# APPENDIX 5

# GEOTECHNICAL EVALUATIONS

*Geotechnical Investigation of Trench 12 at the US Ecology Hazardous Waste Management Facility, Beatty, Nevada* (Grant Environmental *1994*)

*Geotechnical Investigation in Support of Trench 13 Construction - September 2015*

*Geotechnical Investigation of Trench 12 at the US Ecology Hazardous Waste Management Facility, Beatty, Nevada* (Grant Environmental *1994*).

# GEOTECHNICAL INVESTIGATION FOR CELL 12
# at the
# US Ecology Hazardous Waste Management Facility

## Beatty, Nevada

*Prepared for*

*American Ecology*
*Houston, Texas*

**May 25, 1994**

GRANT
ENVIRONMENTAL

# GEOTECHNICAL INVESTIGATION FOR CELL 12
# at the
# US Ecology Hazardous Waste Management Facility

## Beatty, Nevada

***Prepared for***

***American Ecology***
***Houston, Texas***

***Prepared by***

***Grant Environmental***
***Denver, Colorado***

**May 25, 1994**

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**May 25, 1994**

**Project No. 814796**

REGISTERED PROFESSIONAL ENGINEER · STATE OF NEVADA
JAMES L. GRANT CIVIL
No. 5904


Noelle R. Cochran SW

**Noelle R. Cochran**
**Project Engineer**

**James L. Grant, P.E.**
**Senior Project Engineer**

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# 1.0 INTRODUCTION

## 1.1 REPORT PURPOSE AND SCOPE

US Ecology operates a commercial hazardous waste disposal site southeast of Beatty, Nevada. Figure 1.1 shows the site location. The site consists of numerous cells excavated for waste disposal. US Ecology has operated waste disposal cells at the Beatty site since the mid-1960's.

US Ecology is proposing to construct a new hazardous waste disposal cell, designated to be Cell 12, in the northwestern corner of the facility. Figure 1.2 shows the cell location. The cell has an irregular shape and is about 1,300 feet long by 340 feet wide. The cell is proposed to be about 75 feet deep. To maximize the volume available for waste material disposal, the Cell 12 design utilizes excavated side slopes of 0.5 to 1 (horizontal to vertical, H:V). US Ecology retained Grant Environmental (Grant) to evaluate the stability of the excavated side slopes and the stability of an above-grade containment dike. US Ecology also requested that Grant to estimate the settlement of the cell floor under the load of the anticipated waste materials.

Grant performed various tasks for this slope stability and settlement evaluation. These tasks included reviewing previous site investigation and slope stability evaluation reports for pertinent data, conducting a field investigation in the area of Cell 12, correlating soils in the Cell 12 area to soils investigated and tested elsewhere at the site, calculating safety factors for various potential slope failures, and calculating estimated settlement. Details relating to these tasks are presented in the following report sections.

## 1.2 SITE SETTING AND GEOLOGY

The US Ecology site is located in the Amargosa Desert. The Amargosa Desert occupies a broad, linear valley between Bare Mountain and the Amargosa Mountain Range. The site is on the north side of this valley, near a boundary between alluvial fans of the bajada and the desert flat. The site occupies a portion of a low southeastward trending hill that slopes toward the Amargosa River bed at the center of the valley. Natural site elevations range between about 2783 and 2772 feet above sea level.

The shallow valley-fill deposits present at the site are comprised of sands, gravels, and cobbles of local origin, primarily volcanics and quartzite, that were transported to the site by a gravity and water forces. Proposed Cell 12 will be situated within these deposits. The cell foundation and side slope soils are comprised of sand, gravel, and cobble mixtures exhibiting varying degrees of natural cementation.

## 1.3 CELL 12 LOCATION AND DESIGN

US Ecology proposes to excavate Cell 12 in the western portion of the US Ecology facility, north of the low-level radioactive waste (LLRW) trenches and west of hazardous waste disposal Cell 11. US Ecology designed the new cell so that a 150-foot buffer zone exists between Cell 12 and the LLRW trenches. Figure 1.2 shows the location and configuration of the new cell.

The east side of Cell 12 and part of the west side of Cell 11 are contiguous. The synthetic liners of the two cells will be joined across the narrow unexcavated berm that separates the cells. Also, upon closure, components of the final covers of the two cells will be joined.

The designs of Cells 11 and 12 accommodate placement of hazardous waste materials to an elevation that is above the existing grade level. To contain above-grade waste materials in Cell 12, the design includes construction of above-grade, compacted-fill dikes around the perimeters. These dikes are to be constructed after waste materials have filled the below-grade portion of the cell. The materials used for dike construction will be materials excavated from the cell.

The compacted-fill dikes primarily will bear on undisturbed native materials, but a portion of the dikes will extend over the waste materials and will bear on those materials. The dikes constructed to contain the above-grade waste materials will be 32 feet high and, allowing for low crown on the final waste material surface, will allow US Ecology to place as much as 40 feet of above-grade waste materials in the cell. The final cover over the filled cell will be an eight-feet thick soil cover.

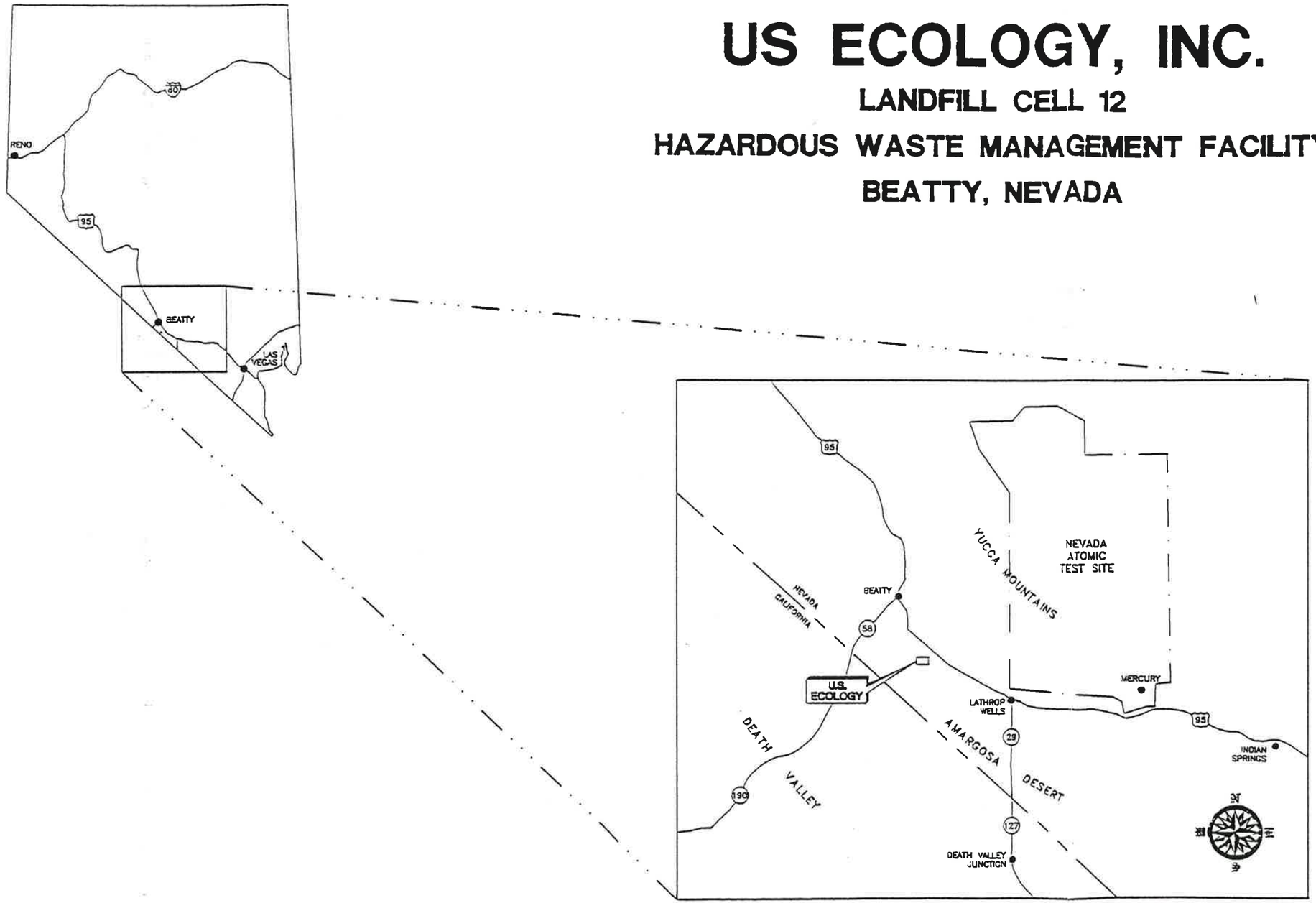
Figure 1.3 shows the design configuration of the excavated and above-grade components of Cell 12.

# US ECOLOGY, INC.

## LANDFILL CELL 12

## HAZARDOUS WASTE MANAGEMENT FACILITY

## BEATTY, NEVADA




VICINITY MAP

20 10 0 20
SCALE MILES

FIGURE 1.1

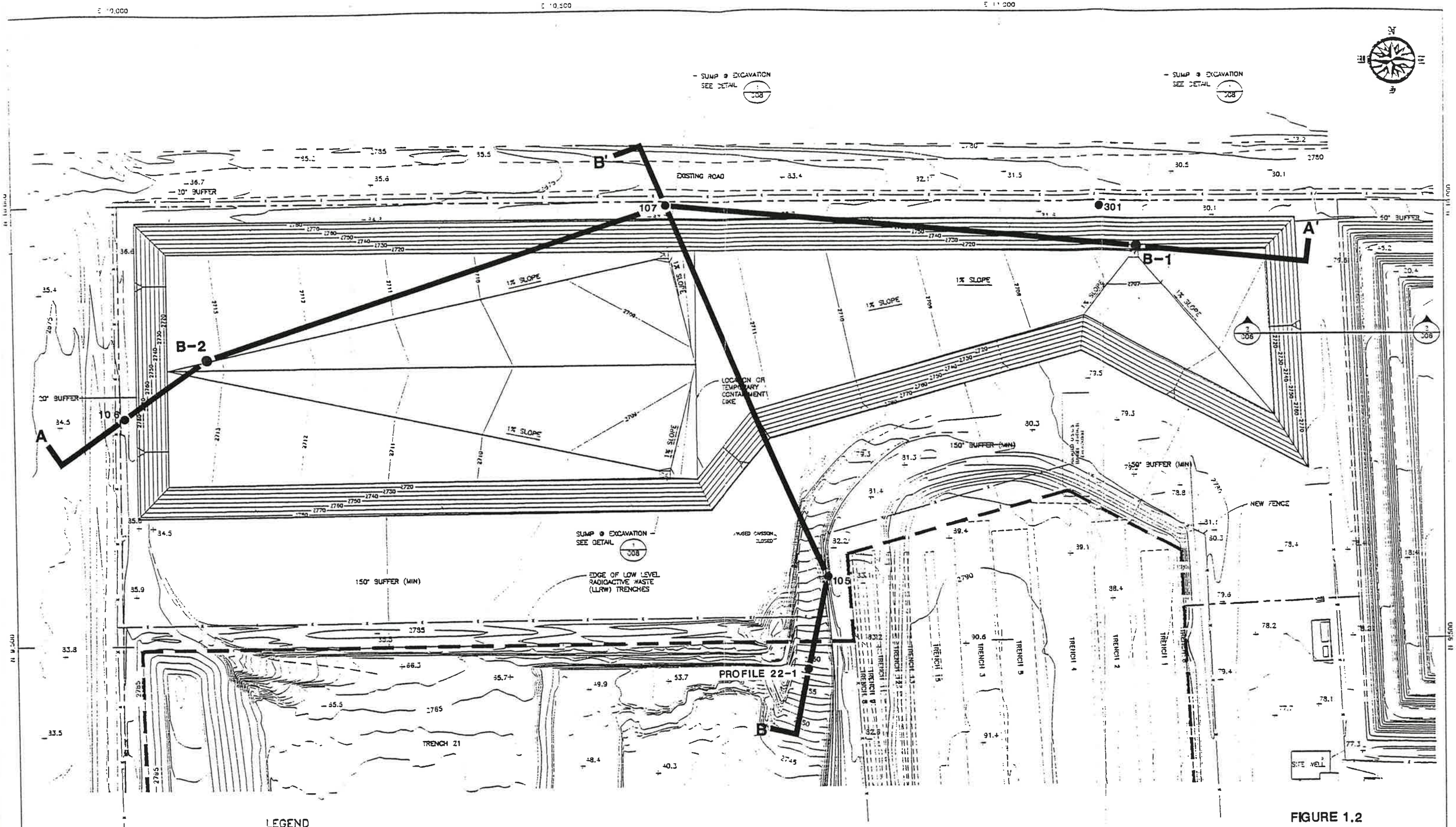



FIGURE 1.2

| Rev | Drawn | Checked | Appr | PE Appr | Date | Description |
|---|---|---|---|---|---|---|
| | | | | | | GRANT 5/94 Add 2 soil boring locations |

REVISIONS

US Ecology
an American Ecology company
US Ecology Inc.
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056

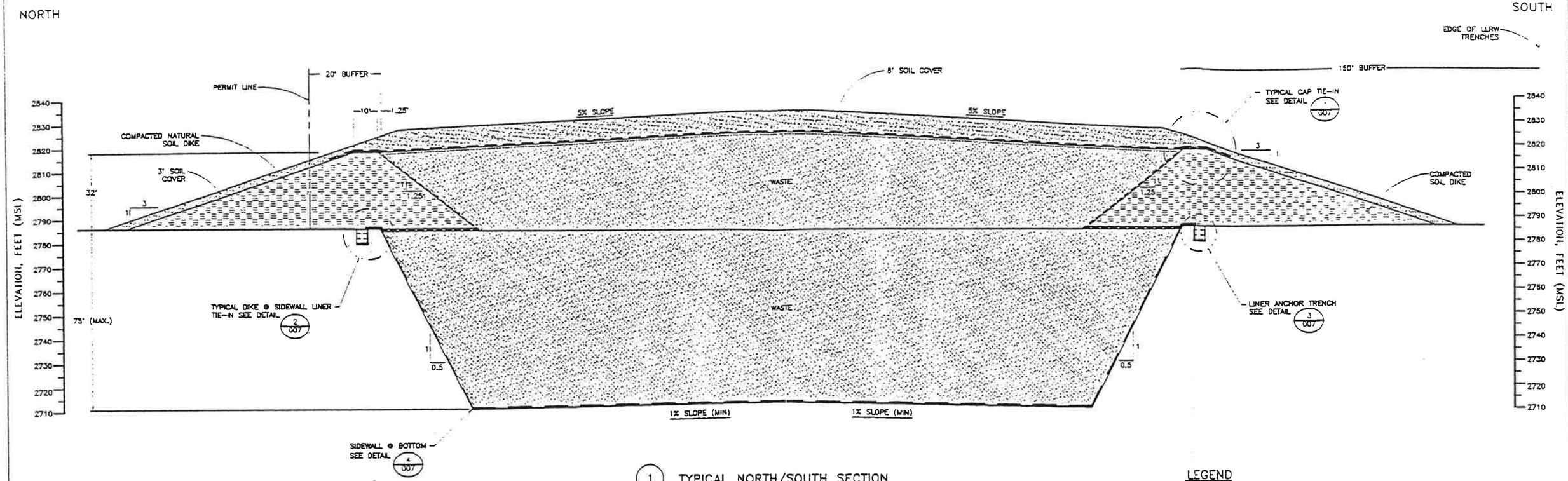
Reference Drawings

Drawn By JKK
Checked By
Appr. By
PE Appr. By
Date 12-93
Scale AS NOTED
Project No. NV148

EXCAVATION PLAN
CELL 12
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology, Inc.
BEATTY, NEVADA

Drawing No. NV-148-TRE-003

Revision No. 0



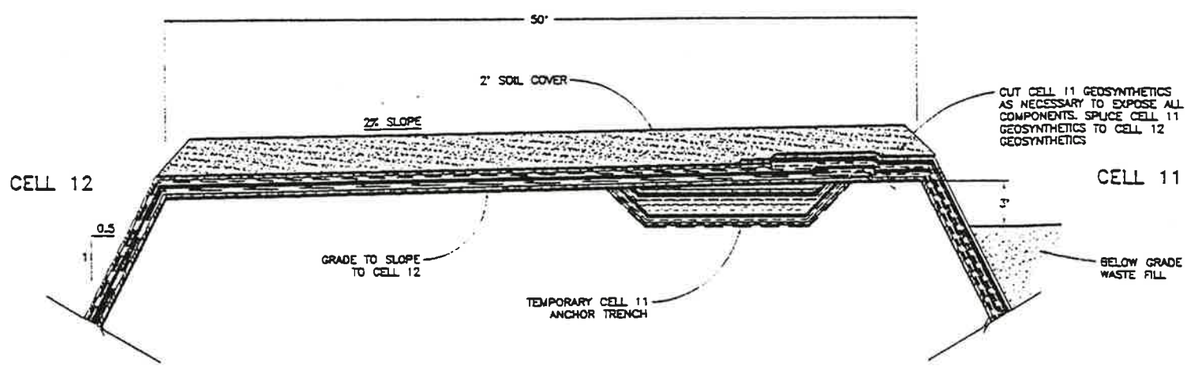

1 TYPICAL NORTH/SOUTH SECTION

REF.: NV-148-TRE-004

20 10 0 20
SCALE FEET

LEGEND

GEOSYNTHETICS - CAP LINER SYSTEM
GEOSYNTHETICS - DIKE LINER SYSTEM
GEOSYNTHETICS - BOTTOM LINER SYSTEM




2 LINER TIE-IN SECTION @ CELL 11

(GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY)

REF.: NV-148-TRE-003

5 2.5 0 5
SCALE FEET

FIGURE 1.3

| Rev | Drawn | Check | Appr | PE Appr | Date | Description |
|---|---|---|---|---|---|---|

REVISIONS

US Ecology
an American Ecology company
US Ecology Inc.
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056

Reference Drawings

Drawn By DKK
Checked By
Appr. By
PE Appr. By SDO
Date 11/93
Scale AS NOTED
Project No. NV148

CROSS SECTION AND DETAIL
CELL 12
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology, Inc.
BEATTY, NEVADA

Drawing No. NV-148-TRE-006

Revision No. 0

# 2.0 FIELD INVESTIGATION

## 2.1 FIELD INVESTIGATION

Grant conducted a field investigation between April 6 and April 9, 1994. Grant and its subcontractor, Beylick Drilling, drilled two soil borings at the site to collect samples for laboratory testing, and for correlating soils in the Cell 12 area to those encountered and tested elsewhere at the site during previous investigations. The borings are located within the Cell 12 excavation area. Boring B-1 was drilled near the proposed toe of the slope in the northwestern portion of the Cell 12 excavation. Boring B-2 was drilled near the proposed toe of the slope in the western portion of the Cell 12 excavation. Figure 1.2 shows the boring locations. Boring records are included in Appendix A.

Borings B-1 and B-2 were advanced to depths of 72 feet and 62 feet respectively. The maximum cell excavation depth will be about 75 feet from grade. Samples were obtained at about ten-foot intervals. The samples were obtained using two-feet long and five-feet long split-barrel samplers. Where the two-feet long sampler was used, standard penetration test values were measured using ASTM method D1586.

## 2.2 LABORATORY TESTING

Laboratory tests were performed on disturbed samples selected to be representative of the soil strata present in the Cell 12 area. Laboratory testing of the collected samples included tests to measure particle size and Atterberg limits. The laboratory tests were performed by Aguirre Engineers, Inc. of Denver, Colorado using standard ASTM methods D422 and D4318, respectively. The laboratory report is presented in Appendix B.

The laboratory test results were used to verify the visual soil descriptions made in the field and to correlate the soils encountered in the Cell 12 area to those encountered and tested elsewhere at the Beatty site during previous investigations. The data were used to estimate material properties for the slope evaluation cross sections.

Undisturbed samples for consolidation tests could not be obtained during the field investigation because of the gravels encountered. Grant attempted to obtain such a sample from each borehole. However, gravels within the samples made undisturbed sampling impossible. Previous site investigations (Law, 1981) also indicate that borehole sampling techniques typically are unsatisfactory for obtaining representative undisturbed samples from some strata. This is because the cementation of the soil strata is destroyed even by the sampling techniques used within the borehole.

## 2.3 CELL 12 SOIL CONDITIONS

### 2.3.1 Review of Data from Previous Investigations

Numerous subsurface investigations have been performed at the site in the past. Soil borings and soil tests were conducted for several of the investigations. The findings from these investigations are presented in reports by Law Engineering Testing Company (1981), The Mark Group (1989), and others. To evaluate soil conditions in the Cell 12 area, Grant correlated data from the recent investigation with data obtained from the previous investigations. The soil strata are fairly consistent across the site, making this correlation possible.

### 2.3.2 Correlation of Data From Past Investigations

Data from the recent borings and the previous investigations were used to prepare stratigraphic cross-sections of the proposed Cell 12 location. These cross-sections are presented in Figures 2.1 and 2.2. The cross-section locations are indicated in Figure 1.2 The cross-sections illustrate the correlation between soil strata identified by the recent investigation to soil strata identified during previous investigations. The recent borings are designated B-1 and B-2.

In the Cell 12 area, the following soil strata are present.

**Surface Silty Sand:** The shallow native soils at Cell 12 are firm to dense, brown, silty sands, sandy silts and sandy gravels that frequently contain cobbles. The stratum is non-cemented and is about eight to 14 feet thick.

**Upper Sand and Gravel:** A dense to very dense, silty sand and gravel is beneath the surface silty sand. It typically is non-cemented to partially cemented, but some zones are cemented. The stratum contains occasional cobbles and is about 19 to 31 feet thick.

**Lower Sand and Gravel:** This layer consists of non-cemented to partially cemented, dense to very dense, brown to grayish-tan, sandy gravel to silty, gravelly sand. The stratum ranges in thickness from about 18 feet to about 51 feet. It contains occasional cobbles.

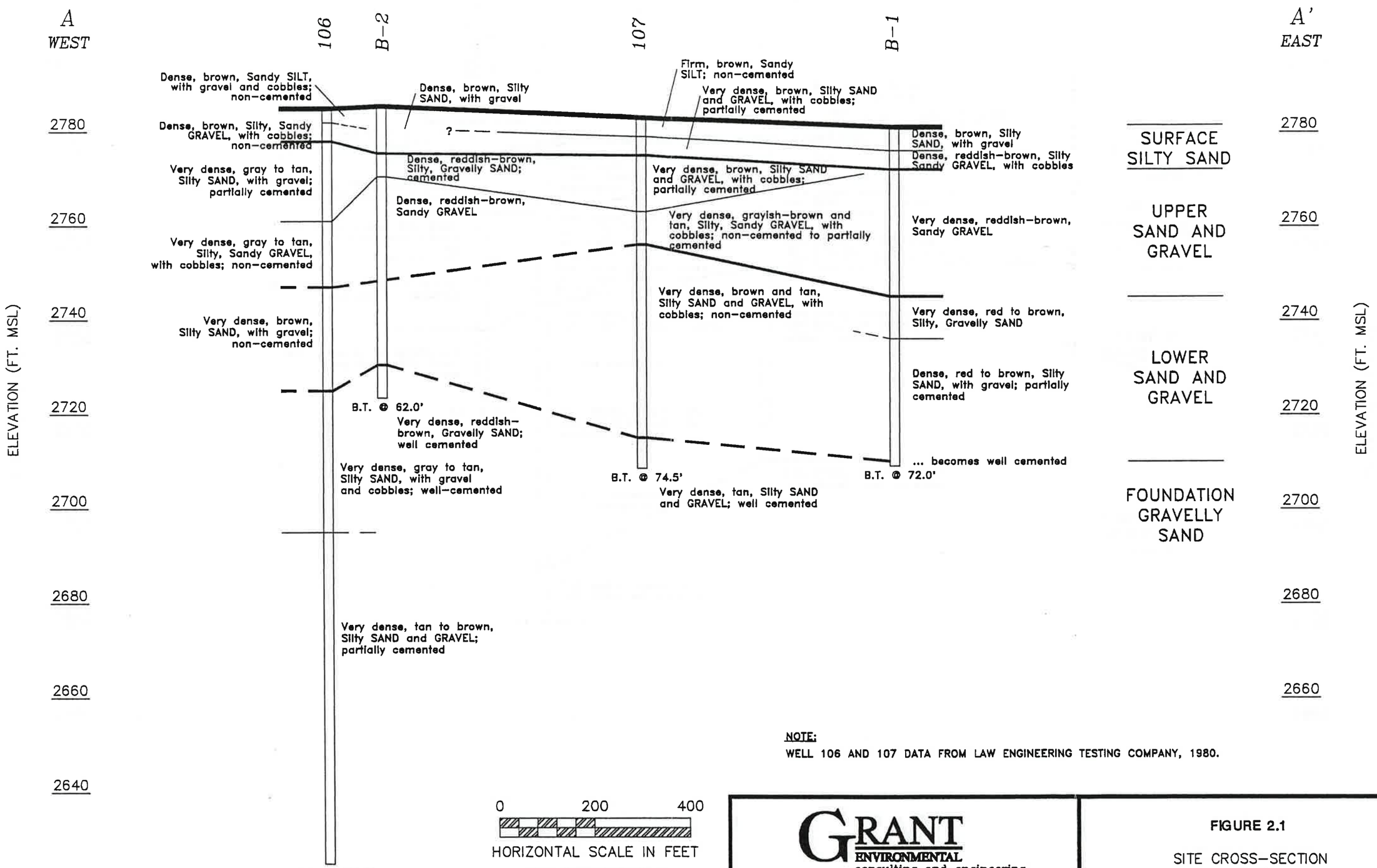
**Foundation Gravelly Sand:** The soils comprising the lower part of the Cell 12 excavation and the cell foundation are gray and tan, well-cemented, dense to very dense, silty sands and gravelly sands. This layer is characterized by very high standard penetration test (SPT) values. This stratum begins at depths of about 58 to 72 feet below grade.

**Cementation:**

Since undisturbed samples could not be obtained, direct measurements or observations were not possible of the degree of cementation in Cell 12 subsurface materials. However, assessment of the degree of cementation is possible through indirect measures. The methods for such assessment are the standard penetration test (SPT) values for boring made in or near Cell 12, and direct observations of soil cementation made in the 50-feet deep excavation for LLRW Cell 21.

High SPT values, typically about 100 blows per foot of penetration, correlate with past observation of cementation. Values greater than 100 blows per foot indicate well-cemented materials.

Undisturbed samples from various depths in Cell 21 (previously designated Cell 22) were obtained during a previous investigation. These samples were tested to determine their unconfined compressive strength. In the past investigation, the unconfined compressive strengths were used to estimate cohesive strength. Cohesive strength is a result of cementation in these sand and gravel materials. The cemented zones in Cell 21 are correlated with similar zones in the Cell 22 area by the method discussed in Section 2.3.2 of this report.




NOTE:
WELL 106 AND 107 DATA FROM LAW ENGINEERING TESTING COMPANY, 1980.

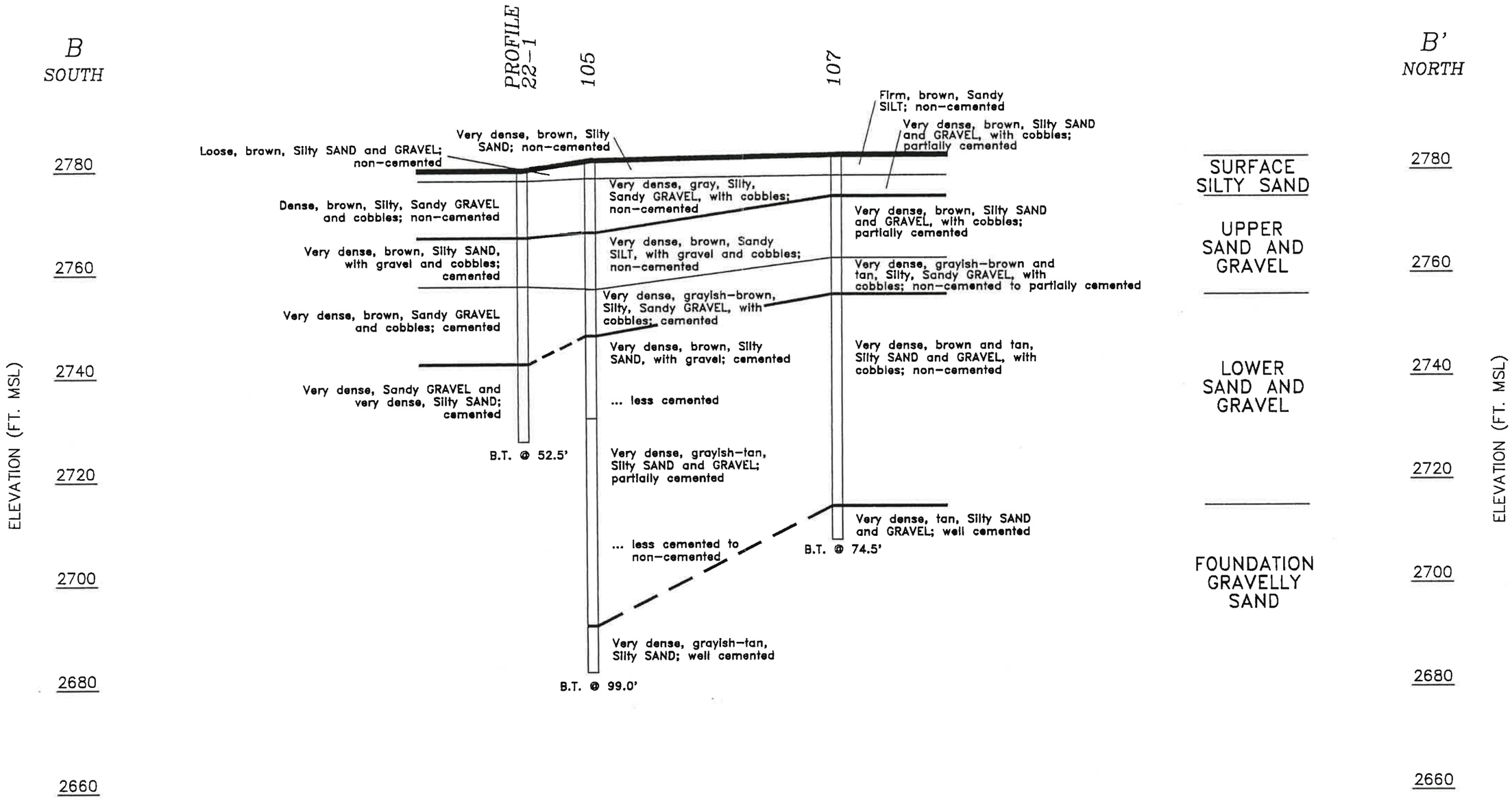
GRANT ENVIRONMENTAL
consulting and engineering
DENVER, COLORADO

**FIGURE 2.1**

SITE CROSS-SECTION
A-A'

814796\SECA-A.DWG; 5/25/94

814796




NOTE:
WELL 105 AND 107 DATA FROM LAW ENGINEERING TESTING COMPANY, 1980.

0 200 400
HORIZONTAL SCALE IN FEET
10:1 EXAGGERATION

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consulting and engineering
DENVER, COLORADO

**FIGURE 2.2**

SITE CROSS-SECTION
B-B'

814796\SECB-B.DWG: 5/25/94

814796

# 3.0 SLOPE STABILITY EVALUATION

The stability of the Cell 12 excavated side slopes and the inside slope of the compacted-fill containment dike were evaluated. Grant prepared a model of the north, east, south, and west cell side walls. Although the maximum slope height and slope angle are similar for each side wall, the geology varies slightly, so separate models were developed. The containment dike will be constructed of materials excavated from the cell and is expected to have similar dimensions and soil properties on all sides of the cell.

The following sections discuss the design slopes used in the models, the design parameters, and the seismic conditions used as model input. The critical conditions relating to acceptable factors of safety and the model run results also are discussed.

## 3.1 DESIGN SLOPE

**Cell Excavation**: A design slope of 0.5:1 (H:V), with a maximum height of 75 feet was used for evaluation of the cell excavation side slopes. The north, east, south, and west side slope cross sections in Figures 3.1 through 3.4.

**Compacted-Fill Dike**: A design slope of 1.25:1, with a height of 32 feet was used to evaluate the above-grade, containment dike interior slope. The slope cross section is shown in Figure 3.5.

Two conditions relating to the overall stability of the design slope were not considered in these model sections. The support offered by the waste materials was not considered. The full depth of these slopes will be exposed only during the early part of the operational period of the cell. During that time, waste materials gradually will be placed in the cell bottom and adjacent to the slope. These waste materials will weight the toe of the slope and provide additional resistance to slope failure. The model did not consider this additional failure resistance. Also, the effect of the synthetic liner covering the slope face also was not considered. The liner does not does not provide resistance to slope failure.

## 3.2 DESIGN PARAMETERS

Soil parameters were determined from field and laboratory testing conducted during this and previous investigations. Laboratory data, standard penetration test values, and field and laboratory descriptions of the subsurface soils were used as a guideline in selecting the soil density ($\gamma$), friction angle ($\phi$), and cohesion (C). Reasonable, but conservative, soil parameters were used in the stability evaluation. The soil parameters are shown on the slope cross sections and are discussed below.

### 3.2.1 Excavation Side-Slope Material Properties

The cross sections, previously discussed in Section 2.3, were reviewed for consistent strata extending across the cell. The continuity of strata with and without significant cementation was given special attention. Two general properties were assigned to all strata. These are the friction angle ($\phi$) and soil density. A friction angle of 35 degrees was used for all strata encountered in the cell side slopes. This angle is considered to be a conservative (low) value, but is consistent with that used in previous slope stability evaluations. An in-situ soil density of 120 pounds per cubic foot (pcf) also was used for all of the soils. These values are consistent with those that were measured by laboratory testing of undisturbed samples from Cell 21 in the 1980 investigations and have been used in previous slope stability evaluations.

Cohesive strength of the various strata were assigned on the basis of the observed or inferred degree of cementation.

- The firm to dense, non-cemented, sandy silt and silty sand encountered from the surface to depths of about nine feet were assumed to be cohesionless and were given a cohesion value of 0. This stratum correlates with the Surface Silty Sand.

- Cohesion in the non-cemented, partially cemented and cemented silty sands and sandy gravels were given cohesion values ranging from 720 to 2,880 pounds per square foot (psf), depending on cementation observations in recovered samples and SPT values. These strata correlate with the Upper Sand and Gravel and Lower Sand and Gravel.

- The very dense, well-cemented silty sand and gravelly sand present at the base of the four design slopes was given a cohesion value of 4,320 psf. This stratum correlates with the Foundation Gravelly Sand.

These values are consistent with those used in previous slope stability evaluations.

The soil strata considered in each cell wall evaluation and the strength parameters used are shown on the design slopes presented in Figures 3.1 through 3.5.

The upper 75 feet of soils at the site are dry and are expected to remain in this condition. Precipitation is possible, but will not cause saturation of these dry soils or development of pore pressures that could affect the slope stability. The slopes were evaluated using dry soil conditions.

### 3.2.2 Compacted-Fill Dike Material Properties

Soils excavated from Cell 12 will be used to construct the containment dike. These fill soils were given a density of 120 pcf, a friction angle between 38 and 42 degrees, and a

cohesion of 0. These values are consistent with properties measured or assumed for previous slope stability analyses.

## 3.3 SEISMIC CONDITIONS

Algermissen and Perkins (1982) indicate that the maximum horizontal acceleration which has a 90 percent probability of not being exceeded within a 50-year period for the site area is 0.15g. This acceleration was used to evaluate seismic effects on the slope stability.

## 3.4 SLOPE EVALUATION

The stability of slope is calculated as a factor of safety. The factor of safety is the ratio of the shearing strength to the shearing force. The shearing force causes the soil mass to move when it is greater than the resisting shearing strength. The shearing force is comprised of soil weight and earthquake forces. A factor of safety greater than one (1.0) indicates that the resisting strength is greater than the forces tending to cause failure.

Various failure modes are possible, depending on the design slope and slope conditions. A circular failure mode was used for this slope stability evaluation. A circle has the least surface area per unit mass and therefore has a smaller ratio of resisting force to driving force (Huang, 1983).

Various failure surfaces were modeled for the cell side wall slopes. Slope failures at the toe of the slope were modeled as well as failures through the soil strata contacts above the toe. Base failures (below the toe) are not likely to be critical because of the high cohesive strength and cementation of the cell foundation soils.

The compacted-fill containment dike will be constructed as a homogeneous soil mass. A slope failure through the toe of the slope was modeled for the dike.

The failure surfaces with the lowest factors of safety are shown on the design slopes presented in Figures 3.1 through 3.5. The computer model output, from which these surfaces were determined, is included in Appendix C.

The exterior slope of the containment dike was not considered in this evaluation. This 3:1 (H:V) slope will be about 42 feet high after placement of the cell cover. The materials used to construct the compacted soil dike will be those excavated from Cell 12. The materials used to construct the soil cover will consist of excavated materials and low-permeability materials. This 3:1 slope is flatter than the 1.25:1 inner dike slope evaluated for short-term stability. Therefore, evaluation of the 3:1 slope was considered unnecessary. The critical aspect of the long-term stability of this slope relates to erosion. Determination of erosion conditions was beyond the scope of this slope stability evaluation.

## 3.5 CRITICAL CONDITIONS

For this evaluation, the slope stability factor of safety requirements of NUREG 1199 and 1200 were referenced. Short-term slope stability requires a factor of safety greater than 1.3 for static conditions and a factor of safety greater than 1.0 (preferably 1.05) for dynamic conditions. The Cell 12 slopes were considered to be exposed only for the short-term, as they will be exposed only during the time the cell is operated.

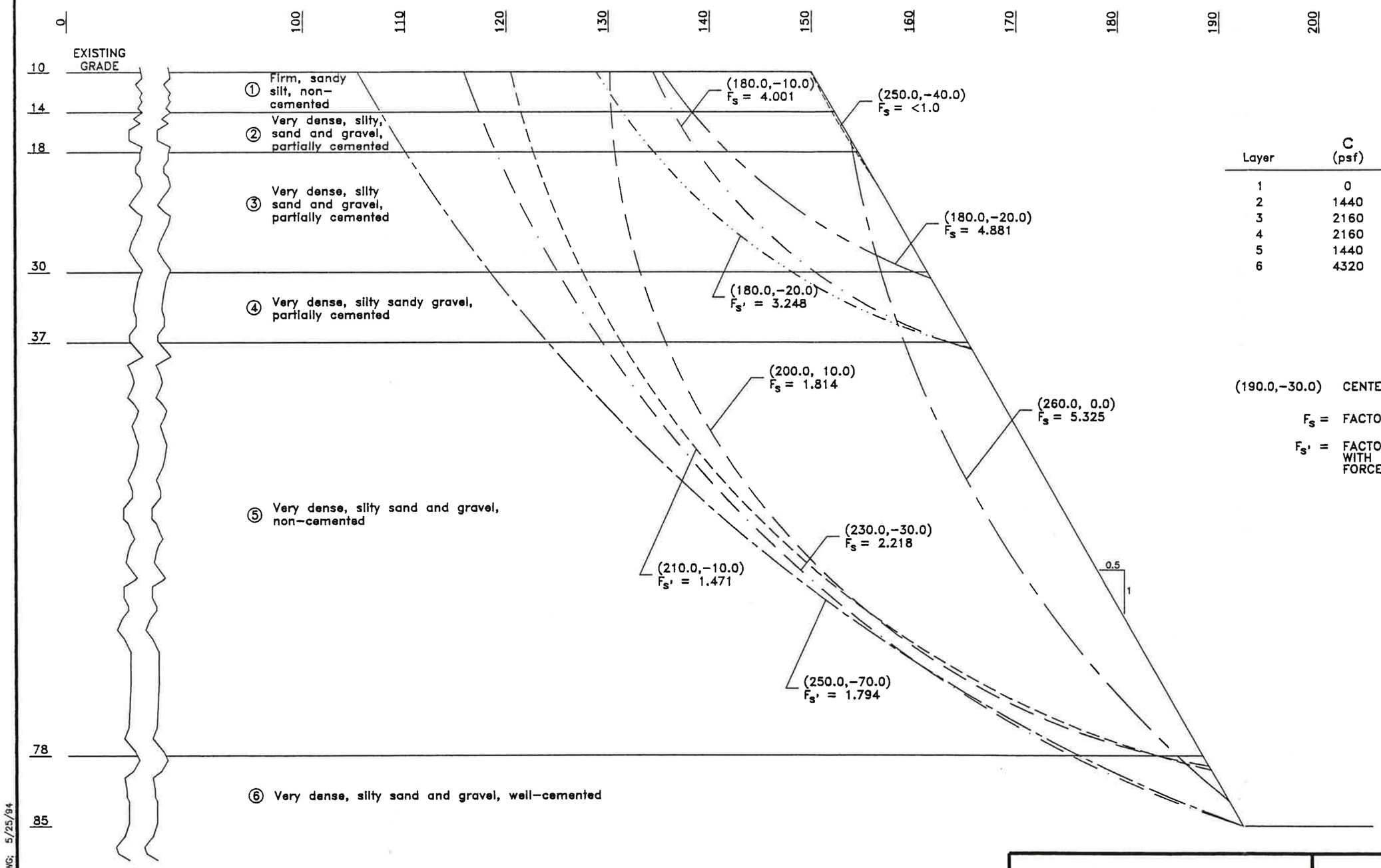
## 3.6 COMPUTER MODEL

Grant evaluated the slope stability using the STABARM computer model. The STABARM model uses the widely accepted Modified Bishop Method of Slices to calculate forces and factors of safety. The method of slices consists of dividing the slope in vertical soil slices and analyzing the forces acting on each slice. The entire soil mass equilibrium is then determined by summing the forces acting on all the slices. The method uses the forces and moments to determined factors of safety.

The STABARM program searches a grid of potential failure circle centers to determine the minimum factor of safety for a given parameter set and failure surface location. To begin the program, a failure surface location, soil parameters ($C, \phi$, and $\gamma$), failure circle center and a tangent or point on the failure surface are input. The program then moves the center of the circle, varies the surface and compares the factor of safety of the new failure surface with the factor of safety for the previous (or minimum) failure surface. If the new failure surface has a lower factor of safety than the previous minimum safety factor surface, the new surface becomes the minimum against which subsequent surfaces are compared. The program compares the centers of new failure surfaces around the beginning failure surface center until a surface with a lower factor of safety is found. The program then begins comparing factors of safety with those for centers around the center of the new minimum surface.

The STABARM program allows consideration of seismic forces. The program uses a pseudo-static method of analysis that considers seismic effects as horizontal mass force based on the earthquake acceleration and potential slide mass. The pseudo-static method frequently is used for evaluating slope stability where seismic accelerations are small and factors of safety are high. For this evaluation, Grant compared factors of safety calculated with seismic forces against those calculated without seismic forces. The output files from the computer model runs are presented in Appendix C.

For the evaluation of excavation side slope stability, several "cases" were evaluated. Each case represents a failure surface position corresponding to failure through a different part of the slope. For the compacted-fill dike evaluation, two cases were evaluated. The first case is the 32 feet high slope with no waste materials present, and the second case is the 32 feet high slope buttressed by 10 feet of water materials.




NOTE:
COORDINATES USED FOR COMPUTER MODEL.

| Layer | C (psf) | $\phi$ (degrees) | $\gamma$ (pcf) |
|---|---|---|---|
| 1 | 0 | 35 | 120 |
| 2 | 1440 | 35 | 120 |
| 3 | 2160 | 35 | 120 |
| 4 | 2160 | 35 | 120 |
| 5 | 1440 | 35 | 120 |
| 6 | 4320 | 35 | 120 |

(190.0,-30.0) CENTER OF FAILURE SURFACE

$F_s$ = FACTOR OF SAFETY

$F_s'$ = FACTOR OF SAFETY WITH HORIZONTAL SEISMIC FORCE OF 0.15g.

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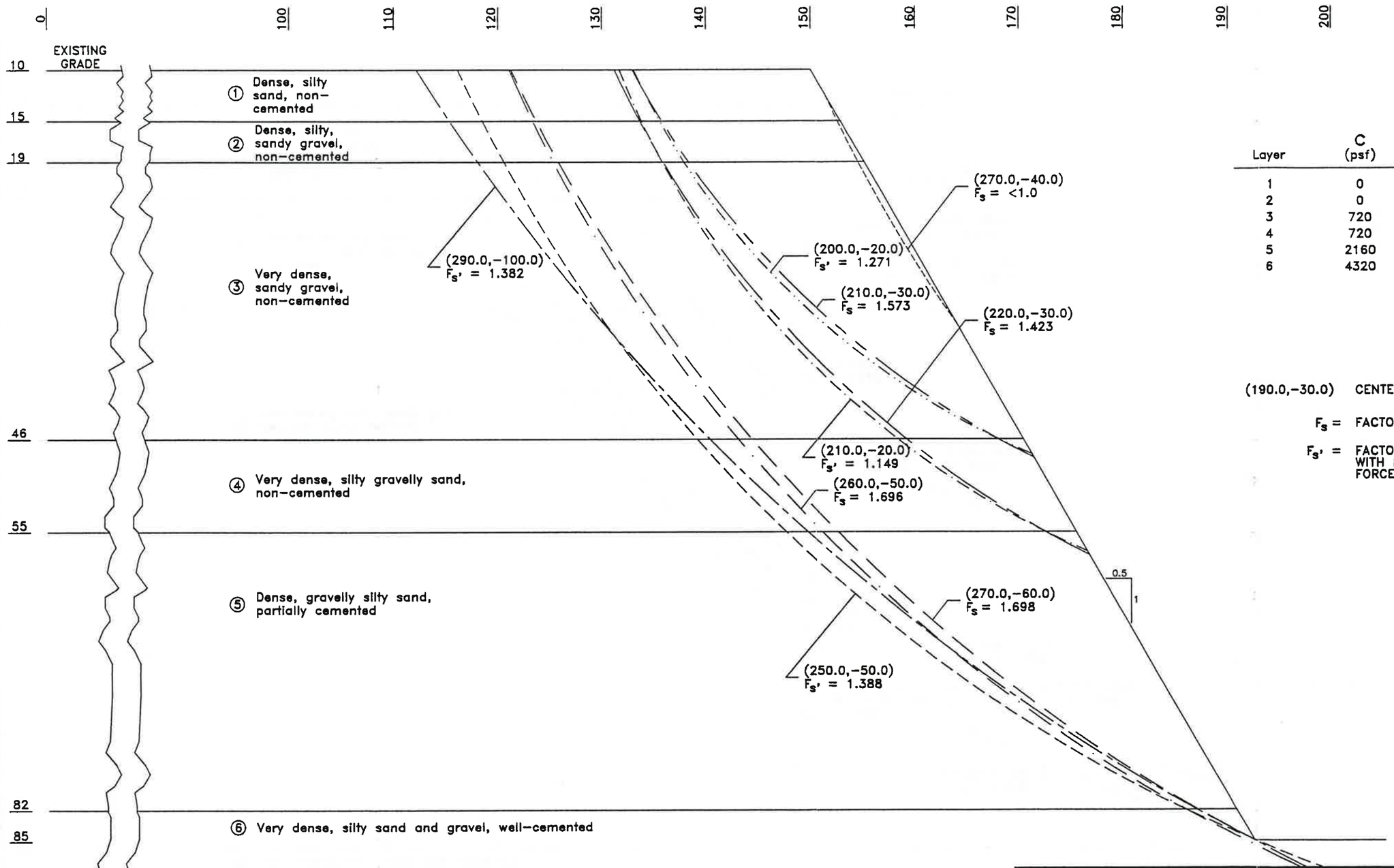
FIGURE 3.1

CROSS-SECTION OF NORTH WALL

814796\WALL_N.DWG; 5/25/94

814796




NOTE:
COORDINATES USED FOR COMPUTER MODEL.

| Layer | C (psf) | $\phi$ (degrees) | $\gamma$ (pcf) |
|---|---|---|---|
| 1 | 0 | 35 | 120 |
| 2 | 0 | 35 | 120 |
| 3 | 720 | 35 | 120 |
| 4 | 720 | 35 | 120 |
| 5 | 2160 | 35 | 120 |
| 6 | 4320 | 35 | 120 |

(190.0,-30.0) CENTER OF FAILURE SURFACE

$F_s$ = FACTOR OF SAFETY

$F_s'$ = FACTOR OF SAFETY WITH HORIZONTAL SEISMIC FORCE OF 0.15g.

