

Earthtec Engineering Inc.

FIGURE NO.: 6

TEST PIT LOG

NO.: TP-5

PROJECT: Edgewater Estates
CLIENT: Bertoldi Architects
LOCATION: See Figure 2
OPERATOR: C.E. Butter Construction
EQUIPMENT: Rubber-tire backhoe
DEPTH TO WATER; INITIAL ▽ :

PROJECT NO.: 12-0941G
DATE: 07/17/12 - 07/17/12
ELEVATION: Not Measured
LOGGED BY: SAS
AT COMPLETION ▼ :

Depth (Ft.)	Graphic Log	USCS	Description	Samples	TEST RESULTS							
					Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0			Topsoil, dry, brown, organic rich									
1		TOPSOIL										
2												
3			Lean Clay with sand, very stiff (estimated), dry, brown, some fissures up to 1/4 inch wide in material, moderate to minor organics									
4												
5		CL		▯	10		40	24	1	18	81	DS
				☒								
6												
7			minor pinhole texture below 6.5 feet									
8			Sandy Lean Clay, stiff (estimated), moist, light brown, moderate iron oxide staining									
9												
10		CL										
11				▯	33	85	43	22	0	42	58	C
			MAXIMUM DEPTH EXPLORED 11 FEET									
12												
13												
14												

Notes: No groundwater encountered.

Tests Key

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

PROJECT NO.: 12-0941G

Earthtec Engineering Inc.

FIGURE NO.: 7

LOG OF TESTPIT 12-0941G.GPJ EARTHTEC.GDT 8/2/12

TEST PIT LOG

NO.: TP-6

PROJECT: Edgewater Estates
CLIENT: Bertoldi Architects
LOCATION: See Figure 2
OPERATOR: C.E. Butter Construction
EQUIPMENT: Rubber-tire backhoe
DEPTH TO WATER; INITIAL ▽ :

PROJECT NO.: 12-0941G
DATE: 07/17/12 - 07/17/12
ELEVATION: Not Measured
LOGGED BY: SAS
AT COMPLETION ▼ :

Depth (Ft.)	Graphic Log	USCS	Description	Samples	TEST RESULTS							
					Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0 1		TOPSOIL	Topsoil, dry, brown, organic rich									
2 3 4		CL	Lean Clay, stiff (estimated), dry, brown, minor pinhole texture, some fissures up to 1/4 inch wide in material	☒								
5 6 7		SC	Clayey Sand, dense (estimated), dry to slightly moist, light brown, moderate cobbles up to 4 inches in diameter below 5.5 feet	☒								
8 9 10		SW-SM	Well Graded Sand with silt and gravel, dense (estimated), slightly moist, olive	☒	4		14	NP	24	70	6	
11 12 13 14			MAXIMUM DEPTH EXPLORED 10 FEET									

Notes: No groundwater encountered.

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

PROJECT NO.: 12-0941G

Earthtec Engineering Inc.

FIGURE NO.: 8

TEST PIT LOG

NO.: TP-7

PROJECT: Edgewater Estates
CLIENT: Bertoldi Architects
LOCATION: See Figure 2
OPERATOR: C.E. Butter Construction
EQUIPMENT: Rubber-tire backhoe
DEPTH TO WATER; INITIAL ▽ :

PROJECT NO.: 12-0941G
DATE: 07/17/12 - 07/17/12
ELEVATION: Not Measured
LOGGED BY: SAS
AT COMPLETION ▼ :

Depth (Ft.) 0	Graphic Log	USCS	Description	Samples	TEST RESULTS Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
1		TOPSOIL	Topsoil, dry, brown, organic rich									
2		CL	Lean Clay, stiff (estimated), dry, brown, minor pinhole texture, some fissures up to 1/4 inch wide in material									
3				☒ ‖								
4												
5		SC	Clayey Sand, medium dense (estimated), slightly moist, light brown, moderate pinhole texture, moderate cobbles up to 2 inches in diameter									
6												
7				‖								
8												
9		SM	Silty Sand, dense (estimated), slightly moist to moist, olive, heavy iron oxide staining									
10				‖								
11			MAXIMUM DEPTH EXPLORED 10 FEET									
12												
13												
14												

Notes: No groundwater encountered.

