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GEOTECHNICAL STUDY
Fairways at Wolf Creek Subdivision Phases 4 & 5
4700 East 4000 North
Eden, Utah

Project No. 167003

March 8, 2016

Prepared For:

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1.0 EXECUTIVE SUMMARY

This report presents the results of Earthtec Engineering's completed geotechnical study for the Fairways at Wolf Creek Subdivision Phases 4 & 5 in Eden, Utah. This executive summary provides a general synopsis of our recommendations and findings. Details of our findings, conclusions, and recommendations are provided within the body of this report.

- The subject property is approximately 14 acres and is proposed to be developed to 41 residential lots. The residential structures will consist of conventionally framed, one- to two-story buildings. We anticipate foundation loads for the proposed structures will not exceed 4,000 pounds per linear foot for bearing wall, 25,000 pounds for column loads, and 100 pounds per square foot for floor slabs
- Our field exploration included the excavation of six (6) test pits to depth of 10 to 14 feet below the existing ground surface. Groundwater was encountered at depths of approximately 6 to 9½ feet below the existing ground surface.
- The subsurface soils encountered generally consisted of topsoil overlying near-surface medium stiff to stiff clay, and dense to very dense sand and gravel. All topsoil should be removed beneath the entire building footprints, exterior flatwork, and pavements prior to construction.
- The native soils have a slight potential for collapse (settlement) and a moderate to high potential for compressibility under increased moisture contents and anticipated load conditions.
- Conventional strip and spread footings may be used to support the structures, with foundations placed entirely on a minimum of 24 inches of firm, undisturbed, uniform granular soils (i.e. completely on sand or gravel soils, etc.), or entirely on a minimum 24 inches of properly placed, compacted, and tested structural fill extending to undisturbed native soils.
- Minimum roadway section consists of 3 inch asphalt, 10 inches road-base. Areas that are soft or deflect under construction traffic should be removed and replaced with granular material or structural fill.

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 in this report are followed and implemented during design and construction.

Failure to consult with Earthtec Engineering (Earthtec) regarding any changes made during design and/or construction of the project from those discussed herein relieves Earthtec from any liability arising from changed conditions at the site. We also strongly recommend that Earthtec observes the building excavations to verify the adequacy of our recommendations presented herein, and that Earthtec performs materials testing and special inspections for this project to provide continuity during construction.

2.0 INTRODUCTION

The project is located at approximately 4700 East 4000 North in Eden, Utah. The general location of the site is shown on Figure No. 1, *Vicinity Map* and Figure No. 2, *Site Plan Showing Location of Test Pits*, at the end of this report. The purposes of this study are 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 residential 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 project as described to us by Mr. Rick Everson with Watts Enterprises, and consists of developing the approximately 14-arce existing parcel into 41 lot residential subdivision. The residential structures will consist of conventionally framed, one- to two-story buildings We have based our recommendations in this report on the assumption that or anticipated foundation loads for the proposed structures will not exceed 4,000 pounds per linear foot for bearing wall, 25,000 pounds for column loads, and 100 pounds per square foot for floor slabs. If structural loads will be greater Earthtec should be notified so that we may review our recommendations and make modifications, if necessary.

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 residential streets will be constructed.

4.0 GENERAL SITE DESCRIPTION

4.1 Site Description

At the time of our subsurface exploration the site was an undeveloped lot covered in approximately 1 to 2 feet of snow. The vegetation observed at the test pit locations consisted of grass, small bushes, and weeds. The site is located on northeast side of Ogden Valley and the site generally slopes to the southwest, a small hill is located at approximately Lot 23. The site also has a small ravine or drainage on the east site of the property. The ground surface appears to slope more than 15 percent grade, we anticipate up to 4 of cut and fill may be required for site grading and road construction. The lot was bounded on the north and west by vacant property on the east and south by a golf course and residential lots.

4.2 Geologic Setting

The subject property is located in the foothill on northeast side of Ogden Valley. The proposed subdivision is between 5220 and 5320 feet above sea level. These foothills start form the southwestern margin of the Ogden Valley, a northwest to southeast trending valley located between the Wasatch Mountains to the west and the southern end of the Bear River Range to the east. The Ogden Valley is part of the Wasatch Hinterlands Section of the Middle Rocky Mountain Physiographic Province. Stokes describes the Wasatch Hinterlands as a belt of mixed, moderately rugged topography located on the east side of the Wasatch Range that has varied topography, with hilly areas dominating valley areas. The Ogden Valley is currently occupied by Pineview Reservoir, a manmade lake formed by damming the Ogden River and several of its tributaries, as well as the towns of Huntsville, Eden, and Liberty.

The Ogden Valley was prehistorically occupied by an arm of Lake Bonneville, a Pleistocene age, fresh water lake that covered most of northwestern Utah and parts of northeastern Nevada. Sediment deposited by the lake are still present within portions of the valley and at places within the foothills surrounding the valley below the elevation of the high stand of the lake which was between approximately 5,170 and 5,200 feet above sea level. The Great Salt Lake of northwestern Utah is a remnant of ancient Lake Bonneville.

The geology at the location of the subject lot and surrounding area has been mapped by Sorenson and Crittenden 1979[1]. The geology at the location of the subject site (Trappers Ridge & Fairways Subdivisions) as shown on the referenced map is described as boulder, colluvium and slopewash deposits, chiefly along eastern margin of Ogden Valley; in part lag from Tertiary units (Map Unit Qcs, Holocene).

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 January 28, 2016 and February 3, 2016 by the excavation of six (6) test pits to depth of 10 to 14 feet below the existing ground surface using a a track-mounted excavator. The approximate locations of the test pits are shown on Figure No. 2, *Site Plan*

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[1] Geologic Map of the Huntsville Quadrangle, Weber and Cash Counties, Utah, by Martin L. Sorensen and Max D. Crittenden, Jr, 1979, USGS GQ-1503

Showing Location of Test Pits. Graphical representations and detailed descriptions of the soils encountered are shown on Figure Nos. 3 through 8, *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 No. 9, *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 Lindon, 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.

5.2 Percolation Testing

Percolation tests were conducted in Test Pit 3 (TP-3), Test Pit 5 (TP-5), and Test Pit 6 (TP-6). The tests were performed at the specified depth by digging a small hole with a shovel, filling the hole with water, by filling the auger with water and measuring the water loss with time. The tests were performed several times and the final measured rate is shown in the table below.

Table 1: Percolation Test Results

Test Pit No.	Depth (ft.)	Percolation Rate (min/in)	Soil Type
TP-3	5	77	GC
TP-3	7½	26	CL
TP-5	5	58	SC
TP-5	8	62	SC
TP-6	5	25	SC
TP-6	7	19	SC

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, dry density tests, liquid and plastic limits determinations, mechanical (partial) gradation analyses, one-dimensional consolidation tests, and direct shear tests. The table below summarizes the laboratory test results, which are also included on the attached *Test Pit Logs* at the respective sample depths, on Figure Nos. 10 to 12, *Consolidation-Swell Test,* and on Figure Nos. 13 and 14, *Direct Shear Test*.

Table 2: 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	2	13	-	50	21	54	24	22	GM
TP-3	8	15	107	41	19	31	18	51	CL
TP-4	6	5	110	49	25	78	12	10	GP-GC
TP-5	10	14	-	-	-	20	50	30	SC
TP-5	12	20	-	-	-	32	38	30	SC
TP-6	4	24	96	53	32	23	55	22	SC

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. The native soils have a slight potential for collapse (settlement) and a moderate to high potential for compressibility under increased moisture contents and anticipated load conditions.

A direct shear test was performed on the native soils in TP-4 at a depth of 6 feet below existing site grades, the results indicated an apparent cohesion of 280 psf and an internal friction angle of 37 degrees. A direct shear test was performed on the native soils in TP-5 at a depth of 12 feet below existing site grades, the results indicated an apparent cohesion of 370 psf and an internal friction angle of 31 degrees.

7.0 SUBSURFACE CONDITIONS

7.1 Soil Types

On the surface of the site, we encountered topsoil which is estimated to extend about 1½ to 2 feet in depth at the test pit locations. Below the fill we encountered layers of clay, sand, and gravel extending to depth of 10 to 14 feet below the existing ground surface. Graphical representations and detailed descriptions of the soils encountered are shown on Figure Nos. 3 through 8, *Test Pit Log* at the end of this report. Based on our experience and observations during field exploration, the clay soils visually ranged from medium stiff to stiff in consistency and the sand and gravel soils visually had a relative density varying from of medium dense to very dense.

7.2 Groundwater Conditions

Groundwater was encountered at depths of approximately 6 to 9½ feet below the existing ground surface. Note that groundwater levels will fluctuate in response to the season, precipitation, 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 foundations, floor slabs, exterior concrete flatwork, and pavement areas. We encountered topsoil on the surface of the site. The fill (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 also may 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 there is more than 30 feet of relief from east to west, we anticipate that up to 4 feet of fill may be placed in some areas of the site during grading. If more than 4 feet of grading fill will be placed above the existing surface (to raise site grades), Earthtec should be notified so that we may provide additional recommendations, if required. 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[2] requirements for Type B soils

8.3 Fill Material Composition

The native soils vary from test pit to test pit some of the soils appear to be suitable for use as placed and compacted structural fill provided the material meets the requirements for structural fill and any existing debris and particles larger than 6 inches in diameter are removed proir to use. Excavated soils, including clay, 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, pavements, etc. We recommend that a professional engineer or geologist verify that the structural fill to be used on this project meets the requirements, stated below. We recommend that structural fill consist of imported sandy/gravelly soils meeting the following requirements in the table below:

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

Table 3: 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 – 25
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 recommendations 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 and the variety of soils 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.

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

Table 4: 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 soil 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 moisture contents within ±2 percent of the optimum moisture content, as determined by ASTM D-1557, will facilitate compaction. Typically, the further the moisture content deviates 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 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, partially loaded equipment, tracked equipment, by working in dry times of the year, and/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. Materials which are more angular and coarse may require thinner lifts in order to achieve compaction. 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 AND GEOLOGIC 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_0.

The site is located at approximately 41.334 degrees latitude and -111.833 degrees longitude from the approximate center of the site. The IRC site value for this property is 0.643g. The design spectral response acceleration parameters are given below.

Table 5: Design Acceleration for Short Period

S_S	F_a	Site Value (S_{DS})
		2/3 S_S*F_a
0.944	1.023	0.643g

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

The subject property is located within the Intermountain Seismic Belt where the potential for active faulting and related earthquakes is present. Structurally the Ogden Valley is a down-faulted block bound on the northeast by the northwest to southeast oriented Northeastern Margin Fault and on the southwest by the northwest to southeast oriented Southwestern Margin Fault, as described by Hecker. The northwest to southeast oriented North Fork Fault also runs below the central portion of the Ogden Valley. None of these faults are mapped by Hecker to be active (showing evidence of movement during Holocene (past 10,000 years) time).

9.3 Liquefaction Potential

According to current liquefaction maps[3] for Weber County, liquefaction potential at the site is not determined. Liquefaction can occur when saturated subsurface soils below groundwater lose their inter-granular strength due to an increase in soil pore water 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.