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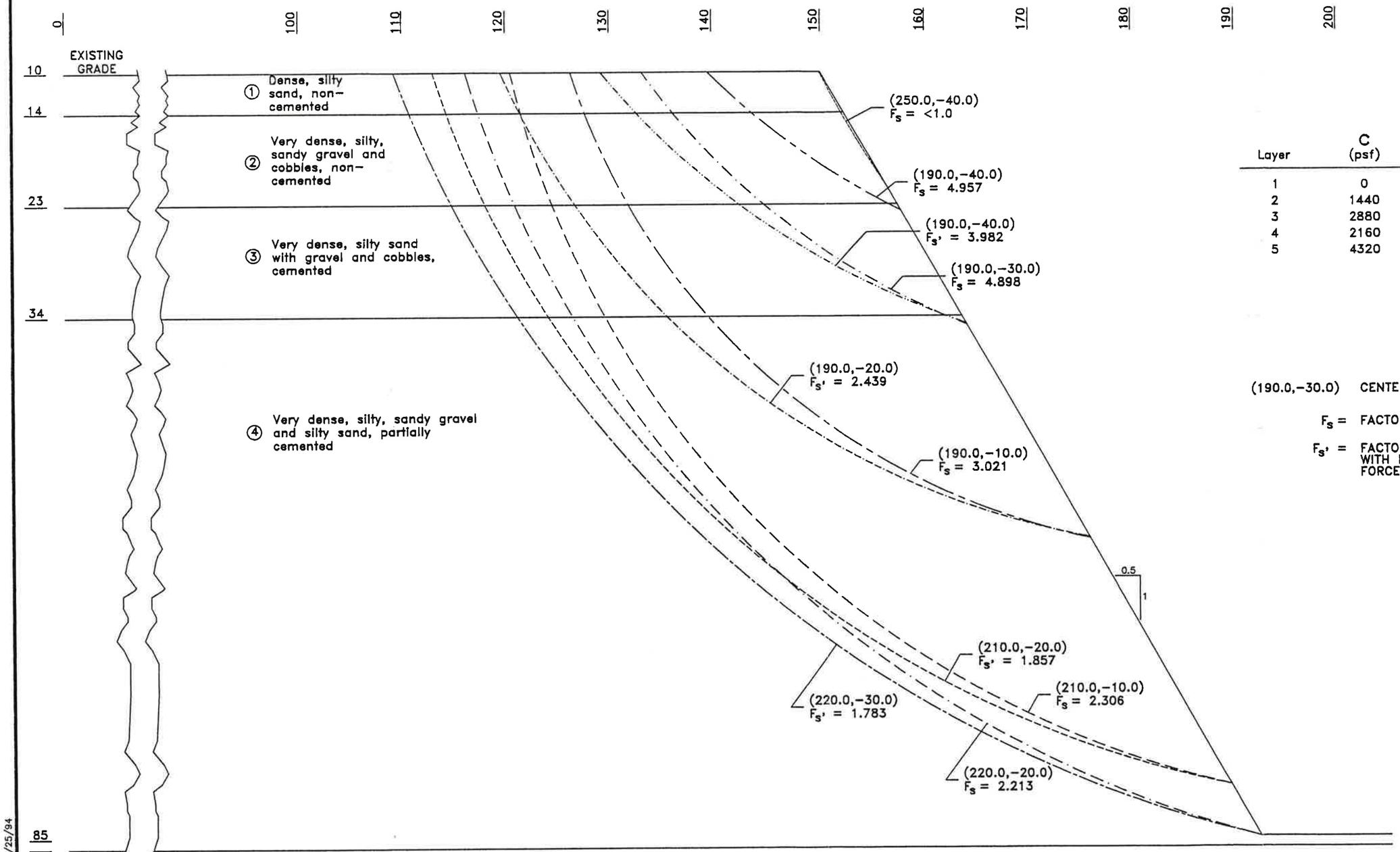
FIGURE 3.2

CROSS-SECTION OF EAST WALL

814796\WALL_E.DWG; 5/25/94

814796




NOTE:
COORDINATES USED FOR COMPUTER MODEL.

| Layer | C (psf) | $\phi$ (degrees) | $\gamma$ (pcf) |
|---|---|---|---|
| 1 | 0 | 35 | 120 |
| 2 | 1440 | 35 | 120 |
| 3 | 2880 | 35 | 120 |
| 4 | 2160 | 35 | 120 |
| 5 | 4320 | 35 | 120 |

(190.0,-30.0) CENTER OF FAILURE SURFACE

$F_s$ = FACTOR OF SAFETY

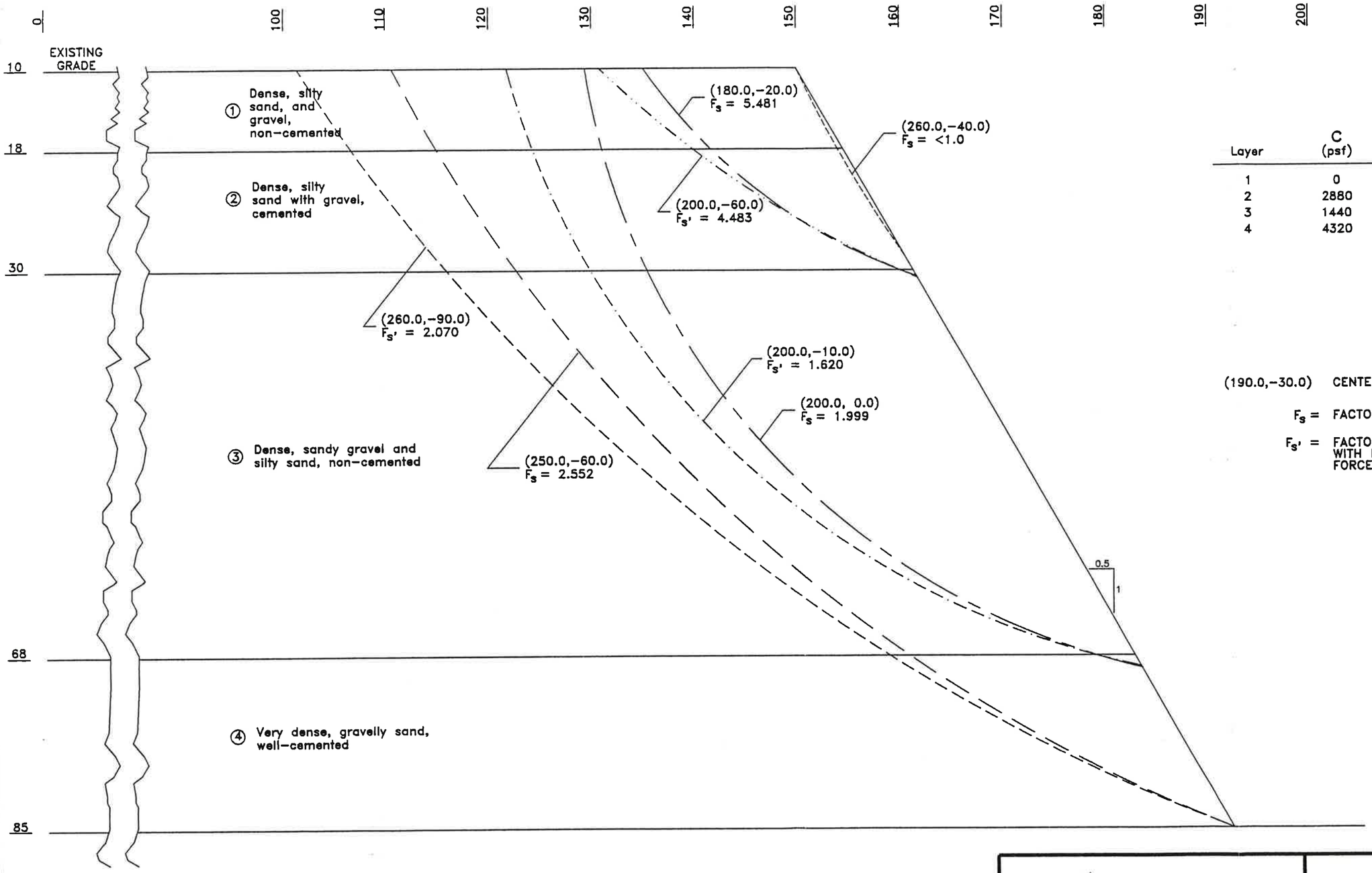
$F_s'$ = FACTOR OF SAFETY WITH HORIZONTAL SEISMIC FORCE OF 0.15g.

GRANT ENVIRONMENTAL consulting and engineering DENVER, COLORADO

FIGURE 3.3
CROSS-SECTION OF SOUTH WALL

814796\WALL_S.DWG; 5/25/94

814796




NOTE:
COORDINATES USED FOR COMPUTER MODEL.

| Layer | C (psf) | $\phi$ (degrees) | $\gamma$ (pcf) |
|---|---|---|---|
| 1 | 0 | 35 | 120 |
| 2 | 2880 | 35 | 120 |
| 3 | 1440 | 35 | 120 |
| 4 | 4320 | 35 | 120 |

(190.0,-30.0) CENTER OF FAILURE SURFACE

$F_s$ = FACTOR OF SAFETY

$F_s$' = FACTOR OF SAFETY WITH HORIZONTAL SEISMIC FORCE OF 0.15g.

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FIGURE 3.4

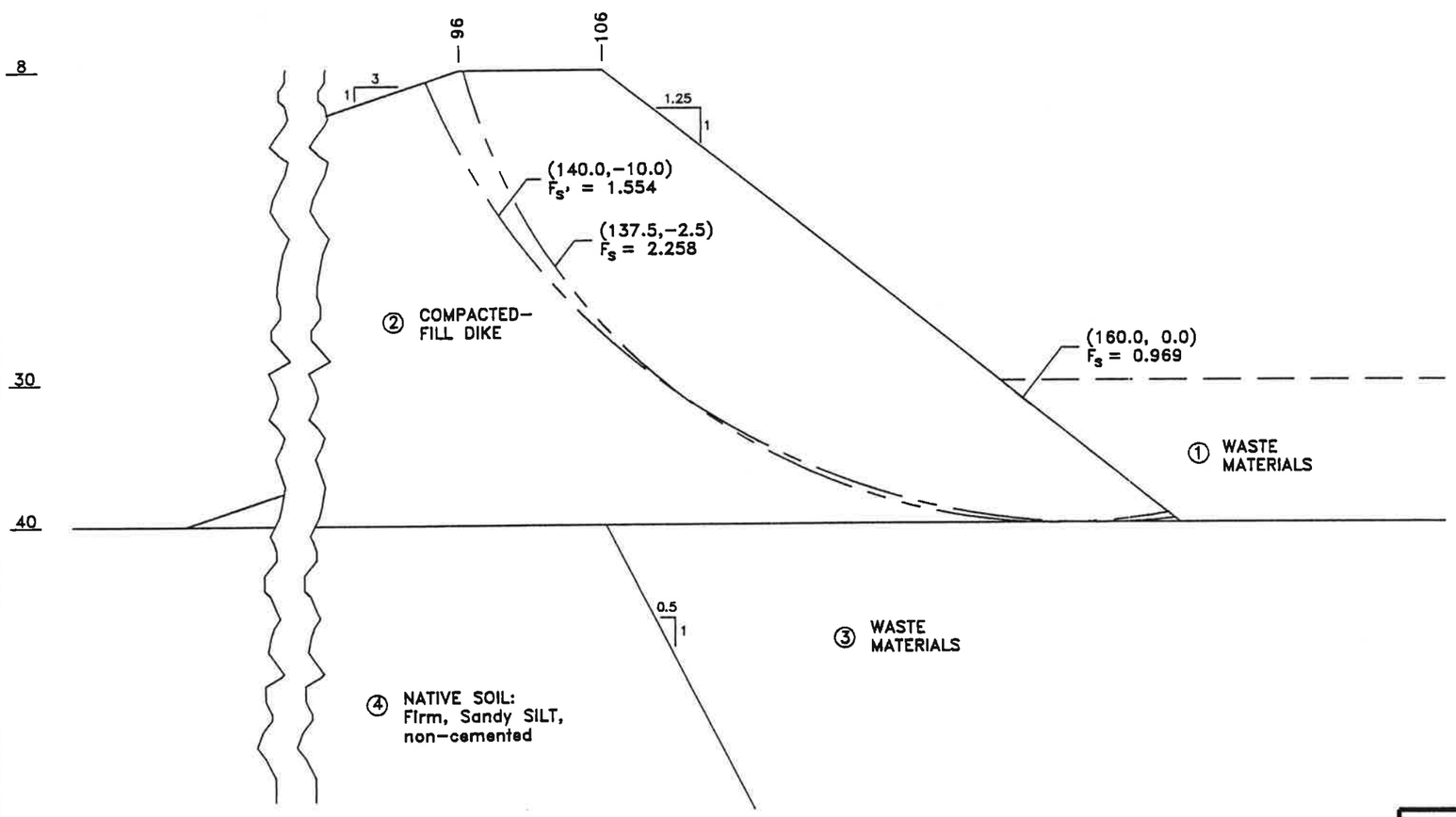
CROSS-SECTION OF WEST WALL

814796\WALL_W.DWG; 5/25/94

814796

NOTE:
COORDINATES USED FOR COMPUTER MODEL.

| Layer | C (psf) | $\Phi$ (degrees) | $\gamma$ (pcf) |
|---|---|---|---|
| 1 | 0 | 30 | 85 |
| 2 | 0 | 38 | 120 |
| 3 | 0 | 30 | 85 |
| 4 | 0 | 35 | 120 |




(190.0,-30.0) CENTER OF FAILURE SURFACE

$F_s$ = FACTOR OF SAFETY

$F_s$' = FACTOR OF SAFETY WITH HORIZONTAL SEISMIC FORCE OF 0.15g.

GRANT ENVIRONMENTAL consulting and engineering DENVER, COLORADO

FIGURE 3.5

CROSS-SECTION OF COMPACTED FILL DIKE

814796\COMPFILL.DWG; 5/25/94

814796

# 4.0 STABILITY EVALUATION RESULTS

The STABARM computer model was used to calculate failure surfaces and factors of safety for the design slopes. Several model runs were performed for each slope. The model runs were made for static conditions (no seismic effects) and dynamic conditions (with horizontal seismic accelerations).

## 4.1 EXCAVATION SIDE SLOPES

The results of excavation side slope evaluations are shown in Figures 3.1 through 3.4. As these figures indicate, several failure surface configurations were considered. In general, these surfaces correspond to one or more points in each of the major strata present in the design slope. In each stratum, the base of the stratum was selected as the critical point for the failure surface to leave the slope. In some thick and relatively weak strata, other surfaces also were considered. The lowest factors of safety for the various failure surfaces under static and dynamic conditions are presented in Table 4.1.

The cell wall side slopes were determined to be stable under both static and dynamic conditions for deep-seated failure surfaces that exit through the toe of the slope and other points in the lower portion of the cell wall.

In each of the four side walls, a probable instability was found in the shallow stratum. This cohesionless material will not stand at a 0.5:1 slope. This condition is consistent with historic observations in waste disposal trenches. The uppermost cohesionless stratum typically fails to a slope approximately equal to the friction angle. This slope that is naturally assumed by these materials is about 1:1.5 (H:V).

## 4.2 COMPACTED-FILL DIKE

The results of compacted-fill dike slope evaluation are shown in Figure 3.5. Several failure surface configurations were considered. The base of the fill was selected as the critical point for the failure surface to leave the slope. The lowest factors of safety for the various failure surfaces are presented in Table 4.2.

The inner slope of the compacted-fill containment dike is 1.25:1. The dike slope identified in Table 4.2 and Appendix C as Case 1 was determined to be marginally stable under static conditions for failure surfaces that exit through the toe of the slope. The factor of safety against this failure is approximately 1.0. This analysis presumes that the friction angle for the fill material is 38 degrees, or equal to the slope of the fill. When a less conservative friction angle of 42 degrees is selected, the factor of safety increases to 1.1. The actual friction angle for the compacted material is expected to be in this range.

The 1.25:1 slope is not stable under dynamic conditions. However, waste materials are expected to be placed against the toe of the slope relatively soon after the dike is constructed. Case 2 in Table 4.2 and Appendix C consider the presence of waste materials. When this occurs, the weight of waste materials will begin to buttress the lower portion of the slope. An analysis of the stability of the slope after placement of 10 feet of waste materials indicates that the buttressed slope is stable for the deep-seated failure under both static and dynamic conditions. The non-buttressed upper portion of the slope still is marginally stable under static conditions.

The dynamic instability of the dike slope is only an operational problem, since the part of the dike against which waste materials have been placed is stable. Should a seismically induced failure of the dike occur, the dike could be repaired before more waste was placed in the trench. Dynamic stability of the inner slope of the dike probably is not necessary to assure long-term stability of the completed cell.

**TABLE 4.1**

**RESULTS OF SLOPE STABILITY ANALYSES FOR CELL 12 EXCAVATION**

| LOCATION | FAILURE PLANE DEPTH (FT.) | Fs | Fs' |
|---|---|---|---|
| EAST WALL | | | |
| Case 1 | 85.0 | 1.698 | 1.382 |
| Case 2 | 82.0 | 1.696 | 1.388 |
| Case 3 | 55.0 | 1.423 | 1.149 |
| Case 4 | 46.0 | 1.573 | 1.271 |
| Case 5 | 19.0 | < 1.0 | NA |
| NORTH WALL | | | |
| Case 1 | 85.0 | 2.218 | 1.794 |
| Case 2 | 78.0 | 1.814 | 1.471 |
| Case 3 | 37.0 | 3.959 | 3.221 |
| Case 4 | 30.0 | 4.881 | NA |
| Case 5 | 18.0 | 5.325 | NA |
| Case 6 | 14.0 | < 1.0 | NA |
| WEST WALL | | | |
| Case 1 | 85.0 | 2.552 | 2.070 |
| Case 2 | 68.0 | 1.999 | 1.620 |
| Case 3 | 30.0 | 5.481 | 4.483 |
| Case 4 | 18.0 | < 1.0 | NA |
| SOUTH WALL | | | |
| Case 1 | 85.0 | 2.213 | 1.783 |
| Case 2 | 80.0 | 2.306 | 1.857 |
| Case 3 | 55.0 | 3.021 | 2.439 |
| Case 4 | 34.0 | 4.898 | 3.982 |
| Case 5 | 23.0 | 4.957 | NA |
| Case 6 | 14.0 | < 1.0 | NA |

Fs' = Safety Factor considering horizontal seismic force of 0.15g

**TABLE 4.2**

**RESULTS OF SLOPE STABILITY ANALYSES FOR CONTAINMENT DIKE**

| CASE | FRICTION ANGLE | FAILURE PLANE DEPTH (FT.) | Fs | Fs' |
|---|---|---|---|---|
| 1 | 38 | 32.0 | 0.969 | 0.720 |
| 1 | 42 | 32.0 | 1.117 | 0.829 |
| 2 | 38 | 32.0 | 2.258 | 1.554 |

Fs' = Safety Factor considering horizontal seismic force of 0.15g

## 5.0 EVALUATION OF SETTLEMENT POTENTIAL

The settlement of the cell foundation soils may result from consolidation caused by the weight of the waste materials and soil cover. Other causes of consolidation and settlement, such as soil saturation, are unlikely because of the dry nature of the site soils. At the Beatty site, the cell foundation soils are comprised of dense to very dense, dry, well-cemented sands and gravels. These soils have densities that are much greater than those of the wastes to be placed above them. Because of the cementation and density of the foundation soils, significant settlement of the foundation is not anticipated. Settlement that may occur should most likely result from localized deformation. The deformation should occur almost concurrently with the placement of the waste load and should not influence the long-term performance of the cell.

To evaluate the potential for settlement, the relative densities of the existing soils and the proposed wastes were compared. Cell 12 will be constructed by excavating a maximum of 75 feet of soils from the present grade down to the proposed cell floor. The pressure at the base of the excavation caused by the weight of these materials is about 9,000 psf. Waste materials will be placed in the excavated cell up to existing grade. The compacted-fill containment dike will be constructed around the cell perimeter so that additional wastes may be placed above grade. The above-grade waste materials will have a maximum thickness of about 40 feet. An eight-feet thick soil cap will be placed over the above-grade waste for closure. The new pressure at foundation level, based on assumptions given below, will be between 10,735 to 12,460 psf. Therefore, the additional load imposed on the cell foundation will be about 1,735 to 3,460 psf

The properties of the foundation soils were determined from field observations, standard penetrations test values, and previous investigation data. Grant was unable to obtain undisturbed samples for consolidation testing. The foundation-level soils are dense to very dense, well-cemented sands characterized by high SPT values. For the settlement evaluation, a very conservative SPT value of 50 was used. Actual SPT values at foundation level range from 50 blows for three inches penetration to over 200 blows for one inch penetration. The average density of excavated soil was assumed to be 120 pcf.

The densities of the waste materials placed in the cell will be variable. For this evaluation, a range of waste densities from 85 pcf (Case 1) to 100 pcf (Case 2) were considered. These densities are comparable to those of waste containers accepted at US Ecology facilities. In either case, the waste densities are less than the density of the soils that will be excavated during the cell construction.

To evaluate possible settlement, the waste materials and cover were assumed to act on the foundation-level soil as would a small footing or large raft foundation with a foundation load of 10,735 (Case 1) to 12,460 psf (Case 2).

Relationships developed by Terzaghi and Peck (Peck, 1974) estimate allowable net soil pressure for foundations using the SPT value:

For a large raft foundation:

$$q_a \text{ (tons/sq. ft.)} = 0.22(\text{SPT}) \qquad \text{(for SPT between 5 and 50)}$$

where $q_a$ is the allowable net soil pressure for a maximum settlement of 2 inches.

For a small footing:

$$q_a \text{ (tons/sq. ft.)} = 0.11(\text{SPT}) \qquad \text{(for SPT between 5 and 50)}$$

where $q_a$ is the allowable soil pressure for a maximum settlement of 1 inch.

Using these equations and an conservatively low SPT value of 50, the differential loading of 1,735 to 3,460 psf caused by replacement of natural soil by waste and cover materials could result in settlement of about one inch at the foundation level. However, sinse the actual SPT value for foundation-level soil is much greater than 50, actual settlement probably will be much less that the calculated value.

These calculated settlement values are estimates only and are based on anticipated waste types and fill depths. The actual settlement may vary depending on waste type, method of placement, and other variables. The estimated settlement at the cell edges should be less than that calculated for the cell floor center since the waste load will be less.

## 6.0 REFERENCES

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# APPENDIX A

# BORING LOGS

# GRANT ENVIRONMENTAL
# DENVER, COLORADO

BORING NUMBER B-1
DRILLER/METHOD BEYLIK / MUD ROTARY
GROUND ELEVATION 2,781.04 Feet MSL

LOCATION US ECOLOGY - BEATTY, NEVADA
COORDS/INSTALL. DATE N 9,949.60 E 11,153.94 / 4-7-94
LOGGED BY/CHECKED BY JED / NRC

| DEPTH feet | SAMPLE | BLOWS/FT. | GRAPHIC LOG | USC | DESCRIPTION AND REMARKS |
|---|---|---|---|---|---|
| | | | | SM | Medium dense, brown, moderately graded, fine to coarse grained, Silty SAND; with some gravels; dry |
| 5 | | 28<br>77 | | GW<br>GM | Medium dense to dense, reddish-brown, well graded, fine to coarse grained, Silty, Sandy GRAVEL; some cobbles up to 6-inch diameter; dry |
| 10 | | | | GW | Very dense, reddish-brown, well graded, fine to coarse grained, Sandy GRAVEL; dry |
| 15 | | 48/<br>8" | | | ... becomes brown at 15.0' |
| 20 | | | | | |
| 25 | | 70 | | | |
| 30 | | | | | |
| 35 | | 55 | | SP<br>SM | Very dense, red to brown, poorly graded, fine to coarse grained, Silty, Gravelly SAND; dry |
| 40 | | | | | |

SOIL BORING ABANDONMENT DIAGRAM

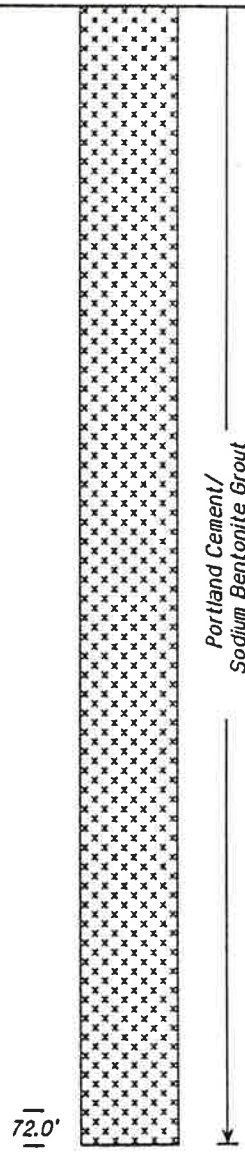
JOB NUMBER: 814796

# GRANT ENVIRONMENTAL
# DENVER, COLORADO

BORING NUMBER B-1
LOCATION US ECOLOGY - BEATTY, NEVADA
DRILLER/METHOD BEYLIK / MUD ROTARY
COORDS/INSTALL. DATE N 9,949.60 E 11,153.94 / 4-7-94
GROUND ELEVATION 2,781.04 Feet MSL
LOGGED BY/CHECKED BY JED / NRC

| DEPTH feet | SAMPLE | BLOWS/FT. | USC | DESCRIPTION AND REMARKS |
|---|---|---|---|---|
| | | | SP SM | Very dense, red to brown, poorly graded, fine to coarse grained, Silty, Gravelly SAND; dry |
| 45 | X | 37 | | Dense to very dense, red to brown, well graded, fine to coarse grained, Silty SAND; contains some gravels, partially cemented; dry |
| 50 | | | | |
| 55 | X X | 35 - | SW SM | |
| 60 | | | | |
| 65 | X | - | | |
| 70 | X | 50/2" | | |
| | | | | *Boring Terminated at 72.0'* |
| 75 | | | | *Notes: 1) 6.5-inch diameter borehole.* |
| 80 | | | | |

SOIL BORING ABANDONMENT DIAGRAM



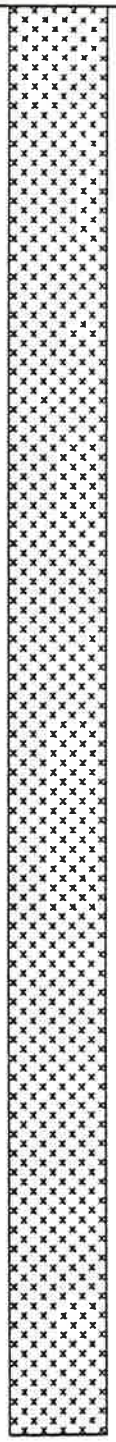

JOB NUMBER: 814796

# GRANT ENVIRONMENTAL
# DENVER, COLORADO

BORING NUMBER B-2
LOCATION US ECOLOGY - BEATTY, NEVADA
DRILLER/METHOD BEYLIK / MUD ROTARY
COORDS/INSTALL. DATE N 9,822.89 E 10,102.30 / 4-9-94
GROUND ELEVATION 2,786.42 Feet MSL
LOGGED BY/CHECKED BY JED / NRC

| DEPTH feet | SAMPLE | BLOWS/FT. | GRAPHIC LOG | USC | DESCRIPTION AND REMARKS |
|---|---|---|---|---|---|
| 5 | | | | SM | Medium dense, brown, poorly graded, fine to coarse grained, Gravelly, very Silty SAND; dry |
| 10 | | | | SM/SW | Dense, reddish-brown, well graded, fine to coarse grained, Silty, Gravelly, SAND; gravels to 2-inch diameter; cemented; dry |
| 15, 20, 25, 30, 35, 40 | | | | GW | Dense, reddish-brown, well graded, fine to coarse grained, Sandy GRAVEL; up to 2-inch diameter; dry |

SOIL BORING ABANDONMENT DIAGRAM




JOB NUMBER: 814796

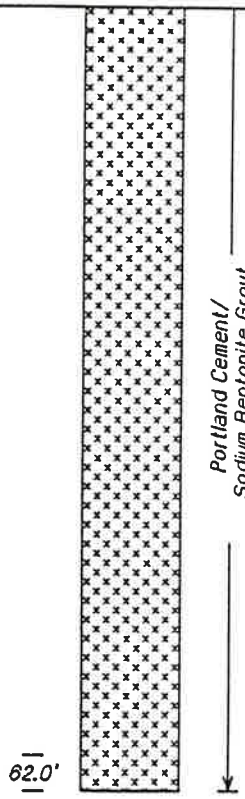
# GRANT ENVIRONMENTAL
# DENVER, COLORADO

BORING NUMBER B-2
DRILLER/METHOD BEYLIK / MUD ROTARY
GROUND ELEVATION 2,786.42 Feet MSL

LOCATION US ECOLOGY - BEATTY, NEVADA
COORDS/INSTALL. DATE N 9,822.89 E 10,102.30 / 4-9-94
LOGGED BY/CHECKED BY JED / NRC

| DEPTH feet | SAMPLE | BLOWS/FT. | GRAPHIC LOG | USC | DESCRIPTION AND REMARKS |
|---|---|---|---|---|---|
| 45, 50 | | | | GW | Dense, reddish-brown, well graded, fine to coarse grained, Sandy GRAVEL; up to 2-inch diameter; dry |
| 55 | | 150 | | SW | Very dense, red to brown, well graded, fine to coarse grained, Gravelly SAND; well cemented; gravel 1/4 to 1-inch diameter; dry |
| 60 | | 177 | | | |
| 62.0' | | | | | *Boring Terminated at 62.0'* |
| 65 | | | | | *Notes:* *1) 6.5-inch diameter borehole.* |
| 70 | | | | | |
| 75 | | | | | |
| 80 | | | | | |

SOIL BORING ABANDONMENT DIAGRAM




JOB NUMBER: 814796

# APPENDIX B

# LABORATORY RESULTS

AGUIRRE ENGINEERS, INC.
Geotechnical • Geoenvironmental • Management

April 18, 1994

Grant Environmental
8301 E. Prentice Avenue, Suite 400
Englewood, CO 80111

Attention: Ms. Kimberly Lombardo

Subject: Report of Laboratory Tests
U.S. Ecology
Beatty, Neveda
Our Project No. 24,017-01

Gentlemen:

As requested by Ms. Kimberly Lombardo, Aguirre Engineers, Inc. is providing laboratory testing for the subject project.

Table 1, attached, indicates Gradation Analysis and Atterberg Limits Determination tests completed on material submitted to our laboratory by your field personnel. The material provided for Consolidation Tests (ASTM D-2435) was improper type for performing this test, therefore we were instructed not to perform this test.

If you have any questions on the contents of this letter, or require additional information, please contact us.

Very truly yours,

AGUIRRE ENGINEERS, INC.

Peter L. Bloomquist
CMT Department Manager

William J. Attwooll, P.E.
Vice President

Enc: Table 1

cc: 2 sent

13276 East Fremont Place • P.O. Box 3814 • Englewood, Colorado 80155-3814 • U.S.A • 303-799-8378 • FAX 303-799-8392

# TABLE 1
# REPORT OF LABORATORY TESTS
# OUR PROJECT NO. 24,017-01

| SAMPLE ID | B-1 5'- 9' | B-1 25'-27 | B-1 35'-45' | B-1 55'-59' | B-2 Surface | B-2 10'-15 |
|---|---|---|---|---|---|---|
| GRADATION ANALYSIS | | | | | | |
| Sieve # | % Passing | % Passing | % Passing | % Passing | % Passing | % Passing |
| 1.5" | 100 | 100 | | | 100 | |
| 1.25" | 94.9 | 80.8 | | | 94.6 | |
| 1" | 86.9 | | 100 | 100 | | 100 |
| 3/4" | 79.7 | 63.4 | 87.2 | 96.8 | 91.8 | 98.2 |
| 1/2" | 68.8 | 56.1 | 80.6 | 83.6 | 87.7 | 87.8 |
| 3/8" | 61.2 | 50.5 | 75.5 | 78.3 | 83.5 | 81.5 |
| 4 | 42.3 | 33.9 | 67.3 | 63.7 | 74.4 | 64.0 |
| 10 | 27.7 | 22.5 | 57.2 | 49.0 | 66.7 | 44.8 |
| 40 | 12.4 | 10.0 | 37.1 | 26.5 | 52.8 | 21.2 |
| 200 | 5.8 | 4.7 | 8.4 | 10.5 | 19.8 | 6.2 |
| ATTERBERG LIMITS | | | | | | |
| LL | --- | --- | --- | 38 | --- | 30 |
| PL | --- | --- | --- | 36 | --- | 23 |
| PI | NP | NP | NP | 2 | NP | 7 |

NP = Non-Plastic

# APPENDIX C

# COMPUTER MODEL OUTPUT

ELL 12, EAST WALL-CASE 1, WITH NO SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

EISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 220.0, -40.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 192.5, 85.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.5 | 154.5 | 168.0 | 172.5 | 186.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 15.0 | 15.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 19.0 | 19.0 | 19.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 46.0 | 46.0 | 46.0 | 46.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 0.0 | 35.0 | 120.0 |
| 3 | 720.0 | 35.0 | 120.0 |
| 4 | 720.0 | 35.0 | 120.0 |
| 5 | 2160.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, EAST WALL-CASE 1, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 88.0 | 128.0 | 220.0 | -40.0 | 3.536 | 3.251 |
| 2 | 93.7 | 133.7 | 240.0 | -40.0 | 5.339 | 4.377 |
| 3 | 88.5 | 108.5 | 220.0 | -20.0 | 2.011 | 1.884 |
| 4 | 95.2 | 115.2 | 240.0 | -20.0 | 1.733 | 1.641 |
| 5 | 104.8 | 124.8 | 260.0 | -20.0 | 1.965 | 1.849 |
| 6 | 97.4 | 97.4 | 240.0 | 0.0 | 2.080 | 1.938 |
| 7 | 93.7 | 133.7 | 240.0 | -40.0 | 5.339 | 4.877 |
| 8 | 99.7 | 119.7 | 250.0 | -20.0 | 1.807 | 1.705 |
| 9 | 96.2 | 106.2 | 240.0 | -10.0 | 1.825 | 1.713 |
| 10 | 91.5 | 111.5 | 230.0 | -20.0 | 1.985 | 1.857 |
| 11 | 94.4 | 124.4 | 240.0 | -30.0 | 1.971 | 1.854 |
| 12 | 101.0 | 111.0 | 250.0 | -10.0 | 2.013 | 1.884 |
| 13 | 92.1 | 102.1 | 230.0 | -10.0 | 5.399 | 4.831 |
| 14 | 91.0 | 121.0 | 230.0 | -30.0 | 1.974 | 1.861 |
| 15 | 98.6 | 128.6 | 250.0 | -30.0 | 1.726 | 1.642 |
| 16 | 103.3 | 133.3 | 260.0 | -30.0 | 1.795 | 1.703 |
| 17 | 97.6 | 137.6 | 250.0 | -40.0 | 1.702 | 1.629 |
| 18 | 102.1 | 142.1 | 260.0 | -40.0 | 1.723 | 1.646 |
| 19 | 93.7 | 133.7 | 240.0 | -40.0 | 5.339 | 4.877 |
| 20 | 96.7 | 146.7 | 250.0 | -50.0 | 1.945 | 1.851 |
| 21 | 103.3 | 133.3 | 260.0 | -30.0 | 1.795 | 1.703 |
| 22 | 94.4 | 124.4 | 240.0 | -30.0 | 1.971 | 1.854 |
| 23 | 93.1 | 143.1 | 240.0 | -50.0 | 1.965 | 1.873 |
| 24 | 100.9 | 150.9 | 260.0 | -50.0 | 1.698 | 1.632 |
| 25 | 105.7 | 155.7 | 270.0 | -50.0 | 1.721 | 1.651 |
| 26 | 99.9 | 159.9 | 260.0 | -60.0 | 1.701 | 1.642 |
| 27 | 107.1 | 147.1 | 270.0 | -40.0 | 1.786 | 1.702 |
| 28 | 97.6 | 137.6 | 250.0 | -40.0 | 1.702 | 1.629 |
| 29 | 96.0 | 156.0 | 250.0 | -60.0 | 1.950 | 1.865 |
| 30 | 104.4 | 164.4 | 270.0 | -60.0 | 1.698 | 1.637 |
| 31 | 109.4 | 169.4 | 280.0 | -60.0 | 1.721 | 1.656 |
| 32 | 103.3 | 173.3 | 270.0 | -70.0 | 1.698 | 1.643 |
| 33 | 110.9 | 160.9 | 280.0 | -50.0 | 1.780 | 1.703 |
| 34 | 100.9 | 150.9 | 260.0 | -50.0 | 1.698 | 1.632 |
| 35 | 99.1 | 169.1 | 260.0 | -70.0 | 6.355 | 5.905 |
| 36 | 108.0 | 178.0 | 280.0 | -70.0 | 1.698 | 1.642 |

.S. MINIMUM= 1.698 FOR THE CIRCLE OF CENTER ( 270.0, -60.0)

'ELL 12, EAST WALL-CASE 1, WITH SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

EISMIC COEFFICIENT S1,S2 = 0.15 0.00

EARCH STARTS AT CENTER ( 260.0, -60.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 192.5, 85.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.5 | 154.5 | 168.0 | 172.5 | 186.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 15.0 | 15.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 19.0 | 19.0 | 19.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 46.0 | 46.0 | 46.0 | 46.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 0.0 | 35.0 | 120.0 |
| 3 | 720.0 | 35.0 | 120.0 |
| 4 | 720.0 | 35.0 | 120.0 |
| 5 | 2160.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, EAST WALL-CASE 1, WITH SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 99.9 | 159.9 | 260.0 | -60.0 | 1.385 | 1.420 |
| 2 | 109.4 | 169.4 | 280.0 | -60.0 | 1.433 | 1.463 |
| 3 | 102.1 | 142.1 | 260.0 | -40.0 | 1.435 | 1.455 |
| 4 | 92.6 | 152.6 | 240.0 | -60.0 | 1.596 | 1.607 |
| 5 | 98.3 | 178.3 | 260.0 | -80.0 | 1.577 | 1.599 |
| 6 | 104.4 | 164.4 | 270.0 | -60.0 | 1.398 | 1.432 |
| 7 | 100.9 | 150.9 | 260.0 | -50.0 | 1.398 | 1.427 |
| 8 | 96.0 | 156.0 | 250.0 | -60.0 | 1.583 | 1.594 |
| 9 | 99.1 | 169.1 | 260.0 | -70.0 | 4.837 | 4.539 |
| 10 | 105.7 | 155.7 | 270.0 | -50.0 | 1.434 | 1.459 |
| 11 | 96.7 | 146.7 | 250.0 | -50.0 | 1.597 | 1.598 |
| 12 | 95.3 | 165.3 | 250.0 | -70.0 | 1.584 | 1.600 |
| 13 | 103.3 | 173.3 | 270.0 | -70.0 | 1.384 | 1.423 |
| 14 | 108.0 | 178.0 | 280.0 | -70.0 | 1.399 | 1.436 |
| 15 | 102.3 | 182.3 | 270.0 | -80.0 | 1.383 | 1.427 |
| 16 | 106.8 | 186.8 | 280.0 | -80.0 | 1.384 | 1.427 |
| 17 | 98.3 | 178.3 | 260.0 | -80.0 | 1.577 | 1.599 |
| 18 | 101.4 | 191.4 | 270.0 | -90.0 | 1.391 | 1.438 |
| 19 | 108.0 | 178.0 | 280.0 | -70.0 | 1.399 | 1.436 |
| 20 | 99.1 | 169.1 | 260.0 | -70.0 | 4.837 | 4.539 |
| 21 | 97.6 | 187.6 | 260.0 | -90.0 | 1.583 | 1.609 |
| 22 | 105.7 | 195.7 | 280.0 | -90.0 | 1.382 | 1.428 |
| 23 | 110.3 | 200.3 | 290.0 | -90.0 | 1.385 | 1.431 |
| 24 | 104.6 | 204.6 | 280.0 | -100.0 | 1.388 | 1.437 |
| 25 | 111.7 | 191.7 | 290.0 | -80.0 | 1.400 | 1.441 |
| 26 | 102.3 | 182.3 | 270.0 | -80.0 | 1.383 | 1.427 |
| 27 | 100.6 | 200.6 | 270.0 | -100.0 | 1.577 | 1.607 |
| 28 | 109.1 | 209.1 | 290.0 | -100.0 | 1.382 | 1.431 |
| 29 | 114.0 | 214.0 | 300.0 | -100.0 | 1.387 | 1.435 |
| 30 | 108.0 | 218.0 | 290.0 | -110.0 | 1.385 | 1.437 |
| 31 | 115.4 | 205.4 | 300.0 | -90.0 | 1.402 | 1.446 |
| 32 | 105.7 | 195.7 | 280.0 | -90.0 | 1.382 | 1.428 |
| 33 | 103.7 | 213.7 | 280.0 | -110.0 | 1.399 | 1.451 |
| 34 | 112.7 | 222.7 | 300.0 | -110.0 | 1.382 | 1.433 |

F.S. MINIMUM= 1.382 FOR THE CIRCLE OF CENTER ( 290.0,-100.0)

:ELL 12, EAST WALL-CASE 2, WITH NO SEISMIC

:ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

,EISMIC COEFFICIENT S1,S2 = 0.00 0.00

:EARCH STARTS AT CENTER ( 260.0, -60.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 186.0, 82.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.5 | 154.5 | 168.0 | 172.5 | 186.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 15.0 | 15.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 19.0 | 19.0 | 19.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 46.0 | 46.0 | 46.0 | 46.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 0.0 | 35.0 | 120.0 |
| 3 | 720.0 | 35.0 | 120.0 |
| 4 | 720.0 | 35.0 | 120.0 |
| 5 | 2160.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, EAST WALL-CASE 2, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 100.1 | 160.1 | 260.0 | -60.0 | 6.765 | 6.266 |
| 2 | 110.3 | 170.3 | 280.0 | -60.0 | 8.768 | 8.196 |
| 3 | 102.7 | 142.7 | 260.0 | -40.0 | 8.089 | 7.452 |
| 4 | 91.9 | 151.9 | 240.0 | -60.0 | 1.782 | 1.723 |
| 5 | 93.4 | 133.4 | 240.0 | -40.0 | 1.718 | 1.647 |
| 6 | 97.8 | 137.8 | 250.0 | -40.0 | 1.701 | 1.629 |
| 7 | 102.7 | 142.7 | 260.0 | -40.0 | 8.089 | 7.452 |
| 8 | 99.0 | 129.0 | 250.0 | -30.0 | 7.456 | 6.809 |
| 9 | 96.7 | 146.7 | 250.0 | -50.0 | 1.707 | 1.643 |
| 10 | 104.2 | 134.2 | 260.0 | -30.0 | 1.776 | 1.686 |
| 11 | 94.3 | 124.3 | 240.0 | -30.0 | 1.863 | 1.761 |
| 12 | 92.6 | 142.6 | 240.0 | -50.0 | 1.745 | 1.681 |
| 13 | 101.3 | 151.3 | 260.0 | -50.0 | 1.696 | 1.630 |
| 14 | 106.5 | 156.5 | 270.0 | -50.0 | 8.518 | 7.909 |
| 15 | 100.1 | 160.1 | 260.0 | -60.0 | 6.765 | 6.266 |
| 16 | 108.1 | 148.1 | 270.0 | -40.0 | 1.766 | 1.684 |
| 17 | 97.8 | 137.8 | 250.0 | -40.0 | 1.701 | 1.629 |
| 18 | 95.8 | 155.8 | 250.0 | -60.0 | 1.730 | 1.671 |
| 19 | 105.0 | 165.0 | 270.0 | -60.0 | 7.784 | 7.240 |

F.S. MINIMUM= 1.696 FOR THE CIRCLE OF CENTER ( 260.0, -50.0)

ELL 12, EAST WALL-CASE 2, WITH SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

SEARCH STARTS AT CENTER ( 260.0, -60.0),WITH FINAL GRID OF 10.0

ALL CIRCLES PASS THROUGH THE POINT ( 186.0, 82.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.5 | 154.5 | 168.0 | 172.5 | 186.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 15.0 | 15.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 19.0 | 19.0 | 19.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 46.0 | 46.0 | 46.0 | 46.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 0.0 | 35.0 | 120.0 |
| 3 | 720.0 | 35.0 | 120.0 |
| 4 | 720.0 | 35.0 | 120.0 |
| 5 | 2160.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, EAST WALL-CASE 2, WITH SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 100.1 | 160.1 | 260.0 | -60.0 | 5.112 | 4.781 |
| 2 | 110.3 | 170.3 | 280.0 | -60.0 | 5.982 | 5.652 |
| 3 | 102.7 | 142.7 | 260.0 | -40.0 | 5.924 | 5.511 |
| 4 | 91.9 | 151.9 | 240.0 | -60.0 | 1.417 | 1.452 |
| 5 | 93.4 | 133.4 | 240.0 | -40.0 | 1.394 | 1.420 |
| 6 | 97.8 | 137.8 | 250.0 | -40.0 | 1.398 | 1.422 |
| 7 | 94.3 | 124.3 | 240.0 | -30.0 | 1.540 | 1.536 |
| 8 | 89.7 | 129.7 | 230.0 | -40.0 | 1.415 | 1.440 |
| 9 | 92.6 | 142.6 | 240.0 | -50.0 | 1.401 | 1.432 |
| 10 | 99.0 | 129.0 | 250.0 | -30.0 | 5.720 | 5.271 |
| 11 | 90.3 | 120.3 | 230.0 | -30.0 | 1.405 | 1.424 |
| 12 | 89.1 | 139.1 | 230.0 | -50.0 | 1.434 | 1.464 |
| 13 | 96.7 | 146.7 | 250.0 | -50.0 | 1.388 | 1.419 |
| 14 | 101.3 | 151.3 | 260.0 | -50.0 | 1.395 | 1.424 |
| 15 | 95.8 | 155.8 | 250.0 | -60.0 | 1.392 | 1.428 |
| 16 | 102.7 | 142.7 | 260.0 | -40.0 | 5.924 | 5.511 |
| 17 | 93.4 | 133.4 | 240.0 | -40.0 | 1.394 | 1.420 |
| 18 | 91.9 | 151.9 | 240.0 | -60.0 | 1.417 | 1.452 |
| 19 | 100.1 | 160.1 | 260.0 | -60.0 | 5.112 | 4.781 |

F.S. MINIMUM= 1.388 FOR THE CIRCLE OF CENTER ( 250.0, -50.0)

ELL 12, EAST WALL-CASE 3, WITH NO SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 260.0, -60.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 172.5, 55.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.5 | 154.5 | 168.0 | 172.5 | 186.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 15.0 | 15.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 19.0 | 19.0 | 19.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 46.0 | 46.0 | 46.0 | 46.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 0.0 | 35.0 | 120.0 |
| 3 | 720.0 | 35.0 | 120.0 |
| 4 | 720.0 | 35.0 | 120.0 |
| 5 | 2160.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, EAST WALL-CASE 3, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 84.5 | 144.5 | 260.0 | -60.0 | 1.448 | 1.424 |
| 2 | 97.4 | 157.4 | 280.0 | -60.0 | 1.568 | 1.535 |
| 3 | 89.2 | 129.2 | 260.0 | -40.0 | 1.607 | 1.565 |
| 4 | 73.3 | 133.3 | 240.0 | -60.0 | 1.454 | 1.433 |
| 5 | 80.9 | 160.9 | 260.0 | -80.0 | 1.457 | 1.440 |
| 6 | 90.8 | 150.8 | 270.0 | -60.0 | 1.490 | 1.462 |
| 7 | 86.7 | 136.7 | 260.0 | -50.0 | 1.491 | 1.460 |
| 8 | 78.7 | 138.7 | 250.0 | -60.0 | 1.437 | 1.414 |
| 9 | 80.5 | 130.5 | 250.0 | -50.0 | 1.443 | 1.415 |
| 10 | 73.3 | 133.3 | 240.0 | -60.0 | 1.454 | 1.433 |
| 11 | 77.1 | 147.1 | 250.0 | -70.0 | 1.455 | 1.436 |
| 12 | 86.7 | 136.7 | 260.0 | -50.0 | 1.491 | 1.460 |
| 13 | 74.8 | 124.8 | 240.0 | -50.0 | 1.432 | 1.406 |
| 14 | 76.5 | 116.5 | 240.0 | -40.0 | 1.437 | 1.406 |
| 15 | 69.7 | 119.7 | 230.0 | -50.0 | 1.455 | 1.430 |
| 16 | 82.6 | 122.6 | 250.0 | -40.0 | 1.494 | 1.458 |
| 17 | 71.0 | 111.0 | 230.0 | -40.0 | 1.427 | 1.398 |
| 18 | 72.6 | 102.6 | 230.0 | -30.0 | 1.432 | 1.397 |
| 19 | 66.2 | 106.2 | 220.0 | -40.0 | 1.458 | 1.430 |
| 20 | 78.5 | 108.5 | 240.0 | -30.0 | 1.500 | 1.459 |
| 21 | 67.4 | 97.4 | 220.0 | -30.0 | 1.423 | 1.390 |
| 22 | 68.8 | 88.8 | 220.0 | -20.0 | 1.428 | 1.387 |
| 23 | 62.9 | 92.9 | 210.0 | -30.0 | 1.468 | 1.434 |
| 24 | 74.5 | 94.5 | 230.0 | -20.0 | 1.511 | 1.464 |
| 25 | 63.9 | 83.9 | 210.0 | -20.0 | 1.424 | 1.385 |
| 26 | 62.1 | 102.1 | 210.0 | -40.0 | 1.533 | 1.502 |
| 27 | 71.0 | 111.0 | 230.0 | -40.0 | 1.427 | 1.398 |

F.S. MINIMUM= 1.423 FOR THE CIRCLE OF CENTER ( 220.0, -30.0)

ELL 12, EAST WALL-CASE 3, WITH SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

EISMIC COEFFICIENT S1,S2 = 0.15 0.00

EARCH STARTS AT CENTER ( 260.0, -60.0),WITH FINAL GRID OF 10.0

L CIRCLES PASS THROUGH THE POINT ( 172.5, 55.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.5 | 154.5 | 168.0 | 172.5 | 186.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 15.0 | 15.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 19.0 | 19.0 | 19.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 46.0 | 46.0 | 46.0 | 46.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 0.0 | 35.0 | 120.0 |
| 3 | 720.0 | 35.0 | 120.0 |
| 4 | 720.0 | 35.0 | 120.0 |
| 5 | 2160.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, EAST WALL-CASE 3, WITH SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 84.5 | 144.5 | 260.0 | -60.0 | 1.189 | 1.257 |
| 2 | 97.4 | 157.4 | 280.0 | -60.0 | 1.319 | 1.381 |
| 3 | 89.2 | 129.2 | 260.0 | -40.0 | 1.361 | 1.415 |
| 4 | 73.3 | 133.3 | 240.0 | -60.0 | 1.164 | 1.235 |
| 5 | 78.7 | 138.7 | 250.0 | -60.0 | 1.165 | 1.235 |
| 6 | 74.8 | 124.8 | 240.0 | -50.0 | 1.160 | 1.228 |
| 7 | 80.5 | 130.5 | 250.0 | -50.0 | 1.185 | 1.251 |
| 8 | 76.5 | 116.5 | 240.0 | -40.0 | 1.181 | 1.244 |
| 9 | 69.7 | 119.7 | 230.0 | -50.0 | 1.162 | 1.231 |
| 10 | 82.6 | 122.6 | 250.0 | -40.0 | 1.246 | 1.306 |
| 11 | 71.0 | 111.0 | 230.0 | -40.0 | 1.155 | 1.220 |
| 12 | 72.6 | 102.6 | 230.0 | -30.0 | 1.177 | 1.237 |
| 13 | 66.2 | 106.2 | 220.0 | -40.0 | 1.163 | 1.227 |
| 14 | 78.5 | 108.5 | 240.0 | -30.0 | 1.254 | 1.309 |
| 15 | 67.4 | 97.4 | 220.0 | -30.0 | 1.151 | 1.212 |
| 16 | 68.8 | 88.8 | 220.0 | -20.0 | 1.175 | 1.230 |
| 17 | 62.9 | 92.9 | 210.0 | -30.0 | 1.166 | 1.227 |
| 18 | 74.5 | 94.5 | 230.0 | -20.0 | 1.268 | 1.317 |
| 19 | 63.9 | 83.9 | 210.0 | -20.0 | 1.149 | 1.206 |
| 20 | 65.0 | 75.0 | 210.0 | -10.0 | 1.175 | 1.225 |
| 21 | 59.9 | 79.9 | 200.0 | -20.0 | 1.178 | 1.232 |
| 22 | 70.5 | 80.5 | 220.0 | -10.0 | 1.290 | 1.333 |
| 23 | 60.6 | 70.6 | 200.0 | -10.0 | 1.153 | 1.203 |
| 24 | 59.3 | 89.3 | 200.0 | -30.0 | 1.222 | 1.277 |
| 25 | 67.4 | 97.4 | 220.0 | -30.0 | 1.151 | 1.212 |

.S. MINIMUM= 1.149 FOR THE CIRCLE OF CENTER ( 210.0, -20.0)

CELL 12, EAST WALL-CASE 4, WITH NO SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

SEARCH STARTS AT CENTER ( 260.0, -60.0),WITH FINAL GRID OF 10.0

ALL CIRCLES PASS THROUGH THE POINT ( 168.0, 46.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.5 | 154.5 | 168.0 | 172.5 | 186.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 15.0 | 15.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 19.0 | 19.0 | 19.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 46.0 | 46.0 | 46.0 | 46.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 0.0 | 35.0 | 120.0 |
| 3 | 720.0 | 35.0 | 120.0 |
| 4 | 720.0 | 35.0 | 120.0 |
| 5 | 2160.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, EAST WALL-CASE 4, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(CMS) |
|---|---|---|---|---|---|---|
| 1 | 80.4 | 140.4 | 260.0 | -60.0 | 1.658 | 1.627 |
| 2 | 94.2 | 154.2 | 280.0 | -60.0 | 1.916 | 1.873 |
| 3 | 85.9 | 125.9 | 260.0 | -40.0 | 2.064 | 2.005 |
| 4 | 68.1 | 128.1 | 240.0 | -60.0 | 1.587 | 1.563 |
| 5 | 74.0 | 134.0 | 250.0 | -60.0 | 1.603 | 1.576 |
| 6 | 70.0 | 120.0 | 240.0 | -50.0 | 1.596 | 1.566 |
| 7 | 62.8 | 122.8 | 230.0 | -60.0 | 1.608 | 1.585 |
| 8 | 66.5 | 136.5 | 240.0 | -70.0 | 1.608 | 1.587 |
| 9 | 76.3 | 126.3 | 250.0 | -50.0 | 1.660 | 1.625 |
| 10 | 64.3 | 114.3 | 230.0 | -50.0 | 1.581 | 1.554 |
| 11 | 66.0 | 106.0 | 230.0 | -40.0 | 1.589 | 1.555 |
| 12 | 59.2 | 109.2 | 220.0 | -50.0 | 1.611 | 1.585 |
| 13 | 72.2 | 112.2 | 240.0 | -40.0 | 1.663 | 1.623 |
| 14 | 60.5 | 100.5 | 220.0 | -40.0 | 1.576 | 1.545 |
| 15 | 62.1 | 92.1 | 220.0 | -30.0 | 1.582 | 1.543 |
| 16 | 55.7 | 95.7 | 210.0 | -40.0 | 1.619 | 1.589 |
| 17 | 68.1 | 98.1 | 230.0 | -30.0 | 1.671 | 1.624 |
| 18 | 56.8 | 86.8 | 210.0 | -30.0 | 1.573 | 1.537 |
| 19 | 58.2 | 78.2 | 210.0 | -20.0 | 1.576 | 1.530 |
| 20 | 52.5 | 82.5 | 200.0 | -30.0 | 1.636 | 1.600 |
| 21 | 64.0 | 84.0 | 220.0 | -20.0 | 1.685 | 1.629 |
| 22 | 53.3 | 73.3 | 200.0 | -20.0 | 1.574 | 1.532 |
| 23 | 51.8 | 91.8 | 200.0 | -40.0 | 1.721 | 1.689 |
| 24 | 60.5 | 100.5 | 220.0 | -40.0 | 1.576 | 1.545 |