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

PROJECT NO.: 12-0941G

Earthtec Engineering Inc.

FIGURE NO.: 9

LEGEND

PROJECT: Edgewater Estates
CLIENT: Bertoldi Architects
DATE: 07/17/12 - 07/17/12
LOGGED BY: SAS

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

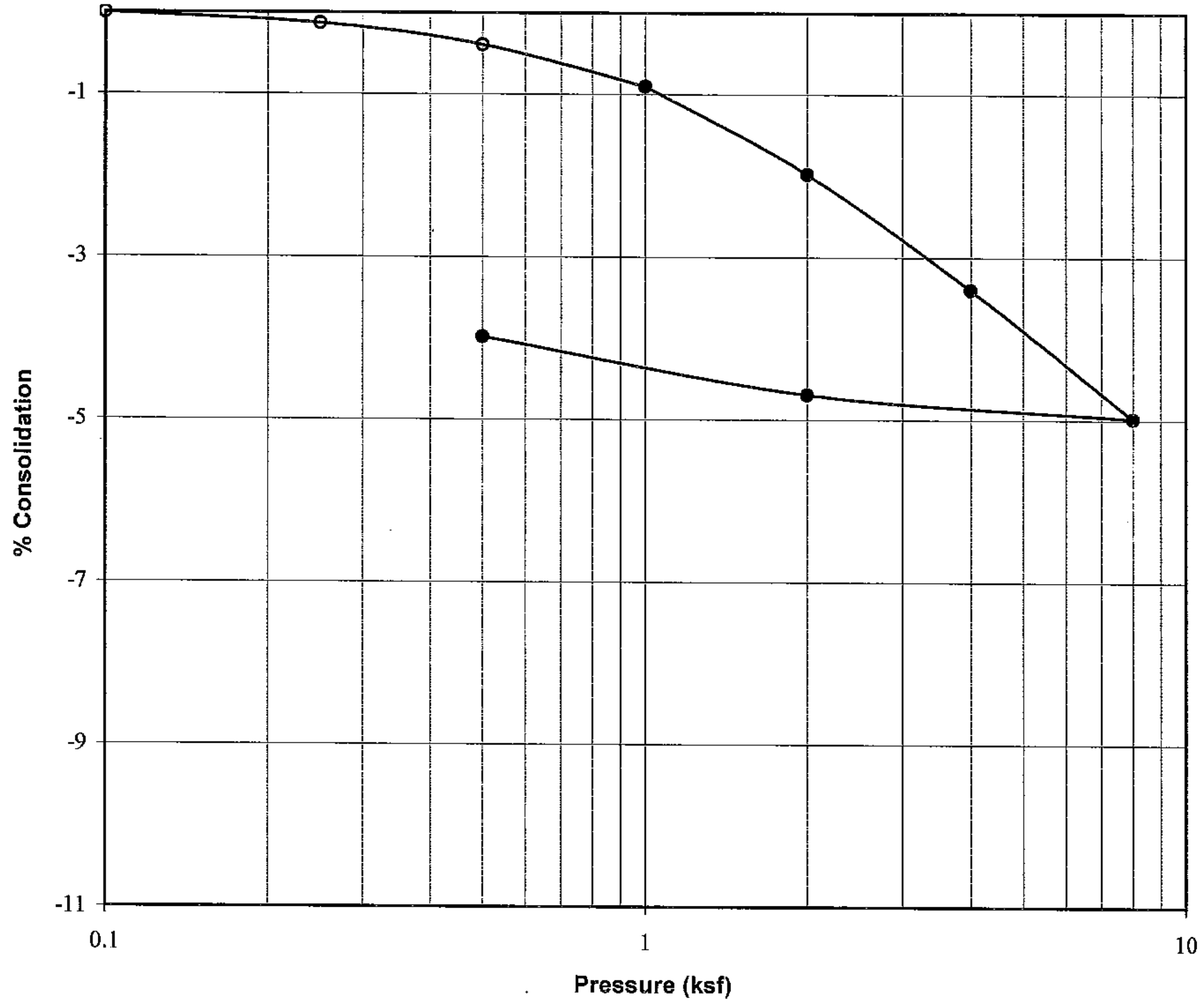
NOTES:
1. The logs are subject to the limitations, conclusions, and recommendations in this report.
2. Results of tests conducted on samples recovered are reported on the logs and any applicable graphs.
3. Strata lines on the logs represent approximate boundaries only. Actual transitions may be gradual.
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.: 12-0941G

Earthtec Engineering Inc.