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 clays and dense to very dense sands and gravels. The soils encountered at this project 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 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 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 structures 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 Strip/Spread Footings

We recommend that conventional strip and spread foundations be constructed entirely on a minimum of 24 inches of firm, undisturbed, uniform granular soils (i.e. completely on sand or gravel soils, etc.), or entirely on a minimum 24 inches of properly placed, compacted, and tested structural fill extending to undisturbed native soils. For foundation design we recommend the

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[3] Utah Geological Survey, Liquefaction-Potential Map For A Part Of Weber County, Utah, Public Information Series 28, August 1994.

following:

- Footings founded on native soils may be designed using a maximum allowable bearing capacity of 1,500 pounds per square foot. Footings founded on a minimum 24 inches of structural fill may be designed using a maximum allowable bearing capacity of 2,000 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 2012 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 groundwater encountered at the site, lowest floor slab depths should be limited to 3 feet below existing site grades. This is intended to provide a minimum of 3 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 a seismic event 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 dependent 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) as backfill material using a 31° friction angle and a dry unit weight of 115 pcf.

Table 6: Lateral Earth Pressures (Static and Dynamic)

Condition	Case	Lateral Pressure Coefficient	Equivalent Fluid Pressure (pcf)
Active	Static	0.32	37
	Seismic	0.42	49
At-Rest	Static	0.48	56
	Seismic	0.66	76
Passive	Static	3.12	359
	Seismic	4.52	520

*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 or structural fill meeting the recommendations presented herein. For concrete or masonry walls shall be selected and constructed in accordance to the provision of Section R404 of the 2012 International Residential Code or sections referenced therein. Retaining wall lateral resistance design should further reference Section R404.4 for reference of Safety Factors.

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

Due to shallow groundwater encountered at the site, lowest floor slab depths should be limited to 3 feet below existing site grades. This is intended to provide a minimum of 3 feet of separation between the observed groundwater condition and the bottom of the floor slab.

Concrete floor slabs and exterior flatwork may be supported on uniform native soils or a minimum of 12 inches of properly placed and compacted structural fill 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 exterior flatwork, we recommend placing a minimum 4 inches of road-base material. Prior to placing the free-draining fill or road-base materials, the native sub-grade 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 sub-grade reaction of 110 pounds per cubic inch. The thickness of slabs supported directly on the ground shall not be less than 3½ inches, as per Section R506.1 of the 2012 International Residential Code.

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:

- The contractor should take precautions to prevent significant wetting of the soil at the base of the excavation. Such precautions may include: grading to prevent runoff from entering the excavation, excavating during normally dry times of the year, covering the base of the excavation if significant rain or snow is forecast, backfill at the earliest possible date, frame floors and/or the roof at the earliest possible date, other precautions that might become evident during construction.

- 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 down spouts designed to discharge well outside of the backfill limits, or at least 10 feet from foundations, whichever is greater.
- Sprinkler nozzles should be aimed away, and all sprinkler components kept at least 5 feet, from foundation walls. Also, sprinklers should not be placed at the top or on the face of slopes. Sprinkler systems should be designed with proper drainage and well maintained. Over-watering should be avoided.
- Any additional precautions which may become evident during construction.

12.2 Subsurface Drainage

Section R405.1 of the 2012 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." Section R310.2.2 of the 2012 International Residential Code states, "Window wells shall be designed for proper drainage by connecting to the building's foundation drainage system." 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 soils observed in the explorations at the depth of foundation consisted primarily of soils which are 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.

- A perforated 4-inch minimum diameter pipe should be installed in all window wells and connected to the foundation drain.
- 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.
- 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 project. The native soils encountered beneath the topsoil during our field exploration were predominantly composed of clays. We estimate that a California Bearing Ratio (CBR) value of 3 is appropriate for these soils. If the concrete flatwork and pavement areas are constructed undocumented fill material and/or topsoil, increased maintenance costs over time should be anticipated.

We anticipate that the traffic volume will be about 400 vehicles a day or less for the residential streets, 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 below.

Table 7: Pavement Section Recommendations

Asphalt Thickness (in)	Compacted Roadbase Thickness (in)	Compacted Subbase Thickness (in)
3	6	8*
3	10*	0

* Stabilization may be required

If the pavement will be required to support 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 SLOPE STABILITY

We evaluated the overall stability of the existing slope with the proposed roadway for the subject subdivision. The test pits preformed near the slope cross-section at the site extended to approximately 10 to 14 feet. The properties of the native soils at the site were estimated using laboratory testing on samples recovered during our field investigations and our experience with similar soils. Direct shear tests were performed on the native soils in encountered at 6 feet and 12 feet below the existing side grades. The results of the test at 6 feet have an internal friction angle of 37 degrees and an apparent cohesion of 280 psf. The results of the test at 12 feet have an internal friction angle of 31 degrees and an apparent cohesion of 370 psf .

For the seismic (pseudostatic) analysis, a peak horizontal ground acceleration of 0.372g for the 2% probability of exceedance in 50 years was obtained for site (grid) locations of 41.334 degrees north latitude and -111.833 degrees west longitude. Typically, one-third to one-half this value is utilized in analysis. Accordingly, a value of 0.186 was used as the pseudostatic coefficient for the stability analysis.

We evaluated the global stability of the proposed 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 configuration analyzed was based aerial photographs, our observations during the field investigation, past and present topographic maps. One cross-section section was analyzed as part of the study.

The configuration of the existing slope that was analyzed at Cross-Section A-A' it started in the fariway for the golf course and extends through the proposed lots and roadway to the top of a local hill. The slope is approximately 40 feet in height, in approximately 400 feet in length, with a maximum slope of the native grade at approximately 20 percent grade.

A water table was conservatively placed at approximately 6 feet at the base of the slope and 9½ feet at the top of the slope.

To model the load imposed on the slope by typical residential buildings and roadway, a 1,500 psf load was modeled approximately 25 feet on either site of the proposed roadway for Cross-

Section A-A'. 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 slope configuration described above meets both these requirements. Placed fill should not exceed 3 feet above existing grades. The slope stability data are attached as Figure Nos. 15 and 16, *Stability Results*. Modifications to the slope, including the construction of retaining walls taller than 4 feet, should be properly designed and engineered.

It should be clearly understood that slope movements or even failure can occur if the slope is undermined or the slope soils become saturated. The property owner and the owner's representatives should be made aware of the risks should these or other conditions occur that could saturate or erode/undermine the soils. Surface water should be directed away from the top and bottom of the slope, the slope should be vegetated with drought resistant plants, and sprinklers should not be placed on the face of the slope.

15.0 GENERAL CONDITIONS

The exploratory data presented in this report was collected to provide geotechnical design recommendations for this project. The explorations 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 explorations may occur and which may be sufficient to require modifications in the design. If during construction, conditions are different than presented in this report, Earthtec should be advised immediately 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 is intended in our proposals, contracts, letters, 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 regarding any changes made during design and construction of the project from those discussed herein. Failure to consult with Earthtec regarding any such changes relieves Earthtec from any liability arising from changed conditions at the site.

To maintain continuity, Earthtec 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 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 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.

Respectfully;

EARTHTEC ENGINEERING

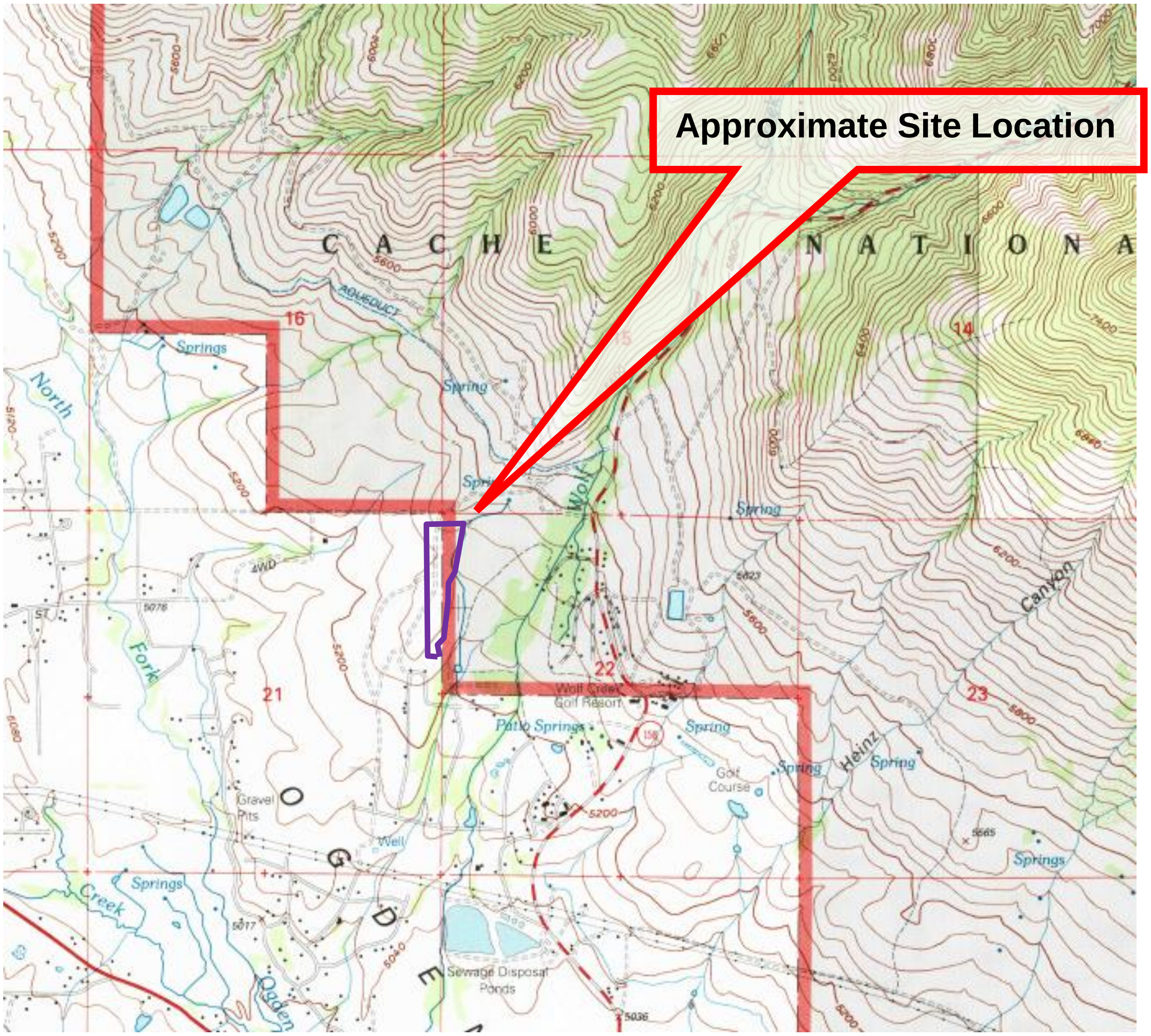
No. 5567049-2202
TIMOTHY ALLAN
MITCHELL
3/8/16

Caleb R. Allred, E.I.T.
Project Engineer

Timothy A. Mitchell, P.E.
Geotechnical Engineer

VICINITY MAP

Fairways At Wolf Creek Subdivision, Phases 4 And 5
4700 East 4000 North
Eden, Utah



Subject Property

(cida.usgs.gov)