F.S. MINIMUM= 1.573 FOR THE CIRCLE OF CENTER ( 210.0, -30.0)

ELL 12, EAST WALL-CASE 4, WITH SEISMIC

CNTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

EARCH STARTS AT CENTER ( 260.0, -60.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 168.0, 46.0)

EOMETRY

| SECTIONS | 0.0 | 150.0 | 152.5 | 154.5 | 168.0 | 172.5 | 186.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 15.0 | 15.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 19.0 | 19.0 | 19.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 46.0 | 46.0 | 46.0 | 46.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

OIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 0.0 | 35.0 | 120.0 |
| 3 | 720.0 | 35.0 | 120.0 |
| 4 | 720.0 | 35.0 | 120.0 |
| 5 | 2160.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, EAST WALL-CASE 4, WITH SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 80.4 | 140.4 | 260.0 | -60.0 | 1.384 | 1.447 |
| 2 | 94.2 | 154.2 | 280.0 | -60.0 | 1.643 | 1.696 |
| 3 | 85.9 | 125.9 | 260.0 | -40.0 | 1.790 | 1.827 |
| 4 | 68.1 | 128.1 | 240.0 | -60.0 | 1.290 | 1.357 |
| 5 | 72.2 | 112.2 | 240.0 | -40.0 | 1.395 | 1.450 |
| 6 | 58.1 | 118.1 | 220.0 | -60.0 | 1.314 | 1.382 |
| 7 | 65.1 | 145.1 | 240.0 | -80.0 | 1.306 | 1.378 |
| 8 | 74.0 | 134.0 | 250.0 | -60.0 | 1.320 | 1.386 |
| 9 | 70.0 | 120.0 | 240.0 | -50.0 | 1.316 | 1.379 |
| 10 | 62.8 | 122.8 | 230.0 | -60.0 | 1.288 | 1.356 |
| 11 | 64.3 | 114.3 | 230.0 | -50.0 | 1.284 | 1.349 |
| 12 | 70.0 | 120.0 | 240.0 | -50.0 | 1.316 | 1.379 |
| 13 | 66.0 | 106.0 | 230.0 | -40.0 | 1.311 | 1.370 |
| 14 | 59.2 | 109.2 | 220.0 | -50.0 | 1.287 | 1.353 |
| 15 | 72.2 | 112.2 | 240.0 | -40.0 | 1.395 | 1.450 |
| 16 | 60.5 | 100.5 | 220.0 | -40.0 | 1.278 | 1.340 |
| 17 | 62.1 | 92.1 | 220.0 | -30.0 | 1.306 | 1.361 |
| 18 | 55.7 | 95.7 | 210.0 | -40.0 | 1.289 | 1.351 |
| 19 | 68.1 | 98.1 | 230.0 | -30.0 | 1.405 | 1.454 |
| 20 | 56.8 | 86.8 | 210.0 | -30.0 | 1.273 | 1.331 |
| 21 | 58.2 | 78.2 | 210.0 | -20.0 | 1.301 | 1.351 |
| 22 | 52.5 | 82.5 | 200.0 | -30.0 | 1.296 | 1.354 |
| 23 | 64.0 | 84.0 | 220.0 | -20.0 | 1.422 | 1.463 |
| 24 | 53.3 | 73.3 | 200.0 | -20.0 | 1.271 | 1.323 |
| 25 | 54.5 | 64.5 | 200.0 | -10.0 | 1.298 | 1.341 |
| 26 | 49.6 | 69.6 | 190.0 | -20.0 | 1.315 | 1.365 |
| 27 | 60.0 | 70.0 | 210.0 | -10.0 | 1.451 | 1.482 |
| 28 | 50.2 | 60.2 | 190.0 | -10.0 | 1.277 | 1.321 |
| 29 | 49.1 | 79.1 | 190.0 | -30.0 | 1.373 | 1.425 |
| 30 | 56.8 | 86.8 | 210.0 | -30.0 | 1.273 | 1.331 |

F.S. MINIMUM= 1.271 FOR THE CIRCLE OF CENTER ( 200.0, -20.0)

ELL 12, EAST WALL-CASE 5, WITH NO SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 190.0, -40.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 154.5, 19.0)

EOMETRY

| SECTIONS | 0.0 | 150.0 | 152.5 | 154.5 | 168.0 | 172.5 | 186.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 15.0 | 15.0 | 15.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 19.0 | 19.0 | 19.0 | 19.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 46.0 | 46.0 | 46.0 | 46.0 | 46.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 55.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 82.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

OIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 0.0 | 35.0 | 120.0 |
| 3 | 720.0 | 35.0 | 120.0 |
| 4 | 720.0 | 35.0 | 120.0 |
| 5 | 2160.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, EAST WALL-CASE 5, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 28.9 | 68.9 | 190.0 | -40.0 | 0.945 | 0.943 |
| 2 | 41.0 | 81.0 | 210.0 | -40.0 | 0.641 | 0.640 |
| 3 | 55.8 | 95.8 | 230.0 | -40.0 | 0.480 | 0.480 |
| 4 | 72.3 | 112.3 | 250.0 | -40.0 | 0.382 | 0.382 |
| 5 | 89.7 | 129.7 | 270.0 | -40.0 | 0.350 | 0.350 |
| 6 | 107.8 | 147.8 | 290.0 | -40.0 | 48.898 | 48.903 |
| 7 | 101.9 | 121.9 | 270.0 | -20.0 | 9.073 | 9.102 |
| 8 | 79.9 | 139.9 | 270.0 | -60.0 | 0.435 | 0.435 |
| 9 | 98.7 | 138.7 | 280.0 | -40.0 | 248.262 | 248.263 |
| 10 | 95.5 | 125.5 | 270.0 | -30.0 | 41.570 | 41.577 |
| 11 | 80.9 | 120.9 | 260.0 | -40.0 | 0.352 | 0.352 |
| 12 | 84.5 | 134.5 | 270.0 | -50.0 | 0.377 | 0.377 |
| 13 | 104.7 | 134.7 | 280.0 | -30.0 | 18.279 | 18.294 |
| 14 | 86.3 | 116.3 | 260.0 | -30.0 | 208.362 | 208.364 |
| 15 | 76.1 | 126.1 | 260.0 | -50.0 | 0.411 | 0.411 |
| 16 | 93.2 | 143.2 | 280.0 | -50.0 | 0.353 | 0.353 |

F.S. MINIMUM= 0.350 FOR THE CIRCLE OF CENTER ( 270.0, -40.0)

ILL 12, NORTH WALL-CASE 1, WITH NO SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

ARCH STARTS AT CENTER ( 220.0, -20.0),WITH FINAL GRID OF 10.0

L CIRCLES PASS THROUGH THE POINT ( 192.5, 85.0)

OMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 154.0 | 160.0 | 163.5 | 184.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 18.0 | 18.0 | 18.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

IL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2160.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 1440.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

RE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, NORTH WALL-CASE 1, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(CMS) |
|---|---|---|---|---|---|---|
| 1 | 88.5 | 108.5 | 220.0 | -20.0 | 2.241 | 2.171 |
| 2 | 95.2 | 115.2 | 240.0 | -20.0 | 6.779 | 6.220 |
| 3 | 89.3 | 89.3 | 220.0 | 0.0 | 4.683 | 4.261 |
| 4 | 85.3 | 105.3 | 200.0 | -20.0 | 2.839 | 2.687 |
| 5 | 88.0 | 128.0 | 220.0 | -40.0 | 3.759 | 3.513 |
| 6 | 91.5 | 111.5 | 230.0 | -20.0 | 2.240 | 2.176 |
| 7 | 95.2 | 115.2 | 240.0 | -20.0 | 6.779 | 6.220 |
| 8 | 92.1 | 102.1 | 230.0 | -10.0 | 5.675 | 5.176 |
| 9 | 91.0 | 121.0 | 230.0 | -30.0 | 2.218 | 2.158 |
| 10 | 94.4 | 124.4 | 240.0 | -30.0 | 2.243 | 2.184 |
| 11 | 88.2 | 118.2 | 220.0 | -30.0 | 2.261 | 2.193 |
| 12 | 90.5 | 130.5 | 230.0 | -40.0 | 2.229 | 2.172 |
| 13 | 95.2 | 115.2 | 240.0 | -20.0 | 6.779 | 6.220 |
| 14 | 88.5 | 108.5 | 220.0 | -20.0 | 2.241 | 2.171 |
| 15 | 88.0 | 128.0 | 220.0 | -40.0 | 3.759 | 3.513 |
| 16 | 93.7 | 133.7 | 240.0 | -40.0 | 5.594 | 5.175 |

F.S. MINIMUM= 2.218 FOR THE CIRCLE OF CENTER ( 230.0, -30.0)

BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, NORTH WALL-CASE 1, WITH SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

SEARCH STARTS AT CENTER ( 220.0, -20.0),WITH FINAL GRID OF 10.0

ALL CIRCLES PASS THROUGH THE POINT ( 192.5, 85.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 154.0 | 160.0 | 163.5 | 184.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 18.0 | 18.0 | 18.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2160.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 1440.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL II, NORTH WALL-CASE 1, WITH SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 88.5 | 108.5 | 220.0 | -20.0 | 1.926 | 1.855 |
| 2 | 95.2 | 115.2 | 240.0 | -20.0 | 5.458 | 5.061 |
| 3 | 89.3 | 89.3 | 220.0 | 0.0 | 3.977 | 3.674 |
| 4 | 85.3 | 105.3 | 200.0 | -20.0 | 2.245 | 2.196 |
| 5 | 88.0 | 128.0 | 220.0 | -40.0 | 3.047 | 2.901 |
| 6 | 91.5 | 111.5 | 230.0 | -20.0 | 1.859 | 1.892 |
| 7 | 88.9 | 98.9 | 220.0 | -10.0 | 1.862 | 1.891 |
| 8 | 86.4 | 106.4 | 210.0 | -20.0 | 1.857 | 1.875 |
| 9 | 88.2 | 118.2 | 220.0 | -30.0 | 1.820 | 1.850 |
| 10 | 91.0 | 121.0 | 230.0 | -30.0 | 1.816 | 1.852 |
| 11 | 94.4 | 124.4 | 240.0 | -30.0 | 1.866 | 1.904 |
| 12 | 91.5 | 111.5 | 230.0 | -20.0 | 1.859 | 1.892 |
| 13 | 90.5 | 130.5 | 230.0 | -40.0 | 1.803 | 1.841 |
| 14 | 93.7 | 133.7 | 240.0 | -40.0 | 4.513 | 4.223 |
| 15 | 88.0 | 128.0 | 220.0 | -40.0 | 3.047 | 2.901 |
| 16 | 90.1 | 140.1 | 230.0 | -50.0 | 1.806 | 1.846 |
| 17 | 94.4 | 124.4 | 240.0 | -30.0 | 1.866 | 1.904 |
| 18 | 88.2 | 118.2 | 220.0 | -30.0 | 1.820 | 1.850 |
| 19 | 87.8 | 137.8 | 220.0 | -50.0 | 2.979 | 2.855 |
| 20 | 93.1 | 143.1 | 240.0 | -50.0 | 1.798 | 1.843 |
| 21 | 96.7 | 146.7 | 250.0 | -50.0 | 1.826 | 1.872 |
| 22 | 92.6 | 152.6 | 240.0 | -60.0 | 1.796 | 1.843 |
| 23 | 96.0 | 156.0 | 250.0 | -60.0 | 1.802 | 1.851 |
| 24 | 89.8 | 149.8 | 230.0 | -60.0 | 3.427 | 3.264 |
| 25 | 92.1 | 162.1 | 240.0 | -70.0 | 3.911 | 3.714 |
| 26 | 96.7 | 146.7 | 250.0 | -50.0 | 1.826 | 1.872 |
| 27 | 90.1 | 140.1 | 230.0 | -50.0 | 1.806 | 1.846 |
| 28 | 89.5 | 159.5 | 230.0 | -70.0 | 3.350 | 3.207 |
| 29 | 95.3 | 165.3 | 250.0 | -70.0 | 1.794 | 1.845 |
| 30 | 99.1 | 169.1 | 260.0 | -70.0 | 5.031 | 4.765 |
| 31 | 94.7 | 174.7 | 250.0 | -80.0 | 1.798 | 1.851 |
| 32 | 99.9 | 159.9 | 260.0 | -60.0 | 1.839 | 1.888 |
| 33 | 92.6 | 152.6 | 240.0 | -60.0 | 1.796 | 1.843 |
| 34 | 91.7 | 171.7 | 240.0 | -80.0 | 3.802 | 3.626 |
| 35 | 98.3 | 178.3 | 260.0 | -80.0 | 1.798 | 1.853 |

S. MINIMUM= 1.794 FOR THE CIRCLE OF CENTER ( 250.0, -70.0)

1 BISHOP MODIFIED,LEFEBVRE 1971

ILL 12, NORTH WALL-CASE 2, WITH NO SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

ARCH STARTS AT CENTER ( 220.0, -20.0),WITH FINAL GRID OF 10.0

L CIRCLES PASS THROUGH THE POINT ( 184.0, 78.0)

OMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 154.0 | 160.0 | 163.5 | 184.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 18.0 | 18.0 | 18.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

IL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2160.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 1440.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

RE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, NORTH WALL-CASE 2, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 84.4 | 104.4 | 220.0 | -20.0 | 1.832 | 1.840 |
| 2 | 92.9 | 112.9 | 240.0 | -20.0 | 1.905 | 1.924 |
| 3 | 85.9 | 85.9 | 220.0 | 0.0 | 1.868 | 1.917 |
| 4 | 79.3 | 99.3 | 200.0 | -20.0 | 1.981 | 1.963 |
| 5 | 83.4 | 123.4 | 220.0 | -40.0 | 1.913 | 1.910 |
| 6 | 88.3 | 108.3 | 230.0 | -20.0 | 1.839 | 1.854 |
| 7 | 85.1 | 95.1 | 220.0 | -10.0 | 1.824 | 1.845 |
| 8 | 89.3 | 99.3 | 230.0 | -10.0 | 1.887 | 1.917 |
| 9 | 85.9 | 85.9 | 220.0 | 0.0 | 1.868 | 1.917 |
| 10 | 81.8 | 91.8 | 210.0 | -10.0 | 1.834 | 1.843 |
| 11 | 90.6 | 90.6 | 230.0 | 0.0 | 2.038 | 2.102 |
| 12 | 82.2 | 82.2 | 210.0 | 0.0 | 1.814 | 1.847 |
| 13 | 82.8 | 72.8 | 210.0 | 10.0 | 1.843 | 1.935 |
| 14 | 79.6 | 79.6 | 200.0 | 0.0 | 1.855 | 1.866 |
| 15 | 86.9 | 76.9 | 220.0 | 10.0 | 2.029 | 2.158 |
| 16 | 79.9 | 69.9 | 200.0 | 10.0 | 1.814 | 1.871 |
| 17 | 78.3 | 68.3 | 190.0 | 10.0 | 1.910 | 1.928 |
| 18 | 78.2 | 78.2 | 190.0 | 0.0 | 1.983 | 1.965 |
| 19 | 82.2 | 82.2 | 210.0 | 0.0 | 1.814 | 1.847 |

F.S. MINIMUM= 1.814 FOR THE CIRCLE OF CENTER ( 200.0, 10.0)

BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, NORTH WALL-CASE 2, WITH SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

SEARCH STARTS AT CENTER ( 220.0, -20.0),WITH FINAL GRID OF 10.0

ALL CIRCLES PASS THROUGH THE POINT ( 184.0, 78.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 154.0 | 160.0 | 163.5 | 184.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 18.0 | 18.0 | 18.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2160.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 1440.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, NORTH WALL-CASE 2, WITH SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 84.4 | 104.4 | 220.0 | -20.0 | 1.478 | 1.583 |
| 2 | 92.9 | 112.9 | 240.0 | -20.0 | 1.590 | 1.707 |
| 3 | 85.9 | 85.9 | 220.0 | 0.0 | 1.552 | 1.700 |
| 4 | 79.3 | 99.3 | 200.0 | -20.0 | 1.537 | 1.618 |
| 5 | 83.4 | 123.4 | 220.0 | -40.0 | 1.509 | 1.600 |
| 6 | 88.3 | 108.3 | 230.0 | -20.0 | 1.510 | 1.622 |
| 7 | 85.1 | 95.1 | 220.0 | -10.0 | 1.492 | 1.611 |
| 8 | 81.4 | 101.4 | 210.0 | -20.0 | 1.488 | 1.583 |
| 9 | 83.8 | 113.8 | 220.0 | -30.0 | 1.487 | 1.584 |
| 10 | 89.3 | 99.3 | 230.0 | -10.0 | 1.572 | 1.701 |
| 11 | 81.8 | 91.8 | 210.0 | -10.0 | 1.471 | 1.578 |
| 12 | 82.2 | 82.2 | 210.0 | 0.0 | 1.475 | 1.606 |
| 13 | 79.4 | 89.4 | 200.0 | -10.0 | 1.501 | 1.593 |
| 14 | 85.9 | 85.9 | 220.0 | 0.0 | 1.552 | 1.700 |
| 15 | 79.6 | 79.6 | 200.0 | 0.0 | 1.474 | 1.586 |
| 16 | 79.3 | 99.3 | 200.0 | -20.0 | 1.537 | 1.618 |
| 17 | 84.4 | 104.4 | 220.0 | -20.0 | 1.478 | 1.583 |

F.S. MINIMUM= 1.471 FOR THE CIRCLE OF CENTER ( 210.0, -10.0)

1 BISHOP MODIFIED,LEFEBVRE 1971

'ELL 12, NORTH WALL-CASE 3, WITH NO SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 220.0, -20.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 163.5, 37.0)

EOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 154.0 | 160.0 | 163.5 | 184.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 18.0 | 18.0 | 18.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

IIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2160.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 1440.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

RE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

1 BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, NORTH WALL-CASE 3, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(CMS) |
|---|---|---|---|---|---|---|
| 1 | 60.3 | 80.3 | 220.0 | -20.0 | 6.603 | 6.530 |
| 2 | 75.4 | 95.4 | 240.0 | -20.0 | 16.083 | 15.990 |
| 3 | 67.5 | 67.5 | 220.0 | 0.0 | 67.011 | 67.038 |
| 4 | 47.7 | 67.7 | 200.0 | -20.0 | 4.408 | 4.370 |
| 5 | 52.0 | 52.0 | 200.0 | 0.0 | 9.253 | 9.151 |
| 6 | 39.3 | 59.3 | 180.0 | -20.0 | 4.064 | 4.032 |
| 7 | 40.5 | 40.5 | 180.0 | 0.0 | 4.243 | 4.200 |
| 8 | 37.1 | 57.1 | 160.0 | -20.0 | 4.972 | 4.893 |
| 9 | 38.7 | 78.7 | 180.0 | -40.0 | 4.423 | 4.396 |
| 10 | 42.9 | 62.9 | 190.0 | -20.0 | 4.066 | 4.035 |
| 11 | 39.8 | 49.8 | 180.0 | -10.0 | 4.001 | 3.965 |
| 12 | 44.0 | 54.0 | 190.0 | -10.0 | 4.329 | 4.286 |
| 13 | 40.5 | 40.5 | 180.0 | 0.0 | 4.243 | 4.200 |
| 14 | 37.4 | 47.4 | 170.0 | -10.0 | 4.166 | 4.117 |
| 15 | 45.5 | 45.5 | 190.0 | 0.0 | 5.519 | 5.448 |
| 16 | 37.6 | 37.6 | 170.0 | 0.0 | 4.018 | 3.970 |
| 17 | 37.4 | 57.4 | 170.0 | -20.0 | 4.399 | 4.352 |
| 18 | 42.9 | 62.9 | 190.0 | -20.0 | 4.066 | 4.035 |

F.S. MINIMUM= 4.001 FOR THE CIRCLE OF CENTER ( 180.0, -10.0)

1 BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, NORTH WALL-CASE 3, WITH SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

SEARCH STARTS AT CENTER ( 220.0, -20.0),WITH FINAL GRID OF 10.0

ALL CIRCLES PASS THROUGH THE POINT ( 163.5, 37.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 154.0 | 160.0 | 163.5 | 184.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 18.0 | 18.0 | 18.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2160.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 1440.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

1 BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, NORTH WALL-CASE 3, WITH SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 60.3 | 80.3 | 220.0 | -20.0 | 5.914 | 5.939 |
| 2 | 75.4 | 95.4 | 240.0 | -20.0 | 14.823 | 14.831 |
| 3 | 67.5 | 67.5 | 220.0 | 0.0 | 62.176 | 62.302 |
| 4 | 47.7 | 67.7 | 200.0 | -20.0 | 3.775 | 3.832 |
| 5 | 52.0 | 52.0 | 200.0 | 0.0 | 8.432 | 8.435 |
| 6 | 39.3 | 59.3 | 180.0 | -20.0 | 3.248 | 3.311 |
| 7 | 40.5 | 40.5 | 180.0 | 0.0 | 3.614 | 3.673 |
| 8 | 37.1 | 57.1 | 160.0 | -20.0 | 3.521 | 3.551 |
| 9 | 38.7 | 78.7 | 180.0 | -40.0 | 3.370 | 3.434 |
| 10 | 42.9 | 62.9 | 190.0 | -20.0 | 3.378 | 3.442 |
| 11 | 39.8 | 49.8 | 180.0 | -10.0 | 3.292 | 3.354 |
| 12 | 37.4 | 57.4 | 170.0 | -20.0 | 3.341 | 3.392 |
| 13 | 39.0 | 69.0 | 180.0 | -30.0 | 3.293 | 3.356 |
| 14 | 44.0 | 54.0 | 190.0 | -10.0 | 3.703 | 3.758 |
| 15 | 37.4 | 47.4 | 170.0 | -10.0 | 3.255 | 3.307 |
| 16 | 37.3 | 67.3 | 170.0 | -30.0 | 3.449 | 3.500 |
| 17 | 42.1 | 72.1 | 190.0 | -30.0 | 3.291 | 3.359 |

.S. MINIMUM= 3.248 FOR THE CIRCLE OF CENTER ( 180.0, -20.0)

BISHOP MODIFIED,LEFEBVRE 1971

ELL 12, NORTH WALL-CASE 4, WITH NO SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 220.0, -20.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 160.0, 30.0)

EOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 154.0 | 160.0 | 163.5 | 184.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 18.0 | 18.0 | 18.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

OIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2160.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 1440.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, NORTH WALL-CASE 4, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 58.1 | 78.1 | 220.0 | -20.0 | 11.112 | 11.007 |
| 2 | 74.3 | 94.3 | 240.0 | -20.0 | 65.884 | 65.878 |
| 3 | 67.1 | 67.1 | 220.0 | 0.0 | ,CIRCLE OUTSIDE SLOPE | |
| 4 | 44.0 | 64.0 | 200.0 | -20.0 | 5.946 | 5.887 |
| 5 | 50.0 | 50.0 | 200.0 | 0.0 | 35.291 | 35.308 |
| 6 | 33.9 | 53.9 | 180.0 | -20.0 | 4.881 | 4.843 |
| 7 | 36.1 | 36.1 | 180.0 | 0.0 | 6.083 | 5.987 |
| 8 | 30.0 | 50.0 | 160.0 | -20.0 | 6.067 | 5.992 |
| 9 | 32.8 | 72.8 | 180.0 | -40.0 | 5.250 | 5.222 |
| 10 | 38.3 | 58.3 | 190.0 | -20.0 | 5.122 | 5.077 |
| 11 | 34.7 | 44.7 | 180.0 | -10.0 | 4.992 | 4.939 |
| 12 | 31.0 | 51.0 | 170.0 | -20.0 | 5.171 | 5.127 |
| 13 | 33.2 | 63.2 | 180.0 | -30.0 | 5.020 | 4.989 |
| 14 | 40.0 | 50.0 | 190.0 | -10.0 | 5.981 | 5.907 |
| 15 | 31.2 | 41.2 | 170.0 | -10.0 | 4.899 | 4.848 |
| 16 | 30.8 | 60.8 | 170.0 | -30.0 | 5.508 | 5.468 |
| 17 | 37.1 | 67.1 | 190.0 | -30.0 | 4.939 | 4.906 |

.S. MINIMUM= 4.881 FOR THE CIRCLE OF CENTER ( 180.0, -20.0)

BISHOP MODIFIED,LEFEBVRE 1971

ELL 12, NORTH WALL-CASE 5, WITH NO SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 220.0, -20.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 154.0, 18.0)

EOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 154.0 | 160.0 | 163.5 | 184.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 18.0 | 18.0 | 18.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

OIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2160.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 1440.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, NORTH WALL-CASE 5, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 56.2 | 76.2 | 220.0 | -20.0 | 78.205 | 78.111 |
| 2 | 74.0 | 94.0 | 240.0 | -20.0 | 284.133 | 284.137 |
| 3 | 68.4 | 68.4 | 220.0 | 0.0 | 21.584 | 21.699 |
| 4 | 87.9 | 87.9 | 240.0 | 0.0 | 8.899 | 9.105 |
| 5 | 107.5 | 107.5 | 260.0 | 0.0 | 5.325 | 5.552 |
| 6 | 127.3 | 127.3 | 280.0 | 0.0 | 19.361 | 18.324 |
| 7 | 92.6 | 112.6 | 260.0 | -20.0 | 35.380 | 35.431 |
| 8 | 117.4 | 117.4 | 270.0 | 0.0 | 25.577 | 24.413 |
| 9 | 116.3 | 106.3 | 260.0 | 10.0 | 21.451 | 20.113 |
| 10 | 97.7 | 97.7 | 250.0 | 0.0 | 6.691 | 6.913 |
| 11 | 99.6 | 109.6 | 260.0 | -10.0 | 11.102 | 11.245 |
| 12 | 126.3 | 116.3 | 270.0 | 10.0 | 18.154 | 16.895 |
| 13 | 106.3 | 96.3 | 250.0 | 10.0 | 25.209 | 23.853 |
| 14 | 90.0 | 100.0 | 250.0 | -10.0 | 16.494 | 16.610 |
| 15 | 109.3 | 119.3 | 270.0 | -10.0 | 8.177 | 8.337 |

F.S. MINIMUM= 5.325 FOR THE CIRCLE OF CENTER ( 260.0, 0.0)

BISHOP MODIFIED,LEFEBVRE 1971

ELL 12, NORTH WALL-CASE 6, WITH NO SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 9 |
| NUMBER OF SOIL LAYER BOUNDARIES | 7 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 190.0, -40.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 152.0, 14.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 154.0 | 160.0 | 163.5 | 184.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 18.0 | 18.0 | 18.0 | 18.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 30.0 | 30.0 | 30.0 | 30.0 | 30.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 37.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 6 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 78.0 | 85.0 | 85.0 |
| BOUNDARY 7 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2160.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 1440.0 | 35.0 | 120.0 |
| 6 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

CELL 12, NORTH WALL-CASE 6, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(CMS) |
|---|---|---|---|---|---|---|
| 1 | 26.0 | 66.0 | 190.0 | -40.0 | 0.906 | 0.905 |
| 2 | 39.2 | 79.2 | 210.0 | -40.0 | 0.608 | 0.608 |
| 3 | 54.9 | 94.9 | 230.0 | -40.0 | 0.455 | 0.455 |
| 4 | 71.9 | 111.9 | 250.0 | -40.0 | 0.364 | 0.364 |
| 5 | 89.8 | 129.8 | 270.0 | -40.0 | 327.237 | 327.228 |
| 6 | 83.7 | 103.7 | 250.0 | -20.0 | 32.851 | 32.865 |
| 7 | 62.8 | 122.8 | 250.0 | -60.0 | 0.504 | 0.504 |
| 8 | 80.7 | 120.7 | 260.0 | -40.0 | 6248820.000 | ********** |
| 9 | 77.4 | 107.4 | 250.0 | -30.0 | 271.087 | 271.076 |
| 10 | 63.2 | 103.2 | 240.0 | -40.0 | 0.404 | 0.404 |
| 11 | 67.0 | 117.0 | 250.0 | -50.0 | 0.434 | 0.434 |
| 12 | 86.6 | 116.6 | 260.0 | -30.0 | 81.271 | 81.263 |
| 13 | 68.4 | 98.4 | 240.0 | -30.0 | 5242880.000 | ********** |
| 14 | 58.8 | 108.8 | 240.0 | -50.0 | 0.483 | 0.483 |
| 15 | 75.5 | 125.5 | 260.0 | -50.0 | 0.394 | 0.394 |

F.S. MINIMUM= 0.364 FOR THE CIRCLE OF CENTER ( 250.0, -40.0)

1 BISHOP MODIFIED,LEFEBVRE 1971

ELL 12, WEST SLOPE-CASE 1, NO SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 5 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

SEARCH STARTS AT CENTER ( 200.0, -60.0),WITH FINAL GRID OF 10.0

ALL CIRCLES PASS THROUGH THE POINT ( 192.5, 85.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 154.0 | 160.0 | 179.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 18.0 | 18.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 30.0 | 30.0 | 30.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 68.0 | 68.0 | 68.0 | 68.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 2880.0 | 35.0 | 120.0 |
| 3 | 1440.0 | 35.0 | 120.0 |
| 4 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

1 BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, WEST SLOPE-CASE 1, NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(CMS) |
|---|---|---|---|---|---|---|
| 1 | 85.2 | 145.2 | 200.0 | -60.0 | 3.053 | 2.957 |
| 2 | 87.6 | 147.6 | 220.0 | -60.0 | 2.721 | 2.646 |
| 3 | 92.6 | 152.6 | 240.0 | -60.0 | 2.566 | 2.500 |
| 4 | 99.9 | 159.9 | 260.0 | -60.0 | 2.581 | 2.514 |
| 5 | 93.7 | 133.7 | 240.0 | -40.0 | 5.889 | 5.478 |
| 6 | 91.7 | 171.7 | 240.0 | -80.0 | 5.105 | 4.830 |
| 7 | 96.0 | 156.0 | 250.0 | -60.0 | 2.552 | 2.486 |
| 8 | 99.9 | 159.9 | 260.0 | -60.0 | 2.581 | 2.514 |
| 9 | 96.7 | 146.7 | 250.0 | -50.0 | 2.571 | 2.498 |
| 10 | 95.3 | 165.3 | 250.0 | -70.0 | 2.556 | 2.495 |
| 11 | 100.9 | 150.9 | 260.0 | -50.0 | 2.642 | 2.566 |
| 12 | 93.1 | 143.1 | 240.0 | -50.0 | 2.554 | 2.482 |
| 13 | 92.1 | 162.1 | 240.0 | -70.0 | 5.210 | 4.911 |
| 14 | 99.1 | 169.1 | 260.0 | -70.0 | 6.887 | 6.479 |

F.S. MINIMUM= 2.552 FOR THE CIRCLE OF CENTER ( 250.0, -60.0)

:ELL 12, WEST SLOPE-CASE 1, WITH SEISMIC

'ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 5 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

EARCH STARTS AT CENTER ( 200.0, -60.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 192.5, 85.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 154.0 | 160.0 | 179.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 18.0 | 18.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 30.0 | 30.0 | 30.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 68.0 | 68.0 | 68.0 | 68.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

)IL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 2880.0 | 35.0 | 120.0 |
| 3 | 1440.0 | 35.0 | 120.0 |
| 4 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000



BISHOP MODIFIED,LEFEBVRE 1971

LL 12, WEST SLOPE-CASE 1, WITH SEISMIC

| NUMBER | TANGENT | RADIUS | X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 85.2 | 145.2 | 200.0 | -60.0 | 2.300 | 2.304 |
| 2 | 87.6 | 147.6 | 220.0 | -60.0 | 2.131 | 2.152 |
| 3 | 92.6 | 152.6 | 240.0 | -60.0 | 2.074 | 2.102 |
| 4 | 96.0 | 156.0 | 250.0 | -60.0 | 2.092 | 2.120 |
| 5 | 93.1 | 143.1 | 240.0 | -50.0 | 2.087 | 2.111 |
| 6 | 89.8 | 149.8 | 230.0 | -60.0 | 3.662 | 3.503 |
| 7 | 92.1 | 162.1 | 240.0 | -70.0 | 4.138 | 3.948 |
| 8 | 96.7 | 146.7 | 250.0 | -50.0 | 2.131 | 2.154 |
| 9 | 90.1 | 140.1 | 230.0 | -50.0 | 2.082 | 2.104 |
| 10 | 89.5 | 159.5 | 230.0 | -70.0 | 3.584 | 3.444 |
| 11 | 95.3 | 165.3 | 250.0 | -70.0 | 2.074 | 2.107 |
| 12 | 99.1 | 169.1 | 260.0 | -70.0 | 5.237 | 4.981 |
| 13 | 94.7 | 174.7 | 250.0 | -80.0 | 2.070 | 2.106 |
| 14 | 98.3 | 178.3 | 260.0 | -80.0 | 2.079 | 2.115 |
| 15 | 91.7 | 171.7 | 240.0 | -80.0 | 4.028 | 3.859 |
| 16 | 94.2 | 184.2 | 250.0 | -90.0 | 4.418 | 4.230 |
| 17 | 99.1 | 169.1 | 260.0 | -70.0 | 5.237 | 4.981 |
| 18 | 92.1 | 162.1 | 240.0 | -70.0 | 4.138 | 3.948 |
| 19 | 91.3 | 181.3 | 240.0 | -90.0 | 3.944 | 3.793 |
| 20 | 97.6 | 187.6 | 260.0 | -90.0 | 2.070 | 2.110 |
| 21 | 101.4 | 191.4 | 270.0 | -90.0 | 2.086 | 2.126 |
| 22 | 96.9 | 196.9 | 260.0 | -100.0 | 2.071 | 2.114 |
| 23 | 102.3 | 182.3 | 270.0 | -80.0 | 2.113 | 2.149 |
| 24 | 94.7 | 174.7 | 250.0 | -80.0 | 2.070 | 2.106 |
| 25 | 93.7 | 193.7 | 250.0 | -100.0 | 4.310 | 4.141 |
| 26 | 100.6 | 200.6 | 270.0 | -100.0 | 2.074 | 2.117 |

F.S. MINIMUM= 2.070 FOR THE CIRCLE OF CENTER ( 260.0, -90.0)

ELL 12, WEST SLOPE-CASE 2, WITH NO SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 5 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 200.0, -60.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 179.0, 68.0)

EOMETRY

| SECTIONS | 0.0 | 150.0 | 154.0 | 160.0 | 179.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 18.0 | 18.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 30.0 | 30.0 | 30.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 68.0 | 68.0 | 68.0 | 68.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

OIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 2880.0 | 35.0 | 120.0 |
| 3 | 1440.0 | 35.0 | 120.0 |
| 4 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

1 BISHOP MODIFIED,LEFEBVRE 1971

ELL 12, WEST SLOPE-CASE 2, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 69.7 | 129.7 | 200.0 | -60.0 | 2.406 | 2.387 |
| 2 | 74.4 | 134.4 | 220.0 | -60.0 | 2.165 | 2.162 |
| 3 | 81.8 | 141.8 | 240.0 | -60.0 | 2.074 | 2.077 |
| 4 | 86.4 | 146.4 | 250.0 | -60.0 | 2.079 | 2.082 |
| 5 | 82.8 | 132.8 | 240.0 | -50.0 | 2.061 | 2.065 |
| 6 | 87.7 | 137.7 | 250.0 | -50.0 | 2.098 | 2.102 |
| 7 | 84.0 | 124.0 | 240.0 | -40.0 | 2.076 | 2.081 |
| 8 | 78.5 | 128.5 | 230.0 | -50.0 | 2.064 | 2.066 |
| 9 | 89.2 | 129.2 | 250.0 | -40.0 | 2.160 | 2.165 |
| 10 | 79.4 | 119.4 | 230.0 | -40.0 | 2.044 | 2.048 |
| 11 | 80.5 | 110.5 | 230.0 | -30.0 | 2.053 | 2.060 |
| 12 | 75.5 | 115.5 | 220.0 | -40.0 | 2.059 | 2.060 |
| 13 | 85.4 | 115.4 | 240.0 | -30.0 | 2.140 | 2.148 |
| 14 | 76.2 | 106.2 | 220.0 | -30.0 | 2.029 | 2.033 |
| 15 | 77.1 | 97.1 | 220.0 | -20.0 | 2.030 | 2.040 |
| 16 | 72.8 | 102.8 | 210.0 | -30.0 | 2.062 | 2.061 |
| 17 | 81.7 | 101.7 | 230.0 | -20.0 | 2.118 | 2.131 |
| 18 | 73.3 | 93.3 | 210.0 | -20.0 | 2.020 | 2.024 |
| 19 | 73.9 | 83.9 | 210.0 | -10.0 | 2.010 | 2.025 |
| 20 | 78.1 | 88.1 | 220.0 | -10.0 | 2.096 | 2.117 |
| 21 | 74.7 | 74.7 | 210.0 | 0.0 | 2.072 | 2.112 |
| 22 | 70.8 | 80.8 | 200.0 | -10.0 | 2.025 | 2.028 |
| 23 | 79.4 | 79.4 | 220.0 | 0.0 | 2.312 | 2.362 |
| 24 | 71.2 | 71.2 | 200.0 | 0.0 | 1.999 | 2.024 |
| 25 | 71.7 | 61.7 | 200.0 | 10.0 | 2.044 | 2.130 |
| 26 | 68.9 | 68.9 | 190.0 | 0.0 | 2.061 | 2.061 |
| 27 | 75.8 | 65.8 | 210.0 | 10.0 | 2.317 | 2.439 |
| 28 | 69.0 | 59.0 | 190.0 | 10.0 | 2.010 | 2.058 |
| 29 | 68.8 | 78.8 | 190.0 | -10.0 | 2.134 | 2.117 |
| 30 | 73.9 | 83.9 | 210.0 | -10.0 | 2.010 | 2.025 |

F.S. MINIMUM= 1.999 FOR THE CIRCLE OF CENTER ( 200.0, 0.0)

ELL 12, WEST SLOPE-CASE 2, WITH SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 5 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

EARCH STARTS AT CENTER ( 200.0, -60.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 179.0, 68.0)

EOMETRY

| SECTIONS | 0.0 | 150.0 | 154.0 | 160.0 | 179.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 18.0 | 18.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 30.0 | 30.0 | 30.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 68.0 | 68.0 | 68.0 | 68.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

OIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 2880.0 | 35.0 | 120.0 |
| 3 | 1440.0 | 35.0 | 120.0 |
| 4 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

1 BISHOP MODIFIED,LEFEBVRE 1971

ELL 12, WEST SLOPE-CASE 2, WITH SEISMIC

| NUMBER | TANGENT | RADIUS | X) CENTER | (Y) CENTER | FS(BISHOP) | FS(CMS) |
|---|---|---|---|---|---|---|
| 1 | 69.7 | 129.7 | 200.0 | -60.0 | 1.808 | 1.883 |
| 2 | 74.4 | 134.4 | 220.0 | -60.0 | 1.694 | 1.783 |
| 3 | 81.8 | 141.8 | 240.0 | -60.0 | 1.674 | 1.770 |
| 4 | 86.4 | 146.4 | 250.0 | -60.0 | 1.702 | 1.799 |
| 5 | 82.8 | 132.8 | 240.0 | -50.0 | 1.683 | 1.781 |
| 6 | 77.8 | 137.8 | 230.0 | -60.0 | 1.672 | 1.765 |
| 7 | 78.5 | 128.5 | 230.0 | -50.0 | 1.660 | 1.756 |
| 8 | 82.8 | 132.8 | 240.0 | -50.0 | 1.683 | 1.781 |
| 9 | 79.4 | 119.4 | 230.0 | -40.0 | 1.664 | 1.763 |
| 10 | 74.9 | 124.9 | 220.0 | -50.0 | 1.667 | 1.758 |
| 11 | 84.0 | 124.0 | 240.0 | -40.0 | 1.717 | 1.818 |
| 12 | 75.5 | 115.5 | 220.0 | -40.0 | 1.648 | 1.743 |
| 13 | 76.2 | 106.2 | 220.0 | -30.0 | 1.645 | 1.745 |
| 14 | 80.5 | 110.5 | 230.0 | -30.0 | 1.694 | 1.798 |
| 15 | 77.1 | 97.1 | 220.0 | -20.0 | 1.670 | 1.778 |
| 16 | 72.8 | 102.8 | 210.0 | -30.0 | 1.641 | 1.735 |
| 17 | 73.3 | 93.3 | 210.0 | -20.0 | 1.629 | 1.730 |
| 18 | 77.1 | 97.1 | 220.0 | -20.0 | 1.670 | 1.778 |
| 19 | 73.9 | 83.9 | 210.0 | -10.0 | 1.646 | 1.760 |
| 20 | 70.5 | 90.5 | 200.0 | -20.0 | 1.643 | 1.734 |
| 21 | 78.1 | 88.1 | 220.0 | -10.0 | 1.754 | 1.875 |
| 22 | 70.8 | 80.8 | 200.0 | -10.0 | 1.620 | 1.722 |
| 23 | 71.2 | 71.2 | 200.0 | 0.0 | 1.625 | 1.750 |
| 24 | 68.8 | 78.8 | 190.0 | -10.0 | 1.664 | 1.748 |
| 25 | 74.7 | 74.7 | 210.0 | 0.0 | 1.728 | 1.868 |
| 26 | 68.9 | 68.9 | 190.0 | 0.0 | 1.629 | 1.732 |
| 27 | 68.7 | 88.7 | 190.0 | -20.0 | 1.707 | 1.783 |
| 28 | 73.3 | 93.3 | 210.0 | -20.0 | 1.629 | 1.730 |

.S. MINIMUM= 1.620 FOR THE CIRCLE OF CENTER ( 200.0, -10.0)

'ELL 12, WEST SLOPE-CASE 3, WITH NO SEISMIC

CNTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 5 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 200.0, -60.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 160.0, 30.0)

EOMETRY

| SECTIONS | 0.0 | 150.0 | 154.0 | 160.0 | 179.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 18.0 | 18.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 30.0 | 30.0 | 30.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 68.0 | 68.0 | 68.0 | 68.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

OIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 2880.0 | 35.0 | 120.0 |
| 3 | 1440.0 | 35.0 | 120.0 |
| 4 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

1 BISHOP MODIFIED,LEFEBVRE 1971

LL 12, WEST SLOPE-CASE 3, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS |
|---|---|---|---|---|---|---|
| 1 | 38.5 | 98.5 | 200.0 | -60.0 | 5.619 | 5.582 |
| 2 | 48.2 | 108.2 | 220.0 | -60.0 | 5.666 | 5.624 |
| 3 | 40.6 | 80.6 | 200.0 | -40.0 | 5.553 | 5.501 |
| 4 | 46.0 | 86.0 | 210.0 | -40.0 | 5.874 | 5.815 |
| 5 | 42.1 | 72.1 | 200.0 | -30.0 | 5.802 | 5.734 |
| 6 | 36.2 | 76.2 | 190.0 | -40.0 | 5.548 | 5.499 |
| 7 | 37.1 | 67.1 | 190.0 | -30.0 | 5.502 | 5.443 |
| 8 | 42.1 | 72.1 | 200.0 | -30.0 | 5.802 | 5.734 |
| 9 | 38.3 | 58.3 | 190.0 | -20.0 | 5.715 | 5.635 |
| 10 | 33.2 | 63.2 | 180.0 | -30.0 | 5.629 | 5.573 |
| 11 | 44.0 | 64.0 | 200.0 | -20.0 | 6.606 | 6.508 |
| 12 | 33.9 | 53.9 | 180.0 | -20.0 | 5.481 | 5.411 |
| 13 | 34.7 | 44.7 | 180.0 | -10.0 | 5.619 | 5.522 |
| 14 | 31.0 | 51.0 | 170.0 | -20.0 | 5.861 | 5.788 |
| 15 | 40.0 | 50.0 | 190.0 | -10.0 | 6.686 | 6.561 |
| 16 | 31.2 | 41.2 | 170.0 | -10.0 | 5.566 | 5.477 |
| 17 | 30.8 | 60.8 | 170.0 | -30.0 | 6.233 | 6.169 |
| 18 | 37.1 | 67.1 | 190.0 | -30.0 | 5.502 | 5.443 |

F.S. MINIMUM= 5.481 FOR THE CIRCLE OF CENTER ( 180.0, -20.0)

CELL 12, WEST SLOPE-CASE 3, WITH SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 5 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

SEARCH STARTS AT CENTER ( 200.0, -60.0),WITH FINAL GRID OF 10.0

ALL CIRCLES PASS THROUGH THE POINT ( 160.0, 30.0)

GEOMETRY

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SECTIONS | 0.0 | 150.0 | 154.0 | 160.0 | 179.0 | 192.5 | 300.0 |
| T. CRACKS | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 18.0 | 18.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 30.0 | 30.0 | 30.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 68.0 | 68.0 | 68.0 | 68.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 2880.0 | 35.0 | 120.0 |
| 3 | 1440.0 | 35.0 | 120.0 |
| 4 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

1 BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, WEST SLOPE-CASE 3, WITH SEISMIC

| NUMBER | TANGENT | RADIUS | X) CENTER | Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 38.5 | 98.5 | 200.0 | -60.0 | 4.483 | 4.533 |
| 2 | 48.2 | 108.2 | 220.0 | -60.0 | 4.749 | 4.798 |
| 3 | 40.6 | 80.6 | 200.0 | -40.0 | 4.618 | 4.657 |
| 4 | 32.2 | 92.2 | 180.0 | -60.0 | 4.790 | 4.834 |
| 5 | 37.0 | 117.0 | 200.0 | -80.0 | 4.579 | 4.634 |
| 6 | 43.0 | 103.0 | 210.0 | -60.0 | 4.544 | 4.595 |
| 7 | 39.4 | 99.4 | 200.0 | -50.0 | 4.501 | 4.547 |
| 8 | 34.9 | 94.9 | 190.0 | -60.0 | 4.563 | 4.612 |
| 9 | 37.7 | 107.7 | 200.0 | -70.0 | 4.516 | 4.569 |
| 10 | 44.3 | 94.3 | 210.0 | -50.0 | 4.687 | 4.731 |
| 11 | 35.4 | 85.4 | 190.0 | -50.0 | 4.493 | 4.539 |
| 12 | 34.4 | 104.4 | 190.0 | -70.0 | 4.657 | 4.708 |
| 13 | 41.8 | 111.8 | 210.0 | -70.0 | 4.495 | 4.549 |

.S. MINIMUM= 4.483 FOR THE CIRCLE OF CENTER ( 200.0, -60.0)

ELL 12, WEST SLOPE-CASE 4, WITH NO SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 5 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 190.0, -50.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 154.0, 18.0)

EOMETRY

| SECTIONS | 0.0 | 150.0 | 154.0 | 160.0 | 179.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 18.0 | 18.0 | 18.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 30.0 | 30.0 | 30.0 | 30.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 68.0 | 68.0 | 68.0 | 68.0 | 68.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

OIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 2880.0 | 35.0 | 120.0 |
| 3 | 1440.0 | 35.0 | 120.0 |
| 4 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

1 BISHOP MODIFIED,LEFEBVRE 1971

ELL 12, WEST SLOPE-CASE 4, WITH NO SEISMIC

| NUMBER | TANGENT | RADIUS | X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 26.9 | 76.9 | 190.0 | -50.0 | 1.095 | 1.093 |
| 2 | 38.1 | 88.1 | 210.0 | -50.0 | 0.748 | 0.748 |
| 3 | 52.0 | 102.0 | 230.0 | -50.0 | 0.563 | 0.563 |
| 4 | 67.6 | 117.6 | 250.0 | -50.0 | 0.449 | 0.449 |
| 5 | 84.5 | 134.5 | 270.0 | -50.0 | 0.373 | 0.373 |
| 6 | 102.1 | 152.1 | 290.0 | -50.0 | 3834318.500 | ********** |
| 7 | 95.5 | 125.5 | 270.0 | -30.0 | 110.438 | 110.474 |
| 8 | 75.6 | 145.6 | 270.0 | -70.0 | 0.491 | 0.491 |
| 9 | 93.2 | 143.2 | 280.0 | -50.0 | 242.344 | 241.942 |
| 10 | 89.7 | 129.7 | 270.0 | -40.0 | 7162.416 | 7156.483 |
| 11 | 75.9 | 125.9 | 260.0 | -50.0 | 0.408 | 0.407 |
| 12 | 79.8 | 139.8 | 270.0 | -60.0 | 0.432 | 0.432 |
| 13 | 98.7 | 138.7 | 280.0 | -40.0 | 558.423 | 558.425 |
| 14 | 80.8 | 120.8 | 260.0 | -40.0 | 0.351 | 0.350 |
| 15 | 86.4 | 116.4 | 260.0 | -30.0 | 468.552 | 468.555 |
| 16 | 72.2 | 112.2 | 250.0 | -40.0 | 0.379 | 0.378 |
| 17 | 95.5 | 125.5 | 270.0 | -30.0 | 110.438 | 110.474 |
| 18 | 77.3 | 107.3 | 250.0 | -30.0 | ,CIRCLE OUTSIDE SLOPE | |
| 19 | 67.6 | 117.6 | 250.0 | -50.0 | 0.449 | 0.449 |
| 20 | 84.5 | 134.5 | 270.0 | -50.0 | 0.373 | 0.373 |

F.S. MINIMUM= 0.351 FOR THE CIRCLE OF CENTER ( 260.0, -40.0)

CELL 12, SOUTH WALL-CASE 1, NO SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 6 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

SEARCH STARTS AT CENTER ( 220.0, -40.0),WITH FINAL GRID OF 10.0

ALL CIRCLES PASS THROUGH THE POINT ( 192.5, 85.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 156.5 | 162.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 23.0 | 23.0 | 23.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 |
| BOUNDARY 6 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2880.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, SOUTH WALL-CASE 1, NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(CMS) |
|---|---|---|---|---|---|---|
| 1 | 88.0 | 128.0 | 220.0 | -40.0 | 3.601 | 3.394 |
| 2 | 93.7 | 133.7 | 240.0 | -40.0 | 5.424 | 5.041 |
| 3 | 88.5 | 108.5 | 220.0 | -20.0 | 2.213 | 2.192 |
| 4 | 95.2 | 115.2 | 240.0 | -20.0 | 6.478 | 5.970 |
| 5 | 89.3 | 89.3 | 220.0 | 0.0 | 4.434 | 4.077 |
| 6 | 85.3 | 105.3 | 200.0 | -20.0 | 2.549 | 2.470 |
| 7 | 91.5 | 111.5 | 230.0 | -20.0 | 2.233 | 2.217 |
| 8 | 88.9 | 98.9 | 220.0 | -10.0 | 2.217 | 2.203 |
| 9 | 86.4 | 106.4 | 210.0 | -20.0 | 2.258 | 2.227 |
| 10 | 88.2 | 118.2 | 220.0 | -30.0 | 2.237 | 2.212 |
| 11 | 92.1 | 102.1 | 230.0 | -10.0 | 5.465 | 5.022 |
| 12 | 86.6 | 96.6 | 210.0 | -10.0 | 3.091 | 2.914 |
| 13 | 86.3 | 116.3 | 210.0 | -30.0 | 2.308 | 2.273 |
| 14 | 91.0 | 121.0 | 230.0 | -30.0 | 2.218 | 2.199 |

