```
                    APPLICATION FOR A C&D DISPOSAL AREA PERMIT
Date:
```

$\qquad$

``` 7/5/2022 County:
``` \(\qquad\)
``` JACKSON
Send to:
Solid Waste Permitting Unit Waste Management Division Dept. of Environmental Quality 707 N. Robinson (PO Box 1677) Oklahoma City, OK 73101-1677
ALTUS MUNICIPAL TRUST AUTHORITY

DEQ Log No.
No. Copies
Date Received:

\section*{FOR DEQ USE}
\(\qquad\)
\(\qquad\)
\(\qquad\)
```

metes \& bounds, platted lot, or land survey. Append extra sheets if necessary)
in JACKSON County, Oklahoma, and hereby makes application for a permit to establish, construct, operate, and maintain a_C\&D DISPOSAL AREA __as required by Oklahoma Solid Waste Management Act and Rules pursuant thereto.

```

Brief description of application:
37.83 ACRES OF C\&D DISPOSAL AREA ADJACENT TO

EXISTING SOLID WASTE DISPOSAL AREA.

Applicant or Authorized Agent:


Typed Name


City:
 State: OL

Date signed:
Phone: \(580-481-2244\)
Facility Address (if any): \(\qquad\)
\(\qquad\)


Address: 7100 N LASSEN BLVD SUITE 500 City: OKLAHOMA CITY State: OK Date signed: \(07 / 05 / 2022\) Phone: 405-463-3369

\section*{VERIFICATION \({ }^{1}\)}


Robert Garrison, of lawful age, being first duly sworn, upon oath state that I have read the foregoing APPLICATION FOR A \(\qquad\) PERMIT, that I am familiar with the matters set forth therein, and that the same are true to the best of my information and belief.


Subscribed and sworn to before me this \(\qquad\) day of \(\qquad\) , 2022. by Robert Garrison (Applicant or legal representative).


My commission expires:
\[
3-16-2025
\]

\footnotetext{
\({ }^{1}\) This Verification is required for a Tier III application.
}

\section*{CELL C\&D PERMIT BOUNDARY-EXHIBIT "A" PART OF THE NE1/4 IN SEC. 11-T2N-R22W JACKSON COUNTY, OKLAHOMA}

\section*{LEGAL DESCRIPTION}

A TRACT OF LAND LYING IN THE NORTHEAST QUARTER (NE1/4) OF SECTION 11, TOWNSHIP 2 NORTH, RANGE 22 WEST OF THE INDIAN MERIDIAN, JACKSON COUNTY, OKLAHOMA AND FURTHER DESCRIBED AS FOLLOWS:

COMMENCING AT THE SOUTHEAST CORNER OF SAID NE1/4;
THENCE N \(00^{\circ} 50^{\prime} 18^{\prime \prime} E\) ALONG THE EAST LINE OF SAID NE1/4 FOR A DISTANCE OF 845.85 FEET TO THE POINT OF BEGINNING;

THENCE N \(90^{\circ} 00^{\prime} 00^{\prime \prime}\) W FOR A DISTANCE OF 1531.30 FEET;

THENCE N000ㅇ́ㅇ"E FOR A DISTANCE OF 1100.00 FEET TO THE SOUTH RIGHT-OF-WAY LINE OF THE HOLLIS AND EASTERN RAILROAD AND A CURVE TO THE RIGHT;

THENCE SOUTHEASTERLY ALONG SAID CURVE TO THE RIGHT AND SOUTH RIGHT-OF-WAY LINE WITH A CENTRAL ANGLE OF \(46^{\circ} 14^{\prime} 52^{\prime \prime}\), A RADIUS OF 1859.83 FEET FOR AN ARC LENGTH OF 1501.21 FEET AND A LONG CHORD DISTANCE OF 1460.79 FEET, BEARING S80 \(57{ }^{\prime} 52^{\prime \prime}\) E;

THENCE S57º \(50^{\prime} 28^{\prime \prime} E\) ALONG SAID SOUTH RIGHT-OF-WAY LINE FOR A DISTANCE OF 118.66 FEET TO SAID EAST LINE;

THENCE S \(00^{\circ} 50^{\prime} 18^{\prime \prime}\) W ALONG SAID EAST LINE FOR A DISTANCE OF 807.52 FEET TO THE POINT OF BEGINNING.

THE ABOVE DESCRIBED TRACT CONTAINING 37.83 ACRES (1,647,686 SQUARE FEET) MORE OR LESS.

BEARINGS ARE BASED ON GRID NORTH (N000\({ }^{\circ} 00^{\prime \prime} \mathrm{E}\) ) OKLAHOMA STATE PLANE COORDINATE SYSTEM, SOUTH ZONE.


\section*{ALTUS MUNICIPAL LANDFILL C\&D DEBRIS CELL}

\section*{CITY OF ALTUS}

SECTION 11, T2N, R22W, I.M. JACKSON COUNTY, OKLAHOMA
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|l|}{SURVEY CONTROL DATA} \\
\hline \multicolumn{2}{|l|}{} \\
\hline \multicolumn{2}{|l|}{BENCHMARKS} \\
\hline  &  \\
\hline
\end{tabular}
 PROJECT
LOCATION










\(\underbrace{\text { TM }}_{\substack{\text { cowan } \\ \text { Throup ensinkerns }}}\)







(1) TYPICAL FINAL COVER SECTION


\section*{TECHNICAL MEMORANDUM}

\section*{ALTUS MUNICIPAL LANDFILL 2022 CONSTRUCTION/DEMOLITION CELL}

\section*{FOR}

THE CITY OF ALTUS, OKLAHOMA


Robert Rose, P.E.
OK PE \#26166

PREPARED BY


\title{
CITY OF ALTUS, OKLAHOMA \\ ALTUS MUNICIPAL LANDFILL 2022 CONSTRUCTION/DEMOLITION CELL ENGINEERING REPORT
}

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J. Existing Contour Map
K. Revised Subsurface Exploration Report (by Standard Testing)
L. Groundwater Elevation Report (by The Carel Corporation)
M. 1989 Permit Application

\section*{I. INTRODUCTION}

The City of Altus is investigating alternatives to increasing the design life of their municipal landfill. The third expansion for the landfill was placed into service in July of 2017. This lateral expansion included a design capacity with a usable volume of 590,000 cubic yards. The fourth expansion was placed into service in June of 2022. This increased the usable volume another 800,000 and increased the design life another 5.8 years.

Cowan Group Engineering contracted with the City of Altus to evaluate the existing landfill and prepare a Technical Memorandum (TM) to discuss and propose a Construction/Demolish (C\&D) Cell to expand the design life of the landfill cells. The purpose of this report is to outline the evaluation of the existing conditions, and to propose a solution to provide for the future demand and comply with the applicable standards.

\section*{II. PROJECT PLANNING AREA}

\section*{A. Site Description}

The Altus landfill is located 8 miles west and 1 mile north of the City of Altus. The permit boundary includes approximately 139.4 acres in the E/2 of Section 11, Township 2 North, Range 22 West, I.M. in Jackson County, Oklahoma.

The historical documents of the site location show that the landfill contains a top layer of clayey soil which sits on top of a layer of very weathered shale that overlays a layer of harder shale and gypsum. A Groundwater Elevation Report and a Subsurface Exploration Report were issued prior to this report to detail the potential ground water elevations and confirm the soil make up of the landfill site.

The results detailed in the Subsurface Exploration Report confirmed the previously reported soil content. There is a clay layer underlain by layers of very weathered shale and harder shale and gypsum. However, above the shale and gypsum layer is groundwater. A contour map and description of the geotechnical investigation can be found in Appendix J and Appendix K.

The topography of the area indicates that most of the surface runoff exits the property on the northeast corner. Stormwater runoff will be directed away from active waste disposal areas to prevent excess water from being collected and conveyed by the leachate collection system. The limited stormwater runoff that enters the waste disposal areas is collected and conveyed by the leachate system and stored in the lined leachate retention pond on the southwest corner of the property. The proposed C\&D cell will not add to the existing leachate system.

\section*{B. Site History}
1983.......................... Operations commence

1984-1987................. Additional geotechnical testing, lateral permeability
July, 1992................. Storm Water Holding Pond
August, 1992............ Additional Geotechnical Testing to a depth of 200'
May, 1993 ................ Closure and Post Closure Bonding
July, 1994................. Permit Upgrade
October, 1994 .......... Lateral Expansion (First / Original Subtitle "D" Expansion)
October, 1995 ........... Protective Casing added to Monitoring Wells
June, 1996................ Gas Monitoring Plan
August, 1996............. Plan for Alternate Applied Daily Cover
November, 1996 ....... Notice of Intent for Storm Water Discharges (EPA)
March, 1997.............. Height Modification to 1502
May, 1997 ................. Storm Water Pollution Prevention Plan
July, 1998 ................. Performance and Emissions Report
June, \(1999 . . . . . . . . . . . . . .\). Monument Monitoring Wells, with Lat, Lon, and Elev.
December, 1999 ....... Hazardous Waste Exclusion Plan
February, 1999 ......... Biomedical Waste Handling Amendment
August, 1996............. Intermediate Cover Plan for Applied Daily Cover
August, 2000............. First Draft, Groundwater Sampling and Analysis Plan
February, 2002 ......... Height Modification to 1526
November, 2002 ....... Draft Groundwater Sampling and Analysis Plan
March, 2003.............. Submittal of 9.88 acre Lateral Expansion
March, 2003.............. Final Groundwater Sampling and Analysis Plan
May, 2003................. Lateral Expansion, Phase I (Second Subtitle "D" Expansion)
December, 2008 ....... Lateral Expansion, Phase II (Second Subtitle "D" Expansion)
January, 2015 ........... Lateral Expansion, (Third Subtitle "D" Expansion)- Submittal
November, 2016 ....... Lateral Expansion, (Third Subtitle "D" Expansion) Construction Completed

July, 2017 ................. Lateral Expansion, (Third Subtitle "D" Expansion) - Waste Receipt Commencement

March 2021............... Lateral Expansion, (Fourth Subtitle "D" Expansion)Submittal

December 2021 ........ Lateral Expansion, (Fourth Subtitle "D" Expansion) Construction Completed
June 16, 2022 ........... Lateral Expansion, (Fourth Subtitle "D" Expansion) - Waste Receipt Commencement

\section*{III. EXISTING FACILITIES}

A C\&D Cell expansion of the existing landfill is required to divert waste disposal from the landfill cells and increase available volume to meet future demand. To analyze the current condition of the landfill growth trends and volume projections were examined to design future volume.

\section*{A. Growth and Usage Trends}

The 2020 Census data is not yet available, therefore census data for the years 1910 through 2010 was obtained from the Oklahoma Department of Commerce (ODOC) website. The census population for the City of Altus is provided in Table 1 and Figure 1, as well as two (2) population projections. The first projection uses the FACT Method from the Guidelines for Engineering Reports for Wastewater Projects, as prepared by the Oklahoma Funding Agency Coordinating Team (FACT), revised in May 2011. The FACT Method yields an annual growth rate of \(-.080 \%\). The other projection uses the projected growth rate prepared by the ODOC in a 2012 report, Oklahoma State and County Population Projections Through 2075. The ODOC projects a growth rate of \(-0.38 \%\) for Jackson County.

Table 1: City of Altus Historical Population and Projections
\begin{tabular}{|c|c|c|c|}
\hline Year & \begin{tabular}{c} 
Actual Population \\
(Census)
\end{tabular} & FACT Forecast & ODOC Forecast \\
\hline 1910 & 4,821 & - & - \\
\hline 1920 & 4,522 & - & - \\
\hline 1930 & 8,349 & - & - \\
\hline 1940 & 8,593 & - & - \\
\hline 1950 & 9,735 & - & - \\
\hline 1960 & 21,225 & - & - \\
\hline 1970 & 23,302 & - & - \\
\hline 1980 & 23,101 & - & - \\
\hline 1990 & 21,940 & - & - \\
\hline 2000 & 21,479 & - & - \\
\hline 2010 & 19,813 & 19,813 & 19,813 \\
\hline 2020 & & 18,276 & 19,073 \\
\hline 2030 & & 16,859 & 18,360 \\
\hline 2040 & & 15,551 & 17,674 \\
\hline
\end{tabular}

Figure 1: Historical Population and Projections, City of Altus


To further analyze population and project volume demand the landfill usage data was analyzed. The investigation found that the usage had no significant increase, validating the population projections.

\section*{B. Volume Analysis}

The Lateral Expansion (Fourth Subtitle "D" Expansion) to the existing landfill was complete in 2022. The volume of 800,000 cubic yards added an additional 5.8 years of waste disposal life to the landfill site. This assumes a flat rate 105,000 cubic yards of waste per year.

It is estimate that approximately \(40 \%\), or 42,000 cubic yards per year, is attributed to C\&D waste. This reduces the flat rate to 63,000 cubic yards of waste per year stored in the landfill.

\section*{IV. PROPOSED DESIGN}

The proposed design for the site includes the construction of a new ten (10) acre C\&D Cell adjacent to the existing Municipal Solid Waste Landfill.
A. Location on Site

The proposed C\&D Cell is designed to accommodate current usage. The proposed project will require a Tier I Modification of the existing permit. The area for the C\&D cell will be deducted from the existing permit. The deducted area will be reapplied for under the less stringent C\&D permit category. See Appendix C for the permit modification boundaries.

The placement on site for this project is proposed to be in the north central of the existing landfill site. See Appendix D for location of the C\&D cell.

\section*{B. Construction Considerations}

The Revised Subsurface Exploration Report in Appendix K shows the site consists of clay and gravel overlaying weathered shale, above shale rock and gypsum. Based on boring locations one (1) through five (5) the shale layer ranges between approximate elevations of 1415 feet to 1438 feet and the shale/gypsum layer ranging between approximate elevations of 1415 feet to 1398 feet. Hydraulic conductivity was found to average \(7.4 \times 10^{-9} \mathrm{~cm} / \mathrm{sec}\) at a depth of \(0-10\) feet and \(2.0 \times 10^{-8} \mathrm{~cm} / \mathrm{sec}\) at a depth of \(10-15\) feet. This meets the required hydraulic conductivity of no greater than \(1.0 \times 10^{-5} \mathrm{~cm} / \mathrm{sec}\) for C\&D Cells. The existing soil is suitable for an in-situ liner.

The highest groundwater levels were found range between 1408 feet and 1412 feet. For purposes of construction, the high groundwater level is 1413 feet. For insitu liners, the lowest surface on which waste will be placed must be fifteen (15) above the highest groundwater level. Therefore, the top of the in-situ liner is 1428 feet.

\section*{C. Volume Requirements}

The proposed volume of the C\&D cell is 455,929 cubic yards. The existing landfill volume of 800,000 would increase in usable life from 5.8 years to 8.64 years. Appendix E and F show full future volume considerations. The proposed elevation for the top of final cover is 1476 ft .

\section*{D. Cost Estimate}

The proposed project is \(\$ 1.35\) million. The project will be funded by the City of Altus or other internal funding. See Appendix \(G\) for the preliminary construction cost estimate.

\section*{v. CONCLUSION AND RECOMMENDATION}

The recommended solution to increase the waste disposal volume for the near-term future demand is to construct a C\&D Cell. A permit modification to remove approximately 30 acres from the existing MSW site will be submitted. A permit application for a 30 -acre C\&D area will be requested. The initial project will include an approximate 10-acre C\&D Cell. The C\&D Cell will have an in-situ liner that is five (5) feet thick. Prior to final design, thirty (30) geotechnical samples will be taken in accordance with OAC 252:515-11-32. The volume of 455,929 cubic yards will add an additional 2.8 years of waste disposal life to the landfill site. The project will be funded by the City of Altus or other internal funding. Below is the anticipated project timeline.
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|c|}{ PROJECT TIMELINE } \\
\hline \begin{tabular}{c} 
Submit Preliminary Design and \\
Engineering Report to ODEQ
\end{tabular} & October 25, 2022 \\
\hline \begin{tabular}{c} 
Submit Final Construction Drawings \\
and Specifications to ODEQ
\end{tabular} & March 25, 2023 \\
\hline Advertise for Bids & August 1, 2023 \\
\hline Award Contract for Construction & October 1, 2023 \\
\hline Completion of Construction & June 2024 \\
\hline
\end{tabular}

\section*{APPENDIX A - Site Location Map}


\section*{APPENDIX B - Existing Conditions}


\section*{APPENDIX C - Permit Modification Map}


\section*{APPENDIX D - Proposed Site Plan}



\section*{APPENDIX E - C\&D Cell Life Calculations}

\section*{C\&D Cell Life Calculations}
\begin{tabular}{lr} 
Design Volume & \begin{tabular}{c}
\(455,929 \mathrm{CY}\) \\
\((96,800)\) \\
3' Final Cover
\end{tabular} \\
Usable Volume & \(359,129 \mathrm{CY}\) \\
Annual Waste Volume & \(42,000 \mathrm{CY/Year}\) \\
Annual Daily Cover & \(8,400 \mathrm{CY} / \mathrm{Year} \quad(20 \%)\) \\
Life of C\&D Cell & 7.13 Years
\end{tabular}

\section*{APPENDIX F - Lateral Expansion Life Calculations}

Lateral Expansion Life Calculations
\begin{tabular}{lrl} 
Design Volume & \begin{tabular}{r}
\(800,000 \mathrm{CY}\) \\
\((74,000)\) \\
3' Final Cover
\end{tabular} \\
Usable Volume & \(726,000 \mathrm{CY}\) \\
Annual Waste Volume & & \\
Annual Volume Diverted to C\&D Cell & 105,000 & CY/Year \\
Annual Daily Cover & 21,000 & \(\mathrm{CY} / \mathrm{Year}\) \\
& & CY/Year (20\%) \\
Life of Fourth Subtitle "D" Expansion & 8.64 Years
\end{tabular}

\section*{APPENDIX G - Preliminary Construction Cost Estimate}
\begin{tabular}{|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { COWAN G } \\
& \text { 7100 N CL } \\
& \text { 405.46OM } \\
& 405.463 .3
\end{aligned}
\] & \begin{tabular}{l}
ROUP ENGINEERING \\
ASSEN, SUTE 500 \\
A CITY, OK 73116
\[
369 \text { O }
\] \\
381 F
\end{tabular} & PRO DE & CT NAME RIPTION OCATION PHASE DATE & ALTUS MUNIC CONSTRUCTION ALTUS, OKLAH ENGINEER'S E 6/27/2022 &  & \begin{tabular}{l}
FILL \\
LITION CELL
\end{tabular} \\
\hline ITEM NUMBER & DESCRIPTION & QUANTITY & UNIT & UNIT COST & & AL COST \\
\hline \multicolumn{7}{|l|}{} \\
\hline 2 & UNCLASSIFIED EXCAVATION AND ON-SITE STOCKPILE & 88,700 & CY & \$ 4.40 & \$ & 390,280.00 \\
\hline 3 & PROTECTIVE SAND LAYER (1' THICKNESS) & 15,600 & CY & \$ 42.00 & \$ & 655,200.00 \\
\hline 4 & GRADING, ACCESS ROAD & 1,400 & CY & \$ 6.00 & \$ & 8,400.00 \\
\hline 5 & EXCAVATION AND RECOMPACTION OF 3' CLAY LINER & 50 & CY & \$ 1,000.00 & \$ & 50,000.00 \\
\hline \multicolumn{7}{|l|}{} \\
\hline \multicolumn{7}{|r|}{SUBTOTAL} \\
\hline & & & CONTIN & VGENCY (10\%) & \$ & 120,388.00 \\
\hline \multicolumn{7}{|r|}{CONSTRUCTION TOTAL} \\
\hline
\end{tabular}

\section*{APPENDIX H - FEMA Flood Plain Map}


\section*{FLOOD HAZARD INFORMATION}

SEE FIS REPORTT For detalied Legend and index map
for dramt firm pane Larout


\section*{NOTES TO USERS}












SCALE



1 inch \(=2,000\) feet \(\quad 1: 24,000\)

\(99^{922^{2} 29.64^{4} \mathrm{~W}} 34937^{7} 3.93^{\prime N} \mathrm{~N}\)

\section*{APPENDIX I - Topographic Map}


\section*{APPENDIX J - Existing Contour Map}


\section*{APPENDIX K - Revised Subsurface Exploration Report (by Standard Testing)}

\title{
REVISED SUBSURFACE EXPLORATION
}

\author{
Altus Landfill Expansion \\ N. 1960 Road \\ Duke, Oklahoma
}

PROJECT NO. 2030-0598

AND ENGINEERING COMPANY Since 1951

\section*{902 Trails West Loop} Enid, OK 73703 (580) 237-3130

202 SE "J" Ave Lawton, OK 73501
(580) 353-0872

January 15, 2021
Cowan Group
7100 N. Classen Blvd, Suite 500
Oklahoma City, OK 73116
Attn: \(\begin{aligned} & \text { Mr. Robert Rose, PE } \\ & \\ & \text { Project Manager }\end{aligned}\)

Re: Subsurface Exploration
Altus Landfill Expansion
N. 1960 Road

Duke, Oklahoma

Dear Mr. Rose:
Standard Testing \& Engineering, LLC (Standard Testing) is pleased to present the following report for the subject project. This geotechnical study was authorized by receipt of the signed "Consultant Agreement for Professional Services" contract, dated September 9 \({ }^{\text {th }}, 2020\).

Standard Testing conducted a geotechnical investigation at the site of the Altus Landfill Expansion project in Duke, Oklahoma. This report contains the detailed results of the geotechnical investigation, including recommendations related to the design and construction of the proposed expansion.

The subsurface soils consist of approximately 1.5 to 20 feet of clay and gravel overlying very weathered shale, shale rock, and gypsum rock which exhibit non-plastic to moderate plasticity characteristics.

We trust that the results and recommendations contained herein will permit adequate economical design and construction of the proposed structure. Unless you specify otherwise, we will keep samples obtained from these borings in our Oklahoma City laboratory for the next thirty (30) days.

We appreciate the opportunity to assist on this project. Please call on us if we can be of further service.
Respectfully submitted,
STANDARD TESTING \& ENGINEERING, LLC


Antonio Franco, E.I.
Staff Geotechnical Engineer


Roy Khalife, P.E.
Geotechnical Engineer

Project No. 2030-0598
Account No. 0230COW01

\title{
REVISED SUBSURFACE EXPLORATION
}

Altus Landfill Expansion
N. 1960 Road

Duke, Oklahoma

PROJECT NO. 2030-0598

PREPARED FOR
Cowan Group
7100 N. Classen Blvd, Suite 500
Oklahoma City, OK 73116

PREPARED BY
STANDARD TESTING \& ENGINEERING, LLC
3400 N. Lincoln Blvd.
Oklahoma City, OK 73105
Certificate of Authorization No. 7933, Expiration 6/30/2021
(405) 528-0541

Prepared By:


Antonio Franco, E.I.
Staff Geotechnical Engineer


Reviewed By:


Roy Khalife, P.E.
Geotechnical Engineer

I certify my e-signature for the study entitled "Subsurface Exploration."

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Soil Profile \\
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Definition of Descriptive Terms
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\section*{Section 1}

\section*{INTRODUCTION}

\subsection*{1.1 Authorization}

This report presents the results of a subsurface exploration performed by Standard Testing \& Engineering, LLC (Standard Testing) in accordance with the proposal (P-20182) prepared for Mr. Robert Rose, dated July \(28^{\text {th }}\), 2020, and identified as Standard Testing project number 2030-0598. This geotechnical study was authorized by receipt of the signed "Consultant Agreement for Professional Services" contract, dated September 9 \({ }^{\text {th }}, 2020\).

\subsection*{1.2 Purpose and Scope}

A geotechnical investigation was performed for the purpose of (1) determining the subsurface conditions, (2) evaluating the plasticity and physical characteristics of the soils, and (3) making recommendations related to the design and construction of the proposed landfill expansion.

Nine (9) exploratory borings (B-1 through B-9) were drilled to a depth ranging from 60 to 100 feet. The boring depths and types of testing were performed according to the scope of work proposed by Standard Testing and accepted by Mr. Rose. Narrative descriptions of our findings and recommendations are contained in the body of this report. A site and boring location plan, the boring logs, the soil profile, summary of test results, and global stability analyses are included in the Appendices of this report.

\subsection*{1.3 Project Location and Description}

The existing facility is located approximately eight (8) miles west and one and one-half ( \(11 / 2\) ) miles north of the City of Altus on North 1960 Road. The proposed C\&D disposal area is planned to take place on the north central portion of the existing disposal area and will be approximately 10 acres in area. The proposed Fourth Subtitle "D" Expansion will be south of the C\&D disposal area and will be approximately 5 acres in area. Due to the current operations, the natural ground topography has been altered and the existing site topography varies.

To achieve the proposed end use development plan, it is our understanding that the landfill expansion will be completed in a series of stages or cells involving above grade refuse placement.

Each stage will generally include site preparation including topsoil stripping, cell excavation, exterior berm construction, compaction and lining of the cell's base soils. The above grade development will proceed in a series of lifts until the design grades for that area are achieved. Details of the liner has not been provided to us at this time.

\section*{STANDARD \\ AND ENGINEERING COMPANY}


Figure 1: Project Location
If the project is not as described or has changed, Standard Testing must be notified in order to reevaluate the recommendations for the project.

\section*{Section 2}

\section*{FIELD EXPLORATION}

\subsection*{2.1 Drilling Information}

The field exploration work was performed between the \(8^{\text {th }}\) and \(14^{\text {th }}\) of December, 2020. Conditions at the site were investigated with nine (9) borings at the locations indicated on the site and boring location plan, included in Appendix "A." Boring surface elevations, rounded to the nearest hundredth, are reported on the individual boring logs, included in Appendix "A."

Boring depths were 60 to 100 feet within Fourth Subtitle "D" Expansion and the C\&D cell's footprint. For accurate sampling, cuttings were observed continuously during drilling with specific samples being taken at distinct lithologic changes. The equipment used, field tests performed, and soil samples taken are discussed below.

\subsection*{2.2 Equipment Used}

Nine (9) borings were drilled with a truck-mounted CME-55 rotary drilling unit equipped with 3.25 "I.D. X 7.25" O.D. hollow stem augers (HSA). Standard penetration tests (SPT) used a \(1.375^{\prime \prime}\) ID split spoon sampler driven by an automatic hammer utilizing a 140 lb . weight falling 30 inches.

\subsection*{2.3 Testing and Sampling Performed}

Standard penetration tests were performed in order to estimate the shear strengths of the soils in their natural state. The test was conducted as specified by ASTM D1586, "Penetration Test and Split-Barrel Sampling of Soils." The in-situ bearing strength is related to the N -value from this test. " N " is the number of blows required to drive a split-spoon sampler twelve inches, after a 6 -inch seating, into undisturbed soil. The soil samples recovered in the split-spoon barrel were removed from the sample tool in the field, visually classified, and labeled according to boring number and depth. Results of the standard penetration tests are denoted at their respective depths on the boring logs.

According to Skempton, A.W. (Geotechnique, Vol. 36, No.3, pp 425-447, 1986), and hammer efficiency the corrected N value can be determined as follows:
\[
N_{60}=C_{b} C_{r}\left(\frac{E_{m}}{60}\right) N
\]

Where:
\(\mathrm{N}_{60}=\) Standard Penetration Test N Value Corrected for Field Testing Procedures
\(C_{b}=\) Borehole Diameter Correction ( \(C_{b}=1.0\) for Boreholes of 3.25" in Diameter)
```