FIGURE NO.: 10

CONSOLIDATION - SWELL TEST



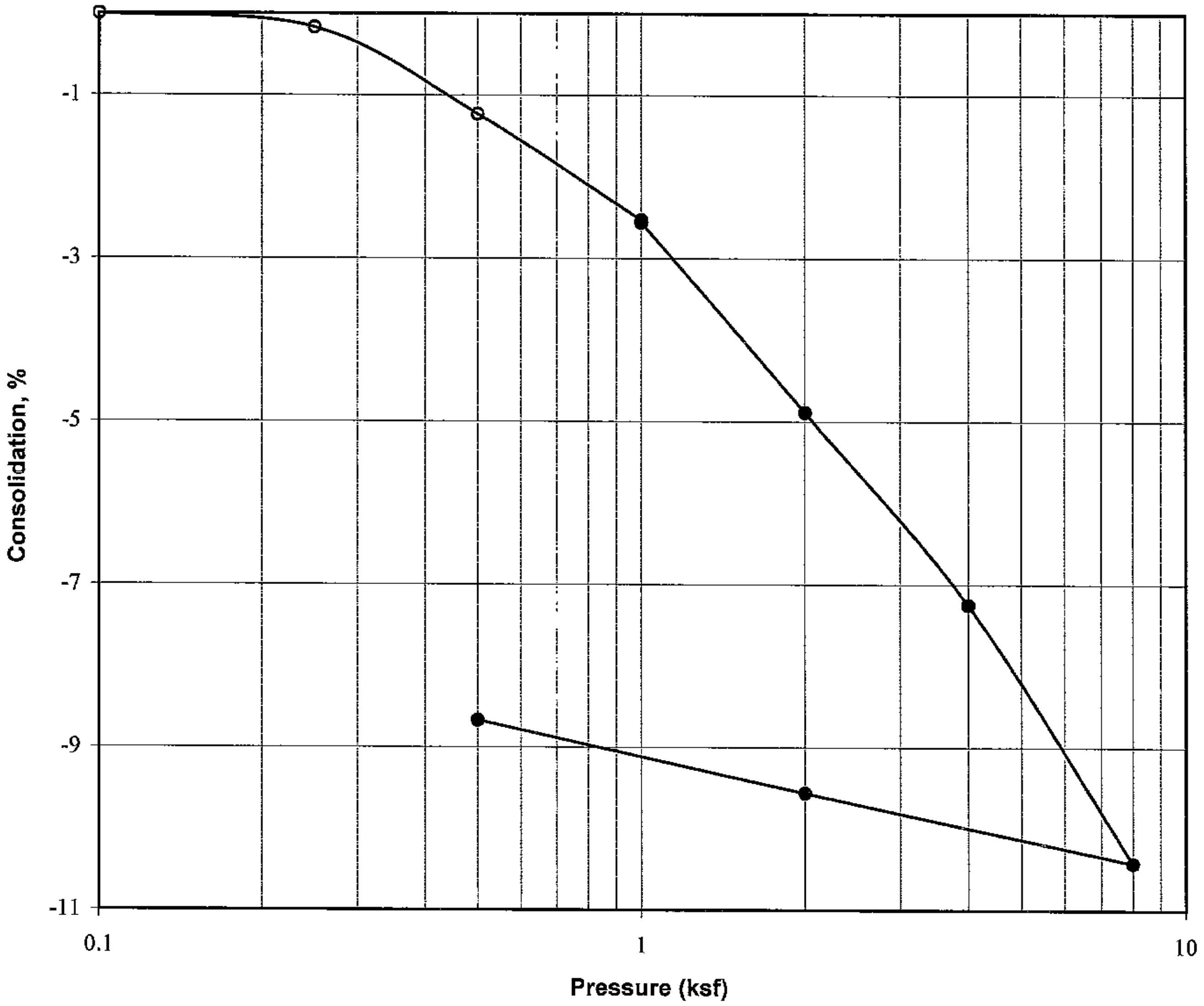
Project:	Edgewater Estates
Location:	TP-3
Sample Depth, ft:	3
Description:	Shelby Tube
Soil Type:	Lean Clay (CL)
Natural Moisture, %:	11
Dry Density, pcf:	104
Liquid Limit:	44
Plasticity Index:	26
Water Added at:	1 ksf
Percent Collapse:	0.0