F.S. MINIMUM= 2.213 FOR THE CIRCLE OF CENTER ( 220.0, -20.0)

ELL 12, SOUTH WALL-CASE 1S, ADD SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 6 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

EISMIC COEFFICIENT S1,S2 = 0.15 0.00

ARCH STARTS AT CENTER ( 220.0, -40.0),WITH FINAL GRID OF 10.0

L CIRCLES PASS THROUGH THE POINT ( 192.5, 85.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 156.5 | 162.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 23.0 | 23.0 | 23.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 |
| BOUNDARY 6 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2880.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 4320.0 | 35.0 | 120.0 |

RE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000



BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, SOUTH WALL-CASE 1S, ADD SEISMIC

| UMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 88.0 | 128.0 | 220.0 | -40.0 | 2.897 | 2.792 |
| 2 | 93.7 | 133.7 | 240.0 | -40.0 | 4.360 | 4.104 |
| 3 | 88.5 | 108.5 | 220.0 | -20.0 | 1.785 | 1.863 |
| 4 | 95.2 | 115.2 | 240.0 | -20.0 | 5.206 | 4.855 |
| 5 | 89.3 | 89.3 | 220.0 | 0.0 | 3.735 | 3.497 |
| 6 | 85.3 | 105.3 | 200.0 | -20.0 | 1.984 | 2.009 |
| 7 | 91.5 | 111.5 | 230.0 | -20.0 | 1.835 | 1.918 |
| 8 | 88.9 | 98.9 | 220.0 | -10.0 | 1.812 | 1.898 |
| 9 | 86.4 | 106.4 | 210.0 | -20.0 | 1.785 | 1.855 |
| 10 | 88.2 | 118.2 | 220.0 | -30.0 | 1.783 | 1.857 |
| 11 | 91.0 | 121.0 | 230.0 | -30.0 | 1.800 | 1.879 |
| 12 | 86.3 | 116.3 | 210.0 | -30.0 | 1.804 | 1.869 |
| 13 | 88.0 | 128.0 | 220.0 | -40.0 | 2.897 | 2.792 |
| 14 | 91.5 | 111.5 | 230.0 | -20.0 | 1.835 | 1.918 |
| 15 | 86.4 | 106.4 | 210.0 | -20.0 | 1.785 | 1.855 |
| 16 | 86.2 | 126.2 | 210.0 | -40.0 | 1.830 | 1.893 |
| 17 | 90.5 | 130.5 | 230.0 | -40.0 | 1.791 | 1.867 |

F.S. MINIMUM= 1.783 FOR THE CIRCLE OF CENTER ( 220.0, -30.0)

ELL 12, SOUTH WALL-CASE 2, NO SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 6 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 220.0, -40.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 190.0, 80.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 156.5 | 162.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 23.0 | 23.0 | 23.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 |
| BOUNDARY 6 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2880.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 4320.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, SOUTH WALL-CASE 2, NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 83.7 | 123.7 | 220.0 | -40.0 | 2.353 | 2.330 |
| 2 | 90.0 | 130.0 | 240.0 | -40.0 | 2.356 | 2.339 |
| 3 | 84.4 | 104.4 | 220.0 | -20.0 | 2.312 | 2.294 |
| 4 | 87.7 | 107.7 | 230.0 | -20.0 | 2.376 | 2.361 |
| 5 | 84.9 | 94.9 | 220.0 | -10.0 | 2.347 | 2.335 |
| 6 | 82.0 | 102.0 | 210.0 | -20.0 | 2.328 | 2.302 |
| 7 | 84.0 | 114.0 | 220.0 | -30.0 | 2.321 | 2.299 |
| 8 | 88.5 | 98.5 | 230.0 | -10.0 | 2.504 | 2.495 |
| 9 | 82.2 | 92.2 | 210.0 | -10.0 | 2.306 | 2.286 |
| 10 | 82.5 | 82.5 | 210.0 | 0.0 | 2.326 | 2.322 |
| 11 | 80.6 | 90.6 | 200.0 | -10.0 | 2.362 | 2.327 |
| 12 | 85.4 | 85.4 | 220.0 | 0.0 | 2.470 | 2.475 |
| 13 | 80.6 | 80.6 | 200.0 | 0.0 | 2.326 | 2.305 |
| 14 | 80.5 | 100.5 | 200.0 | -20.0 | 2.417 | 2.376 |
| 15 | 84.4 | 104.4 | 220.0 | -20.0 | 2.312 | 2.294 |

F.S. MINIMUM= 2.306 FOR THE CIRCLE OF CENTER ( 210.0, -10.0)

CELL 12, SOUTH WALL-CASE 2, ADD SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 6 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

SEARCH STARTS AT CENTER ( 220.0, -40.0),WITH FINAL GRID OF 10.0

ALL CIRCLES PASS THROUGH THE POINT ( 190.0, 80.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 156.5 | 162.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 23.0 | 23.0 | 23.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 |
| BOUNDARY 6 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2880.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 4320.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, SOUTH WALL-CASE 2, ADD SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(CMS) |
|---|---|---|---|---|---|---|
| 1 | 83.7 | 123.7 | 220.0 | -40.0 | 1.869 | 1.943 |
| 2 | 90.0 | 130.0 | 240.0 | -40.0 | 1.937 | 2.017 |
| 3 | 84.4 | 104.4 | 220.0 | -20.0 | 1.883 | 1.963 |
| 4 | 80.4 | 120.4 | 200.0 | -40.0 | 1.946 | 2.002 |
| 5 | 83.2 | 143.2 | 220.0 | -60.0 | 1.908 | 1.979 |
| 6 | 86.5 | 126.5 | 230.0 | -40.0 | 1.883 | 1.961 |
| 7 | 84.0 | 114.0 | 220.0 | -30.0 | 1.865 | 1.942 |
| 8 | 87.0 | 117.0 | 230.0 | -30.0 | 1.908 | 1.989 |
| 9 | 84.4 | 104.4 | 220.0 | -20.0 | 1.883 | 1.963 |
| 10 | 81.8 | 111.8 | 210.0 | -30.0 | 1.869 | 1.938 |
| 11 | 87.7 | 107.7 | 230.0 | -20.0 | 1.972 | 2.057 |
| 12 | 82.0 | 102.0 | 210.0 | -20.0 | 1.857 | 1.930 |
| 13 | 82.2 | 92.2 | 210.0 | -10.0 | 1.864 | 1.945 |
| 14 | 80.5 | 100.5 | 200.0 | -20.0 | 1.884 | 1.945 |
| 15 | 84.9 | 94.9 | 220.0 | -10.0 | 1.938 | 2.028 |
| 16 | 80.6 | 90.6 | 200.0 | -10.0 | 1.863 | 1.932 |
| 17 | 80.5 | 110.5 | 200.0 | -30.0 | 1.912 | 1.971 |
| 18 | 84.0 | 114.0 | 220.0 | -30.0 | 1.865 | 1.942 |

F.S. MINIMUM= 1.857 FOR THE CIRCLE OF CENTER ( 210.0, -20.0)

ELL 12, SOUTH WALL-CASE 3, NO SEISMIC

CNTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 6 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 220.0, -40.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 172.5, 55.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 156.5 | 162.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 23.0 | 23.0 | 23.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 |
| BOUNDARY 6 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2880.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 4320.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, SOUTH WALL-CASE 3, NO SEISMIC

| UMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(CMS) |
|---|---|---|---|---|---|---|
| 1 | 66.2 | 106.2 | 220.0 | -40.0 | 3.102 | 3.082 |
| 2 | 76.5 | 116.5 | 240.0 | -40.0 | 3.473 | 3.443 |
| 3 | 68.8 | 88.8 | 220.0 | -20.0 | 3.419 | 3.387 |
| 4 | 58.9 | 98.9 | 200.0 | -40.0 | 3.118 | 3.096 |
| 5 | 64.4 | 124.4 | 220.0 | -60.0 | 3.111 | 3.096 |
| 6 | 71.0 | 111.0 | 230.0 | -40.0 | 3.235 | 3.211 |
| 7 | 67.4 | 97.4 | 220.0 | -30.0 | 3.190 | 3.165 |
| 8 | 62.1 | 102.1 | 210.0 | -40.0 | 3.064 | 3.045 |
| 9 | 62.9 | 92.9 | 210.0 | -30.0 | 3.064 | 3.042 |
| 10 | 67.4 | 97.4 | 220.0 | -30.0 | 3.190 | 3.165 |
| 11 | 63.9 | 83.9 | 210.0 | -20.0 | 3.142 | 3.117 |
| 12 | 59.3 | 89.3 | 200.0 | -30.0 | 3.054 | 3.031 |
| 13 | 59.9 | 79.9 | 200.0 | -20.0 | 3.032 | 3.008 |
| 14 | 63.9 | 83.9 | 210.0 | -20.0 | 3.142 | 3.117 |
| 15 | 60.6 | 70.6 | 200.0 | -10.0 | 3.095 | 3.072 |
| 16 | 57.0 | 77.0 | 190.0 | -20.0 | 3.070 | 3.040 |
| 17 | 65.0 | 75.0 | 210.0 | -10.0 | 3.390 | 3.362 |
| 18 | 57.3 | 67.3 | 190.0 | -10.0 | 3.021 | 2.994 |
| 19 | 57.7 | 57.7 | 190.0 | 0.0 | 3.062 | 3.045 |
| 20 | 55.4 | 65.4 | 180.0 | -10.0 | 3.143 | 3.099 |
| 21 | 61.5 | 61.5 | 200.0 | 0.0 | 3.366 | 3.349 |
| 22 | 55.5 | 55.5 | 180.0 | 0.0 | 3.067 | 3.033 |
| 23 | 55.4 | 75.4 | 180.0 | -20.0 | 3.255 | 3.208 |
| 24 | 59.9 | 79.9 | 200.0 | -20.0 | 3.032 | 3.008 |

F.S. MINIMUM= 3.021 FOR THE CIRCLE OF CENTER ( 190.0, -10.0)

CELL 12, SOUTH WALL-CASE 3, ADD SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 6 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

SEARCH STARTS AT CENTER ( 220.0, -40.0),WITH FINAL GRID OF 10.0

ALL CIRCLES PASS THROUGH THE POINT ( 172.5, 55.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 156.5 | 162.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 23.0 | 23.0 | 23.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 |
| BOUNDARY 6 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2880.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 4320.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

BISHOP MODIFIED,LEFEBVRE 1971

CELL 12, SOUTH WALL-CASE 3, ADD SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 66.2 | 106.2 | 220.0 | -40.0 | 2.566 | 2.640 |
| 2 | 76.5 | 116.5 | 240.0 | -40.0 | 2.974 | 3.040 |
| 3 | 68.8 | 88.8 | 220.0 | -20.0 | 2.929 | 2.996 |
| 4 | 58.9 | 98.9 | 200.0 | -40.0 | 2.465 | 2.537 |
| 5 | 62.1 | 102.1 | 210.0 | -40.0 | 2.482 | 2.557 |
| 6 | 59.3 | 89.3 | 200.0 | -30.0 | 2.454 | 2.527 |
| 7 | 62.9 | 92.9 | 210.0 | -30.0 | 2.522 | 2.597 |
| 8 | 59.9 | 79.9 | 200.0 | -20.0 | 2.480 | 2.554 |
| 9 | 56.8 | 86.8 | 190.0 | -30.0 | 2.466 | 2.532 |
| 10 | 63.9 | 83.9 | 210.0 | -20.0 | 2.634 | 2.708 |
| 11 | 57.0 | 77.0 | 190.0 | -20.0 | 2.439 | 2.508 |
| 12 | 57.3 | 67.3 | 190.0 | -10.0 | 2.446 | 2.520 |
| 13 | 55.4 | 75.4 | 180.0 | -20.0 | 2.497 | 2.553 |
| 14 | 60.6 | 70.6 | 200.0 | -10.0 | 2.583 | 2.660 |
| 15 | 55.4 | 65.4 | 180.0 | -10.0 | 2.455 | 2.516 |
| 16 | 55.3 | 85.3 | 180.0 | -30.0 | 2.552 | 2.606 |
| 17 | 59.3 | 89.3 | 200.0 | -30.0 | 2.454 | 2.527 |

F.S. MINIMUM= 2.439 FOR THE CIRCLE OF CENTER ( 190.0, -20.0)

ELL 12, SOUTH WALL-CASE 4, NO SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 6 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 220.0, -40.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 162.0, 34.0)

EOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 156.5 | 162.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 23.0 | 23.0 | 23.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 |
| BOUNDARY 6 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2880.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 4320.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

BISHOP MODIFIED,LEFEBVRE 1971

ELL 12, SOUTH WALL-CASE 4, NO SEISMIC

| UMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 54.0 | 94.0 | 220.0 | -40.0 | 5.597 | 5.543 |
| 2 | 67.5 | 107.5 | 240.0 | -40.0 | 7.622 | 7.546 |
| 3 | 59.2 | 79.2 | 220.0 | -20.0 | 8.975 | 8.857 |
| 4 | 43.2 | 83.2 | 200.0 | -40.0 | 4.933 | 4.892 |
| 5 | 46.0 | 66.0 | 200.0 | -20.0 | 5.531 | 5.459 |
| 6 | 36.2 | 76.2 | 180.0 | -40.0 | 5.298 | 5.255 |
| 7 | 41.4 | 101.4 | 200.0 | -60.0 | 5.057 | 5.028 |
| 8 | 48.2 | 88.2 | 210.0 | -40.0 | 5.134 | 5.088 |
| 9 | 44.4 | 74.4 | 200.0 | -30.0 | 5.059 | 5.007 |
| 10 | 39.1 | 79.1 | 190.0 | -40.0 | 4.981 | 4.941 |
| 11 | 42.2 | 92.2 | 200.0 | -50.0 | 4.957 | 4.923 |
| 12 | 50.0 | 80.0 | 210.0 | -30.0 | 5.566 | 5.505 |
| 13 | 39.9 | 69.9 | 190.0 | -30.0 | 4.898 | 4.851 |
| 14 | 40.8 | 60.8 | 190.0 | -20.0 | 4.978 | 4.918 |
| 15 | 36.5 | 66.5 | 180.0 | -30.0 | 5.068 | 5.020 |
| 16 | 46.0 | 66.0 | 200.0 | -20.0 | 5.531 | 5.459 |
| 17 | 36.9 | 56.9 | 180.0 | -20.0 | 4.903 | 4.847 |
| 18 | 36.2 | 76.2 | 180.0 | -40.0 | 5.298 | 5.255 |
| 19 | 43.2 | 83.2 | 200.0 | -40.0 | 4.933 | 4.892 |

.S. MINIMUM= 4.898 FOR THE CIRCLE OF CENTER ( 190.0, -30.0)

ELL 12, SOUTH WALL-CASE 4, ADD SEISMIC

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 6 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

EARCH STARTS AT CENTER ( 220.0, -40.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 162.0, 34.0)

EOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 156.5 | 162.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 23.0 | 23.0 | 23.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 |
| BOUNDARY 6 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2880.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 4320.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

BISHOP MODIFIED,LEFEBVRE 1971

ELL 12, SOUTH WALL-CASE 4, ADD SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 54.0 | 94.0 | 220.0 | -40.0 | 4.834 | 4.875 |
| 2 | 67.5 | 107.5 | 240.0 | -40.0 | 6.800 | 6.820 |
| 3 | 59.2 | 79.2 | 220.0 | -20.0 | 8.108 | 8.089 |
| 4 | 43.2 | 83.2 | 200.0 | -40.0 | 4.070 | 4.120 |
| 5 | 46.0 | 66.0 | 200.0 | -20.0 | 4.789 | 4.813 |
| 6 | 36.2 | 76.2 | 180.0 | -40.0 | 4.069 | 4.116 |
| 7 | 39.1 | 79.1 | 190.0 | -40.0 | 3.982 | 4.033 |
| 8 | 43.2 | 83.2 | 200.0 | -40.0 | 4.070 | 4.120 |
| 9 | 39.9 | 69.9 | 190.0 | -30.0 | 4.009 | 4.055 |
| 10 | 38.5 | 88.5 | 190.0 | -50.0 | 4.021 | 4.075 |
| 11 | 44.4 | 74.4 | 200.0 | -30.0 | 4.270 | 4.311 |
| 12 | 36.5 | 66.5 | 180.0 | -30.0 | 3.989 | 4.032 |
| 13 | 35.9 | 85.9 | 180.0 | -50.0 | 4.172 | 4.221 |
| 14 | 42.2 | 92.2 | 200.0 | -50.0 | 4.006 | 4.062 |

F.S. MINIMUM= 3.982 FOR THE CIRCLE OF CENTER ( 190.0, -40.0)

ELL 12, SOUTH WALL-CASE 5, NO SEISMIC

CNTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 6 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 230.0, -40.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 156.5, 23.0)

GEOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 156.5 | 162.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 23.0 | 23.0 | 23.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 |
| BOUNDARY 6 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2880.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 4320.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

BISHOP MODIFIED,LEFEBVRE 1971

ELL 12, SOUTH WALL-CASE 5, NO SEISMIC

| JMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(CMS) |
|---|---|---|---|---|---|---|
| 1 | 56.8 | 96.8 | 230.0 | -40.0 | 8.017 | 7.965 |
| 2 | 72.7 | 112.7 | 250.0 | -40.0 | 16.042 | 15.968 |
| 3 | 65.2 | 85.2 | 230.0 | -20.0 | 99.395 | 99.380 |
| 4 | 42.7 | 82.7 | 210.0 | -40.0 | 5.570 | 5.536 |
| 5 | 48.6 | 68.6 | 210.0 | -20.0 | 10.230 | 10.239 |
| 6 | 31.4 | 71.4 | 190.0 | -40.0 | 4.957 | 4.933 |
| 7 | 34.5 | 54.5 | 190.0 | -20.0 | 5.473 | 5.424 |
| 8 | 24.4 | 64.4 | 170.0 | -40.0 | 5.901 | 5.874 |
| 9 | 29.5 | 89.5 | 190.0 | -60.0 | 5.278 | 5.261 |
| 10 | 36.6 | 76.6 | 200.0 | -40.0 | 5.087 | 5.059 |
| 11 | 32.7 | 62.7 | 190.0 | -30.0 | 5.001 | 4.969 |
| 12 | 27.2 | 67.2 | 180.0 | -40.0 | 5.196 | 5.173 |
| 13 | 30.3 | 80.3 | 190.0 | -50.0 | 5.078 | 5.059 |
| 14 | 38.6 | 68.6 | 200.0 | -30.0 | 5.530 | 5.489 |
| 15 | 28.0 | 58.0 | 180.0 | -30.0 | 4.965 | 4.938 |
| 16 | 26.7 | 76.7 | 180.0 | -50.0 | 5.494 | 5.474 |
| 17 | 35.0 | 85.0 | 200.0 | -50.0 | 4.984 | 4.962 |

F.S. MINIMUM= 4.957 FOR THE CIRCLE OF CENTER ( 190.0, -40.0)

ELL 12, SOUTH WALL-CASE 6, NO SEISMIC

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 0 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 6 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 190.0, -40.0),WITH FINAL GRID OF 10.0

LL CIRCLES PASS THROUGH THE POINT ( 152.0, 14.0)

EOMETRY

| SECTIONS | 0.0 | 150.0 | 152.0 | 156.5 | 162.0 | 192.5 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| W IN CRACK | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 1 | 10.0 | 10.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 2 | 14.0 | 14.0 | 14.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 3 | 23.0 | 23.0 | 23.0 | 23.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 4 | 34.0 | 34.0 | 34.0 | 34.0 | 34.0 | 85.0 | 85.0 |
| BOUNDARY 5 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 | 86.0 |
| BOUNDARY 6 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 | 300.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 35.0 | 120.0 |
| 2 | 1440.0 | 35.0 | 120.0 |
| 3 | 2880.0 | 35.0 | 120.0 |
| 4 | 2160.0 | 35.0 | 120.0 |
| 5 | 4320.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

BISHOP MODIFIED,LEFEBVRE 1971

ELL 12, SOUTH WALL-CASE 6, NO SEISMIC

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(CMS) |
|---|---|---|---|---|---|---|
| 1 | 26.0 | 66.0 | 190.0 | -40.0 | 0.906 | 0.905 |
| 2 | 39.2 | 79.2 | 210.0 | -40.0 | 0.608 | 0.608 |
| 3 | 54.9 | 94.9 | 230.0 | -40.0 | 0.455 | 0.455 |
| 4 | 71.9 | 111.9 | 250.0 | -40.0 | 0.364 | 0.364 |
| 5 | 89.8 | 129.8 | 270.0 | -40.0 | 261.404 | 261.406 |
| 6 | 83.7 | 103.7 | 250.0 | -20.0 | 38.650 | 38.610 |
| 7 | 62.8 | 122.8 | 250.0 | -60.0 | 0.504 | 0.504 |
| 8 | 80.7 | 120.7 | 260.0 | -40.0 | 6248820.000 | ********** |
| 9 | 77.4 | 107.4 | 250.0 | -30.0 | 216.474 | 216.477 |
| 10 | 63.2 | 103.2 | 240.0 | -40.0 | 0.404 | 0.404 |
| 11 | 67.0 | 117.0 | 250.0 | -50.0 | 0.434 | 0.434 |
| 12 | 86.6 | 116.6 | 260.0 | -30.0 | 85.324 | 85.290 |
| 13 | 68.4 | 98.4 | 240.0 | -30.0 | 5242880.000 | ********** |
| 14 | 58.8 | 108.8 | 240.0 | -50.0 | 0.483 | 0.483 |
| 15 | 75.5 | 125.5 | 260.0 | -50.0 | 0.394 | 0.394 |

'.S. MINIMUM= 0.364 FOR THE CIRCLE OF CENTER ( 250.0, -40.0)

SOIL DIKE - CASE 1 - STATIC CONDITIONS, PHI = 38

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 6 |
| NUMBER OF SOIL LAYER BOUNDARIES | 4 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

SEARCH STARTS AT CENTER ( 160.0, -10.0),WITH FINAL GRID OF 5.0

ALL CIRCLES TANGENT TO DEPTH, 40.0,

GEOMETRY

| SECTIONS | 0.0 | 96.0 | 106.0 | 120.0 | 146.0 | 300.0 |
|---|---|---|---|---|---|---|
| T. CRACKS | 40.0 | 8.0 | 8.0 | 19.0 | 40.0 | 40.0 |
| W IN CRACK | 40.0 | 8.0 | 8.0 | 19.0 | 40.0 | 40.0 |
| BOUNDARY 1 | 40.0 | 8.0 | 8.0 | 19.0 | 40.0 | 40.0 |
| BOUNDARY 2 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| BOUNDARY 3 | 40.0 | 40.0 | 40.0 | 68.0 | 100.0 | 100.0 |
| BOUNDARY 4 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 38.0 | 120.0 |
| 2 | 0.0 | 30.0 | 85.0 |
| 3 | 0.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

SOIL DIKE - CASE 1 - STATIC CONDITIONS, PHI = 38

| UMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 40.0 | 50.0 | 160.0 | -10.0 | 1.027 | 0.998 |
| 2 | 40.0 | 50.0 | 170.0 | -10.0 | ,CIRCLE OUTSIDE SLOPE | |
| 3 | 40.0 | 40.0 | 160.0 | 0.0 | 0.969 | 0.968 |
| 4 | 40.0 | 40.0 | 170.0 | 0.0 | ,CIRCLE OUTSIDE SLOPE | |
| 5 | 40.0 | 30.0 | 160.0 | 10.0 | ,CIRCLE OUTSIDE SLOPE | |
| 6 | 40.0 | 40.0 | 150.0 | 0.0 | 1.187 | 1.084 |
| 7 | 40.0 | 40.0 | 165.0 | 0.0 | ,CIRCLE OUTSIDE SLOPE | |
| 8 | 40.0 | 35.0 | 160.0 | 5.0 | ,CIRCLE OUTSIDE SLOPE | |
| 9 | 40.0 | 40.0 | 155.0 | 0.0 | 1.073 | 1.022 |
| 10 | 40.0 | 45.0 | 160.0 | -5.0 | 1.001 | 0.984 |
| 11 | 40.0 | 35.0 | 165.0 | 5.0 | ,CIRCLE OUTSIDE SLOPE | |
| 12 | 40.0 | 35.0 | 155.0 | 5.0 | 1.046 | 1.007 |
| 13 | 40.0 | 45.0 | 155.0 | -5.0 | 1.097 | 1.035 |
| 14 | 40.0 | 45.0 | 165.0 | -5.0 | ,CIRCLE OUTSIDE SLOPE | |

.S. MINIMUM= 0.969 FOR THE CIRCLE OF CENTER ( 160.0, 0.0)

SOIL DIKE - CASE 1 - DYNAMIC CONDITIONS, PHI = 38

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 6 |
| NUMBER OF SOIL LAYER BOUNDARIES | 4 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

SEARCH STARTS AT CENTER ( 160.0, -10.0),WITH FINAL GRID OF 5.0

ALL CIRCLES TANGENT TO DEPTH, 40.0,

GEOMETRY

| | | | | | | |
|---|---|---|---|---|---|---|
| SECTIONS | 0.0 | 96.0 | 106.0 | 120.0 | 146.0 | 300.0 |
| T. CRACKS | 40.0 | 8.0 | 8.0 | 19.0 | 40.0 | 40.0 |
| W IN CRACK | 40.0 | 8.0 | 8.0 | 19.0 | 40.0 | 40.0 |
| BOUNDARY 1 | 40.0 | 8.0 | 8.0 | 19.0 | 40.0 | 40.0 |
| BOUNDARY 2 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| BOUNDARY 3 | 40.0 | 40.0 | 40.0 | 68.0 | 100.0 | 100.0 |
| BOUNDARY 4 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 38.0 | 120.0 |
| 2 | 0.0 | 30.0 | 85.0 |
| 3 | 0.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

SOIL DIKE - CASE 1 - DYNAMIC CONDITIONS, PHI = 38

| UMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 40.0 | 50.0 | 160.0 | -10.0 | 0.765 | 0.837 |
| 2 | 40.0 | 50.0 | 170.0 | -10.0 | ,CIRCLE OUTSIDE SLOPE | |
| 3 | 40.0 | 40.0 | 160.0 | 0.0 | 0.720 | 0.817 |
| 4 | 40.0 | 40.0 | 170.0 | 0.0 | ,CIRCLE OUTSIDE SLOPE | |
| 5 | 40.0 | 30.0 | 160.0 | 10.0 | ,CIRCLE OUTSIDE SLOPE | |
| 6 | 40.0 | 40.0 | 150.0 | 0.0 | 0.887 | 0.898 |
| 7 | 40.0 | 40.0 | 165.0 | 0.0 | ,CIRCLE OUTSIDE SLOPE | |
| 8 | 40.0 | 35.0 | 160.0 | 5.0 | ,CIRCLE OUTSIDE SLOPE | |
| 9 | 40.0 | 40.0 | 155.0 | 0.0 | 0.801 | 0.854 |
| 10 | 40.0 | 45.0 | 160.0 | -5.0 | 0.745 | 0.828 |
| 11 | 40.0 | 35.0 | 165.0 | 5.0 | ,CIRCLE OUTSIDE SLOPE | |
| 12 | 40.0 | 35.0 | 155.0 | 5.0 | 0.780 | 0.844 |
| 13 | 40.0 | 45.0 | 155.0 | -5.0 | 0.819 | 0.864 |
| 14 | 40.0 | 45.0 | 165.0 | -5.0 | ,CIRCLE OUTSIDE SLOPE | |

.S. MINIMUM= 0.720 FOR THE CIRCLE OF CENTER ( 160.0, 0.0)

OIL DIKE - CASE 1 - STATIC CONDITIONS, PHI = 42

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 6 |
| NUMBER OF SOIL LAYER BOUNDARIES | 4 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

EISMIC COEFFICIENT S1,S2 = 0.00 0.00

EARCH STARTS AT CENTER ( 160.0, -10.0),WITH FINAL GRID OF 5.0

LL CIRCLES TANGENT TO DEPTH, 40.0,

EOMETRY

| SECTIONS | 0.0 | 96.0 | 106.0 | 120.0 | 146.0 | 300.0 |
|---|---|---|---|---|---|---|
| T. CRACKS | 40.0 | 8.0 | 8.0 | 19.0 | 40.0 | 40.0 |
| W IN CRACK | 40.0 | 8.0 | 8.0 | 19.0 | 40.0 | 40.0 |
| BOUNDARY 1 | 40.0 | 8.0 | 8.0 | 19.0 | 40.0 | 40.0 |
| BOUNDARY 2 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| BOUNDARY 3 | 40.0 | 40.0 | 40.0 | 68.0 | 100.0 | 100.0 |
| BOUNDARY 4 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

OIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 42.0 | 120.0 |
| 2 | 0.0 | 30.0 | 85.0 |
| 3 | 0.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

SOIL DIKE - CASE 1 - STATIC CONDITIONS, PHI = 42

| UMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 40.0 | 50.0 | 160.0 | -10.0 | 1.184 | 1.150 |
| 2 | 40.0 | 50.0 | 170.0 | -10.0 | ,CIRCLE OUTSIDE SLOPE | |
| 3 | 40.0 | 40.0 | 160.0 | 0.0 | 1.117 | 1.116 |
| 4 | 40.0 | 40.0 | 170.0 | 0.0 | ,CIRCLE OUTSIDE SLOPE | |
| 5 | 40.0 | 30.0 | 160.0 | 10.0 | ,CIRCLE OUTSIDE SLOPE | |
| 6 | 40.0 | 40.0 | 150.0 | 0.0 | 1.368 | 1.250 |
| 7 | 40.0 | 40.0 | 165.0 | 0.0 | ,CIRCLE OUTSIDE SLOPE | |
| 8 | 40.0 | 35.0 | 160.0 | 5.0 | ,CIRCLE OUTSIDE SLOPE | |
| 9 | 40.0 | 40.0 | 155.0 | 0.0 | 1.237 | 1.177 |
| 10 | 40.0 | 45.0 | 160.0 | -5.0 | 1.154 | 1.134 |
| 11 | 40.0 | 35.0 | 165.0 | 5.0 | ,CIRCLE OUTSIDE SLOPE | |
| 12 | 40.0 | 35.0 | 155.0 | 5.0 | 1.205 | 1.161 |
| 13 | 40.0 | 45.0 | 155.0 | -5.0 | 1.264 | 1.193 |
| 14 | 40.0 | 45.0 | 165.0 | -5.0 | ,CIRCLE OUTSIDE SLOPE | |

.S. MINIMUM= 1.117 FOR THE CIRCLE OF CENTER ( 160.0,  0.0)

OIL DIKE - CASE 1 - DYNAMIC CONDITIONS, PHI = 42

ONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 6 |
| NUMBER OF SOIL LAYER BOUNDARIES | 4 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

EARCH STARTS AT CENTER ( 160.0, -10.0),WITH FINAL GRID OF 5.0

LL CIRCLES TANGENT TO DEPTH, 40.0,

EOMETRY

| SECTIONS | 0.0 | 96.0 | 106.0 | 120.0 | 146.0 | 300.0 |
|---|---|---|---|---|---|---|
| T. CRACKS | 40.0 | 8.0 | 8.0 | 19.0 | 40.0 | 40.0 |
| W IN CRACK | 40.0 | 8.0 | 8.0 | 19.0 | 40.0 | 40.0 |
| BOUNDARY 1 | 40.0 | 8.0 | 8.0 | 19.0 | 40.0 | 40.0 |
| BOUNDARY 2 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| BOUNDARY 3 | 40.0 | 40.0 | 40.0 | 68.0 | 100.0 | 100.0 |
| BOUNDARY 4 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

OIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 42.0 | 120.0 |
| 2 | 0.0 | 30.0 | 85.0 |
| 3 | 0.0 | 35.0 | 120.0 |

ORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

SOIL DIKE - CASE 1 - DYNAMIC CONDITIONS, PHI = 42

| UMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 40.0 | 50.0 | 160.0 | -10.0 | 0.882 | 0.965 |
| 2 | 40.0 | 50.0 | 170.0 | -10.0 | ,CIRCLE OUTSIDE SLOPE | |
| 3 | 40.0 | 40.0 | 160.0 | 0.0 | 0.829 | 0.941 |
| 4 | 40.0 | 40.0 | 170.0 | 0.0 | ,CIRCLE OUTSIDE SLOPE | |
| 5 | 40.0 | 30.0 | 160.0 | 10.0 | ,CIRCLE OUTSIDE SLOPE | |
| 6 | 40.0 | 40.0 | 150.0 | 0.0 | 1.022 | 1.034 |
| 7 | 40.0 | 40.0 | 165.0 | 0.0 | ,CIRCLE OUTSIDE SLOPE | |
| 8 | 40.0 | 35.0 | 160.0 | 5.0 | ,CIRCLE OUTSIDE SLOPE | |
| 9 | 40.0 | 40.0 | 155.0 | 0.0 | 0.923 | 0.984 |
| 10 | 40.0 | 45.0 | 160.0 | -5.0 | 0.858 | 0.954 |
| 11 | 40.0 | 35.0 | 165.0 | 5.0 | ,CIRCLE OUTSIDE SLOPE | |
| 12 | 40.0 | 35.0 | 155.0 | 5.0 | 0.898 | 0.973 |
| 13 | 40.0 | 45.0 | 155.0 | -5.0 | 0.943 | 0.995 |
| 14 | 40.0 | 45.0 | 165.0 | -5.0 | ,CIRCLE OUTSIDE SLOPE | |

.S. MINIMUM= 0.829 FOR THE CIRCLE OF CENTER ( 160.0, 0.0)

SOIL DIKE - CASE 2 - STATIC CONDITIONS, PHI = 38, WITH 10' OF WASTE

CONTROL DATA

NUMBER OF SPECIFIED CENTERS 0
NUMBER OF DEPTH LIMITING TANGENTS 1
NUMBER OF VERTICAL SECTIONS 1

BISHOP MODIFIED,LEFEBVRE 1971

SOIL DIKE - CASE 2 - STATIC CONDITIONS, PHI = 38, WITH 10' OF WASTE

CONTROL DATA

NUMBER OF SPECIFIED CENTERS 0
NUMBER OF DEPTH LIMITING TANGENTS 1
NUMBER OF VERTICAL SECTIONS 7
NUMBER OF SOIL LAYER BOUNDARIES 5
NUMBER OF PORE PRESSURE LINES -1
NUMBER OF POINTS DEFINING COHESION PROFILE 0

SEISMIC COEFFICIENT S1,S2 = 0.00 0.00

SEARCH STARTS AT CENTER ( 140.0, -10.0),WITH FINAL GRID OF 2.5

ALL CIRCLES TANGENT TO DEPTH, 40.0,

GEOMETRY

| SECTIONS | 0.0 | 96.0 | 106.0 | 120.0 | 134.0 | 146.0 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 40.0 | 8.0 | 8.0 | 19.0 | 30.0 | 30.0 | 30.0 |
| W IN CRACK | 40.0 | 8.0 | 8.0 | 19.0 | 30.0 | 30.0 | 30.0 |
| BOUNDARY 1 | 40.0 | 8.0 | 8.0 | 19.0 | 30.0 | 30.0 | 30.0 |
| BOUNDARY 2 | 40.0 | 8.0 | 8.0 | 19.0 | 30.0 | 40.0 | 40.0 |
| BOUNDARY 3 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| BOUNDARY 4 | 40.0 | 40.0 | 40.0 | 68.0 | 90.0 | 100.0 | 100.0 |
| BOUNDARY 5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 30.0 | 85.0 |
| 2 | 0.0 | 38.0 | 120.0 |
| 3 | 0.0 | 30.0 | 85.0 |
| 4 | 0.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

BISHOP MODIFIED,LEFEBVRE 1971

OIL DIKE - CASE 2 - STATIC CONDITIONS, PHI = 38, WITH 10' OF WASTE

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 40.0 | 50.0 | 140.0 | -10.0 | 2.272 | 1.922 |
| 2 | 40.0 | 50.0 | 145.0 | -10.0 | 2.333 | 1.932 |
| 3 | 40.0 | 45.0 | 140.0 | -5.0 | 2.264 | 1.865 |
| 4 | 40.0 | 45.0 | 142.5 | -5.0 | 2.307 | 1.881 |
| 5 | 40.0 | 42.5 | 140.0 | -2.5 | 2.276 | 1.848 |
| 6 | 40.0 | 45.0 | 137.5 | -5.0 | 2.260 | 1.882 |
| 7 | 40.0 | 42.5 | 137.5 | -2.5 | 2.258 | 1.853 |
| 8 | 40.0 | 42.5 | 140.0 | -2.5 | 2.276 | 1.848 |
| 9 | 40.0 | 40.0 | 137.5 | 0.0 | 2.267 | 1.832 |
| 10 | 40.0 | 42.5 | 135.0 | -2.5 | 2.276 | 1.887 |
| 11 | 40.0 | 40.0 | 140.0 | 0.0 | 2.305 | 1.842 |
| 12 | 40.0 | 40.0 | 135.0 | 0.0 | 2.271 | 1.854 |
| 13 | 40.0 | 45.0 | 135.0 | -5.0 | 2.294 | 1.930 |
| 14 | 40.0 | 45.0 | 140.0 | -5.0 | 2.264 | 1.865 |

F.S. MINIMUM= 2.258 FOR THE CIRCLE OF CENTER ( 137.5, -2.5)

SOIL DIKE - CASE 2 - DYNAMIC CONDITIONS, PHI = 38, WITH 10' OF WASTE

CONTROL DATA

| | |
|---|---|
| NUMBER OF SPECIFIED CENTERS | 0 |
| NUMBER OF DEPTH LIMITING TANGENTS | 1 |
| NUMBER OF VERTICAL SECTIONS | 7 |
| NUMBER OF SOIL LAYER BOUNDARIES | 5 |
| NUMBER OF PORE PRESSURE LINES | -1 |
| NUMBER OF POINTS DEFINING COHESION PROFILE | 0 |

SEISMIC COEFFICIENT S1,S2 = 0.15 0.00

SEARCH STARTS AT CENTER ( 160.0, -10.0),WITH FINAL GRID OF 5.0

ALL CIRCLES TANGENT TO DEPTH, 40.0,

GEOMETRY

| SECTIONS | 0.0 | 96.0 | 106.0 | 120.0 | 134.0 | 146.0 | 300.0 |
|---|---|---|---|---|---|---|---|
| T. CRACKS | 40.0 | 8.0 | 8.0 | 19.0 | 30.0 | 30.0 | 30.0 |
| W IN CRACK | 40.0 | 8.0 | 8.0 | 19.0 | 30.0 | 30.0 | 30.0 |
| BOUNDARY 1 | 40.0 | 8.0 | 8.0 | 19.0 | 30.0 | 30.0 | 30.0 |
| BOUNDARY 2 | 40.0 | 8.0 | 8.0 | 19.0 | 30.0 | 40.0 | 40.0 |
| BOUNDARY 3 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 | 40.0 |
| BOUNDARY 4 | 40.0 | 40.0 | 40.0 | 68.0 | 90.0 | 100.0 | 100.0 |
| BOUNDARY 5 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

SOIL PROPERTIES

| LAYER | COHESION | FRICTION ANGLE | DENSITY |
|---|---|---|---|
| 1 | 0.0 | 30.0 | 85.0 |
| 2 | 0.0 | 38.0 | 120.0 |
| 3 | 0.0 | 30.0 | 85.0 |
| 4 | 0.0 | 35.0 | 120.0 |

PORE PRESSURE SPECIFIED WITH THE RU FACTOR

RU=0.000

SOIL DIKE - CASE 2 - DYNAMIC CONDITIONS, PHI = 38, WITH 10' OF WASTE

| NUMBER | TANGENT | RADIUS | (X) CENTER | (Y) CENTER | FS(BISHOP) | FS(OMS) |
|---|---|---|---|---|---|---|
| 1 | 40.0 | 50.0 | 160.0 | -10.0 | 3.023 | 2.681 |
| 2 | 40.0 | 50.0 | 170.0 | -10.0 | 4.180 | 3.848 |
| 3 | 40.0 | 40.0 | 160.0 | 0.0 | 4.245 | 3.820 |
| 4 | 40.0 | 50.0 | 150.0 | -10.0 | 1.717 | 1.474 |
| 5 | 40.0 | 40.0 | 150.0 | 0.0 | 2.069 | 1.735 |
| 6 | 40.0 | 50.0 | 140.0 | -10.0 | 1.554 | 1.389 |
| 7 | 40.0 | 40.0 | 140.0 | 0.0 | 1.590 | 1.345 |
| 8 | 40.0 | 50.0 | 130.0 | -10.0 | 1.692 | 1.554 |
| 9 | 40.0 | 60.0 | 140.0 | -20.0 | 1.595 | 1.480 |
| 10 | 40.0 | 50.0 | 145.0 | -10.0 | 1.581 | 1.385 |
| 11 | 40.0 | 45.0 | 140.0 | -5.0 | 1.558 | 1.359 |
| 12 | 40.0 | 50.0 | 135.0 | -10.0 | 1.597 | 1.451 |
| 13 | 40.0 | 55.0 | 140.0 | -15.0 | 1.569 | 1.432 |
| 14 | 40.0 | 45.0 | 145.0 | -5.0 | 1.626 | 1.388 |
| 15 | 40.0 | 45.0 | 135.0 | -5.0 | 1.576 | 1.399 |
| 16 | 40.0 | 55.0 | 135.0 | -15.0 | 1.629 | 1.507 |
| 17 | 40.0 | 55.0 | 145.0 | -15.0 | 1.565 | 1.402 |

F.S. MINIMUM= 1.554 FOR THE CIRCLE OF CENTER ( 140.0, -10.0)

*Geotechnical Investigation in Support of Trench 13 Construction - September 2015*

# DISPOSAL TRENCH 13
# SUBSURFACE EXPLORATION AND TESTING REPORT

**US Ecology Nevada, Inc.**
**Hazardous Waste Management Facility**
**Beatty, Nevada**

USEPA ID #NVT330010000
Nevada Hazardous Waste Treatment, Storage and Disposal
Permit NEV HW0025

**Prepared for**

US ecology

**Prepared by**

AquAeTer

**with Assistance from**

SWIFT RIVER
ENVIRONMENTAL SERVICES, LLC

**October 2015**

PROFESSIONAL ENGINEER-STATE OF NEVADA
STEPHEN L. WAMPLER
EXP 6/30/16
CIVIL
No 13641

19 OCT 2015

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# 1 INTRODUCTION

This report presents the results of the subsurface exploration and geotechnical laboratory testing conducted for the planned Trench 13 at the US Ecology Nevada (USEN) facility near Beatty in Nye County, Nevada. The new disposal trench is to be located south of the active disposal and support areas on a portion of the 400-acre tract recently transferred by the BLM to the State of Nevada. This exploration was planned and performed during September 2015 by personnel representing **AquAeTer, Inc**. and **Swift River Environmental Services, LLC**. In addition, specialized services including excavation, drilling, and laboratory testing were performed by USEN personnel and subcontractors engaged by **AquAeTer**.

**Figure 1** shows the project site and the locations where subsurface data were collected.

## 1.1 PURPOSE AND SCOPE OF WORK

The subsurface exploration and geotechnical laboratory testing was performed in support of design activities for Disposal Trench 13, and to supplement subsurface and physical properties data obtained by previous subsurface drilling done at the USEN facility near proposed Trench 13, including drilling and geotechnical testing done prior to and during the construction of Disposal Trench 12.

The scope of the Trench 13 subsurface exploration included soil sampling, laboratory testing, and preparation of this report. Subsurface materials were exposed, described, and sampled from four test pits and two soil borings. Geotechnical laboratory testing was done on samples collected from each test pit and boring.

## 1.2 PROJECT DESCRIPTION

Disposal Trench 13 is planned as the next waste disposal unit on property leased by USEN from the State of Nevada. Trench 13 is planned as a RCRA Subtitle C land disposal unit with the capacity (and authorization) to also accept Toxic Substances Control Act (TSCA)-regulated wastes. The construction of the Trench requires excavation to the trench design depth of approximately 75 feet below ground surface. Slope stability of the trench sidewalls is critical from a constructability and safety issue. Subsurface soil types present at Trench

13 are expected to be similar to those known to be present across the USEN facility and specifically within previous disposal cell excavations. Accordingly, the stratigraphic and lithologic character of site-wide subsurface materials, as well as the physical properties of those materials, are important for consideration in Trench 13 design. The present Trench 13 subsurface exploration effort was intended to confirm the similarity of Trench 13 subsurface materials to those materials present elsewhere on the property and to provide site-specific information for consideration in design.

Previous disposal cell excavations on the site document the presence of a surface soil layer of loose, unconsolidated (non-cemented) soil overlying dense, consolidated (cemented or tightly bound) material that forms the majority of the excavated disposal trench walls. This loose soil, also characterized as low cohesion or cohesionless, typically has been removed and then replaced with compacted native soil during construction activities. The test pits done for this subsurface exploration were excavated to confirm the presence and physical characteristics of this material and the depth of the boundary between the surficial layer and underlying consolidated material, and to gather samples for determination of moisture-density relationship (i.e., compaction properties) and shear strength.

Previous drilling near the Trench 13 location documents the presence of predominantly coarse-grained materials to depths exceeding the design maximum depth (75 feet) of Trench 13. Borings drilled for the Trench 13 subsurface exploration were made to document the characteristics of the subsurface materials that will be exposed in the Trench 13 excavation, particularly with regard to excavation wall stability.

## 1.3 SITE DESCRIPTION

The USEN facility is approximately 11 miles south of Beatty, in Nye County, Nevada on the west side of US 95. The USEN facility is a rectangular-shaped parcel that, including the lease of State of Nevada property recently transferred from BLM, has a total area of approximately 440 acres. Disposal Trench 13 will occupy a 47.3 acre portion of the property south of the existing US Ecology waste treatment and disposal areas.

The Trench 13 location is bounded by BLM land to the south and east; the existing US Ecology waste treatment and disposal site to the north, and the 40-acre USGS research area to the west. At the time of this geotechnical investigation, the Trench 13 footprint was undisturbed land with sparse native desert vegetation and some minor ephemeral washes. The project location is shown on **Figure 1**.

# 2 SITE CONDITIONS

## 2.1 GEOLOGY

The USEN Facility is located in the Amargosa Desert basin which was formed by normal block faulting, which displaced the surrounding strata upward with respect to the crustal block underlying the valley. This widespread structural process formed the characteristic topography of the entire Basin and Range province. Erosion of the uplifted areas, during and after their displacement, has filled the basin with a variety of sedimentary deposits. These deposits reach a depth of about 1,000 feet in the center of the basin near Lathrop Wells.

The sediments of the valley floor are loose to partly indurated and Tertiary to Quaternary in age. Deposited as alluvial fans, debris flows, streambeds, dunes, and lake or marsh beds, they exhibit a very, wide range of shapes and grain-size distributions. The mineralogy of the sediments varies widely as well, reflecting the diversity of their source rocks.

Details on the nature of the unconsolidated strata beneath the facility have been determined from the various borings and well installations, which have been made since 1961. Hydrogeologic investigations have been conducted at the site to determine the near-surface and subsurface soil properties and hydrologic characteristics.

Stratigraphic information derived from the site characterization and monitoring well installation programs for the USEN facility describe a sequence of deposits consistent with alluvial fan and playa depositional processes. Deposits from the ground surface to a depth of approximately 300 feet beneath the USEN facility are alluvial in nature. The alluvial sediments are predominantly gravelly sands with poorly sorted gravel or sand deposits which occur in discontinuous intervals. The gravelly sand extends deeper (approximately 350 feet below ground surface) beneath the southwestern portion of the facility.

## 2.2 STRATIGRAPHY

Based on the subsurface field observations and examinations of soil samples in the laboratory, the subsurface materials encountered in the Trench 13 area, as well as the remainder of the facility property, consist of coarse granular soils. The native granular soils

encountered were classified as silty sand and poorly graded sand with silt and gravel with occasional zones of cemented soil. The relative density of the granular materials was generally loose in the upper five feet beneath the USEN facility, including Trench 13 borings and test pits, becoming medium dense to very dense with depth.

In Trench 13 borings, a hard indurated soil layer was identified at a depth of about 65 to 75 feet bgs. A detailed description of subsurface conditions encountered is provided on the boring logs B-1 and B-2 in **Appendix A**. Subsurface material cross sections derived from past investigations is included in **Appendix B**.

## 2.3 GROUNDWATER

Groundwater is present beneath the USEN facility in two deep zones, termed the upper and lower zones. Because of the shallow depth of the Trench 13 exploration, reflecting the Trench 13 design depth, neither groundwater zone is relevant to this investigation.

The upper zone groundwater monitoring wells nearest the Trench investigation area are MW-327, MW-315A, MW-311, MW-317 and MW-309. These wells are located along the southern boundary of the active facility. The depth to groundwater in these locations typically is greater than 300 ft bgs. Upper zone groundwater potentiometric maps developed for the site and presented in other reports show the predominant flow direction is southward (ranging from southwestward to southeastward) toward the Amargosa River at the valley center. A minor groundwater flow divide crosses the facility and the flow direction beneath the areas of Trenches 1 through 10, 11, and future Trench 13 has a slightly more southeastward component.

No sign of perched water or groundwater was encountered during the Trench 13 exploration in borings or test pits.

# 3 SITE INVESTIGATION

## 3.1 BOREHOLE EXPLORATION

Subsurface conditions were investigated by drilling two (2) exploratory borings (B-1 and B-2) on September 9, 10, and 11 at the locations shown in **Figure 1**. Each boring was planned to be drilled to a depth of about 100 feet below ground surface (ft bgs). **AquAeTer** subcontracted Eagle Drilling, of Las Vegas Nevada, to advance the borings. The borings were advanced to depths of approximately 96.5 feet and 65 ft bgs, respectively, using hollow-stem, continuous flight augers. The augers were 8-inch outside diameter, with a 4.5-inch inner diameter, and were "hard faced" on the flight edges with welding material to facilitate drilling. Boring B-1 was advanced using a Mobile B90 drill rig. The B90 rig had a mechanical failure at the termination depth of boring B-1 on September 9, so a Diedrich D120 drill rig was brought in to advance boring B-2. Drilling started on boring B-2 on September 10, and drilling ceased when the drill rig met refusal at 65 ft bgs on September 11.

Borehole drilling were performed under the observation of an **AquAeTer** and/or **Swift River** representative, who visually observed the site, maintained a written record of each boring, visually described the soils encountered, and selected soil samples for laboratory testing.

Soil samples were taken every five feet for classification using a standard 2-inch outer diameter, 18-inch long split-tube sampler. Additional samples were obtained every 25 feet with a modified California split-barrel sampler with four 6-inch long stainless steel liners. The modified California sampler was 3-inch outer diameter and 24 inches long. The soil sampler was driven into the soil using an automatic 140-pound hammer with a free fall of 30-inches. The penetration resistance (hammer blows) of the sampler was recorded for use in evaluate the consistency and/or relative density of the soil encountered. Penetration resistance values were recorded on field data logs as the number of blows required to advance the standard sampler through three successive intervals of 6 inches. The standard penetration test (SPT) value was recorded as the number of blows required to advance the standard sampler 12 inches, typically the sum of blows required to advance the sampler through the second and third 6-inch intervals. This "blows per foot" value is the standard

penetration value or "N-value". Where soil materials are very dense, the test was concluded after less than 18 inches of penetration. In such instances, the "N-value" is recorded as blows for the first 12 inches penetration, 100 blows for less than 12 inches penetration, or 50 blows for less than 6-inches penetration. The soil samples recovered were visually described and classified in the field and through further examination in the laboratory in general accordance with the Unified Soils Classification System.