    C 20 feet of drilling rods, 0.95 for 20 to 33 of drilling rods, and 1.00 for drilling rods in excess of 33 feet)
    $\mathrm{N}=$ Measured Standard Penetration Test N Value $\mathrm{E}_{\mathrm{m}}=$ Hammer Efficiency in Percent ( $\mathrm{E}_{\mathrm{m}}=88 \%$ for STEC CME-55)

```

Thin-walled tube samples were collected as specified by ASTM D1587, "Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes."

Depths of individual split spoon (standard penetration tests), thin-walled tube, and grab samples are indicated on the boring logs included in Appendix "B." All samples were labeled and sealed in water tight, protective containers and returned to the laboratory for further evaluation and testing.

\subsection*{2.4 Subsurface Conditions}

The soils encountered consist of clay and gravel overlying very weathered shale, shale rock, and gypsum rock. The cohesive soils were found to be stiff to very stiff in consistency. Rock materials (i.e., defined by standard penetration test refusal) were encountered in the indicated boring at the elevation shown in the following table:

Table 1: Elevation of Rock Material
\begin{tabular}{|c|c|c|c|c|}
\hline \multirow{2}{*}{ Boring No. } & \begin{tabular}{c} 
Surface Elevation \\
(feet)
\end{tabular} & \begin{tabular}{c} 
Rock Depth \\
(feet)
\end{tabular} & \begin{tabular}{c} 
Rock Elevation \\
(feet)
\end{tabular} & Rock Material \\
\hline \multirow{2}{*}{ B-1 } & \multirow{2}{*}{1454.23} & 26.0 & 1428.23 & Shale \\
\cline { 3 - 5 } & & 45.0 & 1409.24 & Shale with Gypsum \\
\hline \multirow{2}{*}{ B-2 } & \multirow{2}{*}{1449.55} & 35.0 & 1414.55 & Shale \\
\cline { 3 - 5 } & & 43.5 & 1406.05 & Shale with Gypsum \\
\hline \multirow{2}{*}{ B-3 } & \multirow{2}{*}{1445.30} & 15.0 & 1430.30 & Shale \\
\cline { 3 - 5 } & & 30.0 & 1415.30 & Shale with Gypsum \\
\hline \multirow{2}{*}{ B-4 } & \multirow{2}{*}{1444.64} & 20.0 & 1424.64 & Shale \\
\cline { 3 - 5 } & & 35.0 & 1409.64 & Shale with Gypsum \\
\hline B-5 & 1439.22 & 25.0 & 1414.22 & Shale with Gypsum \\
\hline B-6 & 1438.79 & 25.0 & 1413.79 & Shale with Gypsum \\
\hline B-7 & 1443.56 & 30.0 & 1413.56 & Shale with Gypsum \\
\hline \multirow{2}{*}{ B-8 } & \multirow{2}{*}{1434.49} & 20.0 & 1414.49 & Gypsum \\
\cline { 3 - 5 } & & 35.0 & 1399.49 & Shale with Gypsum \\
\hline \multirow{2}{*}{ B-9 } & \multirow{3}{*}{1457.15} & 35.0 & 1422.15 & Shale with Gypsum \\
\cline { 3 - 5 } & & 55.0 & 1402.15 & Gypsum \\
\cline { 3 - 5 } & 65.0 & 1392.15 & Shale with Gypsum \\
\hline
\end{tabular}
\begin{tabular}{|l|c|c|c|c|}
\hline & & 75.0 & 1382.15 & Shale \\
\cline { 3 - 5 } & & 95.0 & 1362.15 & Shale with Gypsum \\
\hline
\end{tabular}

\subsection*{2.5 Groundwater}

During drilling and at completion of drilling operations, groundwater was encountered in the indicated borings at a depth shown in the elevation of groundwater table. Presence of water should be anticipated in any excavation. Water travelling through soil (subsurface water) is often unpredictable and may be present at shallow depths. Due to the seasonal changes in groundwater and the unpredictable nature of groundwater paths, groundwater levels will fluctuate. Therefore, it is necessary during construction to be observant for groundwater seepage in excavations in order to assess the situation and make necessary changes. We cannot assume responsibility for difficulties experienced during construction or for future operational problems due to elevation or volume of water encountered.

Based on the groundwater level data, recommended design groundwater elevation is 1410 feet.

We recommend that piezometers be installed in the uppermost saturated zone at locations representative of the entire expansion area and approved by the Oklahoma Department of Environmental Quality (ODEQ) in accordance with ODEQ Title 252 "Department of Environmental Quality" Chapter 515 "Management of Solid Waste" subsections 252-515-7-52 and 252-515-7-53.

Table 2: Elevation of Groundwater
\begin{tabular}{|c|c|c|c|c|}
\hline \multirow{2}{*}{ Boring No. } & \begin{tabular}{c} 
Surface Elevation \\
(feet)
\end{tabular} & \begin{tabular}{c} 
Depth at \\
Completion(feet)
\end{tabular} & \begin{tabular}{c} 
Depth at 24 Hour \\
(feet)
\end{tabular} & Elevation (feet) \\
\hline \multirow{2}{*}{ B-3 } & \multirow{2}{*}{1445.30} & - & - & - \\
\cline { 3 - 5 } & \multirow{2}{*}{ B-4 } & \multirow{2}{*}{1444.64} & 58.33 & 40.25 \\
\hline \multirow{2}{*}{ B-5 } & \multirow{2}{*}{1439.22} & - & - & 1405.05 \\
\cline { 3 - 5 } & \multirow{2}{*}{ B-6 } & \multirow{2}{*}{1438.79} & - & 34.5 \\
\cline { 3 - 5 } & & - & - & 1386.31 \\
\hline \multirow{2}{*}{ B-7 } & 1443.56 & 53.0 & - & - \\
\cline { 3 - 5 } & \multirow{2}{*}{ B-8 } & 1434.49 & - & 29.5 \\
\hline
\end{tabular}

\section*{STANDARD \\ AND ENGINEERING COMPANY}
\begin{tabular}{|c|c|c|c|c|}
\hline \multirow{2}{*}{\(\mathrm{B}-9\)} & 1457.15 & 87.0 & \multirow{3}{*}{-} & 1370.15 \\
& & - & - \\
\hline
\end{tabular}

\section*{Section 3}

\section*{LABORATORY TESTING}

Laboratory testing was performed in order to determine the plasticity characteristics of the subsurface materials as well as confirm the soil classifications.

\subsection*{3.1 Tests Performed}
- Moisture content tests were performed on split spoon, thin-walled tube, and bag samples, in accordance with ASTM D2216, to determine the in-situ moisture conditions.
- Density tests were performed on intact split spoon, and thin-walled tube samples in accordance with ASTM D7263 Method A.
- Atterberg limits tests were performed on split spoon, thin-walled tube, and bag samples to determine the plasticity characteristics and swell potential of the soil. The tests were performed in accordance with ASTM D4318. Liquid Limits were determined using three-point method
- Sieve analyses were performed on split spoon, thin-walled tube, and bag samples, in accordance with ASTM D2487, for aid in soil classification. These soils were classified according to the Unified Soil Classification System (USCS) and the American Association of State Highway and Transportation Officials (AASHTO) soil classification system.
- Standard Proctor test was conducted on a composite soil sample in accordance with ASTM D698 testing procedures. The Standard Proctor test determines the relationship between moisture content and density at a specified compaction effort. The result of the standard proctor test is presented in Appendix "D."
- Hydraulic conductivity (also referred to as coefficient of permeability) of soil test was performed on a composite sample made of all test borings in accordance with ASTM D5084. Test results are presented in the Appendix "D."
- Direct Shear test was performed on an undisturbed soil sample in accordance with ASTM D3080 testing procedures. The Direct Shear test determines the apparent cohesion and the angle of internal friction of the soil tested. Test results are presented in the Appendix "D."

\subsection*{3.2 Laboratory Summary}

General descriptions of the encountered soils together with visual and laboratory classifications and numerical values of the test results are on the boring logs and soil profile included in Appendix "B." A "Summary of Test Results" is included in Appendix "D."

\section*{Section 4}

\section*{ENGINEERING EVALUATION AND RECOMMENDATIONS}

\subsection*{4.1 Geological Information}

The "Engineering Classification of Geologic Materials," Division Five, Research and Development Division of Oklahoma Highway Department 1967, indicates that the project site is located over the Elm Fork Subunit of the Blaine Formation (Pbef) and Flowerpot Unit (Pf). This geologic formation is described therein as follows:

\begin{abstract}
Elm Fork Subunit (Pbef): This subunit consists of three prominent gypsum or anhydrite beds interbedded with shales and a few thin dolomite beds. The gypsum beds in ascending order are the Haystack gypsum, the Cedartop gypsum, and the Collingsworth gypsum. These gypsum beds generally thicken westward from less than 5 feet in northeastern Kiowa County and Jackson County to about 20 feet in Greer, Beckham, and Harmon Counties. The total thickness of the gypsum beds may not appear at the surface because much of the upper and lower limits may have been lost as the result of the dissolving action of groundwater. Locally, almost all of the gypsum bed may be absent.
\end{abstract}

The shales are reddish-brown to grayish green and occur in sequence up to 20 feet thick, but they are not usually over 12 feet thick. The dolomite beds are generally less than 2 feet thick.

The total thickness of the Elm Fork Subunit varies from 80 to 110 feet.
Topographically, the gypsums and dolomites of the subunit along with the strata of the overlying Van Vacter Subunit form the most pronounced scarps, mesas, and buttes in southwestern Oklahoma. Canyons and barren badland topography is exhibited near the base of the subunit. On the more gentle slopes where the shales are thicker, prairies, and cultivation are common. Mesquite and prickly pear occur on the more salty and gypsiferous soils of the subunit.

The Elm Fork Subunit comprises the lower 80 to 110 feet of the Blaine Unit. The basal Haystack Gypsum is probably equivalent to the Medicine Lodge Gypsum of the basal Blaine Unit on the north flank of the Anadarko Basin. In Division 7, the strata of the Elm Fork Subunit are mapped in the El Reno Unit.

Flowerpot Unit (Pf): This unit consists dominantly of reddish-brown, blocky shale with minor amounts of thin, interbedded, greenish-gray shale, siltstone, gypsum, and
dolomite. On the southern flanks of the Anadarko Basin (Jackson County), the lower 28200 feet of the unit consist of a sandstone and shale zone.

The total thickness of the unit is about 450 feet in Blaine County. Southward, in Division 5 , it varies from 90 to 250 feet in thickness.

Topographically, the unit typically forms valleys where the outcrop is narrow. Elsewhere, the unit forms gently rolling to nearly level topography. Short grass is the major vegetation. Locally, mesquite, cacti, and nearly barren rock exposures denote areas containing salt or gypsum.

\subsection*{4.2 Existing Site Conditions}

\section*{Dewatering}

Based on the field exploration data, groundwater was encountered in borings B-3 through B-9 either during, at completion, or at 24 hours of drilling operation. Dewatering is not expected to be required during excavation.

\section*{Liquefaction Potential}

Based on the field exploration data, no liquefied soils were encountered, it is our opinion that the liquefaction potential is minimal at this due to the absence of cohesionless soils in our borings.

\subsection*{4.3 Soil Conditions}

The soils encountered in this investigation consist of clay and gravel overlying very weathered shale, shale rock and gypsum rock. The cohesive soils were found to be stiff to very stiff in consistency. Rock materials (i.e., defined by standard penetration test refusal) were encountered in all borings.

\subsection*{4.4 Laboratory Testing Results}

Standard Proctor Test Results
Standard proctor test was conducted on a composite soil sample in accordance with ASTM D698 testing method. The result is presented in the following table and are also presented in the Appendix "D."

Table 3: Standard Proctor Test Results
\begin{tabular}{|l|c|c|c|c|c|c|}
\hline Boring No. & Sample I.D. & Depth (feet) & USCS & AASHTO & \begin{tabular}{c} 
Maximum Dry \\
Density (pcf)
\end{tabular} & \begin{tabular}{c} 
Optimum \\
Moisture (\%)
\end{tabular} \\
\hline B-1 to B-9 & Comp 1 & 10.0-15.0 & CL & A-7-6(20) & 97.4 & 25.3 \\
\hline B-1 to B-9 & Comp 2 & \(0.0-10.0\) & CL & A-7-6(21) & 99.7 & 23.5 \\
\hline
\end{tabular}

\section*{Direct Shear Test Results}

Direct Shear test was performed on composite soil sample in accordance with ASTM D3080 testing procedures. The Direct Shear test determines the apparent cohesion and the angle of internal friction of the soil tests. Test results are presented in the table below and in the Appendix "D."

Table 4: Direct Shear Test Results
\begin{tabular}{|c|c|c|c|c|}
\hline Boring No. & Depth (feet) & Condition & \begin{tabular}{c} 
Apparent \\
Cohesion (psf)
\end{tabular} & \begin{tabular}{c} 
Angle of Internal Friction \\
(Degress)
\end{tabular} \\
\hline \hline B-1 to B-9 & \(10.0-15.0\) & Remolded & 645 & 19.0 \\
\hline B-1 to B-9 & \(0.0-10.0\) & Remolded & 850 & 17.0 \\
\hline
\end{tabular}

\section*{Constant Head Permeability Test Results}

Hydraulic conductivity (also referred to as coefficient of permeability) of soil test was performed on a composite sample made of all test borings in accordance with ASTM D5084. Test results are presented in the table below and in the Appendix "D."

Table 5: Permeability Test Results
\begin{tabular}{|c|c|c|c|c|}
\hline Boring No. & Depth (feet) & Condition & \% Compaction & Average K (cm/sec) \\
\hline B-1 to B-9 & \(10.0-15.0\) & Remolded & \(96.4 \%\) & \(2.0 \times 10^{-8}\) \\
\hline B-1 to B-9 & \(0.0-10.0\) & Remolded & \(94.4 \%\) & \(7.4 \times 10^{-9}\) \\
\hline
\end{tabular}

\subsection*{4.5 Settlement}

The rate and magnitude of landfill settlement is an important performance consideration. Generally, waste has consolidation characteristics of rapid initial consolidation followed by secondary consolidation. The rate and magnitude of waste settlement have been found to vary primarily with the unit weight and overburden pressure. Therefore, settlement observed in deep landfills is larger than shallow landfills.

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Over the long term, a typical waste fill might settle between 10 to 25 percent of its total thickness. Settlement in landfills is a result of different mechanisms: (a) distortion, bending, crushing and reorientation, (b) plastic creep, (c) raveling, (d) corrosion, oxidation and combustion, and (e) biochemical decay. The density achieved from compaction is the key factor influencing the magnitude of landfill settlement.

Due to long term settlement, the initial side slopes should be expected to change; therefore, post closure maintenance may need to consider re-grading of slopes. Settlement magnitude for landfills is difficult to estimate due to material variability within the waste fill; and so, a typical settlement range of 10 to \(25 \%\) of the landfill thickness should be expected within the lifetime of the landfill.

Differential settlement may also occur between the perimeter berm fill and the waste within the disposal footprint and at the interface between the recently placed and existing MSW. With the implementation of proper compaction technique, such settlements can be mitigated. However, relative differential settlement between new and existing waste may adversely impact and cause internal tensile stresses in the liner systems. Installation of additional reinforcement layers of high strength geogrid, such as Tensar Liner Support System, will help limit the strains within the existing liner.

A settlement monitoring program is recommended so that settlements are recorded. The monitoring results will be used to assess and verify the anticipated settlement and modify the design of the uncompleted cells, as required.

\subsection*{4.6 Bearing Capacity}

An analysis was performed to evaluate the bearing capacity of the foundation soil below the proposed waste fill embankment. The analysis was undertaken to assess the height to which the waste embankment can be constructed. Based on the provided geometry for the proposed landfill expansion, bearing capacity is not anticipated to be a concern for the proposed design thickness.

\subsection*{4.6 Stability Evaluation}

Analyses were performed to investigate the stability of the proposed landfill configurations, in terms of height and overall side slope that could be developed to maintain acceptable factors of safety against slope instability. An adequate Factor of Safety (FS) against slope instabilities must be achieved for the proposed waste embankment side slopes. In this regard, a design objective FS of 1.5 has been selected for the long-term condition, consistent with acceptable design practice.

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Stability assessment consisted of a limit equilibrium slope stability analysis using software SLOPE/W developed by GeoStudio. Groundwater levels modelled in the analysis were based on a groundwater encountered in the borings 24 hours or more after completion of drilling.

\section*{Analysis Parameters}

The soil strength parameters adopted in the analysis are provided on the analysis models in Appendix D. These parameters are derived based on correlation with index soil properties from laboratory test results and back analysis stability results.

Table 6: Material Strength Parameters for Slope Stability
\begin{tabular}{|c|c|c|c|c|}
\hline Material Type & Material Model & \begin{tabular}{c} 
Unit Weight \\
\((\mathrm{pcf})\)
\end{tabular} & \begin{tabular}{c} 
Apparent Cohesion \\
(psf)
\end{tabular} & \begin{tabular}{c} 
Angle of Internal \\
Friction ( \({ }^{\circ}\) )
\end{tabular} \\
\hline Vegetation Cover & Mohr-Coulomb & 115 & 200 & 10 \\
\hline \begin{tabular}{c} 
Compacted Soil Liner (On-site \\
Soil)
\end{tabular} & Mohr-Coulomb & 120 & 600 & 19 \\
\hline Municipal Solid Waste (MSW) & Bilinear & 63 & \begin{tabular}{c}
500 (if \(\left.\sigma_{\mathrm{n}}<770 \mathrm{psf}\right)\) \\
0 (if \(\left.\sigma_{\mathrm{n}} \geq 770 \mathrm{psf}\right)\)
\end{tabular} & \begin{tabular}{c}
0 (if \(\sigma_{\mathrm{n}}<770 \mathrm{psf}\) ) \\
33 (if \(\left.\sigma_{\mathrm{n}} \geq 770 \mathrm{psf}\right)\)
\end{tabular} \\
\hline Lean Clay & Mohr-Coulomb & 125 & 1,200 & 15 \\
\hline Very Weathered Shale & Mohr-Coulomb & 130 & 2,400 & 10 \\
\hline Shale Bedrock & Impenetrable & - & - & - \\
\hline
\end{tabular}

\section*{Slope Stability under Seismic Conditions}

The stability of the design slopes was investigated using a pseudo-static analysis in which the effects of the earthquake shaking are simulated as constant horizontal and vertical inertial forces acting on the slope. SLOPE/W allows for the definition of dimensionless seismic coefficients, \(k_{h}\) and \(k_{v}\), which are used to calculate and apply the resulting inertial forces in the horizontal and vertical directions.

The US EPA Subtitle D regulations for MSW landfills prescribes that slopes be investigated for stability for seismic events that would have a \(10 \%\) probability of exceedance in 250 years (equivalent to \(2 \%\) probability in 50 years). Based on the USGS 2014 Long-term Model maps, available on the USGS website, the peak ground acceleration (PGA) meeting these criteria is between 0.06 g and 0.1 g . A site-specific seismic investigation using the OSHPD online seismic design maps tool provided the following site-specific information:

\section*{STANDARD}
- MCEg \(_{\text {peak }}\) ground acceleration (PGA) \(=0.087\)
- \(\quad\) Site modified peak ground acceleration \((P G A m)=0.139\)
- Approximate mapped spectral acceleration for short periods \((\mathrm{Ss})=0.167\)
- Approximate mapped spectral acceleration at 1.0 second period \(\left(S_{1}\right)=0.059\)

For the purposes of this analysis, the seismic site coefficients were taken as \(\mathrm{k}_{\mathrm{h}}=0.143\) and \(\mathrm{k}_{\mathrm{v}}=0.09\).

\section*{Analysis Results}

The results of the analysis are presented graphically in Appendix E and are summarized in the table below. The piezometric condition associated with groundwater encountered in our borings does not have a significant impact on the stability. Groundwater level variation could impact the calculated FS. Monitoring is recommended during and post cell development to observe and protect against development of higher groundwater levels.

The seismic analyses show that the accelerations considered should be considered as the yield accelerations, i.e. accelerations resulting in a FS of approximately 1.0. In the cases considered, the interim \(3 \mathrm{H}: 1 \mathrm{~V}\) slope controls.

Table 7: Summary of Slope Stability Analysis
\begin{tabular}{||c|c|c|c||}
\hline Cross Section & Method of Analysis & Critical FS & Figure \# \\
\hline \hline \multirow{2}{*}{ Section 1 } & Static & 3.7 & Section 1-S \\
\cline { 2 - 4 } & Pseudo-Static & 2.0 & Section 1-P \\
\hline \begin{tabular}{c} 
Section 2 \\
(Right Side)
\end{tabular} & Static & 3.0 & Section 2-S \\
\cline { 2 - 4 } & Pseudo-Static & 1.8 & Section 2-P \\
\hline \begin{tabular}{c} 
Section 2 (Left \\
Side)
\end{tabular} & Static & Pseudo-Static & 2.9 \\
\hline \begin{tabular}{c} 
Section 3 \\
(Right Side)
\end{tabular} & Static & 3.5 & Section 2-S \\
\cline { 2 - 4 } & Pseudo-Static & 2.1 & Section 2-S \\
\hline \hline
\end{tabular}
\begin{tabular}{||c|c|c|c|}
\hline \hline \multirow{2}{*}{\begin{tabular}{c} 
Section 3 (Left \\
Side)
\end{tabular}} & Static & 3.9 & Section 2-S \\
\cline { 2 - 4 } & Pseudo-Static & 2.3 & Section 2-P \\
\hline \begin{tabular}{c} 
Section A \\
(Right Side)
\end{tabular} & Static & 2.9 & Section 2-S \\
\cline { 2 - 4 } & Pseudo-Static & 1.8 & Section 2-P \\
\hline \begin{tabular}{c} 
Section B \\
(Right Side)
\end{tabular} & Static & 3.0 & Section B-S \\
\cline { 2 - 4 } & Pseudo-Static & 1.9 & Section B-P \\
\hline \multirow{2}{*}{\begin{tabular}{c} 
Section B (Left \\
Side)
\end{tabular}} & Static & 3.6 & Section B-S \\
\cline { 2 - 4 } & Pseudo-Static & 2.2 & Section B-P \\
\hline
\end{tabular}

\subsection*{4.7 Perimeter Berms and Embankments}

The construction of berms may be required to shield the landfill operations, to reduce noise and litter problems, to provide an initial slope against which to place and compact refuse and facilitate the overall stability, and to direct surface water away from the active operations.

Berms can be constructed and lined with an appropriate geosynthetic liner to control seepage. Side slopes with a maximum height of 15 feet should not be steeper than 3H:1V, higher berms can be constructed with a side slope not steeper than \(4 \mathrm{H}: 1 \mathrm{~V}\) (final slopes) or \(3 \mathrm{H}: 1 \mathrm{~V}\) (interim slopes). All construction activities should be subject to quality control testing. Standard Testing should be retained to observe and test the construction materials during placement.

\section*{Subgrade Preparation}

The existing subgrade should be:
- Stripped of vegetation, topsoil, fills and any other deleterious materials,
- Proofrolled, including removing and replacing any soft material which exhibits permanent subgrade deformation exceeding 0.5 inch when traversed by a loaded truck with a rear axle load of approximately \(16,000 \mathrm{lbs}\)./axle, and
- Tested for moisture and density and, if deficient, scarified to a depth of 8 inches, moisture conditioned and compacted to 95 percent or more of Standard Proctor maximum dry density (ASTM D698).

Removal of soft subgrade should not exceed a 3-foot depth below final top of subgrade elevation, nor extend below the static groundwater elevation. If such a depth is reached without encountering stable subgrade conditions, 12 inches of ODOT Type A aggregate base should be placed in the bottom of the over excavated area and suitable fill material placed and compacted to bring the subgrade to design elevation.

\section*{Compaction Requirements}

All fill material should be:
- Compacted to at least 95 percent or more of Standard Proctor maximum dry density (ASTM D698) at a moisture content within \(-2 \%\) to \(+2 \%\) of the optimum.
- Compacted to at least 95 percent or more of Standard Proctor maximum dry density (ASTM D698) at a moisture content near optimum for ODOT Type A.
- Placed in lifts not to exceed eight (8) inches in loose lifts when compacted with heavy rollers, and no to exceed four (4) inches in loose lifts when compacted with hand operated equipment.
- Tested for field density at frequencies of one test per every 250 linear foot.
- During construction all surfaces and construction areas should be adequately graded to facilitate drainage.

\subsection*{4.8 Drainage}

The importance of internal drainage within the landfill cannot be overstated. The potential for low permeability barriers within the waste may impede drainage and raise the piezometric level and adversely impact the stability of the fill. It is essential to incorporate an efficient leachate collection system in the design to promote downward migration and protect against mounding of liquid within the waste. Regular monitoring of the performance of the leachate collection system should be an integral part of the operating procedures. The components of the drainage system buried within the landfill will be subjected to significant vertical and lateral strain. The leachate collection system design shall account for these conditions.

\section*{Section 5}

\section*{BASIS FOR RECOMMENDATIONS}

\subsection*{5.1 General Comments}

The recommendations and conclusions contained in this report are based on the borings drilled and tests performed. We would point out that there may be variations in material properties over the site and would caution that there may be unknown conditions in existence which differ seriously from those encountered by the test borings. Such conditions, if indeed they exist at all, cannot be, and have not been, accounted for in this report. Therefore, the descriptions, recommendations, and conclusions contained herein should be considered as generalized, applying only to the immediate vicinity of the borings.

\subsection*{5.2 Limitations}

Since this report is being prepared in advance of much of the detailed design, the finalized soil and structure parameters (i.e., floor elevation, structural system and loading, vertical movement tolerance, etc.) may differ from the ones considered during the preparation of this report. If such a design variance is substantial, Standard Testing would request the opportunity to review the plans and specifications of the proposed facility for applicability to the soil conditions in this report, and assurance of consistency with its intent.

It is recommended that Standard Testing be retained for testing and observation during earthwork and foundation construction phases, to help determine that the design requirements are fulfilled.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical practice.

\section*{APPENDIX A}

\section*{Vicinity Map}

Site and Boring Location Plan




\section*{APPENDIX B}

\author{
Boring Logs \\ Soil Profile \\ Key to Symbols \\ Definition of Descriptive Terms
}























\section*{Definition of Descriptive Terms}

Consistency of Cohesive Soils (at moisture content near plastic limit):
Very Soft - Easily penetrated 4 " to 6 " by fist; tall core will sag under its own weight.
Soft - Easily molded by fingers.
Firm - Can be penetrated 2" to 3" by thumb with moderate effort, imprinted with fingers.
Stiff - Readily indented by thumb but penetrated only with great effort.
Very Stiff - Readily indented by thumbnail, imprinted very slightly with pressure from fingers.
Hard - Indented with difficulty by thumbnail, cannot be imprinted with fingers.
Density of Cohesionless Soils:
Very Loose - less than 4 SPT "N" value corrected for overburden.
Loose - 5 to 10 SPT "N" value corrected for overburden.
Medium Dense - 11 to 30 SPT "N" value corrected for overburden.
Dense - 31 to 50 SPT "N" value corrected for overburden.
Very Dense - 51 to \(50 / 6\) " SPT "N" value corrected for overburden.
Hard - less than 6" penetration in 50 SPT "N" blows corrected for overburden (cemented).
Hardness of Rock:
Very Soft - can be scratched readily by fingernail
Soft - can be grooved readily by knife or pick
Medium - can be grooved 0.05 " deep by firm pressure of knife
Moderately Hard - can be scratched by knife
Hard - can be scratched by knife or pick only with difficulty
Very Hard - cannot be scratched by knife or sharp pick
Other Terms Descriptive of Consistency:
Brittle - Ruptures with little deformation
Friable - Crumbles or pulverizes easily.
Elastic - Returns to original length after small deformation.
Spongy - Is very porous, loose and elastic.
Sticky - Adheres or sticks to tools or hands.
In-Situ Moisture Descriptions:
Dry - powdery
Slightly Moist - water not readily absorbed by paper
Moist - water readily absorbed by paper
Very Moist - water condenses on sample tray
Wet - water drips from sample
Degree of Plasticity When Moist to Very Moist:
Nonplastic - cannot be rolled into a ball
Trace of Plasticity - can be rolled into a ball but not into a \(1 / 8\) " thread
Low Plasticity - barely holds its shape when rolled into a \(1 / 8^{\prime \prime}\) thread
Fairly Low Plasticity - 1/8" thread quickly ruptures when bent
Medium Plasticity \(-1 / 8^{\prime \prime}\) thread withstands considerable deformation without rupture.
Fairly High Plasticity - difficult to rupture a \(1 / 8\) " thread by bending.
High Plasticity - can be kneaded without rupture; greasy texture.
Abbreviations:
V. - Very
Tr. - Trace
Fl. - Fairly
Dk. - Dark
Blk. - Black
Lt. - Light
Brn. - Brown
SI. - Slightly
Med. - Medium

\section*{APPENDIX C}

\section*{AASHTO Soil Classification System} Unified Soil Classification System

\section*{Soil Classification System - American Association of State Highway and Transportation Officials}

The tables and charts given below are from AASHTO Designation: M 145-83, The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes. More detailed information as to the background and application of the system may be obtained from the report.


Liquid-limit and plasticity-index ranges for the A-4, A-5, A-6 and A-7 subgrade groups.


Classification of Soils and Soll-Aggregate Mix̧̧ures (with Suggested Subgroups)
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline General classification & & & per & anular m or less & erials ssing \(N\) & 200) & & (Mora & \[
\begin{aligned}
& \text { Silt-clay } \\
& \text { an } 35 \text { per }
\end{aligned}
\] & materic ont pes & No. 200) \\
\hline & A & & A-3 & & & & & A-4 & A. 5 & A-6 & A. 7 \\
\hline & A.1-a & A-1-b & & A-2-4 & A-2-5 & A-2.6 & A. 2.7 & & & & A-7-5; A-7-6 \\
\hline \begin{tabular}{l}
Sieve analysis: \\
Per cent passing: \\
No. 10 \\
No. 40 \\
No. 200
\end{tabular} & \begin{tabular}{l}
50 max. \\
30 max. \\
15 max.
\end{tabular} & \begin{tabular}{l}
50 max. \\
25 max.
\end{tabular} & 51 min . 10 max. & 35 max. & 35 max. & \[
\overline{\text { E }}
\] & 35 max. & 36 min . & 36 min. & - &  \\
\hline Characteristics of fraction passing No. 40, Liquid limil Plasticity index & \multicolumn{2}{|c|}{\[
\delta_{\max .}^{-}
\]} & \(\overline{N P}\) & 40 max. 10 max. & 41 min. 10 max. & \begin{tabular}{l}
40 max. \\
11 min .
\end{tabular} & 41 min . 11 min . & 40 max. 10 max. & 41 min. 10 max. & \begin{tabular}{l}
40 max. \\
11 min .
\end{tabular} & \begin{tabular}{l}
41 min . \\
11 min. \({ }^{\circ}\)
\end{tabular} \\
\hline Usual types of significant constituent materials & \multicolumn{2}{|l|}{Stone fragments, gravel and sand} & Fine sand & \multicolumn{4}{|c|}{Silty or clayey gravel and sand} & \multicolumn{2}{|c|}{Silty soils} & \multicolumn{2}{|r|}{Clayey soils} \\
\hline General rating as subgrade & \multicolumn{5}{|c|}{Excellent to good} & \multicolumn{6}{|c|}{Fair to poor} \\
\hline
\end{tabular}
- P.I. of A-7.5 subgroup is equal to or less than L.L. minus 30. P.I. of A-7-6 subgroup is greater than L.L. minus 30


\section*{APPENDIX D}

\section*{Summary of Test Results}

SUMMARY OF LABORATORY TEST RESULTS

Page 1 of 4

Client: Cowan Group Engineering
Project: Atlus Landfill Expansion

Date: 1/8/2021
Project No.: 2030-0598
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline \multirow{3}{*}{Boring No.} & \multirow[t]{3}{*}{Sample No.} & \multirow[t]{3}{*}{\begin{tabular}{l}
Depth \\
(ft)
\end{tabular}} & \multirow[t]{3}{*}{Moisture Content (\%)} & \multirow[t]{3}{*}{Dry
Density
(pcf)} & \multicolumn{3}{|l|}{\multirow[t]{2}{*}{Atterberg Limits (\% Moisture)}} & \multicolumn{5}{|c|}{\multirow[t]{2}{*}{Sieve Analysis (\% Passing)}} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{Soil
Classification}} & \multicolumn{2}{|c|}{UCT} \\
\hline & & & & & & & & & & & & & & & \multirow[t]{2}{*}{\[
\begin{gathered}
\text { Stress } \\
\text { (psf) } \\
\hline \hline
\end{gathered}
\]} & \multirow[t]{2}{*}{Strain (\%)} \\
\hline & & & & & LL & PL & Pl & \#4 & \#10 & \#40 & \#100 & \#200 & USCS & AASHTO & & \\
\hline \multicolumn{17}{|l|}{B-1} \\
\hline & A & 0.0-1.5 & 21.1 & & & & & & & & & & & & & \\
\hline & B & 1.5-3.0 & 23.3 & 105 & & & & & & & & & & & & \\
\hline & C & 5.0-6.5 & 20.0 & 109 & 39 & 25 & 14 & 100 & 100 & 98 & 94 & 90.1 & CL & A-6(14) & & \\
\hline & D & 8.0-10.0 & 19.3 & & & & & & & & & & & & & \\
\hline & E & 10.0-11.5 & 15.5 & 113 & & & & & & & & & & & & \\
\hline & F & 15.0-16.5 & 18.3 & & 45 & 26 & 19 & 100 & 100 & 98 & 94 & 90.0 & CL & A-7-6(19) & & \\
\hline & G & 20.0-21.5 & 20.1 & 111 & & & & & & & & & & & & \\
\hline & H & 25.0-26.5 & 18.7 & & & & & & & & & & & & & \\
\hline \multicolumn{17}{|l|}{B-2} \\
\hline & A & 0.0-1.5 & 15.3 & & & & & & & & & & & & & \\
\hline & B & 1.5-3.0 & 13.1 & 119 & & & & & & & & & & & & \\
\hline & C & 5.0-6.5 & 17.4 & 114 & & & & & & & & & & & & \\
\hline & D & 8.0-10.0 & 17.7 & & & & & & & & & & & & & \\
\hline & E & 10.0-11.5 & 20.7 & & 44 & 26 & 18 & 100 & 100 & 99 & 97 & 92.1 & CL & A-7-6(19) & & \\
\hline & F & 15.0-16.5 & 20.4 & & & & & & & & & & & & & \\
\hline & G & 20.0-21.5 & 18.9 & & 43 & 27 & 16 & 100 & 100 & 97 & 93 & 88.4 & ML & A-7-6(16) & & \\
\hline & H & 25.0-26.5 & 18.4 & & & & & & & & & & & & & \\
\hline & 1 & 30.0-31.5 & 18.9 & 108 & & & & & & & & & & & & \\
\hline \multicolumn{17}{|l|}{B-3} \\
\hline & A & 0.0-1.5 & 15.8 & & & & & & & & & & & & & \\
\hline & B & 1.5-3.0 & 17.3 & 112 & 40 & 20 & 20 & 100 & 100 & 98 & 95 & 91.5 & CL & A-6(19) & & \\
\hline & C & 5.0-6.5 & 18.4 & 114 & & & & & & & & & & & & \\
\hline & D & 8.0-10.0 & 17.0 & & & & & & & & & & & & & \\
\hline & E & 10.0-11.5 & 18.1 & & & & & & & & & & & & & \\
\hline & F & 15.0-16.3 & 16.1 & & & & & & & & & & & & & \\
\hline & G & 20.0-21.5 & 18.1 & & & & & & & & & & & & & \\
\hline & H & 25.0-26.5 & 15.8 & 117 & 40 & 25 & 15 & 100 & 100 & 100 & 99 & 95.9 & CL & A-6(16) & & \\
\hline \multicolumn{17}{|l|}{B-4} \\
\hline & A & 0.0-1.5 & 12.9 & & & & & & & & & & & & & \\
\hline
\end{tabular}

SUMMARY OF LABORATORY TEST RESULTS

Page 2 of 4

Client: Cowan Group Engineering
Project: Atlus Landfill Expansion

Date: 1/8/2021
Project No.: 2030-0598
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline \multirow{3}{*}{Boring No.} & \multirow[t]{3}{*}{Sample No.} & \multirow[t]{3}{*}{\begin{tabular}{l}
Depth \\
(ft)
\end{tabular}} & \multirow[t]{3}{*}{Moisture Content (\%)} & \multirow[t]{3}{*}{Dry
Density (pcf)} & \multicolumn{3}{|l|}{\multirow[t]{2}{*}{Atterberg Limits (\% Moisture)}} & \multicolumn{5}{|c|}{\multirow[t]{2}{*}{Sieve Analysis (\% Passing)}} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{Soil
Classification}} & \multicolumn{2}{|c|}{UCT} \\
\hline & & & & & & & & & & & & & & & Stres & Strain \\
\hline & & & & & LL & PL & PI & \#4 & \#10 & \#40 & \#100 & \#200 & USCS & AASHTO & (psf) & (\%) \\
\hline & B & 1.5-3.0 & 17.5 & 116 & & & & & & & & & & & & \\
\hline & C & 5.0-6.5 & 16.4 & 114 & 39 & 21 & 18 & 97 & 96 & 95 & 94 & 92.2 & CL & A-6(17) & & \\
\hline & D & 8.0-10.0 & 9.7 & & & & & & & & & & & & & \\
\hline & E & 10.0-11.5 & 18.0 & & & & & & & & & & & & & \\
\hline & F & 15.0-16.5 & 18.1 & 112 & 42 & 27 & 15 & 100 & 100 & 99 & 97 & 95.1 & ML & A-7-6(17) & & \\
\hline & G & 20.0-21.3 & 13.5 & & & & & & & & & & & & & \\
\hline & H & 25.0-26.5 & 18.6 & & & & & & & & & & & & & \\
\hline & I & 30.0-31.5 & 19.0 & & & & & & & & & & & & & \\
\hline & \(J\) & 35.0-35.8 & 16.2 & 116 & & & & & & & & & & & & \\
\hline B-5 & & & & & & & & & & & & & & & & \\
\hline & A & 0.0-1.5 & 17.2 & & & & & & & & & & & & & \\
\hline & B & 1.5-3.0 & 19.1 & & & & & & & & & & & & & \\
\hline & C & 3.0-5.0 & 19.6 & & & & & & & & & & & & & \\
\hline & D & 5.0-6.5 & 19.1 & 109 & 42 & 24 & 18 & 100 & 99 & 97 & 95 & 92.1 & CL & A-7-6(18) & & \\
\hline & E & 8.0-10.0 & 18.3 & & & & & & & & & & & & & \\
\hline & F & 10.0-12.0 & 19.3 & & & & & & & & & & & & & \\
\hline & G & 15.0-16.5 & 18.7 & & & & & & & & & & & & & \\
\hline & H & 20.0-21.5 & 21.1 & & 38 & 23 & 15 & 100 & 100 & 99 & 97 & 94.5 & CL & A-6(15) & & \\
\hline & I & 25.0-26.4 & 20.0 & & & & & & & & & & & & & \\
\hline & L & 40.0-41.0 & 18.2 & 107 & & & & & & & & & & & & \\
\hline B-6 & & & & & & & & & & & & & & & & \\
\hline & A & 0.0-1.5 & 17.5 & & & & & & & & & & & & & \\
\hline & B & 1.5-3.0 & 17.1 & 112 & & & & & & & & & & & & \\
\hline & C & 5.0-6.5 & 15.2 & 119 & & & & & & & & & & & & \\
\hline & D & 8.0-10.0 & 16.6 & & & & & & & & & & & & & \\
\hline & E & 10.0-11.5 & 18.2 & & & & & & & & & & & & & \\
\hline & F & 15.0-17.0 & 18.0 & & & & & & & & & & & & & \\
\hline & G & 20.0-22.0 & 16.9 & & & & & & & & & & & & & \\
\hline & H & 25.0-25.2 & 14.4 & & & & & & & & & & & & & \\
\hline & J & 35.0-35.4 & 14.2 & 118 & 36 & 24 & 12 & 91 & 79 & 68 & 61 & 56.9 & CL & A-6(5) & & \\
\hline & & & & & & & & & & & & & & & & \\
\hline
\end{tabular}

SUMMARY OF LABORATORY TEST RESULTS

Page 3 of 4

Client: Cowan Group Engineering
Project: Atlus Landfill Expansion

Date: 1/8/2021
Project No.: 2030-0598
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline \multirow{3}{*}{Boring No.} & \multirow[t]{3}{*}{Sample No.} & \multirow[t]{3}{*}{\begin{tabular}{l}
Depth \\
(ft)
\end{tabular}} & \multirow[t]{3}{*}{Moisture Content (\%)} & \multirow[t]{3}{*}{Dry
Density
(pcf)} & \multicolumn{3}{|l|}{\multirow[t]{2}{*}{Atterberg Limits (\% Moisture)}} & \multicolumn{5}{|c|}{\multirow[t]{2}{*}{Sieve Analysis (\% Passing)}} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{Soil
Classification}} & \multicolumn{2}{|c|}{UCT} \\
\hline & & & & & & & & & & & & & & & \multirow[t]{2}{*}{Stress (psf)} & \multirow[t]{2}{*}{Strain (\%)} \\
\hline & & & & & LL & PL & PI & \#4 & \#10 & \#40 & \#100 & \#200 & USCS & AASHTO & & \\
\hline \multicolumn{17}{|l|}{B-7} \\
\hline & A & 0.0-1.5 & 14.2 & & & & & & & & & & & & & \\
\hline & B & 1.5-3.0 & 22.9 & 109 & & & & & & & & & & & & \\
\hline & C & 5.0-6.5 & 18.6 & 113 & & & & & & & & & & & & \\
\hline & D & 8.0-10.0 & 18.2 & & & & & & & & & & & & & \\
\hline & E & 10.0-11.5 & 18.5 & & 43 & 27 & 16 & 100 & 100 & 99 & 98 & 96.2 & ML & A-7-6(18) & & \\
\hline & F & 15.0-16.5 & 18.0 & & 41 & 27 & 14 & 100 & 100 & 100 & 100 & 98.6 & ML & A-7-6(16) & & \\
\hline & G & 20.0-22.0 & 17.2 & & & & & & & & & & & & & \\
\hline & H & 25.0-26.5 & 18.6 & & & & & & & & & & & & & \\
\hline \multicolumn{17}{|l|}{B-8} \\
\hline & A & 0.0-1.5 & 13.0 & & & & & & & & & & & & & \\
\hline & B & 1.5-3.0 & 12.9 & & & & & & & & & & & & & \\
\hline & C & 5.0-6.5 & 17.8 & & 43 & 25 & 18 & 100 & 100 & 98 & 95 & 93.1 & CL & A-7-6(19) & & \\
\hline & D & 8.0-10.0 & 14.7 & & & & & & & & & & & & & \\
\hline & E & 10.0-11.5 & 17.1 & 111 & & & & & & & & & & & & \\
\hline & F & 15.0-16.5 & 17.1 & & & & & & & & & & & & & \\
\hline & G & 20.0-20.3 & 12.8 & & NP & NP & NP & 27 & 23 & 20 & 17 & 15.1 & GM & A-1-a & & \\
\hline & H & 25.0-25.1 & 17.3 & & & & & & & & & & & & & \\
\hline & K & 40.0-40.9 & 18.0 & 108 & & & & & & & & & & & & \\
\hline \multicolumn{17}{|l|}{B-9} \\
\hline & A & 0.0-1.5 & 12.8 & & & & & & & & & & & & & \\
\hline & B & 1.5-3.0 & 7.3 & & & & & & & & & & & & & \\
\hline & C & 3.0-5.0 & 15.7 & & & & & & & & & & & & & \\
\hline & D & 5.0-6.5 & 19.0 & 112 & & & & & & & & & & & & \\
\hline & E & 8.0-10.0 & 17.8 & & & & & & & & & & & & & \\
\hline & F & 10.0-11.5 & 19.3 & & & & & & & & & & & & & \\
\hline & G & 15.0-16.5 & 19.1 & & & & & & & & & & & & & \\
\hline & H & 20.0-21.5 & 16.7 & & & & & & & & & & & & & \\
\hline & I & 25.0-26.5 & 20.5 & & 44 & 29 & 15 & 89 & 89 & 88 & 87 & 85.3 & ML & A-7-6(14) & & \\
\hline & K & 35.0-36.0 & 15.7 & 118 & & & & & & & & & & & & \\
\hline & & & & & & & & & & & & & & & & \\
\hline
\end{tabular}

\section*{STANDARD TESTING \\ AND ENGINEERING COMPANY}
-Since 1951 \(\qquad\)
SUMMARY OF LABORATORY TEST RESULTS

Page 4 of 4
Client: Cowan Group Engineering
Project: Atlus Landfill Expansion

Date: 1/8/2021
Project No.: 2030-0598


\section*{COMPACTION TEST REPORT}

Curve No.

\begin{tabular}{|c|c|}
\hline TEST RESULTS & Material Description \\
\hline \multirow[t]{2}{*}{\begin{tabular}{l}
Maximum dry density \(=97.4\) pcf \\
Optimum moisture \(=25.3 \%\)
\end{tabular}} & \\
\hline & Remarks: \\
\hline Project No. 2030-0598 Client: Cowan Group Engineering Project: Atlus Landfill Expansion & \\
\hline Source of Sample: Comp-1 Depth: 10'-15 & Checked by: \\
\hline \[
\begin{aligned}
& \text { STANDARD } \\
& \text { TESTING }
\end{aligned}
\] & Title: \(\quad\) Figure \\
\hline
\end{tabular}

\section*{COMPACTION TEST REPORT}

\section*{Curve No.}

\begin{tabular}{|c|c|}
\hline TEST RESULTS & Material Description \\
\hline Maximum dry density \(=99.7 \mathrm{pcf}\) Optimum moisture \(=23.5 \%\) & Remarks: \\
\hline Project No. 2030-0598 Client: Cowan Group Engineering Project: Atlus Landfill Expansion & \\
\hline Source of Sample: Comp-2 Depth: \(0^{\prime}-10^{\prime}\) & Checked by: \\
\hline \[
\begin{aligned}
& \text { STANDARD } \\
& \text { TESTING } \\
& \text { ANO ENNIEERING COMPANY }
\end{aligned}
\] & Title: Figure \\
\hline
\end{tabular}




Sample Type: Remolded Description:

LL= \(43 \quad\) PL= \(25 \quad\) PI= 18
Assumed Specific Gravity= 2.65
Remarks:

Client: Cowan Group Engineering

Project: Atlus Landfill Expansion

Source of Sample: Comp-1 Depth: 10'-15'

Proj. No.: 2030-0598


Area Offices
902 Trails West Loop
Enid, OK 73703
(580) 237-3130

202 SE "J" Ave.
Lawton, OK 73501
(580) 353-0872

Lab No: 1560
Report No: 1560
Report On: Measurement of Hydraulic Conductivity

File ID: 2030-0598
Acct ID: 0230COW01
Page 1 of 1

Client: Cowan Group Engineering Michael Taylor, P.E.
7100 N Classen Blvd. Oklahoma City, OK 73116

Project: Subsurface Exploration
Altus Landfill Expansion Altus, Oklahoma

Location: Comp 1: B-1 to B-9 (10'-15')
Report Date: 01/15/2021
Sample Date: 01/15/2021
Sampled By:
\begin{tabular}{|c|c|c|c|c|}
\hline S ample I.D.: Comp 1: B-1 to B-9 (10'-15') & \multicolumn{3}{|l|}{\multirow[t]{2}{*}{M aterial Represented: Native Soils}} & \\
\hline Permeant Liquid: Deaired Tap W ater & \multirow[t]{2}{*}{\begin{tabular}{l}
S ample Preparation: \\
Initial
\end{tabular}} & & & \multirow[t]{2}{*}{2.70 (assumed)} \\
\hline Sample Parameter & & Final (at test pr & Specific Gravity: & \\
\hline Moist M ass, g & 150.2 & 156.3 & & \\
\hline A verage Length (L), cm & 2.540 & 2.518 & & \\
\hline A verage Diameter (D), cm & 6.350 & 6.366 & & \\
\hline Cross Sectional Area (A), sq.cm & 31.67 & 31.83 & & \\
\hline Volume, cc & 80.4 & 80.2 & & \\
\hline M oisture Content, \% & 24.1 & 29.2 & & \\
\hline Dry Unit W eight, pcf & 93.9 & 94.2 & & \\
\hline Saturation, \% & 82 & 100 & & \\
\hline & & Perm & Trial & \\
\hline Permeation Parameter & 1 & 2 & 3 & 4 \\
\hline Date & 1/12/2021 & 1/12/2021 & 1/13/2021 & 1/14/2021 \\
\hline Elapsed Time, sec. & 13,500 & 77,640 & 85,800 & 82,560 \\
\hline Permeant Temperature, deg. C & 20.0 & 20.0 & 20.0 & 20.0 \\
\hline Average Back Pressure, psia & 70.4 & 70.4 & 70.4 & 70.4 \\
\hline M inimum Effective Consolidation Stress, psi & 2.9 & 2.9 & 2.9 & 2.9 \\
\hline Maximum Effective Consolidation Stress, psi & 5.2 & 5.2 & 5.2 & 5.2 \\
\hline Influent \(M\) easure A rea ( \(\mathrm{a}_{\text {in }}\) ), sq.cm & 0.875 & 0.875 & 0.875 & 0.875 \\
\hline Effluent M easure Area ( \(\mathrm{o}_{\circ \mathrm{ut}}\) ), sq.cm & 0.875 & 0.875 & 0.875 & 0.875 \\
\hline Beginning Head Loss, cm & 159.8 & 158.9 & 159.1 & 152.4 \\
\hline Ending Head Loss, cm & 158.9 & 146.1 & 152.4 & 148.3 \\
\hline Beginning Gradient & 63.5 & 63.1 & 63.2 & 60.5 \\
\hline Ending Gradient & 63.1 & 58.0 & 60.5 & 58.9 \\
\hline A verage Perm eant Flow Volume, ml & 0.4 & 5.6 & 2.9 & 1.8 \\
\hline ASTM D 5084-10 Calculation M ethod & Method A & Method C & Method A & Method A \\
\hline Temperature Correction for \(V\) is cosity ( \(\mathrm{R} T\) ) & 1.000 & 1.000 & 1.000 & 1.000 \\
\hline Outflow / Inflow Ratio & 1.67 & 0.98 & 1.00 & 0.94 \\
\hline \% Deviation from A verage \(K\) & -27 & 85 & -14 & -4 4 \\
\hline Hydraulic Conductivity (K) , cm/sec & 1.5E-08 & 3.8E-08 & 1.7E-08 & 1.1E-08 \\
\hline
\end{tabular}

Test Methods: ASTM D5084-10

Orig: Cowan Group Engineering (Oklahoma City, OK) Attn: Michael Taylor, P.E. (1-cc copy)
1-cc Laboratory

Respectfully Submitted,
Standard Testing \& Engineering Company

Area Offices
902 Trails West Loop
Enid, OK 73703
(580) 237-3130

202 SE "J" Ave.
Lawton, OK 73501
(580) 353-0872

Lab No: 1560-1
Report No: 1560-1
Page 1 of 1

File ID: 2030-0598
Acct ID: 0230COW01

\author{
Project: Subsurface Exploration \\ Altus Landfill Expansion \\ Altus, Oklahoma
}
\begin{tabular}{|c|c|}
\hline Client: & Cowan Group Engineering Michael Taylor, P.E. 7100 N Classen Blvd. Oklahoma City, OK 73116 \\
\hline
\end{tabular}

Report Date: 01/15/2021
Location: Comp 2: B-1 to B-9 (0'-10'):
\(\begin{array}{ll}\text { Sample Date: } & 01 / 15 / 2021 \\ \text { Sampled By: }\end{array}\)
Sampled By:
\begin{tabular}{|c|c|c|c|c|}
\hline \multirow[t]{2}{*}{S ample I.D.:
Permeant Liquid:} & \multicolumn{3}{|l|}{\multirow[t]{2}{*}{Material Represented: Native Soils}} & \multirow[b]{2}{*}{2.70 (assumed)} \\
\hline & & & Specific Gravity: & \\
\hline Sample Parameter & Initial & Final (at test pr & & \\
\hline Moist M ass, g & 150.3 & 155.3 & & \\
\hline A verage Length (L), cm & 2.540 & 2.514 & & \\
\hline A verage Diameter (D), cm & 6.350 & 6.318 & & \\
\hline Cross Sectional Area (A), sq.cm. & 31.67 & 31.35 & & \\
\hline Volume, cc & 80.4 & 78.8 & & \\
\hline M oisture Content, \% & 23.9 & 28.0 & & \\
\hline Dry Unit W eight, pcf & 94.1 & 96.1 & & \\
\hline \multirow[t]{2}{*}{Saturation, \%} & 82 & 100 & & \\
\hline & & Perm & Trial & \\
\hline Permeation Parameter & 1 & 2 & 3 & 4 \\
\hline Date & 1/12/2021 & 1/12/2021 & 1/13/2021 & 1/14/2021 \\
\hline Elapsed Time, sec. & 13,020 & 78,240 & 85,620 & 85,260 \\
\hline Permeant Temperature, deg. C & 20.0 & 20.0 & 20.0 & 20.0 \\
\hline Average Back Pressure, psia & 70.4 & 70.4 & 70.3 & 70.4 \\
\hline M inimum Effective Consolidation Stress, psi & 2.9 & 2.9 & 3.0 & 3.0 \\
\hline Maximum Effective Consolidation Stress, psi & 5.1 & 5.1 & 5.2 & 5.2 \\
\hline Influent M easure A rea ( \(\mathrm{a}_{\text {in }}\) ), sq.cm. & 0.875 & 0.875 & 0.875 & 0.875 \\
\hline \(E\) ffluent \(M\) easure Area ( \(\mathrm{a}_{0} \mathrm{ut}^{\prime}\) ), sq.cm. & 0.875 & 0.875 & 0.875 & 0.875 \\
\hline Beginning Head Loss, cm & 155.4 & 154.9 & 156.7 & 154.1 \\
\hline Ending Head Loss, cm & 154.9 & 151.7 & 154.1 & 152.0 \\
\hline Beginning Gradient & 61.8 & 61.6 & 62.3 & 61.3 \\
\hline Ending Gradient & 61.6 & 60.3 & 61.3 & 60.4 \\
\hline A verage Permeant Flow Volume, ml & 0.2 & 1.4 & 1.1 & 0.9 \\
\hline ASTM D 5084-10 Calculation M ethod & Method A & Method A & Method A & Method A \\
\hline \multirow[t]{2}{*}{Temperature Correction for \(V\) iscosity ( \(\mathrm{R} T\) )} & 1.000 & 1.000 & 1.000 & 1.000 \\
\hline & 1.00 & 1.33 & 0.83 & 0.90 \\
\hline \% Deviation from A verage K & 7 & 26 & -11 & -2 2 \\
\hline Hydraulic Conductivity (K), cm/sec & 7.9E-09 & 9.4E-09 & 6.6E-09 & 5.8E-09 \\
\hline \multicolumn{4}{|l|}{} & \\
\hline
\end{tabular}

Test Methods: ASTM D5084-10

Orig: Cowan Group Engineering (Oklahoma City, OK) Attn: Michael Taylor, P.E. (1-cc copy)
1-cc Laboratory

Respectfully Submitted,
Standard Testing \& Engineering Company




Figure: Section 2-Static (Right Side)
Project Name: Atlus Landfill Expansion



Figure: Section 2-Pseudo (Right Side)
Project Name: Atlus Landfill Expansion


Figure: Section 2-Pseudo (Left Side)
Project Name: Atlus Landfill Expansion


Figure: Section 3-Static (Right Side)


Figure: Section 3-Static (Left Side)


Figure: Section 3-Pseudo (Right Side)


Figure: Section 3-Pseudo (Left Side)



Figure: Section A-Pseudo (Right Side)


Figure: Section B-Static (Right Side)


Figure: Section B-Static (Left Side)


Figure: Section B-Pseudo (Right Side)


Figure: Section B-Pseudo (Left Side)

\section*{Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section 1
Created By: Administrative User
Revision Number: 11
Date: 01/08/2021
Time: 03:40:22 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 1.gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:40:25 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Municipal Solid Maste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (500.4684, 1,479.1673) ft
Left-Zone Right Coordinate: (639, 1,497.3497) ft
Left-Zone Increment: 15
Right Type: Range
Right-Zone Left Coordinate: (639, 1,497.3497) ft
Right-Zone Right Coordinate: ( \(900.2538,1,524.5598\) ) ft
Right-Zone Increment: 8
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((0,1,455) \mathrm{ft}\)
Right Coordinate: \((1,200,1,532.83) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{\(X\)} & \multicolumn{1}{c|}{\(\boldsymbol{Y}\)} \\
\hline Coordinate 1 & 923.1483 ft & \(1,425 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,455 \mathrm{ft}\) \\
\hline Point 2 & 79.75 ft & \(1,478.83 \mathrm{ft}\) \\
\hline Point 3 & 100 ft & \(1,478.83 \mathrm{ft}\) \\
\hline Point 4 & 200 ft & \(1,478.83 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,475.78 \mathrm{ft}\) \\
\hline Point 6 & 400 ft & \(1,477.76 \mathrm{ft}\) \\
\hline Point 7 & 500 ft & \(1,479.17 \mathrm{ft}\) \\
\hline Point 8 & 600 ft & \(1,484.6 \mathrm{ft}\) \\
\hline Point 9 & 600 ft & \(1,489.46 \mathrm{ft}\) \\
\hline Point 10 & 700 ft & \(1,509.28 \mathrm{ft}\) \\
\hline Point 11 & 700 ft & \(1,509.69 \mathrm{ft}\) \\
\hline Point 12 & 800 ft & \(1,519.75 \mathrm{ft}\) \\
\hline Point 13 & 800 ft & \(1,519.96 \mathrm{ft}\) \\
\hline Point 14 & 748.98 ft & \(1,519.58 \mathrm{ft}\) \\
\hline Point 15 & 807.5 ft & \(1,520 \mathrm{ft}\) \\
\hline Point 16 & 515.5 ft & \(1,479.08 \mathrm{ft}\) \\
\hline Point 17 & 532.89 ft & \(1,475.96 \mathrm{ft}\) \\
\hline Point 18 & 544.75 ft & \(1,474.25 \mathrm{ft}\) \\
\hline Point 19 & 900 ft & \(1,524.55 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|} 
Point 20 & \(1,000 \mathrm{ft}\) & \(1,528.42 \mathrm{ft}\) \\
\hline Point 21 & \(1,100 \mathrm{ft}\) & \(1,530.06 \mathrm{ft}\) \\
\hline Point 22 & \(1,200 \mathrm{ft}\) & \(1,532.83 \mathrm{ft}\) \\
\hline Point 23 & 0 ft & \(1,425 \mathrm{ft}\) \\
\hline Point 24 & \(1,200 \mathrm{ft}\) & \(1,425 \mathrm{ft}\) \\
\hline Point 25 & 0 ft & \(1,430 \mathrm{ft}\) \\
\hline Point 26 & \(1,200 \mathrm{ft}\) & \(1,450 \mathrm{ft}\) \\
\hline Point 27 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline Point 28 & 923.1483 ft & \(1,425 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & \multicolumn{1}{c|}{ Area } \\
\hline Region 1 & Lean Clay & \(22,21,20,19,15,12,10,8,18,17,16,7,6,5,4,3,2,1,25,26\) & \(69,995 \mathrm{ft}^{2}\) \\
\hline Region 2 & Municipal Solid Waste & \(17,9,11,14,13,15,12,10,8,18\) & \(809.97 \mathrm{ft}^{2}\) \\
\hline Region 3 & Shale Bedrock & \(27,28,24\) & \(415.28 \mathrm{ft}^{2}\) \\
\hline Region 4 & Very Weathered Shale & \(26,25,23,28,27\) & \(17,585 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 734 of 864 converged

\section*{Current Slip Surface}

Slip Surface: 195
Factor of Safety: 3.654
Volume: 10,021.892 ft \({ }^{3}\)
Weight: 1,202,550.5 Ibf
Resisting Moment: 63,277,963 lbffft
Activating Moment: 17,319,498 Ibf•ft
Resisting Force: 642,547.79 lbf
Activating Force: 175,872.12 lbf
Slip Rank: 1 of 864 slip surfaces
Exit: (528.45016, 1,476.7566) ft
Entry: (801.51907, 1,519.9681) ft
Radius: 221.55745 ft
Center: \((594,1,523) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{Y} & PWP & \begin{tabular}{l} 
Base Normal \\
Stress
\end{tabular} & \begin{tabular}{l} 
Frictional \\
Strength
\end{tabular} & \begin{tabular}{l} 
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{c} 
Suction \\
Strength
\end{tabular} & Base Material \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
530.67008 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,475.5284\) \\
ft
\end{tabular} & \begin{tabular}{l}
0 \\
psf
\end{tabular} & \begin{tabular}{l}
368.71781 \\
psf
\end{tabular} & \begin{tabular}{l}
98.797639 \\
psf
\end{tabular} & \(1,200 \mathrm{psf}\) & 0 psf & Lean Clay \\
\hline \begin{tabular}{l} 
Slice \\
2
\end{tabular} & 538.82 ft & \begin{tabular}{l}
\(1,471.3328\) \\
ft
\end{tabular} & \begin{tabular}{l}
0 \\
psf
\end{tabular} & \begin{tabular}{l}
901.16339 \\
psf
\end{tabular} & 241.466 psf & \(1,200 \mathrm{psf}\) & 0 psf & Lean Clay \\
\hline \begin{tabular}{l} 
Slice \\
3
\end{tabular} & \begin{tabular}{l} 
ft \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,466.3569\) \\
ft
\end{tabular} & \begin{tabular}{l}
0 \\
psf
\end{tabular} & \begin{tabular}{l}
\(1,699.9848\) \\
psf
\end{tabular} & \begin{tabular}{l}
455.50956 \\
psf
\end{tabular} & \(1,200 \mathrm{psf}\) & 0 psf & Lean Clay \\
\hline Slice & 558.5625 & \(1,462.5814\) & 0 & \(2,421.4318\) & 648.82069 & \(1,200 \mathrm{psf}\) & 0 psf & Lean Clay \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 4 & ft & ft & psf & psf & psf & & & \\
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 567.77083 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,459.2773 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3,065.9449 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 821.51747 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 576.97917 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,456.4224 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,639.3938 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 975.17263 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice
\[
7
\] & \[
\begin{aligned}
& 586.1875 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,453.9989 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,146.5315 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,111.0598 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
8
\end{tabular} & \[
\begin{aligned}
& 595.39583 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.9922 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,591.2301 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,230.2164 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 604.54545 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,450.3987 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,992.3119 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,337.6859 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 613.63636 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,449.2046 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,352.631 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,434.2331 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 11
\end{aligned}
\] & \[
\begin{aligned}
& 622.72727 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,448.3906 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,659.1083 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,516.3535 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 631.81818 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,447.9528 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,913.3786 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,584.485 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& 640.90909 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,447.8888 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,116.7193 } \\
& \text { psf }
\end{aligned}
\] & 1,638.97 psf & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 14
\end{aligned}
\] & 650 ft & \[
\begin{aligned}
& 1,448.1983 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,270.0881 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,680.065 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& 659.09091 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,448.8829 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,374.1494 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,707.9482 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 668.18182 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,449.9461 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 6,429.292 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,722.7236 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 17 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 677.27273 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,451.3935 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,435.6392 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,724.4243 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 18 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \hline 686.36364 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,453.2327 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,393.0514 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,713.013 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& 695.45455 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,455.4739 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,301.1224 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,688.3807 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 20 \\
& \hline
\end{aligned}
\] & 704.898 ft & \[
\begin{aligned}
& 1,458.2503 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,110.5022 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,637.3041 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & 714.694 ft & \[
\begin{aligned}
& 1,461.6139 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,817.2034 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,558.715 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22 \\
& \hline
\end{aligned}
\] & 724.49 ft & \[
\begin{aligned}
& \text { 1,465.5035 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,464.5804 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,464.2299 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23 \\
& \hline
\end{aligned}
\] & 734.286 ft & 1,469.95 ft & \[
\begin{aligned}
& 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,050.5608 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,353.2937 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24 \\
& \hline
\end{aligned}
\] & 744.082 ft & \[
\begin{aligned}
& \text { 1,474.9916 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,572.5234 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,225.2039 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 25 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 753.23167 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,480.2588 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,020.8908 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,077.3944 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26 \\
& \hline
\end{aligned}
\] & 761.735 ft & \[
\begin{aligned}
& 1,485.7173 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,401.9722 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 911.55572 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 27 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 770.23833 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,491.7506 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,728.6746 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 731.14614 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& 778.74167 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,498.4197 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,997.4481 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 535.2146 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29 \\
& \hline
\end{aligned}
\] & 787.245 ft & \[
\begin{aligned}
& 1,505.803 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,204.0349 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 322.62019 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice & 795.74833 & 1,514.0029 & 0 & 343.32245 & 91.992974 & 1,200 psf & 0 psf & Lean Clay \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
30 & ft & ft & psf & psf & psf & & & \\
\hline \begin{tabular}{l} 
Slice \\
31
\end{tabular} & 800.68058 & \(1,519.0585\) & \begin{tabular}{l}
0 \\
ft
\end{tabular} & ft & -178.23883 & \begin{tabular}{l}
-47.758951 \\
psf
\end{tabular} & \(1,200 \mathrm{psf}\) & 0 psf \\
\hline \begin{tabular}{l} 
Slice \\
32
\end{tabular} & 801.44011 & \begin{tabular}{l}
\(1,519.8817\) \\
ft
\end{tabular} & \begin{tabular}{l}
psf
\end{tabular} & \begin{tabular}{l}
-112.60555 \\
ft
\end{tabular} & -0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal Solid \\
Waste
\end{tabular} \\
\hline
\end{tabular}

\section*{FS Dependent Siesmic Psuedo Static}

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\section*{File Information}

File Version: 9.01
Title: Section 1
Created By: Administrative User
Revision Number: 11
Date: 01/08/2021
Time: 03:40:22 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 1.gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW
Last Solved Date: 01/08/2021
Last Solved Time: 03:40:27 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{FS Dependent Siesmic Psuedo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

Lean Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (500.4684, 1,479.1673) ft
Left-Zone Right Coordinate: \((639,1,497.3497) \mathrm{ft}\)
Left-Zone Increment: 15
Right Type: Range
Right-Zone Left Coordinate: (639, 1,497.3497) ft
Right-Zone Right Coordinate: \((900.2538,1,524.5598) \mathrm{ft}\)
Right-Zone Increment: 8
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((0,1,455) \mathrm{ft}\)
Right Coordinate: \((1,200,1,532.83) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{\(X\)} & \multicolumn{1}{|c|}{\(\boldsymbol{Y}\)} \\
\hline Coordinate 1 & 923.1483 ft & \(1,425 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,455 \mathrm{ft}\) \\
\hline Point 2 & 79.75 ft & \(1,478.83 \mathrm{ft}\) \\
\hline Point 3 & 100 ft & \(1,478.83 \mathrm{ft}\) \\
\hline Point 4 & 200 ft & \(1,478.83 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,475.78 \mathrm{ft}\) \\
\hline Point 6 & 400 ft & \(1,477.76 \mathrm{ft}\) \\
\hline Point 7 & 500 ft & \(1,479.17 \mathrm{ft}\) \\
\hline Point 8 & 600 ft & \(1,484.6 \mathrm{ft}\) \\
\hline Point 9 & 600 ft & \(1,489.46 \mathrm{ft}\) \\
\hline Point 10 & 700 ft & \(1,509.28 \mathrm{ft}\) \\
\hline Point 11 & 700 ft & \(1,509.69 \mathrm{ft}\) \\
\hline Point 12 & 800 ft & \(1,519.75 \mathrm{ft}\) \\
\hline Point 13 & 800 ft & \(1,519.96 \mathrm{ft}\) \\
\hline Point 14 & 748.98 ft & \(1,519.58 \mathrm{ft}\) \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|} 
Point 15 & 807.5 ft & \(1,520 \mathrm{ft}\) \\
\hline Point 16 & 515.5 ft & \(1,479.08 \mathrm{ft}\) \\
\hline Point 17 & 532.89 ft & \(1,475.96 \mathrm{ft}\) \\
\hline Point 18 & 544.75 ft & \(1,474.25 \mathrm{ft}\) \\
\hline Point 19 & 900 ft & \(1,524.55 \mathrm{ft}\) \\
\hline Point 20 & \(1,000 \mathrm{ft}\) & \(1,528.42 \mathrm{ft}\) \\
\hline Point 21 & \(1,100 \mathrm{ft}\) & \(1,530.06 \mathrm{ft}\) \\
\hline Point 22 & \(1,200 \mathrm{ft}\) & \(1,532.83 \mathrm{ft}\) \\
\hline Point 23 & 0 ft & \(1,425 \mathrm{ft}\) \\
\hline Point 24 & \(1,200 \mathrm{ft}\) & \(1,425 \mathrm{ft}\) \\
\hline Point 25 & 0 ft & \(1,430 \mathrm{ft}\) \\
\hline Point 26 & \(1,200 \mathrm{ft}\) & \(1,450 \mathrm{ft}\) \\
\hline Point 27 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline Point 28 & 923.1483 ft & \(1,425 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & \multicolumn{1}{c|}{ Area } \\
\hline Region 1 & Lean Clay & \(22,21,20,19,15,12,10,8,18,17,16,7,6,5,4,3,2,1,25,26\) & \(69,995 \mathrm{ft}^{2}\) \\
\hline Region 2 & Municipal Solid Waste & \(17,9,11,14,13,15,12,10,8,18\) & \(809.97 \mathrm{ft}^{2}\) \\
\hline Region 3 & Shale Bedrock & \(27,28,24\) & \(415.28 \mathrm{ft}^{2}\) \\
\hline Region 4 & Very Weathered Shale & \(26,25,23,28,27\) & \(17,585 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 739 of 864 converged

\section*{Current Slip Surface}

Slip Surface: 201
Factor of Safety: 2.000
Volume: 12,984.77 ft \({ }^{3}\)
Weight: 1,572,878.3 Ibf
Resisting Moment: 2.1350284e+08 lbf.ft
Activating Moment: \(1.0675771 \mathrm{e}+08 \mathrm{lbf} \cdot \mathrm{ft}\)
Resisting Force: 812,884.58 lbf
Activating Force: \(406,449.87 \mathrm{lbf}\)
Slip Rank: 1 of 864 slip surfaces
Exit: (528.45016, 1,476.7566) ft
Entry: (834.43537, 1,521.3249) ft
Radius: 245.40966 ft
Center: \((653.97294,1,687.6355) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|l|c|c|l|l|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{ Y } & PWP & \begin{tabular}{l} 
Base Normal \\
Stress
\end{tabular} & \begin{tabular}{c} 
Frictional \\
Strength
\end{tabular} & \begin{tabular}{c} 
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{c} 
Suction \\
Strength
\end{tabular} & \begin{tabular}{c} 
Base \\
Material
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
530.67008 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,475.4665\) \\
ft
\end{tabular} & \begin{tabular}{l}
0 \\
psf
\end{tabular} & 801.61908 psf & \begin{tabular}{l}
214.79318 \\
psf
\end{tabular} & \(1,200 \mathrm{psf}\) & 0 psf & Lean Clay \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
Slice \\
2
\end{tabular} & 538.82 ft & \[
\begin{aligned}
& \text { 1,471.0239 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.8287 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 392.49967 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 3
\end{aligned}
\] & 550.275 ft & \[
\begin{aligned}
& 1,465.2946 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,527.4137 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 677.21847 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 4
\end{aligned}
\] & 561.325 ft & \[
\begin{aligned}
& 1,460.4645 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,543.1313 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 949.37916 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice
\[
5
\] & 572.375 ft & \[
\begin{aligned}
& 1,456.2628 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 4,417.2482 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,183.5981 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 6 \\
& \hline
\end{aligned}
\] & 583.425 ft & \[
\begin{aligned}
& 1,452.6555 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,166.8259 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,384.4468 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{array}{|l}
\hline \text { Slice } \\
7 \\
\hline
\end{array}
\] & 594.475 ft & \[
\begin{aligned}
& \text { 1,449.6156 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\mathrm{psf}
\] & \[
\begin{aligned}
& \text { 5,804.9997 } \\
& \text { psf }
\end{aligned}
\] & 1,555.445 psf & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
8
\end{tabular} & 605 ft & \[
\begin{aligned}
& \text { 1,447.2161 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,342.6421 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,699.5058 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice
\[
9
\] & 615 ft & \[
\begin{aligned}
& \text { 1,445.3932 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,795.4106 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,820.8248 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 10
\end{aligned}
\] & 625 ft & \[
\begin{aligned}
& 1,443.9942 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 7,175.2841 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,922.6116 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 11
\end{aligned}
\] & 635 ft & \[
\begin{aligned}
& \text { 1,443.0118 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 7,486.4032 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,005.9757 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 12 \\
& \hline
\end{aligned}
\] & 645 ft & \[
\begin{aligned}
& 1,442.441 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 7,732.1659 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,071.8276 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & 655 ft & \[
\begin{aligned}
& \text { 1,442.2789 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 7,915.3531 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,120.9125 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice
\[
14
\] & 665 ft & \[
\begin{aligned}
& 1,442.5248 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 8,038.2236 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,153.8355 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & 675 ft & \[
\begin{aligned}
& \text { 1,443.1798 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\mathrm{psf}
\] & 8,102.586 psf & \[
\begin{aligned}
& \text { 2,171.0814 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 16
\end{aligned}
\] & 685 ft & \[
\begin{aligned}
& \text { 1,444.2473 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 8,109.8527 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,173.0285 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 17
\end{aligned}
\] & 695 ft & \[
\begin{aligned}
& \text { 1,445.7327 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 8,061.0797 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,159.9598 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice & 704.898 ft & 1,447.62 ft & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 7,914.9296 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 2,120.799 psf & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & 714.694 ft & \[
\begin{aligned}
& \text { 1,449.9103 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 7,674.8745 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,056.4764 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & 724.49 ft & \[
\begin{aligned}
& \text { 1,452.6311 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 7,384.8784 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,978.7722 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice & 734.286 ft & 1,455.7975 & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 7,044.8218 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,887.6543 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22 \\
& \hline
\end{aligned}
\] & 744.082 ft & \[
\begin{aligned}
& 1,459.4283 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,654.3419 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,783.0255 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 23
\end{aligned}
\] & 754.082 ft & \[
\begin{aligned}
& \text { 1,463.6426 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,144.0974 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,646.3059 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24 \\
& \hline
\end{aligned}
\] & 764.286 ft & \[
\begin{aligned}
& 1,468.491 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,514.3015 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.5526 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25 \\
& \hline
\end{aligned}
\] & 774.49 ft & \[
\begin{aligned}
& 1,473.9366 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,831.1945 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,294.5147 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 26
\end{aligned}
\] & 784.694 ft & \[
\begin{aligned}
& 1,480.0264 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,093.3951 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,096.8219 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & 794.898 ft & \[
\begin{aligned}
& 1,486.8192 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 3,299.2474 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 884.03068 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline
\end{tabular}

FS Dependent Siesmic Psuedo Static
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & 803.75 ft & \[
\begin{aligned}
& 1,493.2896 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,554.1847 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 684.39172 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 811.98923 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,499.9594 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 1,809.0678 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 484.73825 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& 820.96768 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,507.9104 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & 967.39803 psf & \[
\begin{aligned}
& 259.21352 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
31
\end{tabular} & \[
\begin{aligned}
& 829.94614 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,516.7033 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 0 \\
& \mathrm{psf}
\end{aligned}
\] & 76.742626 psf & \[
\begin{aligned}
& 20.563125 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline
\end{tabular}

\section*{Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section 2
Created By: Administrative User
Revision Number: 26
Date: 01/08/2021
Time: 02:48:48 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 2 (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW
Last Solved Date: 01/08/2021
Last Solved Time: 02:48:52 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

\section*{Factor of Safety Convergence Settings}

Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001

\section*{Solution Settings}

Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(32^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Compacted Soil Liner}

Model: Mohr-Coulomb

Unit Weight: 120 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (102, 1,478.8186) ft
Left-Zone Right Coordinate: (311, 1,494.1921) ft
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((311,1,494.1921) \mathrm{ft}\)
Right-Zone Right Coordinate: \((582,1,513.1992) \mathrm{ft}\)
Right-Zone Increment: 10
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: ( \(0,1,463.42\) ) ft
Right Coordinate: \((1,200,1,464.02) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{\(\mathbf{X}\)} & \multicolumn{1}{c|}{\(\mathbf{Y}\)} \\
\hline Coordinate 1 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (884.44, 1,511) ft
Inside Point: (385.496, 1,510.83) ft
Slip Surface Intersection: (443.35125, 1,510.8497) ft
Length: 498.94403 ft
Direction: \(0.019522^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 9.1366675 lbf
Pullout Force per Length: \(5.07426 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 57.85525 ft
Required Length: 1.8005911 ft
Governing Component: Tensile Capacity

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,463.42 \mathrm{ft}\) \\
\hline Point 2 & 100 ft & \(1,478.81 \mathrm{ft}\) \\
\hline Point 3 & 200 ft & \(1,479.24 \mathrm{ft}\) \\
\hline Point 4 & 248.11 ft & \(1,478.45 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,491.44 \mathrm{ft}\) \\
\hline Point 6 & 300 ft & \(1,469.89 \mathrm{ft}\) \\
\hline Point 7 & 361.5 ft & \(1,445 \mathrm{ft}\) \\
\hline Point 8 & 385.496 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 9 & 400 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 10 & 400 ft & \(1,437.26 \mathrm{ft}\) \\
\hline Point 11 & 500 ft & \(1,513.15 \mathrm{ft}\) \\
\hline Point 12 & 500 ft & \(1,436.58 \mathrm{ft}\) \\
\hline Point 13 & 600 ft & \(1,513.21 \mathrm{ft}\) \\
\hline Point 14 & 600 ft & \(1,436.85 \mathrm{ft}\) \\
\hline Point 15 & 700 ft & \(1,513.17 \mathrm{ft}\) \\
\hline Point 16 & 700 ft & \(1,436.98 \mathrm{ft}\) \\
\hline Point 17 & 800 ft & \(1,513.13 \mathrm{ft}\) \\
\hline Point 18 & 800 ft & \(1,436.48 \mathrm{ft}\) \\
\hline Point 19 & 884.44 ft & \(1,513 \mathrm{ft}\) \\
\hline Point 20 & 900 ft & \(1,509.04 \mathrm{ft}\) \\
\hline Point 21 & 900 ft & \(1,437.14 \mathrm{ft}\) \\
\hline Point 22 & 941.14 ft & \(1,437.14 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|} 
Point 23 & \(1,000 \mathrm{ft}\) & \(1,484.05 \mathrm{ft}\) \\
\hline Point 24 & \(1,000 \mathrm{ft}\) & \(1,450.98 \mathrm{ft}\) \\
\hline Point 25 & \(1,032.45 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 26 & \(1,088.68 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 27 & \(1,100 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 28 & \(1,200 \mathrm{ft}\) & \(1,464.02 \mathrm{ft}\) \\
\hline Point 29 & \(1,200 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Point 30 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Point 31 & 0 ft & \(1,448 \mathrm{ft}\) \\
\hline Point 32 & \(1,200 \mathrm{ft}\) & \(1,454 \mathrm{ft}\) \\
\hline Point 33 & \(1,200 \mathrm{ft}\) & \(1,449 \mathrm{ft}\) \\
\hline Point 34 & 0 ft & \(1,430 \mathrm{ft}\) \\
\hline Point 35 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Point 36 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline Point 37 & 349.7661 ft & \(1,449.7489 \mathrm{ft}\) \\
\hline Point 38 & \(1,006.3772 \mathrm{ft}\) & \(1,453.0317 \mathrm{ft}\) \\
\hline Point 39 & 440.9509 ft & \(1,436.9815 \mathrm{ft}\) \\
\hline Point 40 & 976.531 ft & \(1,445.4616 \mathrm{ft}\) \\
\hline Point 41 & 400 ft & \(1,509.83 \mathrm{ft}\) \\
\hline Point 42 & 385.496 ft & \(1,509.83 \mathrm{ft}\) \\
\hline Point 43 & 300 ft & \(1,488.44 \mathrm{ft}\) \\
\hline Point 44 & 884.44 ft & \(1,510 \mathrm{ft}\) \\
\hline Point 45 & \(1,000 \mathrm{ft}\) & \(1,481.05 \mathrm{ft}\) \\
\hline Point 46 & \(1,078.35 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 47 & 255.409 ft & \(1,477.2459 \mathrm{ft}\) \\
\hline Point 48 & 385.496 ft & \(1,511.83 \mathrm{ft}\) \\
\hline Point 49 & 300 ft & \(1,490.44 \mathrm{ft}\) \\
\hline Point 50 & 884.44 ft & \(1,512 \mathrm{ft}\) \\
\hline Point 51 & \(1,000 \mathrm{ft}\) & \(1,483.05 \mathrm{ft}\) \\
\hline Point 52 & \(1,086.396 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 53 & 250.4979 ft & \(1,478.0561 \mathrm{ft}\) \\
\hline Point 54 & 884.44 ft & \(1,511 \mathrm{ft}\) \\
\hline Point 55 & 385.496 ft & \(1,510.83 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & Area \\
\hline Region 1 & Municipal Solid Waste & \(6,37,7,10,39,12,14,16,18,21,22,40,24,38,25,46,45,44,41,42,43,47\) & \(48,060 \mathrm{ft}^{2}\) \\
\hline Region 2 & Very Weathered Shale & \(34,35,36,33,40,22,21,18,16,14,12,39\) & \(19,401 \mathrm{ft}^{2}\) \\
\hline Region 3 & Shale Bedrock & \(30,29,36,35\) & \(13,800 \mathrm{ft}^{2}\) \\
\hline Region 4 & Lean Clay & \(40,24,38,25,46,52,26,27,28,32,33\) & \(2,821.7 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(34,31,1,2,3,4,53,47,6,37,7,10,39\) & \(14,525 \mathrm{ft}^{2}\) \\
\hline Region 6 & Compacted Soil Liner & \(47,43,42,41,44,45,46,52,51,50,48,49,53\) & \(1,661.7 \mathrm{ft}^{2}\) \\
\hline Region 7 & Vegetation Cover & \(4,53,49,48,50,51,52,26,23,20,19,17,15,13,11,9,8,5\) & \(912.38 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 47 of 726 converged

\section*{Current Slip Surface}

Slip Surface: 363
Factor of Safety: 6.895
Volume: 7,259.4258 ft \({ }^{3}\)
Weight: 597,867 lbf
Resisting Moment: 21,908,709 lbf•ft
Activating Moment: 3,177,336.3 lbf•ft
Resisting Force: 402,315.82 lbf
Activating Force: 58,346.558 lbf
Slip Rank: 1 of 726 slip surfaces
Exit: (207.47192, 1,479.1173) ft
Entry: (445.35199, 1,512.9751) ft
Radius: 190.21159 ft
Center: \((914,1,534)\) ft

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & Cohesive Strength & Suction Strength & Base Material \\
\hline \begin{tabular}{l}
Slice \\
1
\end{tabular} & \[
\begin{aligned}
& 211.53573 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,476.8032 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,715.3165 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 439.61552 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 117.79462 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
2
\end{tabular} & \[
\begin{aligned}
& 219.66335 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,472.4293 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,436.7588 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,000.1931 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 268.00093 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
3
\end{tabular} & \[
\begin{aligned}
& 227.79096 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,468.5463 \\
& \mathrm{ft}
\end{aligned}
\] & \[
3,188.8465
\]
psf & \[
\begin{aligned}
& 1,485.0804 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 397.92608 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & \[
\begin{aligned}
& 235.91858 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.1218 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,969.5552 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,901.3762 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 509.47223 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 244.04619 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.1295 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,777.2458 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,254.7171 } \\
& \text { psf }
\end{aligned}
\] & 604.14961 psf & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 249.30395 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,460.3682 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,663.7351
\]
psf & \[
\begin{aligned}
& \text { 2,494.6243 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 668.43256 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & \[
\begin{aligned}
& 252.95345 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,459.2902 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,593.9678 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 2,732.9408 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 732.28927 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
8
\end{tabular} & \[
\begin{aligned}
& 259.12492 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,457.6452 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,487.0965 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,021.8572 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 809.7042 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
9
\end{tabular} & \[
\begin{aligned}
& 266.55675 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.9279 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,374.8559 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,259.2892 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 873.32391 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
10
\end{tabular} & \[
\begin{aligned}
& 273.98858 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,454.5207 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,281.9781 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,454.376 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 925.59725 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline & & & & & & & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& 281.42042 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.4167 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,208.029 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,608.7466 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 966.96073 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & \[
\begin{aligned}
& 288.85225 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,452.6106 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,152.6771 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,723.7396 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 997.77301 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & \[
\begin{aligned}
& 296.28408 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,452.0986 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,115.6851 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3,800.4409 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,018.3251 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 303.78341 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.8789 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,096.9005 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,783.2822 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,013.7274 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice 15 & \[
\begin{aligned}
& 311.35022 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.9559 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,096.5923 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,673.2798 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 984.25235 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
16
\end{tabular} & \[
\begin{aligned}
& 318.91704 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,452.3347 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,115.1209 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,527.0151 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 945.06085 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 326.48385 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.017 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,152.5997 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,344.7949 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 896.23509 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
18
\end{tabular} & \[
\begin{aligned}
& 334.05067 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.0062 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,209.2352 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,126.7599 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 837.81278 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
19
\end{tabular} & \[
\begin{aligned}
& 341.8059 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,455.3475 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,287.7324 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,010.6062 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,881.2355 } \\
& \text { psf }
\end{aligned}
\] & 18.850599 psf & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
20
\] & \[
\begin{aligned}
& 349.74956 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,457.0644 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,389.5436 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,000.4925 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,874.9158 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
21
\end{tabular} & \[
\begin{aligned}