PROJECT NO.: 12-0941G

Earthtec Engineering Inc.

FIGURE NO.: 11

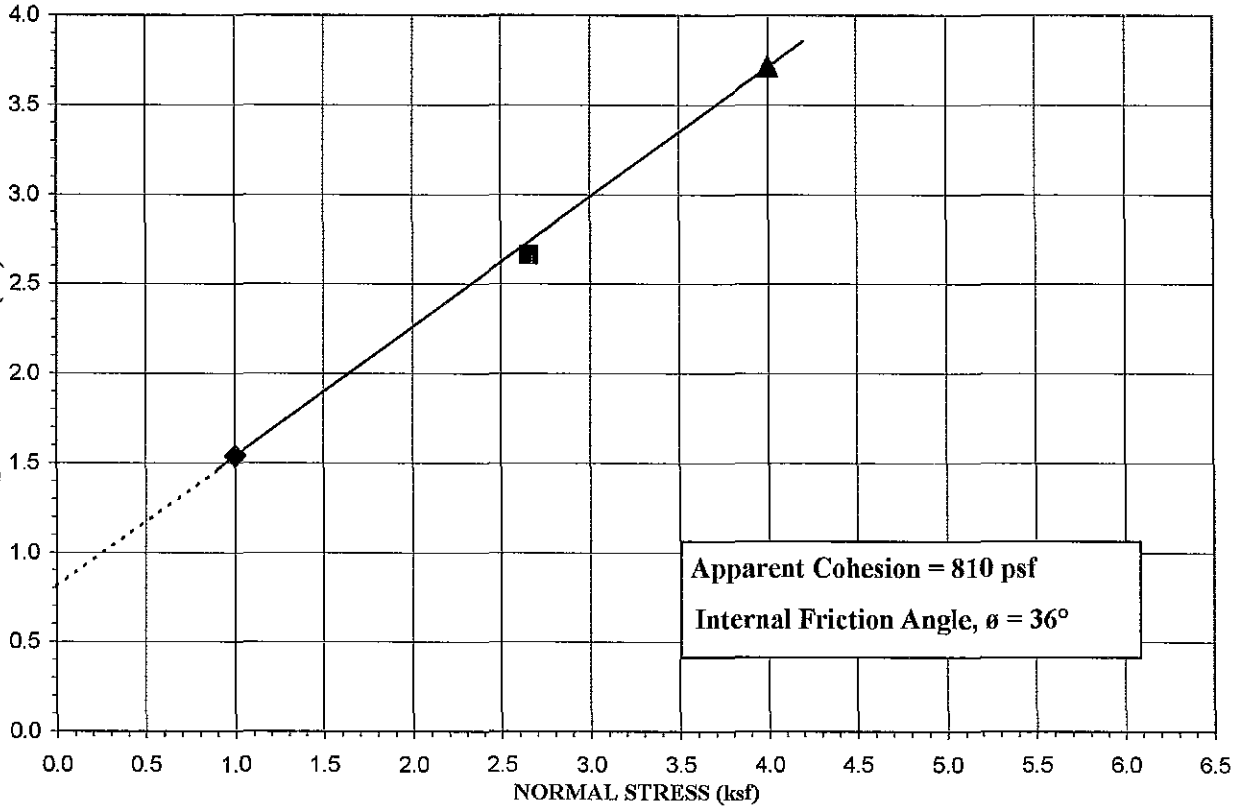
CONSOLIDATION - SWELL TEST



Project:	Edgewater Estates
Location:	TP-5
Sample Depth, ft:	10½
Description:	Shelby Tube
Soil Type:	Sandy Lean Clay (CL)
Natural Moisture, %:	33
Dry Density, pcf:	85
Liquid Limit:	43
Plasticity Index:	22
Water Added at:	1 ksf
Percent Collapse:	0.0