Lithologic records for the two borings, including SPT values, are included in **Appendix A**. Photographs taken during drilling are included in **Appendix C**.

## 3.2 STANDARD PENETRATION TEST RESULTS

SPTs were done on 5.0 feet intervals in each of the two borings. **Figure 8** shows SPT values in both borings increasing from lower values associated with surface and shallow soil to high values in the lower portions of both borings. SPT values increasing with depth correlate well with the increase in shear strength with depth considered in the evaluation of the stability of excavation sidewalls while unsupported by disposed waste.

## 3.3 LABORATORY TESTING OF BORING SAMPLES

Laboratory tests were conducted on the California barrel samples collected from each of the boreholes to determine pertinent physical and engineering properties. Samples were submitted to Geotechnical & Environmental Services, Inc. of Las Vegas, Nevada (GES) for testing. Samples submitted to the laboratory were collected from:

- Boring B-1: Depths at 25, 50, and 75 ft bgs; and
- Boring B-2: Depths at 30, 50, and 65 ft bgs.

These tests included particle size distribution, density, and moisture content. Test results are provided in **Appendix D**.

## 3.4 TEST PIT EXPLORATION

Four test pits were excavated with an excavator to allow shallow subsurface materials to be observed, described, and sampled. The test pits were located at the approximate midpoints of the Trench 13 horizontal control line on north, south, east, and west sides of the trench

footprint, a short distance inside the proposed excavation footprint. The locations were marked by survey prior to excavation; the locations are shown on **Figure 1**.

The test pits were excavated to allow samples to be collected for laboratory testing. The test pit was sized to allow visual observation and description of the soil horizons exposed. The pits were excavated to approximately 20 feet by 6 feet horizontal area, and stepped on one end to allow safe access. Additionally, to allow for test pit soil observations, no trench box or other shielding was used. The test pits were excavated with one of the side walls laid back to allow for the safety of the observers in the pit.

The backhoe operator excavated the pits until a significant change in excavation resistance was identified. Once the pits were excavated, a tape measure was lowered from the ground surface to the deepest portion of the pit to measure maximum pit depth. Next, the test pit walls were examined for the contact between the unconsolidated surface material and underlying consolidated material. Visual observation and resistance to excavation with a hand shovel was used to estimate the contact location. The unconsolidated material raveled easily, while the consolidated material was very hard, did not ravel easily, and was resistant to penetration.

Bulk samples were collected with the hand shovel. The unconsolidated sample was easier to collect, removing material from one of the upper access benches into the pit. The consolidated material was more difficult to collect, and was performed by chipping material out from the wall into the bucket. Care was taken to limit the amount of surface material entering the consolidated sample container.

Photographs taken during pit investigation are included in **Appendix E**.

## 3.5 LABORATORY TESTING OF TEST PIT SAMPLES

Laboratory tests were conducted on samples considered representative for the purpose of classification and to determine pertinent physical and engineering properties. The two general soil types exposed in each test pit were sampled. Each bulk sample was comprised of two 5-gallon pails. The samples were numbered and labeled with the general material

type (unconsolidated and consolidated), date and time of sampling, and test pit number for a total of 8 samples. The samples were submitted to GES for testing. These tests included particle-size distribution, moisture-density relationship, and direct shear.

**Table 2** provides the results of laboratory testing of surface and shallow soil. Laboratory analyses results from test pit samples are provided in **Appendix F**.

# 4 LABORATORY ANALYSES

## 4.1 BORING SAMPLE PROPERTIES

Six soil samples were collected from the two borings using a modified California split –barrel sampler with 6" stainless steel liners. Filled sample liners from each sample were capped, taped, and stored in a sealed plastic bag until delivery to the laboratory for analysis.

The physical properties determined by laboratory testing are summarized in **Table 1**. The samples from both borings show a decrease in density and increase in moisture content with depth. These relationships are illustrated in **Figures 2** and **3**.

Grain-size distribution also can be correlated with depth. A relationship is observed of increasing sand and fines with depth and a decreasing percentage of gravel with depth. Graphs of the percentage of materials in the samples were developed for Borings 1 and 2, and are shown in **Figures 4** and **5**, respectively. Boring 1 indicates a higher percentage of gravel in the shallowest sample collected at 25 feet than the sample collected five feet lower at 30 feet from Boring 2.

Both sample borings identified a hard, cemented layer at about 65 feet bgs. Boring 2 was terminated at this depth because of drilling refusal (i.e., deeper penetration by augering was not possible). The deepest sample from Boring 2 had the greatest amount of fines in any of the six samples collected from the borings. Test results for the soil boring samples are presented in **Appendix D**.

Although a gradation correlation with depth is suggested by these analyses results, it is important to recognize that samples tested were separated by 25 vertical feet and gradation variations occurring within the interval between samples would not be recognized. Gradation sequences representing changes in depositional environment have been identified by geologic description of USEN trench walls in the past. "Fining upward" sequences with varying vertical dimensions have been documented by sidewall mapping.

Several sequences of very coarse-grained basal materials capped by successively finer materials have been observed in USEN trench walls.[1]

## 4.2 TEST PIT SAMPLE PROPERTIES

The test pits were excavated to determine shallow stratigraphy including the thickness and physical properties of the natural low-cohesion surface soil layer. The objective of laboratory testing was to provide site-specific physical properties for the surface soil layer that will result from using compacted soil to replace the low-cohesion native soil and construct the leveling berm that will form the uppermost part of Trench 13 sidewalls.

The laboratory results for Trench 13 test pits are reasonably consistent with data collected previously for Trench 12. The material observed and sampled from the four pits were grouped into two general classes:

- "unconsolidated" (meaning the cohesionless or low-cohesion surface soil) and
- "consolidated" (indicating the indurated soil beneath the low -cohesion layer).

**Figure 6** shows the shear strength values for recompacted samples made from the two material types in the four pits.

Soil samples tested from Trench 13 geotechnical investigation test pits were identified as "unconsolidated" and "consolidated". Eight samples were tested, one from each of these soil types from each of four test pits. The following tests were done.

- Grain-size analyses & soil classification – ASTM D422 & D2487
- Moisture-density relationship – ASTM D1557 (also called Modified Proctor)
- Direct shear – ASTM D3080

Moisture-density testing determined the compaction criteria to be used for replacement of surface soil and berm construction. For the direct shear testing, the test specimens were prepared to satisfy these compaction criteria. Test specimens were compacted at a dry density and moisture content intended to represent the condition of the replaced and

[1] U.S. Geological Survey, 2010, "Characterization of Geologic Deposits in the Vicinity of US Ecology, Amargosa Basin, Southern Nevada. USGS Scientific Investigations Report 2010-5134.

compacted surface soil. The target Maximum Dry Density (MDD) and Optimum Moisture Content (OMC), as determined by ASTM D1557, were 95% (min.) and OMC ± 2%[2].

Considering all of the test pit sample values to be representative of the mixed materials that will be used for the replaced and compacted surface soil layer, the average properties are:

Density = 125 PCF

Cohesive strength, C = 300 PSF

Angle of internal friction, phi = 35 degrees

The Trench 12 values are similar and could be considered together with the more recent Trench 13 test results resulting in a slightly lower density and slightly higher cohesion. However, Trench 13 slope stability analyses were done using the average of only the Trench 13 values. This shallow soil data from test pit sample testing is incorporated into Trench 13 design calculations of excavation stability.

Test results are presented in **Appendix E**.

## 4.3 SUMMARY

The lithologic boring records, grain-size analyses, and density evaluations for the two soil borings demonstrated consistency with past investigations performed for Trench 11 and 12, and in other investigative borings drilled for monitoring well installation. The soil samples collected from the two borings show a general reduction in grain size with depth. However, past geologic studies, and the boring logs from the two borings done for the Trench 13 exploration, show multiple sequences of fining upwards behavior, so it is likely just a coincidence that the samples selected for the laboratory analysis became consistently more fine-grained with depth.

---

[2] The dry densities of soil samples tested to determine cohesive strength were lower that 95% MDD. These values represent the densities before testing and higher 'as-tested' densities would have resulted from normal loads imposed to conduct direct shear testing. The as-tested densities more directly represent the 'as compacted' soil properties in the excavation sidewall.

The moderately cemented layer with increased fines that was identified at depths of about 65 to 75 feet bgs, near the design depth of the proposed Trench13, will serve as a good foundation for the trench bottom and bottom liner system.

The initial Trench 13 slope stability analyses considered the compacted surface soil layer replacing the "cohesionless" surface soil layer to be as much as 26 feet thick. This estimate of compacted soil layer thickness included 16 feet of unconsolidated material to be removed and replaced with compacted fill, and an additional 10 feet of compacted fill placed as the leveling berm. The test pit information suggests that the thickness of the unconsolidated material is less, at about five feet. The Trench 13 slope stability design calculations were revised to consider the thinner low-cohesion surface soil layer and the physical properties determined for Trench 13 samples. For conservatism in the design calculation, an excavation depth of 10 feet of soil was considered for replacement, with 10 feet of additional compacted fill forming the leveling berm for vertical grade control. Those analyses show the excavation sidewalls to remain stable under static and pseudo-static (earthquake) conditions.

In the shallow soil zones explored by test pits, the consolidated and unconsolidated shear strength and friction angle results are similar. It is essentially the same soil, with the unconsolidated layer typically having slightly more fines. This may be attributed to the natural accumulation of windblown fines in the surface soil. When excavated, mixed, and compacted with moisture added, both materials should work equally well as fill material. This similarity eliminates the need to segregate during excavation.

# 5 RECOMMENDATIONS

## 5.1 SITE CLEARING AND EXCAVATIONS

The unconsolidated material should be removed from the trench edge out to the design limit of the anchor trench and final cover. Prior to the Trench 13 excavation, surface grubbing should be performed to remove vegetation, organic material, debris, and other deleterious materials from the anchor trench areas and areas that will be below the Trench 13 cover extent. The excavation will be performed before trench excavation to avoid machinery working near the trench edge. The unconsolidated soils should be excavated to the depth of the consolidated material (to be determined by observation by quality control personnel) to remove the unsuitable deposits. Based on the test pit excavations, this depth will be about 5.0 ft bgs, but up to 10 feet has been examined under the stability calculations. The exposed consolidated soils should then be scarified to a depth of about 0.5 feet, moisture-conditioned and re-compacted in accordance with project specifications.

## 5.2 REWORKED SURFACE MATERIAL AND COMPACTION

Reworked surface material used for fill should be moisture conditioned as required, evenly spread on a horizontal plane in 12-inch thick loose lifts or lifts that do not exceed the maximum particle size and compacted to the following:

- Trench edge fill material and any structural fill locations should be compacted to a minimum 95 percent of maximum dry density and within 2 percent of optimum moisture content as determined by ASTM D1557.

Drainage diversion should be provided at the top of slopes to prevent water from flowing over the slope surface and into the unconsolidated material excavation, anchor trench and Trench 13 excavation.

## 5.3 SUBSURFACE EXCAVATION AND STABILITY

Based on materials encountered in the borings and test pits, excavations extending into the native soil deposits should not require excavation equipment different than has been used in other excavation on the USEN property. Specifically, some less well-cemented materials probably can be self-excavated by typical equipment (e.g., scrapers), but excavation of most

cemented or indurated materials will require equipment assists (e.g., scrapers pushed by bulldozers) and/or prior excavator ripping.

# 6 CONCLUSIONS

In general, the near surface native soils were found to be low strength, unconsolidated material with low expansion potential.

Based on our field and laboratory investigation, the near surface and subsurface materials in the Trench 13 location are similar to those identified elsewhere on the USEN property. The engineering properties of both the unconsolidated materials and consolidated materials are consistent with behavior exhibited during the construction of Trenches 11 and 12, but slightly weaker and thinner in extent. The excavation slope stability analyses were amended to incorporate the information determined through this subsurface exploration and testing.

## Table 1 Boring Sample Physical Data

| Boring | Depth (Ft BGS) | USCS | Gravel % | Sand % | Fines % | Dry Density (PCF) | Moisture Content % |
|---|---|---|---|---|---|---|---|
| B-1 | 25 | GW | 60 | 38 | 2 | 110.5 | 4.6 |
| B-1 | 50 | SW | 36 | 41 | 7 | 105.8 | 6.0 |
| B-1 | 75 | SW | 23 | 67 | 10 | 98.3 | 7.7 |
| B-2 | 30 | SW | 29 | 62 | 9 | 94.3 | 3.9 |
| B-2 | 50 | SM | 22 | 66 | 12 | 86.1 | 6.7 |
| B-2 | 65 | SM | 11 | 70 | 19 | 83.5 | 7.4 |

## Table 2 Surface Soil Replacement – Compaction Properties and Shear Strength

| Sample | Shear Strength (Cohesion) (PCF) | Phi Angle (degrees) | Maximum Dry Density (PCF) | Optimum Moisture Content ( %) | Specimen Dry Density (PCF) (as tested) | Specimen Dry Density (Percent MDD) (as tested) | Specimen Moisture Content (%) (as tested) | Gravel (%) | Sand (%) | Fines (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Unconsol 1 | 250 | 30.6 | 117.6 | 10.5 | 105.9 | 90.1% | 10.7 | 6.0 | 70.0 | 24.0 |
| Unconsol 2 | 550 | 34.0 | 120.7 | 10.6 | 109.3 | 90.6% | 10.4 | 20.0 | 67.0 | 13.0 |
| Unconsol 3 | 170 | 32.2 | 123.9 | 7.8 | 111.6 | 90.0% | 7.9 | 20.0 | 63.0 | 17.0 |
| Unconsol 4 | 270 | 30.1 | 127.0 | 7.7 | 114.7 | 90.3% | 7.5 | 19.0 | 63.0 | 18.0 |
| Consol 1 | 410 | 32.8 | 130.0 | 6.5 | 117.4 | 90.3% | 6.3 | 5.0 | 73.0 | 22.0 |
| Consol 2 | 310 | 37.6 | 125.8 | 8.2 | 116.4 | 92.5% | 7.5 | 25.0 | 68.8 | 6.2 |
| Consol 3 | 300 | 41.2 | 131.7 | 6.9 | 119.5 | 90.7% | 6.9 | 30.0 | 64.1 | 5.9 |
| Consol 4 | 150 | 40.6 | 124.5 | 6.0 | 113.0 | 90.8% | 6.1 | 42.0 | 55.8 | 2.2 |
| Averages: | | | | | | | | | | |
| All soil | 301 | 34.9 | 125.2 | 8.0 | 113.5 | 90.7% | -- | 20.9 | 65.6 | 13.5 |
| Unconsol | 285 | 34.2 | 124.0 | 8.0 | 112.2 | 90.4% | -- | 25.3 | 62.2 | 12.6 |
| Consol | 318 | 35.6 | 126.3 | 8.0 | 114.8 | 90.9% | -- | 16.5 | 69.0 | 14.5 |

## Figure 1 Site Map

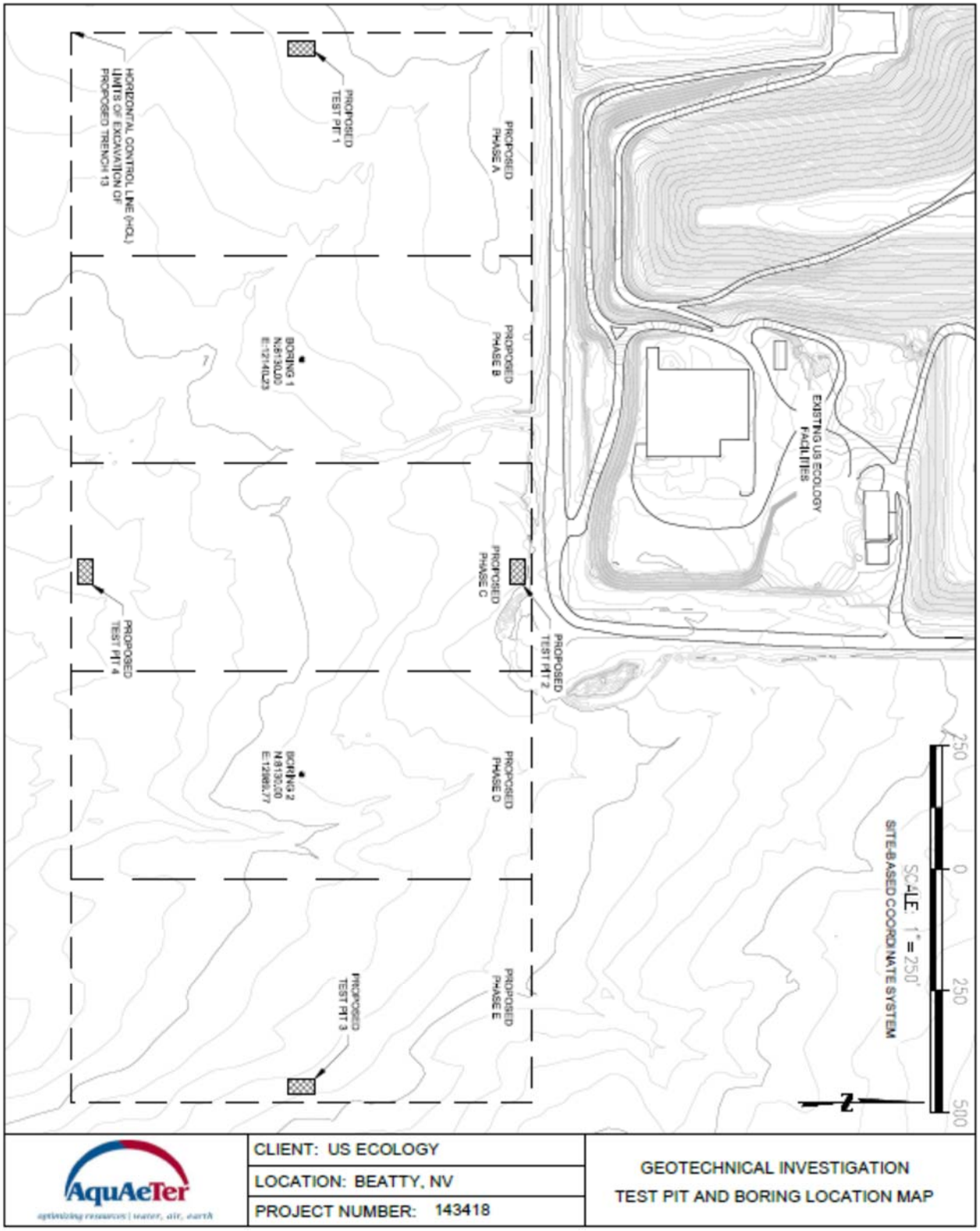


**Figure 2 Borings B-1 and B-2 Dry Density**

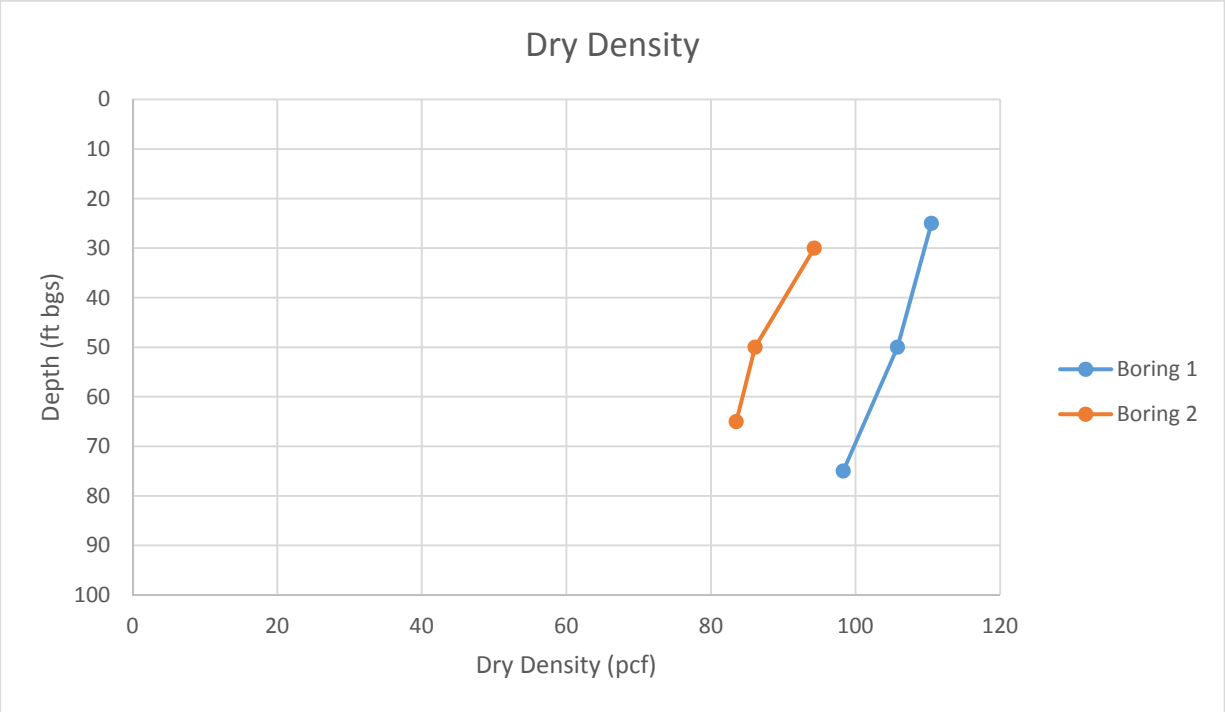



**Figure 3 Borings B-1 and B-2 Moisture Content**

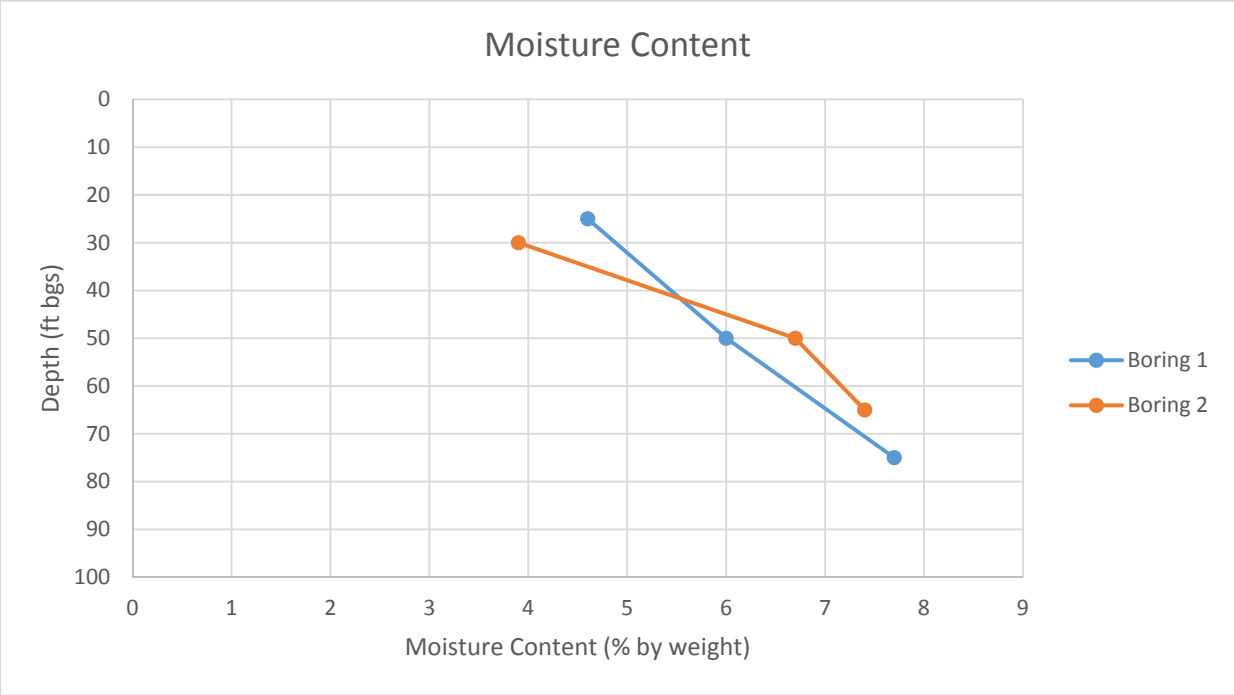


**Figure 4 Boring B-1: Grain Size Percentage**

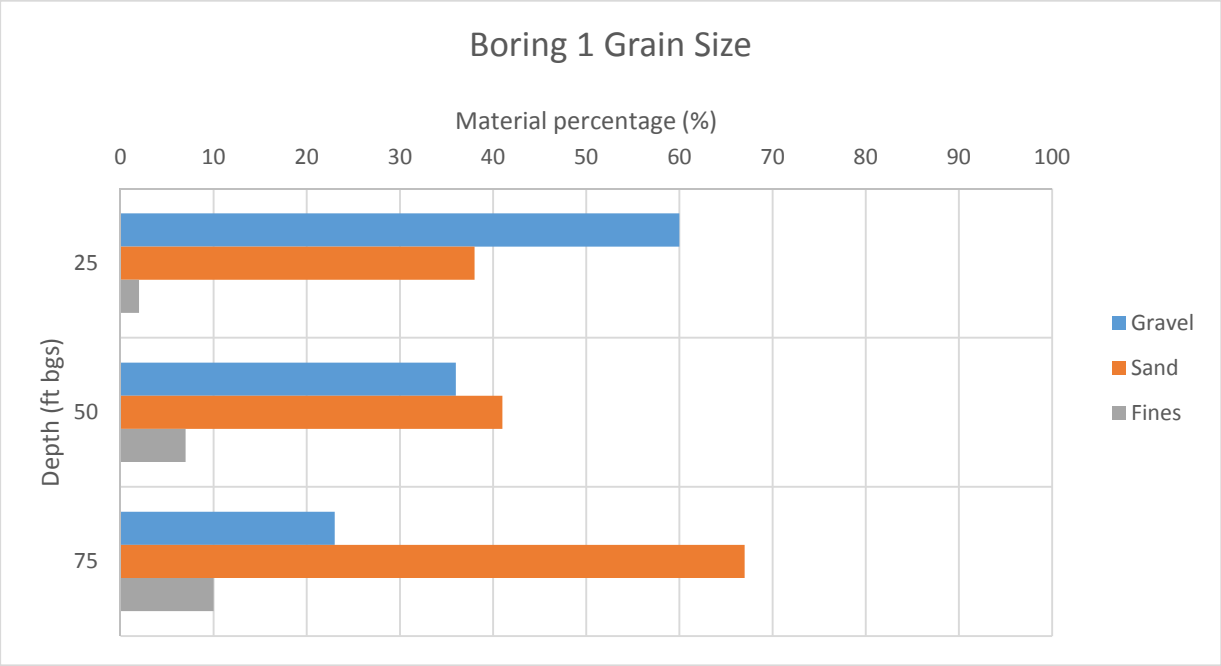



**Figure 5 Boring B-2: Grain Size Percentage**

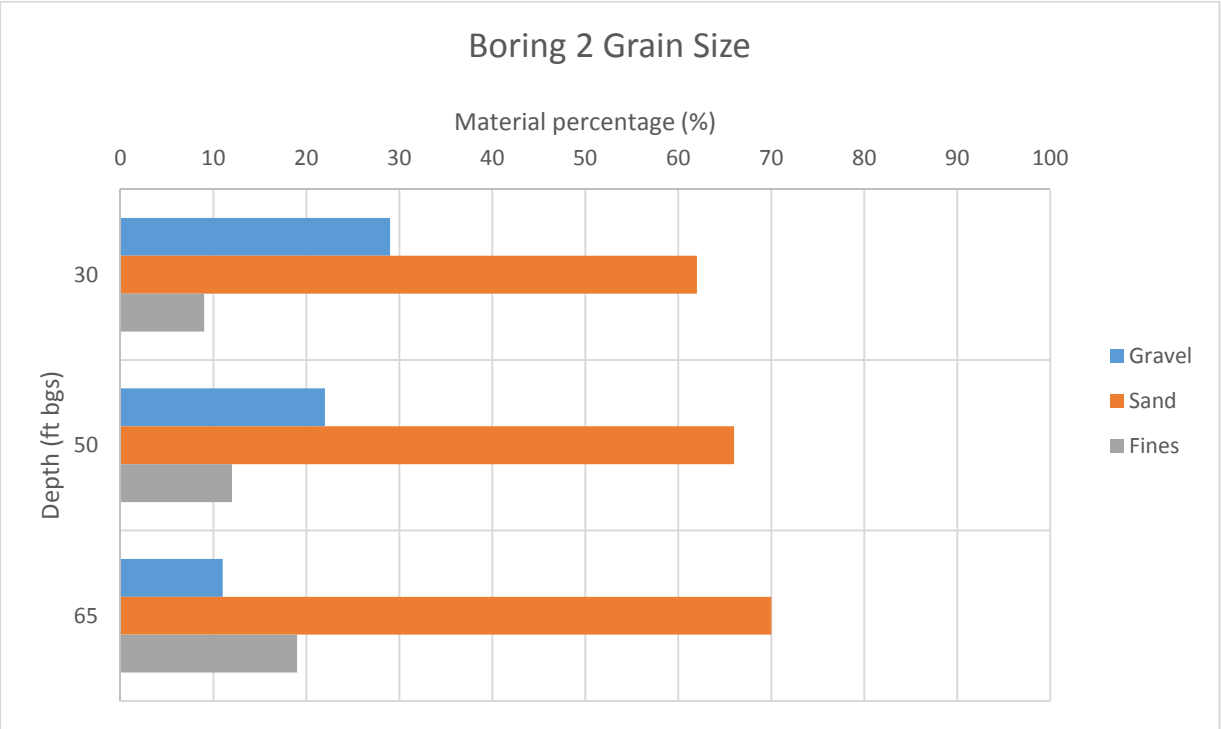


**Figure 6 Recompacted Shallow Soil Shear Strength**

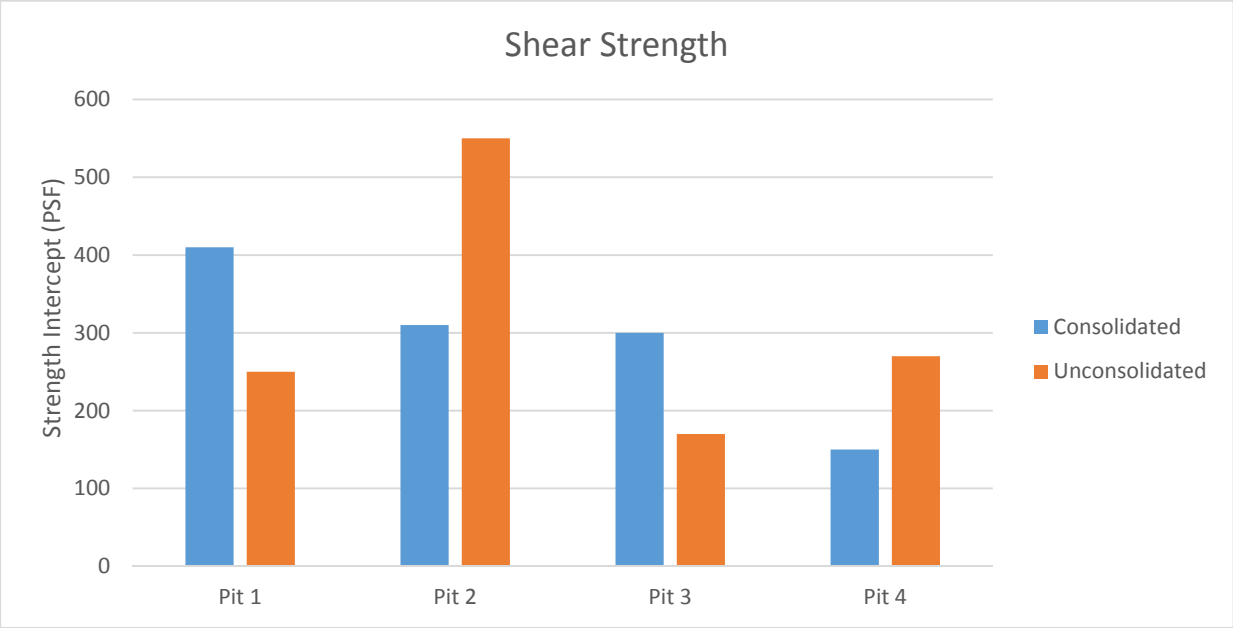



**Figure 7 Recompacted Surface Soil Friction Angle**

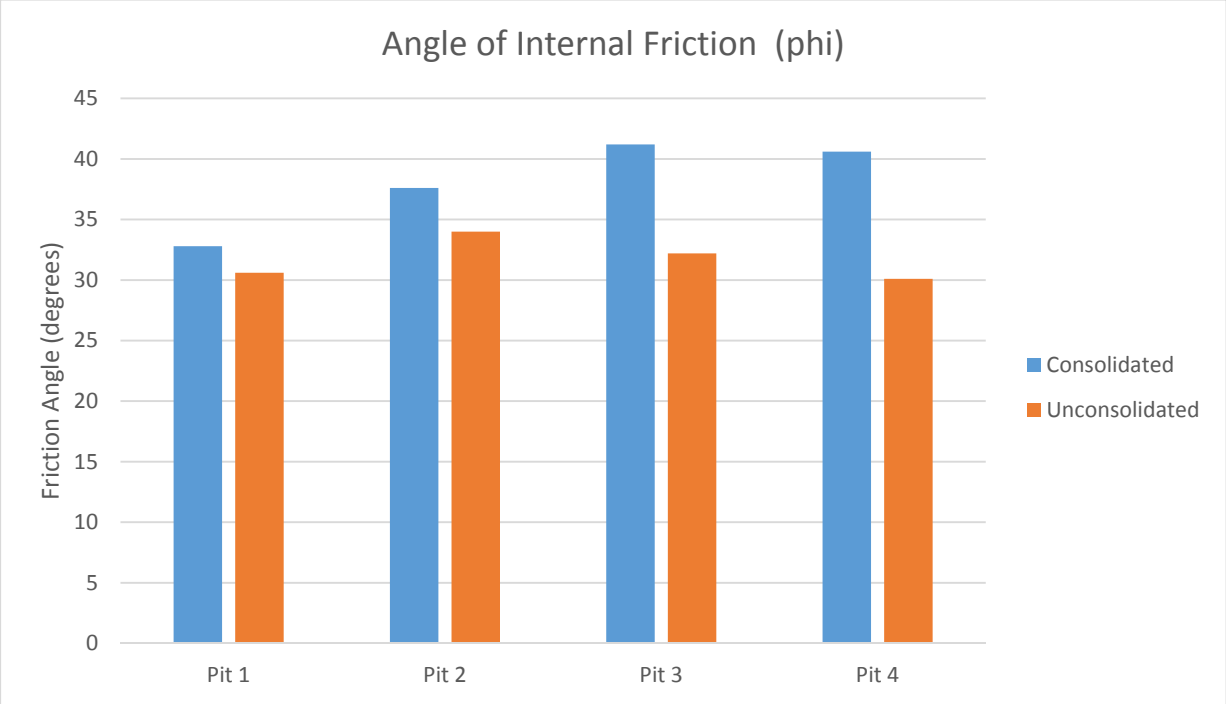
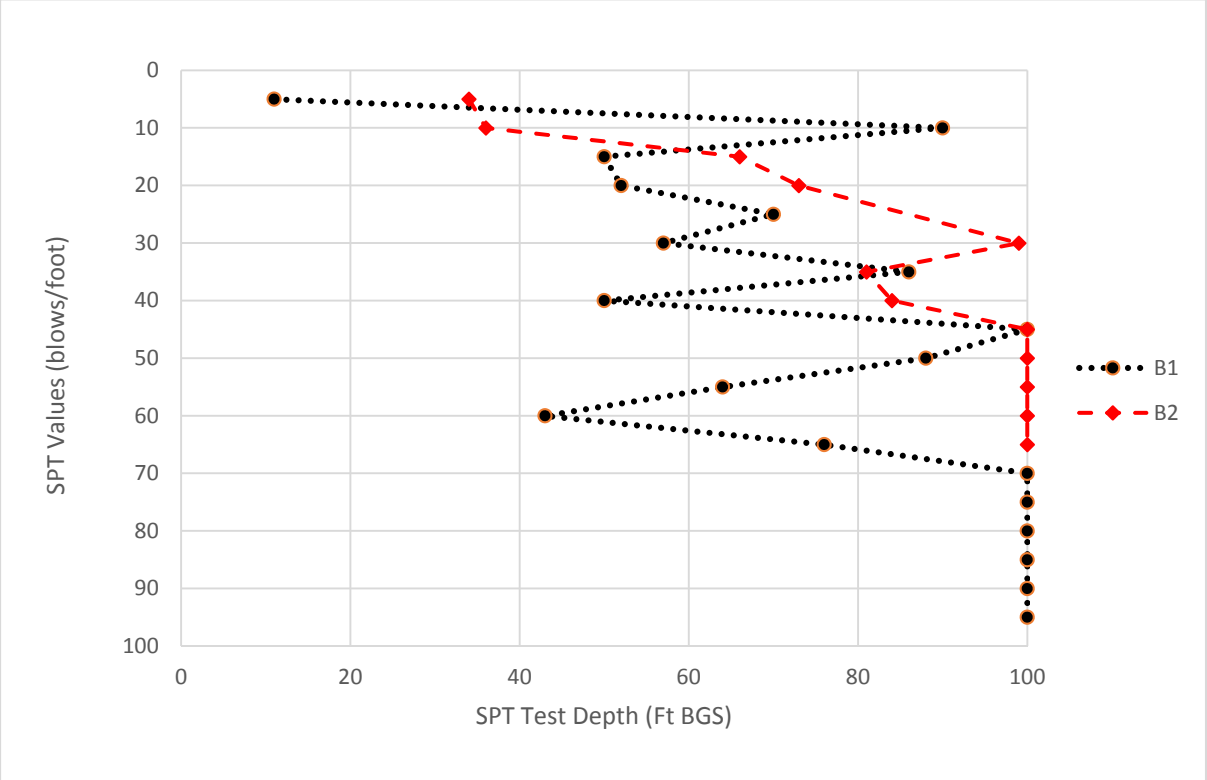


**Figure 8 Borings B-1 and B-2, Standard Penetration Test Values**



# APPENDIX A

## Boring Logs B-1 and B-2

| DEPTH (Feet) | Description | USC | Sample Interval | Recovery | SPT | Graphic Log | Well Completion Detail | DEPTH (Feet) |
|---|---|---|---|---|---|---|---|---|
| 0 | Loose, pale yellow–brown (10YR 6/2), well graded, medium to fine grained silty SAND with gravel, dry. ...increase gravel to 3" sub–rounded | SM | | | | | | 0 |
| 5 | Medium dense, tan (5YR 7/2) well graded, medium to coarse SAND, with gravel (1 1/2"), sub–rounded, dry | SW | | 9" | 11 | | 8" Borehole backfilled with soil cuttings | 5 |
| 10 | Very dense, tan (5YR 7/2), well graded, fine to coarse SAND with subrounded gravel, minor silt, dry | | | 14" | 90 | | | 10 |
| 15 | Dense, tan (5YR 7/2), fine to coarse silty GRAVEL with SAND, subrounded, dry ...harder drilling, rig chatter | GM | | 10" | 50 | | | 15 |
| 20 | Very dense, tan (5YR 7/2), well graded, medium to coarse SAND with fine gravel ...silt and fine sand, from 21.0' to 21.5', dry | | | 12" | 52 | | | 20 |
| 25 | Very dense, tan (5YR 7/2) well graded, fine to coarse SAND with gravel, dry ...coarse, more gravel from 25.5' to 26.5', dry | SW | | 14" | 70 | | Undisturbed soil sample collected with modified California sampler (25' to 26.5') | 25 |
| 30 | Very dense, light brown (5YR 6/4) well graded, fine to coarse silty SAND with sub–angular fine gravel. Silt is slightly damp, sand is dry | | | 13" | 57 | | 8" Borehole backfilled with cement bentonite grout | 30 |
| 35 | Very dense, tan (5YR 7/2), silt, slightly damp, sand, dry ....coarse gravel in bottom 6" | SM | | | 86 | | | 35 |
| 40 | | | | | 50 | | | 40 |

SWIFT RIVER
ENVIRONMENTAL SERVICES, LLC

# Soil Boring Record

Location Boring 1
Coordinates: Lat: 36.764459° Long: –116.688411°
Drilled By Eagle Drilling Method Hollow Stem Auger
Logged By P. Zlatev Checked By SLW
Installation Date September 9, 2015

| DEPTH (Feet) | Description | USC | Sample Interval | Recovery | SPT | Graphic Log | Well Completion Detail | DEPTH (Feet) |
|---|---|---|---|---|---|---|---|---|
| 40 | Dense, tan (5YR 7/2), well graded, fine to coarse grained GRAVEL with sand and silt, dry | GM | | 14" | 50 | | | 40 |
| 45 | ...slightly damp @ 45.0' | | | 10" | 50 / 5" | | | 45 |
| 50 | Very dense, light brown (5YR 6/4), well graded, fine to coarse grained SAND with silt and sub-angular gravel, dry | SM | | 16" | 88 | | Undisturbed soil sample collected with modified California sampler (50' to 51.5') | 50 |
| 55 | Very dense, tan (5YR 7/2), fine to coarse grained GRAVEL with sand and silt, upper 4" light brown (5YR 6/4) sub-angular gravel | GM | | 14" | 64 | | | 55 |
| 60 | Dense, tan (5YR 7/2), fine to coarse grained GRAVEL with sand and silt, gravel size decreases to fine grained with depth, sub-angular gravel | | | 14" | 43 | | 8" Borehole backfilled with cement bentonite grout | 60 |
| 65 | Very dense, light brown (5YR 6/4) and light brownish gray (5YR 6/1), fine grained GRAVEL with silt and sand, partially cemented, dry | | | 12" | 76 | | | 65 |
| 70 | Very dense, light brown (5YR 6/4) and light brownish gray (5YR 6/1) fine grained GRAVEL with silt and sand, partially cemented, dry, rock in shoe | | | 10" | 50 / 9.5" | | | 70 |
| 75 | Very dense, light brown (5YR 6/4) well graded, fine to coarse silty SAND with gravel, dry hand sample in shoe but no cementing observed in 75.5' to 76.0' | SM | | 10" | 50 / 3.5" | | Undisturbed soil sample collected with modified California sampler (75' to 76.5') | 75 |
| 80 | | | | | | | | 80 |

SWIFT RIVER
ENVIRONMENTAL SERVICES, LLC

# Soil Boring Record

Location Boring 1
Coordinates: Lat: 36.764459° Long: −116.688411°
Drilled By Eagle Drilling Method Hollow Stem Auger
Logged By P. Zlatev Checked By SLW
Installation Date September 9, 2015

| DEPTH (Feet) | Description | USC | Sample Interval | Recovery | SPT | Graphic Log | Well Completion Detail | DEPTH (Feet) |
|---|---|---|---|---|---|---|---|---|
| 80 | Very dense, light brown (5YR 6/4), well graded, fine GRAVEL with sand, minor cementing, dry | GW | | 8" | 50/4" | | | 80 |
| 85 | Very dense, tan (5YR 7/2), well graded, fine GRAVEL with sand, some cementing, larger broken rock chips, dry | GW | | 5" | 50/5.5" | | 8" Borehole backfilled with cement bentonite grout | 85 |
| 90 | Very dense, tan (10YR 7/4), fine to medium grained SAND with silt and clay, dry | SM | | 14" | 50/4" | | | 90 |
| 95 | Hard drilling, grinding at 95.0' Very dense, tan (5YR 7/2), fine grained GRAVEL with sand and silt, dry | GM | | | 50/4" | | | 95 |
| | Boring Terminated @ 96.5' | | | | | | | |
| 100 | | | | | | | | 100 |
| 105 | | | | | | | | 105 |
| 110 | | | | | | | | 110 |
| 115 | | | | | | | | 115 |
| 120 | | | | | | | | 120 |

SWIFT RIVER
ENVIRONMENTAL SERVICES, LLC

Soil Boring Record
Location Boring 1
Coordinates: Lat: 36.764459° Long: −116.688411°
Drilled By Eagle Drilling Method Hollow Stem Auger
Logged By P. Zlatev Checked By SLW
Installation Date September 9, 2015

| DEPTH (Feet) | Description | USC | Sample Interval | Recovery | SPT | Graphic Log | Well Completion Detail | DEPTH (Feet) |
|---|---|---|---|---|---|---|---|---|
| 0 | Loose, pale yellow–brown (10YR 6/2), well graded silty SAND, with small amounts of gravel. | SM | | | | | | 0 |
| 5 | Dense, grayish–orange pink (5YR 7/2) localized gravel to 3" surrounded, well graded, fine to coarse SAND, sub–rounded with gravel, some cementation | SW | | 12" | 34 | | 8" Borehole backfilled with soil cuttings | 5 |
| 10 | Dense, light brown (5YR 6/4), well graded, fine to coarse SAND, gravel, little silt, dry | | | 11" | 36 | | | 10 |
| 15 | Dense, light brown (5YR 6/9), well graded, fine to coarse SAND, gravel, some silt | SW/ SM | | 9" | 66 | | | 15 |
| 20 | Very dense, light brown (5YR 4/4), well graded, fine to coarse SAND with gravel, dry<br>...silt and sand @ 20.5' | GM | | 4" | 73 | | | 20 |
| 25 | Very dense, no recovery catcher put in place, retry at 30' | | | | NR | | | 25 |
| 30 | Very dense, light brown (5YR 6/4) well graded, coarse to fine SAND with GRAVEL and silt, large gravel in bottom 3", minor sub–angular gravel | SW/ SM | | 14" | 99 | | Undisturbed soil sample collected with modified California sampler (30' to 31.5') | 30 |
| 35 | Very dense, light brown (5YR 6/4), fine to coarse SAND with silt and fine–grained gravel slightly damp silt, dry sand, gravel <0.5" | SM | | 16" | 81 | | 8" Borehole backfilled with cement bentonite grout | 35 |
| 40 | | | | | 84 | | | 40 |

SWIFT RIVER
ENVIRONMENTAL SERVICES, LLC

# Soil Boring Record

Location Boring 2
Coordinates: Lat: 36.764445° Long: –116.685558°
Drilled By Eagle Drilling Method Hollow Stem Auger
Logged By C. Keener Checked By PAZ
Installation Date September 11, 2015

| DEPTH (Feet) | Description | USC | Sample Interval | Recovery | SPT | Graphic Log | Well Completion Detail | DEPTH (Feet) |
|---|---|---|---|---|---|---|---|---|
| 40 | Very dense, grayish orange pink (5 YR 7/2), well graded, silty SAND, with fine grained sub–angular gravel, damp, silt, dry sand | SM | | 13" | 84 | | | 40 |
| 45 | Very dense, light brown (5YR 5/6), fine to coarse grained sub–angular GRAVEL with silt and some sand, gravel ≦ 1.25", silt, damp | GM | | 12" | 50 / 5.5" | | 8" Borehole backfilled with cement bentonite grout | 45 |
| 50 | Very dense, light brown (5YR 5/6), well graded GRAVEL with silt and sand minor cementation large shattered rock fragments | GW/ GM | | 6" | 50 / 7.5" | | Undisturbed soil sample collected with modified California sampler (50' to 51.5') | 50 |
| 55 | Very dense, grayish orange pink (5YR 7/2), well graded GRAVEL with silt and sand, dry, more gray–brown between 55.0' and 55.5', heavy cementation, gravel ≦ 1.0". Rig Chatter | GM | | 7" | 50 / 5" | | | 55 |
| 60 | Very dense, light brown (5YR 6/4), well graded GRAVEL with silt and sand, dry, mix of brown and gray color, some gravel fragments. | | | 8" | 50 / 4" | | | 60 |
| 65 | Very dense, light brown (5YR 7/2) well graded, gravely silt and sand, medium cementation, shattered rock fragments @ 65.5', brown silty sand with gravel | SM | | 6" | 50 / 5.5" | | | 65 |
| | Boring Terminated @ 65.5' | | | | | | | |
| 70 | | | | | | | | 70 |
| 75 | | | | | | | | 75 |
| 80 | | | | | | | | 80 |

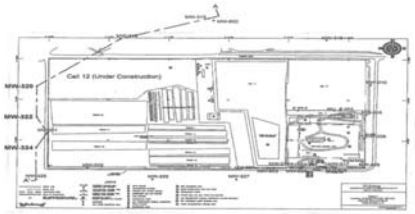
SWIFT RIVER
ENVIRONMENTAL SERVICES, LLC

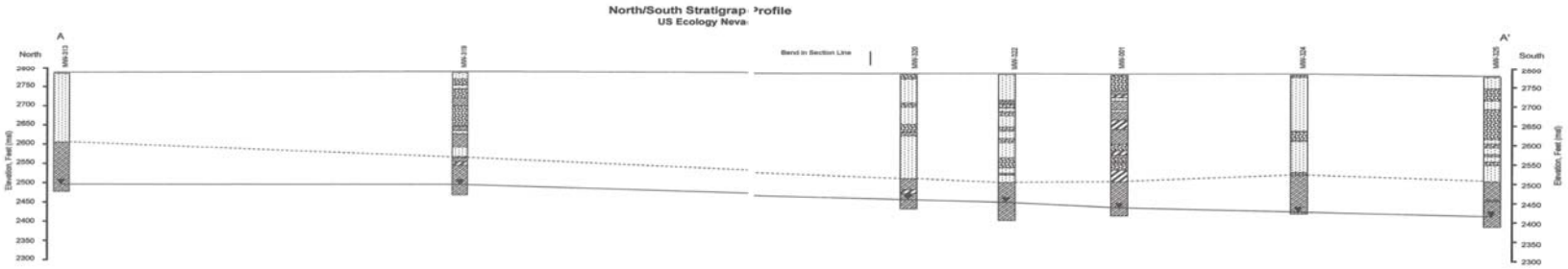
# Soil Boring Record

Location Boring 2
Coordinates: Lat: 36.764445° Long: –116.685558°
Drilled By Eagle Drilling Method Hollow Stem Auger
Logged By C. Keener Checked By PAZ
Installation Date September 11, 2015

# Appendix B

## Previous Subsurface Cross Sections




Explanation

- Sand and gravel mix, less than 10 % silt and clay Sand is predominantly => 50%, (SP)
- Gravel and sand mix, cobbles common, less than 10% silt and clay (GP) Gravel is predominantly => 50% (GP)
- Silty and clayey gravel, gravel sand mixes with more gravel than sand and > 10% silt and clay (GM,GC)
- Silty sand and gravel, silt and clay up to 20-30%, sand and gravel % varies but sand > gravel (SM)

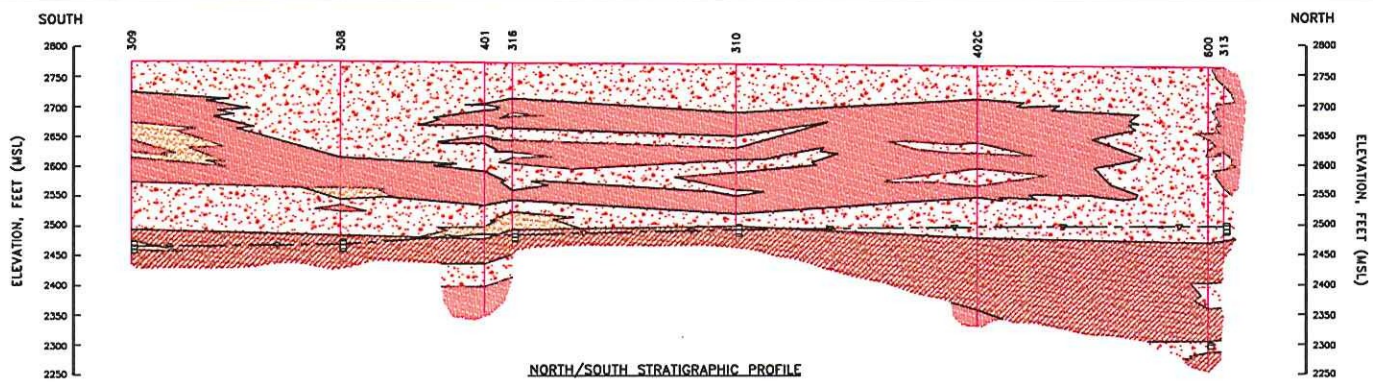
Legend

- Approximate stratigraphic correlation
- Water table

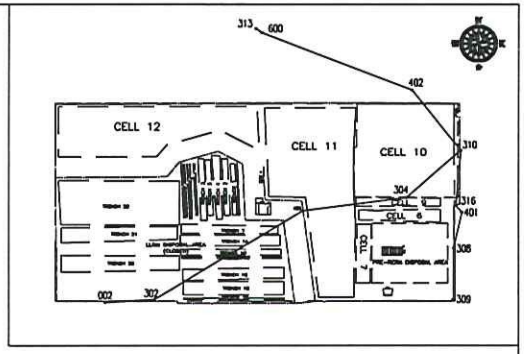
Horizontal Scale

**Figure 5**
North-South Stratigraphic Profile
across West side of Cell 12 and along West side of
the US Ecology Nevada, Beatty, NV Facility

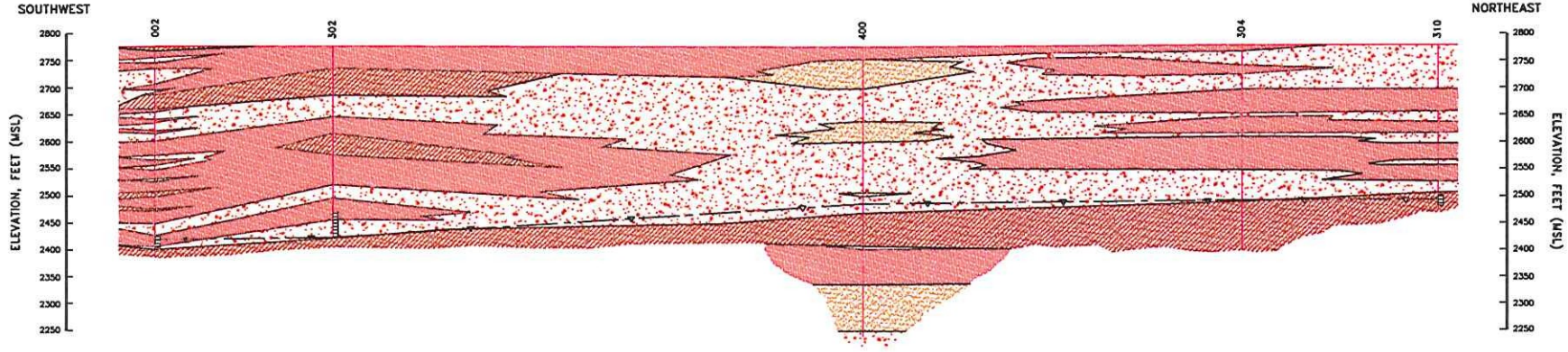
US Ecology Nevada, Beatty, NV
Dwn by: C Feast, 8/4/08




NORTH/SOUTH STRATIGRAPHIC PROFILE




PROFILE LOCATIONS




NORTHEAST/SOUTHWEST STRATIGRAPHIC PROFILE

## EXPLAINATION

**GRAVEL**
SOILS WITH GREATER THAN 50% GRAVEL: SANDY GRAVEL, SILTY GRAVEL AND CLAYEY GRAVEL.

**GRAVELLY SAND**
SOILS WITH GREATER THAN 50% SAND AND 15% OR MORE GRAVEL.

**SAND**
SANDS WITH MINIMAL FINE-GRAINED CONTENT (CLEAN SANDS) AND 15% OR LESS GRAVEL.

**SILT/CLAY**
LOW AND HIGH PLASTICITY SILTS AND CLAYS. ALSO INCORPORATES SAND AND GRAVEL WITH SIGNIFICANT CLAY OR FINE-GRAINED SAND CONTENT, ESPECIALLY WHERE INTERBEDDED OR ASSOCIATED WITH SILTS AND CLAYS.