& 357.69321 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.1422 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,513.8902 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,968.0326 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,854.6326 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & \[
\begin{aligned}
& 365.63687 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,461.5935 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,661.5524 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,912.9076 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,820.1867 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
23
\end{tabular} & \[
\begin{aligned}
& 373.58052 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.4338 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,833.4976 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,834.6573 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,771.2905 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& 381.52417 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,467.6821 } \\
& \mathrm{ft}
\end{aligned}
\] & 3,030.9156
psf & \[
\begin{aligned}
& \text { 2,732.6665 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,707.5596 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice 25 & 389.122 ft & \[
\begin{aligned}
& \text { 1,471.1826 } \\
& \mathrm{ft}
\end{aligned}
\] & 3,244.3193
psf & \[
\begin{aligned}
& \text { 2,560.2771 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,599.8387 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
26
\end{tabular} & 396.374 ft & \[
\begin{aligned}
& \text { 1,474.9233 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
3,472.9435
\]
\[
\mathrm{psf}
\] & \[
\begin{aligned}
& \text { 2,320.2376 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,449.8454 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
27
\] & \[
\begin{aligned}
& 404.2394 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,479.4634 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,751.0621 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,037.5264 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,273.1878 \\
& \text { psf }
\end{aligned}
\] & 18.850599 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
28
\end{tabular} & \[
\begin{aligned}
& 412.7182 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,484.924 \\
& \mathrm{ft}
\end{aligned}
\] & 4,086.2374
psf & \[
\begin{aligned}
& \text { 1,707.5441 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,066.992 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline & & & - & & & & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
Slice \\
29
\end{tabular} & \[
\begin{aligned}
& 421.19699 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,491.0583 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,463.4655 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,347.1435 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 841.78872 \\
& \text { psf }
\end{aligned}
\] & 18.850599 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& 429.67579 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,497.9527 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
4,888.1517 \\
psf
\end{tabular} & \[
\begin{aligned}
& 954.16591 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 596.22903 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& 438.15459 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,505.7236 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,367.5543 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 508.88485 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
32
\] & \[
\begin{aligned}
& 443.3491 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,510.8475 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,683.9258 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 143.68973 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 49.476341 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 33
\end{aligned}
\] & \[
\begin{aligned}
& 444.8281 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,512.4126 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,780.6366 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 31.968696 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 5.6369436 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{FS Dependent Seismic Psuedo Static}

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\section*{File Information}

File Version: 9.01
Title: Section 2
Created By: Administrative User
Revision Number: 26
Date: 01/08/2021
Time: 02:48:48 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 2 (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 02:48:52 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

FS Dependent Seismic Psuedo Static
Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

Lean Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(32^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb

Unit Weight: 120 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((100,1,478.81) \mathrm{ft}\)
Left-Zone Right Coordinate: \((311,1,494.1921) \mathrm{ft}\)
Left-Zone Increment: 8
Right Type: Range
Right-Zone Left Coordinate: \((311,1,494.1921) \mathrm{ft}\)
Right-Zone Right Coordinate: \((582,1,513.1992) \mathrm{ft}\)
Right-Zone Increment: 10
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: ( \(0,1,463.42\) ) ft
Right Coordinate: \((1,200,1,464.02) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{\(\mathbf{X}\)} & \multicolumn{1}{c|}{\(\mathbf{Y}\)} \\
\hline Coordinate 1 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.086

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (884.44, 1,511) ft
Inside Point: (385.496, 1,510.83) ft
Slip Surface Intersection: (416.11621, 1,510.8404) ft
Length: 498.94403 ft
Direction: \(0.019522^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 20.297905 lbf
Pullout Force per Length: \(10.86816 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 30.620213 ft
Required Length: 1.8676487 ft
Governing Component: Tensile Capacity

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,463.42 \mathrm{ft}\) \\
\hline Point 2 & 100 ft & \(1,478.81 \mathrm{ft}\) \\
\hline Point 3 & 200 ft & \(1,479.24 \mathrm{ft}\) \\
\hline Point 4 & 248.11 ft & \(1,478.45 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,491.44 \mathrm{ft}\) \\
\hline Point 6 & 300 ft & \(1,469.89 \mathrm{ft}\) \\
\hline Point 7 & 361.5 ft & \(1,445 \mathrm{ft}\) \\
\hline Point 8 & 385.496 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 9 & 400 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 10 & 400 ft & \(1,437.26 \mathrm{ft}\) \\
\hline Point 11 & 500 ft & \(1,513.15 \mathrm{ft}\) \\
\hline Point 12 & 500 ft & \(1,436.58 \mathrm{ft}\) \\
\hline Point 13 & 600 ft & \(1,513.21 \mathrm{ft}\) \\
\hline Point 14 & 600 ft & \(1,436.85 \mathrm{ft}\) \\
\hline Point 15 & 700 ft & \(1,513.17 \mathrm{ft}\) \\
\hline Point 16 & 700 ft & \(1,436.98 \mathrm{ft}\) \\
\hline Point 17 & 800 ft & \(1,513.13 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 18 & 800 ft & 1,436.48 ft \\
\hline Point 19 & 884.44 ft & 1,513 ft \\
\hline Point 20 & 900 ft & 1,509.04 ft \\
\hline Point 21 & 900 ft & 1,437.14 ft \\
\hline Point 22 & 941.14 ft & 1,437.14 ft \\
\hline Point 23 & 1,000 ft & 1,484.05 ft \\
\hline Point 24 & 1,000 ft & 1,450.98 ft \\
\hline Point 25 & 1,032.45 ft & 1,461.42 ft \\
\hline Point 26 & 1,088.68 ft & 1,461.42 ft \\
\hline Point 27 & 1,100 ft & 1,461.42 ft \\
\hline Point 28 & 1,200 ft & 1,464.02 ft \\
\hline Point 29 & 1,200 ft & 1,410 ft \\
\hline Point 30 & 0 ft & 1,410 ft \\
\hline Point 31 & 0 ft & 1,448 ft \\
\hline Point 32 & 1,200 ft & 1,454 ft \\
\hline Point 33 & 1,200 ft & 1,449 ft \\
\hline Point 34 & 0 ft & 1,430 ft \\
\hline Point 35 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Point 36 & 1,200 ft & 1,428 ft \\
\hline Point 37 & 349.7661 ft & 1,449.7489 ft \\
\hline Point 38 & 1,006.3772 ft & 1,453.0317 ft \\
\hline Point 39 & 440.9509 ft & 1,436.9815 ft \\
\hline Point 40 & 976.531 ft & 1,445.4616 ft \\
\hline Point 41 & 400 ft & 1,509.83 ft \\
\hline Point 42 & 385.496 ft & 1,509.83 ft \\
\hline Point 43 & 300 ft & 1,488.44 ft \\
\hline Point 44 & 884.44 ft & 1,510 ft \\
\hline Point 45 & 1,000 ft & 1,481.05 ft \\
\hline Point 46 & 1,078.35 ft & 1,461.42 ft \\
\hline Point 47 & 255.409 ft & 1,477.2459 ft \\
\hline Point 48 & 385.496 ft & 1,511.83 ft \\
\hline Point 49 & 300 ft & 1,490.44 ft \\
\hline Point 50 & 884.44 ft & 1,512 ft \\
\hline Point 51 & 1,000 ft & 1,483.05 ft \\
\hline Point 52 & 1,086.396 ft & 1,461.42 ft \\
\hline Point 53 & 250.4979 ft & 1,478.0561 ft \\
\hline Point 54 & 884.44 ft & 1,511 ft \\
\hline Point 55 & 385.496 ft & 1,510.83 ft \\
\hline
\end{tabular}

Regions
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & Area \\
\hline Region 1 & Municipal Solid Waste & \(6,37,7,10,39,12,14,16,18,21,22,40,24,38,25,46,45,44,41,42,43,47\) & \(48,060 \mathrm{ft}^{2}\) \\
\hline Region 2 & Very Weathered Shale & \(34,35,36,33,40,22,21,18,16,14,12,39\) & \(19,401 \mathrm{ft}^{2}\) \\
\hline Region 3 & Shale Bedrock & \(30,29,36,35\) & \(13,800 \mathrm{ft}^{2}\) \\
\hline Region 4 & Lean Clay & \(40,24,38,25,46,52,26,27,28,32,33\) & \(2,821.7 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(34,31,1,2,3,4,53,47,6,37,7,10,39\) & \(14,525 \mathrm{ft}^{2}\) \\
\hline Region 6 & Compacted Soil Liner & \(47,43,42,41,44,45,46,52,51,50,48,49,53\) & \(1,661.7 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 186 of 594 converged

\section*{Current Slip Surface}

Slip Surface: 291
Factor of Safety: 3.104
Volume: 5,252.5085 ft \({ }^{3}\)
Weight: 442,514.61 Ibf
Resisting Moment: 16,539,464 Ibf•ft
Activating Moment: 5,328,796.9 lbf•ft
Resisting Force: 331,996.38 lbf
Activating Force: 106,966.3 lbf
Slip Rank: 1 of 594 slip surfaces
Exit: (206.47205, 1,479.1337) ft
Entry: \((418.02246,1,512.8877) \mathrm{ft}\)
Radius: 171.85248 ft
Center: \((914,1,534) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & Cohesive Strength & Suction Strength & Base Material \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 1
\end{aligned}
\] & \[
\begin{aligned}
& 209.94188 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,477.2749 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,745.8439 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 638.58013 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 171.10703 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& 216.88154 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,473.7548 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,521.3927 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,134.6237 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 304.02151 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 223.8212 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,470.6177 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,320.8446 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,555.7316 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 416.85702 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 4
\end{aligned}
\] & \[
\begin{aligned}
& 230.76085 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,467.8409 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,142.7973 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,910.2075 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 511.83855 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 5
\end{aligned}
\] & \[
\begin{aligned}
& 237.70051 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,465.4061 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,986.1002 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,204.5961 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 590.71974 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 6
\end{aligned}
\] & \[
\begin{aligned}
& 244.64017 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,463.2982 } \\
& \mathrm{ft}
\end{aligned}
\] & 2,849.8084
psf & \[
\begin{aligned}
& \text { 2,444.1372 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 654.90459 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& 249.30395 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,462.0251 } \\
& \mathrm{ft}
\end{aligned}
\] & 2,767.1726
psf & \[
\begin{aligned}
& \text { 2,621.8642 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 702.5264 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 252.95345 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,461.1672 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,711.1502 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,836.614 } \\
& \text { psf }
\end{aligned}
\] & \[
760.06843
\]
psf & 1,200 psf & 0 psf & Lean Clay \\
\hline & & & & & & & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & \[
\begin{aligned}
& 259.12492 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.9054 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,628.1963 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3,071.0213 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 822.87768 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 266.55675 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,458.6664 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,545.8223 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,228.9836 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 865.20356 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 11
\end{aligned}
\] & \[
\begin{aligned}
& 273.98858 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,457.7594 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
2,484.1687 \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 3,337.7534 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 894.34834 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & \[
\begin{aligned}
& 281.42042 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,457.1789 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,442.9062 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3,399.7445 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 910.9588 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& 288.85225 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.9218 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,421.8277 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,416.925 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 915.56229 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 296.28408 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,456.9865 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,420.8424
\]
psf & \[
\begin{aligned}
& 3,390.8875 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 908.58558 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& 304.03486 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,457.4046 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,441.6989 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,255.1696 \\
& \text { psf }
\end{aligned}
\] & 872.22007 psf & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 312.10459 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,458.2075 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,486.3703 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,009.8455 \\
& \text { psf }
\end{aligned}
\] & \[
806.48566
\]
psf & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 320.17431 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.3987 \\
& \mathrm{ft}
\end{aligned}
\] & 2,555.2766
psf & \[
\begin{aligned}
& \text { 2,720.6162 } \\
& \text { psf }
\end{aligned}
\] & 728.98692 psf & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{array}{|l}
\hline \text { Slice } \\
18
\end{array}
\] & 327.614 ft & \[
\begin{aligned}
& 1,460.8332 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,639.8042 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,550.7425 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,593.8808 } \\
& \text { psf }
\end{aligned}
\] & 18.850599 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& 334.42365 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.4621 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,736.8889 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,512.7885 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,570.1645 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 341.23329 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.3892 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline- \\
& 2,852.5914 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,456.4313 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,534.9486 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& 348.04294 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.6252 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,987.5772 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,381.7466 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,488.2805 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& 354.85259 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,469.183 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,142.6586 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,288.7195 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,430.1507 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& 361.66224 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,472.0785 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,318.8225 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,177.2442 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,360.4932 } \\
& \text { psf }
\end{aligned}
\] & 18.850599 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& 368.47188 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,475.331 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{array}{|l}
- \\
3,517.2659 \\
\text { psf } \\
\hline
\end{array}
\] & \[
\begin{aligned}
& \text { 2,047.1234 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,279.1847 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& 375.28153 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.9636 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,739.4444 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,898.0652 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,186.0428 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 382.09118 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,483.0049 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline-3,987.139 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,729.6798 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,080.8239 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline & & & - & & & & & \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\begin{tabular}{l} 
Slice \\
27
\end{tabular} & 389.122 ft & \begin{tabular}{l}
\(1,487.6519\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(4,272.4979\) \\
psf
\end{tabular} & \begin{tabular}{l}
\(1,486.0243\) \\
psf
\end{tabular} & \begin{tabular}{l}
928.57107 \\
psf
\end{tabular} & \begin{tabular}{l}
18.850599 \\
psf
\end{tabular} & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
28
\end{tabular} & 396.374 ft & \begin{tabular}{l}
\(1,492.9851\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,600.5492\) \\
psf
\end{tabular} & \begin{tabular}{l}
\(1,169.0687\) \\
psf
\end{tabular} & \begin{tabular}{l}
730.51519 \\
psf
\end{tabular} & \begin{tabular}{l}
18.850599 \\
psf
\end{tabular} & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
29
\end{tabular} & \begin{tabular}{l} 
403.79216 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,499.0958\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,977.0191\) \\
psf
\end{tabular} & \begin{tabular}{l}
826.28989 \\
psf
\end{tabular} & \begin{tabular}{l}
516.32323 \\
psf
\end{tabular} & \begin{tabular}{l}
18.850599 \\
psf
\end{tabular} & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
30
\end{tabular} & \begin{tabular}{l}
411.37649 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,506.1144\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,410.0612\) \\
psf
\end{tabular} & \begin{tabular}{l}
416.64531 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
31
\end{tabular} & \begin{tabular}{l}
416.11395 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,510.838\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,701.7577\) \\
psf
\end{tabular} & \begin{tabular}{l}
67.689829 \\
psf
\end{tabular} & \begin{tabular}{l}
23.307477 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
32
\end{tabular} & \begin{tabular}{l}
417.54086 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,512.3642\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(-5,796.072\) \\
psf
\end{tabular} & \begin{tabular}{l}
5.4410258 \\
psf
\end{tabular} & \begin{tabular}{l}
0.95939965 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline
\end{tabular}

\section*{Not Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section 2
Created By: Administrative User
Revision Number: 26
Date: 01/08/2021
Time: 02:48:48 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 2 (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 02:48:54 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

Lean Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(32^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Compacted Soil Liner}

Model: Mohr-Coulomb

Unit Weight: 120 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: ( \(102,1,478.8186\) ) ft
Left-Zone Right Coordinate: (311, 1,494.1921) ft
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: (575.2992, 1,513.1952) ft
Right-Zone Right Coordinate: (582, 1,513.1992) ft
Right-Zone Increment: 10
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: ( \(0,1,463.42\) ) ft
Right Coordinate: \((1,200,1,464.02) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{\(X\)} & \(\mathbf{Y}\) \\
\hline Coordinate 1 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (884.44, 1,511) ft
Inside Point: (385.496, 1,510.83) ft
Slip Surface Intersection: (571.08065, 1,510.8932) ft
Length: 498.94403 ft
Direction: \(0.019522^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 42 lbf
Pullout Force per Length: \(37.89342 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 185.58466 ft
Required Length: 1.1083719 ft
Governing Component: Tensile Capacity

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,463.42 \mathrm{ft}\) \\
\hline Point 2 & 100 ft & \(1,478.81 \mathrm{ft}\) \\
\hline Point 3 & 200 ft & \(1,479.24 \mathrm{ft}\) \\
\hline Point 4 & 248.11 ft & \(1,478.45 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,491.44 \mathrm{ft}\) \\
\hline Point 6 & 300 ft & \(1,469.89 \mathrm{ft}\) \\
\hline Point 7 & 361.5 ft & \(1,445 \mathrm{ft}\) \\
\hline Point 8 & 385.496 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 9 & 400 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 10 & 400 ft & \(1,437.26 \mathrm{ft}\) \\
\hline Point 11 & 500 ft & \(1,513.15 \mathrm{ft}\) \\
\hline Point 12 & 500 ft & \(1,436.58 \mathrm{ft}\) \\
\hline Point 13 & 600 ft & \(1,513.21 \mathrm{ft}\) \\
\hline Point 14 & 600 ft & \(1,436.85 \mathrm{ft}\) \\
\hline Point 15 & 700 ft & \(1,513.17 \mathrm{ft}\) \\
\hline Point 16 & 700 ft & \(1,436.98 \mathrm{ft}\) \\
\hline Point 17 & 800 ft & \(1,513.13 \mathrm{ft}\) \\
\hline Point 18 & 800 ft & \(1,436.48 \mathrm{ft}\) \\
\hline Point 19 & 884.44 ft & \(1,513 \mathrm{ft}\) \\
\hline Point 20 & 900 ft & \(1,509.04 \mathrm{ft}\) \\
\hline Point 21 & 900 ft & \(1,437.14 \mathrm{ft}\) \\
\hline Point 22 & 941.14 ft & \(1,437.14 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}

Not Factor of Safety Dependent
\begin{tabular}{|l|l|l|} 
Point 23 & \(1,000 \mathrm{ft}\) & \(1,484.05 \mathrm{ft}\) \\
\hline Point 24 & \(1,000 \mathrm{ft}\) & \(1,450.98 \mathrm{ft}\) \\
\hline Point 25 & \(1,032.45 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 26 & \(1,088.68 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 27 & \(1,100 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 28 & \(1,200 \mathrm{ft}\) & \(1,464.02 \mathrm{ft}\) \\
\hline Point 29 & \(1,200 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Point 30 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Point 31 & 0 ft & \(1,448 \mathrm{ft}\) \\
\hline Point 32 & \(1,200 \mathrm{ft}\) & \(1,454 \mathrm{ft}\) \\
\hline Point 33 & \(1,200 \mathrm{ft}\) & \(1,449 \mathrm{ft}\) \\
\hline Point 34 & 0 ft & \(1,430 \mathrm{ft}\) \\
\hline Point 35 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Point 36 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline Point 37 & 349.7661 ft & \(1,449.7489 \mathrm{ft}\) \\
\hline Point 38 & \(1,006.3772 \mathrm{ft}\) & \(1,453.0317 \mathrm{ft}\) \\
\hline Point 39 & 440.9509 ft & \(1,436.9815 \mathrm{ft}\) \\
\hline Point 40 & 976.531 ft & \(1,445.4616 \mathrm{ft}\) \\
\hline Point 41 & 400 ft & \(1,509.83 \mathrm{ft}\) \\
\hline Point 42 & 385.496 ft & \(1,509.83 \mathrm{ft}\) \\
\hline Point 43 & 300 ft & \(1,488.44 \mathrm{ft}\) \\
\hline Point 44 & 884.44 ft & \(1,510 \mathrm{ft}\) \\
\hline Point 45 & \(1,000 \mathrm{ft}\) & \(1,481.05 \mathrm{ft}\) \\
\hline Point 46 & \(1,078.35 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 47 & 255.409 ft & \(1,477.2459 \mathrm{ft}\) \\
\hline Point 48 & 385.496 ft & \(1,511.83 \mathrm{ft}\) \\
\hline Point 49 & 300 ft & \(1,490.44 \mathrm{ft}\) \\
\hline Point 50 & 884.44 ft & \(1,512 \mathrm{ft}\) \\
\hline Point 51 & \(1,000 \mathrm{ft}\) & \(1,483.05 \mathrm{ft}\) \\
\hline Point 52 & \(1,086.396 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 53 & 250.4979 ft & \(1,478.0561 \mathrm{ft}\) \\
\hline Point 54 & 884.44 ft & \(1,511 \mathrm{ft}\) \\
\hline Point 55 & 385.496 ft & \(1,510.83 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & \multicolumn{1}{c|}{\(\mathrm{Area}^{|c|}\)} \\
\hline Region 1 & Municipal Solid Waste & \(6,37,7,10,39,12,14,16,18,21,22,40,24,38,25,46,45,44,41,42,43,47\) & \(48,060 \mathrm{ft}^{2}\) \\
\hline Region 2 & Very Weathered Shale & \(34,35,36,33,40,22,21,18,16,14,12,39\) & \(19,401 \mathrm{ft}^{2}\) \\
\hline Region 3 & Shale Bedrock & \(30,29,36,35\) & \(13,800 \mathrm{ft}^{2}\) \\
\hline Region 4 & Lean Clay & \(40,24,38,25,46,52,26,27,28,32,33\) & \(2,821.7 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(34,31,1,2,3,4,53,47,6,37,7,10,39\) & \(14,525 \mathrm{ft}^{2}\) \\
\hline Region 6 & Compacted Soil Liner & \(47,43,42,41,44,45,46,52,51,50,48,49,53\) & \(1,661.7 \mathrm{ft}^{2}\) \\
\hline Region 7 & Vegetation Cover & \(4,53,49,48,50,51,52,26,23,20,19,17,15,13,11,9,8,5\) & \(912.38 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 77 of 726 converged

\section*{Current Slip Surface}

Slip Surface: 332
Factor of Safety: 8.619
Volume: 12,039.903 ft \({ }^{3}\)
Weight: 877,367.52 lbf
Resisting Moment: 35,899,471 lbffft
Activating Moment: 4,165,382.3 Ibf•ft
Resisting Force: 614,613.17 lbf
Activating Force: 71,312.899 lbf
Slip Rank: 1 of 726 slip surfaces
Exit: (207.47192, 1,479.1173) ft
Entry: (575.2992, 1,513.1952) ft
Radius: 459.80752 ft
Center: \((914,1,534) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & Cohesive Strength & Suction Strength & Base Material \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 1
\end{aligned}
\] & \[
\begin{aligned}
& 214.24494 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.981 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,724.5869 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 319.80925 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 85.69263 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& 227.79096 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,472.9353 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,462.8509 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 808.15857 psf & \[
\begin{aligned}
& 216.54544 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 241.33699 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,469.3375 \\
& \mathrm{ft}
\end{aligned}
\] & 3,229.0793
psf & \[
\begin{aligned}
& \text { 1,235.3532 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 331.01188 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 4
\end{aligned}
\] & \[
\begin{aligned}
& 249.30395 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,467.3741 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,101.1125 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,501.4705 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 402.31782 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 5
\end{aligned}
\] & \[
\begin{aligned}
& 252.95345 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.5542 \\
& \mathrm{ft}
\end{aligned}
\] & 3,047.4601
psf & \[
\begin{aligned}
& \text { 1,711.1049 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 458.48917 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice & \[
\begin{aligned}
& 260.98287 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.8768 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,937.308 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,024.8508 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
542.55714
\]
psf & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& 272.13063 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.7541 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,797.2465 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,349.4056 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 629.52134 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 283.27837 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.9146 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,674.8705 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,636.1513 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 706.35461 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & \[
\begin{aligned}
& 294.42613 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,459.3551 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,569.9658 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,885.8505 } \\
& \text { psf }
\end{aligned}
\] & \[
773.26131
\]
psf & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 305.72267 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,458.0591 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,481.4165 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,015.4823 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 807.99605 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice & 317.16801 & 1,457.0317 & - & 3,025.3844 & 810.64931 & & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 11 & ft & ft & \[
\begin{aligned}
& \text { 2,409.5378 } \\
& \text { psf }
\end{aligned}
\] & psf & psf & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & \[
\begin{aligned}
& 328.61336 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,456.2919 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,355.6112 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,999.0606 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 803.59588 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & \[
\begin{aligned}
& 340.73102 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,455.8294 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,318.5397 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,081.1786 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,925.3341 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 353.52102 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,455.6787 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,300.4829 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,280.327 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,049.7758 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
15
\end{tabular} & \[
\begin{aligned}
& 366.31101 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.884 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,304.6475 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,455.347 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,159.1404 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & 379.101 ft & \[
\begin{aligned}
& \text { 1,456.4456 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,331.0634 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,606.4759 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,253.5763 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
17
\] & 392.748 ft & \[
\begin{aligned}
& \text { 1,457.4524 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,384.6836 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,627.343 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,266.6155 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
18
\end{tabular} & 406.25 ft & \[
\begin{aligned}
& \text { 1,458.8242 } \\
& \text { ft }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,461.1951 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,527.9117 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,204.4839 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & 418.75 ft & \[
\begin{aligned}
& \text { 1,460.4689 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,555.4192 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,415.5746 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,134.2879 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
20
\end{tabular} & 431.25 ft & \[
\begin{aligned}
& 1,462.4644 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,671.5468 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3,282.341 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,051.0343 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & 443.75 ft & \[
\begin{aligned}
& 1,464.8155 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,809.8691 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,128.1711 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,954.6983 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & 456.25 ft & \[
\begin{aligned}
& 1,467.5276 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,970.7361 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,952.98 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,845.2267 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
23
\end{tabular} & 468.75 ft & \[
\begin{aligned}
& \text { 1,470.6075 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,154.5603 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,756.6366 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,722.5378 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & 481.25 ft & \[
\begin{aligned}
& \text { 1,474.0629 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,361.8227 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,538.9626 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,586.5199 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice 25 & 493.75 ft & \[
\begin{aligned}
& \text { 1,477.9025 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,593.0793 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,299.7303 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,437.031 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
26
\end{tabular} & \[
\begin{aligned}
& 505.76853 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,481.9587 } \\
& \mathrm{ft}
\end{aligned}
\] & 3,838.1787
psf & \[
\begin{aligned}
& \text { 2,047.932 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,279.6899 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
27
\] & \[
\begin{aligned}
& 517.30559 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,486.2121 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,095.9165
\]
\[
\mathrm{psf}
\] & \[
\begin{aligned}
& \text { 1,784.8429 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,115.2936 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
28
\end{tabular} & \[
\begin{aligned}
& 528.84265 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,490.8215 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,375.8811
\]
psf & \[
\begin{aligned}
& \text { 1,502.6073 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 938.93325 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline & & & - & & & & & \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\begin{tabular}{l} 
Slice \\
29
\end{tabular} & \begin{tabular}{l}
540.37971 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,495.7987\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(4,678.8057\) \\
psf
\end{tabular} & \begin{tabular}{l}
\(1,200.8783\) \\
psf
\end{tabular} & \begin{tabular}{l}
750.39203 \\
psf
\end{tabular} & \begin{tabular}{l}
18.850599 \\
psf
\end{tabular} & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
30
\end{tabular} & \begin{tabular}{l}
551.91677 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,501.157\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,005.5186\) \\
psf
\end{tabular} & \begin{tabular}{l}
879.26106 \\
psf
\end{tabular} & \begin{tabular}{l}
549.42329 \\
psf
\end{tabular} & \begin{tabular}{l}
18.850599 \\
psf
\end{tabular} & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
31
\end{tabular} & \begin{tabular}{l}
563.45383 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,506.9112\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,356.9568\) \\
psf
\end{tabular} & \begin{tabular}{l}
530.2113 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
32
\end{tabular} & \begin{tabular}{l}
571.07767 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,510.8916\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,600.2969\) \\
psf
\end{tabular} & \begin{tabular}{l}
223.86168 \\
psf
\end{tabular} & \begin{tabular}{l}
77.081756 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
33
\end{tabular} & \begin{tabular}{l}
574.11609 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,512.5445\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,701.4326\) \\
psf
\end{tabular} & \begin{tabular}{l}
60.602628 \\
psf
\end{tabular} & \begin{tabular}{l}
10.685878 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline
\end{tabular}

\section*{Not FS Dependent Psuedo Static}

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\section*{File Information}

File Version: 9.01
Title: Section 2
Created By: Administrative User
Revision Number: 26
Date: 01/08/2021
Time: 02:48:48 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 2 (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 02:48:54 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not FS Dependent Psuedo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

Lean Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(32^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb

Unit Weight: 120 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (103, 1,478.8229) ft
Left-Zone Right Coordinate: \((311,1,494.1921) \mathrm{ft}\)
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((311,1,494.1921) \mathrm{ft}\)
Right-Zone Right Coordinate: \((582,1,513.1992) \mathrm{ft}\)
Right-Zone Increment: 10
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: (0, 1,463.42) ft
Right Coordinate: \((1,200,1,464.02) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{\(\mathbf{X}\)} & \multicolumn{1}{c|}{\(\mathbf{Y}\)} \\
\hline Coordinate 1 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.153
Vert Seismic Coef.: 0.086

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (884.44, 1,511) ft
Inside Point: (385.496, 1,510.83) ft
Slip Surface Intersection: (470.6204, 1,510.859) ft
Length: 498.94403 ft
Direction: \(0.019522^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 42 lbf
Pullout Force per Length: \(36.246339 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 85.124403 ft
Required Length: 1.1587377 ft
Governing Component: Tensile Capacity

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,463.42 \mathrm{ft}\) \\
\hline Point 2 & 100 ft & \(1,478.81 \mathrm{ft}\) \\
\hline Point 3 & 200 ft & \(1,479.24 \mathrm{ft}\) \\
\hline Point 4 & 248.11 ft & \(1,478.45 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,491.44 \mathrm{ft}\) \\
\hline Point 6 & 300 ft & \(1,469.89 \mathrm{ft}\) \\
\hline Point 7 & 361.5 ft & \(1,445 \mathrm{ft}\) \\
\hline Point 8 & 385.496 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 9 & 400 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 10 & 400 ft & \(1,437.26 \mathrm{ft}\) \\
\hline Point 11 & 500 ft & \(1,513.15 \mathrm{ft}\) \\
\hline Point 12 & 500 ft & \(1,436.58 \mathrm{ft}\) \\
\hline Point 13 & 600 ft & \(1,513.21 \mathrm{ft}\) \\
\hline Point 14 & 600 ft & \(1,436.85 \mathrm{ft}\) \\
\hline Point 15 & 700 ft & \(1,513.17 \mathrm{ft}\) \\
\hline Point 16 & 700 ft & \(1,436.98 \mathrm{ft}\) \\
\hline Point 17 & 800 ft & \(1,513.13 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 18 & 800 ft & 1,436.48 ft \\
\hline Point 19 & 884.44 ft & 1,513 ft \\
\hline Point 20 & 900 ft & 1,509.04 ft \\
\hline Point 21 & 900 ft & 1,437.14 ft \\
\hline Point 22 & 941.14 ft & 1,437.14 ft \\
\hline Point 23 & 1,000 ft & 1,484.05 ft \\
\hline Point 24 & 1,000 ft & 1,450.98 ft \\
\hline Point 25 & 1,032.45 ft & 1,461.42 ft \\
\hline Point 26 & 1,088.68 ft & 1,461.42 ft \\
\hline Point 27 & 1,100 ft & 1,461.42 ft \\
\hline Point 28 & 1,200 ft & 1,464.02 ft \\
\hline Point 29 & 1,200 ft & 1,410 ft \\
\hline Point 30 & 0 ft & 1,410 ft \\
\hline Point 31 & 0 ft & 1,448 ft \\
\hline Point 32 & 1,200 ft & 1,454 ft \\
\hline Point 33 & 1,200 ft & 1,449 ft \\
\hline Point 34 & 0 ft & 1,430 ft \\
\hline Point 35 & 0 ft & 1,415 ft \\
\hline Point 36 & 1,200 ft & 1,428 ft \\
\hline Point 37 & 349.7661 ft & 1,449.7489 ft \\
\hline Point 38 & 1,006.3772 ft & 1,453.0317 ft \\
\hline Point 39 & 440.9509 ft & 1,436.9815 ft \\
\hline Point 40 & 976.531 ft & 1,445.4616 ft \\
\hline Point 41 & 400 ft & 1,509.83 ft \\
\hline Point 42 & 385.496 ft & 1,509.83 ft \\
\hline Point 43 & 300 ft & 1,488.44 ft \\
\hline Point 44 & 884.44 ft & 1,510 ft \\
\hline Point 45 & 1,000 ft & 1,481.05 ft \\
\hline Point 46 & 1,078.35 ft & 1,461.42 ft \\
\hline Point 47 & 255.409 ft & 1,477.2459 ft \\
\hline Point 48 & 385.496 ft & 1,511.83 ft \\
\hline Point 49 & 300 ft & 1,490.44 ft \\
\hline Point 50 & 884.44 ft & 1,512 ft \\
\hline Point 51 & 1,000 ft & 1,483.05 ft \\
\hline Point 52 & 1,086.396 ft & 1,461.42 ft \\
\hline Point 53 & 250.4979 ft & 1,478.0561 ft \\
\hline Point 54 & 884.44 ft & 1,511 ft \\
\hline Point 55 & 385.496 ft & 1,510.83 ft \\
\hline
\end{tabular}

Regions
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & Area \\
\hline Region 1 & Municipal Solid Waste & \(6,37,7,10,39,12,14,16,18,21,22,40,24,38,25,46,45,44,41,42,43,47\) & \(48,060 \mathrm{ft}^{2}\) \\
\hline Region 2 & Very Weathered Shale & \(34,35,36,33,40,22,21,18,16,14,12,39\) & \(19,401 \mathrm{ft}^{2}\) \\
\hline Region 3 & Shale Bedrock & \(30,29,36,35\) & \(13,800 \mathrm{ft}^{2}\) \\
\hline Region 4 & Lean Clay & \(40,24,38,25,46,52,26,27,28,32,33\) & \(2,821.7 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(34,31,1,2,3,4,53,47,6,37,7,10,39\) & \(14,525 \mathrm{ft}^{2}\) \\
\hline Region 6 & Compacted Soil Liner & \(47,43,42,41,44,45,46,52,51,50,48,49,53\) & \(1,661.7 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 263 of 726 converged

\section*{Current Slip Surface}

Slip Surface: 501
Factor of Safety: 2.983
Volume: 7,558.3527 ft \({ }^{3}\)
Weight: 546,731.22 lbf
Resisting Moment: 20,376,651 lbf•ft
Activating Moment: 6,831,263.4 lbf•ft
Resisting Force: 385,900.38 lbf
Activating Force: 129,398.63 Ibf
Slip Rank: 1 of 726 slip surfaces
Exit: (249.90073, 1,478.8983) ft
Entry: (472.68151, 1,513.0626) ft
Radius: 179.94128 ft
Center: \((914,1,534) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & \begin{tabular}{l}
Base \\
Normal Stress
\end{tabular} & Frictional Strength & Cohesive Strength & Suction Strength & Base Material \\
\hline \begin{tabular}{l}
Slice \\
1
\end{tabular} & \[
\begin{aligned}
& 250.50262 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.5531 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,798.2085 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 140.50924 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 24.77557 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline \begin{tabular}{l}
Slice \\
2
\end{tabular} & \[
\begin{aligned}
& 251.41867 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,478.0301 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,764.9406 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 407.32603 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 140.2536 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \begin{tabular}{l}
Slice \\
3
\end{tabular} & \[
\begin{aligned}
& 253.57091 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.8453 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,689.5165 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 864.70202 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 231.69621 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & \[
\begin{aligned}
& 259.12492 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,473.9672 } \\
& \mathrm{ft}
\end{aligned}
\] & 3,506.0807
psf & \[
\begin{aligned}
& \text { 1,387.6026 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 371.807 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 266.55675 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,470.4336 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,280.4521 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,939.001 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 519.55375 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 273.98858 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,467.3046 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,080.0801 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 2,408.57 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 645.37439 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & \[
\begin{aligned}
& 281.42042 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,464.5577 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,903.5671
\]
psf & \[
\begin{aligned}
& \text { 2,805.502 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 751.732 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
8
\end{tabular} & \[
\begin{aligned}
& 288.85225 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,462.1748 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,749.7703 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,137.0152 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 840.56069 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline & & & & & & & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & \[
\begin{aligned}
& 296.28408 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,460.1407 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,617.7569 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,408.867 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 913.40316 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 303.74861 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,458.4374 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,506.3732
\]
psf & \[
\begin{aligned}
& 3,562.3651 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 954.53285 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& 311.24582 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,457.0581 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
2,415.1912 \\
psf
\end{tabular} & \[
\begin{aligned}
& 3,603.8578 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 965.65078 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12
\end{aligned}
\] & \[
\begin{aligned}
& 318.74303 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,456.0039 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
2,344.3092 \\
psf
\end{tabular} & \[
\begin{aligned}
& 3,600.1853 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 964.66673 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & \[
\begin{aligned}
& 326.24024 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,455.2692 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,293.3685
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 3,553.7323 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 952.2197 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 14
\end{aligned}
\] & \[
\begin{aligned}
& 333.73746 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,454.8499 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,262.1242
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 3,466.4785 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 928.84011 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
15
\end{tabular} & \[
\begin{aligned}
& 341.48689 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,454.7513 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,250.7238
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 3,447.8633 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 2,154.4641 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 349.48855 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,454.9945 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,260.4944 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3,496.0584 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,184.5798 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
18.850599
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 357.4902 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.5954 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,292.5995
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 3,518.0008 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,198.2909 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
18.850599
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
18
\end{tabular} & \[
\begin{aligned}
& 365.49186 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.5577 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,347.2654
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 3,514.5791 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,196.1527 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& 373.49352 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,457.8873 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,424.8616 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3,486.4727 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,178.5899 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 381.49517 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.5926 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,525.9116 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,434.1751 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,145.9108 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & 389.122 ft & \[
\begin{aligned}
& 1,461.569 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,644.1375 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,307.014 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,066.4517 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & 396.374 ft & \[
\begin{aligned}
& 1,463.7935 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,778.1062
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 3,110.3575 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,943.5671 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& 403.87046 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.4586 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,939.421 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,891.9464 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,807.0887 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& 411.61137 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,469.6067 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,130.7203 \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 2,650.8391 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,656.4281 } \\
& \text { psf }
\end{aligned}
\] & 18.850599 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& 419.35228 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,473.1871 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,349.0123 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,392.1633 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,494.7895 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 427.09319 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,477.2295 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,596.1448 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,115.7712 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,322.0806 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline & & & - & & & & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
Slice \\
27
\end{tabular} & \[
\begin{aligned}
& 434.8341 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,481.7706 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,874.4142 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,821.4673 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,138.1791 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& 442.57501 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,486.8567 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,186.7032 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,509.0262 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 942.94421 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 450.31592 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,492.5465 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,536.6833 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,178.2249 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 736.23661 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& 458.05683 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,498.9165 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,929.1238 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 828.90973 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 517.96028 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
31
\end{tabular} & \[
\begin{aligned}
& 465.79774 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,506.0684 } \\
& \mathrm{ft}
\end{aligned}
\] & 5,370.3837
psf & \[
\begin{aligned}
& 422.61893 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
32
\end{tabular} & \[
\begin{aligned}
& 470.61839 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,510.8569 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,666.0716 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 79.333689 psf & \[
\begin{aligned}
& 27.31678 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 33
\end{aligned}
\] & \[
\begin{aligned}
& 472.12505 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,512.461 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,765.1948 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 12.307184 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 2.1700885 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section 2
Created By: Administrative User
Revision Number: 22
Date: 01/08/2021
Time: 02:31:54 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 2 (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW
Last Solved Date: 01/08/2021
Last Solved Time: 02:31:58 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

\section*{Factor of Safety Convergence Settings}

Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001

\section*{Solution Settings}

Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(32^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Compacted Soil Liner}

Model: Mohr-Coulomb

Unit Weight: 120 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (429.9909, 1,512.926) ft
Left-Zone Right Coordinate: (1,068, 1,466.6973) ft
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((1,069,1,466.4421) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,197,1,463.942) \mathrm{ft}\)
Right-Zone Increment: 10
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: (0, 1,463.42) ft
Right Coordinate: \((1,200,1,464.02) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{\(\mathbf{X}\)} & \multicolumn{1}{c|}{\(\mathbf{Y}\)} \\
\hline Coordinate 1 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (884.44, 1,511) ft
Inside Point: (385.496, 1,510.83) ft
Slip Surface Intersection: (883.61038, 1,510.9997) ft
Length: 498.94403 ft
Direction: \(0.019522^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 7.99448 lbf
Pullout Force per Length: \(9.6362777 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0.82962324 ft
Required Length: 0.82962324 ft
Governing Component: Pullout Resistance (Active Zone)

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,463.42 \mathrm{ft}\) \\
\hline Point 2 & 100 ft & \(1,478.81 \mathrm{ft}\) \\
\hline Point 3 & 200 ft & \(1,479.24 \mathrm{ft}\) \\
\hline Point 4 & 248.11 ft & \(1,478.45 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,491.44 \mathrm{ft}\) \\
\hline Point 6 & 300 ft & \(1,469.89 \mathrm{ft}\) \\
\hline Point 7 & 361.5 ft & \(1,445 \mathrm{ft}\) \\
\hline Point 8 & 385.496 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 9 & 400 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 10 & 400 ft & \(1,437.26 \mathrm{ft}\) \\
\hline Point 11 & 500 ft & \(1,513.15 \mathrm{ft}\) \\
\hline Point 12 & 500 ft & \(1,436.58 \mathrm{ft}\) \\
\hline Point 13 & 600 ft & \(1,513.21 \mathrm{ft}\) \\
\hline Point 14 & 600 ft & \(1,436.85 \mathrm{ft}\) \\
\hline Point 15 & 700 ft & \(1,513.17 \mathrm{ft}\) \\
\hline Point 16 & 700 ft & \(1,436.98 \mathrm{ft}\) \\
\hline Point 17 & 800 ft & \(1,513.13 \mathrm{ft}\) \\
\hline Point 18 & 800 ft & \(1,436.48 \mathrm{ft}\) \\
\hline Point 19 & 884.44 ft & \(1,513 \mathrm{ft}\) \\
\hline Point 20 & 900 ft & \(1,509.04 \mathrm{ft}\) \\
\hline Point 21 & 900 ft & \(1,437.14 \mathrm{ft}\) \\
\hline Point 22 & 941.14 ft & \(1,437.14 \mathrm{ft}\) \\
\hline & & \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|} 
Point 23 & \(1,000 \mathrm{ft}\) & \(1,484.05 \mathrm{ft}\) \\
\hline Point 24 & \(1,000 \mathrm{ft}\) & \(1,450.98 \mathrm{ft}\) \\
\hline Point 25 & \(1,032.45 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 26 & \(1,088.68 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 27 & \(1,100 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 28 & \(1,200 \mathrm{ft}\) & \(1,464.02 \mathrm{ft}\) \\
\hline Point 29 & \(1,200 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Point 30 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Point 31 & 0 ft & \(1,448 \mathrm{ft}\) \\
\hline Point 32 & \(1,200 \mathrm{ft}\) & \(1,454 \mathrm{ft}\) \\
\hline Point 33 & \(1,200 \mathrm{ft}\) & \(1,449 \mathrm{ft}\) \\
\hline Point 34 & 0 ft & \(1,430 \mathrm{ft}\) \\
\hline Point 35 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Point 36 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline Point 37 & 349.7661 ft & \(1,449.7489 \mathrm{ft}\) \\
\hline Point 38 & \(1,006.3772 \mathrm{ft}\) & \(1,453.0317 \mathrm{ft}\) \\
\hline Point 39 & 440.9509 ft & \(1,436.9815 \mathrm{ft}\) \\
\hline Point 40 & 976.531 ft & \(1,445.4616 \mathrm{ft}\) \\
\hline Point 41 & 400 ft & \(1,509.83 \mathrm{ft}\) \\
\hline Point 42 & 385.496 ft & \(1,509.83 \mathrm{ft}\) \\
\hline Point 43 & 300 ft & \(1,488.44 \mathrm{ft}\) \\
\hline Point 44 & 884.44 ft & \(1,510 \mathrm{ft}\) \\
\hline Point 45 & \(1,000 \mathrm{ft}\) & \(1,481.05 \mathrm{ft}\) \\
\hline Point 46 & \(1,078.35 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 47 & 255.409 ft & \(1,477.2459 \mathrm{ft}\) \\
\hline Point 48 & 385.496 ft & \(1,511.83 \mathrm{ft}\) \\
\hline Point 49 & 300 ft & \(1,490.44 \mathrm{ft}\) \\
\hline Point 50 & 884.44 ft & \(1,512 \mathrm{ft}\) \\
\hline Point 51 & \(1,000 \mathrm{ft}\) & \(1,483.05 \mathrm{ft}\) \\
\hline Point 52 & \(1,086.396 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 53 & 250.4979 ft & \(1,478.0561 \mathrm{ft}\) \\
\hline Point 54 & 884.44 ft & \(1,511 \mathrm{ft}\) \\
\hline Point 55 & 385.496 ft & \(1,510.83 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & Area \\
\hline Region 1 & Municipal Solid Waste & \(6,37,7,10,39,12,14,16,18,21,22,40,24,38,25,46,45,44,41,42,43,47\) & \(48,060 \mathrm{ft}^{2}\) \\
\hline Region 2 & Very Weathered Shale & \(34,35,36,33,40,22,21,18,16,14,12,39\) & \(19,401 \mathrm{ft}^{2}\) \\
\hline Region 3 & Shale Bedrock & \(30,29,36,35\) & \(13,800 \mathrm{ft}^{2}\) \\
\hline Region 4 & Lean Clay & \(40,24,38,25,46,52,26,27,28,32,33\) & \(2,821.7 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(34,31,1,2,3,4,53,47,6,37,7,10,39\) & \(14,525 \mathrm{ft}^{2}\) \\
\hline Region 6 & Compacted Soil Liner & \(47,43,42,41,44,45,46,52,51,50,48,49,53\) & \(1,661.7 \mathrm{ft}^{2}\) \\
\hline Region 7 & Vegetation Cover & \(4,53,49,48,50,51,52,26,23,20,19,17,15,13,11,9,8,5\) & \(912.38 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 445 of 726 converged

\section*{Current Slip Surface}

Slip Surface: 464
Factor of Safety: 3.039
Volume: 2,375.5507 ft \({ }^{3}\)
Weight: 179,211.67 lbf
Resisting Moment: 6,409,301.1 lbffft
Activating Moment: 2,108,772.2 lbf•ft
Resisting Force: 121,496.97 lbf
Activating Force: 39,975.329 lbf
Slip Rank: 1 of 726 slip surfaces
Exit: (1,069, 1,466.4421) ft
Entry: (880.6224, 1,513.0059) ft
Radius: 278.14053 ft
Center: \((914,1,534)\) ft

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & \begin{tabular}{l}
Base \\
Normal Stress
\end{tabular} & Frictional Strength & \begin{tabular}{l}
Cohesive \\
Strength
\end{tabular} & Suction Strength & Base Material \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 1
\end{aligned}
\] & \[
\begin{aligned}
& 881.3654 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,512.5025 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,491.0108 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 22.901968 \\
& \text { psf }
\end{aligned}
\] & 4.0382349 psf & 200 psf & 0 psf & Vegetation Cover \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& 883.2742 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,511.2234 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,409.8643 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 100.52285 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 34.612792 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 884.99362 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,510.0851 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,337.6374 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 201.79568 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 69.483826 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 4
\end{aligned}
\] & \[
\begin{aligned}
& 889.16043 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,507.4472 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,170.1313 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 326.96019 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 5
\end{aligned}
\] & \[
\begin{aligned}
& 896.38681 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,503.047 \\
& \mathrm{ft}
\end{aligned}
\] & 4,890.5388
psf & 478.16134 psf & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
6
\] & 903.125 ft & 1,499.2 ft & \[
\begin{aligned}
& \hline-4,645.815 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 607.74782 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & 909.375 ft & \[
\begin{aligned}
& 1,495.858 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,432.9464
\]
psf & \[
\begin{aligned}
& 717.83686 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & 915.625 ft & \[
\begin{aligned}
& \text { 1,492.7169 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,232.6176
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 815.05417 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 509.30237 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & 921.875 ft & \[
\begin{aligned}
& 1,489.7691 \\
& \mathrm{ft}
\end{aligned}
\] & 4,044.3612 psf & \[
\begin{aligned}
& 900.51334 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 562.70319 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & 928.125 ft & \[
\begin{aligned}
& 1,487.008 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,867.7595 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 977.1142 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 610.56871 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice & & 1,484.4277 & - & 1,044.863 & 652.90286 & 18.850599 & & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 11 & 934.375 ft & ft & \[
\begin{aligned}
& 3,702.4383 \\
& \text { psf }
\end{aligned}
\] & psf & psf & psf & 0 psf & Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & 940.625 ft & \[
\begin{aligned}
& \text { 1,482.0226 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,548.0626 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,103.7546 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 689.70244 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & 946.875 ft & \[
\begin{aligned}
& 1,479.788 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,404.3319 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,153.7727 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 720.95721 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & 953.125 ft & \[
\begin{aligned}
& 1,477.7197 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,270.9767 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,194.8892 } \\
& \text { psf }
\end{aligned}
\] & 746.64962 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
15
\end{tabular} & 959.375 ft & \[
\begin{aligned}
& \text { 1,475.8136 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,147.7557 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,227.0637 } \\
& \text { psf }
\end{aligned}
\] & 766.75449 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & 965.625 ft & \[
\begin{aligned}
& 1,474.0665 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,034.4531 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,250.2432 \\
& \text { psf }
\end{aligned}
\] & 781.23865 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
17
\] & 971.875 ft & \[
\begin{aligned}
& 1,472.4751 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,930.8765 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,264.3614 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 790.06066 \\
& \text { psf }
\end{aligned}
\] & 18.850599 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
18
\end{tabular} & 978.125 ft & \[
\begin{aligned}
& 1,471.0368 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,836.8548
\]
psf & \[
\begin{aligned}
& \text { 1,269.3379 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 793.17036 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19 \\
& \hline
\end{aligned}
\] & 984.375 ft & \[
\begin{aligned}
& 1,469.7491 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,752.237 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 1,265.078 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 790.50846 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
20
\end{tabular} & 990.625 ft & \[
\begin{aligned}
& \text { 1,468.6099 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,676.8906 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,251.4713 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 782.00607 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
21
\end{tabular} & 996.875 ft & \[
\begin{aligned}
& 1,467.6174 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,610.7002 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,228.3913 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 767.58409 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & \[
\begin{aligned}
& \text { 1,003.0684 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.7763 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,554.0039 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,194.2313 } \\
& \text { psf }
\end{aligned}
\] & 746.23853 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
23
\end{tabular} & \[
\begin{aligned}
& 1,009.2052 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.0828 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,506.5586 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,148.9624 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 717.95141 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& 1,015.342 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,465.5269 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,467.7007 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,094.0252 } \\
& \text { psf }
\end{aligned}
\] & 683.62284 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
25
\end{tabular} & \[
\begin{aligned}
& \text { 1,021.4788 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.1077 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,437.3786 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,029.2264 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 643.13201 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 1,027.6156 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.8246 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,415.5538 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 954.3508 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 596.34456 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
27
\end{tabular} & \[
\begin{aligned}
& 1,033.7524 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.6772 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,402.2002 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 869.16003 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 543.11147 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
28
\end{tabular} & \[
\begin{aligned}
& \text { 1,039.8891 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.6652 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,397.3043 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 773.39061 psf & \[
\begin{aligned}
& 483.26809 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice & 1,046.0259 & 1,464.7887 & \[
2,400.8651
\] & 671.82565 & 0 psf & 500 psf & 0 psf & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline 29 & ft & ft & psf & psf & & Solid Waste \\
\hline \begin{tabular}{l} 
Slice \\
30
\end{tabular} & \begin{tabular}{l}
\(1,052.1627\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,465.0479\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,412.8939\) \\
psf
\end{tabular} & \begin{tabular}{l}
560.84751 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
31
\end{tabular} & \begin{tabular}{l}
\(1,058.2995\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,465.4431\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,433.4143\) \\
psf
\end{tabular} & \begin{tabular}{l}
440.15603 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
32
\end{tabular} & \begin{tabular}{l}
\(1,064.2616\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,465.9559\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,461.3987\) \\
psf
\end{tabular} & \begin{tabular}{l}
274.86407 \\
psf
\end{tabular} & \begin{tabular}{l}
94.643288 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
33
\end{tabular} & \begin{tabular}{l}
\(1,068.0776\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,466.3396\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,482.7708\) \\
psf
\end{tabular} & \begin{tabular}{l}
62.319169 \\
psf
\end{tabular} & \begin{tabular}{l}
10.988551 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline
\end{tabular}

\section*{FS Dependent Seismic Psuedo Static}

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\section*{File Information}

File Version: 9.01
Title: Section 2
Created By: Administrative User
Revision Number: 22
Date: 01/08/2021
Time: 02:31:54 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 2 (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 02:31:58 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

FS Dependent Seismic Psuedo Static
Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

Lean Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(32^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb

Unit Weight: 120 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((429.9909,1,512.926) \mathrm{ft}\)
Left-Zone Right Coordinate: \((1,066.8137,1,467)\) ft
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((1,066.8137,1,467) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,197,1,463.942) \mathrm{ft}\)
Right-Zone Increment: 8
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: (0, 1,463.42) ft
Right Coordinate: \((1,200,1,464.02) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{\(\mathbf{X}\)} & \multicolumn{1}{c|}{\(\mathbf{Y}\)} \\
\hline Coordinate 1 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.086

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (884.44, 1,511) ft
Inside Point: (385.496, 1,510.83) ft
Slip Surface Intersection: (882.76586, 1,510.9994) ft
Length: 498.94403 ft
Direction: \(0.019522^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 29.051774 lbf
Pullout Force per Length: \(17.353208 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 1.6741443 ft
Required Length: 1.6741443 ft
Governing Component: Pullout Resistance (Active Zone)

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,463.42 \mathrm{ft}\) \\
\hline Point 2 & 100 ft & \(1,478.81 \mathrm{ft}\) \\
\hline Point 3 & 200 ft & \(1,479.24 \mathrm{ft}\) \\
\hline Point 4 & 248.11 ft & \(1,478.45 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,491.44 \mathrm{ft}\) \\
\hline Point 6 & 300 ft & \(1,469.89 \mathrm{ft}\) \\
\hline Point 7 & 361.5 ft & \(1,445 \mathrm{ft}\) \\
\hline Point 8 & 385.496 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 9 & 400 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 10 & 400 ft & \(1,437.26 \mathrm{ft}\) \\
\hline Point 11 & 500 ft & \(1,513.15 \mathrm{ft}\) \\
\hline Point 12 & 500 ft & \(1,436.58 \mathrm{ft}\) \\
\hline Point 13 & 600 ft & \(1,513.21 \mathrm{ft}\) \\
\hline Point 14 & 600 ft & \(1,436.85 \mathrm{ft}\) \\
\hline Point 15 & 700 ft & \(1,513.17 \mathrm{ft}\) \\
\hline Point 16 & 700 ft & \(1,436.98 \mathrm{ft}\) \\
\hline Point 17 & 800 ft & \(1,513.13 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 18 & 800 ft & 1,436.48 ft \\
\hline Point 19 & 884.44 ft & 1,513 ft \\
\hline Point 20 & 900 ft & 1,509.04 ft \\
\hline Point 21 & 900 ft & 1,437.14 ft \\
\hline Point 22 & 941.14 ft & 1,437.14 ft \\
\hline Point 23 & 1,000 ft & 1,484.05 ft \\
\hline Point 24 & 1,000 ft & 1,450.98 ft \\
\hline Point 25 & 1,032.45 ft & 1,461.42 ft \\
\hline Point 26 & 1,088.68 ft & 1,461.42 ft \\
\hline Point 27 & 1,100 ft & 1,461.42 ft \\
\hline Point 28 & 1,200 ft & 1,464.02 ft \\
\hline Point 29 & 1,200 ft & 1,410 ft \\
\hline Point 30 & 0 ft & 1,410 ft \\
\hline Point 31 & 0 ft & 1,448 ft \\
\hline Point 32 & 1,200 ft & 1,454 ft \\
\hline Point 33 & 1,200 ft & 1,449 ft \\
\hline Point 34 & 0 ft & 1,430 ft \\
\hline Point 35 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Point 36 & 1,200 ft & 1,428 ft \\
\hline Point 37 & 349.7661 ft & 1,449.7489 ft \\
\hline Point 38 & 1,006.3772 ft & 1,453.0317 ft \\
\hline Point 39 & 440.9509 ft & 1,436.9815 ft \\
\hline Point 40 & 976.531 ft & 1,445.4616 ft \\
\hline Point 41 & 400 ft & 1,509.83 ft \\
\hline Point 42 & 385.496 ft & 1,509.83 ft \\
\hline Point 43 & 300 ft & 1,488.44 ft \\
\hline Point 44 & 884.44 ft & 1,510 ft \\
\hline Point 45 & 1,000 ft & 1,481.05 ft \\
\hline Point 46 & 1,078.35 ft & 1,461.42 ft \\
\hline Point 47 & 255.409 ft & 1,477.2459 ft \\
\hline Point 48 & 385.496 ft & 1,511.83 ft \\
\hline Point 49 & 300 ft & 1,490.44 ft \\
\hline Point 50 & 884.44 ft & 1,512 ft \\
\hline Point 51 & 1,000 ft & 1,483.05 ft \\
\hline Point 52 & 1,086.396 ft & 1,461.42 ft \\
\hline Point 53 & 250.4979 ft & 1,478.0561 ft \\
\hline Point 54 & 884.44 ft & 1,511 ft \\
\hline Point 55 & 385.496 ft & 1,510.83 ft \\
\hline
\end{tabular}

Regions
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & Area \\
\hline Region 1 & Municipal Solid Waste & \(6,37,7,10,39,12,14,16,18,21,22,40,24,38,25,46,45,44,41,42,43,47\) & \(48,060 \mathrm{ft}^{2}\) \\
\hline Region 2 & Very Weathered Shale & \(34,35,36,33,40,22,21,18,16,14,12,39\) & \(19,401 \mathrm{ft}^{2}\) \\
\hline Region 3 & Shale Bedrock & \(30,29,36,35\) & \(13,800 \mathrm{ft}^{2}\) \\
\hline Region 4 & Lean Clay & \(40,24,38,25,46,52,26,27,28,32,33\) & \(2,821.7 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(34,31,1,2,3,4,53,47,6,37,7,10,39\) & \(14,525 \mathrm{ft}^{2}\) \\
\hline Region 6 & Compacted Soil Liner & \(47,43,42,41,44,45,46,52,51,50,48,49,53\) & \(1,661.7 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 422 of 594 converged

\section*{Current Slip Surface}

Slip Surface: 380
Factor of Safety: 1.906
Volume: 2,362.7384 ft \({ }^{3}\)
Weight: 178,222 lbf
Resisting Moment: 6,644,969.1 lbf•ft
Activating Moment: 3,485,706.5 lbf•ft
Resisting Force: \(125,529.81 \mathrm{lbf}\)
Activating Force: 65,861.321 lbf
Slip Rank: 1 of 594 slip surfaces
Exit: (1,066.8137, 1,467) ft
Entry: \((879.76538,1,513.0072) \mathrm{ft}\)
Radius: 275.79353 ft
Center: \((914,1,534) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & Cohesive Strength & Suction Strength & Base Material \\
\hline \begin{tabular}{l}
Slice \\
1
\end{tabular} & \[
\begin{aligned}
& 880.51081 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,512.5031 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,491.6209 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 17.96455 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3.1676348 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 2 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 882.76586 \\
& \mathrm{ft} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,510.9994 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -5,396.224 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 109.75196 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 37.790629 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \begin{tabular}{l}
Slice \\
3
\end{tabular} & \[
\begin{aligned}
& 884.35774 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,509.9463 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,329.3999 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 235.9625 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & 888.33 ft & \[
\begin{aligned}
& 1,507.449 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,170.8071 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 324.43615 psf & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & 896.11 ft & \[
\begin{aligned}
& 1,502.7371 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,871.3805
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 488.15505 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & 903.125 ft & \[
\begin{aligned}
& 1,498.767 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,618.7844 } \\
& \text { psf }
\end{aligned}
\] & 624.24684 psf & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & 909.375 ft & \[
\begin{aligned}
& 1,495.4659 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,408.4654 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 735.5693 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
8
\end{tabular} & 915.625 ft & \[
\begin{aligned}
& 1,492.3657 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,210.6925 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 833.97721 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 521.1268 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice & & 1,489.459 & - & 922.52462 & 576.45736 & 18.850599 & & Municipal \\
\hline
\end{tabular}

FS Dependent Seismic Psuedo Static
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 9 & 921.875 ft & ft & \[
\begin{aligned}
& \text { 4,025.0011 } \\
& \text { psf }
\end{aligned}
\] & psf & psf & psf & 0 psf & Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & 928.125 ft & \[
\begin{aligned}
& \text { 1,486.7392 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,850.9765 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,002.9787 } \\
& \text { psf }
\end{aligned}
\] & 626.73068 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
11
\] & 934.375 ft & \[
\begin{aligned}
& 1,484.2003 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,688.2475 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,075.2068 } \\
& \text { psf }
\end{aligned}
\] & 671.86375 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 12 \\
& \hline
\end{aligned}
\] & 940.625 ft & \[
\begin{aligned}
& 1,481.8371 \\
& \mathrm{ft} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& -3,536.482 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,139.067 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 711.76808 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & 946.875 ft & \[
\begin{aligned}
& \text { 1,479.6447 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,395.3822 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,194.4073 } \\
& \text { psf }
\end{aligned}
\] & 746.34854 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & 953.125 ft & \[
\begin{aligned}
& 1,477.6188 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,264.6815 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,241.0632 \\
& \text { psf }
\end{aligned}
\] & 775.50236 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
15
\end{tabular} & 959.375 ft & \[
\begin{aligned}
& 1,475.7557 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,144.1415 \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,278.8561 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 799.11799 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & 965.625 ft & \[
\begin{aligned}
& 1,474.052 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,033.5493 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,307.5918 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 817.07405 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & 971.875 ft & \[
\begin{aligned}
& 1,472.5046 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,932.7153 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,327.0585 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 829.23817 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
18
\end{tabular} & 978.125 ft & \[
\begin{aligned}
& 1,471.1107 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,841.4715 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,337.0247 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 835.46578 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
19
\end{tabular} & 984.375 ft & \[
\begin{aligned}
& 1,469.8682 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,759.6699 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,337.2375 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 835.59874 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
20
\end{tabular} & 990.625 ft & \[
\begin{aligned}
& \text { 1,468.7747 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,687.1811 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,327.4197 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 829.46386 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
21
\end{tabular} & 996.875 ft & \[
\begin{aligned}
& 1,467.8287 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,623.8933 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,307.2673 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 816.87127 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & \[
\begin{aligned}
& 1,003.288 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,467.0115 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,568.5395 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,273.23 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 795.60242 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
23
\end{tabular} & \[
\begin{aligned}
& \text { 1,009.8641 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,466.3296 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,521.5196 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,224.1956 } \\
& \text { psf }
\end{aligned}
\] & 764.96229 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& \text { 1,016.4401 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,465.8065 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,484.4158 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,162.3169 } \\
& \text { psf }
\end{aligned}
\] & 726.29624 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
25
\end{tabular} & \[
\begin{aligned}
& 1,023.0162 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,465.4414 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,457.1717 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,087.0647 \\
& \text { psf }
\end{aligned}
\] & 679.27341 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
26
\end{tabular} & \[
\begin{aligned}
& \text { 1,029.5922 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,465.2335 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,439.7481 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 997.85094 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 623.52647 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice & 1,036.1683 & 1,465.1826 & \[
2,432.1227
\] & 894.02168 & 558.64675 & 18.850599 & 0 psf & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline 27 & ft & ft & psf & psf & psf & psf & & Solid Waste \\
\hline \begin{tabular}{l} 
Slice \\
28
\end{tabular} & \begin{tabular}{l}
\(1,042.7444\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,465.2886\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,434.2901\) \\
psf
\end{tabular} & \begin{tabular}{l}
774.88204 \\
psf
\end{tabular} & \begin{tabular}{l}
484.20004 \\
psf
\end{tabular} & \begin{tabular}{l}
18.850599 \\
psf
\end{tabular} & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
29
\end{tabular} & \begin{tabular}{l}
\(1,049.3204\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,465.5516\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,446.2616\) \\
psf
\end{tabular} & \begin{tabular}{l}
655.59709 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
30
\end{tabular} & \begin{tabular}{l}
\(1,055.8965\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,465.9721\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,468.0653\) \\
psf
\end{tabular} & \begin{tabular}{l}
524.47916 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
31
\end{tabular} & \begin{tabular}{l}
\(1,062.066\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,466.5058\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,497.2126\) \\