N

Not to Scale

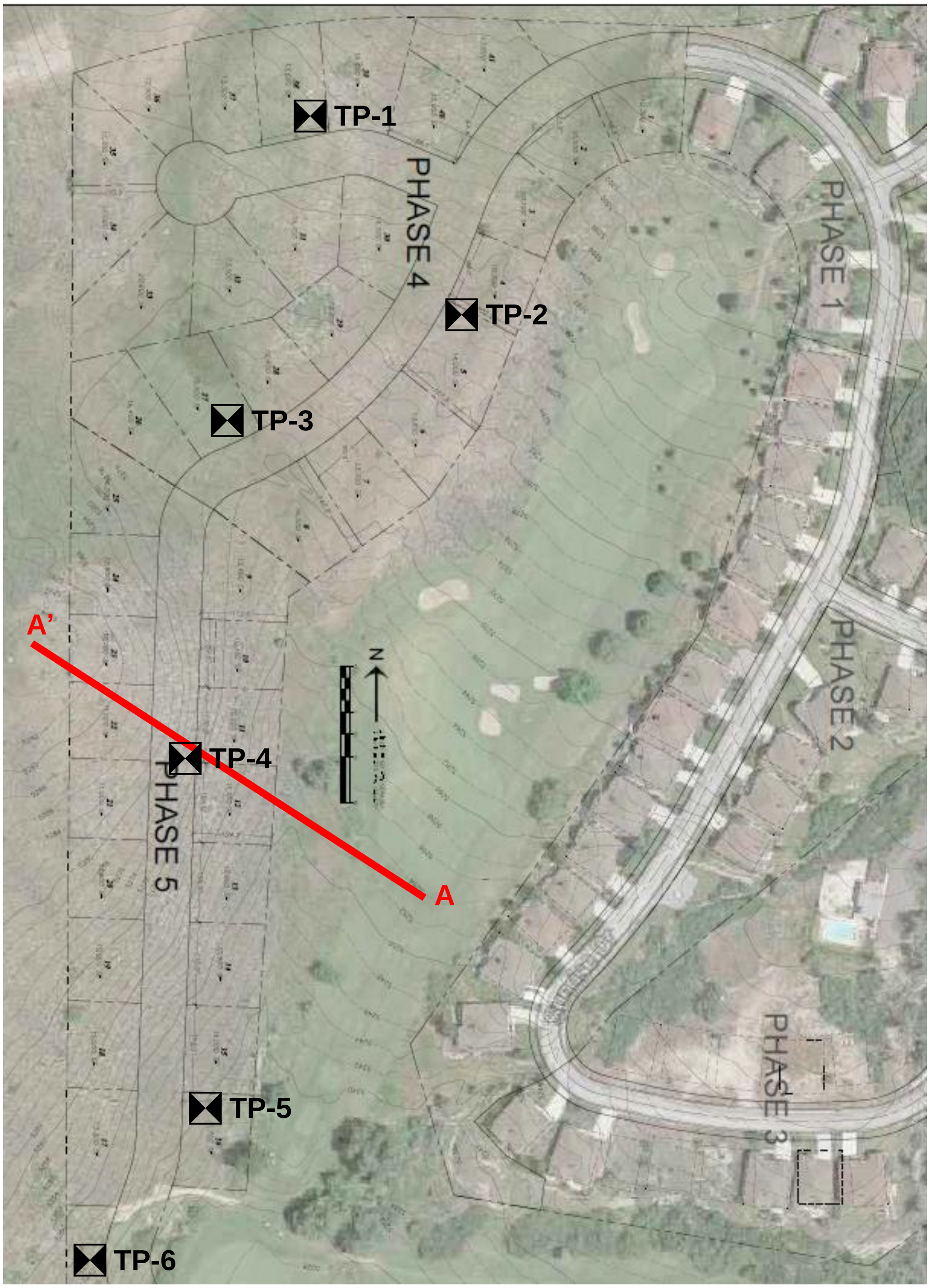
PROJECT NO.: 167003

EARTHTEC ENGINEERING

FIGURE NO.: 1

SITE PLAN SHOWING LOCATION OF TEST PITS

Fairways At Wolf Creek Subdivision, Phases 4 And 5
4700 East 4000 North
Eden, Utah



⧓ **Approximate Location of Test Pits**

Approximate Location of Slope Cross-Section

*Site Plan was provided by the client

PROJECT NO.: 167003	EARTHTEC ENGINEERING	**FIGURE NO.:** 2

TEST PIT LOG

NO.: TP-1

PROJECT:	Fairways at Wolf Creek, Phases 4 & 5	**PROJECT NO.:**	167003
CLIENT:	Watts Enterprises	**DATE:**	02/03/16
LOCATION:	See Figure 2	**ELEVATION:**	Not Measured
OPERATOR:	C.E. Butters	**LOGGED BY:**	F. Namdar
EQUIPMENT:	Trackhoe		
DEPTH TO WATER; INITIAL ▽ :		**AT COMPLETION ▼ :**	6 ft.

Depth (Ft.) 0	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
1			TOPSOIL, lean clay with sand with organics throught, moist, dark brown, some boulders and cobbles.									
2 3 4		GM	Silty GRAVEL with sand, dense (estimated), moist, olive to red-brown, iron oxide staining, some cobbles and boulders encountered.	■	13		50	21	54	24	22	
5 6 7 8 9 10 11 12		GC	Clayey GRAVEL with sand, dense (estimated), very moist to wet, olive to brown, iron oxide staining, some cobbles and boulders encountered. ▼	■ ■ ■								
13 14 15			Maximum depth explored approximatley 12 feet.									

Notes: Groundwater encountered at 6 feet.

Tests Key

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

PROJECT NO.: 167003

FIGURE NO.: 3

TEST PIT LOG

NO.: TP-2

PROJECT:	Fairways at Wolf Creek, Phases 4 & 5	**PROJECT NO.:**	167003
CLIENT:	Watts Enterprises	**DATE:**	02/03/16
LOCATION:	See Figure 2	**ELEVATION:**	Not Measured
OPERATOR:	C.E. Butters	**LOGGED BY:**	F. Namdar
EQUIPMENT:	Trackhoe		

DEPTH TO WATER; INITIAL ▽ **:** **AT COMPLETION** ▼ **:** 6 ft.

Depth (Ft.)	Graphic Log	USCS	Description	Samples	TEST RESULTS							
					Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0 1	▨		TOPSOIL, lean clay with sand with organics throught, moist, dark brown, some boulders and cobbles.									
2 3 4	▨	SC	Clayey SAND with gravel, dense to very dense (estimated), moist, reb-brown, iron oxide staining, some cobbles and boulders encountered.	■								
4 5 6 7 8 9 10	▨	▼ GC	Clayey GRAVEL with sand, dense (estimated), very moist to wet, olive to brown, iron oxide staining, some cobbles and boulders encountered	■ ■ ■								
10 11 12	▨	GP-GC	Poorly Graded GRAVEL with clay and sand, dense (estimated), wet, brown, some cobbles and boulders encountered.	■								
12 13 14 15			Maximum depth explored approximately 12 feet.									

Notes: Groundwater encountered at 6 feet.

Tests Key

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

PROJECT NO.: 167003

EARTHTEC ENGINEERING

FIGURE NO.: 4

TEST PIT LOG

NO.: TP-3

PROJECT: Fairways at Wolf Creek, Phases 4 & 5
PROJECT NO.: 167003
CLIENT: Watts Enterprises
DATE: 02/03/16
LOCATION: See Figure 2
ELEVATION: Not Measured
OPERATOR: C.E. Butters
LOGGED BY: F. Namdar
EQUIPMENT: Trackhoe
DEPTH TO WATER; INITIAL ▽ **:**
AT COMPLETION ▼ **:** 7 ft.

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0 1			TOPSOIL, lean clay with sand with organics throught, moist, dark brown, some boulders and cobbles.									
2 3 4 5 6 7		GC	Clayey GRAVEL with sand, dense (estimated), moist to wet, olive to brown, iron oxide staining, some cobbles and boulders encountered. ▼	■ ■ ■								
8 9 10 11		CL	Gravelly Lean CLAY with sand, stiff to hard (estimated), wet, brown to red-brown, some cobbles and boulders encountered.	■	15	107	41	22	31	18	51	C
12 13 14 15			Maximum depth explored approximately 11 feet.									

Notes: Groundwater encountered at 7 feet.

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

PROJECT NO.: 167003

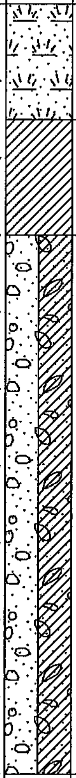
FIGURE NO.: 5

TEST PIT LOG

NO.: TP-4

PROJECT:	Fairways at Wolf Creek, Phases 4 & 5	**PROJECT NO.:**	167003
CLIENT:	Watts Enterprises	**DATE:**	01/28/16
LOCATION:	See Figure 2	**ELEVATION:**	Not Measured
OPERATOR:	C.E. Butters	**LOGGED BY:**	F. Namdar
EQUIPMENT:	Trackhoe		

DEPTH TO WATER; INITIAL ▽ **:** **AT COMPLETION** ▼ **:** 9 ft.



Depth (Ft.)	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0 1		TOPSOIL, lean clay with sand with organics throught, moist, dark brown, some boulders and cobbles.									
2 3	CL	Gravelly Lean CLAY with sand, stiff to hard (estimated), moist, brown to red-brown, some cobbles and boulders encountered.	■								
4 5 6 7 8 9 ▼ 10	GP-GC	Poorly Graded GRAVEL with clay, dense (estimated), moist to wet, olive to brown, iron oxide staining, some cobbles and boulders encountered.	■ ■ ■	5	110	49	25	78	12	10	C, DS
11 12 13 14 15		Maximum depth eplored approximatley 10 feet due large boulders and equipment refusal.									

Notes: Groundwater encountered at 9 feet.

Tests Key

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

PROJECT NO.: 167003

FIGURE NO.: 6

TEST PIT LOG

NO.: TP-5

PROJECT: Fairways at Wolf Creek, Phases 4 & 5
PROJECT NO.: 167003
CLIENT: Watts Enterprises
DATE: 01/28/16
LOCATION: See Figure 2
ELEVATION: Not Measured
OPERATOR: C.E. Butters
LOGGED BY: F. Namdar
EQUIPMENT: Trackhoe
DEPTH TO WATER; INITIAL ▽ :
AT COMPLETION ▼ : 9.5 ft.

Depth (Ft.)	Graphic Log	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0–2			TOPSOIL, lean clay with sand with organics throught, moist, dark brown, some boulders and cobbles.									
2–14		SC	Clayey SAND with gravel, dense (estimated), moist to wet, brown to olive to red-brown.	■								
				■								
				■								
				■								
		▼										
				■	14				20	50	30	
				■	20				32	38	30	DS
14–15			Maximum depth explored approximately 14 feet.									

Notes: Groundwater encountered at 9½ feet.