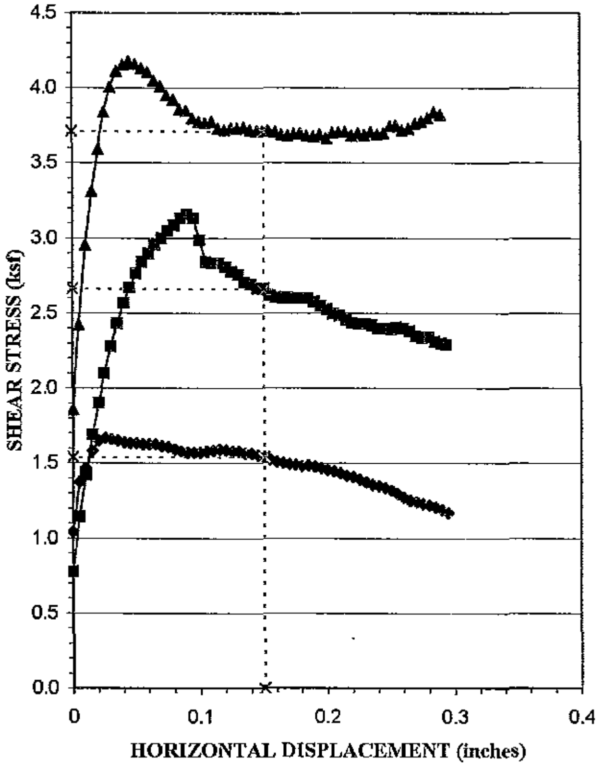
PROJECT NO.: 12-0941G	Earthtec Engineering Inc.	**FIGURE NO.:**	12

DIRECT SHEAR TEST



Apparent Cohesion = 810 psf

Internal Friction Angle, ø = 36°



Source: 5	**Depth:** 4.5 ft		
Type of Test:	Consolidated Drained/Saturated		
Test No. (Symbol)	**1 (◆)**	**2 (■)**	**3 (▲)**
Sample Type	Undisturbed		
Initial Height, in.	1	1	1
Diameter, in.	2.4	2.4	2.4
Dry Density Before, pcf	102.3	101.8	102.5
Dry Density After, pcf	103.8	103.5	103.7
Moisture % Before	10.3	10.3	10.3
Moisture % After	22.9	22.7	22.8
Normal Load, ksf	1.0	2.7	4.0
Shear Stress, ksf	1.54	2.66	3.71
Strain Rate	.00009704 IN/SEC		

Sample Properties	
Cohesion, psf	810
Friction Angle, ϕ	36
Liquid Limit, %	40
Plasticity Index, %	24
Percent Gravel	1
Percent Sand	18
Percent Passing No. 200 sieve	81
Classification	Lean Clay with sand (CL)

PROJECT: Edgewater Estates

PROJECT NO.: 12-0941G

Earthtec Engineering, Inc.

FIGURE NO.: 13

PROJECT NO.: 120941

Earthtec Engineering Inc.