psf
\end{tabular} & \begin{tabular}{l}
380.57503 \\
psf
\end{tabular} & \begin{tabular}{l}
131.04249 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
32
\end{tabular} & \begin{tabular}{l}
\(1,065.8806\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,466.8949\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,518.9251\) \\
psf
\end{tabular} & \begin{tabular}{l}
93.166617 \\
psf
\end{tabular} & \begin{tabular}{l}
16.427788 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline
\end{tabular}

\section*{Not Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section 2
Created By: Administrative User
Revision Number: 22
Date: 01/08/2021
Time: 02:31:54 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 2 (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 02:32:00 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

Lean Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(32^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb

Unit Weight: 120 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (429.9909, 1,512.926) ft
Left-Zone Right Coordinate: \((1,066.8137,1,467) \mathrm{ft}\)
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((1,066.8137,1,467) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,197,1,463.942) \mathrm{ft}\)
Right-Zone Increment: 10
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: ( \(0,1,463.42\) ) ft
Right Coordinate: \((1,200,1,464.02) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{\(X\)} & \(\mathbf{Y}\) \\
\hline Coordinate 1 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (884.44, 1,511) ft
Inside Point: (385.496, 1,510.83) ft
Slip Surface Intersection: (882.76008, 1,510.9994) ft
Length: 498.94403 ft
Direction: \(0.019522^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 42 lbf
Pullout Force per Length: \(33.078163 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 1.6799165 ft
Required Length: 1.2697199 ft
Governing Component: Tensile Capacity

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,463.42 \mathrm{ft}\) \\
\hline Point 2 & 100 ft & \(1,478.81 \mathrm{ft}\) \\
\hline Point 3 & 200 ft & \(1,479.24 \mathrm{ft}\) \\
\hline Point 4 & 248.11 ft & \(1,478.45 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,491.44 \mathrm{ft}\) \\
\hline Point 6 & 300 ft & \(1,469.89 \mathrm{ft}\) \\
\hline Point 7 & 361.5 ft & \(1,445 \mathrm{ft}\) \\
\hline Point 8 & 385.496 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 9 & 400 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 10 & 400 ft & \(1,437.26 \mathrm{ft}\) \\
\hline Point 11 & 500 ft & \(1,513.15 \mathrm{ft}\) \\
\hline Point 12 & 500 ft & \(1,436.58 \mathrm{ft}\) \\
\hline Point 13 & 600 ft & \(1,513.21 \mathrm{ft}\) \\
\hline Point 14 & 600 ft & \(1,436.85 \mathrm{ft}\) \\
\hline Point 15 & 700 ft & \(1,513.17 \mathrm{ft}\) \\
\hline Point 16 & 700 ft & \(1,436.98 \mathrm{ft}\) \\
\hline Point 17 & 800 ft & \(1,513.13 \mathrm{ft}\) \\
\hline Point 18 & 800 ft & \(1,436.48 \mathrm{ft}\) \\
\hline Point 19 & 884.44 ft & \(1,513 \mathrm{ft}\) \\
\hline Point 20 & 900 ft & \(1,509.04 \mathrm{ft}\) \\
\hline Point 21 & 900 ft & \(1,437.14 \mathrm{ft}\) \\
\hline Point 22 & 941.14 ft & \(1,437.14 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}

Not Factor of Safety Dependent
\begin{tabular}{|l|l|l|} 
Point 23 & \(1,000 \mathrm{ft}\) & \(1,484.05 \mathrm{ft}\) \\
\hline Point 24 & \(1,000 \mathrm{ft}\) & \(1,450.98 \mathrm{ft}\) \\
\hline Point 25 & \(1,032.45 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 26 & \(1,088.68 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 27 & \(1,100 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 28 & \(1,200 \mathrm{ft}\) & \(1,464.02 \mathrm{ft}\) \\
\hline Point 29 & \(1,200 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Point 30 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Point 31 & 0 ft & \(1,448 \mathrm{ft}\) \\
\hline Point 32 & \(1,200 \mathrm{ft}\) & \(1,454 \mathrm{ft}\) \\
\hline Point 33 & \(1,200 \mathrm{ft}\) & \(1,449 \mathrm{ft}\) \\
\hline Point 34 & 0 ft & \(1,430 \mathrm{ft}\) \\
\hline Point 35 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Point 36 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline Point 37 & 349.7661 ft & \(1,449.7489 \mathrm{ft}\) \\
\hline Point 38 & \(1,006.3772 \mathrm{ft}\) & \(1,453.0317 \mathrm{ft}\) \\
\hline Point 39 & 440.9509 ft & \(1,436.9815 \mathrm{ft}\) \\
\hline Point 40 & 976.531 ft & \(1,445.4616 \mathrm{ft}\) \\
\hline Point 41 & 400 ft & \(1,509.83 \mathrm{ft}\) \\
\hline Point 42 & 385.496 ft & \(1,509.83 \mathrm{ft}\) \\
\hline Point 43 & 300 ft & \(1,488.44 \mathrm{ft}\) \\
\hline Point 44 & 884.44 ft & \(1,510 \mathrm{ft}\) \\
\hline Point 45 & \(1,000 \mathrm{ft}\) & \(1,481.05 \mathrm{ft}\) \\
\hline Point 46 & \(1,078.35 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 47 & 255.409 ft & \(1,477.2459 \mathrm{ft}\) \\
\hline Point 48 & 385.496 ft & \(1,511.83 \mathrm{ft}\) \\
\hline Point 49 & 300 ft & \(1,490.44 \mathrm{ft}\) \\
\hline Point 50 & 884.44 ft & \(1,512 \mathrm{ft}\) \\
\hline Point 51 & \(1,000 \mathrm{ft}\) & \(1,483.05 \mathrm{ft}\) \\
\hline Point 52 & \(1,086.396 \mathrm{ft}\) & \(1,461.42 \mathrm{ft}\) \\
\hline Point 53 & 250.4979 ft & \(1,478.0561 \mathrm{ft}\) \\
\hline Point 54 & 884.44 ft & \(1,511 \mathrm{ft}\) \\
\hline Point 55 & 385.496 ft & \(1,510.83 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & \multicolumn{1}{c|}{\(\mathrm{Area}^{|c|}\)} \\
\hline Region 1 & Municipal Solid Waste & \(6,37,7,10,39,12,14,16,18,21,22,40,24,38,25,46,45,44,41,42,43,47\) & \(48,060 \mathrm{ft}^{2}\) \\
\hline Region 2 & Very Weathered Shale & \(34,35,36,33,40,22,21,18,16,14,12,39\) & \(19,401 \mathrm{ft}^{2}\) \\
\hline Region 3 & Shale Bedrock & \(30,29,36,35\) & \(13,800 \mathrm{ft}^{2}\) \\
\hline Region 4 & Lean Clay & \(40,24,38,25,46,52,26,27,28,32,33\) & \(2,821.7 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(34,31,1,2,3,4,53,47,6,37,7,10,39\) & \(14,525 \mathrm{ft}^{2}\) \\
\hline Region 6 & Compacted Soil Liner & \(47,43,42,41,44,45,46,52,51,50,48,49,53\) & \(1,661.7 \mathrm{ft}^{2}\) \\
\hline Region 7 & Vegetation Cover & \(4,53,49,48,50,51,52,26,23,20,19,17,15,13,11,9,8,5\) & \(912.38 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 452 of 726 converged

\section*{Current Slip Surface}

Slip Surface: 470
Factor of Safety: 2.994
Volume: 2,687.4316 ft \({ }^{3}\)
Weight: 200,585.66 lbf
Resisting Moment: 7,275,584.8 lbffft
Activating Moment: 2,429,954.4 lbf•ft
Resisting Force: 133,986.46 lbf
Activating Force: 44,750.74 lbf
Slip Rank: 1 of 726 slip surfaces
Exit: (1,079.4992, 1,463.7628) ft
Entry: (879.76538, 1,513.0072) ft
Radius: 294.69469 ft
Center: \((914,1,534) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & \begin{tabular}{l}
Cohesive \\
Strength
\end{tabular} & Suction Strength & Base Material \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 1
\end{aligned}
\] & \[
\begin{aligned}
& 880.50991 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,512.5031 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,491.6215 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 22.740646 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 4.0097895 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& 882.76008 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,510.9994 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,396.2278 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 123.58284 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 42.552984 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 884.35287 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,509.9429 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,329.1921 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 249.94991 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 4
\end{aligned}
\] & 888.33 ft & \[
\begin{aligned}
& \text { 1,507.4276 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,169.4728 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 338.4587 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 5
\end{aligned}
\] & 896.11 ft & \[
\begin{aligned}
& 1,502.6764 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,867.5882 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 501.42845 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 6
\end{aligned}
\] & \[
\begin{aligned}
& 903.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,498.5433 \\
& \mathrm{ft}
\end{aligned}
\] & 4,604.6736
psf & \[
\begin{aligned}
& 640.39163 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & 910 ft & \[
\begin{aligned}
& 1,494.9732 \\
& \mathrm{ft}
\end{aligned}
\] & 4,377.2857
psf & \begin{tabular}{l}
\[
757.77679
\] \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 916.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,491.619 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -4,163.375 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 859.17965 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 536.87503 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \hline 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & \[
\begin{aligned}
& 923.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,488.4726 \\
& \mathrm{ft}
\end{aligned}
\] & 3,962.4352
psf & \[
\begin{aligned}
& 950.41354 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 593.88429 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & 930 ft & \[
\begin{aligned}
& 1,485.5267 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,774.0139 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,032.1735 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 644.9736 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice & 936.66667 & 1,482.7749 & - & 1,104.4612 & 690.14397 & 18.850599 & & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 11 & ft & ft & \[
\begin{aligned}
& 3,597.7067 \\
& \text { psf }
\end{aligned}
\] & psf & psf & psf & 0 psf & Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & \[
\begin{aligned}
& 943.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,480.2113 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,433.1514 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,167.2668 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 729.38924 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & 950 ft & \[
\begin{aligned}
& 1,477.8307 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,280.0234 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,220.5682 \\
& \text { psf }
\end{aligned}
\] & 762.69569 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 14 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 956.66667 } \\
& \mathrm{ft} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,475.6285 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,138.032 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,264.331 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 790.04168 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
15
\end{tabular} & \[
\begin{aligned}
& 963.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,473.6006 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,006.9168 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,298.5071 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 811.39729 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & 970 ft & \[
\begin{aligned}
& 1,471.7431 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,886.4455 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,323.0349 } \\
& \text { psf }
\end{aligned}
\] & 826.72395 psf & 18.850599 psf & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
17
\] & \[
\begin{aligned}
& 976.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.0528 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,776.4107 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,337.8381 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 835.97402 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
18
\] & \[
\begin{aligned}
& 983.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,468.5267 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,676.6287 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,342.8253 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 839.09038 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & 990 ft & \[
\begin{aligned}
& 1,467.1623 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,586.9372 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,337.8891 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 836.00589 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 996.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.9572 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,507.1938 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,322.9051 } \\
& \text { psf }
\end{aligned}
\] & 826.64285 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 21 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,003.2748 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.9173 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,437.804 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,296.088 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 809.88566 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & \[
\begin{aligned}
& 1,009.8245 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.0382 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,378.4947 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,257.409 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
785.71636 \\
psf
\end{tabular} & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
23
\end{tabular} & \[
\begin{aligned}
& 1,016.3742 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.3081 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,328.4826 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,208.4932 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 755.15037 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& \text { 1,022.9239 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.7258 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,287.6986 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,149.1467 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
718.06653 \\
psf
\end{tabular} & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice 25 & \[
\begin{aligned}
& \text { 1,029.4736 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.2904 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,256.0877 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,079.1531 } \\
& \text { psf }
\end{aligned}
\] & 674.32973 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
26
\end{tabular} & \[
\begin{aligned}
& \text { 1,036.0233 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.0013 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,233.6093 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 998.2723 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 623.78976 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
27
\] & \[
\begin{aligned}
& 1,042.5729 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,461.858 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,220.2364 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 906.23755 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 566.28007 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice 28 & \[
\begin{aligned}
& \text { 1,049.1226 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,461.8604 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,215.9558 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 802.75369 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 501.61618 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,055.6723 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.0085 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,220.7676 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 691.71717 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline \begin{tabular}{l} 
Slice \\
30
\end{tabular} & \begin{tabular}{l}
\(1,062.222\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,462.3024\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,234.6857\) \\
psf
\end{tabular} & \begin{tabular}{l}
571.87556 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
31
\end{tabular} & \begin{tabular}{l}
\(1,068.7717\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,462.7426\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,257.7374\) \\
psf
\end{tabular} & \begin{tabular}{l}
441.54664 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
32
\end{tabular} & \begin{tabular}{l}
\(1,074.9235\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,463.2856\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,287.4806\) \\
psf
\end{tabular} & \begin{tabular}{l}
271.44991 \\
psf
\end{tabular} & \begin{tabular}{l}
93.467698 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
33
\end{tabular} & \begin{tabular}{l}
\(1,078.6498\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,463.6674\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,308.7944\) \\
psf
\end{tabular} & \begin{tabular}{l}
59.956831 \\
psf
\end{tabular} & \begin{tabular}{l}
10.572007 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline
\end{tabular}

\section*{Not FS Dependent Psuedo Static}

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\section*{File Information}

File Version: 9.01
Title: Section 2
Created By: Administrative User
Revision Number: 22
Date: 01/08/2021
Time: 02:31:54 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 2 (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 02:32:00 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not FS Dependent Psuedo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

Lean Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(32^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb

Unit Weight: 120 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (429.9909, 1,512.926) ft
Left-Zone Right Coordinate: \((1,066.8137,1,467)\) ft
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((1,066.8137,1,467) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,197,1,463.942) \mathrm{ft}\)
Right-Zone Increment: 10
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: (0, 1,463.42) ft
Right Coordinate: \((1,200,1,464.02) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{\(\mathbf{X}\)} & \multicolumn{1}{c|}{\(\mathbf{Y}\)} \\
\hline Coordinate 1 & 0 ft & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,200 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.153
Vert Seismic Coef.: 0.086

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (884.44, 1,511) ft
Inside Point: (385.496, 1,510.83) ft
Slip Surface Intersection: (882.76008, 1,510.9994) ft
Length: 498.94403 ft
Direction: \(0.019522^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 42 lbf
Pullout Force per Length: \(33.078163 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 1.6799165 ft
Required Length: 1.2697199 ft
Governing Component: Tensile Capacity

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,463.42 \mathrm{ft}\) \\
\hline Point 2 & 100 ft & \(1,478.81 \mathrm{ft}\) \\
\hline Point 3 & 200 ft & \(1,479.24 \mathrm{ft}\) \\
\hline Point 4 & 248.11 ft & \(1,478.45 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,491.44 \mathrm{ft}\) \\
\hline Point 6 & 300 ft & \(1,469.89 \mathrm{ft}\) \\
\hline Point 7 & 361.5 ft & \(1,445 \mathrm{ft}\) \\
\hline Point 8 & 385.496 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 9 & 400 ft & \(1,512.83 \mathrm{ft}\) \\
\hline Point 10 & 400 ft & \(1,437.26 \mathrm{ft}\) \\
\hline Point 11 & 500 ft & \(1,513.15 \mathrm{ft}\) \\
\hline Point 12 & 500 ft & \(1,436.58 \mathrm{ft}\) \\
\hline Point 13 & 600 ft & \(1,513.21 \mathrm{ft}\) \\
\hline Point 14 & 600 ft & \(1,436.85 \mathrm{ft}\) \\
\hline Point 15 & 700 ft & \(1,513.17 \mathrm{ft}\) \\
\hline Point 16 & 700 ft & \(1,436.98 \mathrm{ft}\) \\
\hline Point 17 & 800 ft & \(1,513.13 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 18 & 800 ft & 1,436.48 ft \\
\hline Point 19 & 884.44 ft & 1,513 ft \\
\hline Point 20 & 900 ft & 1,509.04 ft \\
\hline Point 21 & 900 ft & 1,437.14 ft \\
\hline Point 22 & 941.14 ft & 1,437.14 ft \\
\hline Point 23 & 1,000 ft & 1,484.05 ft \\
\hline Point 24 & 1,000 ft & 1,450.98 ft \\
\hline Point 25 & 1,032.45 ft & 1,461.42 ft \\
\hline Point 26 & 1,088.68 ft & 1,461.42 ft \\
\hline Point 27 & 1,100 ft & 1,461.42 ft \\
\hline Point 28 & 1,200 ft & 1,464.02 ft \\
\hline Point 29 & 1,200 ft & 1,410 ft \\
\hline Point 30 & 0 ft & 1,410 ft \\
\hline Point 31 & 0 ft & 1,448 ft \\
\hline Point 32 & 1,200 ft & 1,454 ft \\
\hline Point 33 & 1,200 ft & 1,449 ft \\
\hline Point 34 & 0 ft & 1,430 ft \\
\hline Point 35 & 0 ft & 1,415 ft \\
\hline Point 36 & 1,200 ft & 1,428 ft \\
\hline Point 37 & 349.7661 ft & 1,449.7489 ft \\
\hline Point 38 & 1,006.3772 ft & 1,453.0317 ft \\
\hline Point 39 & 440.9509 ft & 1,436.9815 ft \\
\hline Point 40 & 976.531 ft & 1,445.4616 ft \\
\hline Point 41 & 400 ft & 1,509.83 ft \\
\hline Point 42 & 385.496 ft & 1,509.83 ft \\
\hline Point 43 & 300 ft & 1,488.44 ft \\
\hline Point 44 & 884.44 ft & 1,510 ft \\
\hline Point 45 & 1,000 ft & 1,481.05 ft \\
\hline Point 46 & 1,078.35 ft & 1,461.42 ft \\
\hline Point 47 & 255.409 ft & 1,477.2459 ft \\
\hline Point 48 & 385.496 ft & 1,511.83 ft \\
\hline Point 49 & 300 ft & 1,490.44 ft \\
\hline Point 50 & 884.44 ft & 1,512 ft \\
\hline Point 51 & 1,000 ft & 1,483.05 ft \\
\hline Point 52 & 1,086.396 ft & 1,461.42 ft \\
\hline Point 53 & 250.4979 ft & 1,478.0561 ft \\
\hline Point 54 & 884.44 ft & 1,511 ft \\
\hline Point 55 & 385.496 ft & 1,510.83 ft \\
\hline
\end{tabular}

Regions
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & Area \\
\hline Region 1 & Municipal Solid Waste & \(6,37,7,10,39,12,14,16,18,21,22,40,24,38,25,46,45,44,41,42,43,47\) & \(48,060 \mathrm{ft}^{2}\) \\
\hline Region 2 & Very Weathered Shale & \(34,35,36,33,40,22,21,18,16,14,12,39\) & \(19,401 \mathrm{ft}^{2}\) \\
\hline Region 3 & Shale Bedrock & \(30,29,36,35\) & \(13,800 \mathrm{ft}^{2}\) \\
\hline Region 4 & Lean Clay & \(40,24,38,25,46,52,26,27,28,32,33\) & \(2,821.7 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(34,31,1,2,3,4,53,47,6,37,7,10,39\) & \(14,525 \mathrm{ft}^{2}\) \\
\hline Region 6 & Compacted Soil Liner & \(47,43,42,41,44,45,46,52,51,50,48,49,53\) & \(1,661.7 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 516 of 726 converged

\section*{Current Slip Surface}

Slip Surface: 470
Factor of Safety: 1.834
Volume: 2,687.4316 ft \({ }^{3}\)
Weight: 200,585.66 lbf
Resisting Moment: 7,602,875.2 Ibffft
Activating Moment: 4,145,286.1 lbf•ft
Resisting Force: 139,401.48 lbf
Activating Force: 76,019.944 Ibf
Slip Rank: 1 of 726 slip surfaces
Exit: (1,079.4992, 1,463.7628) ft
Entry: (879.76538, 1,513.0072) ft
Radius: 294.69469 ft
Center: \((914,1,534) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & \begin{tabular}{l}
Base \\
Normal Stress
\end{tabular} & Frictional Strength & Cohesive Strength & Suction Strength & Base Material \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 1
\end{aligned}
\] & \[
\begin{aligned}
& 880.50991 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,512.5031 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,491.6215 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 17.320981 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3.0541563 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& 882.76008 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,510.9994 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,396.2278 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 107.99829 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 37.186794 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 884.35287 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,509.9429 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,329.1921 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 232.20712 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 4
\end{aligned}
\] & 888.33 ft & \[
\begin{aligned}
& 1,507.4276 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,169.4728 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 320.49602 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 5
\end{aligned}
\] & 896.11 ft & \[
\begin{aligned}
& 1,502.6764 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,867.5882 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 484.15177 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 6
\end{aligned}
\] & \[
\begin{aligned}
& 903.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,498.5433 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,604.6736
\]
\[
\mathrm{psf}
\] & 624.91656 psf & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l|l}
\hline \text { Slice } \\
7
\end{array}
\] & 910 ft & \[
\begin{aligned}
& \text { 1,494.9732 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
4,377.2857 \\
psf
\end{tabular} & 744.81353 psf & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\hline \text { Slice } \\
8 \\
\hline
\end{array}
\] & \[
\begin{aligned}
& 916.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,491.619 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -4,163.375 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 850.50204 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 531.45266 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice & 923.33333 & 1,488.4726 & - & 946.46725 & 591.41838 & 18.850599 & & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 9 & ft & ft & \[
\begin{aligned}
& 3,962.4352 \\
& \text { psf }
\end{aligned}
\] & psf & psf & psf & 0 psf & Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & 930 ft & \[
\begin{aligned}
& \text { 1,485.5267 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,774.0139 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,034.0113 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 646.12197 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 11
\end{aligned}
\] & \[
\begin{aligned}
& 936.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,482.7749 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,597.7067 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,112.9821 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 695.46841 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12
\end{aligned}
\] & \[
\begin{aligned}
& 943.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,480.2113 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,433.1514 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,183.2187 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 739.35712 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & 950 ft & \[
\begin{aligned}
& \text { 1,477.8307 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,280.0234 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,244.5493 \\
& \text { psf }
\end{aligned}
\] & 777.68074 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 14
\end{aligned}
\] & \[
\begin{aligned}
& 956.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,475.6285 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,138.032 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,296.7893 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 810.32388 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& 963.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,473.6006 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,006.9168 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,339.7392 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 837.16197 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & 970 ft & \[
\begin{aligned}
& \text { 1,471.7431 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,886.4455 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,373.183 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 858.05995 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 976.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.0528 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,776.4107 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,396.8857 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 872.87106 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& 983.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,468.5267 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,676.6287 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,410.5915 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 881.43541 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & 990 ft & \[
\begin{aligned}
& \text { 1,467.1623 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,586.9372 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,414.0212 } \\
& \text { psf }
\end{aligned}
\] & 883.57849 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 996.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.9572 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,507.1938 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,406.8693 } \\
& \text { psf }
\end{aligned}
\] & 879.10953 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,003.2748 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,464.9173 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,437.804 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,386.9686 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 866.67418 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& 1,009.8245 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.0382 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,378.4947 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,354.0633 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 846.11267 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& 1,016.3742 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.3081 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,328.4826 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,309.7555 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 818.42607 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& 1,022.9239 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,462.7258 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,287.6986 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,253.6215 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 783.34968 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,029.4736 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,462.2904 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,256.0877 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,185.1953 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 740.5922 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 1,036.0233 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.0013 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,233.6093 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,103.9629 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 689.83259 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& 1,042.5729 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,461.858 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,220.2364 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,009.3571 } \\
& \text { psf }
\end{aligned}
\] & 630.71629 psf & \[
\begin{aligned}
& 18.850599 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline \begin{tabular}{l} 
Slice \\
28
\end{tabular} & \begin{tabular}{l}
\(1,049.1226\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,461.8604\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,215.9558\) \\
psf
\end{tabular} & \begin{tabular}{l}
900.74985 \\
psf
\end{tabular} & \begin{tabular}{l}
562.85098 \\
psf
\end{tabular} & \begin{tabular}{l}
18.850599 \\
psf
\end{tabular} & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
29
\end{tabular} & \begin{tabular}{l}
\(1,055.6723\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,462.0085\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,220.7676\) \\
psf
\end{tabular} & \begin{tabular}{l}
777.49141 \\
psf
\end{tabular} & \begin{tabular}{l}
485.83056 \\
psf
\end{tabular} & \begin{tabular}{l}
18.850599 \\
psf
\end{tabular} & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
30
\end{tabular} & \begin{tabular}{l}
\(1,062.222\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,462.3024\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,234.6857\) \\
psf
\end{tabular} & \begin{tabular}{l}
656.23247 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
31
\end{tabular} & \begin{tabular}{l}
\(1,068.7717\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,462.7426\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,257.7374\) \\
psf
\end{tabular} & \begin{tabular}{l}
524.33067 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
32
\end{tabular} & \begin{tabular}{l}
\(1,074.9235\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,463.2856\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,287.4806\) \\
psf
\end{tabular} & \begin{tabular}{l}
384.41268 \\
psf
\end{tabular} & \begin{tabular}{l}
132.3639 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
33
\end{tabular} & \begin{tabular}{l}
\(1,078.6498\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,463.6674\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,308.7944\) \\
psf
\end{tabular} & \begin{tabular}{l}
92.545805 \\
psf
\end{tabular} & \begin{tabular}{l}
16.318322 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline
\end{tabular}

\section*{Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section 3
Created By: Administrative User
Revision Number: 45
Date: 01/08/2021
Time: 03:07:26 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 3 (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW
Last Solved Date: 01/08/2021
Last Solved Time: 03:07:30 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100

Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

Municipal Soil Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)

Pore Water Pressure
Piezometric Line: 1

Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((171,1,462.167) \mathrm{ft}\)
Left-Zone Right Coordinate: \((261.5471,1,470.5) \mathrm{ft}\)
Left-Zone Increment: 8
Right Type: Range
Right-Zone Left Coordinate: \((262,1,470.6151) \mathrm{ft}\)
Right-Zone Right Coordinate: (478, 1,497.6966) ft
Right-Zone Increment: 15
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((0,1,462.167) \mathrm{ft}\)
Right Coordinate: \((1,225,1,441.83) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{X} & \multicolumn{1}{c|}{Y} \\
\hline Coordinate 1 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,225 \mathrm{ft}\) & \(1,405 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (400, 1,495.33) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.0011 ft
Direction: \(180.27^{\circ}\)
F of S Dependent: Yes

Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: (600, 1,495.11) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.00238 ft
Direction: \(359.6^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: (700, 1,495.14) ft
Inside Point: (600, 1,495.11) ft
Length: 100 ft
Direction: \(0.017189^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)

Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((800,1,496.74) \mathrm{ft}\)
Inside Point: \((700,1,495.14) \mathrm{ft}\)
Length: 100.0128 ft
Direction: \(0.91665^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: (855.747, 1,498.58) ft
Inside Point: \((800,1,496.74) \mathrm{ft}\)
Length: 55.777357 ft
Direction: \(1.8904^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1

Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|c|c|c|}
\hline & X & Y \\
\hline Point 1 & 0 ft & 1,462.167 ft \\
\hline Point 2 & 100 ft & 1,462.167 ft \\
\hline Point 3 & 200 ft & 1,462.167 ft \\
\hline Point 4 & 228.75 ft & 1,462.167 ft \\
\hline Point 5 & 300 ft & 1,462.167 ft \\
\hline Point 6 & 300 ft & 1,480.27 ft \\
\hline Point 7 & 357.25 ft & 1,443 ft \\
\hline Point 8 & 371.75 ft & \(1,443 \mathrm{ft}\) \\
\hline Point 9 & 394.999 ft & 1,435.25 ft \\
\hline Point 10 & 400 ft & 1,497.33 ft \\
\hline Point 11 & 400 ft & 1,435.21 ft \\
\hline Point 12 & 500 ft & 1,497.8 ft \\
\hline Point 13 & 500 ft & 1,434.31 ft \\
\hline Point 14 & 600 ft & 1,497.11 ft \\
\hline Point 15 & 600 ft & 1,434.48 ft \\
\hline Point 16 & 700 ft & 1,497.14 ft \\
\hline Point 17 & 700 ft & 1,434.61 ft \\
\hline Point 18 & 800 ft & 1,498.94 ft \\
\hline Point 19 & 800 ft & 1,434.11 ft \\
\hline Point 20 & 855.747 ft & 1,500.58 ft \\
\hline Point 21 & 900 ft & 1,496.03 ft \\
\hline Point 22 & 900 ft & 1,434.98 ft \\
\hline Point 23 & 949 ft & 1,434.98 ft \\
\hline Point 24 & 980.19 ft & 1,445.64 ft \\
\hline Point 25 & 1,000 ft & 1,445.64 ft \\
\hline Point 26 & 1,000 ft & 1,475.08 ft \\
\hline Point 27 & 1,023.64 ft & \(1,445 \mathrm{ft}\) \\
\hline Point 28 & \(1,030.5 \mathrm{ft}\) & 1,448 ft \\
\hline Point 29 & 1,051.63 ft & 1,448 ft \\
\hline Point 30 & 1,100 ft & 1,448 ft \\
\hline Point 31 & 1,100 ft & 1,451.77 ft \\
\hline Point 32 & 1,141 ft & 1,441.83 ft \\
\hline Point 33 & 1,200 ft & 1,441.83 ft \\
\hline Point 34 & 1,225 ft & 1,441.83 ft \\
\hline Point 35 & 1,225 ft & 1,405 ft \\
\hline Point 36 & 0 ft & 1,405 ft \\
\hline Point 37 & 1,225 ft & 1,440 ft \\
\hline Point 38 & 1,225 ft & 1,430 ft \\
\hline Point 39 & 1,225 ft & 1,425 ft \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|} 
Point 40 & \(1,225 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Point 41 & 0 ft & \(1,435 \mathrm{ft}\) \\
\hline Point 42 & 0 ft & \(1,425 \mathrm{ft}\) \\
\hline Point 43 & 0 ft & \(1,420 \mathrm{ft}\) \\
\hline Point 44 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Point 45 & 390.9635 ft & \(1,436.5952 \mathrm{ft}\) \\
\hline Point 46 & 960.5301 ft & \(1,438.9207 \mathrm{ft}\) \\
\hline Point 47 & 300 ft & \(1,479.27 \mathrm{ft}\) \\
\hline Point 48 & 300 ft & \(1,477.27 \mathrm{ft}\) \\
\hline Point 49 & 400 ft & \(1,496.33 \mathrm{ft}\) \\
\hline Point 50 & 400 ft & \(1,494.33 \mathrm{ft}\) \\
\hline Point 51 & 400 ft & \(1,495.33 \mathrm{ft}\) \\
\hline Point 52 & 855.747 ft & \(1,499.58 \mathrm{ft}\) \\
\hline Point 53 & 855.747 ft & \(1,498.58 \mathrm{ft}\) \\
\hline Point 54 & 855.747 ft & \(1,497.58 \mathrm{ft}\) \\
\hline Point 55 & 900 ft & \(1,495.03 \mathrm{ft}\) \\
\hline Point 56 & 900 ft & \(1,493.03 \mathrm{ft}\) \\
\hline Point 57 & \(1,000 \mathrm{ft}\) & \(1,474.08 \mathrm{ft}\) \\
\hline Point 58 & \(1,000 \mathrm{ft}\) & \(1,472.08 \mathrm{ft}\) \\
\hline Point 59 & 232.6896 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 60 & 240.5594 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 61 & \(1,100 \mathrm{ft}\) & \(1,450.77 \mathrm{ft}\) \\
\hline Point 62 & \(1,100 \mathrm{ft}\) & \(1,448.769 \mathrm{ft}\) \\
\hline Point 63 & \(1,130.125 \mathrm{ft}\) & \(1,443.4666 \mathrm{ft}\) \\
\hline Point 64 & \(1,108.3622 \mathrm{ft}\) & \(1,446.7416 \mathrm{ft}\) \\
\hline Point 65 & 500 ft & \(1,496.8 \mathrm{ft}\) \\
\hline Point 66 & 500 ft & \(1,495.8 \mathrm{ft}\) \\
\hline Point 67 & 500 ft & \(1,494.8 \mathrm{ft}\) \\
\hline Point 68 & 600 ft & \(1,496.11 \mathrm{ft}\) \\
\hline Point 69 & 600 ft & \(1,495.11 \mathrm{ft}\) \\
\hline Point 70 & 600 ft & \(1,494.11 \mathrm{ft}\) \\
\hline Point 71 & 700 ft & \(1,496.14 \mathrm{ft}\) \\
\hline Point 72 & 700 ft & \(1,495.14 \mathrm{ft}\) \\
\hline Point 73 & 700 ft & \(1,494.14 \mathrm{ft}\) \\
\hline Point 74 & 800 ft & \(1,497.94 \mathrm{ft}\) \\
\hline Point 75 & 800 ft & \(1,496.74 \mathrm{ft}\) \\
\hline Point 76 & 800 ft & \(1,495.74 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|c|c|}
\hline & Material & \multicolumn{1}{c|}{ Points } & Area \\
\hline \begin{tabular}{l} 
Region \\
1
\end{tabular} & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} & \(5,7,8,45,9,11,13,15,17,19,22,23,46,24,25,27,28,29,30,64,62,58,56,54,76,73,70,67,50,48,60\) & \begin{tabular}{l}
40,163 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} & \(4,59,47,49,65,68,71,74,52,55,57,61,63,32,31,26,21,20,18,16,14,12,10,6\) & \begin{tabular}{l}
904.88 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
3
\end{tabular} & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} & \(59,60,48,50,67,70,73,76,54,56,58,62,64,63,61,57,55,52,74,71,68,65,49,47\) & \(1,780.9\) \\
\hline \begin{tabular}{l} 
Region \\
4
\end{tabular} & Lean Clay & \(41,45,8,7,5,60,59,4,3,2,1\) & \(\mathrm{ft}^{2}\)
\end{tabular}

\section*{Factor of Safety Dependent}
\begin{tabular}{|l|l|l|l|}
5 & Shale & & \(\mathrm{ft}^{2}\) \\
\hline \begin{tabular}{l} 
Region \\
6
\end{tabular} & \begin{tabular}{l} 
Shale \\
Bedrock
\end{tabular} & \(36,35,40,44\) & \begin{tabular}{l}
\(9,187.5\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
7
\end{tabular} & Lean Clay & \(34,33,32,63,64,30,29,28,27,25,24,46,37\) & \begin{tabular}{l}
\(1,380.9\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
8
\end{tabular} & \begin{tabular}{l} 
Shale \\
Bedrock
\end{tabular} & \(39,38,42,43\) & \begin{tabular}{l}
6,125 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
9
\end{tabular} & \begin{tabular}{l} 
Very \\
Weathered \\
Shale
\end{tabular} & \(40,39,43,44\) & \begin{tabular}{l}
12,250 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 529 of 864 converged

\section*{Current Slip Surface}

Slip Surface: 626
Factor of Safety: 3.935
Volume: 1,420.7841 ft \({ }^{3}\)
Weight: 112,334.1 lbf
Resisting Moment: \(3,215,503.8 \mathrm{lbf} \cdot \mathrm{ft}\)
Activating Moment: 817,148.07 lbf•ft
Resisting Force: 81,535.928 Ibf
Activating Force: 20,721.675 lbf
Slip Rank: 1 of 864 slip surfaces
Exit: (239.35492, 1,464.8615) ft
Entry: (376.30513, 1,493.2877) ft
Radius: 193.37347 ft
Center: (291, 1,497.75) ft

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & Cohesive Strength & Suction Strength & Base Material \\
\hline Slice
\[
1
\] & \[
\begin{aligned}
& 240.56222 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.6678 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,474.2204 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 77.011928 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 13.579281 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline \begin{tabular}{l}
Slice \\
2
\end{tabular} & \[
\begin{aligned}
& 244.30394 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.1183 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,440.8661 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 300.86642 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 103.59662 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \begin{tabular}{l}
Slice \\
3
\end{tabular} & \[
\begin{aligned}
& 249.05343 \\
& \mathrm{ft} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.5071 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,403.923 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 460.30777 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & \[
\begin{aligned}
& 253.48357 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.0482 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,376.3987 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 556.87887 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 257.9137 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.692 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,355.2934 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 646.20012 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 262.34384 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.4381 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,340.5715 } \\
& \text { psf }
\end{aligned}
\] & 728.38656 psf & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline & & & & & & - & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & \[
\begin{aligned}
& 266.77398 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.2861 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,332.208 \\
& \text { psf }
\end{aligned}
\] & 804.59408 psf & 522.5095 psf & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 271.20411 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.2356 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,330.1877 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 874.52542 psf & \[
\begin{aligned}
& 567.92345 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
9
\end{tabular} & \[
\begin{aligned}
& 275.63425 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.2867 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,334.5058 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 936.86891 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 608.40978 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 280.06439 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.4394 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,345.1672 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 991.77987 \\
& \text { psf }
\end{aligned}
\] & 644.06938 psf & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 11
\end{aligned}
\] & \[
\begin{aligned}
& 284.49452 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.6939 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,362.187 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,039.3964 } \\
& \text { psf }
\end{aligned}
\] & 674.99195 psf & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12
\end{aligned}
\] & \[
\begin{aligned}
& 288.92466 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.0507 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,385.5905 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,079.8408 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 701.25682 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& 293.3548 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.5104 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,415.4133 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,113.2202 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 722.93368 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 14
\end{aligned}
\] & \[
\begin{aligned}
& 297.78493 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.0735 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,451.7015 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,139.6281 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 740.08313 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& 302.32055 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.7597 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,495.6922 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,147.5596 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 745.23391 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 306.96165 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.575 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,547.7795 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,137.0265 } \\
& \text { psf }
\end{aligned}
\] & 738.39367 psf & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 311.60275 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.5078 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,607.197 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,119.4448 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 726.97592 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& 316.24385 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,467.5598 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,674.0537 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,094.8637 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 711.01279 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& 320.88495 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,468.7329 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,748.4755 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,063.3208 } \\
& \text { psf }
\end{aligned}
\] & 690.52859 psf & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 325.52604 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.0296 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,830.6059 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,024.8419 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
665.5401
\] \\
psf
\end{tabular} & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& 330.16714 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,471.4523 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,920.6079 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
979.4415 \\
psf
\end{tabular} & \[
\begin{aligned}
& 636.05675 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & \[
\begin{aligned}
& 334.80824 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,473.004 \\
& \mathrm{ft}
\end{aligned}
\] & 4,018.6656
psf & \[
\begin{aligned}
& 927.12312 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 602.08079 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& 339.44934 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,474.6881 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,124.9864 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 867.87933 psf & \[
\begin{aligned}
& 563.60743 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& 344.09044 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.5083 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,239.8036 \\
& \mathrm{psf} \\
& \hline
\end{aligned}
\] & 801.69192 psf & \[
\begin{aligned}
& 520.62482 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& 348.73154 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.4687 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,363.3795
\] & 726.76332 psf & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & & & psf & & & & & \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 353.37264 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,480.5742 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,496.0086
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 642.60916 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& 358.01374 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,482.8301 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,638.0223
\]
psf & \[
\begin{aligned}
& 550.2508 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& 362.65484 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,485.2422 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,789.7937 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 449.48389 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 367.29593 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,487.8173 \\
& \mathrm{ft}
\end{aligned}
\] & 4,951.7441 psf & \[
\begin{aligned}
& 340.07888 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& 371.89187 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,490.5348 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,122.5642 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 150.81978 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 51.931415 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& 375.2362 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,492.6053 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,252.6807 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 29.580065 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 5.2157636 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{FS Dependent Seismic Psuedo Static}

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\section*{File Information}

File Version: 9.01
Title: Section 3
Created By: Administrative User
Revision Number: 45
Date: 01/08/2021
Time: 03:07:26 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 3 (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW
Last Solved Date: 01/08/2021
Last Solved Time: 03:07:32 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{FS Dependent Seismic Psuedo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100

Tolerable difference in F of S: 0.001

\section*{Solution Settings}

Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2
Materials
Lean Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Municipal Soil Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Shale Bedrock
Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1
Vegetation Cover
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)

\section*{Pore Water Pressure}

Piezometric Line: 1

Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((171,1,462.167) \mathrm{ft}\)
Left-Zone Right Coordinate: \((261.5471,1,470.5) \mathrm{ft}\)
Left-Zone Increment: 8
Right Type: Range
Right-Zone Left Coordinate: (261.5471, 1,470.5) ft
Right-Zone Right Coordinate: (479, 1,497.7013) ft
Right-Zone Increment: 15
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((0,1,462.167) \mathrm{ft}\)
Right Coordinate: \((1,225,1,441.83) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{X} & \multicolumn{1}{c|}{Y} \\
\hline Coordinate 1 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,225 \mathrm{ft}\) & \(1,405 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic

Outside Point: (400, 1,495.33) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.0011 ft
Direction: \(180.27^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: (600, 1,495.11) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.00238 ft
Direction: 359.6º
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: (700, 1,495.14) ft Inside Point: \((600,1,495.11) \mathrm{ft}\) Length: 100 ft
Direction: \(0.017189^{\circ}\)

F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((800,1,496.74) \mathrm{ft}\)
Inside Point: \((700,1,495.14) \mathrm{ft}\)
Length: 100.0128 ft
Direction: \(0.91665^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: (855.747, 1,498.58) ft
Inside Point: \((800,1,496.74) \mathrm{ft}\)
Length: 55.777357 ft
Direction: \(1.8904^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No Interface Adhesion: 0 psf

Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 2 & 100 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 3 & 200 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 4 & 228.75 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 6 & 300 ft & \(1,480.27 \mathrm{ft}\) \\
\hline Point 7 & 357.25 ft & \(1,443 \mathrm{ft}\) \\
\hline Point 8 & 371.75 ft & \(1,443 \mathrm{ft}\) \\
\hline Point 9 & 394.999 ft & \(1,435.25 \mathrm{ft}\) \\
\hline Point 10 & 400 ft & \(1,497.33 \mathrm{ft}\) \\
\hline Point 11 & 400 ft & \(1,435.21 \mathrm{ft}\) \\
\hline Point 12 & 500 ft & \(1,497.8 \mathrm{ft}\) \\
\hline Point 13 & 500 ft & \(1,434.31 \mathrm{ft}\) \\
\hline Point 14 & 600 ft & \(1,497.11 \mathrm{ft}\) \\
\hline Point 15 & 600 ft & \(1,434.48 \mathrm{ft}\) \\
\hline Point 16 & 700 ft & \(1,497.14 \mathrm{ft}\) \\
\hline Point 17 & 700 ft & \(1,434.61 \mathrm{ft}\) \\
\hline Point 18 & 800 ft & \(1,498.94 \mathrm{ft}\) \\
\hline Point 19 & 800 ft & \(1,434.11 \mathrm{ft}\) \\
\hline Point 20 & 855.747 ft & \(1,500.58 \mathrm{ft}\) \\
\hline Point 21 & 900 ft & \(1,496.03 \mathrm{ft}\) \\
\hline Point 22 & 900 ft & \(1,434.98 \mathrm{ft}\) \\
\hline Point 23 & 949 ft & \(1,434.98 \mathrm{ft}\) \\
\hline Point 24 & 980.19 ft & \(1,445.64 \mathrm{ft}\) \\
\hline Point 25 & \(1,000 \mathrm{ft}\) & \(1,445.64 \mathrm{ft}\) \\
\hline Point 26 & \(1,000 \mathrm{ft}\) & \(1,475.08 \mathrm{ft}\) \\
\hline Point 27 & \(1,023.64 \mathrm{ft}\) & \(1,445 \mathrm{ft}\) \\
\hline Point 28 & \(1,030.5 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 29 & \(1,051.63 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 30 & \(1,100 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 31 & \(1,100 \mathrm{ft}\) & \(1,451.77 \mathrm{ft}\) \\
\hline Point 32 & \(1,141 \mathrm{ft}\) & \(1,441.83 \mathrm{ft}\) \\
\hline Point 33 & \(1,200 \mathrm{ft}\) & \(1,441.83 \mathrm{ft}\) \\
\hline Point 34 & \(1,225 \mathrm{ft}\) & \(1,441.83 \mathrm{ft}\) \\
\hline & \hline 1, \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 35 & 1,225 ft & 1,405 ft \\
\hline Point 36 & 0 ft & 1,405 ft \\
\hline Point 37 & 1,225 ft & 1,440 ft \\
\hline Point 38 & 1,225 ft & 1,430 ft \\
\hline Point 39 & 1,225 ft & 1,425 ft \\
\hline Point 40 & 1,225 ft & 1,415 ft \\
\hline Point 41 & 0 ft & 1,435 ft \\
\hline Point 42 & 0 ft & 1,425 ft \\
\hline Point 43 & 0 ft & 1,420 ft \\
\hline Point 44 & 0 ft & 1,410 ft \\
\hline Point 45 & 390.9635 ft & 1,436.5952 ft \\
\hline Point 46 & 960.5301 ft & 1,438.9207 ft \\
\hline Point 47 & 300 ft & 1,479.27 ft \\
\hline Point 48 & 300 ft & 1,477.27 ft \\
\hline Point 49 & 400 ft & 1,496.33 ft \\
\hline Point 50 & 400 ft & 1,494.33 ft \\
\hline Point 51 & 400 ft & 1,495.33 ft \\
\hline Point 52 & 855.747 ft & 1,499.58 ft \\
\hline Point 53 & 855.747 ft & 1,498.58 ft \\
\hline Point 54 & 855.747 ft & 1,497.58 ft \\
\hline Point 55 & 900 ft & 1,495.03 ft \\
\hline Point 56 & 900 ft & 1,493.03 ft \\
\hline Point 57 & 1,000 ft & 1,474.08 ft \\
\hline Point 58 & 1,000 ft & 1,472.08 ft \\
\hline Point 59 & 232.6896 ft & 1,462.167 ft \\
\hline Point 60 & 240.5594 ft & 1,462.167 ft \\
\hline Point 61 & 1,100 ft & 1,450.77 ft \\
\hline Point 62 & 1,100 ft & 1,448.769 ft \\
\hline Point 63 & 1,130.125 ft & 1,443.4666 ft \\
\hline Point 64 & 1,108.3622 ft & 1,446.7416 ft \\
\hline Point 65 & 500 ft & 1,496.8 ft \\
\hline Point 66 & 500 ft & \(1,495.8 \mathrm{ft}\) \\
\hline Point 67 & 500 ft & 1,494.8 ft \\
\hline Point 68 & 600 ft & 1,496.11 ft \\
\hline Point 69 & 600 ft & 1,495.11 ft \\
\hline Point 70 & 600 ft & 1,494.11 ft \\
\hline Point 71 & 700 ft & 1,496.14 ft \\
\hline Point 72 & 700 ft & 1,495.14 ft \\
\hline Point 73 & 700 ft & 1,494.14 ft \\
\hline Point 74 & 800 ft & 1,497.94 ft \\
\hline Point 75 & 800 ft & 1,496.74 ft \\
\hline Point 76 & 800 ft & 1,495.74 ft \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|c|c|}
\hline & Material & Points & Area \\
\hline \begin{tabular}{l} 
Region \\
1
\end{tabular} & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} & \(5,7,8,45,9,11,13,15,17,19,22,23,46,24,25,27,28,29,30,64,62,58,56,54,76,73,70,67,50,48,60\) & \begin{tabular}{l}
40,163 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} & \(4,59,47,49,65,68,71,74,52,55,57,61,63,32,31,26,21,20,18,16,14,12,10,6\) & 904.88 \\
\hline & & & \(\mathrm{ft}^{2}\)
\end{tabular}
\begin{tabular}{|c|c|c|c|}
\hline Region
\[
3
\] & Compacted Soil Liner & 59,60,48,50,67,70,73,76,54,56,58,62,64,63,61,57,55,52,74,71,68,65,49,47 & \[
\begin{aligned}
& 1,780.9 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline Region
\[
4
\] & Lean Clay & 41,45,8,7,5,60,59,4,3,2,1 & \[
\begin{aligned}
& 9,053.1 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline Region
\[
5
\] & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} & 42,38,37,46,23,22,19,17,15,13,11,9,45,41 & \[
\begin{aligned}
& 10,466 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline Region
\[
6
\] & Shale Bedrock & 36,35,40,44 & \[
\begin{aligned}
& 9,187.5 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline Region
\[
7
\] & Lean Clay & 34,33,32,63,64,30,29,28,27,25,24,46,37 & \[
\begin{aligned}
& 1,380.9 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline Region
\[
8
\] & \begin{tabular}{l}
Shale \\
Bedrock
\end{tabular} & 39,38,42,43 & \[
\begin{aligned}
& 6,125 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline Region
\[
9
\] & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} & 40,39,43,44 & \[
\begin{aligned}
& 12,250 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 601 of 864 converged

\section*{Current Slip Surface}

Slip Surface: 626
Factor of Safety: 2.297
Volume: 1,427.2092 \(\mathrm{ft}^{3}\)
Weight: 112,793.8 lbf
Resisting Moment: 17,212,700 lbf•ft
Activating Moment: 7,495,210.3 lbffft
Resisting Force: 85,437.706 Ibf
Activating Force: 37,193.592 lbf
Slip Rank: 1 of 864 slip surfaces
Exit: \((239.35492,1,464.8615) \mathrm{ft}\)
Entry: (376.61591, 1,493.3407) ft
Radius: 193.79425 ft
Center: (271.28039, 1,656.0079) ft
Slip Slices
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{Y} & \multicolumn{1}{|c|}{PWP} & \begin{tabular}{l} 
Base Normal \\
Stress
\end{tabular} & \begin{tabular}{l} 
Frictional \\
Strength
\end{tabular} & \begin{tabular}{l} 
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{l} 
Suction \\
Strength
\end{tabular} & Base Material \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
240.56184 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,464.6677\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(3,474.2143\) \\
psf
\end{tabular} & \begin{tabular}{l}
108.56053 \\
psf
\end{tabular} & \begin{tabular}{l}
19.14215 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
2
\end{tabular} & \begin{tabular}{l}
244.30204 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,464.1178\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(3,440.8355\) \\
psf
\end{tabular} & \begin{tabular}{l}
407.73368 \\
psf
\end{tabular} & \begin{tabular}{l}
140.39396 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
3
\end{tabular} & \begin{tabular}{l}
249.05051 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,463.5058\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(3,403.8403\) \\
psf
\end{tabular} & \begin{tabular}{l}
543.69927 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
4
\end{tabular} & \begin{tabular}{l}
ft \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,463.0457\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(3,376.2423\) \\
psf
\end{tabular} & \begin{tabular}{l}
642.33822 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} \\
\hline & & & & & &
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 257.91129 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.6881 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,355.0506 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 732.76111 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 262.34168 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.4327 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,340.2296 \\
& \text { psf }
\end{aligned}
\] & 820.00059 psf & \[
\begin{aligned}
& 532.51461 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & \[
\begin{aligned}
& 266.77207 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.2788 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,331.7542 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 901.52672 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{array}{|l|l}
585.4583 \\
\text { psf }
\end{array}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
271.20246
\]
\[
\mathrm{ft}
\] & \[
\begin{aligned}
& 1,462.2264 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,329.6092 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \begin{tabular}{l}
\[
973.43552
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 632.15642 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
9
\end{tabular} & \[
\begin{aligned}
& 275.63285 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.2752 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,333.7895 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,036.122 \\
& \text { psf }
\end{aligned}
\] & 672.86549 psf & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 280.06324 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.4255 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,344.2999 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,089.9422 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 707.81677 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 11
\end{aligned}
\] & \[
\begin{aligned}
& 284.49363 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.6774 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,361.1551 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,135.2177 } \\
& \text { psf }
\end{aligned}
\] & 737.219 psf & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12
\end{aligned}
\] & \[
\begin{aligned}
& 288.92402 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.0314 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,384.3801 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,172.2388 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
761.2608
\] \\
psf
\end{tabular} & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& 293.35441 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.4879 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,414.0098 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,201.2684 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
780.11282
\] \\
psf
\end{tabular} & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 14
\end{aligned}
\] & \[
297.7848
\] & \[
\begin{aligned}
& 1,464.0477 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,450.0902 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,222.5442 \\
& \text { psf }
\end{aligned}
\] & 793.9295 psf & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& 302.3309 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.732 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,493.9659 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,223.7358 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 794.70329 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 306.99271 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.5474 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,546.0619 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,205.1792 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
782.65255
\] \\
psf
\end{tabular} & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 311.65452 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.481 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,605.5346 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,179.4058 } \\
& \text { psf }
\end{aligned}
\] & 765.91508 psf & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& 316.31633 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,467.5345 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,672.4936 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,146.5864 } \\
& \text { psf }
\end{aligned}
\] & 744.60194 psf & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& 320.97814 \\
& \mathrm{ft}
\end{aligned}
\] & 1,468.71 ft & \[
\begin{aligned}
& 3,747.0654 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,106.8765 } \\
& \text { psf }
\end{aligned}
\] & 718.81397 psf & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 325.63994 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.0097 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,829.3944 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,060.417 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
688.64283
\] \\
psf
\end{tabular} & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& 330.30175 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,471.4363 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,919.6446 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,007.3364 } \\
& \text { psf }
\end{aligned}
\] & \[
654.17188
\]
psf & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& 334.96356 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,472.9927 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,018.0014 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 947.75168 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 615.47714 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline Slice & 339.62537 & 1,474.6824 & 4,124.6737 & 881.76991 & 572.62807 & \[
0.043846762
\] & 0 psf & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 23 & ft & ft & psf & psf & psf & psf & & Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& 344.28718 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,476.5089 } \\
& \mathrm{ft}
\end{aligned}
\] & 4,239.8965 psf & \[
\begin{aligned}
& 809.48928 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 525.68849 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& 348.94898 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.4767 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -4,363.934 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 729.55517 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 353.61079 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,480.5905 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -4,497.083 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 640.90054 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& 358.2726 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,482.8555 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,639.6777
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 544.56494 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& 362.93441 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,485.2779 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
4,792.0943 \\
psf
\end{tabular} & \[
\begin{aligned}
& 440.43953 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 367.59622 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,487.8644 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,954.7578
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 328.40145 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& 372.20246 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,490.5877 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,125.9513 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 137.38138 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 47.304204 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& 375.54685 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,492.6583 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
5,256.0686
\]
psf & \[
\begin{aligned}
& 24.804155 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
4.3736417
\] \\
psf
\end{tabular} & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Not Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section 3
Created By: Administrative User
Revision Number: 45
Date: 01/08/2021
Time: 03:07:26 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 3 (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW
Last Solved Date: 01/08/2021
Last Solved Time: 03:07:30 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100

Tolerable difference in F of \(\mathrm{S}: 0.001\)

\section*{Solution Settings}

Search Method: Root Finder
Tolerable difference between starting and converged F of \(\mathrm{S}: 3\)
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2
Materials
Lean Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Municipal Soil Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Shale Bedrock
Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1
Vegetation Cover
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)

\section*{Pore Water Pressure}

Piezometric Line: 1

Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((171,1,462.167) \mathrm{ft}\)
Left-Zone Right Coordinate: \((262,1,470.6151)\) ft
Left-Zone Increment: 8
Right Type: Range
Right-Zone Left Coordinate: (262.5311, 1,470.75) ft
Right-Zone Right Coordinate: \((477,1,497.6919) \mathrm{ft}\)
Right-Zone Increment: 15
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((0,1,462.167) \mathrm{ft}\)
Right Coordinate: \((1,225,1,441.83) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{X} & \multicolumn{1}{c|}{Y} \\
\hline Coordinate 1 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,225 \mathrm{ft}\) & \(1,405 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (400, 1,495.33) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.0011 ft
Direction: \(180.27^{\circ}\)
F of S Dependent: No

Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: (600, 1,495.11) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.00238 ft
Direction: \(359.6^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: \((700,1,495.14) \mathrm{ft}\)
Inside Point: \((600,1,495.11) \mathrm{ft}\)
Length: 100 ft
Direction: \(0.017189^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)

Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((800,1,496.74) \mathrm{ft}\)
Inside Point: \((700,1,495.14) \mathrm{ft}\)
Length: 100.0128 ft
Direction: \(0.91665^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: (855.747, 1,498.58) ft
Inside Point: \((800,1,496.74) \mathrm{ft}\)
Length: 55.777357 ft
Direction: \(1.8904^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5

\section*{Not Factor of Safety Dependent}

Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|c|c|c|}
\hline & X & Y \\
\hline Point 1 & 0 ft & 1,462.167 ft \\
\hline Point 2 & 100 ft & 1,462.167 ft \\
\hline Point 3 & 200 ft & 1,462.167 ft \\
\hline Point 4 & 228.75 ft & 1,462.167 ft \\
\hline Point 5 & 300 ft & 1,462.167 ft \\
\hline Point 6 & 300 ft & 1,480.27 ft \\
\hline Point 7 & 357.25 ft & 1,443 ft \\
\hline Point 8 & 371.75 ft & 1,443 ft \\
\hline Point 9 & 394.999 ft & 1,435.25 ft \\
\hline Point 10 & 400 ft & 1,497.33 ft \\
\hline Point 11 & 400 ft & 1,435.21 ft \\
\hline Point 12 & 500 ft & 1,497.8 ft \\
\hline Point 13 & 500 ft & 1,434.31 ft \\
\hline Point 14 & 600 ft & 1,497.11 ft \\
\hline Point 15 & 600 ft & 1,434.48 ft \\
\hline Point 16 & 700 ft & 1,497.14 ft \\
\hline Point 17 & 700 ft & 1,434.61 ft \\
\hline Point 18 & 800 ft & 1,498.94 ft \\
\hline Point 19 & 800 ft & 1,434.11 ft \\
\hline Point 20 & 855.747 ft & 1,500.58 ft \\
\hline Point 21 & 900 ft & 1,496.03 ft \\
\hline Point 22 & 900 ft & 1,434.98 ft \\
\hline Point 23 & 949 ft & 1,434.98 ft \\
\hline Point 24 & 980.19 ft & 1,445.64 ft \\
\hline Point 25 & 1,000 ft & 1,445.64 ft \\
\hline Point 26 & 1,000 ft & 1,475.08 ft \\
\hline Point 27 & 1,023.64 ft & \(1,445 \mathrm{ft}\) \\
\hline Point 28 & \(1,030.5 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 29 & 1,051.63 ft & 1,448 ft \\
\hline Point 30 & 1,100 ft & \(1,448 \mathrm{ft}\) \\
\hline Point 31 & 1,100 ft & 1,451.77 ft \\
\hline Point 32 & 1,141 ft & \(1,441.83 \mathrm{ft}\) \\
\hline Point 33 & 1,200 ft & 1,441.83 ft \\
\hline Point 34 & 1,225 ft & 1,441.83 ft \\
\hline Point 35 & 1,225 ft & \(1,405 \mathrm{ft}\) \\
\hline Point 36 & 0 ft & 1,405 ft \\
\hline Point 37 & 1,225 ft & 1,440 ft \\
\hline Point 38 & 1,225 ft & 1,430 ft \\
\hline Point 39 & 1,225 ft & \(1,425 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Not Factor of Safety Dependent}
\begin{tabular}{|l|l|l|} 
Point 40 & \(1,225 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Point 41 & 0 ft & \(1,435 \mathrm{ft}\) \\
\hline Point 42 & 0 ft & \(1,425 \mathrm{ft}\) \\
\hline Point 43 & 0 ft & \(1,420 \mathrm{ft}\) \\
\hline Point 44 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Point 45 & 390.9635 ft & \(1,436.5952 \mathrm{ft}\) \\
\hline Point 46 & 960.5301 ft & \(1,438.9207 \mathrm{ft}\) \\
\hline Point 47 & 300 ft & \(1,479.27 \mathrm{ft}\) \\
\hline Point 48 & 300 ft & \(1,477.27 \mathrm{ft}\) \\
\hline Point 49 & 400 ft & \(1,496.33 \mathrm{ft}\) \\
\hline Point 50 & 400 ft & \(1,494.33 \mathrm{ft}\) \\
\hline Point 51 & 400 ft & \(1,495.33 \mathrm{ft}\) \\
\hline Point 52 & 855.747 ft & \(1,499.58 \mathrm{ft}\) \\
\hline Point 53 & 855.747 ft & \(1,498.58 \mathrm{ft}\) \\
\hline Point 54 & 855.747 ft & \(1,497.58 \mathrm{ft}\) \\
\hline Point 55 & 900 ft & \(1,495.03 \mathrm{ft}\) \\
\hline Point 56 & 900 ft & \(1,493.03 \mathrm{ft}\) \\
\hline Point 57 & \(1,000 \mathrm{ft}\) & \(1,474.08 \mathrm{ft}\) \\
\hline Point 58 & \(1,000 \mathrm{ft}\) & \(1,472.08 \mathrm{ft}\) \\
\hline Point 59 & 232.6896 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 60 & 240.5594 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 61 & \(1,100 \mathrm{ft}\) & \(1,450.77 \mathrm{ft}\) \\
\hline Point 62 & \(1,100 \mathrm{ft}\) & \(1,448.769 \mathrm{ft}\) \\
\hline Point 63 & \(1,130.125 \mathrm{ft}\) & \(1,443.4666 \mathrm{ft}\) \\
\hline Point 64 & \(1,108.3622 \mathrm{ft}\) & \(1,446.7416 \mathrm{ft}\) \\
\hline Point 65 & 500 ft & \(1,496.8 \mathrm{ft}\) \\
\hline Point 66 & 500 ft & \(1,495.8 \mathrm{ft}\) \\
\hline Point 67 & 500 ft & \(1,494.8 \mathrm{ft}\) \\
\hline Point 68 & 600 ft & \(1,496.11 \mathrm{ft}\) \\
\hline Point 69 & 600 ft & \(1,495.11 \mathrm{ft}\) \\
\hline Point 70 & 600 ft & \(1,494.11 \mathrm{ft}\) \\
\hline Point 71 & 700 ft & \(1,496.14 \mathrm{ft}\) \\
\hline Point 72 & 700 ft & \(1,495.14 \mathrm{ft}\) \\
\hline Point 73 & 700 ft & \(1,494.14 \mathrm{ft}\) \\
\hline Point 74 & 800 ft & \(1,497.94 \mathrm{ft}\) \\
\hline Point 75 & 800 ft & \(1,496.74 \mathrm{ft}\) \\
\hline Point 76 & 800 ft & \(1,495.74 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|c|c|}
\hline & Material & \multicolumn{1}{c|}{ Points } & Area \\
\hline \begin{tabular}{l} 
Region \\
1
\end{tabular} & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} & \(5,7,8,45,9,11,13,15,17,19,22,23,46,24,25,27,28,29,30,64,62,58,56,54,76,73,70,67,50,48,60\) & \begin{tabular}{l}
40,163 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} & \(4,59,47,49,65,68,71,74,52,55,57,61,63,32,31,26,21,20,18,16,14,12,10,6\) & \begin{tabular}{l}
904.88 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
3
\end{tabular} & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} & \(59,60,48,50,67,70,73,76,54,56,58,62,64,63,61,57,55,52,74,71,68,65,49,47\) & \(1,780.9\) \\
\hline \begin{tabular}{l} 
Region \\
4
\end{tabular} & Lean Clay & \(41,45,8,7,5,60,59,4,3,2,1\) & \(\mathrm{ft}^{2}\)
\end{tabular}

Not Factor of Safety Dependent
\(\left.\begin{array}{|l|l|l|l|}5 & \text { Shale } & & \mathrm{ft}^{2} \\
\hline \begin{array}{l}\text { Region } \\
6\end{array} & \begin{array}{l}\text { Shale } \\
\text { Bedrock }\end{array} & 36,35,40,44 & 9,187.5 \\
\hline \begin{array}{l}\text { Region } \\
7\end{array} & \text { Lean Clay } & 34,33,32,63,64,30,29,28,27,25,24,46,37 & \mathrm{ft}^{2} \\
\hline \begin{array}{l}\text { Region } \\
8\end{array} & \begin{array}{l}\text { Shale } \\
\text { Bedrock }\end{array} & 39,38,42,43 & 1,380.9 \\
\mathrm{ft}^{2}\end{array}\right]\)\begin{tabular}{l}
6,125 \\
\hline \begin{tabular}{l} 
Region \\
9
\end{tabular} \\
\begin{tabular}{l} 
Very \\
\begin{tabular}{l} 
Weathered \\
Shale
\end{tabular}
\end{tabular} 40,39,43,44 \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 605 of 864 converged

\section*{Current Slip Surface}

Slip Surface: 626
Factor of Safety: 3.941
Volume: 1,408.0717 \(\mathrm{ft}^{3}\)
Weight: 111,425.04 lbf
Resisting Moment: 16,225,691 lbffft
Activating Moment: 4,117,368.9 lbf•ft
Resisting Force: 80,975.129 Ibf
Activating Force: 20,544.973 lbf
Slip Rank: 1 of 864 slip surfaces
Exit: (239.6946, 1,464.9478) ft
Entry: \((376.03146,1,493.241) \mathrm{ft}\)
Radius: 192.4985 ft
Center: (271.39614, 1,654.818) ft

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & \begin{tabular}{l}
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{l}
Suction \\
Strength
\end{tabular} & Base Material \\
\hline \begin{tabular}{l}
Slice \\
1
\end{tabular} & \[
\begin{aligned}
& 240.90181 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.7541 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,479.6937 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 77.036066 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
13.583537 \\
psf
\end{tabular} & 200 psf & 0 psf & Vegetation Cover \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& 244.64387 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.2046 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,446.345 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 300.93182 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 103.61913 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 249.37961 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.5955 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,409.5217 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 460.01255 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & \[
\begin{aligned}
& 253.78138 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.1398 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,382.1966 \\
psf
\end{tabular} & \[
\begin{aligned}
& 555.92353 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 258.18315 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.7861 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
3,361.2372
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 644.64161 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 262.58493 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,462.5338 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,346.6085 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 726.28103 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline & & & - & & & - & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& 266.9867 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.3826 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,338.2854 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 801.9179 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 520.77157 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 271.38847 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.332 \\
& \mathrm{ft}
\end{aligned}
\] & 3,336.2532
\[
\mathrm{psf}
\] & \[
\begin{aligned}
& 871.41871 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 565.90592 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & \[
\begin{aligned}
& 275.79025 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.3822 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,340.5068 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 933.39176 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 606.1517 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 280.19202 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,462.5331 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,351.0512 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 987.9912 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 641.60899 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& 284.59379 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.7851 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,367.9013 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,035.3541 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 672.36683 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline Slice
\[
12
\] & \[
\begin{aligned}
& 288.99557 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.1384 \\
& \mathrm{ft}
\end{aligned}
\] & 3,391.0818
psf & \[
\begin{aligned}
& 1,075.6019 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 698.50403 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& 293.39734 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.5937 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,420.6279 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,108.8411 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 720.0898 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 297.79911 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.1517 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,456.5853 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,135.1644 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 737.1844 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
15
\end{tabular} & \[
\begin{aligned}
& 302.31134 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.8326 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,500.2428 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,143.1293 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 742.35683 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & ```
306.93403
ft
``` & \[
\begin{aligned}
& 1,465.6429 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,552.0088 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,132.7307 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 735.60394 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 311.55671 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,466.5702 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,611.0783 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,115.3071 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 724.28892 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
18
\end{tabular} & \[
\begin{aligned}
& 316.17939 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,467.6162 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,677.56 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,090.9082 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 708.44404 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& 320.80208 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,468.783 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
3,751.5791
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,059.5715 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 688.0938 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 325.42476 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,470.0728 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,833.2783 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,021.3234 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 663.25517 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& 330.04745 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,471.4882 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,922.82 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 976.17863 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 633.93781 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& 334.67013 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,473.0321 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,020.3874 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 924.14103 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 600.1442 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& 339.29281 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,474.7079 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,126.1871 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 865.20362 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 561.8698 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& 343.9155 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,476.5194 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,240.4515 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 799.34858 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 519.10304 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
25
\end{tabular} & \[
\begin{aligned}
& 348.53818 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,478.4705 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,363.4415
\] & \[
\begin{aligned}
& 724.70343 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline
\end{tabular}