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

PROJECT NO.: 167003

EARTHTEC ENGINEERING

FIGURE NO.: 7

TEST PIT LOG
NO.: TP-6

PROJECT: Fairways at Wolf Creek, Phases 4 & 5
CLIENT: Watts Enterprises
LOCATION: See Figure 2
OPERATOR: C.E. Butters
EQUIPMENT: Trackhoe
DEPTH TO WATER; INITIAL ▽ **:**

PROJECT NO.: 167003
DATE: 01/28/16
ELEVATION: Not Measured
LOGGED BY: F. Namdar
AT COMPLETION ▼ **:** 9 ft.

Depth (Ft.)	USCS	Description	Samples	Water Cont. (%)	Dry Dens. (pcf)	LL	PI	Gravel (%)	Sand (%)	Fines (%)	Other Tests
0		TOPSOIL, lean clay with sand with organics throught, moist, dark brown, some boulders and cobbles.									
1											
2		Clayey SAND with gravel, dense (estimated), moist to very moist, brown to olive to red-brown.	■								
3											
4			■	24	96	53	32	23	55	22	C
5	SC										
6			■								
7											
8		Poorly Graded GRAVEL with clay, very dense (estimated), moist to wet, brown to orange-brown, some boulders and cobbles.	■								
9	GP-GC ▼										
10		Maximum depth explored approximately 10 feet due to equipment refusal.									
11											
12											
13											
14											
15											

Notes: Groundwater encountered at 9 feet.

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

PROJECT NO.: 167003

EARTHTEC ENGINEERING

FIGURE NO.: 8

LEGEND

PROJECT: Fairways at Wolf Creek, Phases 4 & 5
CLIENT: Watts Enterprises
DATE:
LOGGED BY:

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

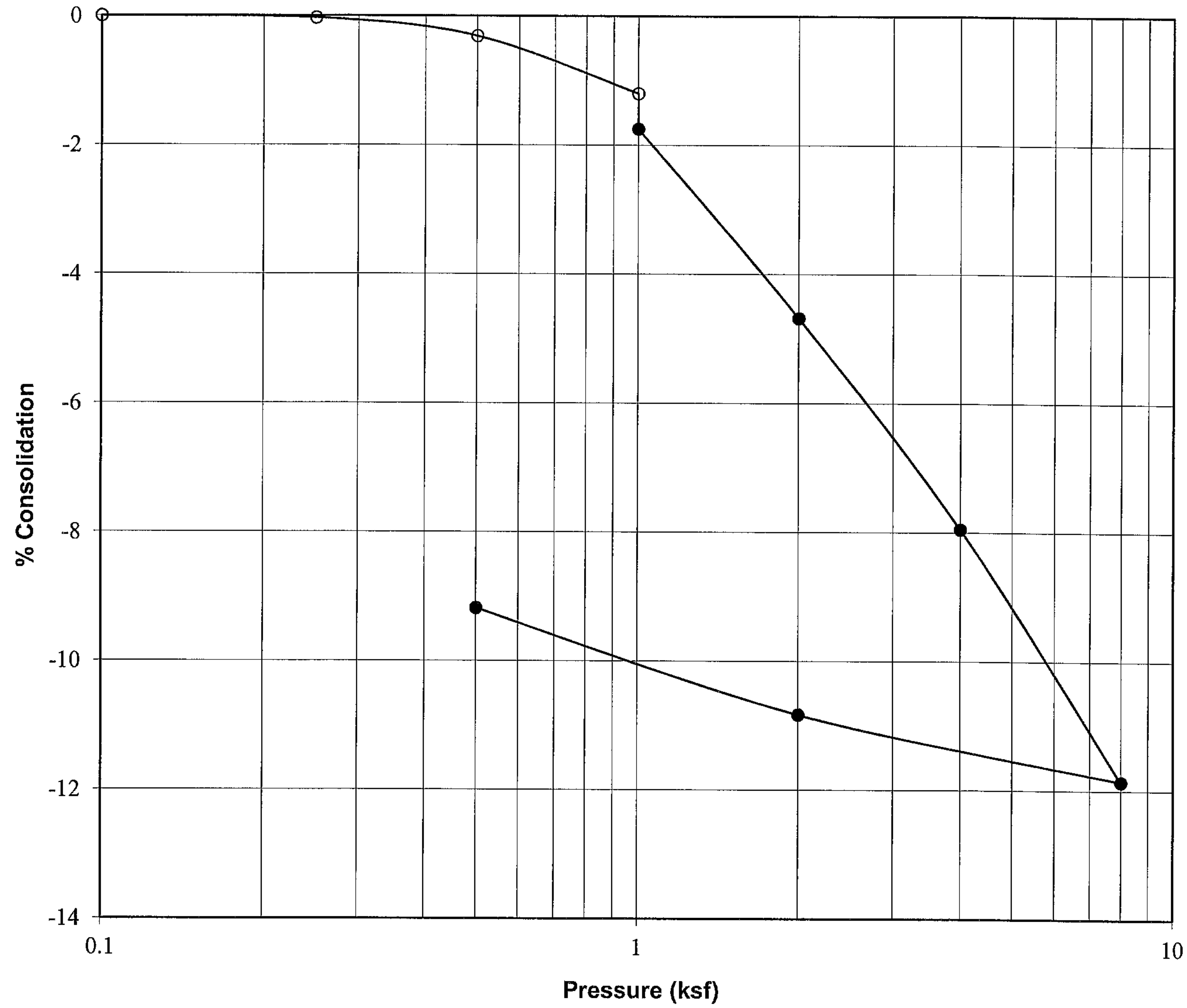
NOTES:
1. The logs are subject to the limitations, conclusions, and recommendations in this report.
2. Results of tests conducted on samples recovered are reported on the logs and any applicable graphs.
3. Strata lines on the logs represent approximate boundaries only. Actual transitions may be gradual.
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.: 167003

EARTHTEC ENGINEERING

FIGURE NO.: 9

CONSOLIDATION - SWELL TEST



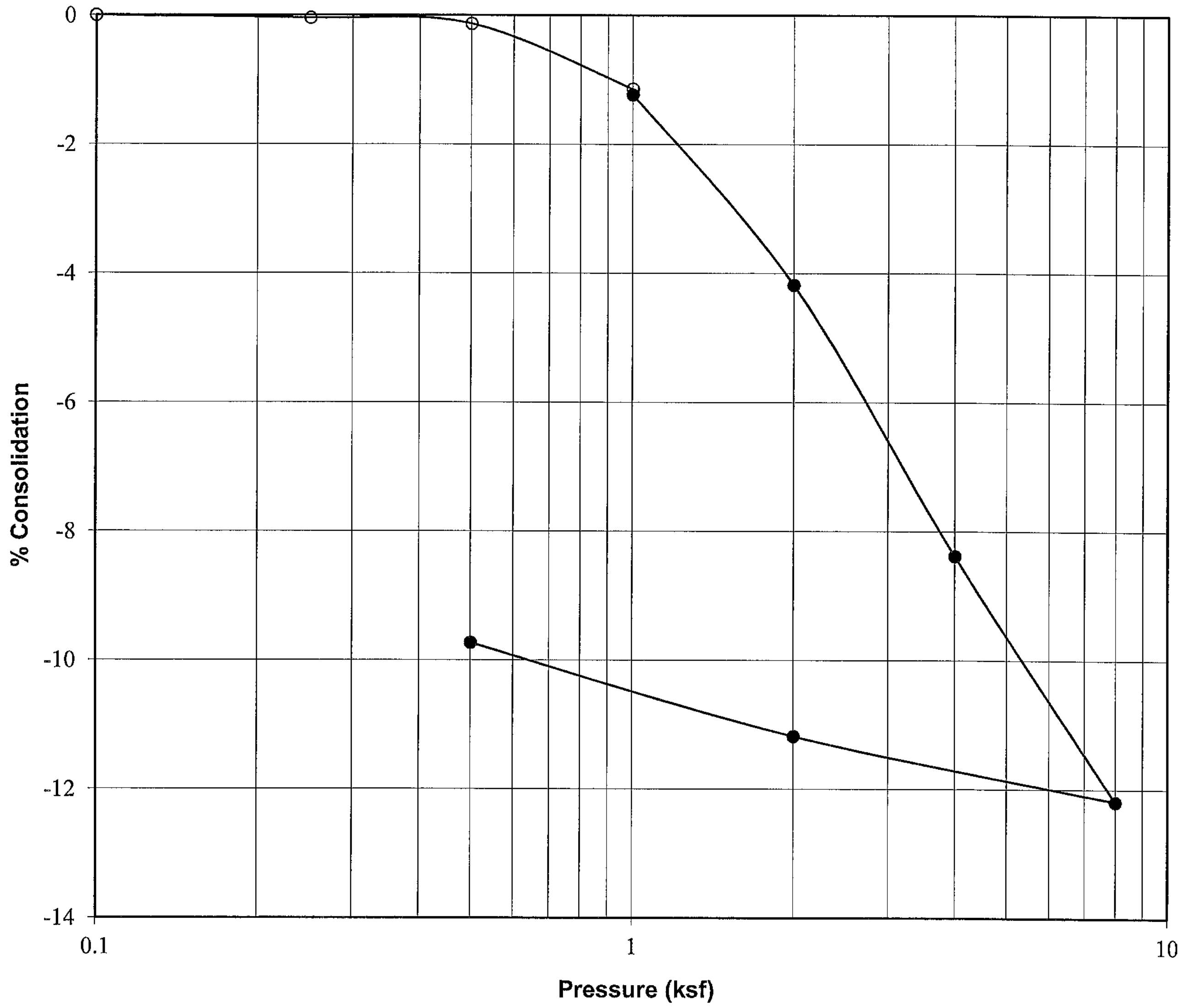
Project:	Fairways at Wolf Creek Phases 4 & 5
Location:	TP-3
Sample Depth, ft:	8
Description:	Block
Soil Type:	Gravelly Lean CLAY with sand (CL)
Natural Moisture, %:	15
Dry Density, pcf:	107
Liquid Limit:	41
Plasticity Index:	19
Water Added at:	1 ksf
Percent Collapse:	0.6