FIGURE NO.: 14

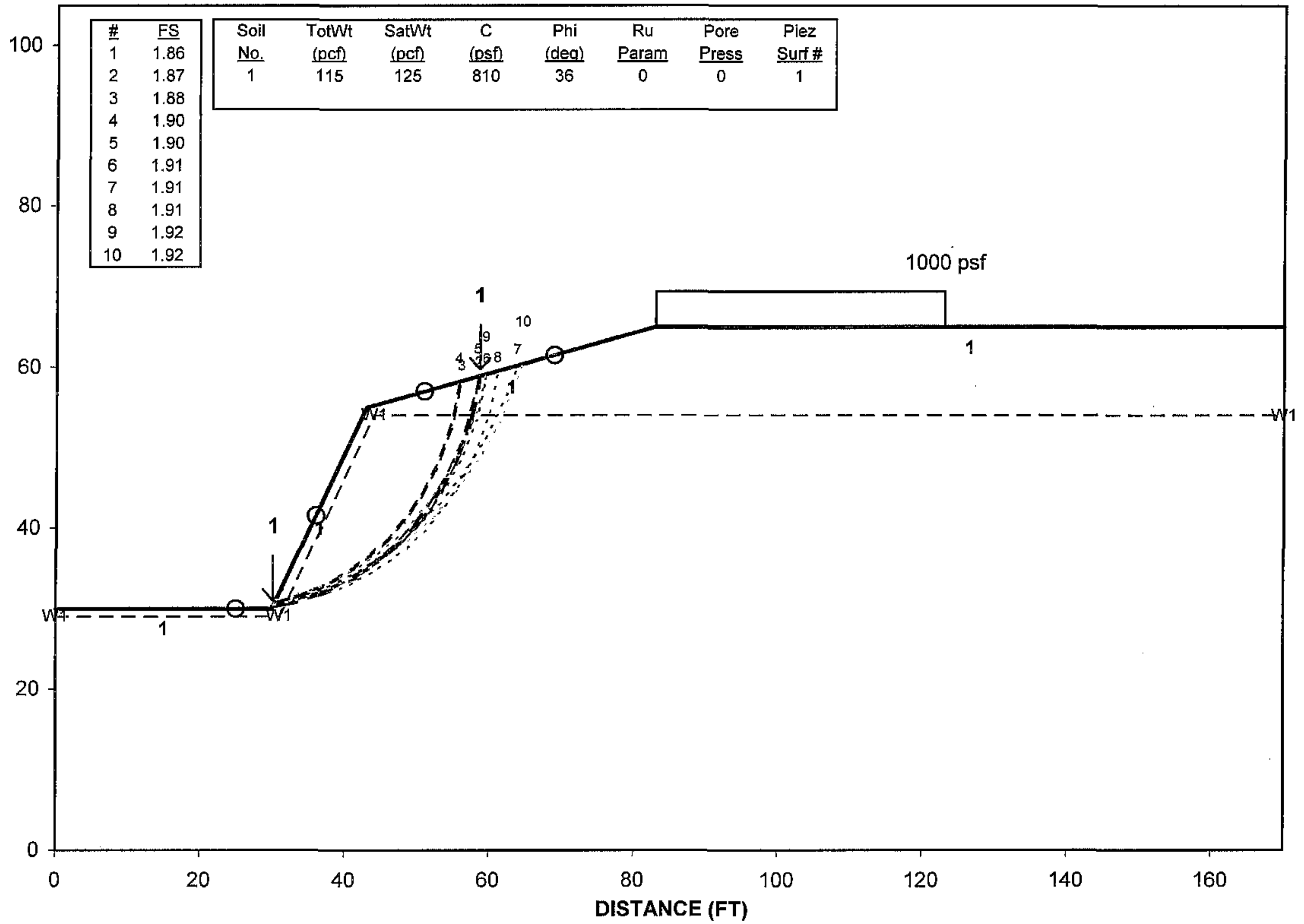
STABILITY RESULTS

Edgewater Estates Static

Ten Most Critical Surfaces. 120941G .OPT Run By: Earthtec 8-08-12

#	FS
1	1.86
2	1.87
3	1.88
4	1.90
5	1.90
6	1.91
7	1.91
8	1.91
9	1.92
10	1.92

Soil No.	TotWt (pcf)	SatWt (pcf)	C (psf)	Phi (deg)	Ru Param	Pore Press	Piez Surf #
1	115	125	810	36	0	0	1