Not Factor of Safety Dependent
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & & & psf & & & & & \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 353.16086 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,480.5662 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
4,495.4506 \\
psf
\end{tabular} & \begin{tabular}{l}
\[
640.9629
\] \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& 357.78355 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,482.8116 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,636.8088
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 549.05341 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& 362.40623 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,485.2127 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,787.8878
\]
\[
\mathrm{psf}
\] & \[
\begin{aligned}
& 448.77207 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 367.02892 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,487.7762 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,949.1072
\]
psf & \[
\begin{aligned}
& 339.89094 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& 371.61674 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,490.4878 \\
& \mathrm{ft}
\end{aligned}
\] & 5,119.5639
psf & \[
\begin{aligned}
& 150.98676 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 51.98891 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& 374.96235 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,492.5586 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
5,249.6943
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 29.633987 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 5.2252714 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Not FS Dependent Psuedo Static}

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\section*{File Information}

File Version: 9.01
Title: Section 3
Created By: Administrative User
Revision Number: 45
Date: 01/08/2021
Time: 03:07:26 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 3 (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW
Last Solved Date: 01/08/2021
Last Solved Time: 03:07:32 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not FS Dependent Psuedo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100

Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

Municipal Soil Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)

\section*{Pore Water Pressure}

Piezometric Line: 1

Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((172,1,462.167) \mathrm{ft}\)
Left-Zone Right Coordinate: \((262,1,470.6151) \mathrm{ft}\)
Left-Zone Increment: 8
Right Type: Range
Right-Zone Left Coordinate: \((262,1,470.6151) \mathrm{ft}\)
Right-Zone Right Coordinate: (476.2336, 1,497.6883) ft
Right-Zone Increment: 15
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((0,1,462.167) \mathrm{ft}\)
Right Coordinate: \((1,225,1,441.83) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{X} & \multicolumn{1}{c|}{Y} \\
\hline Coordinate 1 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,225 \mathrm{ft}\) & \(1,405 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic

Outside Point: (400, 1,495.33) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.0011 ft
Direction: \(180.27^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((600,1,495.11) \mathrm{ft}\)
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.00238 ft
Direction: 359.6 \({ }^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: \((700,1,495.14) \mathrm{ft}\) Inside Point: \((600,1,495.11) \mathrm{ft}\)
Length: 100 ft
Direction: \(0.017189^{\circ}\)

F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((800,1,496.74) \mathrm{ft}\)
Inside Point: \((700,1,495.14) \mathrm{ft}\)
Length: 100.0128 ft
Direction: \(0.91665^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 Ibf
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((855.747,1,498.58) \mathrm{ft}\)
Inside Point: \((800,1,496.74) \mathrm{ft}\)
Length: 55.777357 ft
Direction: \(1.8904^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No Interface Adhesion: 0 psf

Interface Shear Angle: \(8^{\circ}\)

\section*{Surface Area Factor: 2}

Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 2 & 100 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 3 & 200 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 4 & 228.75 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 6 & 300 ft & \(1,480.27 \mathrm{ft}\) \\
\hline Point 7 & 357.25 ft & \(1,443 \mathrm{ft}\) \\
\hline Point 8 & 371.75 ft & \(1,443 \mathrm{ft}\) \\
\hline Point 9 & 394.999 ft & \(1,435.25 \mathrm{ft}\) \\
\hline Point 10 & 400 ft & \(1,497.33 \mathrm{ft}\) \\
\hline Point 11 & 400 ft & \(1,435.21 \mathrm{ft}\) \\
\hline Point 12 & 500 ft & \(1,497.8 \mathrm{ft}\) \\
\hline Point 13 & 500 ft & \(1,434.31 \mathrm{ft}\) \\
\hline Point 14 & 600 ft & \(1,497.11 \mathrm{ft}\) \\
\hline Point 15 & 600 ft & \(1,434.48 \mathrm{ft}\) \\
\hline Point 16 & 700 ft & \(1,497.14 \mathrm{ft}\) \\
\hline Point 17 & 700 ft & \(1,434.61 \mathrm{ft}\) \\
\hline Point 18 & 800 ft & \(1,498.94 \mathrm{ft}\) \\
\hline Point 19 & 800 ft & \(1,434.11 \mathrm{ft}\) \\
\hline Point 20 & 855.747 ft & \(1,500.58 \mathrm{ft}\) \\
\hline Point 21 & 900 ft & \(1,496.03 \mathrm{ft}\) \\
\hline Point 22 & 900 ft & \(1,434.98 \mathrm{ft}\) \\
\hline Point 23 & 949 ft & \(1,434.98 \mathrm{ft}\) \\
\hline Point 24 & 980.19 ft & \(1,445.64 \mathrm{ft}\) \\
\hline Point 25 & \(1,000 \mathrm{ft}\) & \(1,445.64 \mathrm{ft}\) \\
\hline Point 26 & \(1,000 \mathrm{ft}\) & \(1,475.08 \mathrm{ft}\) \\
\hline Point 27 & \(1,023.64 \mathrm{ft}\) & \(1,445 \mathrm{ft}\) \\
\hline Point 28 & \(1,030.5 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 29 & \(1,051.63 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 30 & \(1,100 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 31 & \(1,100 \mathrm{ft}\) & \(1,451.77 \mathrm{ft}\) \\
\hline Point 32 & \(1,141 \mathrm{ft}\) & \(1,441.83 \mathrm{ft}\) \\
\hline Point 33 & \(1,200 \mathrm{ft}\) & \(1,441.83 \mathrm{ft}\) \\
\hline Point 34 & \(1,225 \mathrm{ft}\) & \(1,441.83 \mathrm{ft}\) \\
\hline & & \\
\hline & 1,4 \\
\hline
\end{tabular}

\section*{Not FS Dependent Psuedo Static}
\begin{tabular}{|c|c|c|}
\hline Point 35 & 1,225 ft & 1,405 ft \\
\hline Point 36 & 0 ft & 1,405 ft \\
\hline Point 37 & 1,225 ft & 1,440 ft \\
\hline Point 38 & 1,225 ft & 1,430 ft \\
\hline Point 39 & 1,225 ft & 1,425 ft \\
\hline Point 40 & 1,225 ft & 1,415 ft \\
\hline Point 41 & 0 ft & 1,435 ft \\
\hline Point 42 & 0 ft & 1,425 ft \\
\hline Point 43 & 0 ft & 1,420 ft \\
\hline Point 44 & 0 ft & 1,410 ft \\
\hline Point 45 & 390.9635 ft & 1,436.5952 ft \\
\hline Point 46 & 960.5301 ft & 1,438.9207 ft \\
\hline Point 47 & 300 ft & 1,479.27 ft \\
\hline Point 48 & 300 ft & 1,477.27 ft \\
\hline Point 49 & 400 ft & 1,496.33 ft \\
\hline Point 50 & 400 ft & 1,494.33 ft \\
\hline Point 51 & 400 ft & \(1,495.33 \mathrm{ft}\) \\
\hline Point 52 & 855.747 ft & 1,499.58 ft \\
\hline Point 53 & 855.747 ft & 1,498.58 ft \\
\hline Point 54 & 855.747 ft & 1,497.58 ft \\
\hline Point 55 & 900 ft & 1,495.03 ft \\
\hline Point 56 & 900 ft & 1,493.03 ft \\
\hline Point 57 & 1,000 ft & 1,474.08 ft \\
\hline Point 58 & 1,000 ft & 1,472.08 ft \\
\hline Point 59 & 232.6896 ft & 1,462.167 ft \\
\hline Point 60 & 240.5594 ft & 1,462.167 ft \\
\hline Point 61 & 1,100 ft & 1,450.77 ft \\
\hline Point 62 & 1,100 ft & 1,448.769 ft \\
\hline Point 63 & 1,130.125 ft & 1,443.4666 ft \\
\hline Point 64 & 1,108.3622 ft & 1,446.7416 ft \\
\hline Point 65 & 500 ft & 1,496.8 ft \\
\hline Point 66 & 500 ft & 1,495.8 ft \\
\hline Point 67 & 500 ft & 1,494.8 ft \\
\hline Point 68 & 600 ft & 1,496.11 ft \\
\hline Point 69 & 600 ft & 1,495.11 ft \\
\hline Point 70 & 600 ft & 1,494.11 ft \\
\hline Point 71 & 700 ft & 1,496.14 ft \\
\hline Point 72 & 700 ft & 1,495.14 ft \\
\hline Point 73 & 700 ft & 1,494.14 ft \\
\hline Point 74 & 800 ft & 1,497.94 ft \\
\hline Point 75 & 800 ft & 1,496.74 ft \\
\hline Point 76 & 800 ft & 1,495.74 ft \\
\hline
\end{tabular}

\section*{Regions}
\(\left.\begin{array}{|l|l|c|c|}\hline & \text { Material } & \text { Points } & \text { Area } \\
\hline \begin{array}{l}\text { Region } \\
1\end{array} & \begin{array}{l}\text { Municipal } \\
\text { Soil Waste }\end{array} & 5,7,8,45,9,11,13,15,17,19,22,23,46,24,25,27,28,29,30,64,62,58,56,54,76,73,70,67,50,48,60 & 40,163 \\
\mathrm{ft}^{2}\end{array}\right]\)\begin{tabular}{l}
904.88 \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} \\
\begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline
\end{tabular}

\section*{Not FS Dependent Psuedo Static}
\begin{tabular}{|l|l|l|l|l|}
\begin{tabular}{l} 
Region \\
3
\end{tabular} & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} & \(59,60,48,50,67,70,73,76,54,56,58,62,64,63,61,57,55,52,74,71,68,65,49,47\) & \begin{tabular}{l}
\(1,780.9\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
4
\end{tabular} & Lean Clay & \(41,45,8,7,5,60,59,4,3,2,1\) & \begin{tabular}{l}
\(9,053.1\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
5
\end{tabular} & \begin{tabular}{l} 
Very \\
Weathered \\
Shale
\end{tabular} & \(42,38,37,46,23,22,19,17,15,13,11,9,45,41\) & 10,466 \\
\hline \begin{tabular}{l} 
Region \\
6
\end{tabular} & \begin{tabular}{l} 
Shale \\
Bedrock
\end{tabular} & \(36,35,40,44\) & \(\mathrm{ft}^{2}\)
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 604 of 864 converged

\section*{Current Slip Surface}

Slip Surface: 626
Factor of Safety: 2.303
Volume: 1,389.6311 \(\mathrm{ft}^{3}\)
Weight: 110,104.85 Ibf
Resisting Moment: 16,635,719 lbf•ft
Activating Moment: 7,224,262.8 lbffft
Resisting Force: 83,658.329 Ibf
Activating Force: 36,322.082 lbf
Slip Rank: 1 of 864 slip surfaces
Exit: (239.9369, 1,465.0093) ft
Entry: (375.37646, 1,493.1292) ft
Radius: 191.25183 ft
Center: (271.40954, 1,653.6538) ft

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & Cohesive Strength & Suction Strength & Base Material \\
\hline \begin{tabular}{l}
Slice \\
1
\end{tabular} & \[
\begin{aligned}
& 241.14462 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.8158 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
3,483.6071
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 108.23993 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 19.08562 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline \begin{tabular}{l}
Slice \\
2
\end{tabular} & \[
\begin{aligned}
& 244.88921 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.267 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
3,450.2993
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 406.51098 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 139.97296 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 249.61667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,463.6605 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
3,413.6392
\]
psf & \[
\begin{aligned}
& 542.10109 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & \[
\begin{aligned}
& 253.99783 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,463.2089 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,386.5656 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 639.31804 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline & & & & & & & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 5
\end{aligned}
\] & \[
\begin{aligned}
& 258.37899 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.859 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,365.8386 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 728.40782 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 6
\end{aligned}
\] & \[
\begin{aligned}
& 262.76015 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.6102 \\
& \mathrm{ft}
\end{aligned}
\] & 3,351.4233
psf & \[
\begin{aligned}
& 813.75454 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 528.45838 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& 267.1413 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.4622 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,343.295 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 893.96887 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 580.55017 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 271.52246 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.4146 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,341.4391 \\
psf
\end{tabular} & \[
\begin{aligned}
& 964.68466 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 626.47354 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & ```
275.90362
ft
``` & \[
\begin{aligned}
& 1,462.4673 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
3,345.8509
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,026.2897 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 666.48033 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 280.28478 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.6206 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,356.5357 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,079.134 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 700.79779 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 11
\end{aligned}
\] & \[
\begin{aligned}
& 284.66594 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,462.8746 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,373.5085 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,123.5332 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 729.63101 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12
\end{aligned}
\] & \[
\begin{aligned}
& 289.0471 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,463.2297 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,396.7945 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,159.7729 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 753.16533 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& 293.42826 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,463.6865 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
3,426.4292
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,188.111 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 771.56832 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 14
\end{aligned}
\] & \[
\begin{aligned}
& 297.80942 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.2457 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
3,462.4585
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,208.7812 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 784.99167 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& 302.28945 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.9257 \\
& \mathrm{ft}
\end{aligned}
\] & 3,506.0481
psf & \[
\begin{aligned}
& \text { 1,209.6526 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 785.5576 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 306.86836 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,465.7323 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,557.571 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,191.1023 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 773.51089 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline Slice
\[
17
\] & \[
\begin{aligned}
& 311.44727 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.6544 \\
& \mathrm{ft}
\end{aligned}
\] & 3,616.3098
psf & \[
\begin{aligned}
& \text { 1,165.5023 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 756.88606 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& 316.02618 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,467.6939 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,682.3719 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,133.0173 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 735.79007 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& 320.60508 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,468.8527 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,755.881 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,093.7969 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 710.31999 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 325.18399 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.133 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,836.9782 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,047.9768 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 680.56409 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& 329.7629 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,471.5374 \\
& \mathrm{ft}
\end{aligned}
\] & 3,925.8237
psf & \[
\begin{aligned}
& 995.68074 \\
& \text { psf }
\end{aligned}
\] & 646.60263 psf & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& 334.3418 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,473.0689 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,022.5983
\]
psf & \[
\begin{aligned}
& 937.02141 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
608.50882 \\
psf
\end{tabular} & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline Slice & 338.92071 & 1,474.7306 & \[
4,127.5059
\] & 872.10178 & 566.34952 & \[
0.043846762
\] & 0 psf & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 23 & ft & ft & psf & psf & psf & psf & & Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& 343.49962 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.5262 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,240.7756
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 801.01642 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 520.18614 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& 348.07853 \\
& \mathrm{ft}
\end{aligned}
\] & 1,478.46 ft & 4,362.6647
psf & \[
\begin{aligned}
& 722.13314 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 352.65743 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,480.5364 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
4,493.4622 \\
psf
\end{tabular} & \[
\begin{aligned}
& 634.92233 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& 357.23634 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,482.7607 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,633.4932 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 540.18978 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & ```
361.81525
ft
``` & \[
\begin{aligned}
& 1,485.1388 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,783.1238 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 437.82833 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 366.39415 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,487.6772 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
4,942.7671 \\
psf
\end{tabular} & \[
\begin{aligned}
& 327.71712 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& 370.96096 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,490.3759 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,112.4123 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 137.50459 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
47.346628 \\
psf
\end{tabular} & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& 374.30739 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,492.4468 \\
& \mathrm{ft}
\end{aligned}
\] & \[
5,242.5517
\]
psf & \[
\begin{aligned}
& 24.802018 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
4.373265
\] \\
psf
\end{tabular} & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section 3
Created By: Administrative User
Revision Number: 31
Date: 01/08/2021
Time: 02:55:24 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 3 (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW
Last Solved Date: 01/08/2021
Last Solved Time: 02:55:26 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100

Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

Municipal Soil Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)

Pore Water Pressure
Piezometric Line: 1

Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (750, 1,498.04) ft
Left-Zone Right Coordinate: (1,000, 1,475.08) ft
Left-Zone Increment: 15
Right Type: Range
Right-Zone Left Coordinate: \((1,000,1,475.08) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,225,1,441.83) \mathrm{ft}\)
Right-Zone Increment: 8
Radius Increments: 4

\section*{Slip Surface Limits}

Left Coordinate: \((0,1,462.167) \mathrm{ft}\)
Right Coordinate: \((1,225,1,441.83) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{X} & \multicolumn{1}{c|}{Y} \\
\hline Coordinate 1 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,225 \mathrm{ft}\) & \(1,405 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (400, 1,495.33) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.0011 ft
Direction: \(180.27^{\circ}\)
F of S Dependent: Yes

Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: (600, 1,495.11) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.00238 ft
Direction: \(359.6^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: (700, 1,495.14) ft
Inside Point: (600, 1,495.11) ft
Length: 100 ft
Direction: \(0.017189^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)

Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((800,1,496.74) \mathrm{ft}\)
Inside Point: \((700,1,495.14) \mathrm{ft}\)
Length: 100.0128 ft
Direction: \(0.91665^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: (855.747, 1,498.58) ft
Inside Point: \((800,1,496.74) \mathrm{ft}\)
Length: 55.777357 ft
Direction: \(1.8904^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1

Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|c|c|c|}
\hline & X & Y \\
\hline Point 1 & 0 ft & 1,462.167 ft \\
\hline Point 2 & 100 ft & 1,462.167 ft \\
\hline Point 3 & 200 ft & 1,462.167 ft \\
\hline Point 4 & 228.75 ft & 1,462.167 ft \\
\hline Point 5 & 300 ft & 1,462.167 ft \\
\hline Point 6 & 300 ft & 1,480.27 ft \\
\hline Point 7 & 357.25 ft & 1,443 ft \\
\hline Point 8 & 371.75 ft & 1,443 ft \\
\hline Point 9 & 394.999 ft & 1,435.25 ft \\
\hline Point 10 & 400 ft & 1,497.33 ft \\
\hline Point 11 & 400 ft & 1,435.21 ft \\
\hline Point 12 & 500 ft & 1,497.8 ft \\
\hline Point 13 & 500 ft & 1,434.31 ft \\
\hline Point 14 & 600 ft & 1,497.11 ft \\
\hline Point 15 & 600 ft & 1,434.48 ft \\
\hline Point 16 & 700 ft & 1,497.14 ft \\
\hline Point 17 & 700 ft & 1,434.61 ft \\
\hline Point 18 & 800 ft & 1,498.94 ft \\
\hline Point 19 & 800 ft & 1,434.11 ft \\
\hline Point 20 & 855.747 ft & 1,500.58 ft \\
\hline Point 21 & 900 ft & 1,496.03 ft \\
\hline Point 22 & 900 ft & 1,434.98 ft \\
\hline Point 23 & 949 ft & 1,434.98 ft \\
\hline Point 24 & 980.19 ft & 1,445.64 ft \\
\hline Point 25 & 1,000 ft & 1,445.64 ft \\
\hline Point 26 & 1,000 ft & 1,475.08 ft \\
\hline Point 27 & 1,023.64 ft & 1,445 ft \\
\hline Point 28 & \(1,030.5 \mathrm{ft}\) & 1,448 ft \\
\hline Point 29 & 1,051.63 ft & \(1,448 \mathrm{ft}\) \\
\hline Point 30 & 1,100 ft & 1,448 ft \\
\hline Point 31 & 1,100 ft & 1,451.77 ft \\
\hline Point 32 & 1,141 ft & \(1,441.83 \mathrm{ft}\) \\
\hline Point 33 & 1,200 ft & \(1,441.83 \mathrm{ft}\) \\
\hline Point 34 & 1,225 ft & 1,441.83 ft \\
\hline Point 35 & 1,225 ft & 1,405 ft \\
\hline Point 36 & 0 ft & 1,405 ft \\
\hline Point 37 & 1,225 ft & 1,440 ft \\
\hline Point 38 & 1,225 ft & 1,430 ft \\
\hline Point 39 & 1,225 ft & 1,425 ft \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|} 
Point 40 & \(1,225 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Point 41 & 0 ft & \(1,435 \mathrm{ft}\) \\
\hline Point 42 & 0 ft & \(1,425 \mathrm{ft}\) \\
\hline Point 43 & 0 ft & \(1,420 \mathrm{ft}\) \\
\hline Point 44 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Point 45 & 390.9635 ft & \(1,436.5952 \mathrm{ft}\) \\
\hline Point 46 & 960.5301 ft & \(1,438.9207 \mathrm{ft}\) \\
\hline Point 47 & 300 ft & \(1,479.27 \mathrm{ft}\) \\
\hline Point 48 & 300 ft & \(1,477.27 \mathrm{ft}\) \\
\hline Point 49 & 400 ft & \(1,496.33 \mathrm{ft}\) \\
\hline Point 50 & 400 ft & \(1,494.33 \mathrm{ft}\) \\
\hline Point 51 & 400 ft & \(1,495.33 \mathrm{ft}\) \\
\hline Point 52 & 855.747 ft & \(1,499.58 \mathrm{ft}\) \\
\hline Point 53 & 855.747 ft & \(1,498.58 \mathrm{ft}\) \\
\hline Point 54 & 855.747 ft & \(1,497.58 \mathrm{ft}\) \\
\hline Point 55 & 900 ft & \(1,495.03 \mathrm{ft}\) \\
\hline Point 56 & 900 ft & \(1,493.03 \mathrm{ft}\) \\
\hline Point 57 & \(1,000 \mathrm{ft}\) & \(1,474.08 \mathrm{ft}\) \\
\hline Point 58 & \(1,000 \mathrm{ft}\) & \(1,472.08 \mathrm{ft}\) \\
\hline Point 59 & 232.6896 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 60 & 240.5594 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 61 & \(1,100 \mathrm{ft}\) & \(1,450.77 \mathrm{ft}\) \\
\hline Point 62 & \(1,100 \mathrm{ft}\) & \(1,448.769 \mathrm{ft}\) \\
\hline Point 63 & \(1,130.125 \mathrm{ft}\) & \(1,443.4666 \mathrm{ft}\) \\
\hline Point 64 & \(1,108.3622 \mathrm{ft}\) & \(1,446.7416 \mathrm{ft}\) \\
\hline Point 65 & 500 ft & \(1,496.8 \mathrm{ft}\) \\
\hline Point 66 & 500 ft & \(1,495.8 \mathrm{ft}\) \\
\hline Point 67 & 500 ft & \(1,494.8 \mathrm{ft}\) \\
\hline Point 68 & 600 ft & \(1,496.11 \mathrm{ft}\) \\
\hline Point 69 & 600 ft & \(1,495.11 \mathrm{ft}\) \\
\hline Point 70 & 600 ft & \(1,494.11 \mathrm{ft}\) \\
\hline Point 71 & 700 ft & \(1,496.14 \mathrm{ft}\) \\
\hline Point 72 & 700 ft & \(1,495.14 \mathrm{ft}\) \\
\hline Point 73 & 700 ft & \(1,494.14 \mathrm{ft}\) \\
\hline Point 74 & 800 ft & \(1,497.94 \mathrm{ft}\) \\
\hline Point 75 & 800 ft & \(1,496.74 \mathrm{ft}\) \\
\hline Point 76 & 800 ft & \(1,495.74 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|l|}
\hline & Material & \multicolumn{1}{c|}{ Points } & Area \\
\hline \begin{tabular}{l} 
Region \\
1
\end{tabular} & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} & \(5,7,8,45,9,11,13,15,17,19,22,23,46,24,25,27,28,29,30,64,62,58,56,54,76,73,70,67,50,48,60\) & \begin{tabular}{l}
40,163 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} & \(4,59,47,49,65,68,71,74,52,55,57,61,63,32,31,26,21,20,18,16,14,12,10,6\) & \begin{tabular}{l}
904.88 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
3
\end{tabular} & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} & \(59,60,48,50,67,70,73,76,54,56,58,62,64,63,61,57,55,52,74,71,68,65,49,47\) & \(1,780.9\) \\
\hline \begin{tabular}{l} 
Region \\
4
\end{tabular} & Lean Clay & \(41,45,8,7,5,60,59,4,3,2,1\) & \(\mathrm{ft}^{2}\)
\end{tabular}

\section*{Factor of Safety Dependent}
\begin{tabular}{|l|l|l|l|}
5 & Shale & & \(\mathrm{ft}^{2}\) \\
\hline \begin{tabular}{l} 
Region \\
6
\end{tabular} & \begin{tabular}{l} 
Shale \\
Bedrock
\end{tabular} & \(36,35,40,44\) & \begin{tabular}{l}
\(9,187.5\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
7
\end{tabular} & Lean Clay & \(34,33,32,63,64,30,29,28,27,25,24,46,37\) & \begin{tabular}{l}
\(1,380.9\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
8
\end{tabular} & \begin{tabular}{l} 
Shale \\
Bedrock
\end{tabular} & \(39,38,42,43\) & \begin{tabular}{l}
6,125 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
9
\end{tabular} & \begin{tabular}{l} 
Very \\
Weathered \\
Shale
\end{tabular} & \(40,39,43,44\) & \begin{tabular}{l}
12,250 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 362 of 720 converged

\section*{Current Slip Surface}

Slip Surface: 422
Factor of Safety: 3.494
Volume: 2,689.8586 ft \({ }^{3}\)
Weight: 200,434.55 lbf
Resisting Moment: 31,272,594 lbf.ft
Activating Moment: 8,950,290.6 lbffft
Resisting Force: 134,724.24 Ibf
Activating Force: \(38,558.923 \mathrm{lbf}\)
Slip Rank: 1 of 720 slip surfaces
Exit: (1,083.5849, 1,455.5964) ft
Entry: (901.17094, 1,495.7847) ft
Radius: 221.61151 ft
Center: (1,035.6176, 1,671.9544) ft

\section*{Slip Slices}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{Y} & \multicolumn{1}{c|}{ PWP } & \begin{tabular}{l} 
Base Normal \\
Stress
\end{tabular} & \begin{tabular}{l} 
Frictional \\
Strength
\end{tabular} & \begin{tabular}{l} 
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{l} 
Suction \\
Strength
\end{tabular} & Base Material \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
902.08754 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,495.0927\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,542.2182\) \\
psf
\end{tabular} & \begin{tabular}{l}
21.267182 \\
psf
\end{tabular} & \begin{tabular}{l}
3.749978 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
2
\end{tabular} & \begin{tabular}{l}
904.92422 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,492.9984\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,412.1944\) \\
psf
\end{tabular} & \begin{tabular}{l}
123.06716 \\
psf
\end{tabular} & \begin{tabular}{l}
42.375423 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
3
\end{tabular} & \begin{tabular}{l}
909.9495 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,489.4579\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,192.4403\) \\
psf
\end{tabular} & \begin{tabular}{l}
342.96709 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
4
\end{tabular} & \begin{tabular}{l}
916.15987 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,485.332\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,936.4425\) \\
psf
\end{tabular} & \begin{tabular}{l}
511.08091 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
5
\end{tabular} & \begin{tabular}{l}
922.37025 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,481.498\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,698.6663\) \\
psf
\end{tabular} & \begin{tabular}{l}
664.61262 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
6
\end{tabular} & \begin{tabular}{l}
928.58063 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,477.9385\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,478.0295\) \\
psf
\end{tabular} & \begin{tabular}{l}
802.12852 \\
psf
\end{tabular} & \begin{tabular}{l}
520.90835 \\
psf
\end{tabular} & \begin{tabular}{l}
- \\
0.043846762 \\
psf
\end{tabular} & 0 psf & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& 934.79101 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,474.6386 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,273.6029 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 921.62728 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 598.51176 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 941.00139 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,471.5856 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,084.5844 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,030.003 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 668.89177 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & \[
\begin{aligned}
& 947.21177 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,468.7682 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,910.2784 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,127.3424 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 732.10473 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 953.42215 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.1769 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,750.0798 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,213.7098 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 788.19235 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& 959.63253 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.803 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,603.461 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,289.1473 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 837.18207 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline Slice
\[
12
\] & \[
\begin{aligned}
& 965.84291 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,461.6393 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,469.9617 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,353.6747 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 879.08665 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & \[
\begin{aligned}
& 972.05329 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.6792 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,349.1802 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,407.2885 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 913.90382 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 978.26367 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,457.9173 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,240.7668 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,449.9614 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 941.61593 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& 984.47405 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.3487 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,144.4181 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,481.6418 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 962.18942 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 990.68443 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.9691 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,059.872 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,502.2527 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 975.57429 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 996.89481 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.775 \\
& \mathrm{ft}
\end{aligned}
\] & 2,986.9045
psf & \[
\begin{aligned}
& \text { 1,511.6906 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 981.70338 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
18
\end{tabular} & \[
\begin{aligned}
& 1,002.9515 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,452.7839 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,926.5785
\]
psf & \[
\begin{aligned}
& \text { 1,505.8464 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 977.90807 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
19
\end{tabular} & \[
\begin{aligned}
& 1,008.8545 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.9849 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,878.2008
\]
psf & \[
\begin{aligned}
& \text { 1,484.9964 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 964.36795 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,014.7575 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.3467 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,839.8628 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,453.4547 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 943.88454 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
21
\end{tabular} & \[
\begin{aligned}
& 1,020.6604 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,450.868 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,811.4777 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,411.0269 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 916.33161 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline Slice
\[
22
\] & \[
\begin{aligned}
& 1,026.5634 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,450.5476 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,792.9809 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,357.4881 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 881.56307 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,032.4664 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,450.3849 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,784.3293 } \\
& \text { psf }
\end{aligned}
\] & 1,292.58 psf & \[
\begin{aligned}
& 839.41127 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& 1,038.3694 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,450.3796 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,785.5013 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,216.0082 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 789.68493 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline Slice & 1,044.2724 & 1,450.5316 & \[
2,796.4962
\] & 1,127.4379 & 732.16674 & \[
0.043846762
\] & 0 psf & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 25 & ft & ft & psf & psf & psf & psf & & Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 1,050.1754 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,450.8413 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,817.3342 } \\
& \text { psf }
\end{aligned}
\] & 1,026.49 psf & \[
\begin{aligned}
& 666.61041 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
27
\end{tabular} & \[
\begin{aligned}
& 1,056.0784 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.3093 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
2,848.0569 \\
psf
\end{tabular} & \[
\begin{aligned}
& 912.73539 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 592.73729 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& 1,061.9813 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.9367 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,888.7273
\]
psf & \[
\begin{aligned}
& 785.68914 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 510.23249 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 1,067.8843 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,452.7248 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,939.431 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 652.74088 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline Slice 30 & \[
\begin{aligned}
& 1,073.7873 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,453.6753 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,000.2766 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 508.82531 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
31
\end{tabular} & \[
\begin{aligned}
& 1,079.0493 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.6532 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,062.6691 \\
psf
\end{tabular} & \[
\begin{aligned}
& 330.81496 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 113.90873 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \begin{tabular}{l}
Slice \\
32
\end{tabular} & \[
\begin{aligned}
& 1,082.4724 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,455.3557 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
3,107.3966
\] \\
psf
\end{tabular} & \begin{tabular}{l}
85.600899 \\
psf
\end{tabular} & \[
\begin{aligned}
& 15.093748 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{FS Dependent Seismic Psuedo Static}

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\section*{File Information}

File Version: 9.01
Title: Section 3
Created By: Administrative User
Revision Number: 31
Date: 01/08/2021
Time: 02:55:24 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 3 (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW
Last Solved Date: 01/08/2021
Last Solved Time: 02:55:28 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{FS Dependent Seismic Psuedo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100

Tolerable difference in F of S: 0.001

\section*{Solution Settings}

Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Municipal Soil Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)

\section*{Pore Water Pressure}

Piezometric Line: 1

Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (750, 1,498.04) ft
Left-Zone Right Coordinate: (1,000, 1,475.08) ft
Left-Zone Increment: 15
Right Type: Range
Right-Zone Left Coordinate: \((1,000.3432,1,475) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,225,1,441.83)\) ft
Right-Zone Increment: 8
Radius Increments: 4

\section*{Slip Surface Limits}

Left Coordinate: \((0,1,462.167) \mathrm{ft}\)
Right Coordinate: \((1,225,1,441.83) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{X} & \multicolumn{1}{c|}{Y} \\
\hline Coordinate 1 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,225 \mathrm{ft}\) & \(1,405 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic

Outside Point: (400, 1,495.33) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.0011 ft
Direction: \(180.27^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: (600, 1,495.11) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.00238 ft
Direction: 359.6º
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: (700, 1,495.14) ft Inside Point: \((600,1,495.11) \mathrm{ft}\) Length: 100 ft
Direction: \(0.017189^{\circ}\)

F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((800,1,496.74) \mathrm{ft}\)
Inside Point: \((700,1,495.14) \mathrm{ft}\)
Length: 100.0128 ft
Direction: \(0.91665^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((855.747,1,498.58) \mathrm{ft}\)
Inside Point: \((800,1,496.74) \mathrm{ft}\)
Length: 55.777357 ft
Direction: \(1.8904^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No Interface Adhesion: 0 psf

Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 2 & 100 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 3 & 200 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 4 & 228.75 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 6 & 300 ft & \(1,480.27 \mathrm{ft}\) \\
\hline Point 7 & 357.25 ft & \(1,443 \mathrm{ft}\) \\
\hline Point 8 & 371.75 ft & \(1,443 \mathrm{ft}\) \\
\hline Point 9 & 394.999 ft & \(1,435.25 \mathrm{ft}\) \\
\hline Point 10 & 400 ft & \(1,497.33 \mathrm{ft}\) \\
\hline Point 11 & 400 ft & \(1,435.21 \mathrm{ft}\) \\
\hline Point 12 & 500 ft & \(1,497.8 \mathrm{ft}\) \\
\hline Point 13 & 500 ft & \(1,434.31 \mathrm{ft}\) \\
\hline Point 14 & 600 ft & \(1,497.11 \mathrm{ft}\) \\
\hline Point 15 & 600 ft & \(1,434.48 \mathrm{ft}\) \\
\hline Point 16 & 700 ft & \(1,497.14 \mathrm{ft}\) \\
\hline Point 17 & 700 ft & \(1,434.61 \mathrm{ft}\) \\
\hline Point 18 & 800 ft & \(1,498.94 \mathrm{ft}\) \\
\hline Point 19 & 800 ft & \(1,434.11 \mathrm{ft}\) \\
\hline Point 20 & 855.747 ft & \(1,500.58 \mathrm{ft}\) \\
\hline Point 21 & 900 ft & \(1,496.03 \mathrm{ft}\) \\
\hline Point 22 & 900 ft & \(1,434.98 \mathrm{ft}\) \\
\hline Point 23 & 949 ft & \(1,434.98 \mathrm{ft}\) \\
\hline Point 24 & 980.19 ft & \(1,445.64 \mathrm{ft}\) \\
\hline Point 25 & \(1,000 \mathrm{ft}\) & \(1,445.64 \mathrm{ft}\) \\
\hline Point 26 & \(1,000 \mathrm{ft}\) & \(1,475.08 \mathrm{ft}\) \\
\hline Point 27 & \(1,023.64 \mathrm{ft}\) & \(1,445 \mathrm{ft}\) \\
\hline Point 28 & \(1,030.5 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 29 & \(1,051.63 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 30 & \(1,100 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 31 & \(1,100 \mathrm{ft}\) & \(1,451.77 \mathrm{ft}\) \\
\hline Point 32 & \(1,141 \mathrm{ft}\) & \(1,441.83 \mathrm{ft}\) \\
\hline Point 33 & \(1,200 \mathrm{ft}\) & \(1,441.83 \mathrm{ft}\) \\
\hline Point 34 & \(1,225 \mathrm{ft}\) & \(1,441.83 \mathrm{ft}\) \\
\hline & & 1, \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 35 & 1,225 ft & 1,405 ft \\
\hline Point 36 & 0 ft & 1,405 ft \\
\hline Point 37 & 1,225 ft & 1,440 ft \\
\hline Point 38 & 1,225 ft & 1,430 ft \\
\hline Point 39 & 1,225 ft & 1,425 ft \\
\hline Point 40 & 1,225 ft & 1,415 ft \\
\hline Point 41 & 0 ft & 1,435 ft \\
\hline Point 42 & 0 ft & 1,425 ft \\
\hline Point 43 & 0 ft & 1,420 ft \\
\hline Point 44 & 0 ft & 1,410 ft \\
\hline Point 45 & 390.9635 ft & 1,436.5952 ft \\
\hline Point 46 & 960.5301 ft & 1,438.9207 ft \\
\hline Point 47 & 300 ft & 1,479.27 ft \\
\hline Point 48 & 300 ft & 1,477.27 ft \\
\hline Point 49 & 400 ft & 1,496.33 ft \\
\hline Point 50 & 400 ft & 1,494.33 ft \\
\hline Point 51 & 400 ft & 1,495.33 ft \\
\hline Point 52 & 855.747 ft & 1,499.58 ft \\
\hline Point 53 & 855.747 ft & 1,498.58 ft \\
\hline Point 54 & 855.747 ft & 1,497.58 ft \\
\hline Point 55 & 900 ft & 1,495.03 ft \\
\hline Point 56 & 900 ft & 1,493.03 ft \\
\hline Point 57 & 1,000 ft & 1,474.08 ft \\
\hline Point 58 & 1,000 ft & 1,472.08 ft \\
\hline Point 59 & 232.6896 ft & 1,462.167 ft \\
\hline Point 60 & 240.5594 ft & 1,462.167 ft \\
\hline Point 61 & 1,100 ft & 1,450.77 ft \\
\hline Point 62 & 1,100 ft & 1,448.769 ft \\
\hline Point 63 & 1,130.125 ft & 1,443.4666 ft \\
\hline Point 64 & 1,108.3622 ft & 1,446.7416 ft \\
\hline Point 65 & 500 ft & 1,496.8 ft \\
\hline Point 66 & 500 ft & \(1,495.8 \mathrm{ft}\) \\
\hline Point 67 & 500 ft & 1,494.8 ft \\
\hline Point 68 & 600 ft & 1,496.11 ft \\
\hline Point 69 & 600 ft & 1,495.11 ft \\
\hline Point 70 & 600 ft & 1,494.11 ft \\
\hline Point 71 & 700 ft & 1,496.14 ft \\
\hline Point 72 & 700 ft & 1,495.14 ft \\
\hline Point 73 & 700 ft & 1,494.14 ft \\
\hline Point 74 & 800 ft & 1,497.94 ft \\
\hline Point 75 & 800 ft & 1,496.74 ft \\
\hline Point 76 & 800 ft & 1,495.74 ft \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|c|c|}
\hline & Material & Points & Area \\
\hline \begin{tabular}{l} 
Region \\
1
\end{tabular} & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} & \(5,7,8,45,9,11,13,15,17,19,22,23,46,24,25,27,28,29,30,64,62,58,56,54,76,73,70,67,50,48,60\) & \begin{tabular}{l}
40,163 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} & \(4,59,47,49,65,68,71,74,52,55,57,61,63,32,31,26,21,20,18,16,14,12,10,6\) & 904.88 \\
\hline & & & \(\mathrm{ft}^{2}\)
\end{tabular}
\begin{tabular}{|c|c|c|c|}
\hline Region
\[
3
\] & Compacted Soil Liner & 59,60,48,50,67,70,73,76,54,56,58,62,64,63,61,57,55,52,74,71,68,65,49,47 & \[
\begin{aligned}
& 1,780.9 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline Region
\[
4
\] & Lean Clay & 41,45,8,7,5,60,59,4,3,2,1 & \[
\begin{aligned}
& 9,053.1 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline Region
\[
5
\] & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} & 42,38,37,46,23,22,19,17,15,13,11,9,45,41 & \[
\begin{aligned}
& 10,466 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline Region
\[
6
\] & Shale Bedrock & 36,35,40,44 & \[
\begin{aligned}
& 9,187.5 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline Region
\[
7
\] & Lean Clay & 34,33,32,63,64,30,29,28,27,25,24,46,37 & \[
\begin{aligned}
& 1,380.9 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline Region
\[
8
\] & \begin{tabular}{l}
Shale \\
Bedrock
\end{tabular} & 39,38,42,43 & \[
\begin{aligned}
& 6,125 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline Region
\[
9
\] & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} & 40,39,43,44 & \[
\begin{aligned}
& 12,250 \\
& \mathrm{ft}^{2}
\end{aligned}
\] \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 362 of 720 converged

\section*{Current Slip Surface}

Slip Surface: 377
Factor of Safety: 2.103
Volume: 3,379.7063 \(\mathrm{ft}^{3}\)
Weight: 246,978.74 lbf
Resisting Moment: 43,146,815 Ibf•ft
Activating Moment: 20,515,957 lbf•ft
Resisting Force: 172,499.41 lbf
Activating Force: 82,029.48 Ibf
Slip Rank: 1 of 720 slip surfaces
Exit: \((1,083.7994,1,455.5464) \mathrm{ft}\)
Entry: \((884.44925,1,497.6289) \mathrm{ft}\)
Radius: 239.76252 ft
Center: \((1,028.9541,1,688.9517) \mathrm{ft}\)
Slip Slices
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{Y} & \multicolumn{1}{|c|}{ PWP } & \begin{tabular}{l} 
Base Normal \\
Stress
\end{tabular} & \multicolumn{1}{|c|}{\begin{tabular}{l} 
Frictional \\
Strength
\end{tabular}} & \begin{tabular}{l} 
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{l} 
Suction \\
Strength
\end{tabular} & Base Material \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
885.22305 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,497.0493\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,660.0764\) \\
psf
\end{tabular} & \begin{tabular}{l}
13.984109 \\
psf
\end{tabular} & \begin{tabular}{l}
2.4657757 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
2
\end{tabular} & \begin{tabular}{l}
887.59126 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,495.3058\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,551.8331\) \\
psf
\end{tabular} & \begin{tabular}{l}
100.03899 \\
psf
\end{tabular} & \begin{tabular}{l}
34.446188 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
3
\end{tabular} & \begin{tabular}{l}
891.88926 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,492.2579\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,362.6469\) \\
psf
\end{tabular} & \begin{tabular}{l}
325.49957 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
4
\end{tabular} & \begin{tabular}{l}
897.29642 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,488.5974\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,135.4951\) \\
psf
\end{tabular} & \begin{tabular}{l}
507.49428 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} \\
\hline & & & & & &
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 903.33333 \\
& \mathrm{ft}
\end{aligned}
\] & 1,484.77 ft & \[
\begin{aligned}
& \text { 4,898.0889 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 679.91178 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & 910 ft & \[
\begin{aligned}
& 1,480.8141 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,652.8228 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 835.85687 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{array}{|l|l}
542.8118 \\
\text { psf }
\end{array}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & \[
\begin{aligned}
& 916.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.142 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,425.2675 } \\
& \text { psf }
\end{aligned}
\] & 974.99286 psf & \[
\begin{aligned}
& 633.16777 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
8
\end{tabular} & \[
\begin{aligned}
& 923.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,473.7389 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,214.5149 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,104.0971 } \\
& \text { psf }
\end{aligned}
\] & 717.00904 psf & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
9
\end{tabular} & 930 ft & \[
\begin{aligned}
& 1,470.5925 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,019.7782 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,223.0288 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 794.2442 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
10
\end{tabular} & \[
\begin{aligned}
& 936.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,467.6916 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,840.3732 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,331.6363 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
864.77472
\] \\
psf
\end{tabular} & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline Slice
\[
11
\] & \[
\begin{aligned}
& 943.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.0267 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,675.7032 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,429.7561 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 928.49448 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & 950 ft & \[
\begin{aligned}
& 1,462.5895 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,525.2474 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,517.2093 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 985.28723 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & \[
\begin{aligned}
& 956.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.3727 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,388.5504 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,593.7976 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,035.0242 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 963.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,458.3699 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,265.2151 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,659.3002 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,077.5621 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & 970 ft & \[
\begin{aligned}
& 1,456.5756 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,154.8956 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,713.4701 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,112.7405 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
16
\end{tabular} & \[
\begin{aligned}
& 976.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.985 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,057.2922 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,756.0309 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,140.3798 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 983.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.5939 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,972.1469 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,786.6725 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,160.2787 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
18
\end{tabular} & 990 ft & \[
\begin{aligned}
& 1,452.3989 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,899.2395 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,805.0471 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,172.2113 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
19
\end{tabular} & \[
\begin{aligned}
& 996.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.3969 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,838.3854 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,810.7642 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,175.924 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 1,003.2158 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,450.5966 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,790.0913 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,798.5997 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,168.0243 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& 1,009.6473 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,449.9896 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,753.8311 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,768.2896 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,148.3407 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & \[
\begin{aligned}
& \text { 1,016.0788 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,449.5568 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,728.4522 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,724.4747 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,119.8869 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline Slice & 1,022.5103 & 1,449.2974 & \[
2,713.8956
\] & 1,666.5799 & 1,082.2896 & \[
0.043846762
\] & 0 psf & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 23 & ft & ft & psf & psf & psf & psf & & Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,028.9418 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,449.2107 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,710.1262
\]
psf & \[
\begin{aligned}
& \text { 1,593.9576 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,035.1282 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& 1,035.3734 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,449.2967 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,717.1323
\]
psf & \[
\begin{aligned}
& \text { 1,505.8771 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 977.92801 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,041.8049 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,449.5555 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,734.9254
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,401.5115 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 910.1522 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& 1,048.2364 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,449.9876 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,763.5407
\]
psf & \[
\begin{aligned}
& \text { 1,279.9226 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 831.19146 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& 1,054.6679 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,450.594 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,803.0371
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,140.0424 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 740.35218 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,061.0994 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.376 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,853.4978
\]
psf & \[
\begin{aligned}
& 980.65016 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 636.84166 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,067.531 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,452.3354 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,915.0319
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 800.37377 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 519.7688 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& 1,073.9625 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,453.4743 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,987.7745
\]
psf & \[
\begin{aligned}
& 625.44555 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 32
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,079.4094 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.5693 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
3,057.5205
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 468.9403 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 161.46909 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 33
\end{aligned}
\] & 1,082.72 ft & \[
\begin{aligned}
& 1,455.298 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,103.8562 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 125.03219 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 22.046549 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Not Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section 3
Created By: Administrative User
Revision Number: 31
Date: 01/08/2021
Time: 02:55:24 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 3 (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW
Last Solved Date: 01/08/2021
Last Solved Time: 02:55:28 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100

Tolerable difference in F of \(\mathrm{S}: 0.001\)

\section*{Solution Settings}

Search Method: Root Finder
Tolerable difference between starting and converged F of \(\mathrm{S}: 3\)
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2
Materials
Lean Clay
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Municipal Soil Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Shale Bedrock
Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1
Vegetation Cover
Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)

\section*{Pore Water Pressure}

Piezometric Line: 1

Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (750, 1,498.04) ft
Left-Zone Right Coordinate: (1,000, 1,475.08) ft
Left-Zone Increment: 15
Right Type: Range
Right-Zone Left Coordinate: \((1,000,1,475.08) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,225,1,441.83) \mathrm{ft}\)
Right-Zone Increment: 8
Radius Increments: 4

\section*{Slip Surface Limits}

Left Coordinate: \((0,1,462.167) \mathrm{ft}\)
Right Coordinate: \((1,225,1,441.83) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{X} & \multicolumn{1}{c|}{Y} \\
\hline Coordinate 1 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,225 \mathrm{ft}\) & \(1,405 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (400, 1,495.33) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.0011 ft
Direction: \(180.27^{\circ}\)
F of S Dependent: No

Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: (600, 1,495.11) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.00238 ft
Direction: \(359.6^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: \((700,1,495.14) \mathrm{ft}\)
Inside Point: \((600,1,495.11) \mathrm{ft}\)
Length: 100 ft
Direction: \(0.017189^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)

Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((800,1,496.74) \mathrm{ft}\)
Inside Point: \((700,1,495.14) \mathrm{ft}\)
Length: 100.0128 ft
Direction: \(0.91665^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: (855.747, 1,498.58) ft
Inside Point: \((800,1,496.74) \mathrm{ft}\)
Length: 55.777357 ft
Direction: \(1.8904^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5

\section*{Not Factor of Safety Dependent}

Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|c|c|c|}
\hline & X & Y \\
\hline Point 1 & 0 ft & 1,462.167 ft \\
\hline Point 2 & 100 ft & 1,462.167 ft \\
\hline Point 3 & 200 ft & 1,462.167 ft \\
\hline Point 4 & 228.75 ft & 1,462.167 ft \\
\hline Point 5 & 300 ft & 1,462.167 ft \\
\hline Point 6 & 300 ft & 1,480.27 ft \\
\hline Point 7 & 357.25 ft & 1,443 ft \\
\hline Point 8 & 371.75 ft & \(1,443 \mathrm{ft}\) \\
\hline Point 9 & 394.999 ft & 1,435.25 ft \\
\hline Point 10 & 400 ft & 1,497.33 ft \\
\hline Point 11 & 400 ft & 1,435.21 ft \\
\hline Point 12 & 500 ft & 1,497.8 ft \\
\hline Point 13 & 500 ft & 1,434.31 ft \\
\hline Point 14 & 600 ft & 1,497.11 ft \\
\hline Point 15 & 600 ft & 1,434.48 ft \\
\hline Point 16 & 700 ft & 1,497.14 ft \\
\hline Point 17 & 700 ft & 1,434.61 ft \\
\hline Point 18 & 800 ft & 1,498.94 ft \\
\hline Point 19 & 800 ft & 1,434.11 ft \\
\hline Point 20 & 855.747 ft & 1,500.58 ft \\
\hline Point 21 & 900 ft & 1,496.03 ft \\
\hline Point 22 & 900 ft & 1,434.98 ft \\
\hline Point 23 & 949 ft & 1,434.98 ft \\
\hline Point 24 & 980.19 ft & 1,445.64 ft \\
\hline Point 25 & 1,000 ft & 1,445.64 ft \\
\hline Point 26 & 1,000 ft & 1,475.08 ft \\
\hline Point 27 & 1,023.64 ft & \(1,445 \mathrm{ft}\) \\
\hline Point 28 & \(1,030.5 \mathrm{ft}\) & 1,448 ft \\
\hline Point 29 & 1,051.63 ft & 1,448 ft \\
\hline Point 30 & 1,100 ft & 1,448 ft \\
\hline Point 31 & 1,100 ft & 1,451.77 ft \\
\hline Point 32 & 1,141 ft & 1,441.83 ft \\
\hline Point 33 & 1,200 ft & 1,441.83 ft \\
\hline Point 34 & 1,225 ft & 1,441.83 ft \\
\hline Point 35 & 1,225 ft & 1,405 ft \\
\hline Point 36 & 0 ft & 1,405 ft \\
\hline Point 37 & 1,225 ft & 1,440 ft \\
\hline Point 38 & 1,225 ft & 1,430 ft \\
\hline Point 39 & 1,225 ft & 1,425 ft \\
\hline
\end{tabular}