PROJECT NO.: 167003

EARTHTEC ENGINEERING

FIGURE NO.: 10

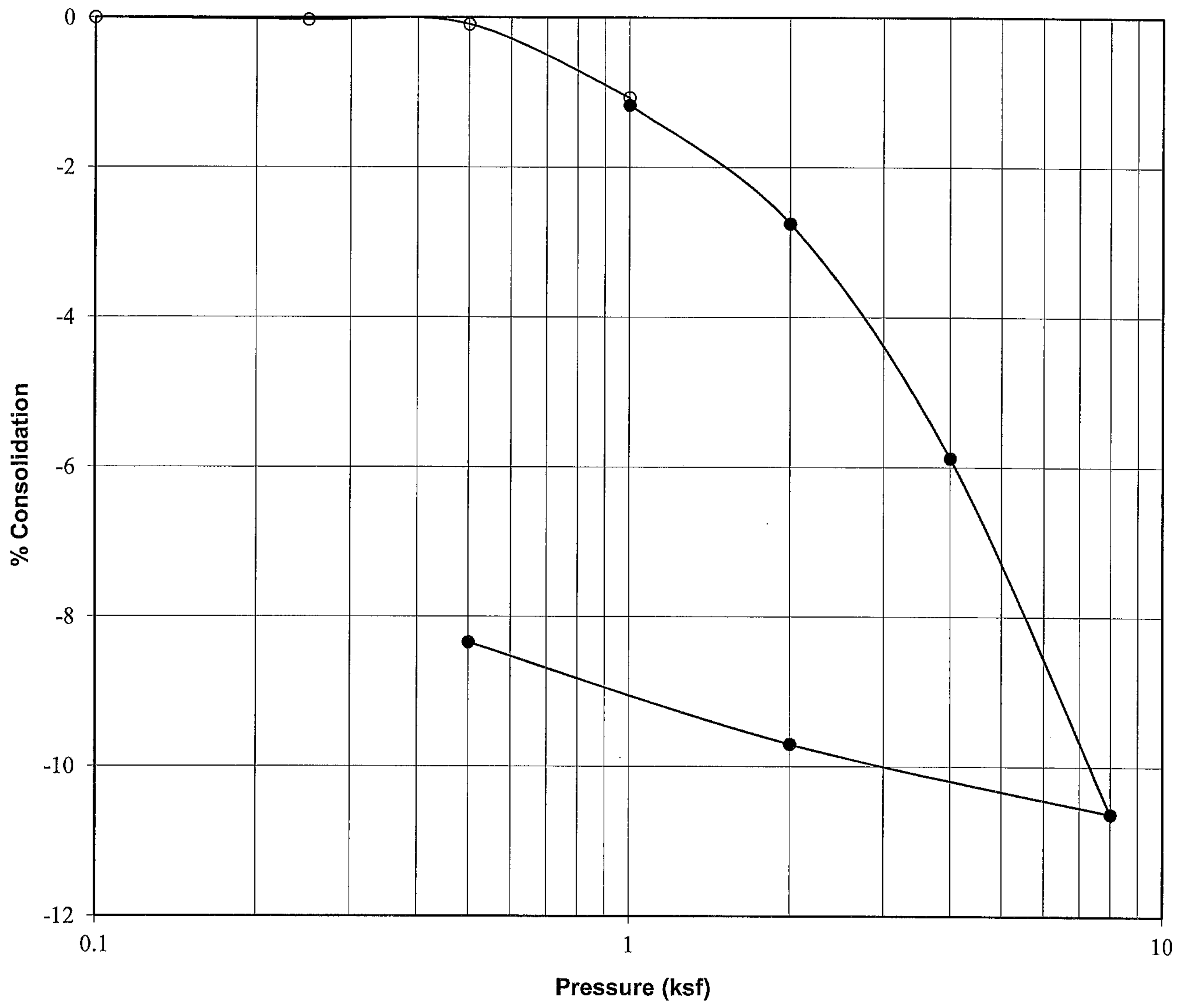
CONSOLIDATION - SWELL TEST



Project:	Fairways at Wolf Creek Phases 4 & 5
Location:	TP-4
Sample Depth, ft:	6
Description:	Block
Soil Type:	Poorly Graded GRAVEL with clay (GP-GC)
Natural Moisture, %:	5
Dry Density, pcf:	110
Liquid Limit:	49
Plasticity Index:	25
Water Added at:	1 ksf
Percent Collapse:	0.1

PROJECT NO.: 167003	EARTHTEC ENGINEERING	**FIGURE NO.:** 11

CONSOLIDATION - SWELL TEST



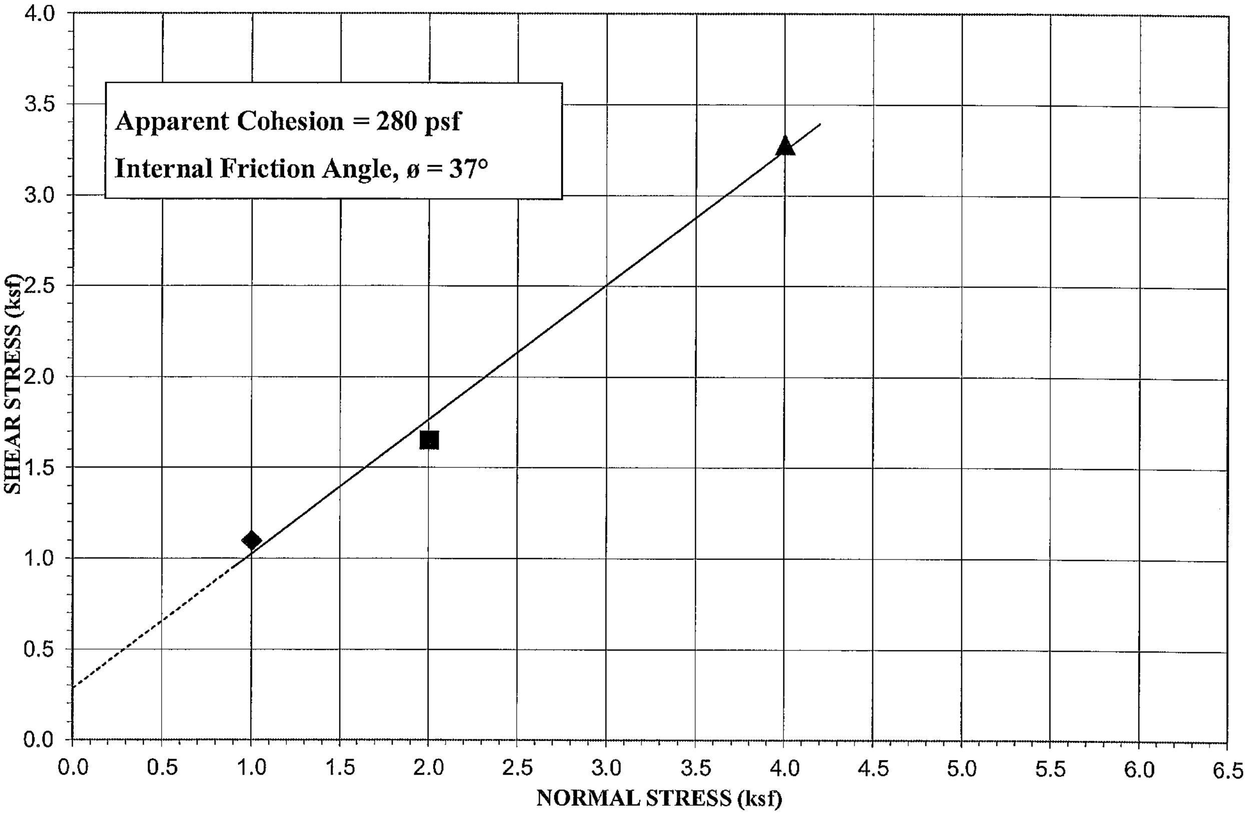
Project:	Fairways at Wolf Creek Phases 4 & 5
Location:	TP-6
Sample Depth, ft:	4
Description:	Block
Soil Type:	Clayey SAND with gravel (SC)
Natural Moisture, %:	24
Dry Density, pcf:	96
Liquid Limit:	53
Plasticity Index:	32
Water Added at:	1 ksf
Percent Collapse:	0.1

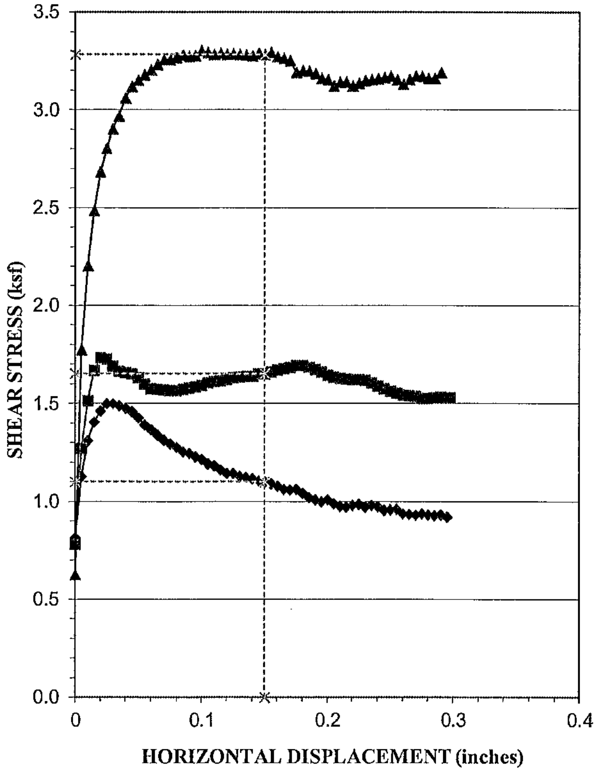
PROJECT NO.: 167003

EARTHTEC ENGINEERING

FIGURE NO.: 12

DIRECT SHEAR TEST





Source: TP-4	**Depth:** 6.0 ft		
Type of Test:	Consolidated Drained/Saturated		
Test No. (Symbol)	**1 (◆)**	**2 (■)**	**3 (▲)**
Sample Type	Remolded		
Initial Height, in.	1	1	1
Diameter, in.	2.4	2.4	2.4
Dry Density Before, pcf	118.6	119.2	118.9
Dry Density After, pcf	117.4	117.5	117.7
Moisture % Before	15.0	15.0	15.0
Moisture % After	23.4	23.4	23.4
Normal Load, ksf	1.0	2.0	4.0
Shear Stress, ksf	1.10	1.65	3.28
Strain Rate	.00003567 IN/SEC		
Sample Properties			
Cohesion, psf	280		
Friction Angle, ϕ	37		
Liquid Limit, %	49		
Plasticity Index, %	25		
Percent Gravel	78		
Percent Sand	12		
Percent Passing No. 200 sieve	10		
Classification	GP-GC		

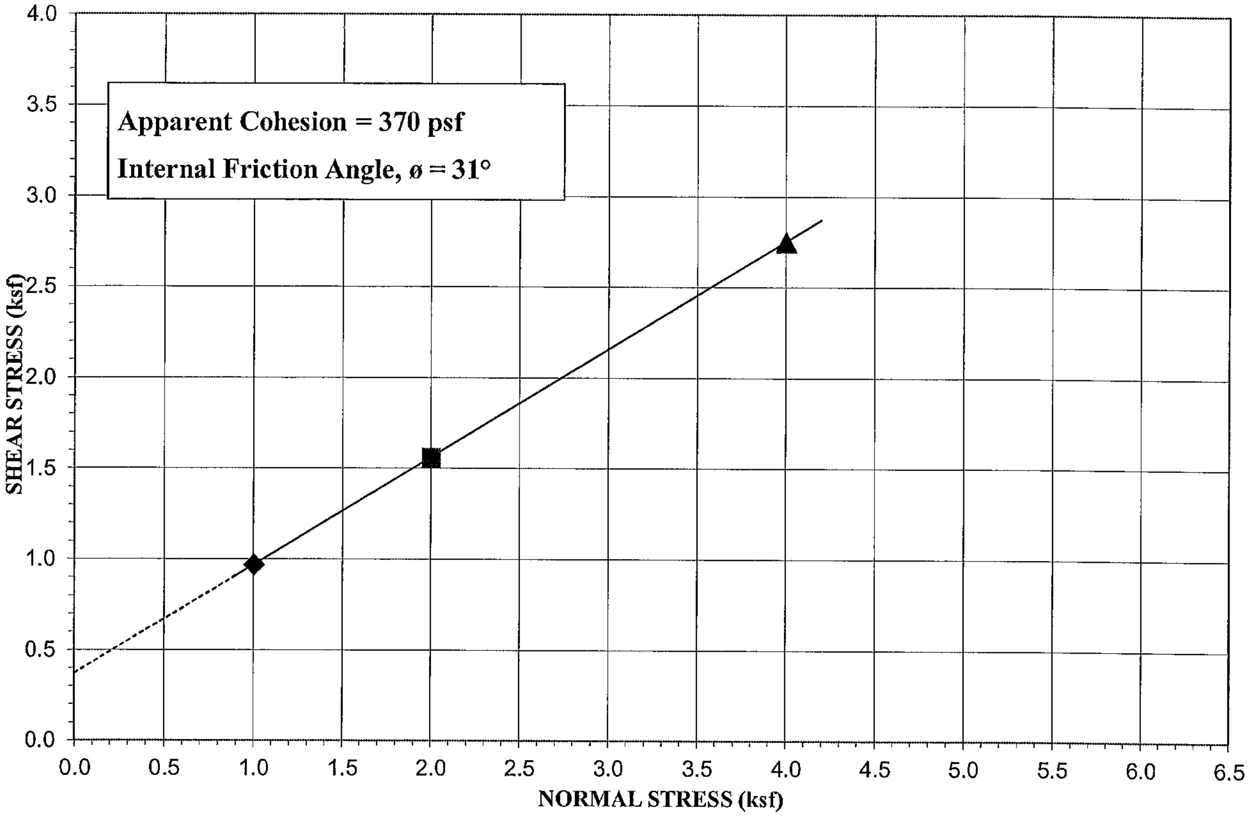
PROJECT: Fairways at Wolf Creek Phases 4 & 5