## LEGEND

WATER TABLE

SCREEN INTERVAL

100 50 0 100
SCALE FEET

| Rev | Drawn | Check | Appr | Date | Description |
|---|---|---|---|---|---|

REVISIONS

American Ecology
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056

Reference Drawings NV-153-GMS-003

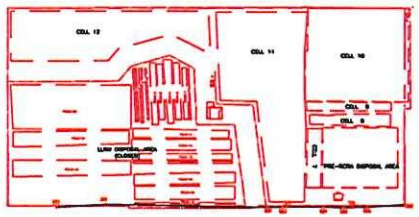
Drawn By: DKK
Checked By: L.IRWIN
Appr. By:
Date: 11/95
Scale: AS SHOWN
Project No.: NV-163

SITE STRATIGRAPHIC PROFILES

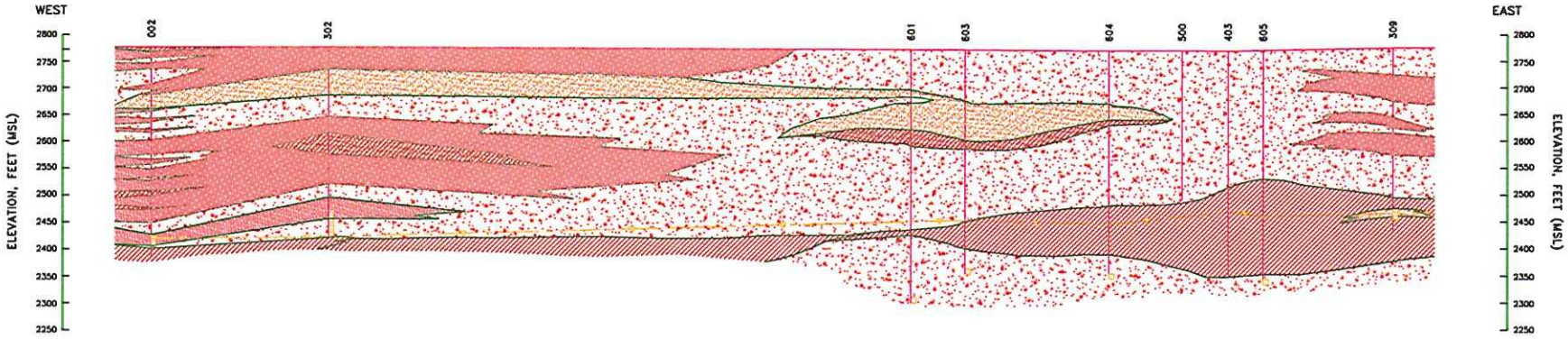
HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA

Drawing No. NV-163-GMS-004

Figure 1-2



PROFILE LOCATION




EAST/WEST STRATIGRAPHIC PROFILE

## EXPLAINATION

**GRAVEL**
SOILS WITH GREATER THAN 50% GRAVEL: SANDY GRAVEL, SILTY GRAVEL AND CLAYEY GRAVEL.

**GRAVELLY SAND**
SOILS WITH GREATER THAN 50% SAND AND 15% OR MORE GRAVEL.

**SAND**
SANDS WITH MINIMAL FINE-GRAINED CONTENT (CLEAN SANDS) AND 15% OR LESS GRAVEL.

**SILT/CLAY**
LOW AND HIGH PLASTICITY SILTS AND CLAYS. ALSO INCORPORATES SAND AND GRAVEL WITH SIGNIFICANT CLAY OR FINE-GRAINED SAND CONTENT, ESPECIALLY WHERE INTERBEDDED OR ASSOCIATED WITH SILTS AND CLAYS.

## LEGEND

WATER TABLE

SCREEN INTERVAL

100 50 0 100
SCALE FEET

| Rev | Drawn | Check | Appr | Date | Description |
|---|---|---|---|---|---|
| | | | | | |

REVISIONS

American Ecology
5333 WESTHEIMER
Suite 1000
Houston, Texas 77056

Reference Drawings
NV-153-GMS-004

Drawn By: DKK
Checked By: L.IRWIN
Appr. By:
Date: 11/95
Scale: AS SHOWN
Project No.: NV-163

SITE STRATIGRAPHIC PROFILE

HAZARDOUS WASTE MANAGEMENT FACILITY
U.S. Ecology
BEATTY, NEVADA

Drawing No.
NV-163-GMS-005

Figure
1-3

# APPENDIX C

## Site Photos - Borings

**DISPOSAL TRENCH 13 - SUBSURFACE EXPLORATION AND TESTING REPORT**
**US Ecology Nevada**

Photo 1: Drilling at Boring B-1

Photo 2: Auger flights with welded beading to improve cutting, at Boring B-1

# Appendix D

## Laboratory Analyses – Borings

GEOTECHNICAL &
ENVIRONMENTAL
SERVICES, INC.

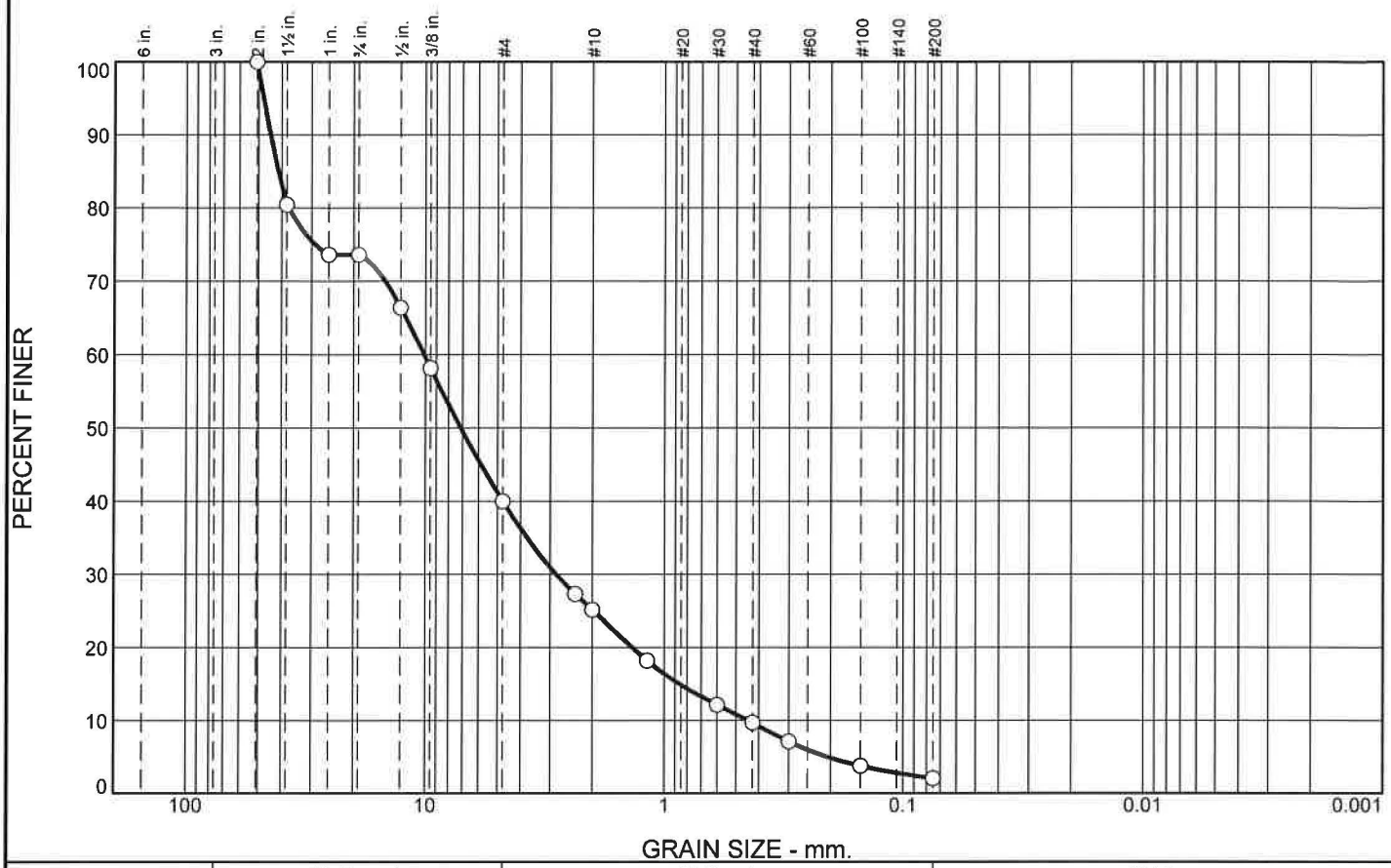
7150 Placid Street
Las Vegas, NV 89119
(702) 365-1001

# Moisture/Density Log - Sample Rings

**Project Name:** USE TRENCH 13 GEOTECH **Lab No.:** 15-266
**Project No.:** 2015 MISC/SWIFT RIVER **Tested By:** T. FULLER **Date:** 09/15/15

| Sample | BORING 1 | BORING 1 | BORING 1 | BORING 2 | BORING 2 | BORING 2 | | |
|---|---|---|---|---|---|---|---|---|
| Depth | 25' | 50' | 75' | 30' | 50' | ~~75'~~ 65 ft | | |
| Soil Description: Remarks/Condition: | | | | | | | | |
| Length (in) | 12 | 12 | 6 | 12 | 6 | 6 | | |
| Tube + Wet Soil (gm) | 2218.80 | 2173.87 | 1040.30 | 1974.40 | 949.80 | 928.90 | | |
| Tube (gm) | 571.00 | 574.79 | 285.80 | 578.20 | 295.40 | 289.60 | | |
| Wet Soil (gm) | 1647.80 | 1599.08 | 754.50 | 1396.20 | 654.40 | 639.30 | | |
| Volume ($in^3$) | 0.0314 | 0.0314 | 0.0157 | 0.0314 | 0.0157 | 0.0157 | | |
| Wet Density $lbs/ft^3$ | 115.6 | 112.2 | 105.9 | 98.0 | 91.8 | 89.7 | | |
| Tare + Wet Soil (gm) | 932.40 | 894.70 | 475.20 | 704.46 | 357.00 | 389.74 | | |
| Tare + Dry Soil (gm) | 896.00 | 850.00 | 449.00 | 682.00 | 341.50 | 370.50 | | |
| Water Loss (gm) | 36.40 | 44.70 | 26.20 | 22.46 | 15.50 | 19.24 | | |
| Tare Weight (gm) | 110.34 | 108.50 | 108.70 | 108.40 | 108.60 | 111.20 | | |
| Wt. Dry Soil (gm) | 785.66 | 741.50 | 340.30 | 573.60 | 232.90 | 259.30 | | |
| Moisture Content (%) | 4.6 | 6.0 | 7.7 | 3.9 | 6.7 | 7.4 | | |
| Dry Density ($lbs/ft^3$) | 110.5 | 105.8 | 98.3 | 94.3 | 86.1 | 83.5 | | |

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 26 | 34 | 15 | 15 | 8 | 2 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 2 | 100 | | |
| 1.5 | 80 | | |
| 1 | 74 | | |
| .75 | 74 | | |
| .5 | 66 | | |
| .375 | 58 | | |
| #4 | 40 | | |
| #8 | 27 | | |
| #10 | 25 | | |
| #16 | 18 | | |
| #30 | 12 | | |
| #40 | 10 | | |
| #50 | 7 | | |
| #100 | 4 | | |
| #200 | 2.0 | | |

* (no specification provided)

**Soil Description**

**Atterberg Limits**

PL= N/A LL= N/A PI= N/A

**Coefficients**

$D_{90}$= 44.5334 $D_{85}$= 41.3484 $D_{60}$= 10.1441
$D_{50}$= 7.1236 $D_{30}$= 2.8310 $D_{15}$= 0.8638
$D_{10}$= 0.4448 $C_u$= 22.81 $C_c$= 1.78

**Classification**

USCS= GW AASHTO= N/A

**Remarks**

SAMPLED BY:CLIENT
ASTM D6913

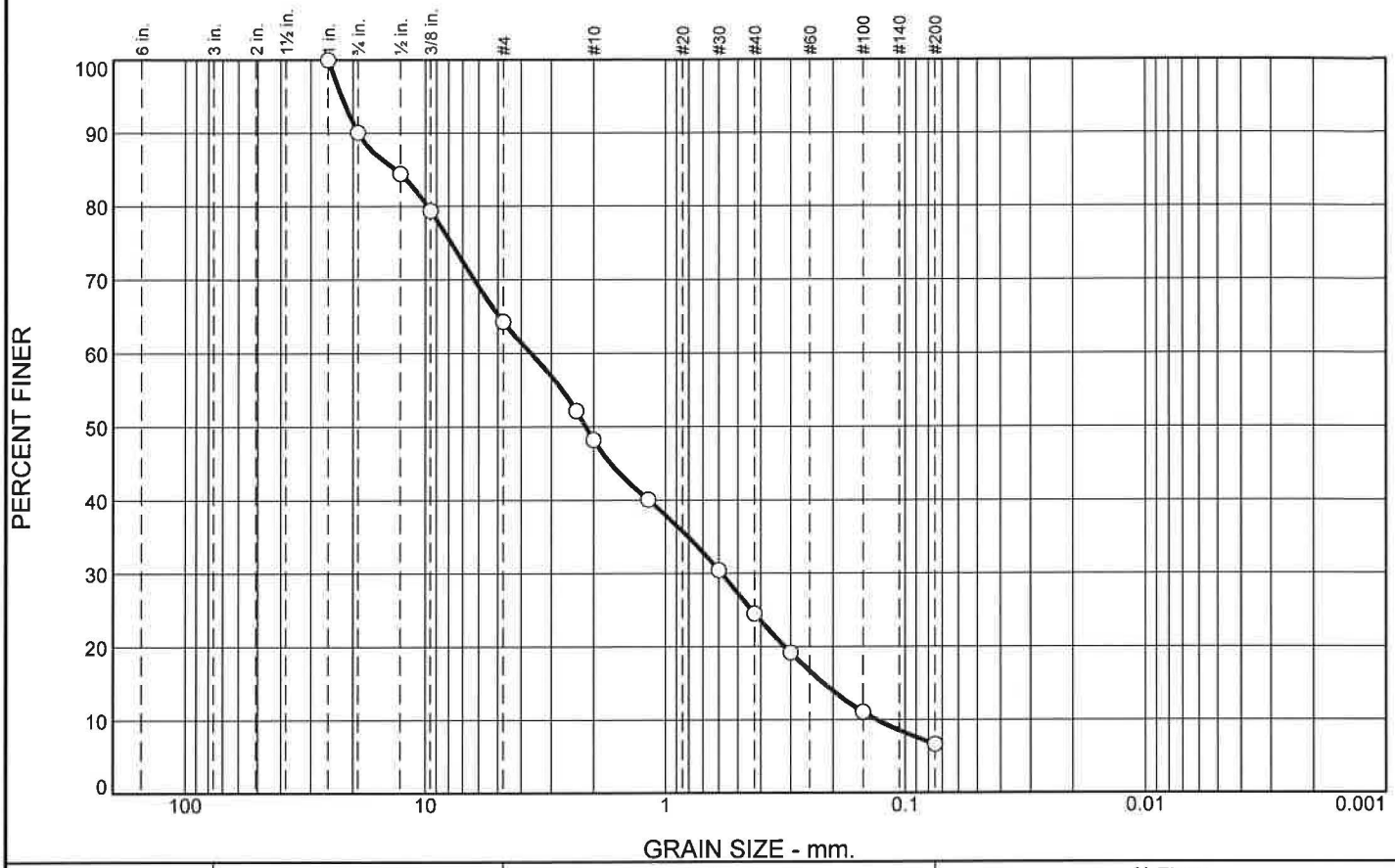
**Location:** BORING 1 @ 25'
**Sample Number:** B-1 **Depth:** 25' **Date:** 09/15/15

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH
**Project No:** 2015 MISC **Figure** 15-266-1

**Tested By:** T. FULLER

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 10 | 26 | 16 | 23 | 18 | 7 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 1 | 100 | | |
| .75 | 90 | | |
| .5 | 84 | | |
| .375 | 79 | | |
| #4 | 64 | | |
| #8 | 52 | | |
| #10 | 48 | | |
| #16 | 40 | | |
| #30 | 30 | | |
| #40 | 25 | | |
| #50 | 19 | | |
| #100 | 11 | | |
| #200 | 6.6 | | |

* (no specification provided)

**Soil Description**

**Atterberg Limits**

PL= N/A LL= N/A PI= N/A

**Coefficients**

$D_{90}$= 18.9830 $D_{85}$= 13.2752 $D_{60}$= 3.6509
$D_{50}$= 2.1568 $D_{30}$= 0.5843 $D_{15}$= 0.2188
$D_{10}$= 0.1320 $C_u$= 27.67 $C_c$= 0.71

**Classification**

USCS= N/A AASHTO= N/A

**Remarks**

SAMPLED BY:CLIENT
ASTM D6913

**Location:** BORING 1 @ 50'
**Sample Number:** B-1 **Depth:** 50'

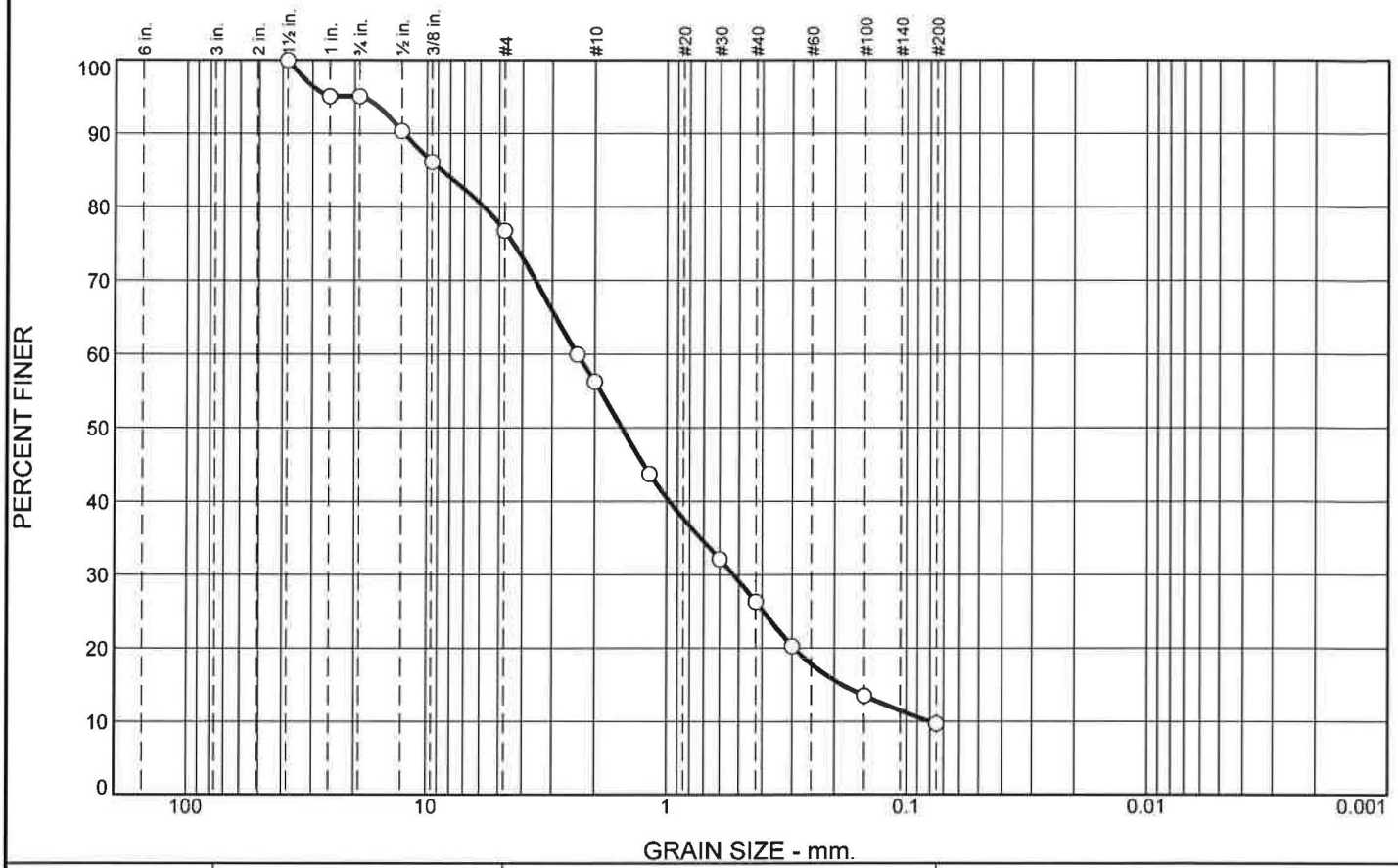
**Date:** 09/15/15

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH
**Project No:** 2015 MISC **Figure** 15-266-2

**Tested By:** T. FULLER

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 5 | 18 | 21 | 30 | 16 | 10 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 1.5 | 100 | | |
| 1 | 95 | | |
| .75 | 95 | | |
| .5 | 90 | | |
| .375 | 86 | | |
| #4 | 77 | | |
| #8 | 60 | | |
| #10 | 56 | | |
| #16 | 44 | | |
| #30 | 32 | | |
| #40 | 26 | | |
| #50 | 20 | | |
| #100 | 13 | | |
| #200 | 9.7 | | |

* (no specification provided)

**Soil Description**

**Atterberg Limits**

PL= N/A LL= N/A PI= N/A

**Coefficients**

$D_{90}$= 12.4109 $D_{85}$= 8.7099 $D_{60}$= 2.3666
$D_{50}$= 1.5418 $D_{30}$= 0.5270 $D_{15}$= 0.1859
$D_{10}$= 0.0798 $C_u$= 29.67 $C_c$= 1.47

**Classification**

USCS= N/A AASHTO= N/A

**Remarks**

SAMPLED BY:CLIENT
ASTM D6913

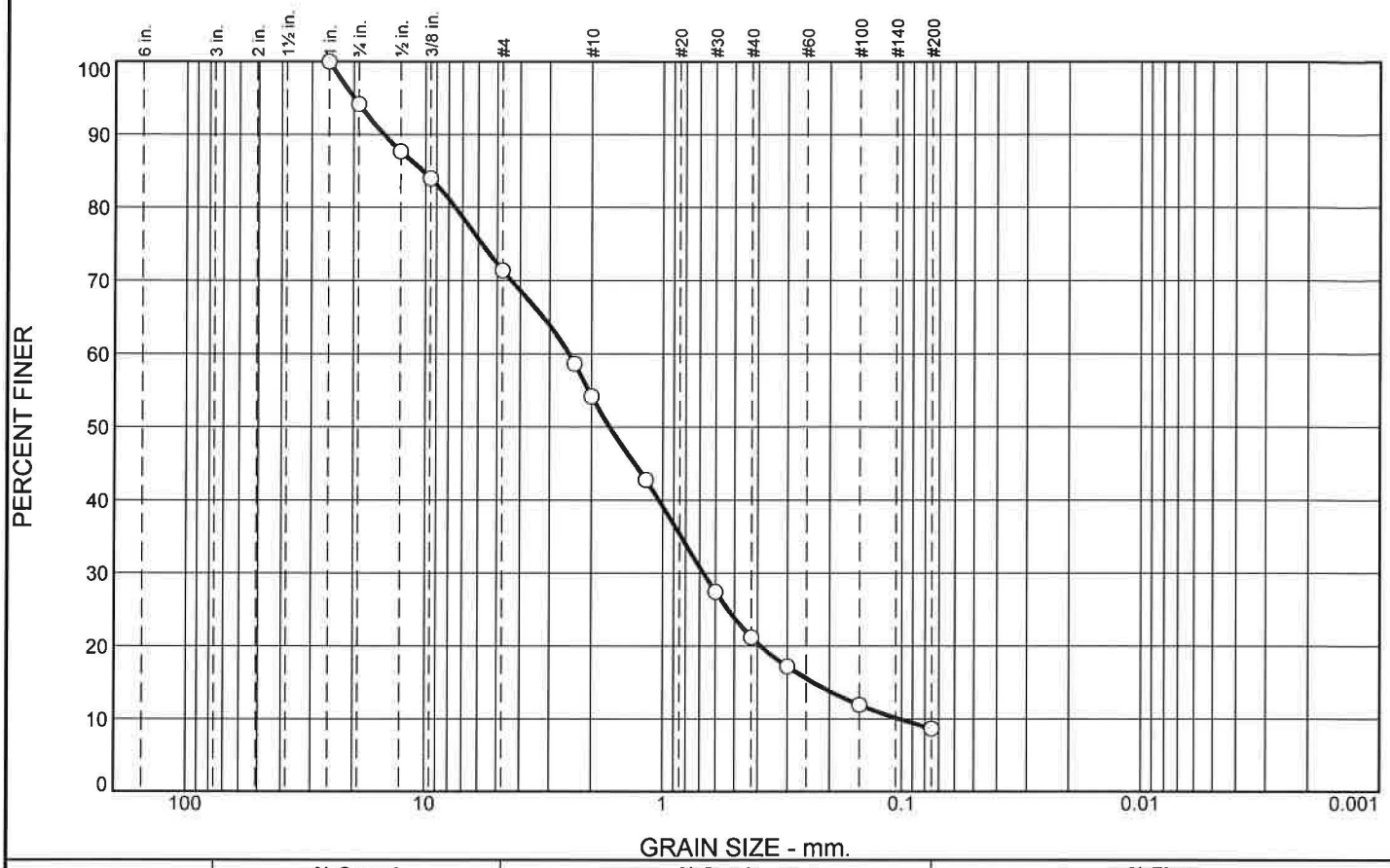
**Location:** BORING 1 @ 75'
**Sample Number:** B-1 **Depth:** 75' **Date:** 09/15/15

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH
**Project No:** 2015 MISC **Figure** 15-266-3

**Tested By:** T. FULLER

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 6 | 23 | 17 | 33 | 12 | 9 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 1 | 100 | | |
| .75 | 94 | | |
| .5 | 88 | | |
| .375 | 84 | | |
| #4 | 71 | | |
| #8 | 59 | | |
| #10 | 54 | | |
| #16 | 43 | | |
| #30 | 27 | | |
| #40 | 21 | | |
| #50 | 17 | | |
| #100 | 12 | | |
| #200 | 8.7 | | |

* (no specification provided)

**Soil Description**

**Atterberg Limits**

PL= N/A LL= N/A PI= N/A

**Coefficients**

$D_{90}$= 14.9529 $D_{85}$= 10.2653 $D_{60}$= 2.4911
$D_{50}$= 1.6787 $D_{30}$= 0.6747 $D_{15}$= 0.2337
$D_{10}$= 0.1030 $C_u$= 24.19 $C_c$= 1.77

**Classification**

USCS= N/A AASHTO= N/A

**Remarks**

SAMPLED BY:CLIENT
ASTM D6913

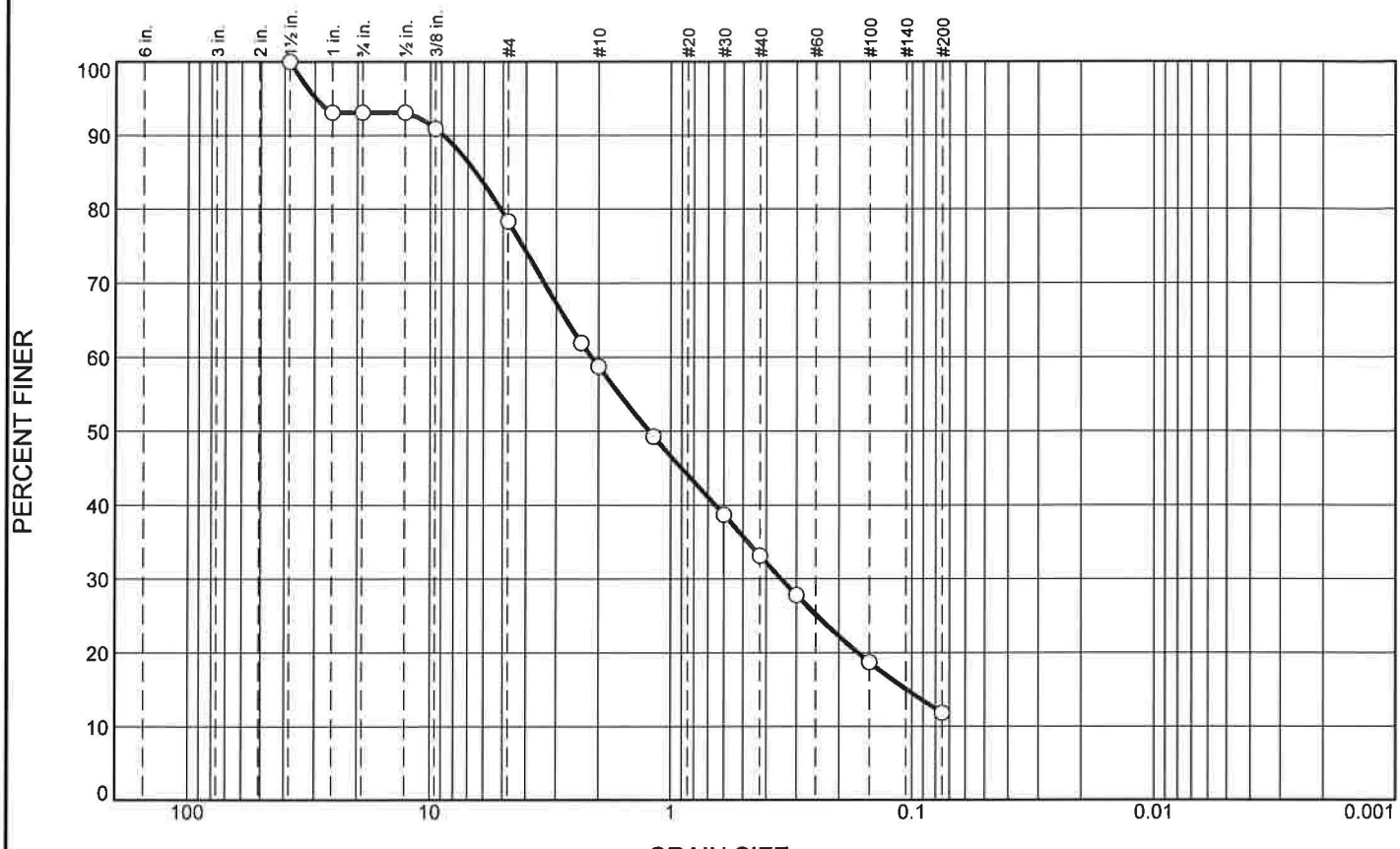
**Location:** BORING 2 @ 30'
**Sample Number:** B-2 **Depth:** 30' **Date:** 09/15/15

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH
**Project No:** 2015 MISC **Figure** 15-266-4

**Tested By:** T. FULLER

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 7 | 15 | 19 | 26 | 21 | 12 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 1.5 | 100 | | |
| 1 | 93 | | |
| .75 | 93 | | |
| .5 | 93 | | |
| .375 | 91 | | |
| #4 | 78 | | |
| #8 | 62 | | |
| #10 | 59 | | |
| #16 | 49 | | |
| #30 | 39 | | |
| #40 | 33 | | |
| #50 | 28 | | |
| #100 | 19 | | |
| #200 | 12 | | |

* (no specification provided)

**Soil Description**

**Atterberg Limits**

PL= N/A LL= N/A PI= N/A

**Coefficients**

$D_{90}$= 8.8311 $D_{85}$= 6.4859 $D_{60}$= 2.1391
$D_{50}$= 1.2308 $D_{30}$= 0.3473 $D_{15}$= 0.1051
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= N/A AASHTO= N/A

**Remarks**

SAMPLED BY:CLIENT
ASTM D6913

**Location:** BORING 2 @ 50'
**Sample Number:** B-2 **Depth:** 50' **Date:** 09/15/15

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH
**Project No:** 2015 MISC **Figure** 15-266-5

**Tested By:** T. FULLER

# Particle Size Distribution Report

| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 4 | 7 | 9 | 20 | 41 | 19 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 1.5 | 100 | | |
| 1 | 96 | | |
| .75 | 96 | | |
| .5 | 96 | | |
| .375 | 94 | | |
| #4 | 89 | | |
| #8 | 83 | | |
| #10 | 80 | | |
| #16 | 74 | | |
| #30 | 67 | | |
| #40 | 60 | | |
| #50 | 51 | | |
| #100 | 31 | | |
| #200 | 19 | | |

* (no specification provided)

**Soil Description**

**Atterberg Limits**

PL= N/A LL= N/A PI= N/A

**Coefficients**

$D_{90}$= 5.7013 $D_{85}$= 2.8258 $D_{60}$= 0.4196
$D_{50}$= 0.2887 $D_{30}$= 0.1409 $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= N/A AASHTO= N/A

**Remarks**

SAMPLED BY:CLIENT
ASTM D6913

**Location:** BORING 2 @ ~~75'~~ 65 ft
**Sample Number:** B-2 **Depth:** ~~75'~~ 65 ft **Date:** 09/15/15

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH
**Project No:** 2015 MISC **Figure** 15-266-6

**Tested By:** T. FULLER

# APPENDIX E

## Site Photos - Test Pits

**DISPOSAL TRENCH 13 - SUBSURFACE EXPLORATION AND TESTING REPORT**
**US Ecology Nevada**

Test Pit 1: Excavator in Operation

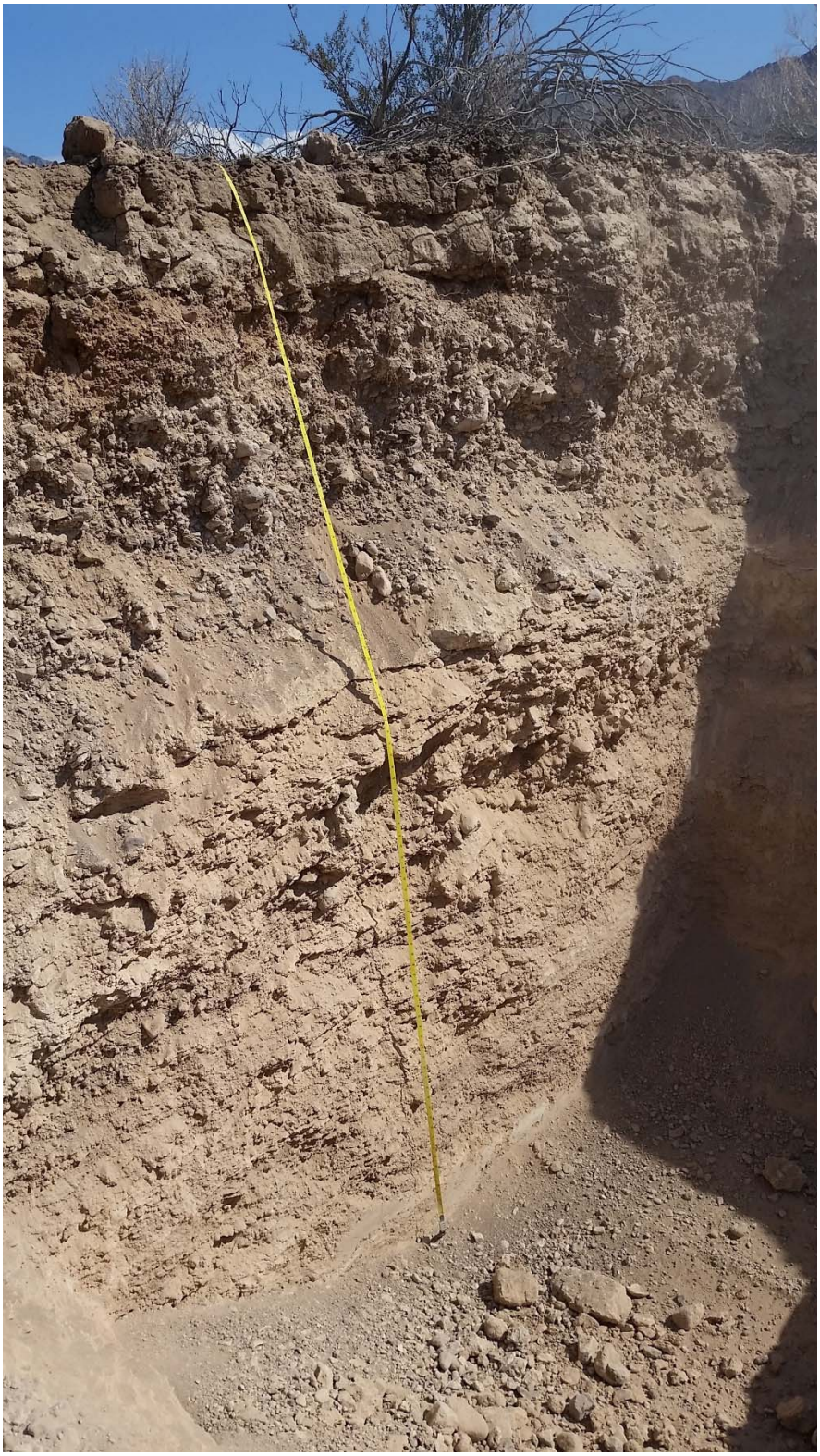
**DISPOSAL TRENCH 13 - SUBSURFACE EXPLORATION AND TESTING REPORT**
**US Ecology Nevada**

Test Pit 1: North wall of Pit 1, total depth of 6 feet bgs

**DISPOSAL TRENCH 13 - SUBSURFACE EXPLORATION AND TESTING REPORT**
**US Ecology Nevada**

Test Pit 1: North wall of Pit 1, Unconsolidated/Consolidated contact at 3 feet 7 inches bgs

Test Pit 2: North wall of Pit 2, total depth of 9 feet 4 inches bgs



**DISPOSAL TRENCH 13 - SUBSURFACE EXPLORATION AND TESTING REPORT**
**US Ecology Nevada**

Test Pit 2: North wall of Pit 2, Unconsolidated/Consolidated contact at 3 feet 10 inches bgs

**DISPOSAL TRENCH 13 - SUBSURFACE EXPLORATION AND TESTING REPORT**
**US Ecology Nevada**

Test Pit 2: East wall of Pit 2, Unconsolidated/Consolidated contact at 3 feet 10 inches bgs

**DISPOSAL TRENCH 13 - SUBSURFACE EXPLORATION AND TESTING REPORT**
**US Ecology Nevada**

Test Pit 3: South wall of Pit 3, total depth 5 feet 10 inches bgs

**DISPOSAL TRENCH 13 - SUBSURFACE EXPLORATION AND TESTING REPORT**
**US Ecology Nevada**

Test Pit 3: South wall of Pit 3, Unconsolidated/Consolidated contact at 3 feet 6 inches bgs

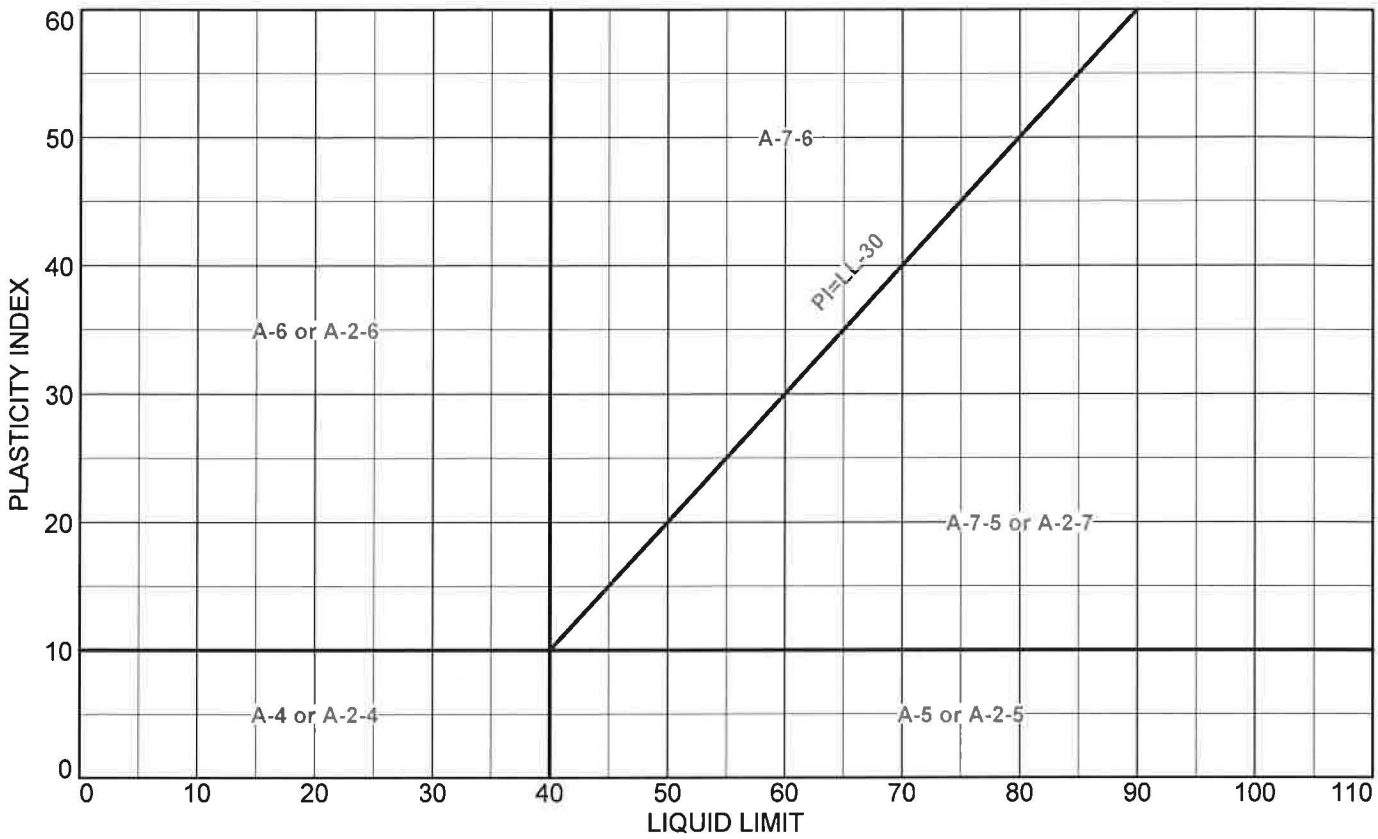
Test Pit 4: North wall of Pit 4, total depth 8 feet 3 inches

Test Pit 4: North wall of Pit 4, Unconsolidated/Consolidated contact at 4 feet bgs

# Appendix E

## Laboratory Analyses – Test Pits

# LIQUID AND PLASTIC LIMITS TEST REPORT




## SOIL DATA

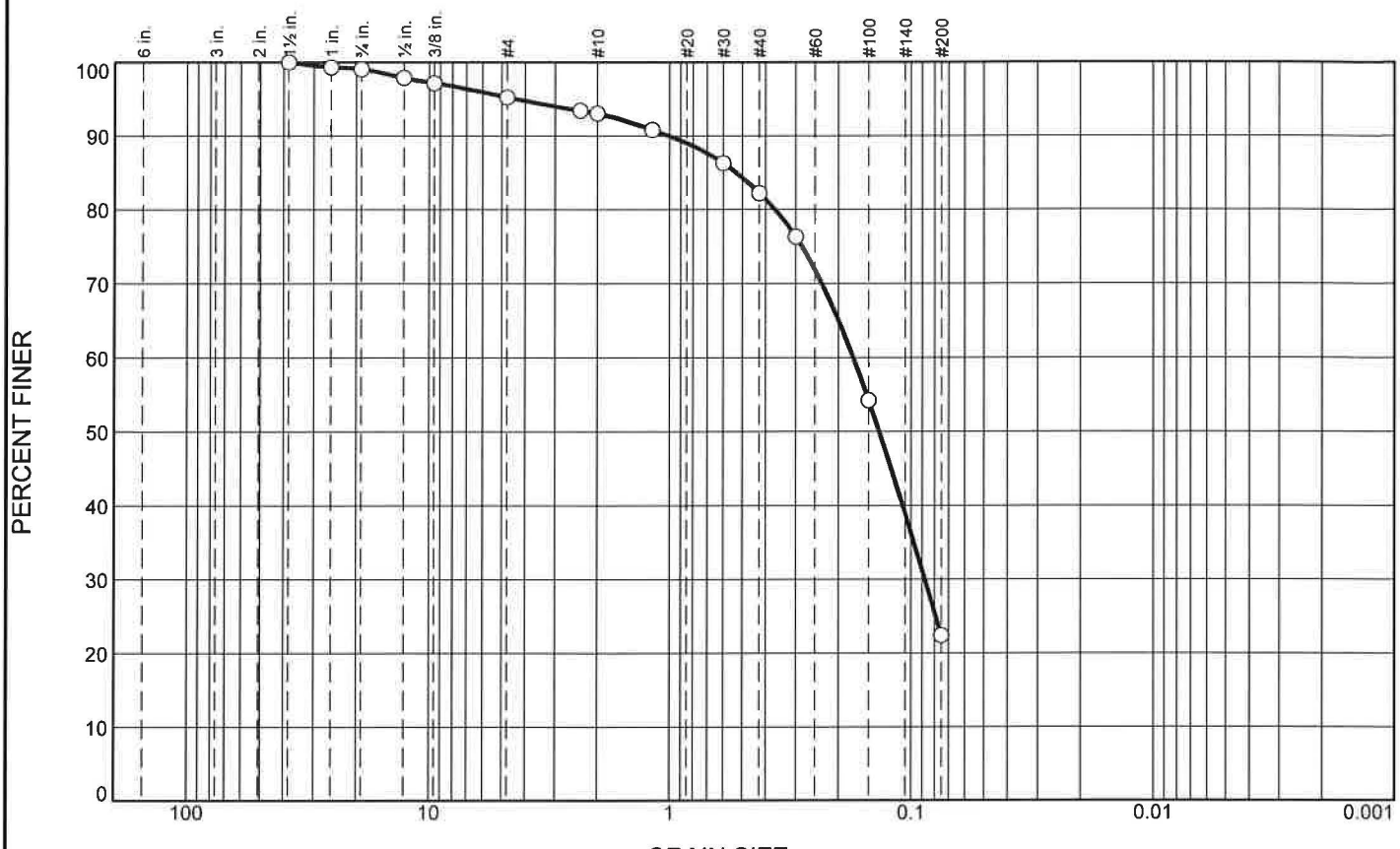
| | SOURCE | SAMPLE NO. | DEPTH | NATURAL WATER CONTENT (%) | PLASTIC LIMIT (%) | LIQUID LIMIT (%) | PLASTICITY INDEX (%) | AASHTO |
|---|---|---|---|---|---|---|---|---|
| ● | LAB#15-265 | 15-265-1 | | N/A | NP | NV | NP | A-2-4(0) |
| ■ | LAB#15-265 | 15-265-2 | | N/A | NP | NV | NP | A-2-4(0) |
| ▲ | LAB#15-265 | 15-265-3 | | N/A | NP | NV | NP | A-1-b |
| ◆ | LAB#15-265 | 15-265-4 | | N/A | NP | NV | NP | A-2-4(0) |
| ▼ | LAB#15-265 | 15-265-5 | | N/A | NP | NV | NP | A-1-a |
| ✱ | LAB#15-265 | 15-265-6 | | N/A | NP | NV | NP | A-2-4(0) |
| ⊕ | LAB#15-265 | 15-265-7 | | N/A | NP | NV | NP | A-1-a |
| ⊞ | LAB#15-265 | 15-265-8 | | | NP | NV | NP | A-2-4(0) |

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.
GES

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH
**Project No.:** 2015 MISC **Figure**

**Tested By:** ● A. SANDERS ■ A. SANDERS ▲ A. SANDERS ◆ J. JOHNSON ▼ J. JOHNSON ✱ J. JOHNSON ⊕

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 1 | 4 | 2 | 11 | 60 | 22 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 1.5 | 100 | | |
| 1 | 99 | | |
| .75 | 99 | | |
| .5 | 98 | | |
| .375 | 97 | | |
| #4 | 95 | | |
| #8 | 93 | | |
| #10 | 93 | | |
| #16 | 91 | | |
| #30 | 86 | | |
| #40 | 82 | | |
| #50 | 76 | | |
| #100 | 54 | | |
| #200 | 22 | | |