\section*{Not Factor of Safety Dependent}
\begin{tabular}{|l|l|l|} 
Point 40 & \(1,225 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Point 41 & 0 ft & \(1,435 \mathrm{ft}\) \\
\hline Point 42 & 0 ft & \(1,425 \mathrm{ft}\) \\
\hline Point 43 & 0 ft & \(1,420 \mathrm{ft}\) \\
\hline Point 44 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Point 45 & 390.9635 ft & \(1,436.5952 \mathrm{ft}\) \\
\hline Point 46 & 960.5301 ft & \(1,438.9207 \mathrm{ft}\) \\
\hline Point 47 & 300 ft & \(1,479.27 \mathrm{ft}\) \\
\hline Point 48 & 300 ft & \(1,477.27 \mathrm{ft}\) \\
\hline Point 49 & 400 ft & \(1,496.33 \mathrm{ft}\) \\
\hline Point 50 & 400 ft & \(1,494.33 \mathrm{ft}\) \\
\hline Point 51 & 400 ft & \(1,495.33 \mathrm{ft}\) \\
\hline Point 52 & 855.747 ft & \(1,499.58 \mathrm{ft}\) \\
\hline Point 53 & 855.747 ft & \(1,498.58 \mathrm{ft}\) \\
\hline Point 54 & 855.747 ft & \(1,497.58 \mathrm{ft}\) \\
\hline Point 55 & 900 ft & \(1,495.03 \mathrm{ft}\) \\
\hline Point 56 & 900 ft & \(1,493.03 \mathrm{ft}\) \\
\hline Point 57 & \(1,000 \mathrm{ft}\) & \(1,474.08 \mathrm{ft}\) \\
\hline Point 58 & \(1,000 \mathrm{ft}\) & \(1,472.08 \mathrm{ft}\) \\
\hline Point 59 & 232.6896 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 60 & 240.5594 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 61 & \(1,100 \mathrm{ft}\) & \(1,450.77 \mathrm{ft}\) \\
\hline Point 62 & \(1,100 \mathrm{ft}\) & \(1,448.769 \mathrm{ft}\) \\
\hline Point 63 & \(1,130.125 \mathrm{ft}\) & \(1,443.4666 \mathrm{ft}\) \\
\hline Point 64 & \(1,108.3622 \mathrm{ft}\) & \(1,446.7416 \mathrm{ft}\) \\
\hline Point 65 & 500 ft & \(1,496.8 \mathrm{ft}\) \\
\hline Point 66 & 500 ft & \(1,495.8 \mathrm{ft}\) \\
\hline Point 67 & 500 ft & \(1,494.8 \mathrm{ft}\) \\
\hline Point 68 & 600 ft & \(1,496.11 \mathrm{ft}\) \\
\hline Point 69 & 600 ft & \(1,495.11 \mathrm{ft}\) \\
\hline Point 70 & 600 ft & \(1,494.11 \mathrm{ft}\) \\
\hline Point 71 & 700 ft & \(1,496.14 \mathrm{ft}\) \\
\hline Point 72 & 700 ft & \(1,495.14 \mathrm{ft}\) \\
\hline Point 73 & 700 ft & \(1,494.14 \mathrm{ft}\) \\
\hline Point 74 & 800 ft & \(1,497.94 \mathrm{ft}\) \\
\hline Point 75 & 800 ft & \(1,496.74 \mathrm{ft}\) \\
\hline Point 76 & 800 ft & \(1,495.74 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|c|c|}
\hline & Material & \multicolumn{1}{c|}{ Points } & Area \\
\hline \(\begin{array}{l}\text { Region } \\
1\end{array}\) & \(\begin{array}{l}\text { Municipal } \\
\text { Soil Waste }\end{array}\) & \(5,7,8,45,9,11,13,15,17,19,22,23,46,24,25,27,28,29,30,64,62,58,56,54,76,73,70,67,50,48,60\) & \(\begin{array}{l}40,163 \\
\mathrm{ft}^{2}\end{array}\) \\
\hline \(\begin{array}{l}\text { Region } \\
2\end{array}\) & \(\begin{array}{l}\text { Vegetation } \\
\text { Cover }\end{array}\) & \(4,59,47,49,65,68,71,74,52,55,57,61,63,32,31,26,21,20,18,16,14,12,10,6\) & 904.88 \\
\hline \(\begin{array}{l}\text { Region } \\
3\end{array}\) & \(\begin{array}{l}\text { Compacted } \\
\text { Soil Liner }\end{array}\) & \(59,60,48,50,67,70,73,76,54,56,58,62,64,63,61,57,55,52,74,71,68,65,49,47\) & \(1,780.9\) \\
\hline \(\begin{array}{l}\text { Region } \\
4\end{array}\) & Lean Clay & \(41,45,8,7,5,60,59,4,3,2,1\) & \(\mathrm{ft}^{2}\)
\end{tabular}\(\left.] \begin{array}{l}9,053.1 \\
\mathrm{ft}^{2}\end{array}\right]\)

Not Factor of Safety Dependent
\(\left.\begin{array}{|l|l|l|l|}5 & \text { Shale } & & \mathrm{ft}^{2} \\
\hline \begin{array}{l}\text { Region } \\
6\end{array} & \begin{array}{l}\text { Shale } \\
\text { Bedrock }\end{array} & 36,35,40,44 & 9,187.5 \\
\hline \begin{array}{l}\text { Region } \\
7\end{array} & \text { Lean Clay } & 34,33,32,63,64,30,29,28,27,25,24,46,37 & \mathrm{ft}^{2} \\
\hline \begin{array}{l}\text { Region } \\
8\end{array} & \begin{array}{l}\text { Shale } \\
\text { Bedrock }\end{array} & 39,38,42,43 & 1,380.9 \\
\mathrm{ft}^{2}\end{array}\right]\)\begin{tabular}{l}
6,125 \\
\hline \begin{tabular}{l} 
Region \\
9
\end{tabular} \\
\begin{tabular}{l} 
Very \\
\begin{tabular}{l} 
Weathered \\
Shale
\end{tabular}
\end{tabular} 40,39,43,44 \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 362 of 720 converged

\section*{Current Slip Surface}

Slip Surface: 422
Factor of Safety: 3.494
Volume: 2,689.8586 ft \({ }^{3}\)
Weight: 200,434.55 lbf
Resisting Moment: 31,272,594 lbf•ft
Activating Moment: 8,950,290.6 lbf•ft
Resisting Force: 134,724.24 lbf
Activating Force: 38,558.923 Ibf
Slip Rank: 1 of 720 slip surfaces
Exit: \((1,083.5849,1,455.5964) \mathrm{ft}\)
Entry: \((901.17094,1,495.7847) \mathrm{ft}\)
Radius: 221.61151 ft
Center: \((1,035.6176,1,671.9544) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & \begin{tabular}{l}
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{l}
Suction \\
Strength
\end{tabular} & Base Material \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 1
\end{aligned}
\] & \[
\begin{aligned}
& 902.08754 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,495.0927 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,542.2182 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 21.267182 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
3.749978
\] \\
psf
\end{tabular} & 200 psf & 0 psf & Vegetation Cover \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& 904.92422 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,492.9984 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
5,412.1944
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 123.06716 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 42.375423 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 909.9495 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,489.4579 } \\
& \text { ft }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,192.4403 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 342.96709 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 4
\end{aligned}
\] & \[
\begin{aligned}
& 916.15987 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,485.332 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,936.4425
\]
psf & \[
\begin{aligned}
& 511.08091 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 5
\end{aligned}
\] & \[
\begin{aligned}
& 922.37025 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,481.498 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,698.6663
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 664.61262 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 6
\end{aligned}
\] & \[
\begin{aligned}
& 928.58063 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,477.9385 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,478.0295
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 802.12852 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 520.90835 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& 934.79101 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,474.6386 } \\
& \mathrm{ft}
\end{aligned}
\] & 4,273.6029 psf & \[
\begin{aligned}
& 921.62728 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 598.51176 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 941.00139 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,471.5856 \\
& \mathrm{ft}
\end{aligned}
\] & 4,084.5844 psf & \[
\begin{aligned}
& \text { 1,030.003 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 668.89177 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & \[
\begin{aligned}
& 947.21177 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,468.7682 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,910.2784 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,127.3424 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 732.10473 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 953.42215 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,466.1769 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
3,750.0798
\]
psf & \[
\begin{aligned}
& 1,213.7098 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 788.19235 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 11
\end{aligned}
\] & \[
\begin{aligned}
& 959.63253 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.803 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,603.461 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,289.1473 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 837.18207 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12
\end{aligned}
\] & \[
\begin{aligned}
& 965.84291 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,461.6393 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,469.9617 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,353.6747 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 879.08665 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& 972.05329 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.6792 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,349.1802 \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,407.2885 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 913.90382 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 14
\end{aligned}
\] & \[
\begin{aligned}
& 978.26367 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,457.9173 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
3,240.7668
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,449.9614 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 941.61593 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& 984.47405 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.3487 \\
& \mathrm{ft}
\end{aligned}
\] & \[
3,144.4181
\]
psf & \[
\begin{aligned}
& 1,481.6418 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 962.18942 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 990.68443 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,454.9691 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,059.872 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,502.2527 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 975.57429 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 17
\end{aligned}
\] & \[
\begin{aligned}
& 996.89481 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.775 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,986.9045 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,511.6906 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 981.70338 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& 1,002.9515 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,452.7839 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,926.5785
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,505.8464 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 977.90807 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,008.8545 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.9849 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,878.2008
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,484.9964 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 964.36795 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 1,014.7575 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.3467 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,839.8628
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,453.4547 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 943.88454 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,020.6604 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,450.868 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,811.4777 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,411.0269 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 916.33161 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,026.5634 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,450.5476 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,792.9809 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,357.4881 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 881.56307 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,032.4664 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,450.3849 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,784.3293 \\
& \text { psf }
\end{aligned}
\] & 1,292.58 psf & \[
\begin{aligned}
& 839.41127 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,038.3694 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,450.3796 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,785.5013 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,216.0082 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 789.68493 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline Slice & 1,044.2724 & 1,450.5316 & \[
2,796.4962
\] & 1,127.4379 & 732.16674 & \[
0.043846762
\] & 0 psf & Municipal \\
\hline
\end{tabular}

\section*{Not Factor of Safety Dependent}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 25 & ft & ft & psf & psf & psf & psf & & Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 1,050.1754 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,450.8413 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,817.3342 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,026.49 psf & \[
\begin{aligned}
& 666.61041 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& 1,056.0784 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.3093 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,848.0569
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 912.73539 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 592.73729 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& 1,061.9813 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.9367 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,888.7273
\]
psf & \[
\begin{aligned}
& 785.68914 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 510.23249 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 1,067.8843 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,452.7248 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,939.431 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 652.74088 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,073.7873 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.6753 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,000.2766 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 508.82531 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,079.0493 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.6532 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,062.6691 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 330.81496 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 113.90873 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 32
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,082.4724 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.3557 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,107.3966 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 85.600899 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 15.093748 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Not FS Dependent Psuedo Static}

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\section*{File Information}

File Version: 9.01
Title: Section 3
Created By: Administrative User
Revision Number: 31
Date: 01/08/2021
Time: 02:55:24 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section 3 (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW
Last Solved Date: 01/08/2021
Last Solved Time: 02:55:28 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not FS Dependent Psuedo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100

Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

Municipal Soil Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)

\section*{Pore Water Pressure}

Piezometric Line: 1

Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((750,1,498.04) \mathrm{ft}\)
Left-Zone Right Coordinate: (1,000, 1,475.08) ft
Left-Zone Increment: 15
Right Type: Range
Right-Zone Left Coordinate: \((1,000,1,475.08) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,225,1,441.83) \mathrm{ft}\)
Right-Zone Increment: 8
Radius Increments: 4

\section*{Slip Surface Limits}

Left Coordinate: \((0,1,462.167) \mathrm{ft}\)
Right Coordinate: \((1,225,1,441.83) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{X} & \multicolumn{1}{c|}{Y} \\
\hline Coordinate 1 & 0 ft & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(1,225 \mathrm{ft}\) & \(1,405 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic

Outside Point: (400, 1,495.33) ft
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.0011 ft
Direction: \(180.27^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((600,1,495.11) \mathrm{ft}\)
Inside Point: \((500,1,495.8) \mathrm{ft}\)
Length: 100.00238 ft
Direction: 359.6 \({ }^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: \((700,1,495.14) \mathrm{ft}\) Inside Point: \((600,1,495.11) \mathrm{ft}\) Length: 100 ft
Direction: \(0.017189^{\circ}\)

F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((800,1,496.74) \mathrm{ft}\)
Inside Point: \((700,1,495.14) \mathrm{ft}\)
Length: 100.0128 ft
Direction: \(0.91665^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 2
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 Ibf
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((855.747,1,498.58) \mathrm{ft}\)
Inside Point: \((800,1,496.74) \mathrm{ft}\)
Length: 55.777357 ft
Direction: \(1.8904^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No Interface Adhesion: 0 psf

Interface Shear Angle: \(8^{\circ}\)

\section*{Surface Area Factor: 2}

Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & 0 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 2 & 100 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 3 & 200 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 4 & 228.75 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 5 & 300 ft & \(1,462.167 \mathrm{ft}\) \\
\hline Point 6 & 300 ft & \(1,480.27 \mathrm{ft}\) \\
\hline Point 7 & 357.25 ft & \(1,443 \mathrm{ft}\) \\
\hline Point 8 & 371.75 ft & \(1,443 \mathrm{ft}\) \\
\hline Point 9 & 394.999 ft & \(1,435.25 \mathrm{ft}\) \\
\hline Point 10 & 400 ft & \(1,497.33 \mathrm{ft}\) \\
\hline Point 11 & 400 ft & \(1,435.21 \mathrm{ft}\) \\
\hline Point 12 & 500 ft & \(1,497.8 \mathrm{ft}\) \\
\hline Point 13 & 500 ft & \(1,434.31 \mathrm{ft}\) \\
\hline Point 14 & 600 ft & \(1,497.11 \mathrm{ft}\) \\
\hline Point 15 & 600 ft & \(1,434.48 \mathrm{ft}\) \\
\hline Point 16 & 700 ft & \(1,497.14 \mathrm{ft}\) \\
\hline Point 17 & 700 ft & \(1,434.61 \mathrm{ft}\) \\
\hline Point 18 & 800 ft & \(1,498.94 \mathrm{ft}\) \\
\hline Point 19 & 800 ft & \(1,434.11 \mathrm{ft}\) \\
\hline Point 20 & 855.747 ft & \(1,500.58 \mathrm{ft}\) \\
\hline Point 21 & 900 ft & \(1,496.03 \mathrm{ft}\) \\
\hline Point 22 & 900 ft & \(1,434.98 \mathrm{ft}\) \\
\hline Point 23 & 949 ft & \(1,434.98 \mathrm{ft}\) \\
\hline Point 24 & 980.19 ft & \(1,445.64 \mathrm{ft}\) \\
\hline Point 25 & \(1,000 \mathrm{ft}\) & \(1,445.64 \mathrm{ft}\) \\
\hline Point 26 & \(1,000 \mathrm{ft}\) & \(1,475.08 \mathrm{ft}\) \\
\hline Point 27 & \(1,023.64 \mathrm{ft}\) & \(1,445 \mathrm{ft}\) \\
\hline Point 28 & \(1,030.5 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 29 & \(1,051.63 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 30 & \(1,100 \mathrm{ft}\) & \(1,448 \mathrm{ft}\) \\
\hline Point 31 & \(1,100 \mathrm{ft}\) & \(1,451.77 \mathrm{ft}\) \\
\hline Point 32 & \(1,141 \mathrm{ft}\) & \(1,441.83 \mathrm{ft}\) \\
\hline Point 33 & \(1,200 \mathrm{ft}\) & \(1,441.83 \mathrm{ft}\) \\
\hline Point 34 & \(1,225 \mathrm{ft}\) & \(1,441.83 \mathrm{ft}\) \\
\hline & & 1, \\
\hline
\end{tabular}

\section*{Not FS Dependent Psuedo Static}
\begin{tabular}{|c|c|c|}
\hline Point 35 & 1,225 ft & 1,405 ft \\
\hline Point 36 & 0 ft & 1,405 ft \\
\hline Point 37 & 1,225 ft & 1,440 ft \\
\hline Point 38 & 1,225 ft & 1,430 ft \\
\hline Point 39 & 1,225 ft & 1,425 ft \\
\hline Point 40 & 1,225 ft & 1,415 ft \\
\hline Point 41 & 0 ft & 1,435 ft \\
\hline Point 42 & 0 ft & 1,425 ft \\
\hline Point 43 & 0 ft & 1,420 ft \\
\hline Point 44 & 0 ft & 1,410 ft \\
\hline Point 45 & 390.9635 ft & 1,436.5952 ft \\
\hline Point 46 & 960.5301 ft & 1,438.9207 ft \\
\hline Point 47 & 300 ft & 1,479.27 ft \\
\hline Point 48 & 300 ft & 1,477.27 ft \\
\hline Point 49 & 400 ft & 1,496.33 ft \\
\hline Point 50 & 400 ft & 1,494.33 ft \\
\hline Point 51 & 400 ft & 1,495.33 ft \\
\hline Point 52 & 855.747 ft & 1,499.58 ft \\
\hline Point 53 & 855.747 ft & 1,498.58 ft \\
\hline Point 54 & 855.747 ft & 1,497.58 ft \\
\hline Point 55 & 900 ft & 1,495.03 ft \\
\hline Point 56 & 900 ft & 1,493.03 ft \\
\hline Point 57 & 1,000 ft & 1,474.08 ft \\
\hline Point 58 & 1,000 ft & 1,472.08 ft \\
\hline Point 59 & 232.6896 ft & 1,462.167 ft \\
\hline Point 60 & 240.5594 ft & 1,462.167 ft \\
\hline Point 61 & 1,100 ft & 1,450.77 ft \\
\hline Point 62 & 1,100 ft & 1,448.769 ft \\
\hline Point 63 & 1,130.125 ft & 1,443.4666 ft \\
\hline Point 64 & 1,108.3622 ft & 1,446.7416 ft \\
\hline Point 65 & 500 ft & 1,496.8 ft \\
\hline Point 66 & 500 ft & 1,495.8 ft \\
\hline Point 67 & 500 ft & 1,494.8 ft \\
\hline Point 68 & 600 ft & 1,496.11 ft \\
\hline Point 69 & 600 ft & 1,495.11 ft \\
\hline Point 70 & 600 ft & 1,494.11 ft \\
\hline Point 71 & 700 ft & 1,496.14 ft \\
\hline Point 72 & 700 ft & 1,495.14 ft \\
\hline Point 73 & 700 ft & 1,494.14 ft \\
\hline Point 74 & 800 ft & 1,497.94 ft \\
\hline Point 75 & 800 ft & 1,496.74 ft \\
\hline Point 76 & 800 ft & 1,495.74 ft \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|c|c|}
\hline & Material & Points & Area \\
\hline \begin{tabular}{l} 
Region \\
1
\end{tabular} & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} & \(5,7,8,45,9,11,13,15,17,19,22,23,46,24,25,27,28,29,30,64,62,58,56,54,76,73,70,67,50,48,60\) & \begin{tabular}{l}
40,163 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} & \(4,59,47,49,65,68,71,74,52,55,57,61,63,32,31,26,21,20,18,16,14,12,10,6\) & 904.88 \\
\hline & & & \(\mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Not FS Dependent Psuedo Static}
\begin{tabular}{|l|l|l|l|l|}
\begin{tabular}{l} 
Region \\
3
\end{tabular} & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} & \(59,60,48,50,67,70,73,76,54,56,58,62,64,63,61,57,55,52,74,71,68,65,49,47\) & \begin{tabular}{l}
\(1,780.9\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
4
\end{tabular} & Lean Clay & \(41,45,8,7,5,60,59,4,3,2,1\) & \begin{tabular}{l}
\(9,053.1\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
5
\end{tabular} & \begin{tabular}{l} 
Very \\
Weathered \\
Shale
\end{tabular} & \(42,38,37,46,23,22,19,17,15,13,11,9,45,41\) & 10,466 \\
\hline \begin{tabular}{l} 
Region \\
6
\end{tabular} & \begin{tabular}{l} 
Shale \\
Bedrock
\end{tabular} & \(36,35,40,44\) & \(\mathrm{ft}^{2}\)
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 362 of 720 converged

\section*{Current Slip Surface}

\section*{Slip Surface: 377}

Factor of Safety: 2.103
Volume: 3,372.5834 \(\mathrm{ft}^{3}\)
Weight: 246,492.24 lbf
Resisting Moment: 43,018,762 lbf•ft
Activating Moment: 20,451,463 Ibf•ft
Resisting Force: 172,176.25 Ibf
Activating Force: 81,861.411 Ibf
Slip Rank: 1 of 720 slip surfaces
Exit: \((1,083.5849,1,455.5964) \mathrm{ft}\)
Entry: \((884.44925,1,497.6289) \mathrm{ft}\)
Radius: 239.49836 ft
Center: \((1,028.7924,1,688.7428) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{Y} & \multicolumn{1}{|c|}{PWP} & \begin{tabular}{l} 
Base Normal \\
Stress
\end{tabular} & \multicolumn{1}{|c|}{\begin{tabular}{l} 
Frictional \\
Strength
\end{tabular}} & \begin{tabular}{l} 
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{l} 
Suction \\
Strength
\end{tabular} & Base Material \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
885.22308 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,497.0493\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,660.0762\) \\
psf
\end{tabular} & \begin{tabular}{l}
13.988433 \\
psf
\end{tabular} & \begin{tabular}{l}
2.4665381 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
2
\end{tabular} & \begin{tabular}{l}
887.59145 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,495.3058\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(-5,551.832\) \\
psf
\end{tabular} & \begin{tabular}{l}
100.05965 \\
psf
\end{tabular} & \begin{tabular}{l}
34.453301 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
3
\end{tabular} & \begin{tabular}{l}
891.88949 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,492.2582\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,362.6622\) \\
psf
\end{tabular} & \begin{tabular}{l}
325.52444 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} \\
\hline Slice & \begin{tabular}{l}
897.2965 \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,488.5983\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,135.5509\) \\
psf
\end{tabular} & \begin{tabular}{l}
507.50612 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Soil Waste
\end{tabular} \\
\hline Slice & 903.33333 & \(1,484.7718\) & - & 679.89805 & & & Municipal
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 5 & ft & ft & \[
\begin{aligned}
& \text { 4,898.2006 } \\
& \text { psf }
\end{aligned}
\] & psf & 0 psf & 500 psf & 0 psf & Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & 910 ft & \[
\begin{aligned}
& 1,480.8171 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,653.0078
\]
\[
\mathrm{psf}
\] & \[
\begin{aligned}
& 835.8083 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 542.78026 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & ```
916.66667
ft
``` & \[
\begin{aligned}
& \text { 1,477.1463 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,425.5409
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 974.89828 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 633.10635 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 923.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,473.745 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,214.8904
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,103.9434 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 716.90924 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & 930 ft & \[
\begin{aligned}
& 1,470.6003 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,020.2685 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,222.8027 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 794.09735 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 936.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,467.7014 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,840.9903 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,331.3241 } \\
& \text { psf }
\end{aligned}
\] & 864.57195 psf & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 11
\end{aligned}
\] & \[
\begin{aligned}
& 943.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.0388 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,676.4584 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,429.3438 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 928.2267 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12
\end{aligned}
\] & 950 ft & \[
\begin{aligned}
& 1,462.604 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,526.1514 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,516.6823 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 984.94502 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& 956.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.3897 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,389.6137 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,593.141 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,034.5978 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 963.33333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,458.3896 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,266.4478 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,658.4982 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,077.0413 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
15
\end{tabular} & 970 ft & \[
\begin{aligned}
& 1,456.5982 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,156.3078 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,712.5063 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,112.1146 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 976.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.0106 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,058.8939 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,754.8877 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,139.6374 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & ```
983.33333
ft
``` & \[
\begin{aligned}
& 1,453.6228 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,973.9481 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,785.3314 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,159.4078 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
18
\end{tabular} & 990 ft & \[
\begin{aligned}
& \text { 1,452.4311 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,901.2504 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,803.4881 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,171.1989 } \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
19
\end{tabular} & \[
\begin{aligned}
& 996.66667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.4327 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,840.6163 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,808.966 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,174.7563 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 1,003.2068 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,450.6368 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,792.5985 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,796.5839 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,166.7152 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& 1,009.6205 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,450.0347 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,756.6407 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,766.1151 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,146.9285 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,016.0342 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,449.606 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,731.5145
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,722.1925 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,118.4049 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& 1,022.4478 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,449.3499 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,717.1617
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,664.2438 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,080.7726 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Soil Waste \\
\hline
\end{tabular}

\section*{Not FS Dependent Psuedo Static}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,028.8615 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,449.2659 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,713.5478
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,591.6243 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,033.6129 } \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& 1,035.2752 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,449.3536 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,720.6614
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,503.6068 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 976.45368 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,041.6888 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,449.6134 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,738.5144 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,399.3685 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 908.76056 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,048.1025 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,450.0458 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,767.1419 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,277.9762 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 829.92746 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,054.5162 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,450.6517 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,806.6025 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,138.3675 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 739.26447 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,060.9298 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,451.4325 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,856.9793 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 979.32847 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 635.98335 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& 1,067.3435 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,452.3898 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,918.3807 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 799.49548 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 519.19843 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Soil Waste \\
\hline Slice
\[
31
\] & \[
\begin{aligned}
& 1,073.7572 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.5259 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,990.9412 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 625.15668 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Soil Waste \\
\hline \begin{tabular}{l}
Slice \\
32
\end{tabular} & \[
\begin{aligned}
& 1,079.1951 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.6192 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
3,060.5845
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 468.87786 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 161.44759 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \begin{tabular}{l}
Slice \\
33
\end{tabular} & \[
\begin{aligned}
& 1,082.5056 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.348 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
3,106.9221
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 125.01689 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 22.043851 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section A
Created By: Administrative User
Revision Number: 15
Date: 01/08/2021
Time: 03:20:28 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section A (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW
Last Solved Date: 01/08/2021
Last Solved Time: 03:20:32 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Compacted Soil Liner}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb

Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((1,000,1,490.42) \mathrm{ft}\)
Left-Zone Right Coordinate: \((1,116.6653,1,505.75) \mathrm{ft}\)
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((1,116.6653,1,505.75) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,499.4845,1,515.25) \mathrm{ft}\)
Right-Zone Increment: 15
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((1,000,1,490.42) \mathrm{ft}\)
Right Coordinate: \((2,300,1,463.14) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,300 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: \((1,887.215,1,505) \mathrm{ft}\)
Inside Point: \((1,800,1,509.01) \mathrm{ft}\)
Length: 87.307138 ft
Direction: \(357.37^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.01) \mathrm{ft}\)
Inside Point: \((1,800,1,509.01) \mathrm{ft}\)
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: (1,600, 1,513.23) ft

Inside Point: (1,700, 1,509.01) ft
Length: 100.089 ft
Direction: \(177.58^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.23) \mathrm{ft}\)
Inside Point: (1,600, 1,513.23) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((1,400,1,517.11) \mathrm{ft}\)
Inside Point: (1,500, 1,513.23) ft
Length: 100.07524 ft

Direction: \(177.78^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 6}

Type: Geosynthetic
Outside Point: \((1,300,1,517.11) \mathrm{ft}\)
Inside Point: (1,400, 1,517.11) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{ X } & Y \\
\hline Point 1 & \(1,300 \mathrm{ft}\) & \(1,514.79 \mathrm{ft}\) \\
\hline Point 2 & \(1,400 \mathrm{ft}\) & \(1,493.68 \mathrm{ft}\) \\
\hline Point 3 & \(1,500 \mathrm{ft}\) & \(1,472.03 \mathrm{ft}\) \\
\hline Point 4 & \(2,200 \mathrm{ft}\) & \(1,463.14 \mathrm{ft}\) \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 5 & 2,300 ft & 1,463.14 ft \\
\hline Point 6 & 1,300 ft & 1,519.11 ft \\
\hline Point 7 & 1,400 ft & 1,519.11 ft \\
\hline Point 8 & 1,500 ft & 1,515.23 ft \\
\hline Point 9 & 1,600 ft & 1,515.23 ft \\
\hline Point 10 & 1,700 ft & 1,511.01 ft \\
\hline Point 11 & 1,800 ft & 1,511.01 ft \\
\hline Point 12 & 1,900 ft & 1,503.57 ft \\
\hline Point 13 & 2,000 ft & 1,477.59 ft \\
\hline Point 14 & 2,100 ft & 1,452.85 ft \\
\hline Point 15 & 1,000 ft & 1,490.42 ft \\
\hline Point 16 & 1,050.62 ft & 1,493.125 ft \\
\hline Point 17 & 1,225.24 ft & 1,521.75 ft \\
\hline Point 18 & 1,244.865 ft & 1,521.75 ft \\
\hline Point 19 & 1,887.215 ft & 1,507 ft \\
\hline Point 20 & 2,085.72 ft & 1,455.83 ft \\
\hline Point 21 & 2,111.71 ft & 1,455.83 ft \\
\hline Point 22 & 2,094.99 ft & 1,452.83 ft \\
\hline Point 23 & 1,618.79 ft & 1,432.25 ft \\
\hline Point 24 & 1,700 ft & 1,432.25 ft \\
\hline Point 25 & 1,800 ft & 1,432.25 ft \\
\hline Point 26 & 1,900 ft & 1,432.25 ft \\
\hline Point 27 & 2,000 ft & 1,432.25 ft \\
\hline Point 28 & 2,018.54 ft & 1,432.25 ft \\
\hline Point 29 & 2,073.81 ft & 1,453.125 ft \\
\hline Point 30 & 1,200 ft & 1,521.68 ft \\
\hline Point 31 & 2,090.8227 ft & 1,454.252 ft \\
\hline Point 32 & 1,000 ft & 1,410 ft \\
\hline Point 33 & 2,300 ft & 1,410 ft \\
\hline Point 34 & 1,000 ft & 1,450 ft \\
\hline Point 35 & 1,000 ft & 1,428 ft \\
\hline Point 36 & 2,300 ft & 1,440 ft \\
\hline Point 37 & 2,300 ft & 1,430 ft \\
\hline Point 38 & 2,300 ft & 1,425 ft \\
\hline Point 39 & 2,300 ft & 1,415 ft \\
\hline Point 40 & 1,579.0891 ft & 1,445.5449 ft \\
\hline Point 41 & 2,044.267 ft & 1,441.9669 ft \\
\hline Point 42 & 1,300 ft & 1,518.11 ft \\
\hline Point 43 & 1,300 ft & 1,517.11 ft \\
\hline Point 44 & 1,300 ft & 1,516.11 ft \\
\hline Point 45 & 1,400 ft & 1,518.11 ft \\
\hline Point 46 & 1,400 ft & 1,517.11 ft \\
\hline Point 47 & 1,400 ft & 1,516.11 ft \\
\hline Point 48 & 1,500 ft & 1,514.23 ft \\
\hline Point 49 & 1,500 ft & 1,513.23 ft \\
\hline Point 50 & 1,500 ft & 1,512.23 ft \\
\hline Point 51 & 1,600 ft & 1,514.23 ft \\
\hline Point 52 & 1,600 ft & 1,513.23 ft \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|} 
Point 53 & \(1,600 \mathrm{ft}\) & \(1,512.23 \mathrm{ft}\) \\
\hline Point 54 & \(1,700 \mathrm{ft}\) & \(1,510.01 \mathrm{ft}\) \\
\hline Point 55 & \(1,700 \mathrm{ft}\) & \(1,509.01 \mathrm{ft}\) \\
\hline Point 56 & \(1,700 \mathrm{ft}\) & \(1,508.01 \mathrm{ft}\) \\
\hline Point 57 & \(1,800 \mathrm{ft}\) & \(1,510.01 \mathrm{ft}\) \\
\hline Point 58 & \(1,800 \mathrm{ft}\) & \(1,509.01 \mathrm{ft}\) \\
\hline Point 59 & \(1,800 \mathrm{ft}\) & \(1,508.01 \mathrm{ft}\) \\
\hline Point 60 & \(1,887.215 \mathrm{ft}\) & \(1,506 \mathrm{ft}\) \\
\hline Point 61 & \(1,887.215 \mathrm{ft}\) & \(1,505 \mathrm{ft}\) \\
\hline Point 62 & \(1,887.215 \mathrm{ft}\) & \(1,504 \mathrm{ft}\) \\
\hline Point 63 & \(1,900 \mathrm{ft}\) & \(1,502.57 \mathrm{ft}\) \\
\hline Point 64 & \(1,900 \mathrm{ft}\) & \(1,501.57 \mathrm{ft}\) \\
\hline Point 65 & \(1,900 \mathrm{ft}\) & \(1,500.57 \mathrm{ft}\) \\
\hline Point 66 & \(2,000 \mathrm{ft}\) & \(1,476.59 \mathrm{ft}\) \\
\hline Point 67 & \(2,000 \mathrm{ft}\) & \(1,475.59 \mathrm{ft}\) \\
\hline Point 68 & \(2,000 \mathrm{ft}\) & \(1,474.59 \mathrm{ft}\) \\
\hline Point 69 & \(1,257.6267 \mathrm{ft}\) & \(1,520.139 \mathrm{ft}\) \\
\hline Point 70 & \(1,283.1576 \mathrm{ft}\) & \(1,516.9161 \mathrm{ft}\) \\
\hline Point 71 & \(2,088.5872 \mathrm{ft}\) & \(1,454.1039 \mathrm{ft}\) \\
\hline Point 72 & \(2,082.3334 \mathrm{ft}\) & \(1,453.6896 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & Area \\
\hline Region 1 & Municipal Solid Waste & \(1,2,3,40,23,24,25,26,27,28,41,29,72,68,65,62,59,56,53,50,47,44,70\) & \(40,058 \mathrm{ft}^{2}\) \\
\hline Region 2 & Lean Clay & \(34,40,3,2,1,70,69,18,17,30,16,15\) & \(28,365 \mathrm{ft}^{2}\) \\
\hline Region 3 & Very Weathered Shale & \(35,39,36,41,28,27,26,25,24,23,40,34\) & \(25,586 \mathrm{ft}^{2}\) \\
\hline Region 4 & Shale Bedrock & \(32,33,39,35\) & \(14,950 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(5,4,21,14,22,31,71,72,29,41,36\) & \(4,527.3 \mathrm{ft}^{2}\) \\
\hline Region 6 & Vegetation Cover & \(18,69,42,45,48,51,54,57,60,63,66,71,31,20,13,12,19,11,10,9,8,7,6\) & \(837.97 \mathrm{ft}^{2}\) \\
\hline Region 7 & Compacted Soil Liner & \(70,44,47,50,53,56,59,62,65,68,72,71,66,63,60,57,54,51,48,45,42,69\) & \(1,630.2 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 816 of 1056 converged

\section*{Current Slip Surface}

Slip Surface: 33
Factor of Safety: 4.545
Volume: 7,558.2426 ft \({ }^{3}\)
Weight: 944,780.33 lbf
Resisting Moment: \(1.1194219 \mathrm{e}+08 \mathrm{lbf} \cdot \mathrm{ft}\)
Activating Moment: \(24,629,506 \mathrm{lbf} \cdot \mathrm{ft}\)
Resisting Force: 541,030.81 Ibf
Activating Force: 119,045.42 lbf
Slip Rank: 1 of 1,056 slip surfaces

Exit: \((1,000,1,490.42) \mathrm{ft}\)
Entry: \((1,243.3117,1,521.75) \mathrm{ft}\)
Radius: 192.19718 ft
Center: \((1,102.7589,1,652.8403) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & Cohesive Strength & Suction Strength & Base Material \\
\hline \begin{tabular}{l}
Slice \\
1
\end{tabular} & \[
\begin{aligned}
& \text { 1,004.2183 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,487.8998 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,863.3014 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 585.95206 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 157.00538 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
2
\end{tabular} & \[
\begin{aligned}
& 1,012.655 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,483.1399 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,566.1384 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,275.5436 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 341.78088 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,021.0917 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.9194 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -4,302.649 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,879.2458 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 503.54239 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & \[
\begin{aligned}
& \text { 1,029.5283 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,475.1996 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,070.4244 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,405.8114 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 644.63521 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 1,037.965 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,471.9497 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,867.5296 \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 2,862.0939 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 766.89576 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 1,046.4017 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,469.1445 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,692.4034 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3,253.538 \\
& \text { psf }
\end{aligned}
\] & 871.78289 psf & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & \[
\begin{aligned}
& \text { 1,054.7694 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.7801 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,544.7926 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,657.1886 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 979.94072 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
8
\end{tabular} & \[
\begin{aligned}
& \text { 1,063.0683 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.8339 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,423.2882 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,075.7516 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,092.0943 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
9
\end{tabular} & \[
\begin{aligned}
& \text { 1,071.3672 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.2707 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,325.7019 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,439.7373 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,189.624 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
10
\end{tabular} & \[
\begin{aligned}
& \text { 1,079.6661 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,462.0813 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,251.4445 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 4,751.4692 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,273.1523 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& 1,087.965 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,461.2585 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,200.0806 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,012.8046 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,343.1769 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & \[
\begin{aligned}
& \text { 1,096.2639 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.7978 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,171.3154 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,225.2008 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,400.0883 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & \[
\begin{aligned}
& \text { 1,104.5628 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.6964 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,164.9861 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,389.7639 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,444.1829 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 14 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,112.8617 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.9538 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,181.057 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,507.2832 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,475.6721 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
15
\end{tabular} & \[
\begin{aligned}
& \text { 1,121.1606 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,461.5715 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,219.6187 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,578.2555 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,494.6891 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice & 1,129.4594 & 1,462.553 & 3,280.8906 & 5,602.8992 & 1,501.2923 & 1,200 psf & 0 psf & Lean \\
\hline
\end{tabular}

Factor of Safety Dependent
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 16 & ft & ft & psf & psf & psf & & & Clay \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& \text { 1,137.7583 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.9038 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,365.2274 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,581.1607 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,495.4675 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & \[
\begin{aligned}
& \text { Lean } \\
& \text { Clay }
\end{aligned}
\] \\
\hline Slice
\[
18
\] & \[
\begin{aligned}
& 1,146.0572 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.6322 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,473.1294 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,512.712 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.1267 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
19
\end{tabular} & \[
\begin{aligned}
& 1,154.3561 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,467.7486 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,605.2581 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,396.9414 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,446.1061 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & \[
\begin{aligned}
& \text { Lean } \\
& \text { Clay }
\end{aligned}
\] \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 1,162.655 \\
& \mathrm{ft} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.2666 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,762.458 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 5,232.934 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,402.1604 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & \[
\begin{aligned}
& \hline \text { Lean } \\
& \text { Clay } \\
& \hline
\end{aligned}
\] \\
\hline \begin{tabular}{l}
Slice \\
21
\end{tabular} & \[
\begin{aligned}
& \text { 1,170.9539 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,473.2032 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,945.7859 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,019.4429 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,344.9557 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & \[
\begin{aligned}
& \text { 1,179.2528 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.5792 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,156.5512 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,754.8477 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,274.0576 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
23
\end{tabular} & \[
\begin{aligned}
& \text { 1,187.5517 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,480.4206 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,396.3702 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,437.0973 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,188.9166 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& \text { 1,195.8506 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,484.7594 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,667.2415 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,063.6318 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,088.8469 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,204.2067 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,489.673 \\
& \mathrm{ft}
\end{aligned}
\] & -4,974 psf & \[
\begin{aligned}
& \text { 3,537.1737 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 947.78285 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & 1,212.62 ft & \[
\begin{aligned}
& 1,495.2205 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,320.3317 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,855.8176 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
765.21402 \\
psf
\end{tabular} & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
27
\end{tabular} & \[
\begin{aligned}
& \text { 1,221.0333 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,501.4388 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,708.5404 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,109.1012 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 565.13196 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & \[
\begin{aligned}
& \text { Lean } \\
& \text { Clay }
\end{aligned}
\] \\
\hline \begin{tabular}{l}
Slice \\
28
\end{tabular} & \[
\begin{aligned}
& \text { 1,229.7579 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,508.7058 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,162.2234 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,256.3461 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 336.63692 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
29
\end{tabular} & \[
\begin{aligned}
& 1,238.7938 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,517.2183 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,693.6599 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 284.40886 \\
& \text { psf }
\end{aligned}
\] & 76.207125 psf & 1,200 psf & 0 psf & Lean Clay \\
\hline
\end{tabular}

\section*{FS Dependent Seismic Pseudo Static}

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\section*{File Information}

File Version: 9.01
Title: Section A
Created By: Administrative User
Revision Number: 15
Date: 01/08/2021
Time: 03:20:28 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section A (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:20:34 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

FS Dependent Seismic Pseudo Static
Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Compacted Soil Liner}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb

Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (1,001.0298, 1,490.475) ft
Left-Zone Right Coordinate: \((1,116,1,505.6228) \mathrm{ft}\)
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((1,116.6653,1,505.75) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,500,1,515.23)\) ft
Right-Zone Increment: 15
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((1,000,1,490.42) \mathrm{ft}\)
Right Coordinate: \((2,300,1,463.14) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,300 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: \((1,887.215,1,505) \mathrm{ft}\)
Inside Point: (1,800, 1,509.01) ft
Length: 87.307138 ft
Direction: \(357.37^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.01) \mathrm{ft}\)
Inside Point: (1,800, 1,509.01) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft

Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: \((1,600,1,513.23) \mathrm{ft}\)
Inside Point: \((1,700,1,509.01) \mathrm{ft}\)
Length: 100.089 ft
Direction: \(177.58^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 Ibf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: (1,500, 1,513.23) ft
Inside Point: \((1,600,1,513.23) \mathrm{ft}\)
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((1,400,1,517.11) \mathrm{ft}\)
Inside Point: \((1,500,1,513.23) \mathrm{ft}\)
Length: 100.07524 ft
Direction: \(177.78^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 6}

Type: Geosynthetic
Outside Point: (1,300, 1,517.11) ft
Inside Point: \((1,400,1,517.11) \mathrm{ft}\)
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)
\begin{tabular}{|c|c|c|}
\hline & X & Y \\
\hline Point 1 & 1,300 ft & 1,514.79 ft \\
\hline Point 2 & 1,400 ft & 1,493.68 ft \\
\hline Point 3 & 1,500 ft & \(1,472.03 \mathrm{ft}\) \\
\hline Point 4 & 2,200 ft & 1,463.14 ft \\
\hline Point 5 & 2,300 ft & 1,463.14 ft \\
\hline Point 6 & 1,300 ft & 1,519.11 ft \\
\hline Point 7 & 1,400 ft & 1,519.11 ft \\
\hline Point 8 & 1,500 ft & 1,515.23 ft \\
\hline Point 9 & 1,600 ft & 1,515.23 ft \\
\hline Point 10 & 1,700 ft & 1,511.01 ft \\
\hline Point 11 & 1,800 ft & 1,511.01 ft \\
\hline Point 12 & 1,900 ft & 1,503.57 ft \\
\hline Point 13 & 2,000 ft & 1,477.59 ft \\
\hline Point 14 & 2,100 ft & 1,452.85 ft \\
\hline Point 15 & 1,000 ft & 1,490.42 ft \\
\hline Point 16 & 1,050.62 ft & 1,493.125 ft \\
\hline Point 17 & 1,225.24 ft & \(1,521.75 \mathrm{ft}\) \\
\hline Point 18 & 1,244.865 ft & 1,521.75 ft \\
\hline Point 19 & 1,887.215 ft & 1,507 ft \\
\hline Point 20 & 2,085.72 ft & 1,455.83 ft \\
\hline Point 21 & 2,111.71 ft & 1,455.83 ft \\
\hline Point 22 & 2,094.99 ft & 1,452.83 ft \\
\hline Point 23 & 1,618.79 ft & 1,432.25 ft \\
\hline Point 24 & 1,700 ft & 1,432.25 ft \\
\hline Point 25 & 1,800 ft & 1,432.25 ft \\
\hline Point 26 & 1,900 ft & 1,432.25 ft \\
\hline Point 27 & 2,000 ft & \(1,432.25 \mathrm{ft}\) \\
\hline Point 28 & 2,018.54 ft & 1,432.25 ft \\
\hline Point 29 & 2,073.81 ft & 1,453.125 ft \\
\hline Point 30 & 1,200 ft & 1,521.68 ft \\
\hline Point 31 & 2,090.8227 ft & 1,454.252 ft \\
\hline Point 32 & 1,000 ft & 1,410 ft \\
\hline Point 33 & 2,300 ft & 1,410 ft \\
\hline Point 34 & 1,000 ft & 1,450 ft \\
\hline Point 35 & 1,000 ft & 1,428 ft \\
\hline Point 36 & 2,300 ft & 1,440 ft \\
\hline Point 37 & 2,300 ft & 1,430 ft \\
\hline Point 38 & 2,300 ft & 1,425 ft \\
\hline Point 39 & 2,300 ft & 1,415 ft \\
\hline Point 40 & 1,579.0891 ft & 1,445.5449 ft \\
\hline Point 41 & 2,044.267 ft & \(1,441.9669 \mathrm{ft}\) \\
\hline Point 42 & 1,300 ft & 1,518.11 ft \\
\hline Point 43 & 1,300 ft & 1,517.11 ft \\
\hline Point 44 & 1,300 ft & 1,516.11 ft \\
\hline Point 45 & 1,400 ft & 1,518.11 ft \\
\hline Point 46 & 1,400 ft & 1,517.11 ft \\
\hline Point 47 & 1,400 ft & 1,516.11 ft \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 48 & 1,500 ft & 1,514.23 ft \\
\hline Point 49 & 1,500 ft & 1,513.23 ft \\
\hline Point 50 & 1,500 ft & 1,512.23 ft \\
\hline Point 51 & 1,600 ft & 1,514.23 ft \\
\hline Point 52 & 1,600 ft & 1,513.23 ft \\
\hline Point 53 & 1,600 ft & 1,512.23 ft \\
\hline Point 54 & 1,700 ft & 1,510.01 ft \\
\hline Point 55 & 1,700 ft & 1,509.01 ft \\
\hline Point 56 & 1,700 ft & 1,508.01 ft \\
\hline Point 57 & 1,800 ft & 1,510.01 ft \\
\hline Point 58 & 1,800 ft & 1,509.01 ft \\
\hline Point 59 & 1,800 ft & 1,508.01 ft \\
\hline Point 60 & 1,887.215 ft & 1,506 ft \\
\hline Point 61 & 1,887.215 ft & 1,505 ft \\
\hline Point 62 & 1,887.215 ft & 1,504 ft \\
\hline Point 63 & 1,900 ft & 1,502.57 ft \\
\hline Point 64 & 1,900 ft & 1,501.57 ft \\
\hline Point 65 & 1,900 ft & 1,500.57 ft \\
\hline Point 66 & 2,000 ft & 1,476.59 ft \\
\hline Point 67 & 2,000 ft & 1,475.59 ft \\
\hline Point 68 & 2,000 ft & 1,474.59 ft \\
\hline Point 69 & 1,257.6267 ft & 1,520.139 ft \\
\hline Point 70 & 1,283.1576 ft & 1,516.9161 ft \\
\hline Point 71 & 2,088.5872 ft & 1,454.1039 ft \\
\hline Point 72 & 2,082.3334 ft & 1,453.6896 ft \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & Area \\
\hline Region 1 & Municipal Solid Waste & \(1,2,3,40,23,24,25,26,27,28,41,29,72,68,65,62,59,56,53,50,47,44,70\) & \(40,058 \mathrm{ft}^{2}\) \\
\hline Region 2 & Lean Clay & \(34,40,3,2,1,70,69,18,17,30,16,15\) & \(28,365 \mathrm{ft}^{2}\) \\
\hline Region 3 & Very Weathered Shale & \(35,39,36,41,28,27,26,25,24,23,40,34\) & \(25,586 \mathrm{ft}^{2}\) \\
\hline Region 4 & Shale Bedrock & \(32,33,39,35\) & \(14,950 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(5,4,21,14,22,31,71,72,29,41,36\) & \(4,527.3 \mathrm{ft}^{2}\) \\
\hline Region 6 & Vegetation Cover & \(18,69,42,45,48,51,54,57,60,63,66,71,31,20,13,12,19,11,10,9,8,7,6\) & \(837.97 \mathrm{ft}^{2}\) \\
\hline Region 7 & Compacted Soil Liner & \(70,44,47,50,53,56,59,62,65,68,72,71,66,63,60,57,54,51,48,45,42,69\) & \(1,630.2 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 885 of 1056 converged

\section*{Current Slip Surface}

Slip Surface: 39
Factor of Safety: 2.318
Volume: 9,818.8463 ft \({ }^{3}\)
Weight: 1,227,181.6 lbf

Resisting Moment: \(1.502428 \mathrm{e}+08 \mathrm{lbf} f \mathrm{ft}\)
Activating Moment: 64,807,456 lbf•ft
Resisting Force: 671,245.81 Ibf
Activating Force: 289,533.63 Ibf
Slip Rank: 1 of 1,056 slip surfaces
Exit: \((1,001.0298,1,490.475) \mathrm{ft}\)
Entry: \((1,269.1214,1,520.5885) \mathrm{ft}\)
Radius: 208.73039 ft
Center: \((1,117.295,1,663.8266) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & \begin{tabular}{l}
Base \\
Normal Stress
\end{tabular} & Frictional Strength & \begin{tabular}{l}
Cohesive \\
Strength
\end{tabular} & Suction Strength & Base Material \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 1
\end{aligned}
\] & \[
\begin{aligned}
& 1,005.1623 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,487.8419 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,859.6846 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,037.3686 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 277.96209 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& 1,013.4273 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,482.8372 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,547.2383
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,875.2266 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 502.46545 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,021.6924 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.3357 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,266.2079 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,599.1881 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 696.45035 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 4
\end{aligned}
\] & \[
\begin{aligned}
& 1,029.9574 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,474.3014 \\
& \mathrm{ft}
\end{aligned}
\] & 4,014.3475
psf & \[
\begin{aligned}
& \text { 3,224.6339 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 864.03804 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 5
\end{aligned}
\] & \[
\begin{aligned}
& 1,038.2224 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.705 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,789.8238 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,763.3015 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,008.3736 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 6
\end{aligned}
\] & \[
\begin{aligned}
& 1,046.4875 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,467.5223 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,591.1306 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,224.3417 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,131.9089 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& 1,055.0135 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,464.6578 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,412.2993 \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 4,716.5976 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,263.8085 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,063.8006 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,462.1188 } \\
& \mathrm{ft}
\end{aligned}
\] & 3,253.7837
psf & \[
\begin{aligned}
& \text { 5,237.2218 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,403.3094 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & \[
\begin{aligned}
& 1,072.5876 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.9899 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,120.8806 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,685.2138 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,523.3485 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 1,081.3747 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,458.2586 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,012.7926 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,065.6248 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,625.2793 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 11
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,090.1618 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.9147 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
2,928.8955 \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 6,382.5599 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,710.2018 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,098.9488 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,455.9508 } \\
& \text { ft }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,868.7193 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,639.3647 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,779.0124 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,107.7359 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,455.3616 } \\
& \mathrm{ft}
\end{aligned}
\] & 2,831.9342 & \[
\begin{aligned}
& \text { 6,838.7622 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,832.4408 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & & & psf & & & & & \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 1,116.5229 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,455.1439 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,818.3419 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,982.9545 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,871.077 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
15
\end{array}
\] & 1,125.31 ft & \[
\begin{aligned}
& 1,455.2965 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,827.8695 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 7,073.6992 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,895.392 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,134.0971 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.8203 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,860.5681
\]
psf & \[
\begin{aligned}
& \text { 7,112.3662 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,905.7528 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
17
\end{array}
\] & \[
\begin{aligned}
& \text { 1,142.8841 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.718 \\
& \mathrm{ft}
\end{aligned}
\] & 2,916.6136
psf & \[
\begin{aligned}
& \text { 7,099.9799 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,902.4339 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,151.6712 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,457.9946 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,996.3123 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 7,037.2484 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,885.625 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,160.4582 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.6572 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,100.1085 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,924.5843 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,855.4368 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,169.2453 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,461.7153 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,228.5982 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,762.1152 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,811.9033 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& 1,178.0324 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.1813 \\
& \mathrm{ft}
\end{aligned}
\] & 3,382.5467
psf & \[
\begin{aligned}
& \text { 6,549.6879 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,754.9836 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,186.8194 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,467.0704 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,562.9133 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,286.8637 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,684.56 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,195.6065 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.4016 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,770.8846 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,972.9063 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,600.4354 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,204.2067 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,474.1075 \\
& \mathrm{ft}
\end{aligned}
\] & 4,002.2446
psf & \[
\begin{aligned}
& 5,521.742 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,479.5463 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & 1,212.62 ft & \[
\begin{aligned}
& 1,478.1948 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,257.4152 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,938.3918 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,323.2381 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 1,221.0333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,482.7652 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,542.7451
\]
psf & \[
\begin{aligned}
& \text { 4,310.3569 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,154.9566 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
27
\end{array}
\] & \[
\begin{aligned}
& 1,230.1463 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,488.3303 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,890.1758 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,573.3973 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 957.48892 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 28 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,239.9588 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,495.051 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text {-5,309.751 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,718.349 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 728.37943 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 1,251.2459 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,503.9634 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
5,866.1515
\]
psf & \[
\begin{aligned}
& \text { 1,602.6463 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 429.42778 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 30 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,262.5648 \\
& \mathrm{ft} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,514.1011 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -6,499.052 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 384.09321 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 102.91747 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& 1,267.8581 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,519.2622 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,821.2581 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& -34.397172 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
11.843896
\] \\
psf
\end{tabular} & 600 psf & 0 psf & Compacted Soil Liner \\
\hline & & & & & & & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
Slice \\
32
\end{tabular} & \[
\begin{aligned}
& \text { 1,268.6673 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,520.1103 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,874.2074 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& -10.236288 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
1.8049338 \\
psf
\end{tabular} & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Not Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section A
Created By: Administrative User
Revision Number: 15
Date: 01/08/2021
Time: 03:20:28 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section A (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:20:34 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

\section*{Not Factor of Safety Dependent}

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Compacted Soil Liner}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb

Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: ( \(1,000,1,490.42\) ) ft
Left-Zone Right Coordinate: \((1,116,1,505.6228) \mathrm{ft}\)
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((1,116,1,505.6228) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,499.4845,1,515.25) \mathrm{ft}\)
Right-Zone Increment: 15
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: (1,000, 1,490.42) ft
Right Coordinate: \((2,300,1,463.14) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,300 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: \((1,887.215,1,505) \mathrm{ft}\)
Inside Point: (1,800, 1,509.01) ft
Length: 87.307138 ft
Direction: \(357.37^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.01) \mathrm{ft}\)
Inside Point: (1,800, 1,509.01) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: (1,600, 1,513.23) ft

Inside Point: (1,700, 1,509.01) ft
Length: 100.089 ft
Direction: \(177.58^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.23) \mathrm{ft}\)
Inside Point: (1,600, 1,513.23) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((1,400,1,517.11) \mathrm{ft}\)
Inside Point: (1,500, 1,513.23) ft
Length: 100.07524 ft

Direction: \(177.78^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 6}

Type: Geosynthetic
Outside Point: \((1,300,1,517.11) \mathrm{ft}\)
Inside Point: (1,400, 1,517.11) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{X} & Y \\
\hline Point 1 & \(1,300 \mathrm{ft}\) & \(1,514.79 \mathrm{ft}\) \\
\hline Point 2 & \(1,400 \mathrm{ft}\) & \(1,493.68 \mathrm{ft}\) \\
\hline Point 3 & \(1,500 \mathrm{ft}\) & \(1,472.03 \mathrm{ft}\) \\
\hline Point 4 & \(2,200 \mathrm{ft}\) & \(1,463.14 \mathrm{ft}\) \\
\hline
\end{tabular}

Not Factor of Safety Dependent
\begin{tabular}{|l|l|l|} 
Point 5 & \(2,300 \mathrm{ft}\) & \(1,463.14 \mathrm{ft}\) \\
\hline Point 6 & \(1,300 \mathrm{ft}\) & \(1,519.11 \mathrm{ft}\) \\
\hline Point 7 & \(1,400 \mathrm{ft}\) & \(1,519.11 \mathrm{ft}\) \\
\hline Point 8 & \(1,500 \mathrm{ft}\) & \(1,515.23 \mathrm{ft}\) \\
\hline Point 9 & \(1,600 \mathrm{ft}\) & \(1,515.23 \mathrm{ft}\) \\
\hline Point 10 & \(1,700 \mathrm{ft}\) & \(1,511.01 \mathrm{ft}\) \\
\hline Point 11 & \(1,800 \mathrm{ft}\) & \(1,511.01 \mathrm{ft}\) \\
\hline Point 12 & \(1,900 \mathrm{ft}\) & \(1,503.57 \mathrm{ft}\) \\
\hline Point 13 & \(2,000 \mathrm{ft}\) & \(1,477.59 \mathrm{ft}\) \\
\hline Point 14 & \(2,100 \mathrm{ft}\) & \(1,452.85 \mathrm{ft}\) \\
\hline Point 15 & \(1,000 \mathrm{ft}\) & \(1,490.42 \mathrm{ft}\) \\
\hline Point 16 & \(1,050.62 \mathrm{ft}\) & \(1,493.125 \mathrm{ft}\) \\
\hline Point 17 & \(1,225.24 \mathrm{ft}\) & \(1,521.75 \mathrm{ft}\) \\
\hline Point 18 & \(1,244.865 \mathrm{ft}\) & \(1,521.75 \mathrm{ft}\) \\
\hline Point 19 & \(1,887.215 \mathrm{ft}\) & \(1,507 \mathrm{ft}\) \\
\hline Point 20 & \(2,085.72 \mathrm{ft}\) & \(1,455.83 \mathrm{ft}\) \\
\hline Point 21 & \(2,111.71 \mathrm{ft}\) & \(1,455.83 \mathrm{ft}\) \\
\hline Point 22 & \(2,094.99 \mathrm{ft}\) & \(1,452.83 \mathrm{ft}\) \\
\hline Point 23 & \(1,618.79 \mathrm{ft}\) & \(1,432.25 \mathrm{ft}\) \\
\hline Point 24 & \(1,700 \mathrm{ft}\) & \(1,432.25 \mathrm{ft}\) \\
\hline Point 25 & \(1,800 \mathrm{ft}\) & \(1,432.25 \mathrm{ft}\) \\
\hline Point 26 & \(1,900 \mathrm{ft}\) & \(1,432.25 \mathrm{ft}\) \\
\hline Point 27 & \(2,000 \mathrm{ft}\) & \(1,432.25 \mathrm{ft}\) \\
\hline Point 28 & \(2,018.54 \mathrm{ft}\) & \(1,432.25 \mathrm{ft}\) \\
\hline Point 29 & \(2,073.81 \mathrm{ft}\) & \(1,453.125 \mathrm{ft}\) \\
\hline Point 30 & \(1,200 \mathrm{ft}\) & \(1,521.68 \mathrm{ft}\) \\
\hline Point 31 & \(2,090.8227 \mathrm{ft}\) & \(1,454.252 \mathrm{ft}\) \\
\hline Point 32 & \(1,000 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Point 33 & \(2,300 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Point 34 & \(1,000 \mathrm{ft}\) & \(1,450 \mathrm{ft}\) \\
\hline Point 35 & \(1,000 \mathrm{ft}\) & \(1,428 \mathrm{ft}\) \\
\hline Point 36 & \(2,300 \mathrm{ft}\) & \(1,440 \mathrm{ft}\) \\
\hline Point 37 & \(2,300 \mathrm{ft}\) & \(1,430 \mathrm{ft}\) \\
\hline Point 38 & \(2,300 \mathrm{ft}\) & \(1,425 \mathrm{ft}\) \\
\hline Point 39 & \(2,300 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Point 40 & \(1,579.0891 \mathrm{ft}\) & \(1,445.5449 \mathrm{ft}\) \\
\hline Point 41 & \(2,044.267 \mathrm{ft}\) & \(1,441.9669 \mathrm{ft}\) \\
\hline Point 42 & \(1,300 \mathrm{ft}\) & \(1,518.11 \mathrm{ft}\) \\
\hline Point 43 & \(1,300 \mathrm{ft}\) & \(1,517.11 \mathrm{ft}\) \\
\hline Point 44 & \(1,300 \mathrm{ft}\) & \(1,516.11 \mathrm{ft}\) \\
\hline Point 45 & \(1,400 \mathrm{ft}\) & \(1,518.11 \mathrm{ft}\) \\
\hline Point 46 & \(1,400 \mathrm{ft}\) & \(1,517.11 \mathrm{ft}\) \\
\hline Point 47 & \(1,400 \mathrm{ft}\) & \(1,516.11 \mathrm{ft}\) \\
\hline Point 48 & \(1,500 \mathrm{ft}\) & \(1,514.23 \mathrm{ft}\) \\
\hline Point 49 & \(1,500 \mathrm{ft}\) & \(1,513.23 \mathrm{ft}\) \\
\hline Point 50 & \(1,500 \mathrm{ft}\) & \(1,512.23 \mathrm{ft}\) \\
\hline Point 51 & \(1,600 \mathrm{ft}\) & \(1,514.23 \mathrm{ft}\) \\
\hline Point 52 & \(1,600 \mathrm{ft}\) & \(1,513.23 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}