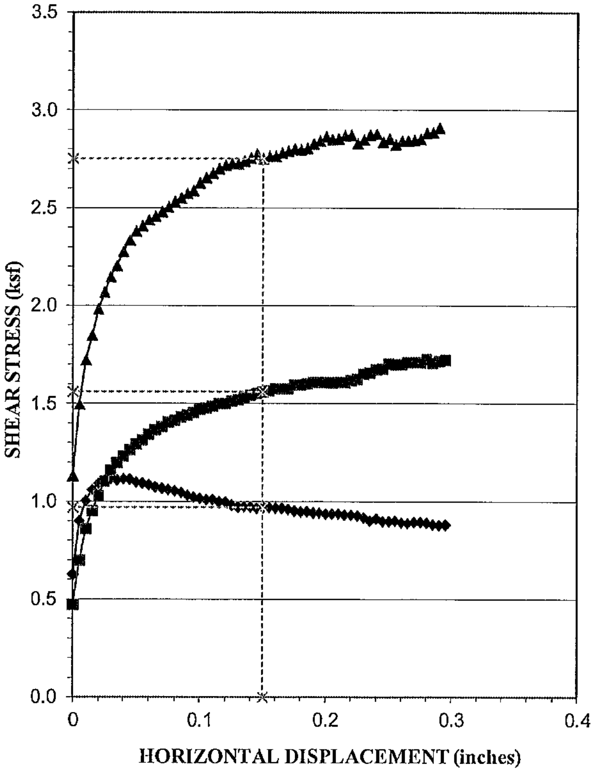
PROJECT NO.: 167003

EARTHTEC ENGINEERING

FIGURE NO.: 13

DIRECT SHEAR TEST





Source: TP-5	**Depth:** 12.0 ft		
Type of Test:	Consolidated Drained/Saturated		
Test No. (Symbol)	**1 (◆)**	**2 (■)**	**3 (▲)**
Sample Type	Remolded		
Initial Height, in.	1	1	1
Diameter, in.	2.4	2.4	2.4
Dry Density Before, pcf	126.4	126.0	126.9
Dry Density After, pcf	126.3	126.2	126.7
Moisture % Before	14.2	14.2	14.2
Moisture % After	23.6	23.6	23.6
Normal Load, ksf	1.0	2.0	4.0
Shear Stress, ksf	0.97	1.56	2.75
Strain Rate	.00003567 IN/SEC		

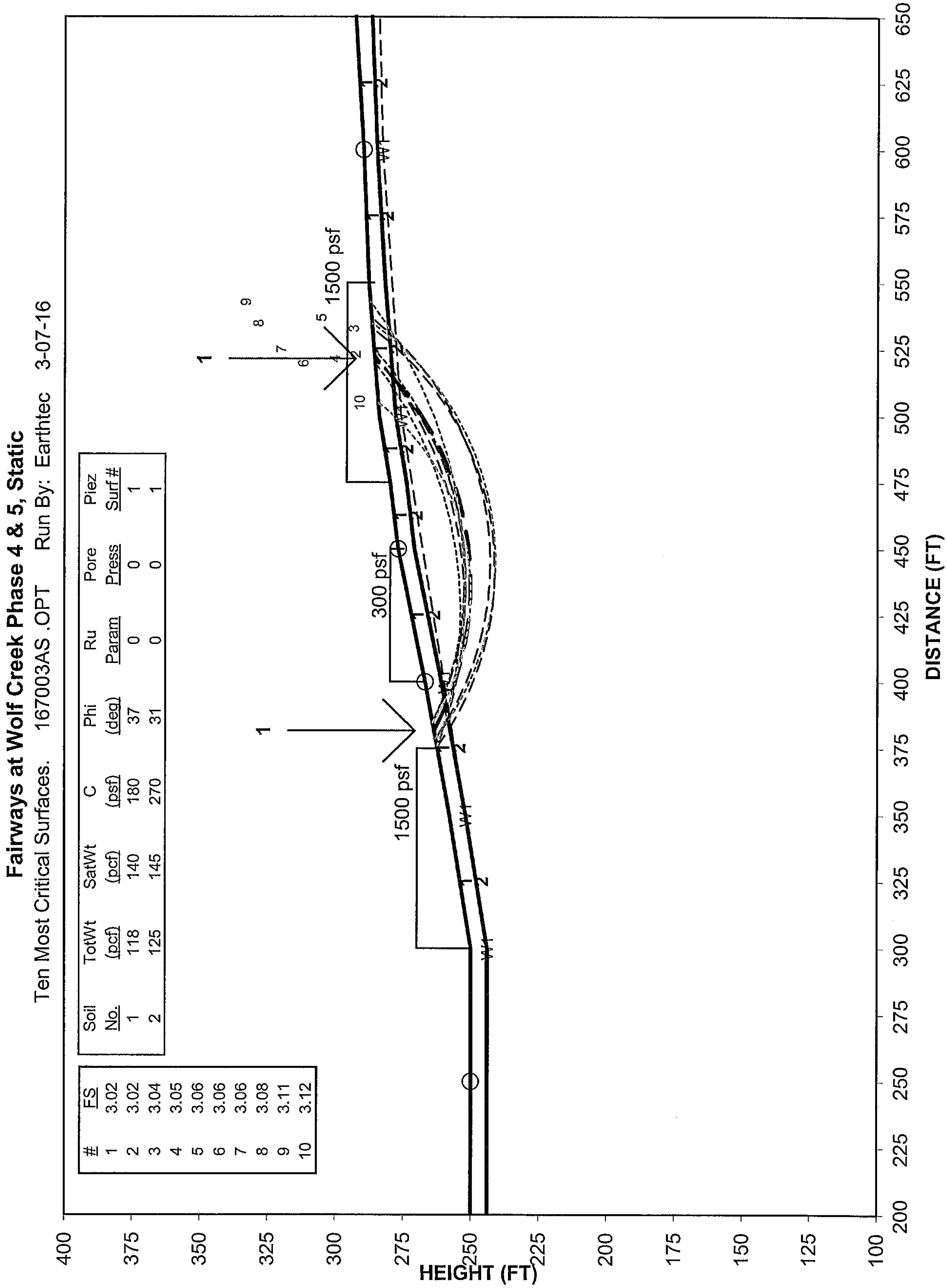
Sample Properties	
Cohesion, psf	370
Friction Angle, ϕ	31
Liquid Limit, %	
Plasticity Index, %	
Percent Gravel	32
Percent Sand	38
Percent Passing No. 200 sieve	30
Classification	

PROJECT: Fairways at Wolf Creek Phases 4 & 5

PROJECT NO.: 167003

FIGURE NO.: 14

STABILITY RESULTS



Fairways at Wolf Creek Phase 4 & 5, Static

Ten Most Critical Surfaces. 167003AS .OPT Run By: Earthtec 3-07-16

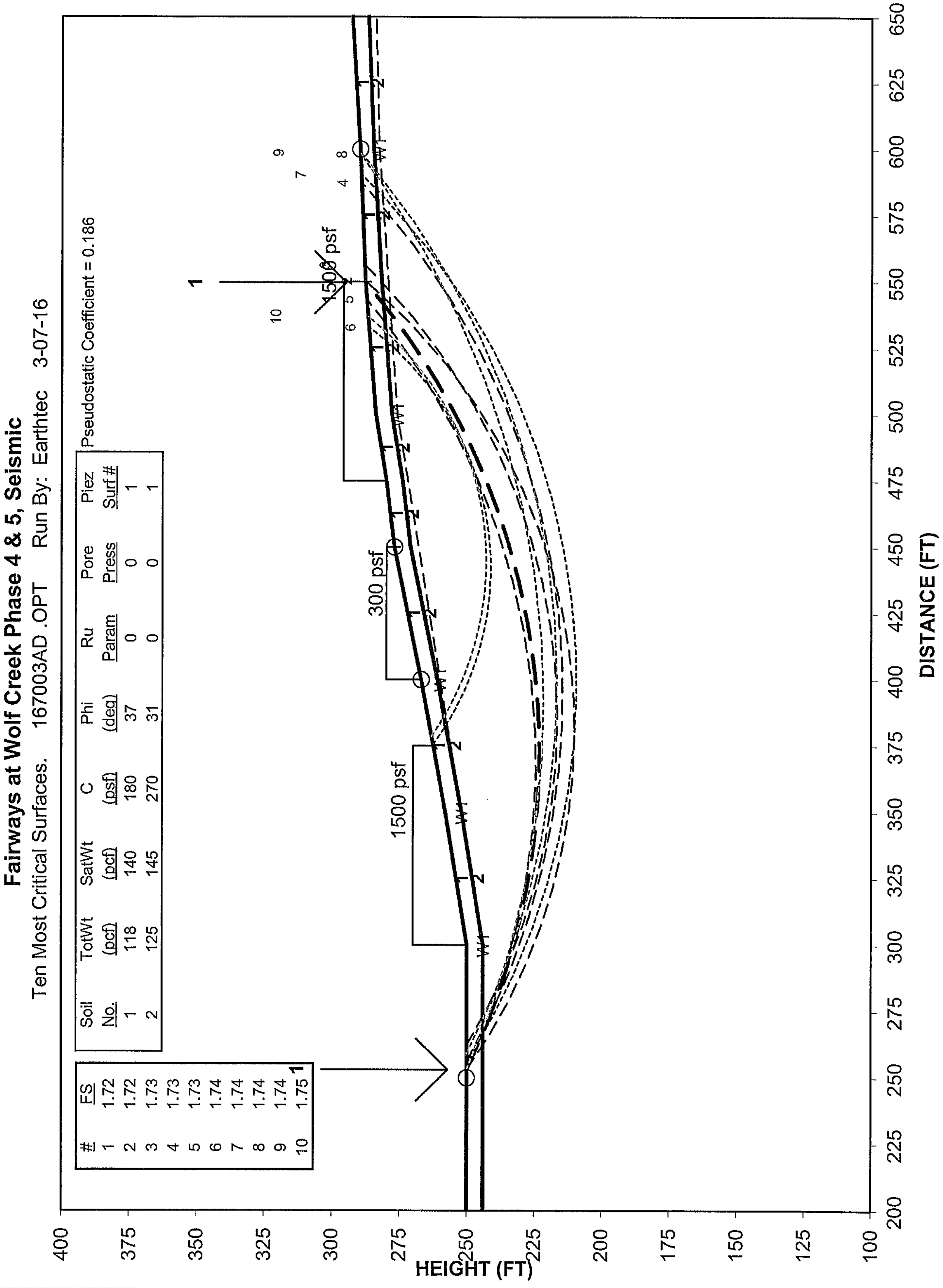
#	FS
1	3.02
2	3.02
3	3.04
4	3.05
5	3.06
6	3.06
7	3.06
8	3.08
9	3.11
10	3.12