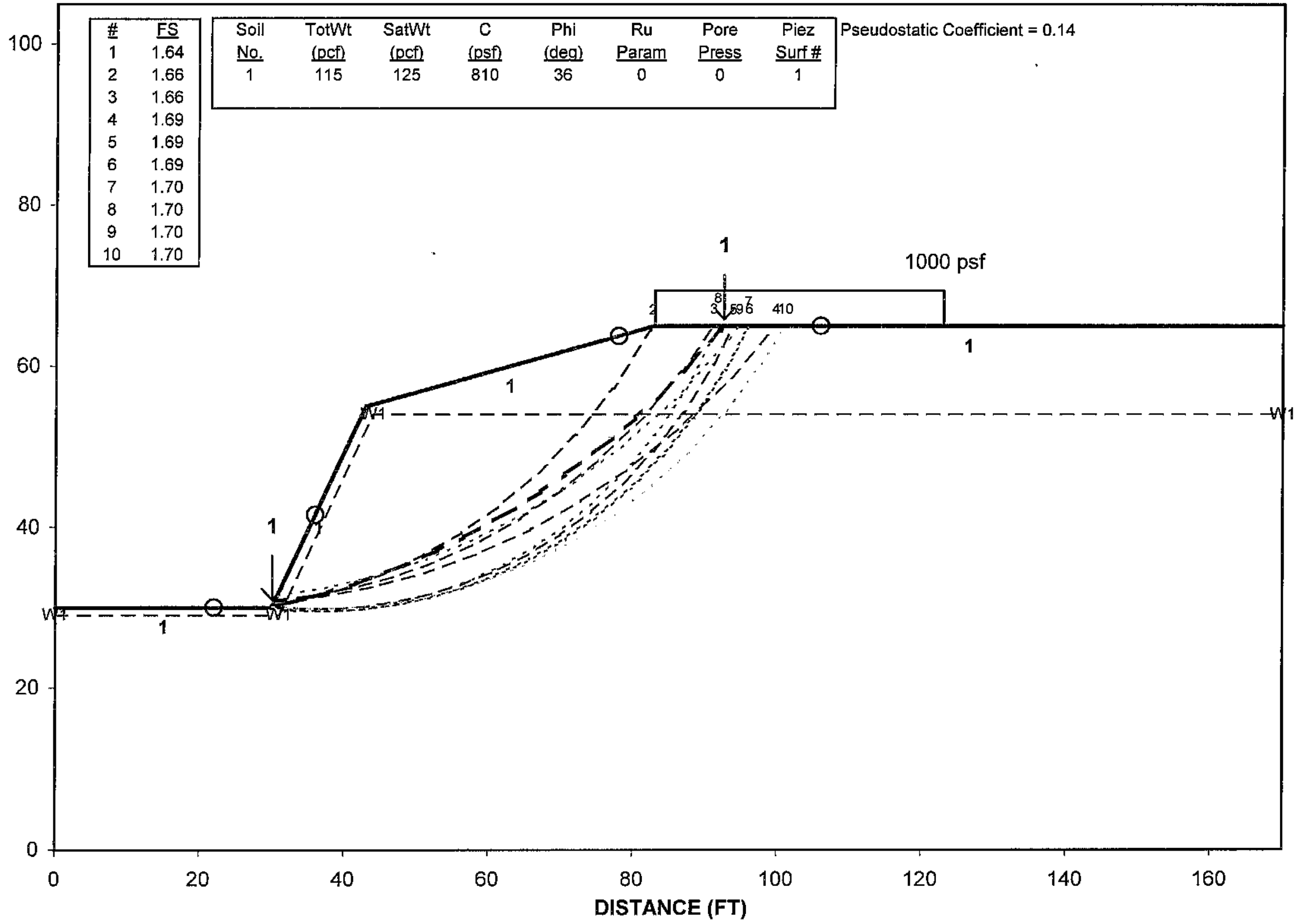


STABILITY RESULTS

PROJECT NO.: 120941

Edgewater Estates Seismic

Ten Most Critical Surfaces. 120941S .OPT Run By: Earthtec 8-08-12



#	FS
1	1.64
2	1.66
3	1.66
4	1.69
5	1.69
6	1.69
7	1.70
8	1.70
9	1.70
10	1.70

Soil No.	TotWt (pcf)	SatWt (pcf)	C (psf)	Phi (deg)	Ru Param	Pore Press	Piez Surf #
1	115	125	810	36	0	0	1

FIGURE NO.: 15