Not Factor of Safety Dependent
\begin{tabular}{|l|l|l|} 
Point 53 & \(1,600 \mathrm{ft}\) & \(1,512.23 \mathrm{ft}\) \\
\hline Point 54 & \(1,700 \mathrm{ft}\) & \(1,510.01 \mathrm{ft}\) \\
\hline Point 55 & \(1,700 \mathrm{ft}\) & \(1,509.01 \mathrm{ft}\) \\
\hline Point 56 & \(1,700 \mathrm{ft}\) & \(1,508.01 \mathrm{ft}\) \\
\hline Point 57 & \(1,800 \mathrm{ft}\) & \(1,510.01 \mathrm{ft}\) \\
\hline Point 58 & \(1,800 \mathrm{ft}\) & \(1,509.01 \mathrm{ft}\) \\
\hline Point 59 & \(1,800 \mathrm{ft}\) & \(1,508.01 \mathrm{ft}\) \\
\hline Point 60 & \(1,887.215 \mathrm{ft}\) & \(1,506 \mathrm{ft}\) \\
\hline Point 61 & \(1,887.215 \mathrm{ft}\) & \(1,505 \mathrm{ft}\) \\
\hline Point 62 & \(1,887.215 \mathrm{ft}\) & \(1,504 \mathrm{ft}\) \\
\hline Point 63 & \(1,900 \mathrm{ft}\) & \(1,502.57 \mathrm{ft}\) \\
\hline Point 64 & \(1,900 \mathrm{ft}\) & \(1,501.57 \mathrm{ft}\) \\
\hline Point 65 & \(1,900 \mathrm{ft}\) & \(1,500.57 \mathrm{ft}\) \\
\hline Point 66 & \(2,000 \mathrm{ft}\) & \(1,476.59 \mathrm{ft}\) \\
\hline Point 67 & \(2,000 \mathrm{ft}\) & \(1,475.59 \mathrm{ft}\) \\
\hline Point 68 & \(2,000 \mathrm{ft}\) & \(1,474.59 \mathrm{ft}\) \\
\hline Point 69 & \(1,257.6267 \mathrm{ft}\) & \(1,520.139 \mathrm{ft}\) \\
\hline Point 70 & \(1,283.1576 \mathrm{ft}\) & \(1,516.9161 \mathrm{ft}\) \\
\hline Point 71 & \(2,088.5872 \mathrm{ft}\) & \(1,454.1039 \mathrm{ft}\) \\
\hline Point 72 & \(2,082.3334 \mathrm{ft}\) & \(1,453.6896 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & \multicolumn{1}{c|}{\(\mathrm{Area}^{|c|}\)} \\
\hline Region 1 & Municipal Solid Waste & \(1,2,3,40,23,24,25,26,27,28,41,29,72,68,65,62,59,56,53,50,47,44,70\) & \(40,058 \mathrm{ft}^{2}\) \\
\hline Region 2 & Lean Clay & \(34,40,3,2,1,70,69,18,17,30,16,15\) & \(28,365 \mathrm{ft}^{2}\) \\
\hline Region 3 & Very Weathered Shale & \(35,39,36,41,28,27,26,25,24,23,40,34\) & \(25,586 \mathrm{ft}^{2}\) \\
\hline Region 4 & Shale Bedrock & \(32,33,39,35\) & \(14,950 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(5,4,21,14,22,31,71,72,29,41,36\) & \(4,527.3 \mathrm{ft}^{2}\) \\
\hline Region 6 & Vegetation Cover & \(18,69,42,45,48,51,54,57,60,63,66,71,31,20,13,12,19,11,10,9,8,7,6\) & \(837.97 \mathrm{ft}^{2}\) \\
\hline Region 7 & Compacted Soil Liner & \(70,44,47,50,53,56,59,62,65,68,72,71,66,63,60,57,54,51,48,45,42,69\) & \(1,630.2 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 815 of 1056 converged

\section*{Current Slip Surface}

Slip Surface: 33
Factor of Safety: 4.545
Volume: 7,522.3534 ft \({ }^{3}\)
Weight: 940,294.18 lbf
Resisting Moment: 1.1140262e+08 lbf•ft
Activating Moment: 24,510,227 Ibf•ft
Resisting Force: 539,293.15 lbf
Activating Force: \(118,658.34 \mathrm{lbf}\)
Slip Rank: 1 of 1,056 slip surfaces

Exit: (1,000, 1,490.42) ft
Entry: \((1,242.8601,1,521.75) \mathrm{ft}\)
Radius: 191.88137 ft
Center: (1,102.5273, 1,652.6131) ft

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & Cohesive Strength & Suction Strength & \begin{tabular}{l}
Base \\
Material
\end{tabular} \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 1
\end{aligned}
\] & \[
\begin{aligned}
& 1,004.2183 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,487.9023 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,863.4524 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 585.51904 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 156.88935 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& 1,012.655 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,483.1474 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,566.6067 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,274.3954 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 341.47323 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,021.0917 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.9324 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,303.4637 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,877.3075 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 503.02303 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & \[
\begin{aligned}
& \text { 1,029.5283 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,475.2186 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,071.6124 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,403.0204 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 643.88738 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 1,037.965 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,471.9751 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,869.1165 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,858.3958 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 765.90484 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& \text { 1,046.4017 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,469.1767 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,694.4144 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 3,248.8831 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 870.53561 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & \[
\begin{aligned}
& \text { 1,054.7694 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.8194 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,547.2489 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,651.5325 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 978.42518 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
8
\end{tabular} & \[
\begin{aligned}
& 1,063.0683 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,464.8807 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,426.2114 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,069.0483 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,090.2982 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & \[
\begin{aligned}
& 1,071.3672 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,463.3255 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,329.1179 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,431.9383 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,187.5343 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
10
\end{tabular} & \[
\begin{aligned}
& \text { 1,079.6661 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,462.1443 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,255.3808 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 4,742.5249 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,270.7557 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& 1,087.965 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,461.3304 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,204.5666 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,002.6636 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,340.4597 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & \[
\begin{aligned}
& 1,096.2639 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.879 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,176.3826 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,213.8091 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,397.0359 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,104.5628 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.7874 \\
& \mathrm{ft} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& -3,170.669 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,377.0638 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,440.7799 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,200 psf & 0 psf & \[
\begin{aligned}
& \text { Lean } \\
& \text { Clay } \\
& \hline
\end{aligned}
\] \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& \text { 1,112.8617 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,461.0553 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,187.3933 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 5,493.2125 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,471.9019 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean
Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,121.1606 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,461.6841 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,226.6502 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,562.7465 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,490.5334 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice & 1,129.4594 & 1,462.6775 & -3,288.664 & 5,585.8775 & 1,496.7314 & & & Lean \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 16 & ft & ft & psf & psf & psf & 1,200 psf & 0 psf & Clay \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 1,137.7583 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.0411 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,373.7949 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,562.5439 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,490.4792 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice
\[
18
\] & \[
\begin{aligned}
& 1,146.0572 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.7831 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,482.5502 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 5,492.4084 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,471.6864 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
19
\end{tabular} & \[
\begin{aligned}
& 1,154.3561 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,467.9143 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,615.5998 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,374.8478 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,440.1861 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
20
\end{tabular} & \[
\begin{aligned}
& 1,162.655 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.4483 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,773.7982 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 5,208.9335 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,395.7295 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
21
\end{tabular} & \[
\begin{aligned}
& \text { 1,170.9539 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,473.4023 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,958.2149 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,993.4021 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,337.978 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & \[
\begin{aligned}
& 1,179.2528 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,476.7974 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,170.1749 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,726.613 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,266.4921 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& 1,187.5517 \\
& \mathrm{ft}
\end{aligned}
\] & 1,480.66 ft & \[
4,411.3146
\]
\[
\mathrm{psf}
\] & \[
\begin{aligned}
& \text { 4,406.4904 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,180.7155 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& 1,195.8506 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,485.0223 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,683.6581 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,030.4433 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,079.954 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline Slice 25 & \[
\begin{aligned}
& 1,204.2067 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,489.9627 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,992.0872 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,501.1867 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 938.14015 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
26
\end{tabular} & 1,212.62 ft & \[
\begin{aligned}
& 1,495.5409 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,340.3372 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,816.7799 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 754.7539 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
27
\end{tabular} & \[
\begin{aligned}
& 1,221.0333 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,501.7948 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
5,730.7679
\]
psf & \[
\begin{aligned}
& \text { 2,066.6701 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 553.76258 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& 1,229.645 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,508.9993 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,180.5435 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,222.2442 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 327.49936 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 1,238.4551 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,517.3242 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,700.2678 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 272.4908 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 73.013691 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline
\end{tabular}

\section*{Not FS Dependent Pseudo Static}

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\section*{File Information}

File Version: 9.01
Title: Section A
Created By: Administrative User
Revision Number: 15
Date: 01/08/2021
Time: 03:20:28 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section A (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:20:36 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not FS Dependent Pseudo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Compacted Soil Liner}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb

Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((1,001.5705,1,490.5039) \mathrm{ft}\)
Left-Zone Right Coordinate: \((1,116.6653,1,505.75)\) ft
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((1,116.6653,1,505.75) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,499.4845,1,515.25) \mathrm{ft}\)
Right-Zone Increment: 15
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((1,000,1,490.42) \mathrm{ft}\)
Right Coordinate: \((2,300,1,463.14) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,300 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: (1,887.215, 1,505) ft
Inside Point: \((1,800,1,509.01) \mathrm{ft}\)
Length: 87.307138 ft
Direction: \(357.37^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.01) \mathrm{ft}\)
Inside Point: \((1,800,1,509.01) \mathrm{ft}\)
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft

Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: \((1,600,1,513.23) \mathrm{ft}\)
Inside Point: \((1,700,1,509.01) \mathrm{ft}\)
Length: 100.089 ft
Direction: \(177.58^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.23) \mathrm{ft}\)
Inside Point: \((1,600,1,513.23) \mathrm{ft}\)
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((1,400,1,517.11) \mathrm{ft}\)
Inside Point: \((1,500,1,513.23) \mathrm{ft}\)
Length: 100.07524 ft
Direction: \(177.78^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 6}

Type: Geosynthetic
Outside Point: \((1,300,1,517.11) \mathrm{ft}\)
Inside Point: \((1,400,1,517.11) \mathrm{ft}\)
Slip Surface Intersection: \((1,343.8221,1,517.11) \mathrm{ft}\)
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 24.68004 lbf
Pullout Force per Length: \(13.213537 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 43.82213 ft
Required Length: 1.8677846 ft
Governing Component: Tensile Capacity

\section*{Points}
\begin{tabular}{|c|c|c|}
\hline & X & Y \\
\hline Point 1 & 1,300 ft & 1,514.79 ft \\
\hline Point 2 & 1,400 ft & 1,493.68 ft \\
\hline Point 3 & 1,500 ft & 1,472.03 ft \\
\hline Point 4 & 2,200 ft & 1,463.14 ft \\
\hline Point 5 & 2,300 ft & 1,463.14 ft \\
\hline Point 6 & 1,300 ft & 1,519.11 ft \\
\hline Point 7 & 1,400 ft & 1,519.11 ft \\
\hline Point 8 & 1,500 ft & 1,515.23 ft \\
\hline Point 9 & 1,600 ft & 1,515.23 ft \\
\hline Point 10 & 1,700 ft & 1,511.01 ft \\
\hline Point 11 & 1,800 ft & 1,511.01 ft \\
\hline Point 12 & 1,900 ft & 1,503.57 ft \\
\hline Point 13 & 2,000 ft & 1,477.59 ft \\
\hline Point 14 & 2,100 ft & 1,452.85 ft \\
\hline Point 15 & 1,000 ft & 1,490.42 ft \\
\hline Point 16 & 1,050.62 ft & 1,493.125 ft \\
\hline Point 17 & 1,225.24 ft & 1,521.75 ft \\
\hline Point 18 & 1,244.865 ft & 1,521.75 ft \\
\hline Point 19 & 1,887.215 ft & 1,507 ft \\
\hline Point 20 & 2,085.72 ft & 1,455.83 ft \\
\hline Point 21 & 2,111.71 ft & 1,455.83 ft \\
\hline Point 22 & 2,094.99 ft & 1,452.83 ft \\
\hline Point 23 & 1,618.79 ft & 1,432.25 ft \\
\hline Point 24 & 1,700 ft & 1,432.25 ft \\
\hline Point 25 & 1,800 ft & 1,432.25 ft \\
\hline Point 26 & 1,900 ft & 1,432.25 ft \\
\hline Point 27 & 2,000 ft & 1,432.25 ft \\
\hline Point 28 & 2,018.54 ft & 1,432.25 ft \\
\hline Point 29 & 2,073.81 ft & 1,453.125 ft \\
\hline Point 30 & 1,200 ft & 1,521.68 ft \\
\hline Point 31 & 2,090.8227 ft & 1,454.252 ft \\
\hline Point 32 & 1,000 ft & 1,410 ft \\
\hline Point 33 & 2,300 ft & 1,410 ft \\
\hline Point 34 & 1,000 ft & 1,450 ft \\
\hline Point 35 & 1,000 ft & 1,428 ft \\
\hline Point 36 & 2,300 ft & 1,440 ft \\
\hline Point 37 & 2,300 ft & 1,430 ft \\
\hline Point 38 & 2,300 ft & 1,425 ft \\
\hline Point 39 & 2,300 ft & 1,415 ft \\
\hline Point 40 & 1,579.0891 ft & 1,445.5449 ft \\
\hline Point 41 & 2,044.267 ft & 1,441.9669 ft \\
\hline Point 42 & 1,300 ft & 1,518.11 ft \\
\hline Point 43 & 1,300 ft & 1,517.11 ft \\
\hline Point 44 & 1,300 ft & 1,516.11 ft \\
\hline Point 45 & 1,400 ft & 1,518.11 ft \\
\hline Point 46 & 1,400 ft & 1,517.11 ft \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|} 
Point 47 & \(1,400 \mathrm{ft}\) & \(1,516.11 \mathrm{ft}\) \\
\hline Point 48 & \(1,500 \mathrm{ft}\) & \(1,514.23 \mathrm{ft}\) \\
\hline Point 49 & \(1,500 \mathrm{ft}\) & \(1,513.23 \mathrm{ft}\) \\
\hline Point 50 & \(1,500 \mathrm{ft}\) & \(1,512.23 \mathrm{ft}\) \\
\hline Point 51 & \(1,600 \mathrm{ft}\) & \(1,514.23 \mathrm{ft}\) \\
\hline Point 52 & \(1,600 \mathrm{ft}\) & \(1,513.23 \mathrm{ft}\) \\
\hline Point 53 & \(1,600 \mathrm{ft}\) & \(1,512.23 \mathrm{ft}\) \\
\hline Point 54 & \(1,700 \mathrm{ft}\) & \(1,510.01 \mathrm{ft}\) \\
\hline Point 55 & \(1,700 \mathrm{ft}\) & \(1,509.01 \mathrm{ft}\) \\
\hline Point 56 & \(1,700 \mathrm{ft}\) & \(1,508.01 \mathrm{ft}\) \\
\hline Point 57 & \(1,800 \mathrm{ft}\) & \(1,510.01 \mathrm{ft}\) \\
\hline Point 58 & \(1,800 \mathrm{ft}\) & \(1,509.01 \mathrm{ft}\) \\
\hline Point 59 & \(1,800 \mathrm{ft}\) & \(1,508.01 \mathrm{ft}\) \\
\hline Point 60 & \(1,887.215 \mathrm{ft}\) & \(1,506 \mathrm{ft}\) \\
\hline Point 61 & \(1,887.215 \mathrm{ft}\) & \(1,505 \mathrm{ft}\) \\
\hline Point 62 & \(1,887.215 \mathrm{ft}\) & \(1,504 \mathrm{ft}\) \\
\hline Point 63 & \(1,900 \mathrm{ft}\) & \(1,502.57 \mathrm{ft}\) \\
\hline Point 64 & \(1,900 \mathrm{ft}\) & \(1,501.57 \mathrm{ft}\) \\
\hline Point 65 & \(1,900 \mathrm{ft}\) & \(1,500.57 \mathrm{ft}\) \\
\hline Point 66 & \(2,000 \mathrm{ft}\) & \(1,476.59 \mathrm{ft}\) \\
\hline Point 67 & \(2,000 \mathrm{ft}\) & \(1,475.59 \mathrm{ft}\) \\
\hline Point 68 & \(2,000 \mathrm{ft}\) & \(1,474.59 \mathrm{ft}\) \\
\hline Point 69 & \(1,257.6267 \mathrm{ft}\) & \(1,520.139 \mathrm{ft}\) \\
\hline Point 70 & \(1,283.1576 \mathrm{ft}\) & \(1,516.9161 \mathrm{ft}\) \\
\hline Point 71 & \(2,088.5872 \mathrm{ft}\) & \(1,454.1039 \mathrm{ft}\) \\
\hline Point 72 & \(2,082.3334 \mathrm{ft}\) & \(1,453.6896 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & \multicolumn{1}{c|}{\(\mathrm{Area}^{|c|}\)} \\
\hline Region 1 & Municipal Solid Waste & \(1,2,3,40,23,24,25,26,27,28,41,29,72,68,65,62,59,56,53,50,47,44,70\) & \(40,058 \mathrm{ft}^{2}\) \\
\hline Region 2 & Lean Clay & \(34,40,3,2,1,70,69,18,17,30,16,15\) & \(28,365 \mathrm{ft}^{2}\) \\
\hline Region 3 & Very Weathered Shale & \(35,39,36,41,28,27,26,25,24,23,40,34\) & \(25,586 \mathrm{ft}^{2}\) \\
\hline Region 4 & Shale Bedrock & \(32,33,39,35\) & \(14,950 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(5,4,21,14,22,31,71,72,29,41,36\) & \(4,527.3 \mathrm{ft}^{2}\) \\
\hline Region 6 & Vegetation Cover & \(18,69,42,45,48,51,54,57,60,63,66,71,31,20,13,12,19,11,10,9,8,7,6\) & \(837.97 \mathrm{ft}^{2}\) \\
\hline Region 7 & Compacted Soil Liner & \(70,44,47,50,53,56,59,62,65,68,72,71,66,63,60,57,54,51,48,45,42,69\) & \(1,630.2 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 267 of 1056 converged

\section*{Current Slip Surface}

Slip Surface: 57
Factor of Safety: 2.553
Volume: 17,428.629 ft \({ }^{3}\)

Weight: 2,168,914 lbf
Resisting Moment: 59,120,212 lbffft
Activating Moment: 23,159,744 Ibf•ft
Resisting Force: 1,075,698.9 lbf
Activating Force: 421,408.75 Ibf
Slip Rank: 1 of 1,056 slip surfaces
Exit: (1,001.5705, 1,490.5039) ft
Entry: \((1,345.7729,1,519.11) \mathrm{ft}\)
Radius: 261.41419 ft
Center: \((1,933,1,516) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & \begin{tabular}{l}
Base \\
Normal Stress
\end{tabular} & Frictional Strength & Cohesive Strength & Suction Strength & Base Material \\
\hline \begin{tabular}{l}
Slice \\
1
\end{tabular} & \[
\begin{aligned}
& \text { 1,007.7017 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,486.2178 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,758.2914 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,326.7197 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 355.49347 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
2
\end{tabular} & \[
\begin{aligned}
& \text { 1,019.9641 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,478.1396 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,253.9698 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,691.628 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 721.21955 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
3
\end{tabular} & \[
\begin{aligned}
& 1,032.2264 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,471.0013 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,808.3237 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,842.0367 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,029.4706 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & \[
\begin{aligned}
& \text { 1,044.4888 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.717 \\
& \mathrm{ft}
\end{aligned}
\] & \[
3,415.9947
\]
psf & \[
\begin{aligned}
& \text { 4,813.3093 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,289.7223 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 1,056.2631 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.4102 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,084.6861 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,723.5372 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,533.6172 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 1,067.5494 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.9748 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,807.7856 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,595.3726 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,767.2248 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & \[
\begin{aligned}
& 1,078.8356 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,451.1292 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,567.7029 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 7,356.1595 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,971.077 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
8
\end{tabular} & \[
\begin{aligned}
& 1,090.2548 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,447.8141 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,360.742 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 8,120.895 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,431.9329 } \\
& \text { psf }
\end{aligned}
\] & 2,400 psf & 0 psf & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} \\
\hline \begin{tabular}{l}
Slice \\
9
\end{tabular} & \[
\begin{aligned}
& \text { 1,101.8069 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,445.0203 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,186.3223 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 8,694.0414 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,532.9941 \\
& \text { psf }
\end{aligned}
\] & 2,400 psf & 0 psf & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} \\
\hline \begin{tabular}{l}
Slice \\
10
\end{tabular} & \[
\begin{aligned}
& 1,113.359 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,442.7745 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,046.1198 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 9,176.8256 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,618.122 } \\
& \text { psf }
\end{aligned}
\] & 2,400 psf & 0 psf & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& \text { 1,124.9112 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,441.0626 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,939.2438 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 9,574.0504 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,688.1634 } \\
& \text { psf }
\end{aligned}
\] & 2,400 psf & 0 psf & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & \[
\begin{aligned}
& \text { 1,136.4633 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,439.8739 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,865.0358 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 9,889.5714 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,743.7983 } \\
& \text { psf }
\end{aligned}
\] & 2,400 psf & 0 psf & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} \\
\hline Slice & 1,148.0154 & 1,439.2014 & -1,823.049 & 10,126.456 & 1,785.5674 & & & Very \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 13 & ft & ft & psf & psf & psf & 2,400 psf & 0 psf & Weathered Shale \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& \text { 1,159.5675 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,439.041 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -1,813.034 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 10,287.1 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,813.8932 } \\
& \text { psf }
\end{aligned}
\] & 2,400 psf & 0 psf & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} \\
\hline Slice 15 & \[
\begin{aligned}
& \text { 1,171.1197 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,439.3917 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,834.9317 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 10,373.312 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,829.0949 \\
& \text { psf }
\end{aligned}
\] & 2,400 psf & 0 psf & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 1,182.6718 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,440.2557 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,888.8717 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 10,386.378 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,831.3987 } \\
& \text { psf }
\end{aligned}
\] & 2,400 psf & 0 psf & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} \\
\hline Slice
\[
17
\] & \[
\begin{aligned}
& \text { 1,194.2239 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,441.6381 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,975.1753 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 10,327.096 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,820.9456 } \\
& \text { psf }
\end{aligned}
\] & 2,400 psf & 0 psf & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} \\
\hline \begin{tabular}{l}
Slice \\
18
\end{tabular} & 1,206.31 ft & \[
\begin{aligned}
& \text { 1,443.6615 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,101.495 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 10,033.707 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,769.2132 } \\
& \text { psf }
\end{aligned}
\] & 2,400 psf & 0 psf & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} \\
\hline \begin{tabular}{l}
Slice \\
19
\end{tabular} & 1,218.93 ft & \[
\begin{aligned}
& 1,446.3914 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,271.9236 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 9,504.8814 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,675.967 } \\
& \text { psf }
\end{aligned}
\] & 2,400 psf & 0 psf & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} \\
\hline \begin{tabular}{l}
Slice \\
20
\end{tabular} & \[
\begin{aligned}
& 1,225.8629 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,448.0886 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,377.8778 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 9,191.8109 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,620.7643 } \\
& \text { psf }
\end{aligned}
\] & 2,400 psf & 0 psf & \begin{tabular}{l}
Very \\
Weathered \\
Shale
\end{tabular} \\
\hline \begin{tabular}{l}
Slice \\
21
\end{tabular} & \[
\begin{aligned}
& 1,231.0806 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,449.6073 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,472.6886 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 8,946.3026 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,397.1546 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & \[
\begin{aligned}
& 1,240.2702 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,452.4927 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,652.8247 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 8,474.7621 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,270.8057 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
23
\end{tabular} & \[
\begin{aligned}
& 1,251.2459 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.4831 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,901.9485 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 7,811.3572 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,093.0469 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& \text { 1,264.0094 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,461.7893 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,233.2156 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,944.8978 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,860.8797 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
25
\end{tabular} & \[
\begin{aligned}
& \text { 1,276.7749 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,467.9179 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,615.8282 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,004.9856 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,609.031 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
26
\end{tabular} & \[
\begin{aligned}
& 1,291.5788 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.2355 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,135.0971 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,764.9615 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,276.7676 } \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
27
\end{tabular} & \[
\begin{aligned}
& \text { 1,305.6651 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,485.1785 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,693.4054 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3,467.7762 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 929.18784 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
28
\end{tabular} & \[
\begin{aligned}
& 1,316.9952 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,493.4496 \\
& \mathrm{ft}
\end{aligned}
\] & \[
5,209.7745
\]
psf & \[
\begin{aligned}
& \text { 2,323.9305 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 622.69531 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 1,328.3254 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,502.7164 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,788.3047 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,109.9445 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 297.40874 \\
& \text { psf }
\end{aligned}
\] & 1,200 psf & 0 psf & Lean Clay \\
\hline \begin{tabular}{l}
Slice \\
30
\end{tabular} & \[
\begin{aligned}
& 1,338.4147 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,511.8623 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,359.2832 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 441.89358 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline & & & - & & & & & \\
\hline
\end{tabular}

Not FS Dependent Pseudo Static
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\begin{tabular}{l} 
Slice \\
31
\end{tabular} & \begin{tabular}{l}
\(1,343.8221\) \\
ft
\end{tabular} & \(1,517.11 \mathrm{ft}\) & \begin{tabular}{l}
\(6,686.8975\) \\
psf
\end{tabular} & \begin{tabular}{l}
47.919634 \\
psf
\end{tabular} & \begin{tabular}{l}
16.500053 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
32
\end{tabular} & \begin{tabular}{l}
\(1,345.2891\) \\
ft
\end{tabular} & \(1,518.61 \mathrm{ft}\) & \begin{tabular}{l}
- \\
\(6,780.5428\) \\
psf
\end{tabular} & \begin{tabular}{l}
-4.1379919 \\
psf
\end{tabular} & \begin{tabular}{l}
- \\
0.72963961 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline
\end{tabular}

\section*{Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section A
Created By: Administrative User
Revision Number: 12
Date: 01/08/2021
Time: 03:14:19 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section A (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:14:24 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Compacted Soil Liner}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb

Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((1,800,1,511.01) \mathrm{ft}\)
Left-Zone Right Coordinate: \((1,981,1,482.5262) \mathrm{ft}\)
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((1,981,1,482.5262) \mathrm{ft}\)
Right-Zone Right Coordinate: \((2,142,1,458.3379) \mathrm{ft}\)
Right-Zone Increment: 15
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((1,000,1,490.42) \mathrm{ft}\)
Right Coordinate: \((2,300,1,463.14) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,300 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: \((1,887.215,1,505) \mathrm{ft}\)
Inside Point: (1,800, 1,509.01) ft
Slip Surface Intersection: \((1,876.8263,1,505.4777) \mathrm{ft}\)
Length: 87.307138 ft
Direction: \(357.37^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 21.547372 lbf
Pullout Force per Length: \(11.536326 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 10.399718 ft
Required Length: 1.8677846 ft
Governing Component: Tensile Capacity

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.01) \mathrm{ft}\)
Inside Point: (1,800, 1,509.01) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8{ }^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic

Outside Point: \((1,600,1,513.23) \mathrm{ft}\)
Inside Point: \((1,700,1,509.01) \mathrm{ft}\)
Length: 100.089 ft
Direction: \(177.58^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.23) \mathrm{ft}\)
Inside Point: \((1,600,1,513.23) \mathrm{ft}\)
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((1,400,1,517.11) \mathrm{ft}\) Inside Point: \((1,500,1,513.23) \mathrm{ft}\)

Length: 100.07524 ft
Direction: \(177.78^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 6}

Type: Geosynthetic
Outside Point: \((1,300,1,517.11) \mathrm{ft}\)
Inside Point: (1,400, 1,517.11) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|l|l|c|}
\hline & X & Y \\
\hline Point 1 & \(1,300 \mathrm{ft}\) & \(1,514.79 \mathrm{ft}\) \\
\hline Point 2 & \(1,400 \mathrm{ft}\) & \(1,493.68 \mathrm{ft}\) \\
\hline Point 3 & \(1,500 \mathrm{ft}\) & \(1,472.03 \mathrm{ft}\) \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 4 & 2,200 ft & 1,463.14 ft \\
\hline Point 5 & 2,300 ft & 1,463.14 ft \\
\hline Point 6 & 1,300 ft & 1,519.11 ft \\
\hline Point 7 & 1,400 ft & 1,519.11 ft \\
\hline Point 8 & 1,500 ft & 1,515.23 ft \\
\hline Point 9 & 1,600 ft & 1,515.23 ft \\
\hline Point 10 & 1,700 ft & 1,511.01 ft \\
\hline Point 11 & 1,800 ft & 1,511.01 ft \\
\hline Point 12 & 1,900 ft & 1,503.57 ft \\
\hline Point 13 & 2,000 ft & 1,477.59 ft \\
\hline Point 14 & 2,100 ft & 1,452.85 ft \\
\hline Point 15 & 1,000 ft & 1,490.42 ft \\
\hline Point 16 & 1,050.62 ft & 1,493.125 ft \\
\hline Point 17 & 1,225.24 ft & 1,521.75 ft \\
\hline Point 18 & 1,244.865 ft & 1,521.75 ft \\
\hline Point 19 & 1,887.215 ft & 1,507 ft \\
\hline Point 20 & 2,085.72 ft & 1,455.83 ft \\
\hline Point 21 & 2,111.71 ft & 1,455.83 ft \\
\hline Point 22 & 2,094.99 ft & 1,452.83 ft \\
\hline Point 23 & 1,618.79 ft & 1,432.25 ft \\
\hline Point 24 & 1,700 ft & 1,432.25 ft \\
\hline Point 25 & 1,800 ft & 1,432.25 ft \\
\hline Point 26 & 1,900 ft & 1,432.25 ft \\
\hline Point 27 & 2,000 ft & 1,432.25 ft \\
\hline Point 28 & 2,018.54 ft & 1,432.25 ft \\
\hline Point 29 & 2,073.81 ft & 1,453.125 ft \\
\hline Point 30 & 1,200 ft & 1,521.68 ft \\
\hline Point 31 & 2,090.8227 ft & 1,454.252 ft \\
\hline Point 32 & 1,000 ft & 1,410 ft \\
\hline Point 33 & 2,300 ft & 1,410 ft \\
\hline Point 34 & 1,000 ft & 1,450 ft \\
\hline Point 35 & 1,000 ft & 1,428 ft \\
\hline Point 36 & 2,300 ft & 1,440 ft \\
\hline Point 37 & 2,300 ft & 1,430 ft \\
\hline Point 38 & 2,300 ft & 1,425 ft \\
\hline Point 39 & 2,300 ft & 1,415 ft \\
\hline Point 40 & 1,579.0891 ft & 1,445.5449 ft \\
\hline Point 41 & 2,044.267 ft & 1,441.9669 ft \\
\hline Point 42 & 1,300 ft & 1,518.11 ft \\
\hline Point 43 & 1,300 ft & 1,517.11 ft \\
\hline Point 44 & 1,300 ft & 1,516.11 ft \\
\hline Point 45 & 1,400 ft & 1,518.11 ft \\
\hline Point 46 & 1,400 ft & 1,517.11 ft \\
\hline Point 47 & 1,400 ft & 1,516.11 ft \\
\hline Point 48 & 1,500 ft & 1,514.23 ft \\
\hline Point 49 & 1,500 ft & 1,513.23 ft \\
\hline Point 50 & 1,500 ft & 1,512.23 ft \\
\hline Point 51 & 1,600 ft & 1,514.23 ft \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 52 & 1,600 ft & 1,513.23 ft \\
\hline Point 53 & 1,600 ft & 1,512.23 ft \\
\hline Point 54 & 1,700 ft & 1,510.01 ft \\
\hline Point 55 & 1,700 ft & 1,509.01 ft \\
\hline Point 56 & 1,700 ft & 1,508.01 ft \\
\hline Point 57 & 1,800 ft & 1,510.01 ft \\
\hline Point 58 & 1,800 ft & 1,509.01 ft \\
\hline Point 59 & 1,800 ft & 1,508.01 ft \\
\hline Point 60 & 1,887.215 ft & 1,506 ft \\
\hline Point 61 & 1,887.215 ft & 1,505 ft \\
\hline Point 62 & 1,887.215 ft & 1,504 ft \\
\hline Point 63 & 1,900 ft & 1,502.57 ft \\
\hline Point 64 & 1,900 ft & 1,501.57 ft \\
\hline Point 65 & 1,900 ft & 1,500.57 ft \\
\hline Point 66 & 2,000 ft & 1,476.59 ft \\
\hline Point 67 & 2,000 ft & 1,475.59 ft \\
\hline Point 68 & 2,000 ft & 1,474.59 ft \\
\hline Point 69 & 1,257.6267 ft & 1,520.139 ft \\
\hline Point 70 & 1,283.1576 ft & 1,516.9161 ft \\
\hline Point 71 & 2,088.5872 ft & 1,454.1039 ft \\
\hline Point 72 & 2,082.3334 ft & 1,453.6896 ft \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & Area \\
\hline Region 1 & Municipal Solid Waste & \(1,2,3,40,23,24,25,26,27,28,41,29,72,68,65,62,59,56,53,50,47,44,70\) & \(40,058 \mathrm{ft}^{2}\) \\
\hline Region 2 & Lean Clay & \(34,40,3,2,1,70,69,18,17,30,16,15\) & \(28,365 \mathrm{ft}^{2}\) \\
\hline Region 3 & Very Weathered Shale & \(35,39,36,41,28,27,26,25,24,23,40,34\) & \(25,586 \mathrm{ft}^{2}\) \\
\hline Region 4 & Shale Bedrock & \(32,33,39,35\) & \(14,950 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(5,4,21,14,22,31,71,72,29,41,36\) & \(4,527.3 \mathrm{ft}^{2}\) \\
\hline Region 6 & Vegetation Cover & \(18,69,42,45,48,51,54,57,60,63,66,71,31,20,13,12,19,11,10,9,8,7,6\) & \(837.97 \mathrm{ft}^{2}\) \\
\hline Region 7 & Compacted Soil Liner & \(70,44,47,50,53,56,59,62,65,68,72,71,66,63,60,57,54,51,48,45,42,69\) & \(1,630.2 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 860 of 1056 converged

\section*{Current Slip Surface}

Slip Surface: 446
Factor of Safety: 2.924
Volume: 3,200.8622 ft \({ }^{3}\)
Weight: 238,193.82 lbf
Resisting Moment: 51,625,058 lbf•ft
Activating Moment: 17,657,328 lbf•ft
Resisting Force: \(156,537.61 \mathrm{lbf}\)
Activating Force: 53,537.958 lbf

Slip Rank: 1 of 1,056 slip surfaces
Exit: \((2,087.7559,1,455.2004) \mathrm{ft}\)
Entry: \((1,873.6155,1,507.6253) \mathrm{ft}\)
Radius: 315.32569 ft
Center: \((2,050.937,1,768.3692) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & Cohesive Strength & Suction Strength & Base Material \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 1
\end{aligned}
\] & \[
\begin{aligned}
& 1,874.4096 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,507.0888 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,061.2703 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 22.333824 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3.9380558 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& 1,876.8263 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,505.4777 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,960.6881 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 125.41696 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 43.184524 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 1,882.8319 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,501.6406 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{array}{|l}
\hline-5,721.141 \\
\text { psf } \\
\hline
\end{array}
\] & \[
\begin{aligned}
& 400.69374 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 4
\end{aligned}
\] & \[
\begin{aligned}
& 1,890.4113 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,496.9876 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,430.6495 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 610.04544 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 5
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,896.8038 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,493.3059 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,200.8027 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 728.87029 \\
& \mathrm{psf}
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 6
\end{aligned}
\] & \[
\begin{aligned}
& 1,903.5714 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,489.6267 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,971.1108 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 840.85412 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 546.05705 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& 1,910.7143 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,485.9652 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,742.5242
\]
psf & \[
\begin{aligned}
& 948.24589 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 615.79808 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 1,917.8571 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,482.5291 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -4,528.008 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,045.5149 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 678.96534 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & 1,925 ft & \[
\begin{aligned}
& 1,479.3104 \\
& \mathrm{ft}
\end{aligned}
\] & 4,327.0598
psf & \[
\begin{aligned}
& \text { 1,132.6636 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 735.56032 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 1,932.1429 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.3018 \\
& \mathrm{ft}
\end{aligned}
\] & 4,139.2308 psf & \[
\begin{aligned}
& \text { 1,209.683 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 785.57735 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
11
\end{array}
\] & \[
\begin{aligned}
& 1,939.2857 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,473.4968 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,964.1189 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,276.5526 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 829.00296 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,946.4286 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.8898 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,801.3642 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,333.2388 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 865.81542 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& 1,953.5714 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,468.4756 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,650.6442 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,379.6947 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 895.98422 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
14
\] & \[
\begin{aligned}
& \text { 1,960.7143 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.2496 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,511.6702 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,415.8591 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 919.46964 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline Slice & 1,967.8571 & 1,464.2075 & -3,384.184 & 1,441.6559 & 936.22227 & \[
0.043846762
\] & 0 psf & Municipal \\
\hline
\end{tabular}

\section*{Factor of Safety Dependent}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 15 & ft & ft & psf & psf & psf & psf & & Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & 1,975 ft & \[
\begin{aligned}
& 1,462.3458 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,267.9557 \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,456.9932 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 946.18246 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 17
\end{aligned}
\] & \[
\begin{aligned}
& 1,982.1429 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.6611 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,162.7807 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,461.7627 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 949.2798 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& 1,989.2857 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.1506 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,068.4782 \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,455.8384 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 945.4325 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& 1,996.4286 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,457.8116 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,984.8896 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,439.0757 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 934.54667 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,003.6227 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.6349 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,911.4279 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,412.3674 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 917.20214 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& 2,010.8682 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.6209 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
2,848.1244 \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,375.3998 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 893.19508 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,018.1137 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.7776 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,795.4752
\] psf & \[
\begin{aligned}
& \text { 1,326.7568 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 861.60594 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& 2,025.3591 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.1036 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,753.3947
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,266.1958 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 822.27717 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& 2,032.6046 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.5977 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,721.8149
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,193.4462 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 775.03305 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,039.8501 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.2593 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,700.6852
\]
\[
\mathrm{psf}
\] & \[
\begin{aligned}
& 1,108.2071 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 719.67811 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 2,047.0956 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.0877 \\
& \mathrm{ft}
\end{aligned}
\] & \[
2,689.9719
\] psf & \[
\begin{aligned}
& \text { 1,010.144 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 655.9952 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& 2,054.341 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.0827 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,689.658 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 898.88606 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 583.74343 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,061.5865 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.2442 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,699.743 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 774.02236 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 502.656 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 2,068.832 \\
& \mathrm{ft}
\end{aligned}
\] & \[
1,453.5726
\]
\[
\mathrm{ft}
\] & \[
\begin{aligned}
& -2,720.243 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 643.4608 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,076.0774 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.0683 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,751.1905 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 501.08234 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& 2,082.5233 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.6423 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,787.026 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 324.85255 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 111.8557 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline Slice
\[
32
\] & \[
\begin{aligned}
& \text { 2,085.5332 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.9471 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,806.058 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 135.45981 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 23.88522 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 33
\end{aligned}
\] & \[
\begin{aligned}
& 2,086.7379 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.0841 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
2,814.6076 \\
psf
\end{tabular} & \[
\begin{aligned}
& 75.77865 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 13.361821 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{FS Dependent Seismic Pseudo Static}

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\section*{File Information}

File Version: 9.01
Title: Section A
Created By: Administrative User
Revision Number: 12
Date: 01/08/2021
Time: 03:14:19 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section A (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:14:26 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{FS Dependent Seismic Pseudo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Compacted Soil Liner}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb

Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((1,800,1,511.01) \mathrm{ft}\)
Left-Zone Right Coordinate: \((1,981,1,482.5262) \mathrm{ft}\)
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((1,981,1,482.5262) \mathrm{ft}\)
Right-Zone Right Coordinate: \((2,142,1,458.3379) \mathrm{ft}\)
Right-Zone Increment: 15
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((1,000,1,490.42) \mathrm{ft}\)
Right Coordinate: \((2,300,1,463.14) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,300 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: \((1,887.215,1,505) \mathrm{ft}\)
Inside Point: (1,800, 1,509.01) ft
Slip Surface Intersection: \((1,876.8263,1,505.4777) \mathrm{ft}\)
Length: 87.307138 ft
Direction: \(357.37^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 34.019249 lbf
Pullout Force per Length: \(18.21369 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 10.399718 ft
Required Length: 1.8677846 ft
Governing Component: Tensile Capacity

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: (1,700, 1,509.01) ft
Inside Point: (1,800, 1,509.01) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft

Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: \((1,600,1,513.23) \mathrm{ft}\)
Inside Point: (1,700, 1,509.01) ft
Length: 100.089 ft
Direction: \(177.58^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.23) \mathrm{ft}\)
Inside Point: (1,600, 1,513.23) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((1,400,1,517.11) \mathrm{ft}\)
Inside Point: \((1,500,1,513.23) \mathrm{ft}\)
Length: 100.07524 ft
Direction: \(177.78^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 6}

Type: Geosynthetic
Outside Point: (1,300, 1,517.11) ft
Inside Point: \((1,400,1,517.11) \mathrm{ft}\)
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)
\begin{tabular}{|c|c|c|}
\hline & X & Y \\
\hline Point 1 & 1,300 ft & 1,514.79 ft \\
\hline Point 2 & 1,400 ft & 1,493.68 ft \\
\hline Point 3 & 1,500 ft & 1,472.03 ft \\
\hline Point 4 & 2,200 ft & 1,463.14 ft \\
\hline Point 5 & 2,300 ft & 1,463.14 ft \\
\hline Point 6 & 1,300 ft & 1,519.11 ft \\
\hline Point 7 & 1,400 ft & 1,519.11 ft \\
\hline Point 8 & 1,500 ft & 1,515.23 ft \\
\hline Point 9 & 1,600 ft & 1,515.23 ft \\
\hline Point 10 & 1,700 ft & 1,511.01 ft \\
\hline Point 11 & 1,800 ft & 1,511.01 ft \\
\hline Point 12 & 1,900 ft & 1,503.57 ft \\
\hline Point 13 & 2,000 ft & 1,477.59 ft \\
\hline Point 14 & 2,100 ft & 1,452.85 ft \\
\hline Point 15 & 1,000 ft & 1,490.42 ft \\
\hline Point 16 & 1,050.62 ft & 1,493.125 ft \\
\hline Point 17 & 1,225.24 ft & 1,521.75 ft \\
\hline Point 18 & 1,244.865 ft & 1,521.75 ft \\
\hline Point 19 & 1,887.215 ft & 1,507 ft \\
\hline Point 20 & 2,085.72 ft & 1,455.83 ft \\
\hline Point 21 & 2,111.71 ft & 1,455.83 ft \\
\hline Point 22 & 2,094.99 ft & 1,452.83 ft \\
\hline Point 23 & 1,618.79 ft & 1,432.25 ft \\
\hline Point 24 & 1,700 ft & 1,432.25 ft \\
\hline Point 25 & 1,800 ft & 1,432.25 ft \\
\hline Point 26 & 1,900 ft & 1,432.25 ft \\
\hline Point 27 & 2,000 ft & \(1,432.25 \mathrm{ft}\) \\
\hline Point 28 & 2,018.54 ft & 1,432.25 ft \\
\hline Point 29 & 2,073.81 ft & 1,453.125 ft \\
\hline Point 30 & 1,200 ft & 1,521.68 ft \\
\hline Point 31 & 2,090.8227 ft & 1,454.252 ft \\
\hline Point 32 & 1,000 ft & 1,410 ft \\
\hline Point 33 & 2,300 ft & 1,410 ft \\
\hline Point 34 & 1,000 ft & 1,450 ft \\
\hline Point 35 & 1,000 ft & 1,428 ft \\
\hline Point 36 & 2,300 ft & 1,440 ft \\
\hline Point 37 & 2,300 ft & 1,430 ft \\
\hline Point 38 & 2,300 ft & 1,425 ft \\
\hline Point 39 & 2,300 ft & 1,415 ft \\
\hline Point 40 & 1,579.0891 ft & 1,445.5449 ft \\
\hline Point 41 & 2,044.267 ft & 1,441.9669 ft \\
\hline Point 42 & 1,300 ft & 1,518.11 ft \\
\hline Point 43 & 1,300 ft & 1,517.11 ft \\
\hline Point 44 & 1,300 ft & 1,516.11 ft \\
\hline Point 45 & 1,400 ft & 1,518.11 ft \\
\hline Point 46 & 1,400 ft & 1,517.11 ft \\
\hline Point 47 & 1,400 ft & 1,516.11 ft \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 48 & 1,500 ft & 1,514.23 ft \\
\hline Point 49 & 1,500 ft & 1,513.23 ft \\
\hline Point 50 & 1,500 ft & 1,512.23 ft \\
\hline Point 51 & 1,600 ft & 1,514.23 ft \\
\hline Point 52 & 1,600 ft & 1,513.23 ft \\
\hline Point 53 & 1,600 ft & 1,512.23 ft \\
\hline Point 54 & 1,700 ft & 1,510.01 ft \\
\hline Point 55 & 1,700 ft & 1,509.01 ft \\
\hline Point 56 & 1,700 ft & 1,508.01 ft \\
\hline Point 57 & 1,800 ft & 1,510.01 ft \\
\hline Point 58 & 1,800 ft & 1,509.01 ft \\
\hline Point 59 & 1,800 ft & 1,508.01 ft \\
\hline Point 60 & 1,887.215 ft & 1,506 ft \\
\hline Point 61 & 1,887.215 ft & 1,505 ft \\
\hline Point 62 & 1,887.215 ft & 1,504 ft \\
\hline Point 63 & 1,900 ft & 1,502.57 ft \\
\hline Point 64 & 1,900 ft & 1,501.57 ft \\
\hline Point 65 & 1,900 ft & 1,500.57 ft \\
\hline Point 66 & 2,000 ft & 1,476.59 ft \\
\hline Point 67 & 2,000 ft & 1,475.59 ft \\
\hline Point 68 & 2,000 ft & 1,474.59 ft \\
\hline Point 69 & 1,257.6267 ft & 1,520.139 ft \\
\hline Point 70 & 1,283.1576 ft & 1,516.9161 ft \\
\hline Point 71 & 2,088.5872 ft & 1,454.1039 ft \\
\hline Point 72 & 2,082.3334 ft & 1,453.6896 ft \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & Area \\
\hline Region 1 & Municipal Solid Waste & \(1,2,3,40,23,24,25,26,27,28,41,29,72,68,65,62,59,56,53,50,47,44,70\) & \(40,058 \mathrm{ft}^{2}\) \\
\hline Region 2 & Lean Clay & \(34,40,3,2,1,70,69,18,17,30,16,15\) & \(28,365 \mathrm{ft}^{2}\) \\
\hline Region 3 & Very Weathered Shale & \(35,39,36,41,28,27,26,25,24,23,40,34\) & \(25,586 \mathrm{ft}^{2}\) \\
\hline Region 4 & Shale Bedrock & \(32,33,39,35\) & \(14,950 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(5,4,21,14,22,31,71,72,29,41,36\) & \(4,527.3 \mathrm{ft}^{2}\) \\
\hline Region 6 & Vegetation Cover & \(18,69,42,45,48,51,54,57,60,63,66,71,31,20,13,12,19,11,10,9,8,7,6\) & \(837.97 \mathrm{ft}^{2}\) \\
\hline Region 7 & Compacted Soil Liner & \(70,44,47,50,53,56,59,62,65,68,72,71,66,63,60,57,54,51,48,45,42,69\) & \(1,630.2 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 863 of 1056 converged

\section*{Current Slip Surface}

Slip Surface: 446
Factor of Safety: 1.852
Volume: 3,200.8622 ft \({ }^{3}\)
Weight: 238,193.82 lbf

Resisting Moment: 54,145,044 lbf•ft
Activating Moment: 29,237,291 lbffft
Resisting Force: 164,422.23 lbf
Activating Force: 88,787.225 Ibf
Slip Rank: 1 of 1,056 slip surfaces
Exit: \((2,087.7559,1,455.2004) \mathrm{ft}\)
Entry: \((1,873.6155,1,507.6253) \mathrm{ft}\)
Radius: 315.32569 ft
Center: \((2,050.937,1,768.3692) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & \begin{tabular}{l}
Base \\
Normal Stress
\end{tabular} & Frictional Strength & Cohesive Strength & \begin{tabular}{l}
Suction \\
Strength
\end{tabular} & Base Material \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 1
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,874.4096 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,507.0888 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,061.2703 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 18.280581 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3.2233596 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,876.8263 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,505.4777 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,960.6881 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 114.4296 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 39.401271 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 1,882.8319 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,501.6406 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -5,721.141 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 387.81036 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & \[
\begin{aligned}
& \text { 1,890.4113 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,496.9876 } \\
& \mathrm{ft}
\end{aligned}
\] & 5,430.6495
psf & \[
\begin{aligned}
& 598.00134 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& \text { 1,896.8038 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,493.3059 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,200.8027 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 719.09882 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 1,903.5714 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,489.6267 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,971.1108 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 834.24597 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 541.76567 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & \[
\begin{aligned}
& \text { 1,910.7143 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,485.9652 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,742.5242
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 946.21578 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 614.47971 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
8
\end{tabular} & \[
\begin{aligned}
& \text { 1,917.8571 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,482.5291 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -4,528.008 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,049.2466 } \\
& \text { psf }
\end{aligned}
\] & 681.38869 psf & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
9
\end{tabular} & 1,925 ft & \[
\begin{aligned}
& \text { 1,479.3104 } \\
& \mathrm{ft}
\end{aligned}
\] & 4,327.0598 psf & \[
\begin{aligned}
& \text { 1,143.1769 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 742.38774 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
10
\end{tabular} & \[
\begin{aligned}
& \text { 1,932.1429 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,476.3018 } \\
& \text { ft }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,139.2308 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,227.8377 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 797.36714 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& \text { 1,939.2857 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,473.4968 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,964.1189 \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,303.0504 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 846.21083 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & \[
\begin{aligned}
& \text { 1,946.4286 } \\
& \text { ft }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,470.8898 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,801.3642 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,368.6243 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 888.795 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & \[
\begin{aligned}
& \text { 1,953.5714 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,468.4756 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,650.6442 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,424.3547 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 924.98675 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline & & & & & & & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& \text { 1,960.7143 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,466.2496 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,511.6702 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,470.0208 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 954.64265 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
15
\] & \[
\begin{aligned}
& \text { 1,967.8571 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,464.2075 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,384.184 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,505.3833 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 977.60732 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
16
\] & 1,975 ft & \[
\begin{aligned}
& 1,462.3458 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,267.9557 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,530.1822 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 993.71195 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
17
\] & \[
\begin{aligned}
& \text { 1,982.1429 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.6611 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,162.7807 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,544.1344 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,002.7726 } \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
18
\end{tabular} & \[
\begin{aligned}
& 1,989.2857 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.1506 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,068.4782 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,546.9308 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,004.5886 } \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline Slice 19 & \[
\begin{aligned}
& \text { 1,996.4286 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,457.8116 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,984.8896 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,538.2334 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 998.94042 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,003.6227 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.6349 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,911.4279 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,518.8749 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 986.36892 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
21
\end{tabular} & \[
\begin{aligned}
& \text { 2,010.8682 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.6209 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,848.1244 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,488.3312 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 966.53359 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & \[
\begin{aligned}
& \text { 2,018.1137 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.7776 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,795.4752 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,444.7916 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 938.25866 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,025.3591 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,454.1036 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,753.3947 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,387.7469 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 901.21335 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& \text { 2,032.6046 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.5977 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,721.8149 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,316.6352 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 855.03287 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline Slice 25 & \[
\begin{aligned}
& \text { 2,039.8501 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.2593 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,700.6852 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,230.836 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 799.31421 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
26
\end{tabular} & \[
\begin{aligned}
& \text { 2,047.0956 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.0877 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,689.9719 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,129.6625 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 733.6114 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
27
\] & \[
\begin{aligned}
& 2,054.341 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.0827 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,689.658 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,012.3533 } \\
& \text { psf }
\end{aligned}
\] & 657.42995 psf & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
28
\end{tabular} & \[
\begin{aligned}
& \text { 2,061.5865 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.2442 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,699.743 \\
& \text { psf }
\end{aligned}
\] & \[
878.06248
\]
psf & 570.22044 psf & \[
0.043846762
\]
psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 2,068.832 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.5726 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,720.243 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 732.26524 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
30
\end{tabular} & \[
\begin{aligned}
& \text { 2,076.0774 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,454.0683 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,751.1905 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 586.94016 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,082.5233 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.6423 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,787.026 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 440.49454 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 151.67443 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline Slice
\[
32
\] & \[
\begin{aligned}
& \text { 2,085.5332 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.9471 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,806.058 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 172.98244 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 30.501472 \\
& \text { p.sf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}
\(\left.\begin{array}{|l|l|l|l|l|l|l|l|l|}\hline \begin{array}{l}\text { Slice } \\
33\end{array} & \begin{array}{l}2,086.7379 \\
\mathrm{ft}\end{array} & \begin{array}{l}1,455.0841 \\
\mathrm{ft}\end{array} & \begin{array}{l}- \\
2,814.6076 \\
\mathrm{psf}\end{array} & \begin{array}{l}108.67003 \\
\mathrm{psf}\end{array} & \begin{array}{l}19.161457 \\
\mathrm{psf}\end{array} & 200 \mathrm{psf}\end{array}\right\} 0 \mathrm{psf}\)\begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular}

\section*{Not Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section A
Created By: Administrative User
Revision Number: 12
Date: 01/08/2021
Time: 03:14:19 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section A (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:14:28 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

\section*{Not Factor of Safety Dependent}

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Compacted Soil Liner}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb

Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((1,800,1,511.01) \mathrm{ft}\)
Left-Zone Right Coordinate: ( \(1,981,1,482.5262\) ) ft
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: ( \(1,981,1,482.5262\) ) ft
Right-Zone Right Coordinate: ( \(2,142,1,458.3379\) ) ft
Right-Zone Increment: 15
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: (1,000, 1,490.42) ft
Right Coordinate: \((2,300,1,463.14) \mathrm{ft}\)

\section*{Piezometric Lines}

Piezometric Line 1

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,300 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: \((1,887.215,1,505) \mathrm{ft}\)
Inside Point: (1,800, 1,509.01) ft
Slip Surface Intersection: \((1,876.8263,1,505.4777) \mathrm{ft}\)
Length: 87.307138 ft
Direction: \(357.37^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 42 lbf
Pullout Force per Length: \(33.7298 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 10.399718 ft
Required Length: 1.2451897 ft
Governing Component: Tensile Capacity

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.01) \mathrm{ft}\)
Inside Point: (1,800, 1,509.01) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic

Outside Point: \((1,600,1,513.23) \mathrm{ft}\)
Inside Point: (1,700, 1,509.01) ft
Length: 100.089 ft
Direction: \(177.58^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.23) \mathrm{ft}\)
Inside Point: (1,600, 1,513.23) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((1,400,1,517.11) \mathrm{ft}\) Inside Point: (1,500, 1,513.23) ft

Length: 100.07524 ft
Direction: \(177.78^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 6}

Type: Geosynthetic
Outside Point: \((1,300,1,517.11) \mathrm{ft}\)
Inside Point: (1,400, 1,517.11) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|l|l|c|}
\hline & \multicolumn{1}{|c|}{\(X\)} & \(Y\) \\
\hline Point 1 & \(1,300 \mathrm{ft}\) & \(1,514.79 \mathrm{ft}\) \\
\hline Point 2 & \(1,400 \mathrm{ft}\) & \(1,493.68 \mathrm{ft}\) \\
\hline Point 3 & \(1,500 \mathrm{ft}\) & \(1,472.03 \mathrm{ft}\) \\
\hline
\end{tabular}