* (no specification provided)

**Soil Description**

Silty sand

**Atterberg Limits**

PL= NP LL= NV PI= NP

**Coefficients**

$D_{90}$= 1.0121 $D_{85}$= 0.5302 $D_{60}$= 0.1739
$D_{50}$= 0.1357 $D_{30}$= 0.0878 $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= SM AASHTO= A-2-4(0)

**Remarks**

ASTM D6913

**Location:** CONSOLIDATED PIT 1
**Sample Number:** 15-265-1

**Date:** 09/25/15

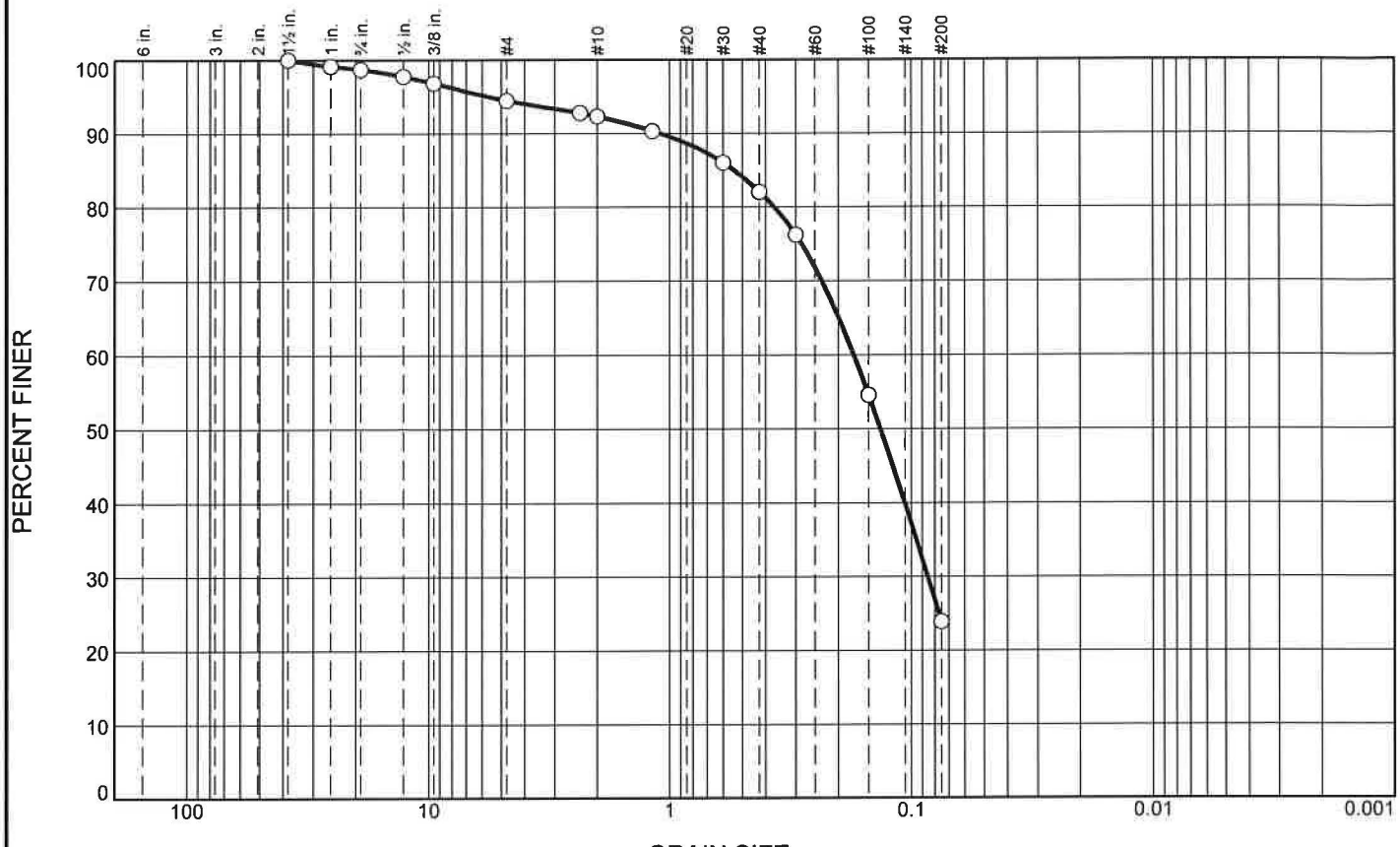
GES **GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.**

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH

**Project No:** 2015 MISC **Figure**

**Tested By:** T. FULLER

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 1 | 5 | 2 | 10 | 58 | 24 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 1.5 | 100 | | |
| 1 | 99 | | |
| .75 | 99 | | |
| .5 | 98 | | |
| .375 | 97 | | |
| #4 | 94 | | |
| #8 | 93 | | |
| #10 | 92 | | |
| #16 | 90 | | |
| #30 | 86 | | |
| #40 | 82 | | |
| #50 | 76 | | |
| #100 | 55 | | |
| #200 | 24 | | |

* (no specification provided)

**Soil Description**

Silty sand

**Atterberg Limits**

PL= NP LL= NV PI= NP

**Coefficients**

$D_{90}$= 1.1050 $D_{85}$= 0.5423 $D_{60}$= 0.1729
$D_{50}$= 0.1340 $D_{30}$= 0.0855 $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= SM AASHTO= A-2-4(0)

**Remarks**

SAMPLED BY: CLIENT
ASTM D6913

**Location:** UNCONSOLIDATED PIT 1
**Sample Number:** 15-265-2

**Date:** 9/25/15

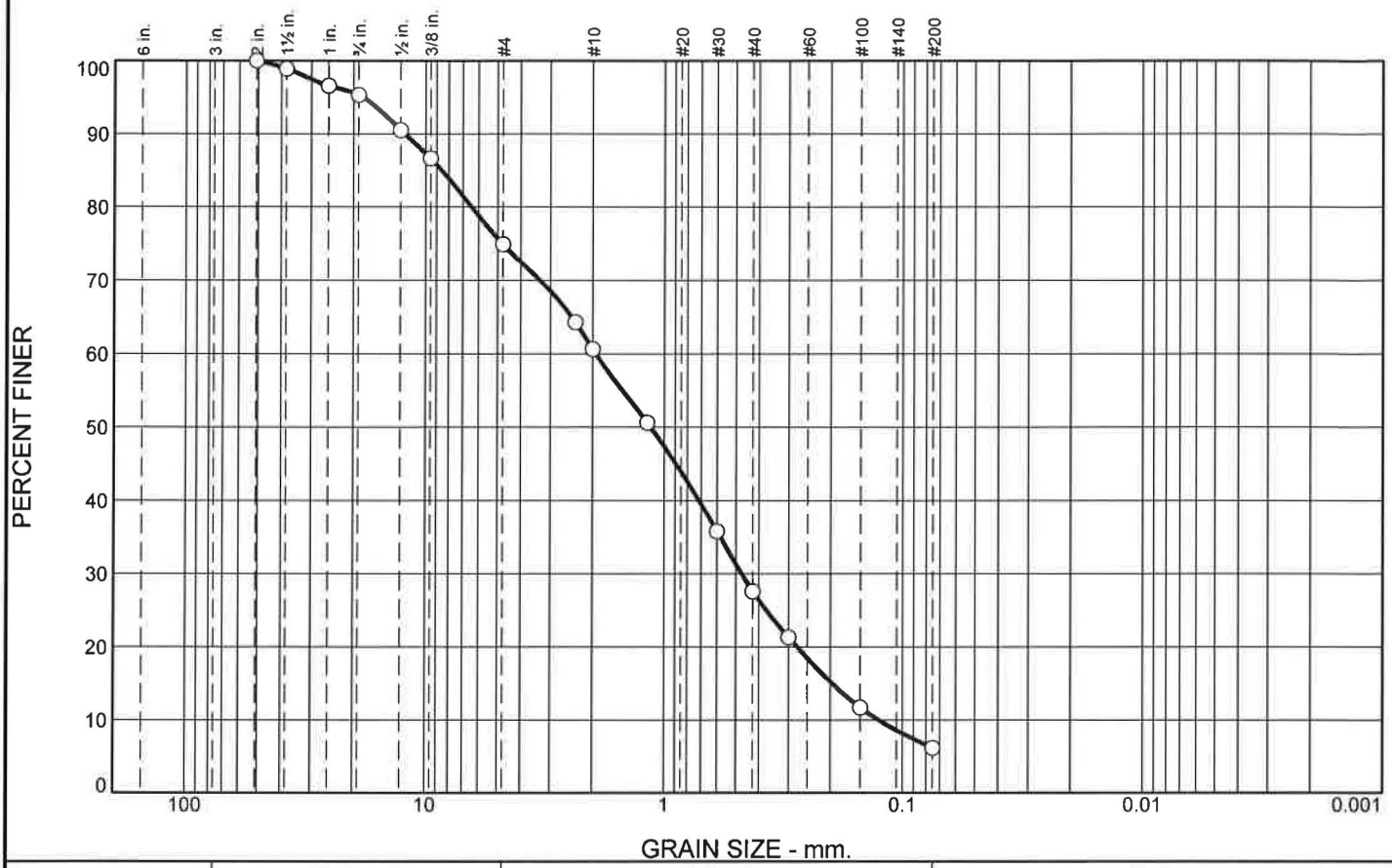
GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH

**Project No:** 2015 MISC **Figure**

**Tested By:** T. FULLER

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 5 | 20 | 14 | 33 | 22 | 6 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 2 | 100 | | |
| 1.5 | 99 | | |
| 1 | 97 | | |
| .75 | 95 | | |
| .5 | 90 | | |
| .375 | 87 | | |
| #4 | 75 | | |
| #8 | 64 | | |
| #10 | 61 | | |
| #16 | 51 | | |
| #30 | 36 | | |
| #40 | 28 | | |
| #50 | 21 | | |
| #100 | 12 | | |
| #200 | 6.2 | | |

* (no specification provided)

**Soil Description**

Poorly graded sand with silt and gravel

**Atterberg Limits**

PL= NP LL= NV PI= NP

**Coefficients**

$D_{90}$= 12.2372 $D_{85}$= 8.5797 $D_{60}$= 1.9434
$D_{50}$= 1.1421 $D_{30}$= 0.4726 $D_{15}$= 0.1966
$D_{10}$= 0.1260 $C_u$= 15.42 $C_c$= 0.91

**Classification**

USCS= SP-SM AASHTO= A-1-b

**Remarks**

SAMPLED BY: CLIENT
ASTM D6913

**Location:** CONSOLIDADED PIT 2
**Sample Number:** 15-265-3

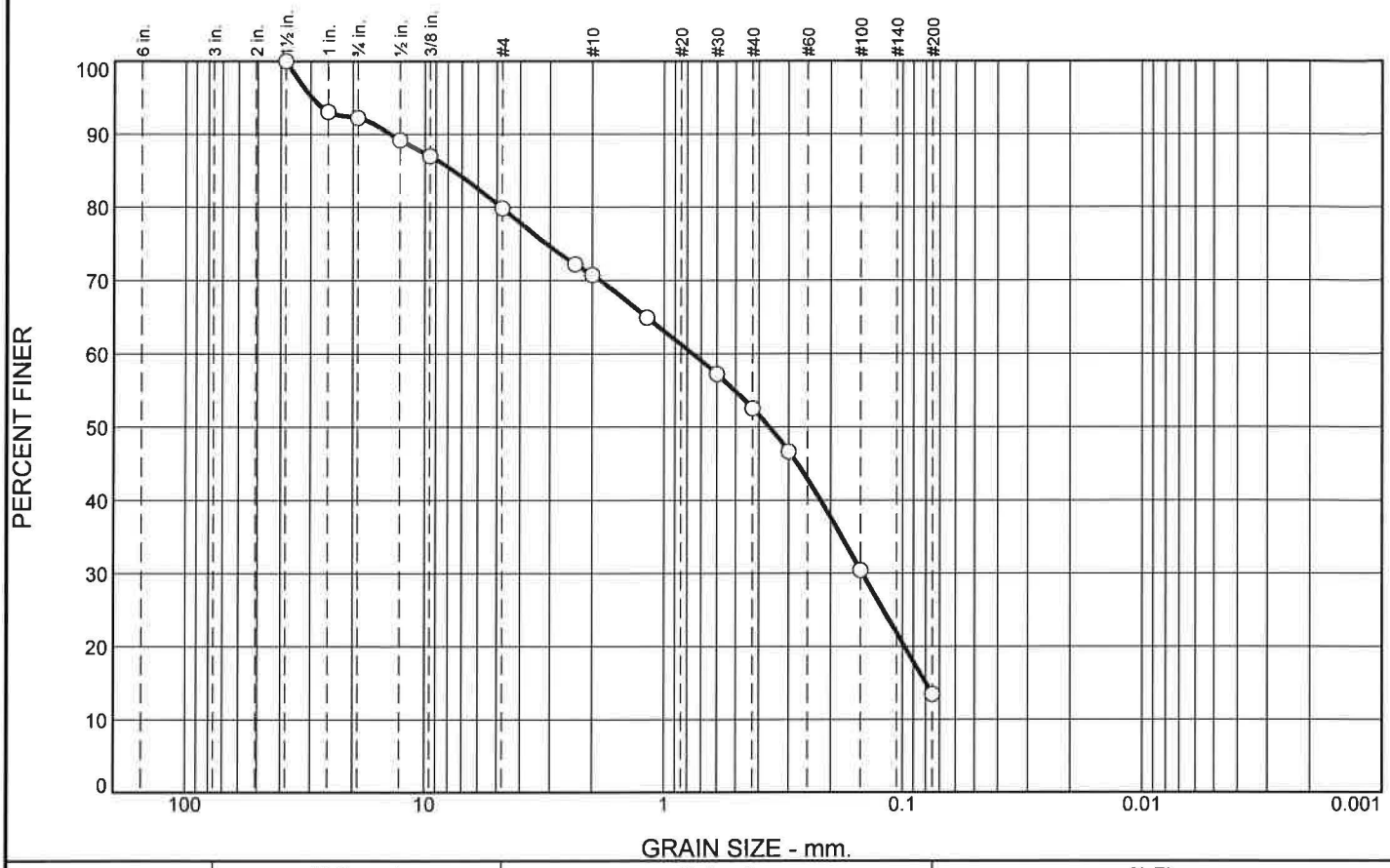
**Date:** 9/25/15

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH
**Project No:** 2015 MISC **Figure**

**Tested By:** T. FULLER

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 8 | 12 | 9 | 18 | 40 | 13 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 1.5 | 100 | | |
| 1 | 93 | | |
| .75 | 92 | | |
| .5 | 89 | | |
| .375 | 87 | | |
| #4 | 80 | | |
| #8 | 72 | | |
| #10 | 71 | | |
| #16 | 65 | | |
| #30 | 57 | | |
| #40 | 53 | | |
| #50 | 47 | | |
| #100 | 30 | | |
| #200 | 13 | | |

* (no specification provided)

**Soil Description**

Silty sand with gravel

**Atterberg Limits**

PL= NP LL= NV PI= NP

**Coefficients**

$D_{90}$= 13.9402 $D_{85}$= 7.6182 $D_{60}$= 0.7597
$D_{50}$= 0.3609 $D_{30}$= 0.1472 $D_{15}$= 0.0799
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= SM AASHTO= A-2-4(0)

**Remarks**

SAMPLED BY: CLIENT
ASTM D6913

**Location:** UNCONSOLIDATED PIT 2
**Sample Number:** 15-265-4

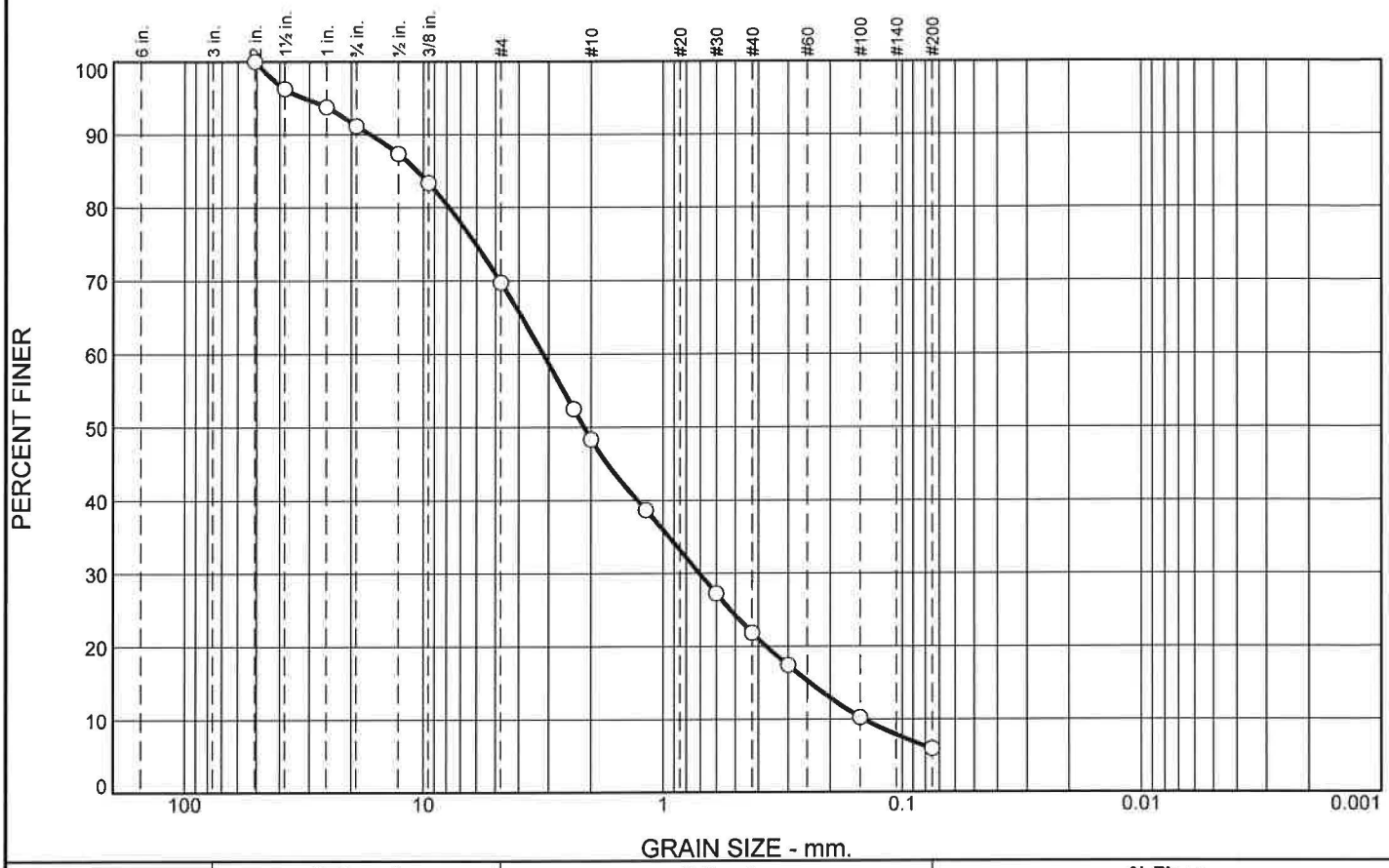
**Date:** 9/25/15

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH
**Project No:** 2015 MISC **Figure**

**Tested By:** J.J./T.F.

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 9 | 21 | 22 | 26 | 16 | 6 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 2 | 100 | | |
| 1.5 | 96 | | |
| 1 | 94 | | |
| .75 | 91 | | |
| .5 | 87 | | |
| .375 | 83 | | |
| #4 | 70 | | |
| #8 | 52 | | |
| #10 | 48 | | |
| #16 | 39 | | |
| #30 | 27 | | |
| #40 | 22 | | |
| #50 | 17 | | |
| #100 | 10 | | |
| #200 | 5.9 | | |

* (no specification provided)

**Soil Description**

Well-graded sand with silt and gravel

**Atterberg Limits**

PL= NP LL= NV PI= NP

**Coefficients**

$D_{90}$= 16.6904 $D_{85}$= 10.5793 $D_{60}$= 3.1662
$D_{50}$= 2.1415 $D_{30}$= 0.7048 $D_{15}$= 0.2433
$D_{10}$= 0.1452 $C_u$= 21.80 $C_c$= 1.08

**Classification**

USCS= SW-SM AASHTO= A-1-a

**Remarks**

SAMPLED BY: CLIENT
ASTM D6913

**Location:** CONSOLIDATED PIT 3
**Sample Number:** 15-265-5

**Date:** 9/25/15

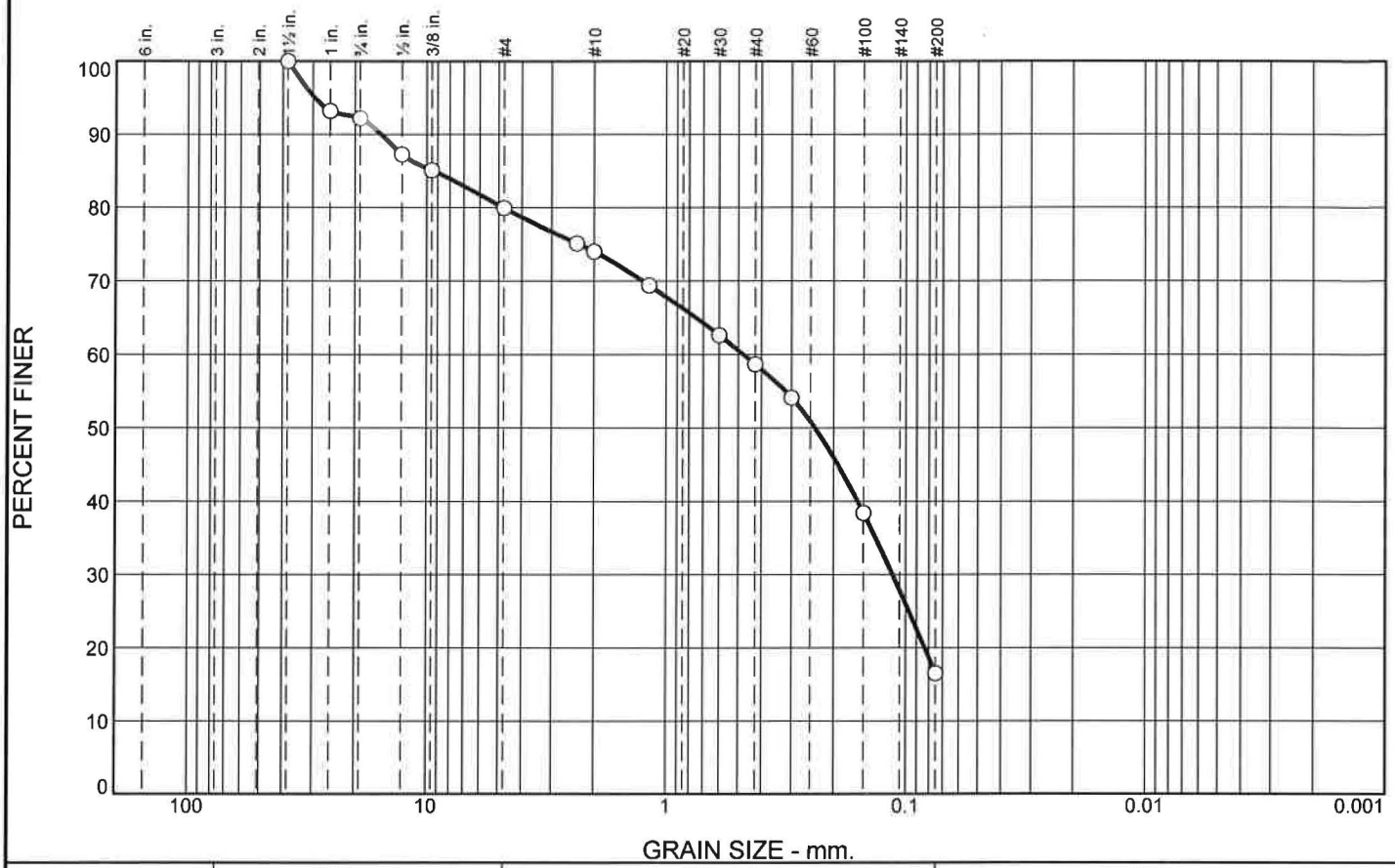
GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH

**Project No:** 2015 MISC **Figure**

**Tested By:** J.J./T.F.

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 8 | 12 | 6 | 15 | 42 | 17 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 1.5 | 100 | | |
| 1 | 93 | | |
| .75 | 92 | | |
| .5 | 87 | | |
| .375 | 85 | | |
| #4 | 80 | | |
| #8 | 75 | | |
| #10 | 74 | | |
| #16 | 69 | | |
| #30 | 63 | | |
| #40 | 59 | | |
| #50 | 54 | | |
| #100 | 38 | | |
| #200 | 17 | | |

* (no specification provided)

**Soil Description**

Silty sand with gravel

**Atterberg Limits**

PL= NP LL= NV PI= NP

**Coefficients**

$D_{90}$= 15.5825 $D_{85}$= 9.4044 $D_{60}$= 0.4768
$D_{50}$= 0.2395 $D_{30}$= 0.1135 $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= SM AASHTO= A-2-4(0)

**Remarks**

SAMPLED BY: CLIENT
ASTM D6913

**Location:** UNCONSOLIDATED PIT 3
**Sample Number:** 15-265-6

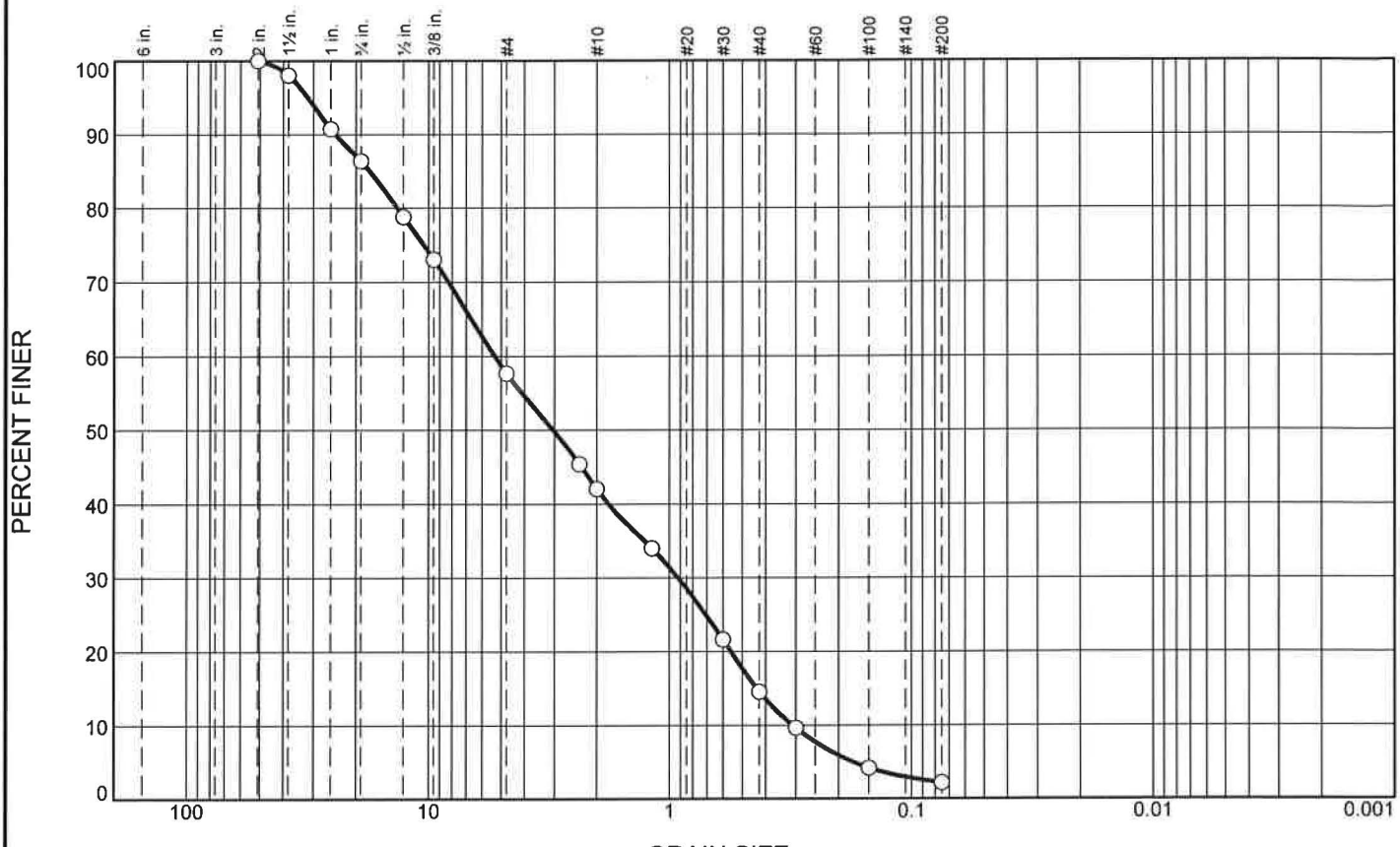
**Date:** 9/25/15

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH
**Project No:** 2015 MISC **Figure**

**Tested By:** J.J./T.F.

# Particle Size Distribution Report




| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 14 | 28 | 16 | 27 | 13 | 2 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 2 | 100 | | |
| 1.5 | 98 | | |
| 1 | 91 | | |
| .75 | 86 | | |
| .5 | 79 | | |
| .375 | 73 | | |
| #4 | 58 | | |
| #8 | 45 | | |
| #10 | 42 | | |
| #16 | 34 | | |
| #30 | 22 | | |
| #40 | 15 | | |
| #50 | 10 | | |
| #100 | 4 | | |
| #200 | 2.2 | | |

* (no specification provided)

**Soil Description**

Poorly graded sand with gravel

**Atterberg Limits**

PL= NP LL= NV PI= NP

**Coefficients**

$D_{90}$= 24.3198 $D_{85}$= 17.5252 $D_{60}$= 5.3235
$D_{50}$= 3.0349 $D_{30}$= 0.9208 $D_{15}$= 0.4359
$D_{10}$= 0.3099 $C_u$= 17.18 $C_c$= 0.51

**Classification**

USCS= SP AASHTO= A-1-a

**Remarks**

SAMPLED BY: CLIENT
ASTM D6913

**Location:** CONSOLIDATED PIT 4
**Sample Number:** 15-265-7

**Date:** 9/25/15

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH
**Project No:** 2015 MISC **Figure**

**Tested By:** J.J./T.F.

# Particle Size Distribution Report

| % +3" | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|
| | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| 0 | 6 | 13 | 7 | 17 | 39 | 18 | |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|---|---|---|---|
| 2 | 100 | | |
| 1.5 | 98 | | |
| 1 | 96 | | |
| .75 | 94 | | |
| .5 | 91 | | |
| .375 | 88 | | |
| #4 | 81 | | |
| #8 | 75 | | |
| #10 | 74 | | |
| #16 | 70 | | |
| #30 | 63 | | |
| #40 | 57 | | |
| #50 | 51 | | |
| #100 | 36 | | |
| #200 | 18 | | |

* (no specification provided)

**Soil Description**

Silty sand with gravel

**Atterberg Limits**

PL= NP LL= NV PI= NP

**Coefficients**

$D_{90}$= 11.5970 $D_{85}$= 7.0198 $D_{60}$= 0.5152
$D_{50}$= 0.2905 $D_{30}$= 0.1193 $D_{15}$=
$D_{10}$= $C_u$= $C_c$=

**Classification**

USCS= SM AASHTO= A-2-4(0)

**Remarks**

SAMPLED BY: CLIENT
ASTM D6913

**Location:** UNCONSOLIDATED PIT 4
**Sample Number:** 15-265-8

**Date:** 9/25/15

GES GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Project:** USE TRENCH 13 GEOTECH

**Project No:** 2015 MISC **Figure**

**Tested By:** J.J./T.F.

# COMPACTION TEST REPORT

**Curve No.: 15-265-1**

**Project No.:** 2015 MISC **Date:** 09/16/15
**Project:** USE TRENCH 13 GEOTECH
**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Location:** CONSOLIDATED PIT 1
**Sample Number:** 15-265-1
**Remarks:**

**MATERIAL DESCRIPTION**

**Description:** Silty sand

**Classifications -** **USCS:** SM **AASHTO:** A-2-4(0)
**Nat. Moist. =** N/A % **Sp.G. =** 2.65
**Liquid Limit =** NV **Plasticity Index =** NP
**% < No.200 =** 22 %

| ROCK CORRECTED TEST RESULTS |
|---|
| Maximum dry density = 123.0 pcf |
| Optimum moisture = 8.5 % |

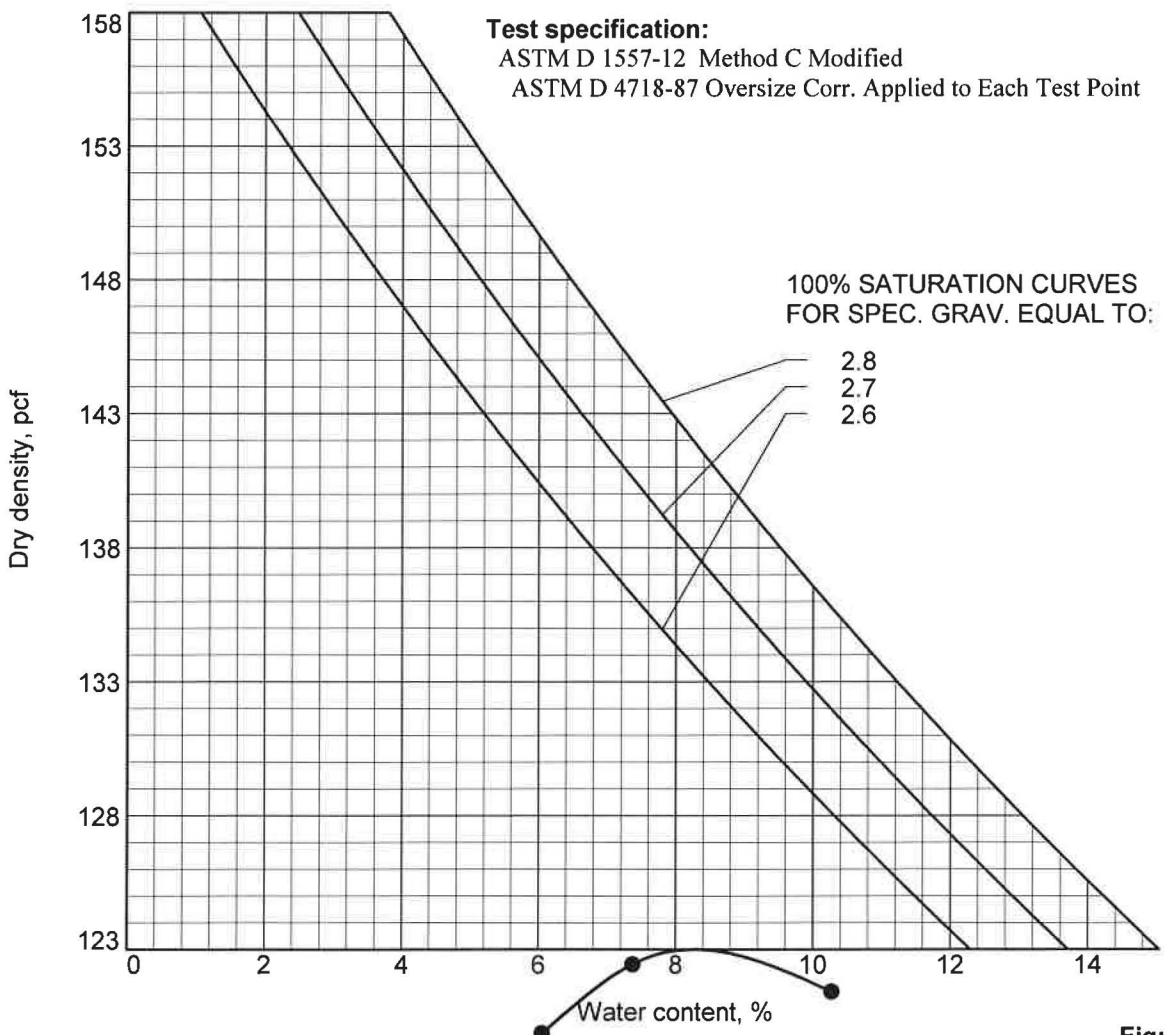



**Figure** 15-265-1

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Tested By:** T. FULLER

# COMPACTION TEST REPORT

**Curve No.: 15-265-2**

**Project No.:** 2015 MISC **Date:** 09/16/15
**Project:** USE TRENCH 13 GEOTECH
**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Location:** UNCONSOLIDATED PIT 1
**Sample Number:** 15-265-2
**Remarks:**

**MATERIAL DESCRIPTION**

**Description:** Silty sand

**Classifications -** **USCS:** SM **AASHTO:** A-2-4(0)
**Nat. Moist. =** N/A % **Sp.G. =** 2.65
**Liquid Limit =** NV **Plasticity Index =** NP
**% < No.200 =** 24 %

| ROCK CORRECTED TEST RESULTS |
|---|
| Maximum dry density = 118.0 pcf |
| Optimum moisture = 10.5 % |

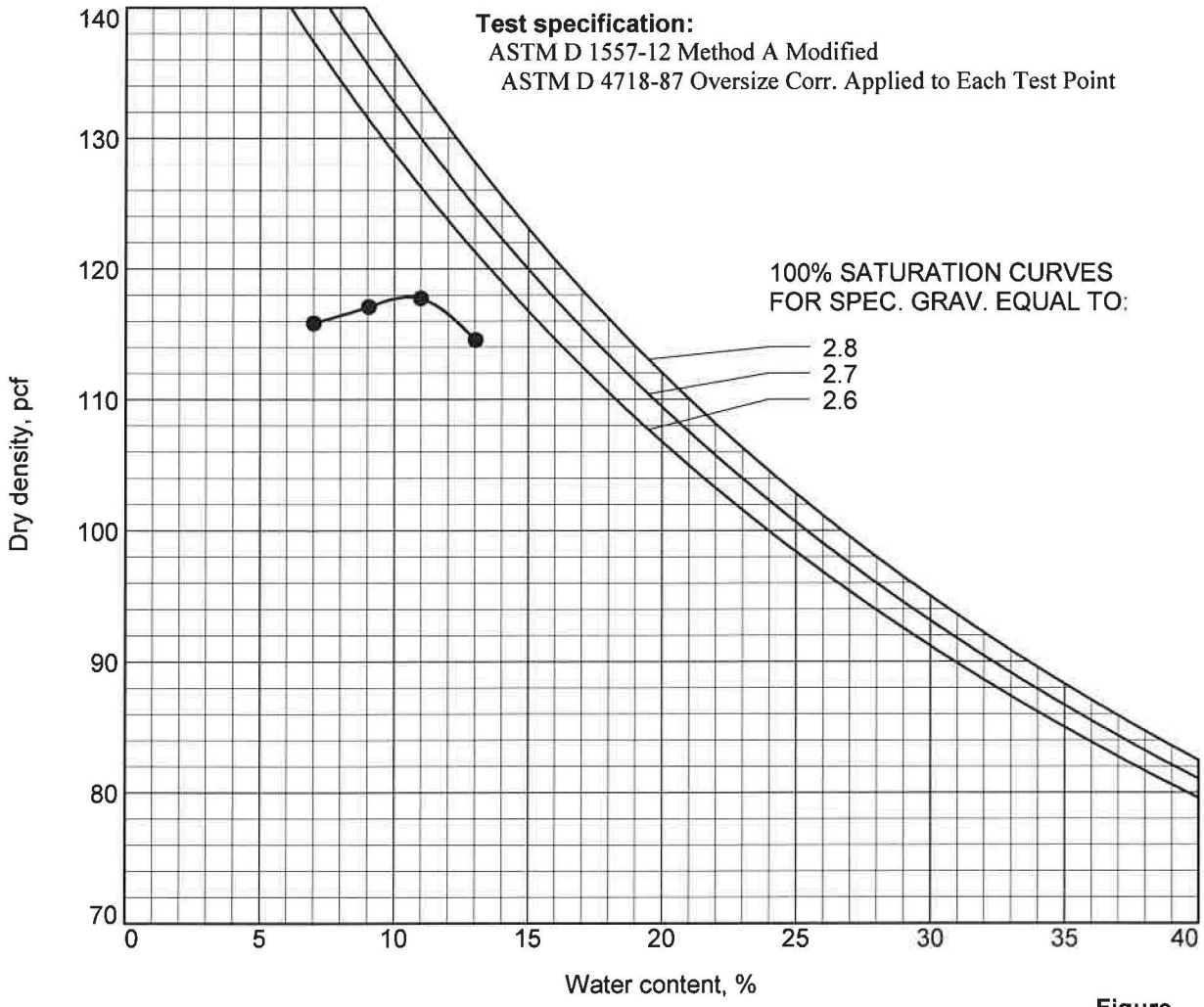



**Figure** 15-265-2

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Tested By:** J. JOHNSON

# COMPACTION TEST REPORT

**Curve No.: 15-265-3**

**Project No.:** 2015 MISC **Date:** 09/18/15
**Project:** USE TRENCH 13 GEOTECH
**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Location:** CONSOLIDADED PIT 2
**Sample Number:** 15-265-3
**Remarks:**

**MATERIAL DESCRIPTION**

**Description:** Poorly graded sand with silt and gravel

**Classifications -** **USCS:** SP-SM **AASHTO:** A-1-b
**Nat. Moist. =** N/A % **Sp.G. =** 2.65
**Liquid Limit =** NV **Plasticity Index =** NP
**% < No.200 =** 6.2 %

| ROCK CORRECTED TEST RESULTS |
|---|
| Maximum dry density = 125.0 pcf |
| Optimum moisture = 8.5 % |

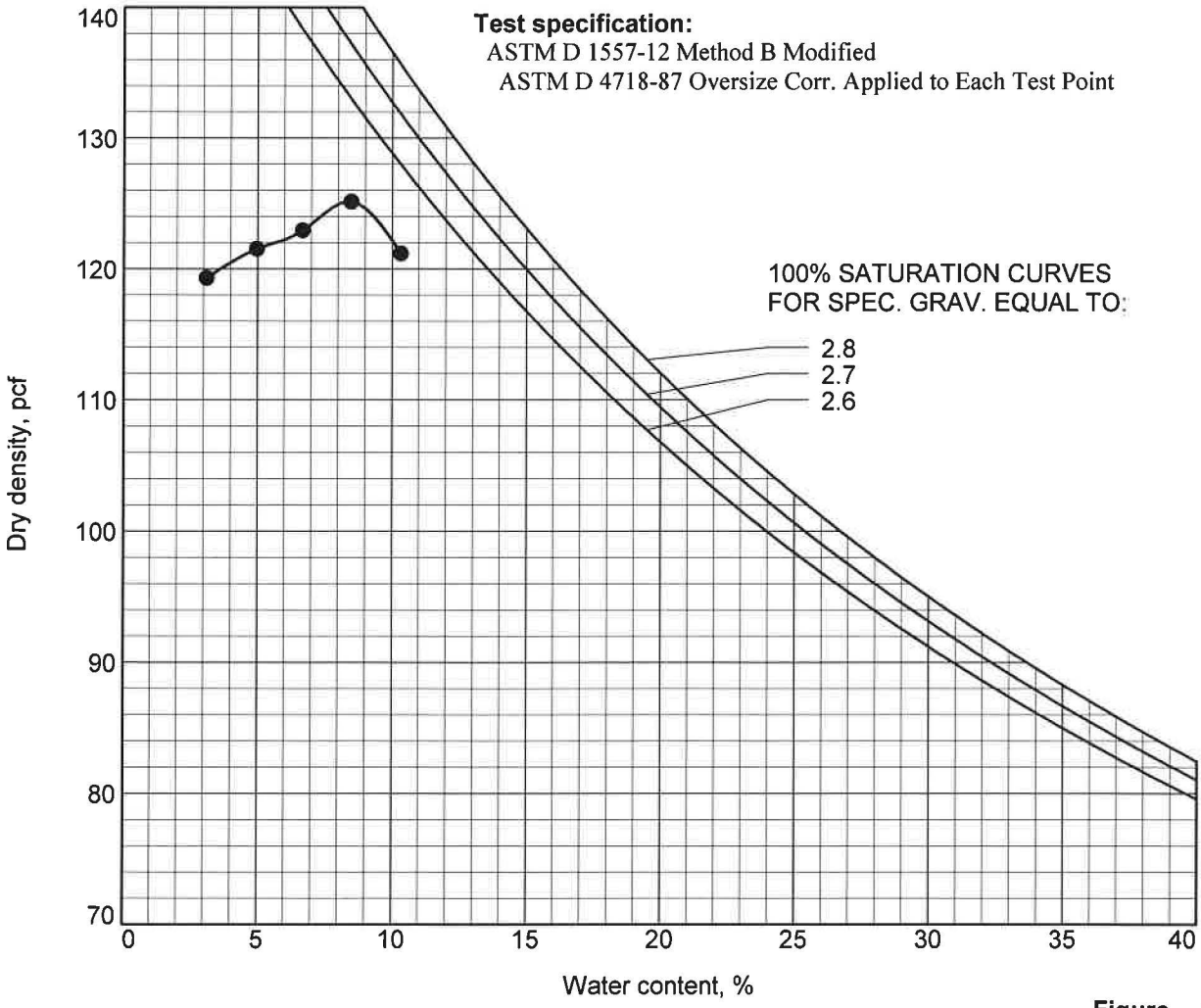



**Figure** 15-265-3

**GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.**

**Tested By:** J. JOHNSON

# COMPACTION TEST REPORT

**Curve No.: 15-265-4**

**Project No.:** 2015 MISC **Date:** 09/18/15
**Project:** USE TRENCH 13 GEOTECH
**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Location:** UNCONSOLIDATED PIT 2
**Sample Number:** 15-265-4
**Remarks:**

**MATERIAL DESCRIPTION**

**Description:** Silty sand with gravel

**Classifications -** **USCS:** SM **AASHTO:** A-2-4(0)
**Nat. Moist. =** N/A % **Sp.G. =** 2.65
**Liquid Limit =** NV **Plasticity Index =** NP
**% < No.200 =** 13 %

| ROCK CORRECTED TEST RESULTS |
|---|
| Maximum dry density = 121.0 pcf |
| Optimum moisture = 10.5 % |

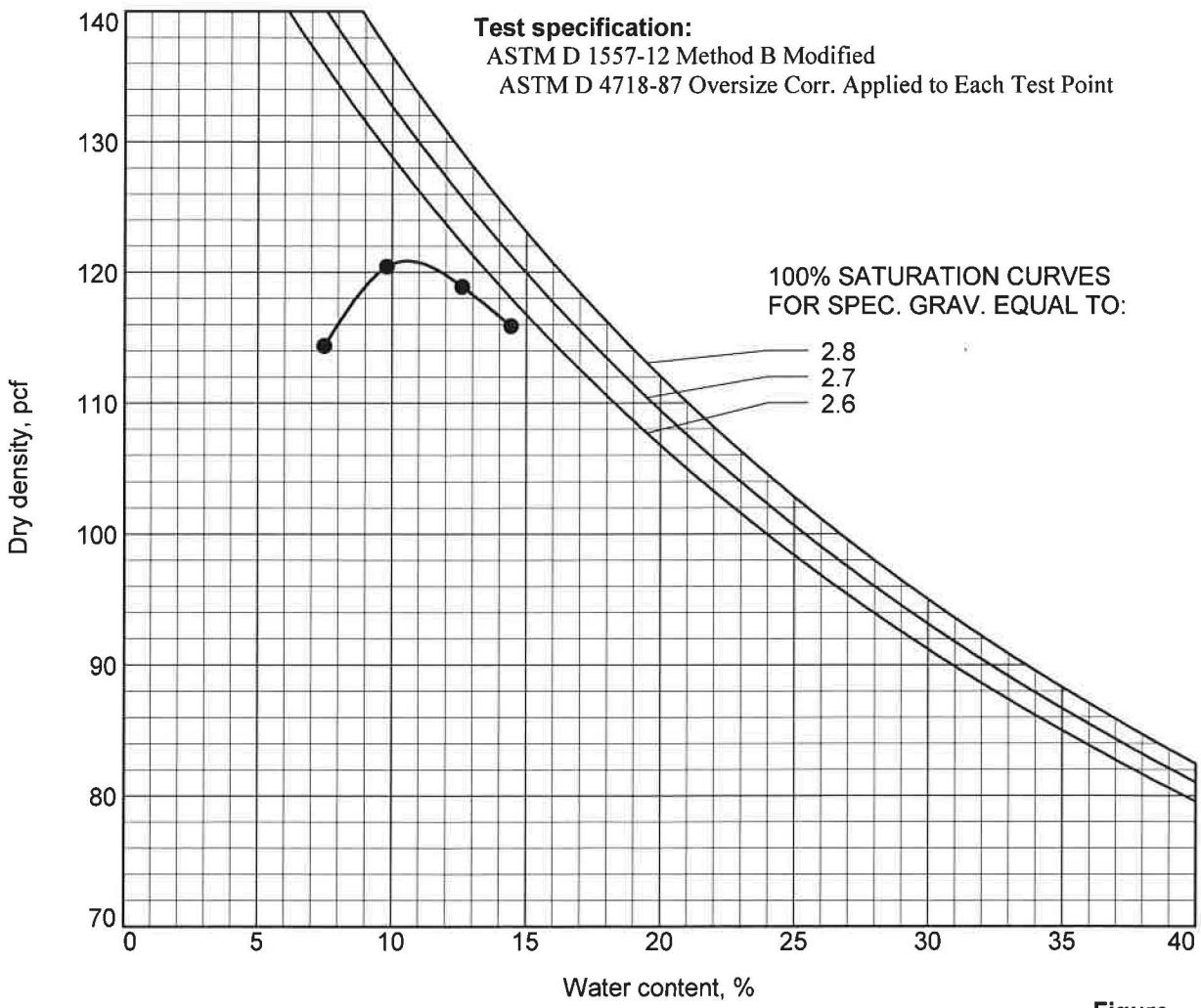



**Figure** 15-265-4

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Tested By:** J. JOHNSON

# COMPACTION TEST REPORT

**Curve No.: 15-265-5**

**Project No.:** 2015 MISC **Date:** 09/18/15
**Project:** USE TRENCH 13 GEOTECH
**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Location:** CONSOLIDATED PIT 3
**Sample Number:** 15-265-5
**Remarks:**

**MATERIAL DESCRIPTION**

**Description:** Well-graded sand with silt and gravel

**Classifications -** **USCS:** SW-SM **AASHTO:** A-1-a
**Nat. Moist. =** N/A % **Sp.G. =** 2.65
**Liquid Limit =** NV **Plasticity Index =** NP
**% < No.200 =** 5.9 %

| ROCK CORRECTED TEST RESULTS |
|---|
| Maximum dry density = 132.0 pcf |
| Optimum moisture = 7.0 % |