Soil No.	TotWt (pcf)	SatWt (pcf)	C (psf)	Phi (deg)	Ru Param	Pore Press	Piez Surf #
1	118	140	180	37	0	0	1
2	125	145	270	31	0	0	1

PROJECT NO.: 167003

FIGURE NO.: 15

STABILITY RESULTS



#	FS
1	1.72
2	1.72
3	1.73
4	1.73
5	1.73
6	1.74
7	1.74
8	1.74
9	1.74
10	1.75

Soil No.	TotWt (pcf)	SatWt (pcf)	C (psf)	Phi (deg)	Ru Param	Pore Press	Piez Surf #
1	118	140	180	37	0	0	1
2	125	145	270	31	0	0	1

PROJECT NO.: 167003

EARTHTEC ENGINEERING

FIGURE NO.: 16

APPENDIX A

SETTLEMENT OF FOOTINGS								
Project:	Fairways at Wolf Creek subdivision, Phase 4 and 5							
B:	2.66667	feet (width or diameter)			b =	1.333333	ft (1/2 width/dia)	
L:	25	feet (length)			l =	12.5	ft (1/2 length)	
foot. depth:	2.5	feet					Spread Load,k:	25
unit weight:	115.5	pcf (above footing depth)					Strip Load,k:	4
allowable q:	1500	psf						
footing type:	1	(1=strip,2&3=square/rect.,4=circular)						
	4	(4 for center, 1 for corner of square/rect.)						
water depth:	9	feet						

DEFINE SOIL PROFILE:

Soil type	C_c'	C_r'	preconsol press.,σ_c'(psf)	OCR	Density (pcf)	Collapse (%)	Below ftg. depth (ft)	Avg. OCR
Fill	0.001	0.000125			135		3.0	1.00
CL1	0.14	0.024	1300		115.5	0.1	12.5	1.07

STRIP FOOTINGS...

Soil Type	Below ftg. depth (ft)	Influence	Increased Stress (psf)	avg. ovrbn. press.(psf)	Incremnt. Sett. (in.)	Collapse Sett. (in.)	Total Set. (in.)	
Fill	1	0.896	1343.9	423.8	0.007	0.000	0.01	
Fill	2	0.668	1002.2	558.8	0.005	0.000	0.01	
Fill	3	0.503	753.8	693.8	0.004	0.000	0.02	
CL1	4	0.396	593.7	809.3	0.115	0.012	0.14	
CL1	5	0.324	486.6	924.8	0.103	0.012	0.26	
CL1	6	0.274	411.0	1040.3	0.108	0.012	0.38	<---2B
CL1	7	0.237	355.3	1124.6	0.113	0.012	0.50	
CL1	8	0.208	312.6	1177.7	0.112	0.012	0.63	
CL1	9	0.186	278.9	1230.8	0.149	0.012	0.79	
CL1	10	0.168	251.7	1283.9	0.131	0.012	0.93	
CL1	11	0.153	229.3	1337.0	0.115	0.012	1.06	
CL1	12	0.140	210.5	1390.1	0.103	0.012	1.17	
CL1	12.5	0.135	202.2	1416.6	0.049	0.006	1.23	

SETTLEMENT OF FOOTINGS								
Project:	Fairways at Wolf Creek subdivision, Phase 4 and 5							
B:	4.08248	feet (width or diameter)			b =	2.041241	ft (1/2 width/dia)	
L:	4.08248	feet (length)			l =	2.041241	ft (1/2 length)	
foot. depth:	2.5	feet					Spread Load,k:	25
unit weight:	115.5	pcf (above footing depth)					Strip Load,k:	4
allowable q:	1500	psf						
footing type:	2	(1=strip,2&3=square/rect.,4=circular)						
	4	(4 for center, 1 for corner of square/rect.)						
water depth:	9	feet						

DEFINE SOIL PROFILE:			preconsol		Density	Collapse	Below ftg.	Avg.
Soil type	C_c'	C_r'	press.,σ_c'(psf)	OCR	(pcf)	(%)	depth (ft)	OCR
Fill	0.001	0.000125			135		3.0	1.00
CL1	0.14	0.024	1300		115.5	0.1	12.5	1.07

	SQUARE/RECTANGULAR FOOTINGS (Boussinesq Method)...							
	Below ftg.		Increased	avg. ovrbn.	Incremnt.	Collapse	Total	
Soil Type	depth (ft)	Influence	Stress (psf)	press.(psf)	Sett. (in.)	Sett. (in.)	Set. (in.)	
Fill	1	0.933	1400.0	423.8	0.008	0.000	0.01	
Fill	2	0.711	1066.2	558.8	0.006	0.000	0.01	
Fill	3	0.495	743.0	693.8	0.004	0.000	0.02	
CL1	4	0.346	518.7	809.3	0.075	0.012	0.10	
CL1	5	0.249	373.2	924.8	0.042	0.012	0.16	
CL1	6	0.185	277.8	1040.3	0.038	0.012	0.21	
CL1	7	0.142	213.3	1124.6	0.039	0.012	0.26	
CL1	8	0.112	168.2	1177.7	0.038	0.012	0.31	
CL1	9	0.090	135.7	1230.8	0.076	0.012	0.40	<---2B
CL1	10	0.074	111.6	1283.9	0.061	0.012	0.47	
CL1	11	0.062	93.3	1337.0	0.049	0.012	0.53	
CL1	12	0.053	79.1	1390.1	0.040	0.012	0.58	
CL1	12.5	0.049	73.1	1416.6	0.018	0.006	0.61	

SETTLEMENT OF FOOTINGS								
Project:	Fairways at Wolf Creek subdivision, Phase 4 and 5							
B:	4.08248	feet (width or diameter)			b =	2.041241	ft (1/2 width/dia)	
L:	4.08248	feet (length)			l =	2.041241	ft (1/2 length)	
foot. depth:	2.5	feet					Spread Load,k:	25
unit weight:	115.5	pcf (above footing depth)					Strip Load,k:	4
allowable q:	1500	psf						
footing type:	3	(1=strip,2&3=square/rect.,4=circular)						
	4	(4 for center, 1 for corner of square/rect.)						
water depth:	9	feet						
----------------	-------------	----------------	---------------	---------------	-------------------------		--------------	----------

DEFINE SOIL PROFILE:			preconsol		Density	Collapse	Below ftg.	Avg.
Soil type	C_c'	C_r'	press.,σ_c'(psf)	OCR	(pcf)	(%)	depth (ft)	OCR
Fill	0.001	0.000125			135		3.0	1.00
CL1	0.14	0.024	1300		115.5	0.1	12.5	1.07