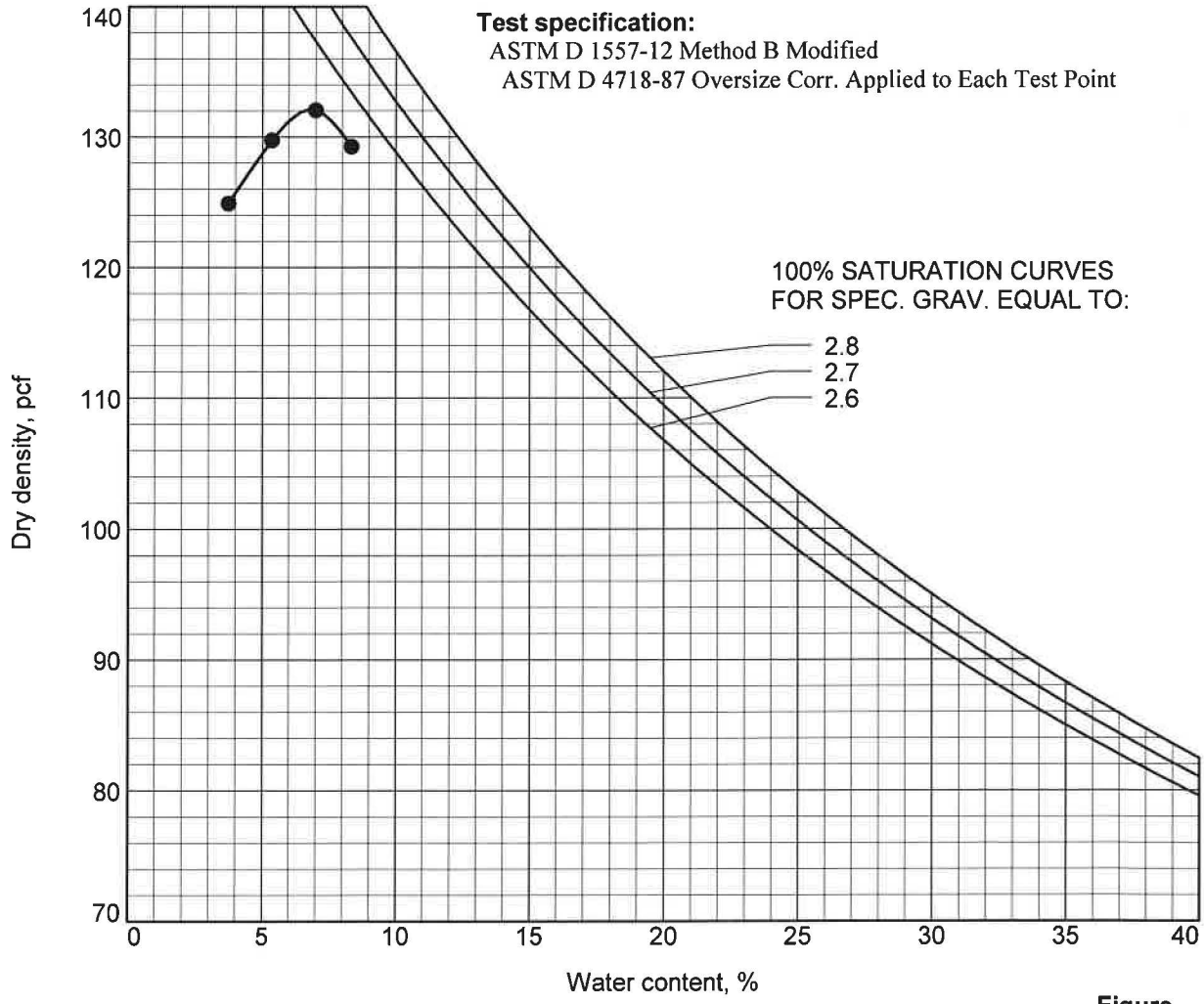



**Figure** 15-265-5

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Tested By:** T. FULLER

# COMPACTION TEST REPORT

**Curve No.: 15-265-6**

**Project No.:** 2015 MISC **Date:** 09/18/15
**Project:** USE TRENCH 13 GEOTECH
**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Location:** UNCONSOLIDATED PIT 3
**Sample Number:** 15-265-6
**Remarks:**

**MATERIAL DESCRIPTION**

**Description:** Silty sand with gravel

**Classifications -** **USCS:** SM **AASHTO:** A-2-4(0)
**Nat. Moist. =** N/A % **Sp.G. =** 2.65
**Liquid Limit =** NV **Plasticity Index =** NP
**% < No.200 =** 17 %

| ROCK CORRECTED TEST RESULTS |
|---|
| Maximum dry density = 124.0 pcf |
| Optimum moisture = 8.0 % |

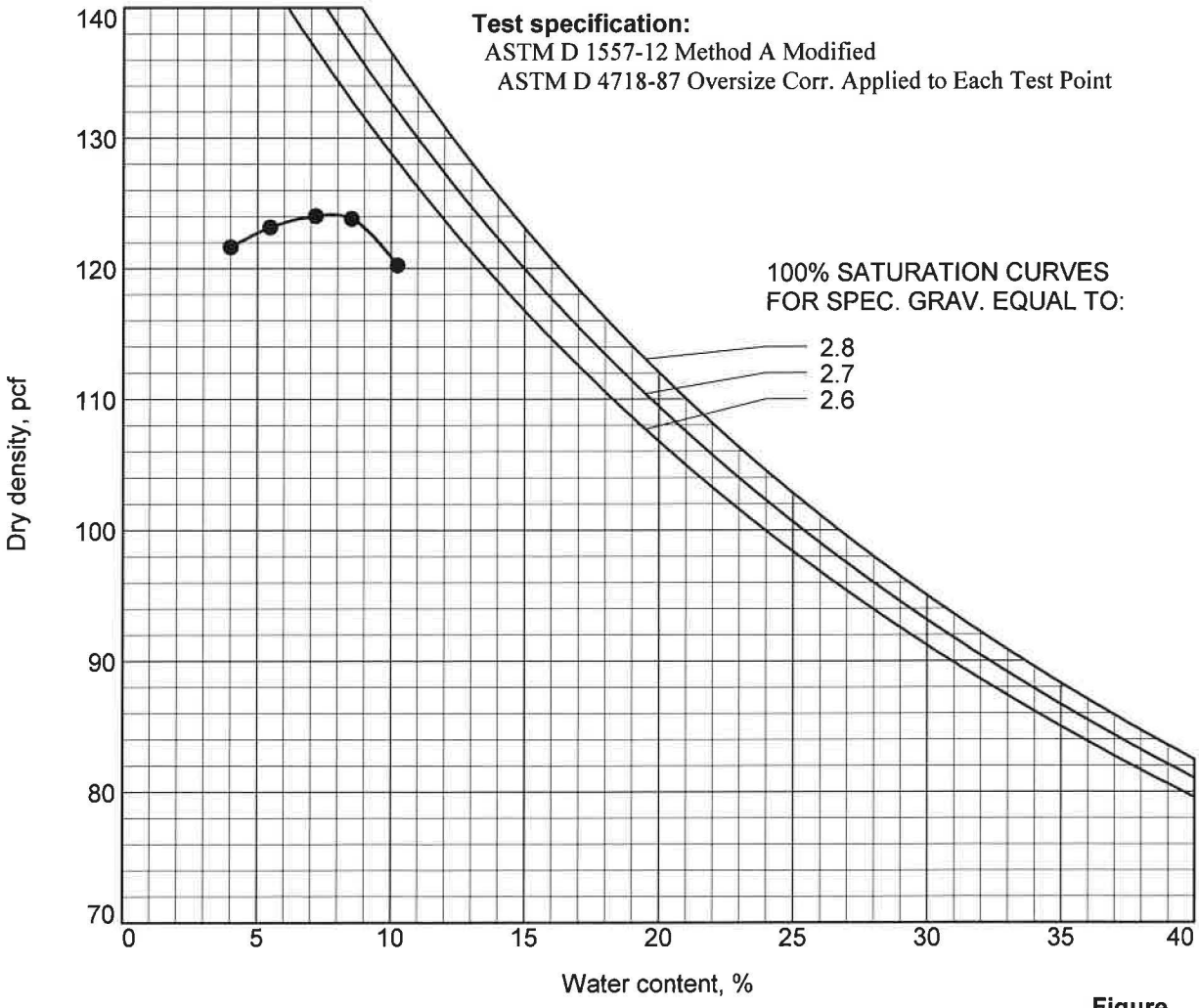



**Figure** 15-265-6

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Tested By:** J. JOHNSON

# COMPACTION TEST REPORT

**Curve No.: 15-265-7**

**Project No.:** 2015 MISC **Date:** 09/18/15
**Project:** USE TRENCH 13 GEOTECH
**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Location:** CONSOLIDATED PIT 4
**Sample Number:** 15-265-7
**Remarks:**

**MATERIAL DESCRIPTION**

**Description:** Poorly graded sand with gravel

**Classifications -** **USCS:** SP **AASHTO:** A-1-a
**Nat. Moist. =** N/A % **Sp.G. =** 2.65
**Liquid Limit =** NV **Plasticity Index =** NP
**% < No.200 =** 2.2 %

| ROCK CORRECTED TEST RESULTS |
|---|
| Maximum dry density = 126.5 pcf |
| Optimum moisture = 6.0 % |

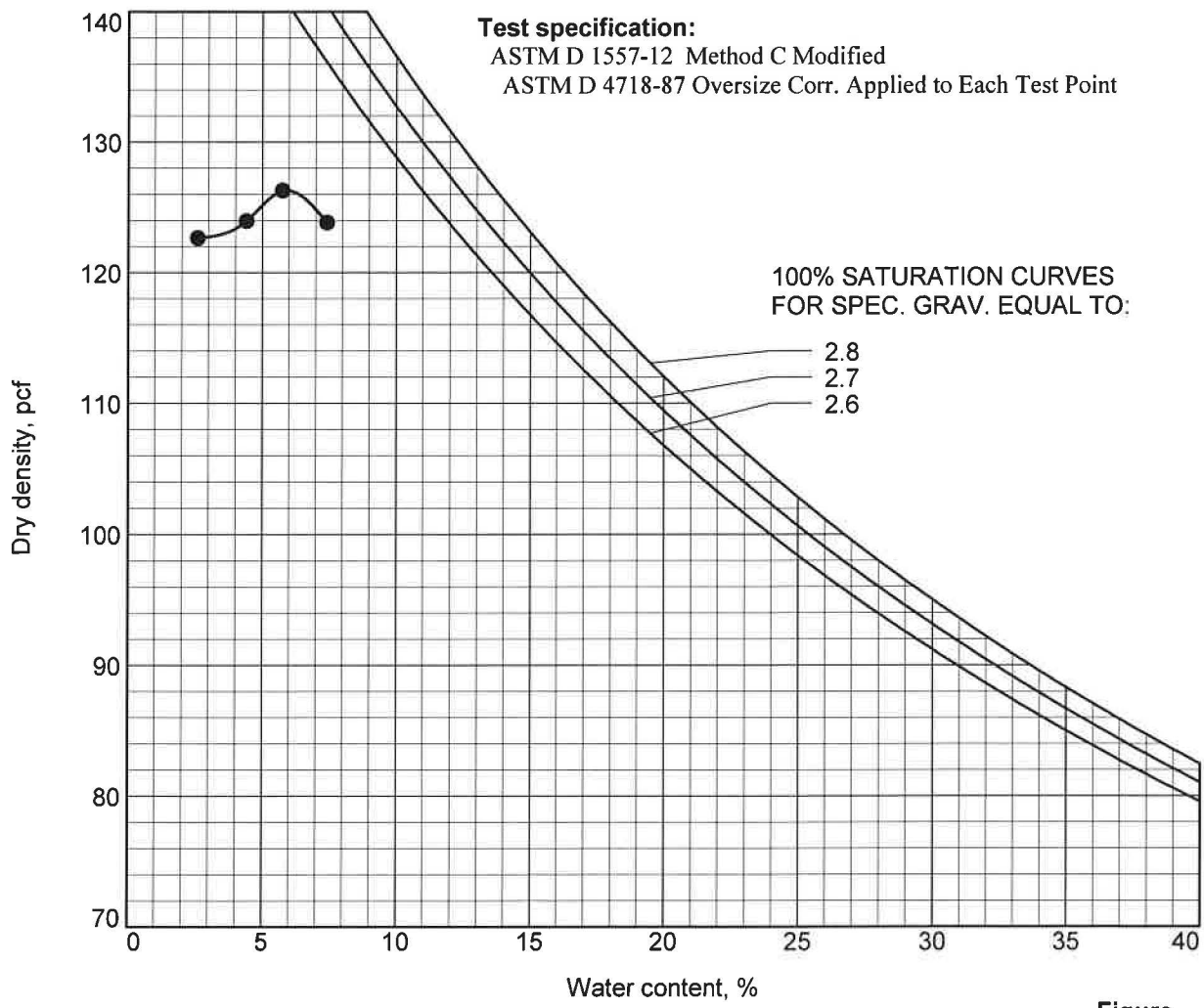



**Figure** 15-265-7

GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Tested By:** T. FULLER

# COMPACTION TEST REPORT

**Curve No.: 15-265-8**

**Project No.:** 2015 MISC **Date:** 9/18/15
**Project:** USE TRENCH 13 GEOTECH
**Client:** SWIFT RIVER ENVIRONMENTAL SERVICES
**Location:** UNCONSOLIDATED PIT 4
**Sample Number:** 15-265-8
**Remarks:** SAMPLED BY: CLIENT

**MATERIAL DESCRIPTION**

**Description:** Silty sand with gravel

**Classifications -** **USCS:** SM **AASHTO:** A-2-4(0)
**Nat. Moist. =**
**Liquid Limit =** NV
**Sp.G. =** 2.65
**Plasticity Index =** NP
**% < No.200 =** 18 %

| ROCK CORRECTED TEST RESULTS |
|---|
| Maximum dry density = 127.0 pcf |
| Optimum moisture = 7.5 % |

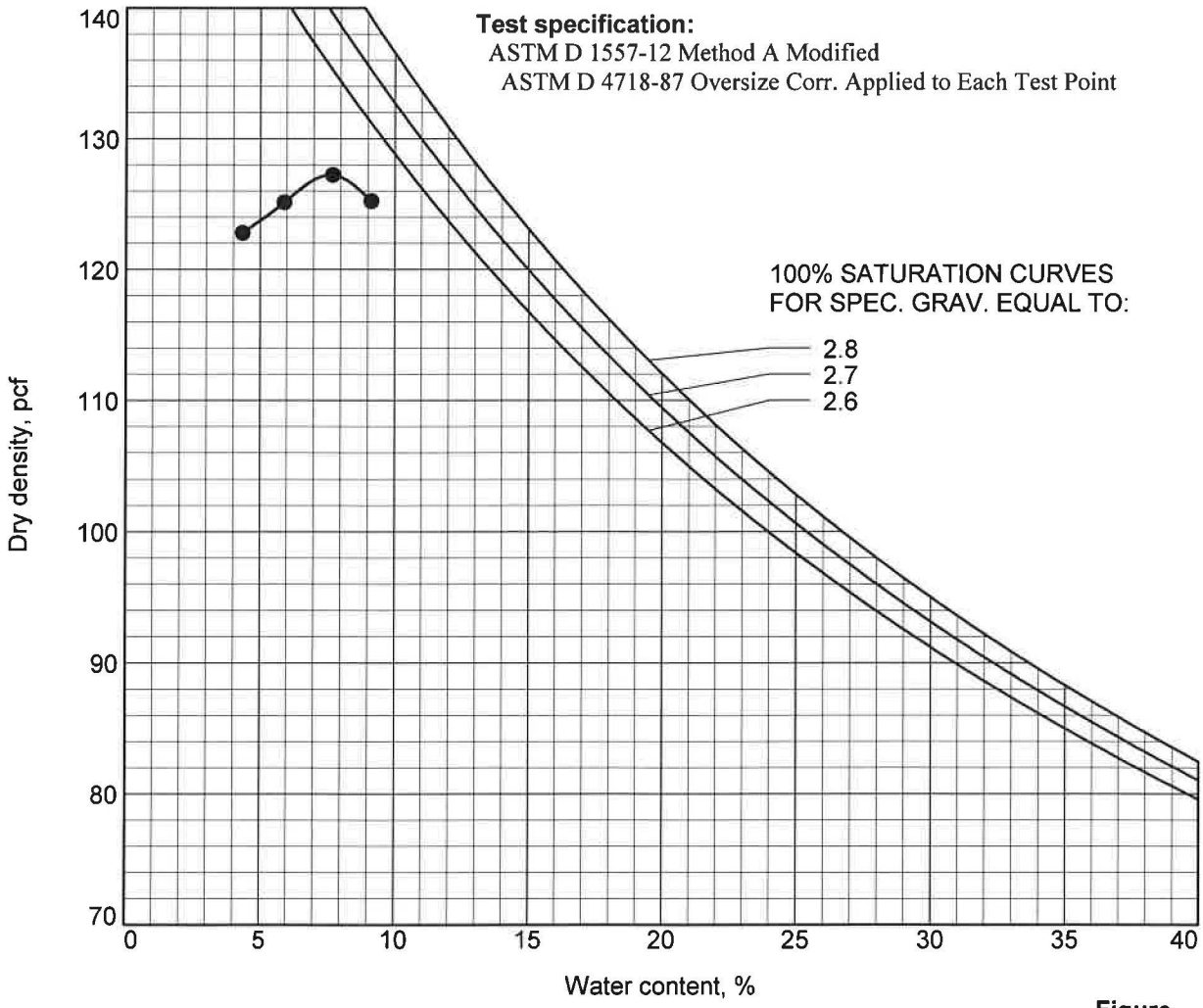
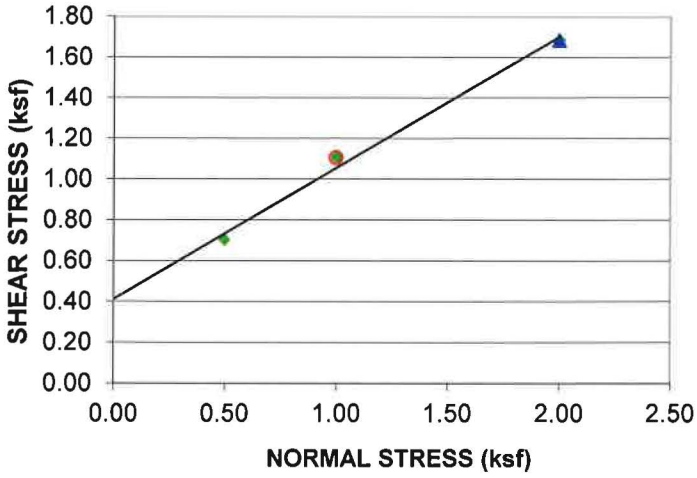



**Figure** 15-265-8

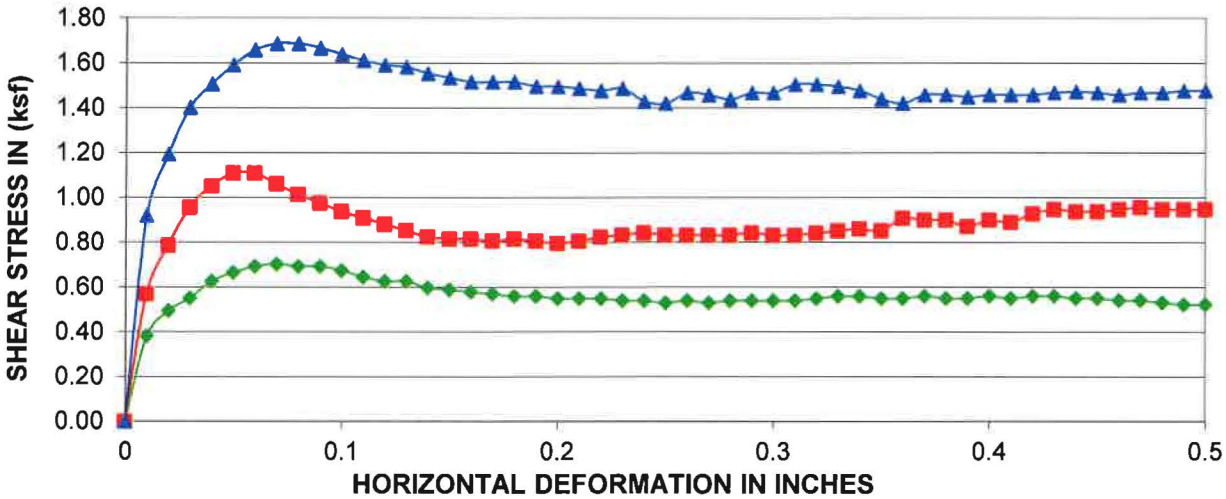
GEOTECHNICAL & ENVIRONMENTAL SERVICES, INC.

**Tested By:** J. JOHNSON

# DIRECT SHEAR TEST




| | |
|---|---|
| STRENGTH INTERCEPT: | 0.41 KSF |
| FRICTION ANGLE (PHI) | 32.8 DEG. |




| SYMBOL | MOISTURE CONTENT % | DRY DENSITY (pcf) | NORMAL STRESS (ksf) | PEAK SHEAR (ksf) | RESIDUAL SHEAR (ksf) |
|---|---|---|---|---|---|
| 1.0 ksf | 6.3 | 117.4 | 0.50 | 0.70 | 0.52 |
| 2.0 ksf | 6.3 | 117.7 | 1.00 | 1.11 | 0.95 |
| 4.0 ksf | 6.3 | 117.9 | 2.00 | 1.69 | 1.48 |

SAMPLED BY: CLIENT TESTED BY: A.S LAB NO: 15-265-1

SOIL DESCRIPTION: SAND DATE OF TEST: 9/17/2015

LOCATION OF SAMPLE: CONSOLIDATED PIT 1

REMARKS:

GES
GEOTECHNICAL & ENVIRONMENTAL SERVICES INC
(702) 365 1001
7150 PLACID STREET
LAS VEGAS, NV 89119

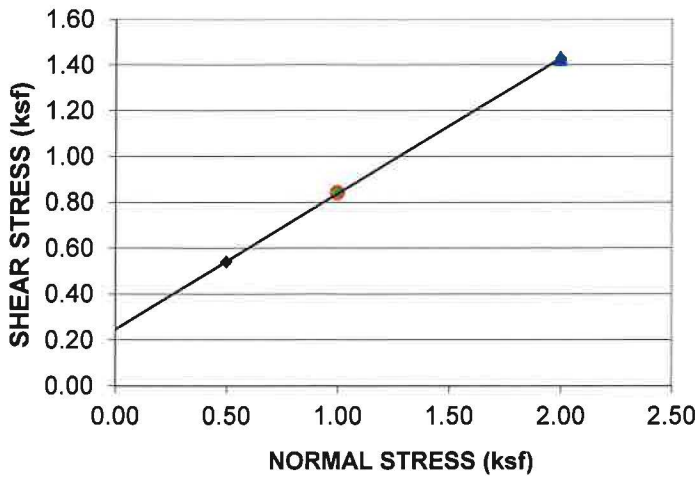
PROJECT NAME: USE TRENCH 13 GEOTECH

CLIENT NAME: SWIFT RIVER ENVIRONMENTAL SERVICES

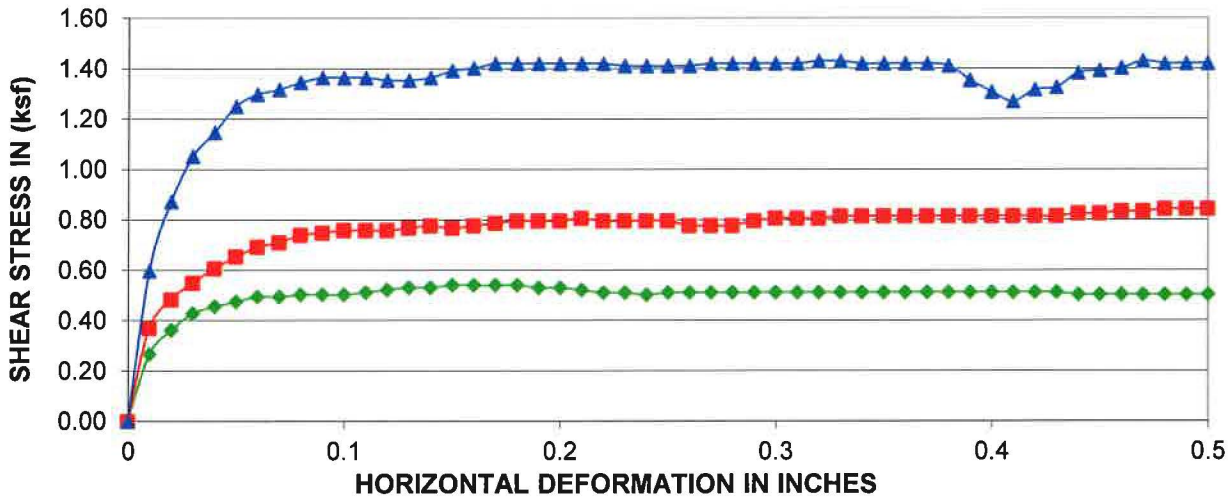
PROJECT NO. 2015MISC

Figure 15-265

# DIRECT SHEAR TEST




| | |
|---|---|
| STRENGTH INTERCEPT: | 0.25 KSF |
| FRICTION ANGLE (PHI) | 30.6 DEG. |




| SYMBOL | MOISTURE CONTENT % | DRY DENSITY (pcf) | NORMAL STRESS (ksf) | PEAK SHEAR (ksf) | RESIDUAL SHEAR (ksf) |
|---|---|---|---|---|---|
| 1.0 ksf | 10.7 | 105.7 | 0.50 | 0.54 | 0.50 |
| 2.0 ksf | 10.7 | 105.9 | 1.00 | 0.84 | 0.84 |
| 4.0 ksf | 10.7 | 106.0 | 2.00 | 1.43 | 1.42 |

SAMPLED BY: CLIENT TESTED BY: A.S LAB NO: 15-265-2

SOIL DESCRIPTION: SAND DATE OF TEST: 9/16/2015

LOCATION OF SAMPLE: UNCONSOLITATED PIT 1

REMARKS:

GES
GEOTECHNICAL & ENVIRONMENTAL SERVICES INC
(702) 365 1001
7150 PLACID STREET
LAS VEGAS, NV 89119

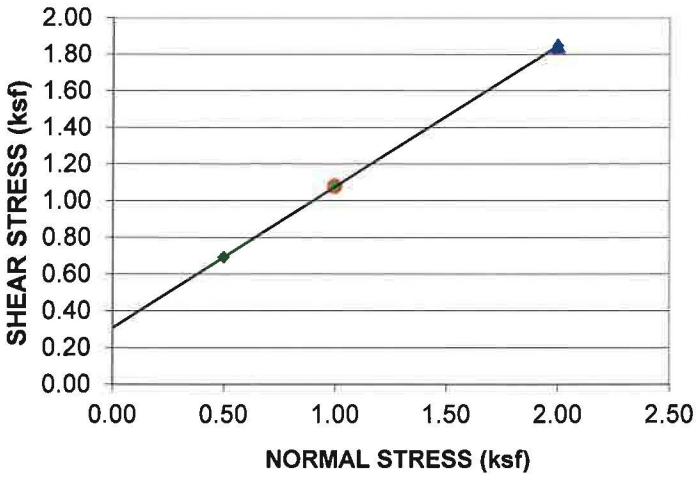
PROJECT NAME: USE TRENCH 13 GEOTECH

CLIENT NAME: SWIFT RIVER ENVIRONMENTAL SERVICES

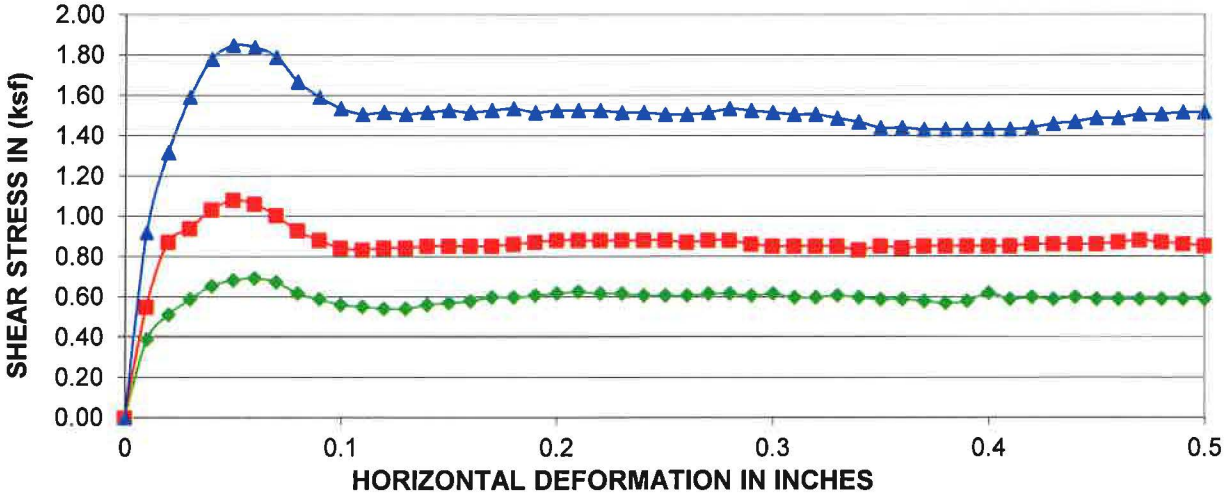
PROJECT NO. 2015MISC

Figure 15-265

# DIRECT SHEAR TEST




| | |
|---|---|
| STRENGTH INTERCEPT: | 0.31 KSF |
| FRICTION ANGLE (PHI) | 37.6 DEG. |




| SYMBOL | MOISTURE CONTENT % | DRY DENSITY (pcf) | NORMAL STRESS (ksf) | PEAK SHEAR (ksf) | RESIDUAL SHEAR (ksf) |
|---|---|---|---|---|---|
| 1.0 ksf | 7.5 | 116.2 | 0.50 | 0.69 | 0.59 |
| 2.0 ksf | 7.5 | 116.6 | 1.00 | 1.08 | 0.85 |
| 4.0 ksf | 7.5 | 116.3 | 2.00 | 1.85 | 1.52 |

SAMPLED BY: CLIENT TESTED BY: A.S LAB NO: 15-265-3

SOIL DESCRIPTION: SAND DATE OF TEST: 9/21/2015

LOCATION OF SAMPLE: CONSOLIDATED 2

REMARKS:

GES
GEOTECHNICAL & ENVIRONMENTAL SERVICES INC
(702) 365 1001
7150 PLACID STREET
LAS VEGAS, NV 89119

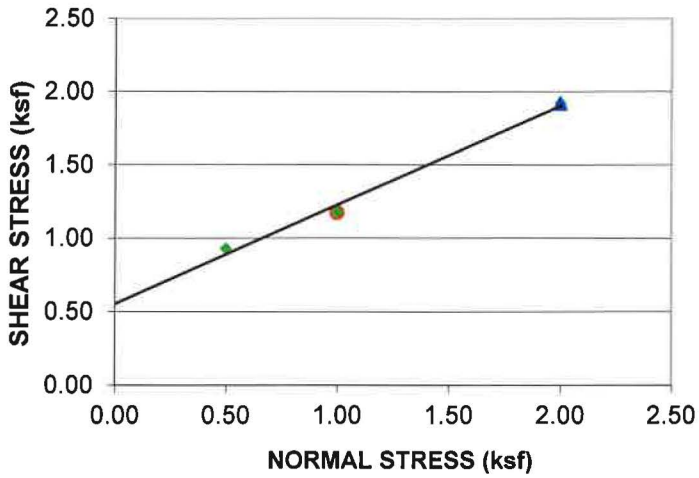
PROJECT NAME: USE TRENCH 13 GEOTECH

CLIENT NAME: SWIFT RIVER ENVIRONMENTAL SERVICES

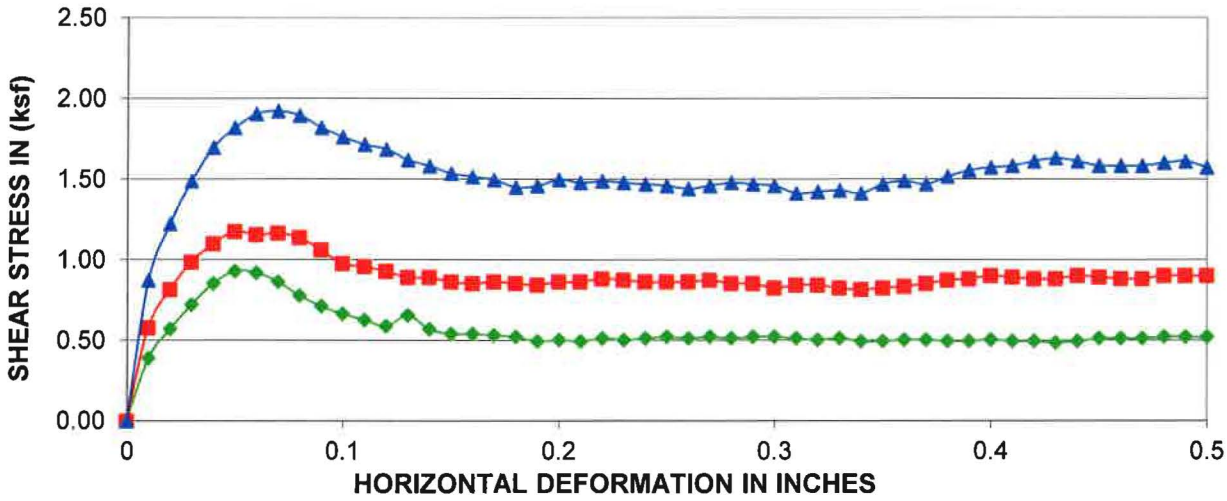
PROJECT NO. 2015 MISC

Figure 15-265

# DIRECT SHEAR TEST




| | |
|---|---|
| STRENGTH INTERCEPT: | 0.55 KSF |
| FRICTION ANGLE (PHI) | 34.0 DEG. |




| SYMBOL | MOISTURE CONTENT % | DRY DENSITY (pcf) | NORMAL STRESS (ksf) | PEAK SHEAR (ksf) | RESIDUAL SHEAR (ksf) |
|---|---|---|---|---|---|
| 1.0 ksf | 10.4 | 109.6 | 0.50 | 0.93 | 0.52 |
| 2.0 ksf | 10.4 | 109.6 | 1.00 | 1.17 | 0.90 |
| 4.0 ksf | 10.4 | 108.8 | 2.00 | 1.92 | 1.57 |

SAMPLED BY: CLIENT TESTED BY: A.S LAB NO: 15-265-4

SOIL DESCRIPTION: SAND DATE OF TEST: 9/18/2015

LOCATION OF SAMPLE: UNCONSOLIDATED PIT 2

REMARKS:

GES
GEOTECHNICAL & ENVIRONMENTAL SERVICES INC
(702) 365 1001
7150 PLACID STREET
LAS VEGAS, NV 89119

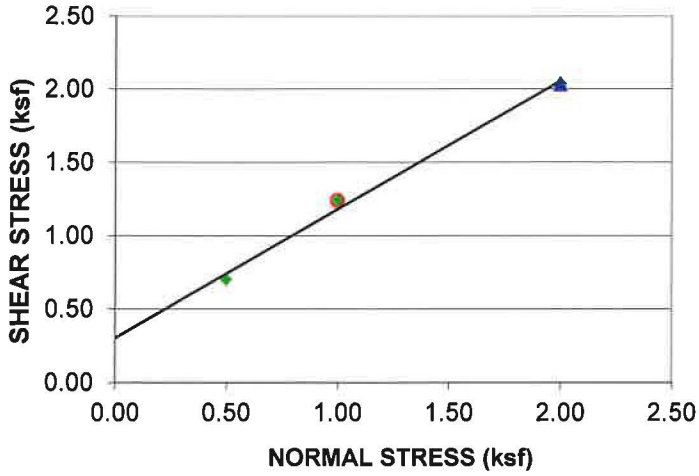
PROJECT NAME: USE TRENCH 13 GEOTECH

CLIENT NAME: SWIFT RIVER ENVIRONMENTAL SERVICES

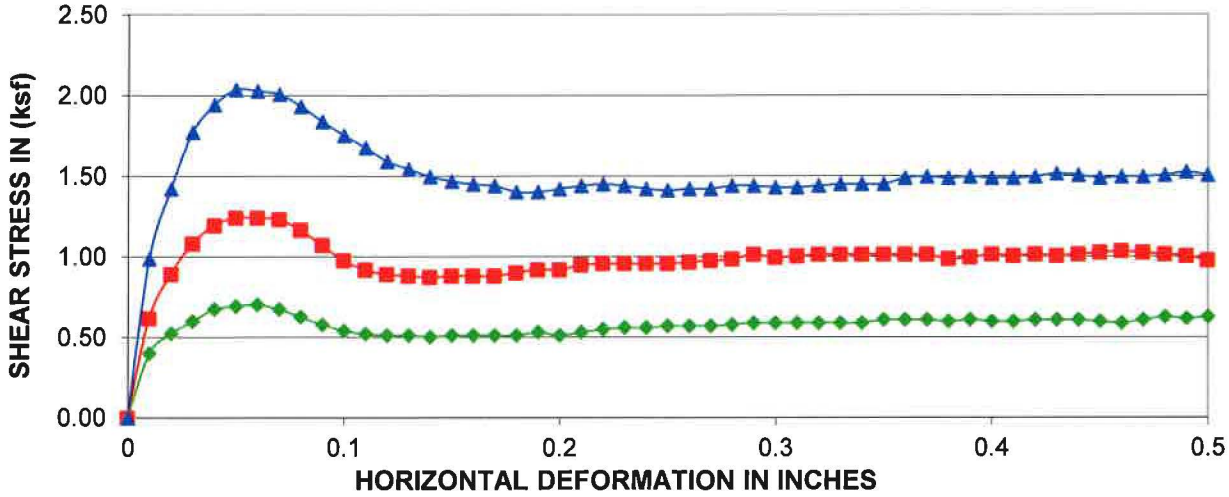
PROJECT NO. 2015MISC

Figure 15-265

# DIRECT SHEAR TEST




| | |
|---|---|
| STRENGTH INTERCEPT: | 0.30 KSF |
| FRICTION ANGLE (PHI) | 41.2 DEG. |




| SYMBOL | MOISTURE CONTENT % | DRY DENSITY (pcf) | NORMAL STRESS (ksf) | PEAK SHEAR (ksf) | RESIDUAL SHEAR (ksf) |
|---|---|---|---|---|---|
| 1.0 ksf | 6.9 | 118.8 | 0.50 | 0.70 | 0.63 |
| 2.0 ksf | 6.9 | 119.6 | 1.00 | 1.24 | 0.98 |
| 4.0 ksf | 6.9 | 120.1 | 2.00 | 2.04 | 1.51 |

SAMPLED BY: CLIENT TESTED BY: A.S LAB NO: 15-265-5

SOIL DESCRIPTION: SAND DATE OF TEST: 9/21/2015

LOCATION OF SAMPLE: CONSOLIDATED PIT 3

REMARKS:

GES
GEOTECHNICAL & ENVIRONMENTAL SERVICES INC
(702) 365 1001
7150 PLACID STREET
LAS VEGAS, NV 89119

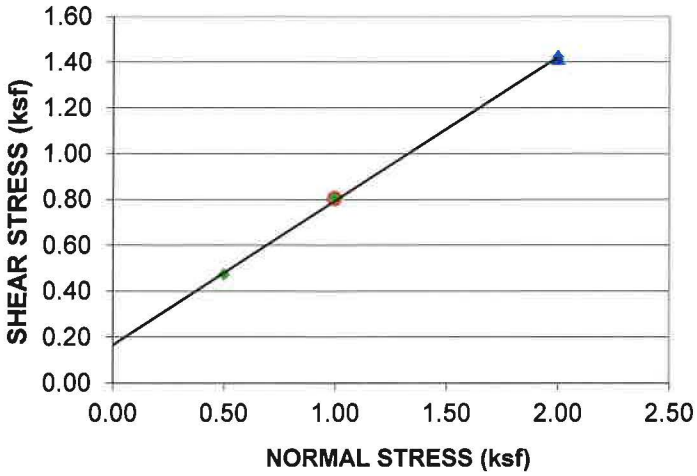
PROJECT NAME: USE TRENCH 13 GEOTECH

CLIENT NAME: SWIFT RIVER ENVIRONMENTAL SERVICES

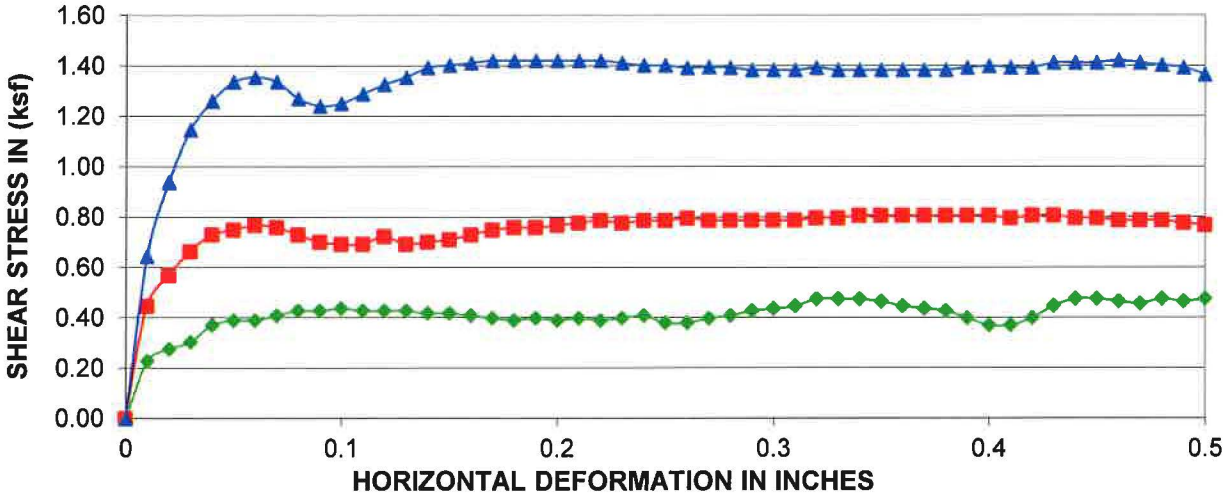
PROJECT NO. 2015 MISC

Figure 15-265

# DIRECT SHEAR TEST




| | |
|---|---|
| STRENGTH INTERCEPT: | 0.17 KSF |
| FRICTION ANGLE (PHI) | 32.2 DEG. |




| SYMBOL | MOISTURE CONTENT % | DRY DENSITY (pcf) | NORMAL STRESS (ksf) | PEAK SHEAR (ksf) | RESIDUAL SHEAR (ksf) |
|---|---|---|---|---|---|
| 1.0 ksf | 7.9 | 111.3 | 0.50 | 0.47 | 0.47 |
| 2.0 ksf | 7.9 | 111.7 | 1.00 | 0.80 | 0.77 |
| 4.0 ksf | 7.9 | 111.7 | 2.00 | 1.42 | 1.36 |

SAMPLED BY: CLIENT TESTED BY: A.S LAB NO: 15-265-6

SOIL DESCRIPTION: SAND DATE OF TEST: 9/21/2015

LOCATION OF SAMPLE: UNCONSOLIDATED PIT 3

REMARKS:

GES
GEOTECHNICAL & ENVIRONMENTAL SERVICES INC
(702) 365 1001
7150 PLACID STREET
LAS VEGAS, NV 89119

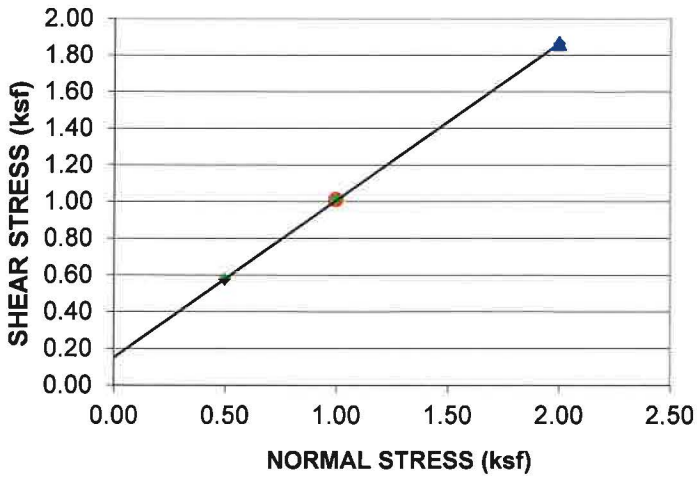
PROJECT NAME: USE TRENCH 13 GEOTECH

CLIENT NAME: SWIFT RIVER ENVIRONMENTAL SERVICES

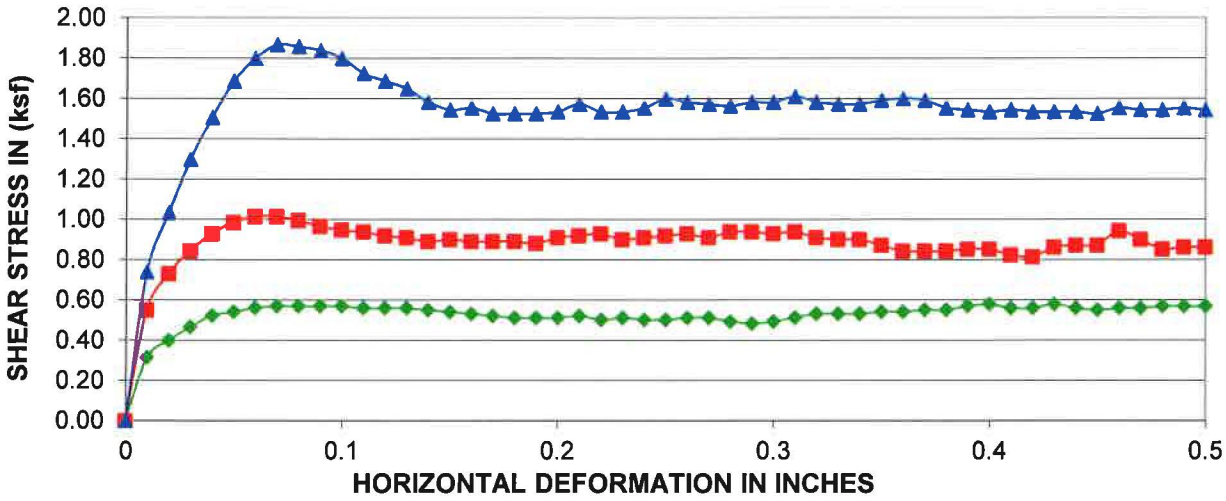
PROJECT NO. 2015 MISC

Figure 15-265

# DIRECT SHEAR TEST




| | |
|---|---|
| STRENGTH INTERCEPT: | 0.15 KSF |
| FRICTION ANGLE (PHI) | 40.6 DEG. |




| SYMBOL | MOISTURE CONTENT % | DRY DENSITY (pcf) | NORMAL STRESS (ksf) | PEAK SHEAR (ksf) | RESIDUAL SHEAR (ksf) |
|---|---|---|---|---|---|
| 1.0 ksf | 6.1 | 113.0 | 0.50 | 0.58 | 0.57 |
| 2.0 ksf | 6.1 | 112.6 | 1.00 | 1.01 | 0.86 |
| 4.0 ksf | 6.1 | 113.6 | 2.00 | 1.87 | 1.54 |

SAMPLED BY: CLIENT TESTED BY: A.S LAB NO: 15-265-7

SOIL DESCRIPTION: SAND DATE OF TEST: 9/22/2015

LOCATION OF SAMPLE: CONSOLIDATED PIT 4

REMARKS:

GES
GEOTECHNICAL & ENVIRONMENTAL SERVICES INC
(702) 365 1001
7150 PLACID STREET
LAS VEGAS, NV 89119

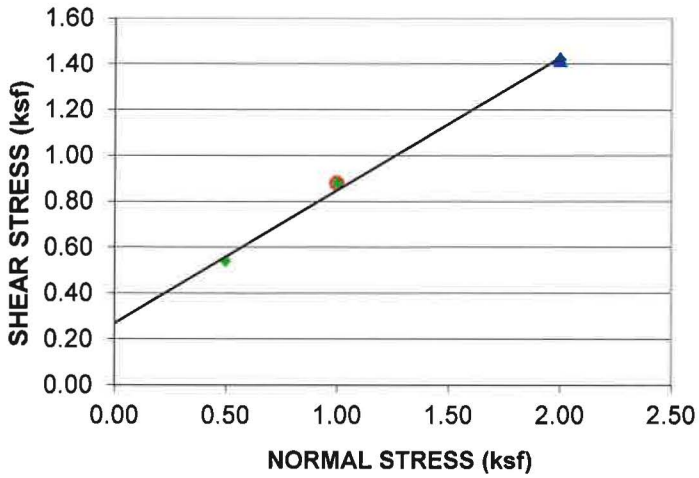
PROJECT NAME: USE TRENCH 13 GEOTECK

CLIENT NAME: SWIFT RIVER ENVIRONMENTAL SERVICES

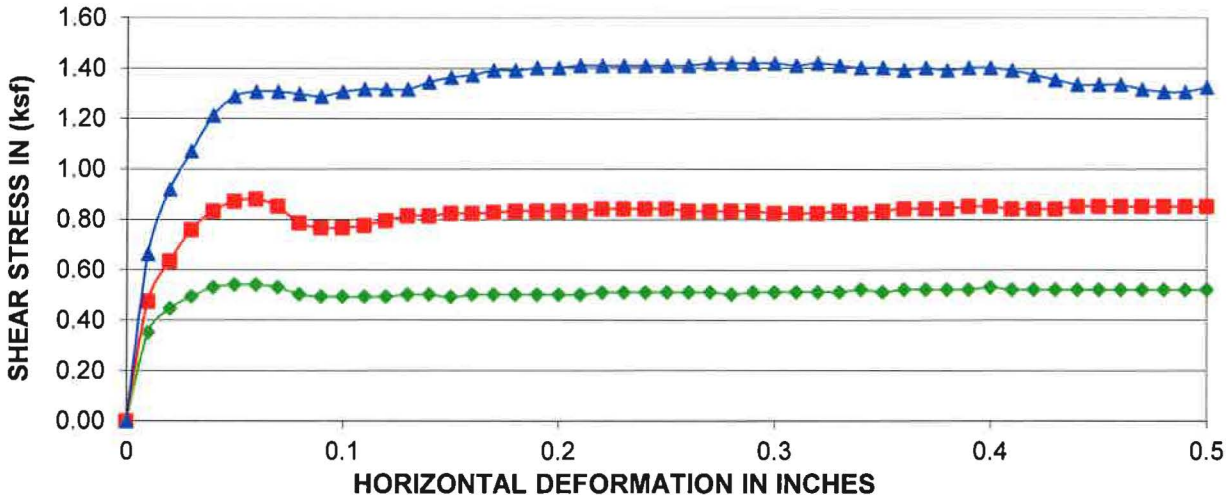
PROJECT NO. 2015 MISC

Figure 15-265

# DIRECT SHEAR TEST




| | |
|---|---|
| STRENGTH INTERCEPT: | 0.27 KSF |
| FRICTION ANGLE (PHI) | 30.1 DEG. |




| SYMBOL | MOISTURE CONTENT % | DRY DENSITY (pcf) | NORMAL STRESS (ksf) | PEAK SHEAR (ksf) | RESIDUAL SHEAR (ksf) |
|---|---|---|---|---|---|
| 1.0 ksf | 7.5 | 114.5 | 0.50 | 0.54 | 0.52 |
| 2.0 ksf | 7.5 | 115.0 | 1.00 | 0.88 | 0.85 |
| 4.0 ksf | 7.5 | 114.6 | 2.00 | 1.42 | 1.33 |

SAMPLED BY: CLIENT TESTED BY: A.S LAB NO: 15-265-8

SOIL DESCRIPTION: SAND DATE OF TEST: 9/22/2015

LOCATION OF SAMPLE: UNCONSOLIDATED PIT 4

REMARKS:

GES
GEOTECHNICAL & ENVIRONMENTAL SERVICES INC
(702) 365 1001
7150 PLACID STREET
LAS VEGAS, NV 89119

PROJECT NAME: USE TRENCH 13 GEOTECH

CLIENT NAME: SWIFT RIVER ENVIRONMENTAL SERVICES

PROJECT NO. 2015 MISC

Figure 15-265