	SQUARE/RECTANGULAR FOOTINGS (Westergard Method)...							
	Below ftg.		Increased	avg. ovrbn.	Incremnt.	Collapse	Total	
Soil Type	depth (ft)	Influence	Stress (psf)	press.(psf)	Sett. (in.)	Sett. (in.)	Set. (in.)	
Fill	1	0.753	1130.1	423.8	0.007	0.000	0.01	
Fill	2	0.547	820.8	558.8	0.005	0.000	0.01	
Fill	3	0.395	592.5	693.8	0.003	0.000	0.01	
CL1	4	0.417	626.2	809.3	0.132	0.012	0.16	
CL1	5	0.333	500.0	924.8	0.109	0.012	0.28	
CL1	6	0.269	403.2	1040.3	0.104	0.012	0.40	
CL1	7	0.219	329.1	1124.6	0.100	0.012	0.51	
CL1	8	0.181	271.9	1177.7	0.092	0.012	0.61	
CL1	9	0.152	227.4	1230.8	0.124	0.012	0.75	<---2B
CL1	10	0.128	192.3	1283.9	0.102	0.012	0.86	
CL1	11	0.110	164.3	1337.0	0.085	0.012	0.96	
CL1	12	0.095	141.8	1390.1	0.071	0.012	1.04	
CL1	12.5	0.088	132.1	1416.6	0.033	0.006	1.08	

```
                                          167003AS
XSTABL File: 167003AS    3-07-**    15:37

               *******************************************
               *              X S T A B L                *
               *                                         *
               *        Slope Stability Analysis         *
               *               using the                 *
               *            Method of Slices             *
               *                                         *
               *         Copyright (C) 1992 Ä 94         *
               *    Interactive Software Designs, Inc.   *
               *        Moscow, ID 83843, U.S.A.         *
               *                                         *
               *           All Rights Reserved           *
               *                                         *
               *  Ver. 5.004                 94 Ä 1295   *
               *******************************************


    Problem Description : Fairways at Wolf Creek Phase 4 & 5



    -----------------------------
    SEGMENT BOUNDARY COORDINATES
    -----------------------------

       11 SURFACE boundary segments

    Segment    x-left     y-left     x-right    y-right      Soil Unit
      No.       (ft)       (ft)       (ft)       (ft)     Below Segment

       1          .0       250.0      300.0      250.0           1
       2        300.0      250.0      350.0      258.0           1
       3        350.0      258.0      400.0      267.0           1
       4        400.0      267.0      450.0      277.0           1
       5        450.0      277.0      475.0      280.0           1
       6        475.0      280.0      500.0      284.0           1
       7        500.0      284.0      550.0      288.0           1
       8        550.0      288.0      600.0      290.0           1
       9        600.0      290.0      650.0      293.0           1
      10        650.0      293.0      700.0      295.0           1
      11        700.0      295.0      750.0      293.0           1

       11 SUBSURFACE boundary segments

    Segment    x-left     y-left     x-right    y-right      Soil Unit
      No.       (ft)       (ft)       (ft)       (ft)     Below Segment

       1          .0       244.0      300.0      244.0           2
       2        300.0      244.0      350.0      252.0           2
       3        350.0      252.0      400.0      261.0           2
       4        400.0      261.0      450.0      271.0           2
       5        450.0      271.0      475.0      274.0           2
       6        475.0      274.0      500.0      278.0           2
       7        500.0      278.0      550.0      282.0           2
       8        550.0      282.0      600.0      285.0           2
       9        600.0      285.0      650.0      287.0           2
      10        650.0      287.0      700.0      289.0           2
      11        700.0      289.0      750.0      288.0           2
```

```
--------------------------
ISOTROPIC Soil Parameters
--------------------------

 2 Soil unit(s) specified

Soil   Unit Weight   Cohesion  Friction    Pore Pressure      Water
Unit  Moist    Sat.  Intercept   Angle  Parameter Constant  Surface
 No.  (pcf)   (pcf)    (psf)     (deg)      Ru      (psf)      No.

  1   118.0   140.0    180.0     37.00     .000        .0       1
  2   125.0   145.0    270.0     31.00     .000        .0       1


 1 Water surface(s) have been specified

Unit weight of water =    62.40  (pcf)

Water Surface No.  1 specified by  7 coordinate points

**********************************
         PHREATIC SURFACE,
**********************************

  Point       x-water     y-water
   No.          (ft)        (ft)

    1            .00      244.00
    2         300.00      244.00
    3         350.00      252.00
    4         400.00      260.00
    5         500.00      276.00
    6         600.00      283.00
    7         700.00      285.50


BOUNDARY LOADS

    3 load(s) specified

Load         x-left       x-right     Intensity     Direction
 No.          (ft)         (ft)         (psf)         (deg)

  1          300.0        375.0        1500.0           .0
  2          400.0        450.0         300.0           .0
  3          475.0        550.0        1500.0           .0

NOTE - Intensity is specified as a uniformly distributed
       force acting on a HORIZONTALLY projected surface.


A critical failure surface searching method, using a random
technique for generating CIRCULAR surfaces has been specified.


 1000 trial surfaces will be generated and analyzed.
```

```
   20 Surfaces initiate from each of  50 points equally spaced
along the ground surface between  x =    250.0 ft
                              and  x =    400.0 ft

Each surface terminates between    x =    450.0 ft
                             and   x =    600.0 ft

Unless further limitations were imposed, the minimum elevation
at which a surface extends is  y =        .0 ft

    9.0 ft line segments define each trial failure surface.


ANGULAR RESTRICTIONS :

  The first segment of each failure surface will be inclined
  within the angular range defined by :

          Lower angular limit :=   -45.0 degrees
          Upper angular limit :=  (slope angle - 5.0) degrees



Factors of safety have been calculated by the :

 * * * * *   SIMPLIFIED BISHOP METHOD   * * * * *


  The most critical circular failure surface
  is specified by 18 coordinate points

       Point       x-surf       y-surf
        No.         (ft)         (ft)

         1        381.63       263.69
         2        389.76       259.84
         3        398.16       256.60
         4        406.78       254.02
         5        415.57       252.09
         6        424.49       250.83
         7        433.47       250.24
         8        442.47       250.34
         9        451.43       251.12
        10        460.31       252.57
        11        469.06       254.69
        12        477.62       257.46
        13        485.95       260.87
        14        494.00       264.90
        15        501.72       269.53
        16        509.06       274.73
        17        516.00       280.47
        18        521.44       285.72
```

```
                              167003AS
****  Simplified BISHOP FOS =   3.016   ****



The following is a summary of the TEN most critical surfaces

Problem Description : Fairways at Wolf Creek Phase 4 & 5

        FOS      Circle Center     Radius   Initial  Terminal  Resisting
      (BISHOP)  x-coord  y-coord             x-coord  x-coord    Moment
                  (ft)     (ft)      (ft)      (ft)     (ft)     (ft-lb)

  1.    3.016    436.68   369.24   119.04   381.63   521.44   2.889E+07
  2.    3.024    429.34   401.12   148.62   375.51   523.04   3.468E+07
  3.    3.035    441.87   355.42   114.11   375.51   532.81   3.882E+07
  4.    3.050    437.71   372.97   120.96   384.69   521.37   2.778E+07
  5.    3.055    444.74   361.63   118.65   378.57   536.83   3.994E+07
  6.    3.063    426.28   408.38   154.38   375.51   519.80   3.329E+07
  7.    3.063    438.44   381.29   128.79   384.69   525.00   3.029E+07
  8.    3.081    445.07   352.14   111.10   378.57   534.81   3.848E+07
  9.    3.108    435.94   431.76   179.64   375.51   542.80   5.107E+07
 10.    3.119    433.52   341.97    91.79   384.69   504.92   1.849E+07

                      * * *  END OF FILE  * * *
```

```
          *****************************************
          *              X S T A B L              *
          *                                       *
          *       Slope Stability Analysis        *
          *              using the                *
          *           Method of Slices            *
          *                                       *
          *        Copyright (C) 1992 Ä 94        *
          *   Interactive Software Designs, Inc.  *
          *      Moscow, ID 83843, U.S.A.         *
          *                                       *
          *         All Rights Reserved           *
          *                                       *
          * Ver. 5.004                 94 Ä 1295  *
          *****************************************


 Problem Description : Fairways at Wolf Creek Phase 4 & 5



 -----------------------------
 SEGMENT BOUNDARY COORDINATES
 -----------------------------

    11 SURFACE boundary segments

 Segment    x-left    y-left    x-right   y-right     Soil Unit
   No.       (ft)      (ft)      (ft)      (ft)     Below Segment

   1           .0     250.0     300.0     250.0           1
   2        300.0     250.0     350.0     258.0           1
   3        350.0     258.0     400.0     267.0           1
   4        400.0     267.0     450.0     277.0           1
   5        450.0     277.0     475.0     280.0           1
   6        475.0     280.0     500.0     284.0           1
   7        500.0     284.0     550.0     288.0           1
   8        550.0     288.0     600.0     290.0           1
   9        600.0     290.0     650.0     293.0           1
  10        650.0     293.0     700.0     295.0           1
  11        700.0     295.0     750.0     293.0           1

    11 SUBSURFACE boundary segments

 Segment    x-left    y-left    x-right   y-right     Soil Unit
   No.       (ft)      (ft)      (ft)      (ft)     Below Segment

   1           .0     244.0     300.0     244.0           2
   2        300.0     244.0     350.0     252.0           2
   3        350.0     252.0     400.0     261.0           2
   4        400.0     261.0     450.0     271.0           2
   5        450.0     271.0     475.0     274.0           2
   6        475.0     274.0     500.0     278.0           2
   7        500.0     278.0     550.0     282.0           2
   8        550.0     282.0     600.0     285.0           2
   9        600.0     285.0     650.0     287.0           2
  10        650.0     287.0     700.0     289.0           2
  11        700.0     289.0     750.0     288.0           2
```

```
--------------------------
ISOTROPIC Soil Parameters
--------------------------

 2 Soil unit(s) specified

Soil   Unit Weight   Cohesion  Friction    Pore Pressure      Water
Unit  Moist    Sat.  Intercept   Angle  Parameter  Constant  Surface
 No.  (pcf)   (pcf)    (psf)     (deg)      Ru       (psf)      No.

  1   118.0   140.0    180.0     37.00     .000         .0       1
  2   125.0   145.0    270.0     31.00     .000         .0       1


 1 Water surface(s) have been specified

Unit weight of water =    62.40  (pcf)

Water Surface No.  1 specified by  7 coordinate points

**********************************
         PHREATIC SURFACE,
**********************************

  Point       x-water     y-water
   No.          (ft)        (ft)

    1            .00      244.00
    2         300.00      244.00
    3         350.00      252.00
    4         400.00      260.00
    5         500.00      276.00
    6         600.00      283.00
    7         700.00      285.50


A horizontal earthquake loading coefficient
of   .186 has been assigned

A vertical earthquake loading coefficient
of   .000 has been assigned


BOUNDARY LOADS

    3 load(s) specified

Load          x-left       x-right      Intensity      Direction
 No.           (ft)          (ft)         (psf)           (deg)

  1           300.0         375.0        1500.0             .0
  2           400.0         450.0         300.0             .0
  3           475.0         550.0        1500.0             .0

NOTE - Intensity is specified as a uniformly distributed
       force acting on a HORIZONTALLY projected surface.
```

```
A critical failure surface searching method, using a random
technique for generating CIRCULAR surfaces has been specified.


 1000 trial surfaces will be generated and analyzed.


   20 Surfaces initiate from each of  50 points equally spaced
along the ground surface between  x =    250.0 ft
                              and  x =    400.0 ft


Each surface terminates between   x =    450.0 ft
                             and  x =    600.0 ft


Unless further limitations were imposed, the minimum elevation
at which a surface extends is  y =       .0 ft


    9.0 ft line segments define each trial failure surface.


ANGULAR RESTRICTIONS :

  The first segment of each failure surface will be inclined
  within the angular range defined by :

          Lower angular limit :=   -45.0 degrees
          Upper angular limit :=  (slope angle - 5.0) degrees



Factors of safety have been calculated by the :

* * * * *   SIMPLIFIED BISHOP METHOD   * * * * *


  The most critical circular failure surface
  is specified by 37 coordinate points

       Point      x-surf      y-surf
        No.        (ft)        (ft)

         1        253.06      250.00
         2        261.25      246.26
         3        269.55      242.78
         4        277.96      239.58
         5        286.47      236.65
         6        295.07      234.00
         7        303.75      231.63
         8        312.51      229.55
         9        321.33      227.76
        10        330.20      226.25
        11        339.12      225.03
        12        348.07      224.11
```

```
         13            357.05        223.47
         14            366.04        223.13
         15            375.04        223.09
         16            384.04        223.34
         17            393.02        223.88
         18            401.98        224.71
         19            410.91        225.83
         20            419.80        227.25
         21            428.64        228.95
         22            437.41        230.95
         23            446.12        233.22
         24            454.75        235.78
         25            463.29        238.62
         26            471.73        241.74
         27            480.07        245.13
         28            488.29        248.79
         29            496.39        252.71
         30            504.36        256.90
         31            512.18        261.35
         32            519.86        266.05
         33            527.38        270.99
         34            534.73        276.18
         35            541.91        281.61
         36            548.91        287.27
         37            549.74        287.98

****  Simplified BISHOP FOS =   1.717  ****



The following is a summary of the TEN most critical surfaces

Problem Description : Fairways at Wolf Creek Phase 4 & 5

        FOS      Circle  Center     Radius   Initial  Terminal  Resisting
      (BISHOP)  x-coord  y-coord             x-coord  x-coord    Moment
                 (ft)     (ft)       (ft)     (ft)     (ft)     (ft-lb)

  1.    1.717   371.96   499.04    275.97   253.06   549.74   1.932E+08
  2.    1.720   380.65   433.57    223.56   253.06   550.28   1.951E+08
  3.    1.726   384.88   456.97    240.58   262.24   556.31   1.916E+08
  4.    1.730   394.26   499.64    285.31   256.12   587.19   2.614E+08
  5.    1.731   368.64   497.60    273.25   253.06   543.25   1.812E+08
  6.    1.736   441.87   355.42    114.11   375.51   532.81   3.789E+07
  7.    1.740   398.53   478.89    269.58   256.12   590.44   2.691E+08
  8.    1.741   390.91   569.46    347.93   253.06   598.02   2.949E+08
  9.    1.741   398.95   525.09    308.56   259.18   598.69   2.826E+08
 10.    1.747   444.74   361.63    118.65   378.57   536.83   3.897E+07

                      * * *  END OF FILE  * * *
```