Not Factor of Safety Dependent
\begin{tabular}{|c|c|c|}
\hline Point 4 & 2,200 ft & 1,463.14 ft \\
\hline Point 5 & 2,300 ft & 1,463.14 ft \\
\hline Point 6 & 1,300 ft & 1,519.11 ft \\
\hline Point 7 & 1,400 ft & 1,519.11 ft \\
\hline Point 8 & 1,500 ft & 1,515.23 ft \\
\hline Point 9 & 1,600 ft & 1,515.23 ft \\
\hline Point 10 & 1,700 ft & 1,511.01 ft \\
\hline Point 11 & 1,800 ft & 1,511.01 ft \\
\hline Point 12 & 1,900 ft & 1,503.57 ft \\
\hline Point 13 & 2,000 ft & 1,477.59 ft \\
\hline Point 14 & 2,100 ft & 1,452.85 ft \\
\hline Point 15 & 1,000 ft & 1,490.42 ft \\
\hline Point 16 & 1,050.62 ft & 1,493.125 ft \\
\hline Point 17 & 1,225.24 ft & 1,521.75 ft \\
\hline Point 18 & 1,244.865 ft & 1,521.75 ft \\
\hline Point 19 & 1,887.215 ft & 1,507 ft \\
\hline Point 20 & 2,085.72 ft & 1,455.83 ft \\
\hline Point 21 & 2,111.71 ft & 1,455.83 ft \\
\hline Point 22 & 2,094.99 ft & 1,452.83 ft \\
\hline Point 23 & 1,618.79 ft & 1,432.25 ft \\
\hline Point 24 & 1,700 ft & 1,432.25 ft \\
\hline Point 25 & 1,800 ft & 1,432.25 ft \\
\hline Point 26 & 1,900 ft & 1,432.25 ft \\
\hline Point 27 & 2,000 ft & 1,432.25 ft \\
\hline Point 28 & 2,018.54 ft & 1,432.25 ft \\
\hline Point 29 & 2,073.81 ft & 1,453.125 ft \\
\hline Point 30 & 1,200 ft & 1,521.68 ft \\
\hline Point 31 & 2,090.8227 ft & 1,454.252 ft \\
\hline Point 32 & 1,000 ft & 1,410 ft \\
\hline Point 33 & 2,300 ft & 1,410 ft \\
\hline Point 34 & 1,000 ft & 1,450 ft \\
\hline Point 35 & 1,000 ft & 1,428 ft \\
\hline Point 36 & 2,300 ft & 1,440 ft \\
\hline Point 37 & 2,300 ft & 1,430 ft \\
\hline Point 38 & 2,300 ft & 1,425 ft \\
\hline Point 39 & 2,300 ft & 1,415 ft \\
\hline Point 40 & 1,579.0891 ft & 1,445.5449 ft \\
\hline Point 41 & 2,044.267 ft & 1,441.9669 ft \\
\hline Point 42 & 1,300 ft & 1,518.11 ft \\
\hline Point 43 & 1,300 ft & 1,517.11 ft \\
\hline Point 44 & 1,300 ft & 1,516.11 ft \\
\hline Point 45 & 1,400 ft & 1,518.11 ft \\
\hline Point 46 & 1,400 ft & 1,517.11 ft \\
\hline Point 47 & 1,400 ft & 1,516.11 ft \\
\hline Point 48 & 1,500 ft & 1,514.23 ft \\
\hline Point 49 & 1,500 ft & 1,513.23 ft \\
\hline Point 50 & 1,500 ft & 1,512.23 ft \\
\hline Point 51 & 1,600 ft & 1,514.23 ft \\
\hline & & \\
\hline
\end{tabular}

Not Factor of Safety Dependent
\begin{tabular}{|l|l|l|} 
Point 52 & \(1,600 \mathrm{ft}\) & \(1,513.23 \mathrm{ft}\) \\
\hline Point 53 & \(1,600 \mathrm{ft}\) & \(1,512.23 \mathrm{ft}\) \\
\hline Point 54 & \(1,700 \mathrm{ft}\) & \(1,510.01 \mathrm{ft}\) \\
\hline Point 55 & \(1,700 \mathrm{ft}\) & \(1,509.01 \mathrm{ft}\) \\
\hline Point 56 & \(1,700 \mathrm{ft}\) & \(1,508.01 \mathrm{ft}\) \\
\hline Point 57 & \(1,800 \mathrm{ft}\) & \(1,510.01 \mathrm{ft}\) \\
\hline Point 58 & \(1,800 \mathrm{ft}\) & \(1,509.01 \mathrm{ft}\) \\
\hline Point 59 & \(1,800 \mathrm{ft}\) & \(1,508.01 \mathrm{ft}\) \\
\hline Point 60 & \(1,887.215 \mathrm{ft}\) & \(1,506 \mathrm{ft}\) \\
\hline Point 61 & \(1,887.215 \mathrm{ft}\) & \(1,505 \mathrm{ft}\) \\
\hline Point 62 & \(1,887.215 \mathrm{ft}\) & \(1,504 \mathrm{ft}\) \\
\hline Point 63 & \(1,900 \mathrm{ft}\) & \(1,502.57 \mathrm{ft}\) \\
\hline Point 64 & \(1,900 \mathrm{ft}\) & \(1,501.57 \mathrm{ft}\) \\
\hline Point 65 & \(1,900 \mathrm{ft}\) & \(1,500.57 \mathrm{ft}\) \\
\hline Point 66 & \(2,000 \mathrm{ft}\) & \(1,476.59 \mathrm{ft}\) \\
\hline Point 67 & \(2,000 \mathrm{ft}\) & \(1,475.59 \mathrm{ft}\) \\
\hline Point 68 & \(2,000 \mathrm{ft}\) & \(1,474.59 \mathrm{ft}\) \\
\hline Point 69 & \(1,257.6267 \mathrm{ft}\) & \(1,520.139 \mathrm{ft}\) \\
\hline Point 70 & \(1,283.1576 \mathrm{ft}\) & \(1,516.9161 \mathrm{ft}\) \\
\hline Point 71 & \(2,088.5872 \mathrm{ft}\) & \(1,454.1039 \mathrm{ft}\) \\
\hline Point 72 & \(2,082.3334 \mathrm{ft}\) & \(1,453.6896 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & \multicolumn{1}{c|}{\(\mathrm{Area}^{\prime}\)} \\
\hline Region 1 & Municipal Solid Waste & \(1,2,3,40,23,24,25,26,27,28,41,29,72,68,65,62,59,56,53,50,47,44,70\) & \(40,058 \mathrm{ft}^{2}\) \\
\hline Region 2 & Lean Clay & \(34,40,3,2,1,70,69,18,17,30,16,15\) & \(28,365 \mathrm{ft}^{2}\) \\
\hline Region 3 & Very Weathered Shale & \(35,39,36,41,28,27,26,25,24,23,40,34\) & \(25,586 \mathrm{ft}^{2}\) \\
\hline Region 4 & Shale Bedrock & \(32,33,39,35\) & \(14,950 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(5,4,21,14,22,31,71,72,29,41,36\) & \(4,527.3 \mathrm{ft}^{2}\) \\
\hline Region 6 & Vegetation Cover & \(18,69,42,45,48,51,54,57,60,63,66,71,31,20,13,12,19,11,10,9,8,7,6\) & \(837.97 \mathrm{ft}^{2}\) \\
\hline Region 7 & Compacted Soil Liner & \(70,44,47,50,53,56,59,62,65,68,72,71,66,63,60,57,54,51,48,45,42,69\) & \(1,630.2 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 860 of 1056 converged

\section*{Current Slip Surface}

Slip Surface: 446
Factor of Safety: 2.925
Volume: 3,200.8622 ft \({ }^{3}\)
Weight: 238,193.82 lbf
Resisting Moment: 51,608,402 lbf•ft
Activating Moment: 17,645,962 lbf•ft
Resisting Force: \(156,475.58 \mathrm{lbf}\)
Activating Force: 53,499.536 lbf

Slip Rank: 1 of 1,056 slip surfaces
Exit: \((2,087.7559,1,455.2004) \mathrm{ft}\)
Entry: \((1,873.6155,1,507.6253) \mathrm{ft}\)
Radius: 315.32569 ft
Center: \((2,050.937,1,768.3692) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & \begin{tabular}{l}
Cohesive \\
Strength
\end{tabular} & Suction Strength & Base Material \\
\hline \begin{tabular}{l}
Slice \\
1
\end{tabular} & \[
\begin{aligned}
& 1,874.4096 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,507.0888 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,061.2703 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 22.33588 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 3.9384182 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& 1,876.8263 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,505.4777 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,960.6881 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 126.3339 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 43.50025 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 1,882.8319 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,501.6406 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -5,721.141 \\
& \mathrm{psf}
\end{aligned}
\] & \[
\begin{aligned}
& 400.72389 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & \[
\begin{aligned}
& 1,890.4113 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,496.9876 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
5,430.6495
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 610.08765 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 1,896.8038 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,493.3059 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,200.8027 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 728.91728 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 1,903.5714 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,489.6267 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,971.1108
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 840.90092 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 546.08744 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & \[
\begin{aligned}
& 1,910.7143 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,485.9652 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,742.5242 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 948.29372 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 615.82915 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 1,917.8571 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,482.5291 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -4,528.008 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,045.5623 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 678.9961 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
9
\end{tabular} & 1,925 ft & \[
\begin{aligned}
& 1,479.3104 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,327.0598 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,132.7091 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 735.58991 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
10
\end{tabular} & \[
\begin{aligned}
& 1,932.1429 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.3018 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,139.2308
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,209.7256 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 785.605 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& 1,939.2857 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,473.4968 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,964.1189 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,276.5912 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 829.028 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12
\end{aligned}
\] & \[
\begin{aligned}
& 1,946.4286 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.8898 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,801.3642 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,333.2725 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 865.83727 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & \[
\begin{aligned}
& 1,953.5714 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,468.4756 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,650.6442 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,379.7227 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 896.00239 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 1,960.7143 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.2496 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,511.6702 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,415.8808 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 919.48376 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline Slice & 1,967.8571 & 1,464.2075 & -3,384.184 & 1,441.6709 & 936.23202 & \[
0.043846762
\] & 0 psf & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 15 & ft & ft & psf & psf & psf & psf & & Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
16
\end{tabular} & 1,975 ft & \[
\begin{aligned}
& 1,462.3458 \\
& \mathrm{ft}
\end{aligned}
\] & 3,267.9557
psf & \[
\begin{aligned}
& \text { 1,457.0012 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 946.18764 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\hline \text { Slice } \\
17
\end{array}
\] & \[
\begin{aligned}
& \text { 1,982.1429 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.6611 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,162.7807 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,461.7635 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 949.28029 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& 1,989.2857 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.1506 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,068.4782 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.8319 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 945.42828 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,996.4286 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,457.8116 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,984.8896 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,439.062 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 934.53781 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,003.6227 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,456.6349 } \\
& \mathrm{ft}
\end{aligned}
\] & 2,911.4279
psf & \[
\begin{aligned}
& 1,412.3468 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 917.18877 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,010.8682 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,455.6209 } \\
& \mathrm{ft}
\end{aligned}
\] & 2,848.1244
psf & \[
\begin{aligned}
& \text { 1,375.3726 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 893.17743 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,018.1137 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.7776 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,795.4752 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,326.7236 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 861.5844 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,025.3591 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.1036 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,753.3947 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,266.1574 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 822.25224 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,032.6046 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.5977 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
2,721.8149 \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,193.4036 } \\
& \text { psf }
\end{aligned}
\] & 775.00538 psf & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,039.8501 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,453.2593 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,700.6852 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,108.1615 } \\
& \text { psf }
\end{aligned}
\] & \[
719.64846
\]
psf & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,047.0956 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.0877 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,689.9719 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,010.0968 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 655.96451 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& 2,054.341 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.0827 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,689.658 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 898.83889 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 583.7128 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,061.5865 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.2442 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,699.743 \\
& \text { osf }
\end{aligned}
\] & \[
\begin{aligned}
& 773.97724 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 502.62669 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 29 \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 2,068.832 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.5726 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline-2,720.243 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 643.41541 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,076.0774 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.0683 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,751.1905 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 501.03491 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,082.5233 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.6423 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline-2,787.026 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 324.78399 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 111.8321 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{array}{|l}
\hline \text { Slice } \\
32 \\
\hline
\end{array}
\] & \[
\begin{aligned}
& \text { 2,085.5332 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,454.9471 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,806.058 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 135.43766 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 23.881313 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 33
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,086.7379 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.0841 \\
& \mathrm{ft}
\end{aligned}
\] & 2,814.6076
psf & \[
\begin{aligned}
& 75.758251 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 13.358224 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Not FS Dependent Pseudo Static}

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\section*{File Information}

File Version: 9.01
Title: Section A
Created By: Administrative User
Revision Number: 12
Date: 01/08/2021
Time: 03:14:19 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section A (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering
Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:14:30 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not FS Dependent Pseudo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Municipal Solid Waste}

Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Compacted Soil Liner}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb

Unit Weight: 115 pcf
Cohesion': 200 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Very Weathered Shale}

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((1,800,1,511.01) \mathrm{ft}\)
Left-Zone Right Coordinate: \((1,981,1,482.5262) \mathrm{ft}\)
Left-Zone Increment: 10
Right Type: Range
Right-Zone Left Coordinate: \((1,981,1,482.5262) \mathrm{ft}\)
Right-Zone Right Coordinate: \((2,142,1,458.3379) \mathrm{ft}\)
Right-Zone Increment: 15
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((1,000,1,490.42) \mathrm{ft}\)
Right Coordinate: \((2,300,1,463.14) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,300 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: \((1,887.215,1,505) \mathrm{ft}\)
Inside Point: (1,800, 1,509.01) ft
Slip Surface Intersection: \((1,876.8263,1,505.4777) \mathrm{ft}\)
Length: 87.307138 ft
Direction: \(357.37^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 34.016291 lbf
Pullout Force per Length: \(18.212106 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 10.399718 ft
Required Length: 1.8677846 ft
Governing Component: Tensile Capacity

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: (1,700, 1,509.01) ft
Inside Point: (1,800, 1,509.01) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft

Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: \((1,600,1,513.23) \mathrm{ft}\)
Inside Point: (1,700, 1,509.01) ft
Length: 100.089 ft
Direction: \(177.58^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.23) \mathrm{ft}\)
Inside Point: (1,600, 1,513.23) ft
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((1,400,1,517.11) \mathrm{ft}\)
Inside Point: \((1,500,1,513.23) \mathrm{ft}\)
Length: 100.07524 ft
Direction: \(177.78^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 6}

Type: Geosynthetic
Outside Point: (1,300, 1,517.11) ft
Inside Point: \((1,400,1,517.11) \mathrm{ft}\)
Length: 100 ft
Direction: \(180^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)
\begin{tabular}{|c|c|c|}
\hline & X & Y \\
\hline Point 1 & 1,300 ft & 1,514.79 ft \\
\hline Point 2 & 1,400 ft & 1,493.68 ft \\
\hline Point 3 & 1,500 ft & \(1,472.03 \mathrm{ft}\) \\
\hline Point 4 & 2,200 ft & 1,463.14 ft \\
\hline Point 5 & 2,300 ft & 1,463.14 ft \\
\hline Point 6 & 1,300 ft & 1,519.11 ft \\
\hline Point 7 & 1,400 ft & 1,519.11 ft \\
\hline Point 8 & 1,500 ft & 1,515.23 ft \\
\hline Point 9 & 1,600 ft & 1,515.23 ft \\
\hline Point 10 & 1,700 ft & 1,511.01 ft \\
\hline Point 11 & 1,800 ft & 1,511.01 ft \\
\hline Point 12 & 1,900 ft & 1,503.57 ft \\
\hline Point 13 & 2,000 ft & 1,477.59 ft \\
\hline Point 14 & 2,100 ft & 1,452.85 ft \\
\hline Point 15 & 1,000 ft & 1,490.42 ft \\
\hline Point 16 & 1,050.62 ft & 1,493.125 ft \\
\hline Point 17 & 1,225.24 ft & \(1,521.75 \mathrm{ft}\) \\
\hline Point 18 & 1,244.865 ft & 1,521.75 ft \\
\hline Point 19 & 1,887.215 ft & 1,507 ft \\
\hline Point 20 & 2,085.72 ft & 1,455.83 ft \\
\hline Point 21 & 2,111.71 ft & 1,455.83 ft \\
\hline Point 22 & 2,094.99 ft & 1,452.83 ft \\
\hline Point 23 & 1,618.79 ft & 1,432.25 ft \\
\hline Point 24 & 1,700 ft & 1,432.25 ft \\
\hline Point 25 & 1,800 ft & 1,432.25 ft \\
\hline Point 26 & 1,900 ft & 1,432.25 ft \\
\hline Point 27 & 2,000 ft & \(1,432.25 \mathrm{ft}\) \\
\hline Point 28 & 2,018.54 ft & 1,432.25 ft \\
\hline Point 29 & 2,073.81 ft & 1,453.125 ft \\
\hline Point 30 & 1,200 ft & 1,521.68 ft \\
\hline Point 31 & 2,090.8227 ft & 1,454.252 ft \\
\hline Point 32 & 1,000 ft & 1,410 ft \\
\hline Point 33 & 2,300 ft & 1,410 ft \\
\hline Point 34 & 1,000 ft & 1,450 ft \\
\hline Point 35 & 1,000 ft & 1,428 ft \\
\hline Point 36 & 2,300 ft & 1,440 ft \\
\hline Point 37 & 2,300 ft & 1,430 ft \\
\hline Point 38 & 2,300 ft & 1,425 ft \\
\hline Point 39 & 2,300 ft & 1,415 ft \\
\hline Point 40 & 1,579.0891 ft & 1,445.5449 ft \\
\hline Point 41 & 2,044.267 ft & \(1,441.9669 \mathrm{ft}\) \\
\hline Point 42 & 1,300 ft & 1,518.11 ft \\
\hline Point 43 & 1,300 ft & 1,517.11 ft \\
\hline Point 44 & 1,300 ft & 1,516.11 ft \\
\hline Point 45 & 1,400 ft & 1,518.11 ft \\
\hline Point 46 & 1,400 ft & 1,517.11 ft \\
\hline Point 47 & 1,400 ft & 1,516.11 ft \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|} 
Point 48 & \(1,500 \mathrm{ft}\) & \(1,514.23 \mathrm{ft}\) \\
\hline Point 49 & \(1,500 \mathrm{ft}\) & \(1,513.23 \mathrm{ft}\) \\
\hline Point 50 & \(1,500 \mathrm{ft}\) & \(1,512.23 \mathrm{ft}\) \\
\hline Point 51 & \(1,600 \mathrm{ft}\) & \(1,514.23 \mathrm{ft}\) \\
\hline Point 52 & \(1,600 \mathrm{ft}\) & \(1,513.23 \mathrm{ft}\) \\
\hline Point 53 & \(1,600 \mathrm{ft}\) & \(1,512.23 \mathrm{ft}\) \\
\hline Point 54 & \(1,700 \mathrm{ft}\) & \(1,510.01 \mathrm{ft}\) \\
\hline Point 55 & \(1,700 \mathrm{ft}\) & \(1,509.01 \mathrm{ft}\) \\
\hline Point 56 & \(1,700 \mathrm{ft}\) & \(1,508.01 \mathrm{ft}\) \\
\hline Point 57 & \(1,800 \mathrm{ft}\) & \(1,510.01 \mathrm{ft}\) \\
\hline Point 58 & \(1,800 \mathrm{ft}\) & \(1,509.01 \mathrm{ft}\) \\
\hline Point 59 & \(1,800 \mathrm{ft}\) & \(1,508.01 \mathrm{ft}\) \\
\hline Point 60 & \(1,887.215 \mathrm{ft}\) & \(1,506 \mathrm{ft}\) \\
\hline Point 61 & \(1,887.215 \mathrm{ft}\) & \(1,505 \mathrm{ft}\) \\
\hline Point 62 & \(1,887.215 \mathrm{ft}\) & \(1,504 \mathrm{ft}\) \\
\hline Point 63 & \(1,900 \mathrm{ft}\) & \(1,502.57 \mathrm{ft}\) \\
\hline Point 64 & \(1,900 \mathrm{ft}\) & \(1,501.57 \mathrm{ft}\) \\
\hline Point 65 & \(1,900 \mathrm{ft}\) & \(1,500.57 \mathrm{ft}\) \\
\hline Point 66 & \(2,000 \mathrm{ft}\) & \(1,476.59 \mathrm{ft}\) \\
\hline Point 67 & \(2,000 \mathrm{ft}\) & \(1,475.59 \mathrm{ft}\) \\
\hline Point 68 & \(2,000 \mathrm{ft}\) & \(1,474.59 \mathrm{ft}\) \\
\hline Point 69 & \(1,257.6267 \mathrm{ft}\) & \(1,520.139 \mathrm{ft}\) \\
\hline Point 70 & \(1,283.1576 \mathrm{ft}\) & \(1,516.9161 \mathrm{ft}\) \\
\hline Point 71 & \(2,088.5872 \mathrm{ft}\) & \(1,454.1039 \mathrm{ft}\) \\
\hline Point 72 & \(2,082.3334 \mathrm{ft}\) & \(1,453.6896 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|c|}
\hline & \multicolumn{1}{|c|}{ Material } & \multicolumn{1}{|c|}{ Points } & \multicolumn{1}{c|}{\(\mathrm{Area}^{|c|}\)} \\
\hline Region 1 & Municipal Solid Waste & \(1,2,3,40,23,24,25,26,27,28,41,29,72,68,65,62,59,56,53,50,47,44,70\) & \(40,058 \mathrm{ft}^{2}\) \\
\hline Region 2 & Lean Clay & \(34,40,3,2,1,70,69,18,17,30,16,15\) & \(28,365 \mathrm{ft}^{2}\) \\
\hline Region 3 & Very Weathered Shale & \(35,39,36,41,28,27,26,25,24,23,40,34\) & \(25,586 \mathrm{ft}^{2}\) \\
\hline Region 4 & Shale Bedrock & \(32,33,39,35\) & \(14,950 \mathrm{ft}^{2}\) \\
\hline Region 5 & Lean Clay & \(5,4,21,14,22,31,71,72,29,41,36\) & \(4,527.3 \mathrm{ft}^{2}\) \\
\hline Region 6 & Vegetation Cover & \(18,69,42,45,48,51,54,57,60,63,66,71,31,20,13,12,19,11,10,9,8,7,6\) & \(837.97 \mathrm{ft}^{2}\) \\
\hline Region 7 & Compacted Soil Liner & \(70,44,47,50,53,56,59,62,65,68,72,71,66,63,60,57,54,51,48,45,42,69\) & \(1,630.2 \mathrm{ft}^{2}\) \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 833 of 1056 converged

\section*{Current Slip Surface}

Slip Surface: 446
Factor of Safety: 1.852
Volume: 3,200.8622 ft \({ }^{3}\)
Weight: 238,193.82 lbf

Resisting Moment: 8,110,831.8 lbffft
Activating Moment: 4,379,244.6 lbf•ft
Resisting Force: 164,426.93 lbf
Activating Force: 88,783.437 lbf
Slip Rank: 1 of 1,056 slip surfaces
Exit: \((2,087.7559,1,455.2004) \mathrm{ft}\)
Entry: \((1,873.6155,1,507.6253) \mathrm{ft}\)
Radius: 315.32569 ft
Center: \((1,933,1,516) \mathrm{ft}\)

\section*{Slip Slices}

\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 14
\end{aligned}
\] & \[
\begin{aligned}
& 1,960.7143 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,466.2496 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,511.6702 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,470.266 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 954.8019 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,967.8571 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,464.2075 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,384.184 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,505.5853 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 977.7385 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & 1,975 ft & \[
\begin{aligned}
& \text { 1,462.3458 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
3,267.9557
\]
psf & \[
\begin{aligned}
& \text { 1,530.3368 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 993.81234 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 1,982.1429 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.6611 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,162.7807 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,544.2389 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,002.8405 } \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,989.2857 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.1506 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,068.4782 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,546.984 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,004.6232 } \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,996.4286 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,457.8116 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
2,984.8896 \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,538.2359 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 998.9421 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,003.6227 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,456.6349 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,911.4279 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,518.8292 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 986.33921 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,010.8682 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,455.6209 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,848.1244 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,488.2415 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 966.47534 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,018.1137 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,454.7776 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,795.4752 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,444.6651 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 938.17647 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,025.3591 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,454.1036 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,753.3947 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,387.5929 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 901.11338 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,032.6046 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,453.5977 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,721.8149 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,316.4655 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 854.92271 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,039.8501 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,453.2593 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,700.6852 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,230.6642 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 799.20267 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,047.0956 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.0877 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,689.9719 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,129.5033 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 733.508 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& 2,054.341 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.0827 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,689.658 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,012.2212 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 657.34415 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,061.5865 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.2442 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,699.743 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
877.9701 \\
psf
\end{tabular} & \[
\begin{aligned}
& 570.16045 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,068.832 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,453.5726 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline-2,720.243 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 731.99884 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,076.0774 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.0683 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,751.1905 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 586.63413 psf & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,082.5233 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.6423 \\
& \mathrm{ft} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& -2,787.026 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 440.12314 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 151.54655 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 32
\end{aligned}
\] & \[
\begin{aligned}
& 2,085.5332 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline 1,454.9471 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \hline-2,806.058 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 172.83693 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 30.475814 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline \begin{tabular}{l} 
Slice \\
33
\end{tabular} & \begin{tabular}{l}
\(2,086.7379\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,455.0841\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(2,814.6076\) \\
psf
\end{tabular} & \begin{tabular}{l}
108.5306 \\
psf
\end{tabular} & \begin{tabular}{l}
19.136873 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline
\end{tabular}

\section*{Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section B
Created By: Administrative User
Revision Number: 21
Date: 01/08/2021
Time: 03:36:25 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section B (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:36:30 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

\section*{Factor of Safety Convergence Settings}

Maximum Number of Iterations: 100
Tolerable difference in F of \(\mathrm{S}: 0.001\)
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of \(\mathrm{S}: 3\)
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Municipal Solid Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\author{
Shale Bedrock \\ Model: Bedrock (Impenetrable) \\ Pore Water Pressure \\ Piezometric Line: 1
}

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf

Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: \((1,103,1,466.8709) \mathrm{ft}\)
Left-Zone Right Coordinate: \((1,350.7729,1,490.75) \mathrm{ft}\)
Left-Zone Increment: 20
Right Type: Range
Right-Zone Left Coordinate: \((1,350.7729,1,490.75) \mathrm{ft}\)
Right-Zone Right Coordinate: \((1,576,1,513.862) \mathrm{ft}\)
Right-Zone Increment: 20
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((1,000,1,465.92) \mathrm{ft}\)
Right Coordinate: \((2,370,1,459.33) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,370 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic

Outside Point: \((1,879.7,1,505) \mathrm{ft}\)
Inside Point: ( \(1,800,1,506.73\) ) ft
Length: 79.718774 ft
Direction: \(358.76^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.02) \mathrm{ft}\)
Inside Point: \((1,800,1,506.73) \mathrm{ft}\)
Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: \((1,600,1,511.31) \mathrm{ft}\) Inside Point: (1,700, 1,509.02) ft Length: 100.02622 ft

Direction: \(178.69^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: (1,500, 1,513.61) ft
Inside Point: \((1,600,1,511.31) \mathrm{ft}\)
Length: 100.02645 ft
Direction: \(178.68^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((1,468.17,1,514.33) \mathrm{ft}\)
Inside Point: \((1,500,1,513.61) \mathrm{ft}\)
Slip Surface Intersection: (1,470.376, 1,514.2801) ft
Length: 31.838142 ft
Direction: \(178.7^{\circ}\)
F of S Dependent: Yes

Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 17.26755 Ibf
Pullout Force per Length: \(9.2449366 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 2.2065332 ft
Required Length: 1.8677846 ft
Governing Component: Tensile Capacity

\section*{Points}
\begin{tabular}{|c|c|c|}
\hline & X & Y \\
\hline Point 1 & 1,100 ft & 1,466.63 ft \\
\hline Point 2 & 1,200 ft & 1,474.66 ft \\
\hline Point 3 & 1,300 ft & 1,475.83 ft \\
\hline Point 4 & 1,300 ft & 1,480.24 ft \\
\hline Point 5 & 1,400 ft & 1,470.97 ft \\
\hline Point 6 & 1,400 ft & 1,500.94 ft \\
\hline Point 7 & 1,500 ft & 1,464.71 ft \\
\hline Point 8 & 1,500 ft & 1,515.61 ft \\
\hline Point 9 & 1,600 ft & 1,513.31 ft \\
\hline Point 10 & 1,600 ft & 1,438.5 ft \\
\hline Point 11 & 1,700 ft & 1,511.02 ft \\
\hline Point 12 & 1,700 ft & 1,432.79 ft \\
\hline Point 13 & 1,800 ft & 1,508.73 ft \\
\hline Point 14 & 1,800 ft & 1,433.38 ft \\
\hline Point 15 & 1,900 ft & 1,501.96 ft \\
\hline Point 16 & 1,900 ft & 1,433.98 ft \\
\hline Point 17 & 2,000 ft & 1,477.09 ft \\
\hline Point 18 & 2,000 ft & 1,434.58 ft \\
\hline Point 19 & 2,100 ft & 1,458.83 ft \\
\hline Point 20 & 2,200 ft & 1,462 ft \\
\hline Point 21 & 2,300 ft & 1,462 ft \\
\hline Point 22 & 1,000 ft & 1,465.92 ft \\
\hline Point 23 & 1,260.15 ft & 1,478.67 ft \\
\hline Point 24 & 1,279.59 ft & 1,478.67 ft \\
\hline Point 25 & 1,468.17 ft & 1,516.33 ft \\
\hline Point 26 & 1,541.66 ft & 1,458.07 ft \\
\hline Point 27 & 1,618.54 ft & \(1,432.33 \mathrm{ft}\) \\
\hline Point 28 & 1,879.7 ft & 1,507 ft \\
\hline Point 29 & 2,019.04 ft & 1,434.67 ft \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 30 & 2,075.44 ft & 1,458.67 ft \\
\hline Point 31 & 2,090.22 ft & 1,455.67 ft \\
\hline Point 32 & 2,108.27 ft & 1,460.92 ft \\
\hline Point 33 & 2,370 ft & 1,459.33 ft \\
\hline Point 34 & 2,084.21 ft & 1,455.67 ft \\
\hline Point 35 & 2,082.95 ft & 1,456.08 ft \\
\hline Point 36 & 2,370 ft & 1,410 ft \\
\hline Point 37 & 1,000 ft & 1,410 ft \\
\hline Point 38 & 1,000 ft & 1,430 ft \\
\hline Point 39 & 1,000 ft & 1,415 ft \\
\hline Point 40 & 2,370 ft & 1,435 ft \\
\hline Point 41 & 1,400 ft & 1,499.94 ft \\
\hline Point 42 & 1,400 ft & 1,497.94 ft \\
\hline Point 43 & 1,468.17 ft & 1,515.33 ft \\
\hline Point 44 & 1,468.17 ft & 1,514.33 ft \\
\hline Point 45 & 1,468.17 ft & 1,513.33 ft \\
\hline Point 46 & 1,500 ft & 1,514.61 ft \\
\hline Point 47 & 1,500 ft & 1,513.61 ft \\
\hline Point 48 & 1,500 ft & 1,512.61 ft \\
\hline Point 49 & 1,600 ft & 1,512.31 ft \\
\hline Point 50 & 1,600 ft & 1,511.31 ft \\
\hline Point 51 & 1,600 ft & 1,510.31 ft \\
\hline Point 52 & 1,700 ft & 1,510.02 ft \\
\hline Point 53 & 1,700 ft & 1,509.02 ft \\
\hline Point 54 & 1,700 ft & 1,508.02 ft \\
\hline Point 55 & 1,800 ft & 1,507.73 ft \\
\hline Point 56 & 1,800 ft & 1,506.73 ft \\
\hline Point 57 & 1,800 ft & 1,505.73 ft \\
\hline Point 58 & 1,879.7 ft & 1,506 ft \\
\hline Point 59 & \(1,879.7 \mathrm{ft}\) & 1,505 ft \\
\hline Point 60 & 1,879.7 ft & 1,504 ft \\
\hline Point 61 & 1,900 ft & 1,500.96 ft \\
\hline Point 62 & 1,900 ft & 1,498.96 ft \\
\hline Point 63 & 2,000 ft & 1,476.09 ft \\
\hline Point 64 & 2,000 ft & 1,474.09 ft \\
\hline Point 65 & 2,075.44 ft & 1,457.67 ft \\
\hline Point 66 & 2,075.44 ft & 1,455.67 ft \\
\hline Point 67 & 1,300 ft & 1,479.24 ft \\
\hline Point 68 & 1,300 ft & 1,477.24 ft \\
\hline Point 69 & 1,284.2223 ft & 1,478.0254 ft \\
\hline Point 70 & 1,293.4767 ft & 1,476.7377 ft \\
\hline Point 71 & 2,081.4818 ft & 1,455.5881 ft \\
\hline Point 72 & 2,078.5396 ft & 1,454.6025 ft \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|c|c|c|c|}
\hline & Material & Points & Area \\
\hline Region & Municipal & & 40,219
\end{tabular}

Factor of Safety Dependent
\begin{tabular}{|l|l|ll|l|l|}
\hline 1 & \begin{tabular}{l} 
Solid \\
Waste
\end{tabular} & \(3,5,7,26,10,27,12,14,16,18,29,72,66,64,62,60,57,54,51,48,45,42,68,70\) & \(\mathrm{ft}^{2}\) \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} & \(24,69,67,41,43,46,49,52,55,58,61,63,65,71,35,30,17,15,28,13,11,9,8,25,6,4\) & \begin{tabular}{l}
800.31 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
3
\end{tabular} & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} & \(70,68,42,45,48,51,54,57,60,62,64,66,72,71,65,63,61,58,55,52,49,46,43,41,67,69\) & \begin{tabular}{l}
\(1,582.3\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
4
\end{tabular} & \begin{tabular}{l} 
Very \\
Weathered \\
Shale
\end{tabular} & \(39,36,40,38\) & 27,400 \\
\hline \begin{tabular}{l} 
Region \\
5
\end{tabular} & Lean Clay & \(22,38,40,33,21,20,32,19,31,34,35,71,72,29,18,16,14,12,27,10,26,7,5,3,70,69,24,23,2,1\) & \begin{tabular}{l}
30,900 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
6
\end{tabular} & \begin{tabular}{l} 
Shale \\
Bedrock
\end{tabular} & \(37,36,39\) & 3,425 \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 2296 of 2646 converged

\section*{Current Slip Surface}

Slip Surface: 2,084
Factor of Safety: 3.648
Volume: 1,965.9324 ft \({ }^{3}\)
Weight: 152,856.84 lbf
Resisting Moment: 26,857,024 Ibf•ft
Activating Moment: 7,361,870.6 lbf•ft
Resisting Force: 106,612.78 lbf
Activating Force: 29,218.592 lbf
Slip Rank: 1 of 2,646 slip surfaces
Exit: (1,301.9371, 1,480.641) ft
Entry: (1,473.4203, 1,516.2112) ft
Radius: 242.09662 ft
Center: \((1,341.8372,1,719.427) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{Y} & \multicolumn{1}{c|}{ PWP } & \begin{tabular}{l} 
Base \\
Normal \\
Stress
\end{tabular} & \begin{tabular}{l} 
Frictional \\
Strength
\end{tabular} & \begin{tabular}{l} 
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{l} 
Suction \\
Strength
\end{tabular} & \multicolumn{1}{c|}{\begin{tabular}{c} 
Base \\
Material
\end{tabular}} \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
\(1,303.2949\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,480.422\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,153.4152\) \\
psf
\end{tabular} & \begin{tabular}{l}
79.595123 \\
psf
\end{tabular} & \begin{tabular}{l}
14.034768 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
2
\end{tabular} & \begin{tabular}{l}
\(1,307.5076\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,479.7941\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,115.1715\) \\
psf
\end{tabular} & \begin{tabular}{l}
309.81852 \\
psf
\end{tabular} & \begin{tabular}{l}
106.67907 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
3
\end{tabular} & \begin{tabular}{l}
\(1,313.1638\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,479.0509\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,070.0655\) \\
psf
\end{tabular} & \begin{tabular}{l}
473.11879 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
4
\end{tabular} & \begin{tabular}{l}
\(1,318.7662\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,478.4486\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(-4,033.739\) \\
psf
\end{tabular} & \begin{tabular}{l}
580.75046 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline Slice & \(1,324.3685\) & \(1,477.9778\) & \begin{tabular}{l}
- \\
\(4,005.6207\)
\end{tabular} & 679.12564 & 0 psf & 500 psf & 0 psf & Municipal
\end{tabular}

\section*{Factor of Safety Dependent}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 5 & ft & ft & psf & psf & & & & Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 1,329.9708 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.6376 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,985.6624 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 768.40642 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,335.5732 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.4277 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,973.8298 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 851.69377 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 553.0964 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 1,341.1755 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.3475 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,970.1016 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 925.19363 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 600.82777 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,346.7778 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.397 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,974.47 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 989.08488 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 642.31923 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 1,352.3802 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.5763 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,986.9397 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,043.5892 } \\
& \text { psf }
\end{aligned}
\] & 677.71477 psf & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& 1,357.9825 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.8857 \\
& \mathrm{ft}
\end{aligned}
\] & 4,007.5289
psf & \[
\begin{aligned}
& \text { 1,088.9052 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 707.14328 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & \[
\begin{aligned}
& 1,363.5848 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.3256 \\
& \mathrm{ft}
\end{aligned}
\] & 4,036.2688 psf & \[
\begin{aligned}
& \text { 1,125.2097 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 730.71975 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,369.1872 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.8967 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,073.2042 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,152.6603 } \\
& \text { psf }
\end{aligned}
\] & 748.54635 psf & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& \text { 1,374.7895 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,479.6001 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,118.3937 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,171.3957 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 760.71329 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
15
\end{array}
\] & \[
\begin{aligned}
& 1,380.3918 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,480.4369 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,171.9102 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,181.5379 } \\
& \text { psf }
\end{aligned}
\] & \[
767.29966
\]
psf & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 1,385.9942 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,481.4085 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,233.8415
\]
psf & \[
\begin{aligned}
& \text { 1,183.1923 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 768.37405 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
17
\] & \[
\begin{aligned}
& 1,391.5965 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,482.5165 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,304.2913 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,176.4494 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 763.99515 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
18
\end{array}
\] & \[
\begin{aligned}
& \text { 1,397.1988 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,483.7629 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,383.3798 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,161.385 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 754.21226 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& 1,402.8404 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,485.1606 } \\
& \mathrm{ft}
\end{aligned}
\] & 4,471.9233
\[
\mathrm{psf}
\] & \[
\begin{aligned}
& \text { 1,141.0029 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 740.97594 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 1,408.5213 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,486.7141 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,570.2074 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,115.1562 } \\
& \text { psf }
\end{aligned}
\] & 724.19088 psf & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
21
\end{array}
\] & \[
\begin{aligned}
& \text { 1,414.2021 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,488.4178 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,677.8641 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,080.7946 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 701.87623 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& 1,419.8829 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,490.275 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,795.1025 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,037.9416 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 674.04717 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline Slice & 1,425.5638 & 1,492.2894 & - & 986.60734 & 640.7103 & - & & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 23 & ft & ft & \[
\begin{aligned}
& \text { 4,922.1579 } \\
& \text { psf }
\end{aligned}
\] & psf & psf & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& \text { 1,431.2446 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,494.4653 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,059.2942 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 926.78909 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 601.86387 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline Slice 25 & \[
\begin{aligned}
& 1,436.9254 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,496.8075 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,206.8072 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 858.47152 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 557.49792 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
26
\end{tabular} & \[
\begin{aligned}
& 1,442.6063 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,499.3211 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,365.0285 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
781.62668 \\
psf
\end{tabular} & 507.5943 psf & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
27
\end{tabular} & \[
\begin{aligned}
& 1,448.2871 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,502.0122 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,534.3298 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 692.42457 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
28
\end{tabular} & \[
\begin{aligned}
& 1,453.9679 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,504.8875 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,715.1285 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 592.7143 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \hline \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.6488 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,507.9545 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -5,907.894 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 482.78393 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
30
\] & \[
\begin{aligned}
& 1,465.3296 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,511.2216 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,113.1558 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 362.36013 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
31
\end{tabular} & \[
\begin{aligned}
& 1,468.5028 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,513.1106 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,231.8122 } \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
287.23875
\] \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
32
\end{tabular} & \[
\begin{aligned}
& 1,470.376 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,514.2801 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,305.2493 } \\
& \text { psf }
\end{aligned}
\] & 144.91999 psf & 49.899953 psf & 600 psf & 0 psf & \begin{tabular}{l}
Compacted \\
Soil Liner
\end{tabular} \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 33
\end{aligned}
\] & \[
\begin{aligned}
& 1,472.6683 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,515.7282 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,396.1797 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 28.143934 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 4.9625349 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{FS Dependent Seismic Psuedo Static}

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\section*{File Information}

File Version: 9.01
Title: Section B
Created By: Administrative User
Revision Number: 21
Date: 01/08/2021
Time: 03:36:25 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section B (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:36:36 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

FS Dependent Seismic Psuedo Static
Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

\section*{Factor of Safety Convergence Settings}

Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Municipal Solid Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf

Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: ( \(1,103.5385,1,466.9141\) ) ft
Left-Zone Right Coordinate: \((1,349.5652,1,490.5) \mathrm{ft}\)
Left-Zone Increment: 20
Right Type: Range
Right-Zone Left Coordinate: ( \(1,349.5652,1,490.5\) ) ft
Right-Zone Right Coordinate: (1,575.7018, 1,513.8689) ft
Right-Zone Increment: 20
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: (1,000, 1,465.92) ft
Right Coordinate: \((2,370,1,459.33) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(X\) & \(Y\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,370 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: \((1,879.7,1,505) \mathrm{ft}\)
Inside Point: (1,800, 1,506.73) ft
Length: 79.718774 ft
Direction: \(358.76^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.02) \mathrm{ft}\)
Inside Point: \((1,800,1,506.73) \mathrm{ft}\)
Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: (1,600, 1,511.31) ft
Inside Point: \((1,700,1,509.02) \mathrm{ft}\)
Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.61) \mathrm{ft}\)
Inside Point: \((1,600,1,511.31) \mathrm{ft}\)
Length: 100.02645 ft
Direction: \(178.68^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic

Outside Point: \((1,468.17,1,514.33) \mathrm{ft}\)
Inside Point: \((1,500,1,513.61) \mathrm{ft}\)
Slip Surface Intersection: (1,481.0504, 1,514.0386) ft
Length: 31.838142 ft
Direction: \(178.7^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 29.279521 Ibf
Pullout Force per Length: \(15.67607 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 12.883714 ft
Required Length: 1.8677846 ft
Governing Component: Tensile Capacity

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{\(X\)} & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & \(1,100 \mathrm{ft}\) & \(1,466.63 \mathrm{ft}\) \\
\hline Point 2 & \(1,200 \mathrm{ft}\) & \(1,474.66 \mathrm{ft}\) \\
\hline Point 3 & \(1,300 \mathrm{ft}\) & \(1,475.83 \mathrm{ft}\) \\
\hline Point 4 & \(1,300 \mathrm{ft}\) & \(1,480.24 \mathrm{ft}\) \\
\hline Point 5 & \(1,400 \mathrm{ft}\) & \(1,470.97 \mathrm{ft}\) \\
\hline Point 6 & \(1,400 \mathrm{ft}\) & \(1,500.94 \mathrm{ft}\) \\
\hline Point 7 & \(1,500 \mathrm{ft}\) & \(1,464.71 \mathrm{ft}\) \\
\hline Point 8 & \(1,500 \mathrm{ft}\) & \(1,515.61 \mathrm{ft}\) \\
\hline Point 9 & \(1,600 \mathrm{ft}\) & \(1,513.31 \mathrm{ft}\) \\
\hline Point 10 & \(1,600 \mathrm{ft}\) & \(1,438.5 \mathrm{ft}\) \\
\hline Point 11 & \(1,700 \mathrm{ft}\) & \(1,511.02 \mathrm{ft}\) \\
\hline Point 12 & \(1,700 \mathrm{ft}\) & \(1,432.79 \mathrm{ft}\) \\
\hline Point 13 & \(1,800 \mathrm{ft}\) & \(1,508.73 \mathrm{ft}\) \\
\hline Point 14 & \(1,800 \mathrm{ft}\) & \(1,433.38 \mathrm{ft}\) \\
\hline Point 15 & \(1,900 \mathrm{ft}\) & \(1,501.96 \mathrm{ft}\) \\
\hline Point 16 & \(1,900 \mathrm{ft}\) & \(1,433.98 \mathrm{ft}\) \\
\hline Point 17 & \(2,000 \mathrm{ft}\) & \(1,477.09 \mathrm{ft}\) \\
\hline Point 18 & \(2,000 \mathrm{ft}\) & \(1,434.58 \mathrm{ft}\) \\
\hline Point 19 & \(2,100 \mathrm{ft}\) & \(1,458.83 \mathrm{ft}\) \\
\hline Point 20 & \(2,200 \mathrm{ft}\) & \(1,462 \mathrm{ft}\) \\
\hline Point 21 & \(2,300 \mathrm{ft}\) & \(1,462 \mathrm{ft}\) \\
\hline Point 22 & \(1,000 \mathrm{ft}\) & \(1,465.92 \mathrm{ft}\) \\
\hline Point 23 & \(1,260.15 \mathrm{ft}\) & \(1,478.67 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|} 
Point 24 & \(1,279.59 \mathrm{ft}\) & \(1,478.67 \mathrm{ft}\) \\
\hline Point 25 & \(1,468.17 \mathrm{ft}\) & \(1,516.33 \mathrm{ft}\) \\
\hline Point 26 & \(1,541.66 \mathrm{ft}\) & \(1,458.07 \mathrm{ft}\) \\
\hline Point 27 & \(1,618.54 \mathrm{ft}\) & \(1,432.33 \mathrm{ft}\) \\
\hline Point 28 & \(1,879.7 \mathrm{ft}\) & \(1,507 \mathrm{ft}\) \\
\hline Point 29 & \(2,019.04 \mathrm{ft}\) & \(1,434.67 \mathrm{ft}\) \\
\hline Point 30 & \(2,075.44 \mathrm{ft}\) & \(1,458.67 \mathrm{ft}\) \\
\hline Point 31 & \(2,090.22 \mathrm{ft}\) & \(1,455.67 \mathrm{ft}\) \\
\hline Point 32 & \(2,108.27 \mathrm{ft}\) & \(1,460.92 \mathrm{ft}\) \\
\hline Point 33 & \(2,370 \mathrm{ft}\) & \(1,459.33 \mathrm{ft}\) \\
\hline Point 34 & \(2,084.21 \mathrm{ft}\) & \(1,455.67 \mathrm{ft}\) \\
\hline Point 35 & \(2,082.95 \mathrm{ft}\) & \(1,456.08 \mathrm{ft}\) \\
\hline Point 36 & \(2,370 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Point 37 & \(1,000 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Point 38 & \(1,000 \mathrm{ft}\) & \(1,430 \mathrm{ft}\) \\
\hline Point 39 & \(1,000 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Point 40 & \(2,370 \mathrm{ft}\) & \(1,435 \mathrm{ft}\) \\
\hline Point 41 & \(1,400 \mathrm{ft}\) & \(1,499.94 \mathrm{ft}\) \\
\hline Point 42 & \(1,400 \mathrm{ft}\) & \(1,497.94 \mathrm{ft}\) \\
\hline Point 43 & \(1,468.17 \mathrm{ft}\) & \(1,515.33 \mathrm{ft}\) \\
\hline Point 44 & \(1,468.17 \mathrm{ft}\) & \(1,514.33 \mathrm{ft}\) \\
\hline Point 45 & \(1,468.17 \mathrm{ft}\) & \(1,513.33 \mathrm{ft}\) \\
\hline Point 46 & \(1,500 \mathrm{ft}\) & \(1,514.61 \mathrm{ft}\) \\
\hline Point 47 & \(1,500 \mathrm{ft}\) & \(1,513.61 \mathrm{ft}\) \\
\hline Point 48 & \(1,500 \mathrm{ft}\) & \(1,512.61 \mathrm{ft}\) \\
\hline Point 49 & \(1,600 \mathrm{ft}\) & \(1,512.31 \mathrm{ft}\) \\
\hline Point 50 & \(1,600 \mathrm{ft}\) & \(1,511.31 \mathrm{ft}\) \\
\hline Point 51 & \(1,600 \mathrm{ft}\) & \(1,510.31 \mathrm{ft}\) \\
\hline Point 52 & \(1,700 \mathrm{ft}\) & \(1,510.02 \mathrm{ft}\) \\
\hline Point 53 & \(1,700 \mathrm{ft}\) & \(1,509.02 \mathrm{ft}\) \\
\hline Point 54 & \(1,700 \mathrm{ft}\) & \(1,508.02 \mathrm{ft}\) \\
\hline Point 55 & \(1,800 \mathrm{ft}\) & \(1,507.73 \mathrm{ft}\) \\
\hline Point 56 & \(1,800 \mathrm{ft}\) & \(1,506.73 \mathrm{ft}\) \\
\hline Point 57 & \(1,800 \mathrm{ft}\) & \(1,505.73 \mathrm{ft}\) \\
\hline Point 58 & \(1,879.7 \mathrm{ft}\) & \(1,506 \mathrm{ft}\) \\
\hline Point 59 & \(1,879.7 \mathrm{ft}\) & \(1,505 \mathrm{ft}\) \\
\hline Point 60 & \(1,879.7 \mathrm{ft}\) & \(1,504 \mathrm{ft}\) \\
\hline Point 61 & \(1,900 \mathrm{ft}\) & \(1,500.96 \mathrm{ft}\) \\
\hline Point 62 & \(1,900 \mathrm{ft}\) & \(1,498.96 \mathrm{ft}\) \\
\hline Point 63 & \(2,000 \mathrm{ft}\) & \(1,476.09 \mathrm{ft}\) \\
\hline Point 64 & \(2,000 \mathrm{ft}\) & \(1,474.09 \mathrm{ft}\) \\
\hline Point 65 & \(2,075.44 \mathrm{ft}\) & \(1,457.67 \mathrm{ft}\) \\
\hline Point 66 & \(2,075.44 \mathrm{ft}\) & \(1,455.67 \mathrm{ft}\) \\
\hline Point 67 & \(1,300 \mathrm{ft}\) & \(1,479.24 \mathrm{ft}\) \\
\hline Point 68 & \(1,300 \mathrm{ft}\) & \(1,477.24 \mathrm{ft}\) \\
\hline Point 69 & \(1,284.2223 \mathrm{ft}\) & \(1,478.0254 \mathrm{ft}\) \\
\hline Point 70 & \(1,293.4767 \mathrm{ft}\) & \(1,476.7377 \mathrm{ft}\) \\
\hline Point 71 & \(2,081.4818 \mathrm{ft}\) & \(1,455.5881 \mathrm{ft}\) \\
\hline Point 72 & \(2,078.5396 \mathrm{ft}\) & \(1,454.6025 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|l|l|}
\hline & Material & \multicolumn{1}{|c|}{ Points } & Area \\
\hline \(\begin{array}{l}\text { Region } \\
1\end{array}\) & \(\begin{array}{l}\text { Municipal } \\
\text { Solid } \\
\text { Waste }\end{array}\) & \(3,5,7,26,10,27,12,14,16,18,29,72,66,64,62,60,57,54,51,48,45,42,68,70\) & \(\begin{array}{l}40,219 \\
\mathrm{ft}^{2}\end{array}\) \\
\hline \(\begin{array}{l}\text { Region } \\
2\end{array}\) & \(\begin{array}{l}\text { Vegetation } \\
\text { Cover }\end{array}\) & \(24,69,67,41,43,46,49,52,55,58,61,63,65,71,35,30,17,15,28,13,11,9,8,25,6,4\) & \(\begin{array}{l}800,31 \\
\mathrm{ft}^{2}\end{array}\) \\
\hline \(\begin{array}{l}\text { Region } \\
3\end{array}\) & \(\begin{array}{l}\text { Compacted } \\
\text { Soil Liner }\end{array}\) & \(70,68,42,45,48,51,54,57,60,62,64,66,72,71,65,63,61,58,55,52,49,46,43,41,67,69\) & \(\begin{array}{l}1,582.3 \\
\mathrm{ft}^{2}\end{array}\) \\
\hline \(\begin{array}{l}\text { Region } \\
4\end{array}\) & \(\begin{array}{l}\text { Very } \\
\text { Weathered } \\
\text { Shale }\end{array}\) & \(39,36,40,38\) & \(\begin{array}{l}27,400 \\
\mathrm{ft}^{2}\end{array}\) \\
\hline \(\begin{array}{l}\text { Region } \\
5\end{array}\) & \(\begin{array}{lll}\text { Lean Clay }\end{array}\) & \(22,38,40,33,21,20,32,19,31,34,35,71,72,29,18,16,14,12,27,10,26,7,5,3,70,69,24,23,2,1\)
\end{tabular} \(\left.\begin{array}{l}30,900 \\
\mathrm{ft}^{2}\end{array}\right]\)\begin{tabular}{l}
3,425 \\
\(\mathrm{ft}^{2}\)
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 2054 of 2646 converged

\section*{Current Slip Surface}

Slip Surface: 2,090
Factor of Safety: 2.152
Volume: 2,465.4525 ft \({ }^{3}\)
Weight: 186,398.08 lbf
Resisting Moment: 35,082,251 lbffft
Activating Moment: 16,304,365 Ibf•ft
Resisting Force: 132,905.21 lbf
Activating Force: 61,769.261 lbf
Slip Rank: 1 of 2,646 slip surfaces
Exit: (1,301.0768, 1,480.4629) ft
Entry: \((1,484.146,1,515.9686) \mathrm{ft}\)
Radius: 254.62849 ft
Center: (1,347.4977, 1,730.8242) ft

\section*{Slip Slices}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline & \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{Y} & \multicolumn{1}{c|}{ PWP } & \begin{tabular}{l} 
Base \\
Normal \\
Stress
\end{tabular} & \multicolumn{1}{|c|}{\begin{tabular}{l} 
Frictional \\
Strength
\end{tabular}} & \multicolumn{1}{c|}{\begin{tabular}{l} 
Cohesive \\
Strength
\end{tabular}} & \begin{tabular}{l} 
Suction \\
Strength
\end{tabular} & \multicolumn{1}{c|}{\begin{tabular}{c} 
Base \\
Material
\end{tabular}} \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
\(1,302.3685\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,480.2303\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,141.2323\) \\
psf
\end{tabular} & \begin{tabular}{l}
113.3724 \\
psf
\end{tabular} & \begin{tabular}{l}
19.990613 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
2
\end{tabular} & \begin{tabular}{l}
\(1,306.3576\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,479.556\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,100.0468\) \\
psf
\end{tabular} & \begin{tabular}{l}
426.27043 \\
psf
\end{tabular} & \begin{tabular}{l}
146.77668 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline Slice & \(1,312.0864\) & \(1,478.6886\) & \(-4,047.2\) & 573.75593 & & & & Municipal
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 3 & ft & ft & psf & psf & 0 psf & 500 psf & 0 psf & Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & \[
\begin{aligned}
& \text { 1,318.1494 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.9111 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,000.0396 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 702.76786 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 1,324.2124 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,477.2809 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,962.0781 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 826.44886 psf & \[
\begin{aligned}
& 536.70217 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 1,330.2754 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,476.7969 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 3,933.2472 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 944.59401 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 613.42652 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & \[
\begin{aligned}
& 1,336.3385 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.4584 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,913.4947 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,048.2897 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 680.76729 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 1,342.4015 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.2647 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,902.7843 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,138.2237 } \\
& \text { psf }
\end{aligned}
\] & \[
739.17113
\]
psf & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
9
\end{tabular} & \[
\begin{aligned}
& 1,348.4645 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.2156 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,901.0954 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,215.0268 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 789.04762 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 1,354.5275 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.3108 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,908.4228 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,279.2654 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 830.76464 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& 1,360.5905 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.5506 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,924.7766 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,331.4491 } \\
& \text { psf }
\end{aligned}
\] & 864.65315 psf & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
12
\] & \[
\begin{aligned}
& 1,366.6535 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.9354 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,950.1824 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,372.0373 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 891.01145 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & \[
\begin{aligned}
& 1,372.7165 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,477.4659 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,984.6815 \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,401.4446 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 910.10876 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 1,378.7795 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.143 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,028.3311 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,420.0455 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 922.18833 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
15
\end{tabular} & \[
\begin{aligned}
& 1,384.8425 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,478.9678 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,081.2052 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,428.1789 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 927.4702 \\
& \mathrm{psf}
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
16
\end{tabular} & \[
\begin{aligned}
& \text { 1,390.9055 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,479.9418 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,143.3947 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,426.1514 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 926.15353 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
17
\] & \[
\begin{aligned}
& 1,396.9685 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,481.0668 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,215.0087 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,414.2409 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 918.41876 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& 1,403.0986 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,482.3606 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,297.1823 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,396.0284 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 906.59144 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& 1,409.2959 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,483.8293 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,390.2849 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,371.3807 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 890.58504 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\hline \text { Slice } \\
20
\end{array}
\] & \[
\begin{aligned}
& 1,415.4932 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,485.4633 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,493.7071 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,336.921 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 868.20664 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Solid Waste \\
\hline Slice & 1,421.6905 & 1,487.2659 & - & 1,292.8518 & 839.5878 & - & & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 21 & ft & ft & \[
\begin{aligned}
& \text { 4,607.6567 } \\
& \text { psf }
\end{aligned}
\] & psf & psf & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& 1,427.8877 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,489.2409 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,732.3696 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,239.3563 } \\
& \text { psf }
\end{aligned}
\] & 804.84739 psf & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& 1,434.085 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,491.3926 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,868.1122 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,176.5998 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 764.09288 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& 1,440.2823 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,493.7258 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,015.1853 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,104.7323 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 717.42157 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& 1,446.4795 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,496.2459 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -5,173.927 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,023.8898 \\
& \text { psf }
\end{aligned}
\] & 664.92181 psf & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 1,452.6768 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,498.959 \\
& \mathrm{ft}
\end{aligned}
\] & 5,344.7183 psf & \[
\begin{aligned}
& 934.19619 \\
& \text { psf }
\end{aligned}
\] & 606.6741 psf & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
27
\] & \[
\begin{aligned}
& 1,458.8741 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,501.872 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -5,527.988 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 835.76536 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 542.75237 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.0714 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,504.9926 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,724.2194 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 726.42801 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\hline \text { Slice } \\
29
\end{array}
\] & \[
\begin{aligned}
& 1,470.9987 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,508.1748 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -5,924.239 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 567.99185 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.656 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,511.409 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,127.4349 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 365.89805 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& 1,481.0504 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,514.0386 \\
& \mathrm{ft}
\end{aligned}
\] & 6,292.6072 psf & \[
\begin{aligned}
& 131.91284 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 45.421233 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 32
\end{aligned}
\] & \[
\begin{aligned}
& 1,483.3811 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,515.4859 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,383.4922 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 23.21951 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 4.094226 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Not Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section B
Created By: Administrative User
Revision Number: 21
Date: 01/08/2021
Time: 03:36:25 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section B (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:36:38 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

\section*{Factor of Safety Convergence Settings}

Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Municipal Solid Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf

Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (1,103, 1,466.8709) ft
Left-Zone Right Coordinate: \((1,350.7729,1,490.75) \mathrm{ft}\)
Left-Zone Increment: 20
Right Type: Range
Right-Zone Left Coordinate: ( \(1,350.7729,1,490.75\) ) ft
Right-Zone Right Coordinate: ( \(1,576.4437,1,513.8518\) ) ft
Right-Zone Increment: 20
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: (1,000, 1,465.92) ft
Right Coordinate: \((2,370,1,459.33) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,370 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic

Outside Point: \((1,879.7,1,505) \mathrm{ft}\)
Inside Point: (1,800, 1,506.73) ft
Length: 79.718774 ft
Direction: \(358.76^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.02) \mathrm{ft}\)
Inside Point: ( \(1,800,1,506.73\) ) ft
Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: (1,600, 1,511.31) ft Inside Point: (1,700, 1,509.02) ft Length: 100.02622 ft

Direction: \(178.69^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: (1,500, 1,513.61) ft
Inside Point: \((1,600,1,511.31) \mathrm{ft}\)
Length: 100.02645 ft
Direction: \(178.68^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((1,468.17,1,514.33) \mathrm{ft}\)
Inside Point: \((1,500,1,513.61) \mathrm{ft}\)
Slip Surface Intersection: \((1,470.6188,1,514.2746) \mathrm{ft}\)
Length: 31.838142 ft
Direction: \(178.7^{\circ}\)
F of S Dependent: No

Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 42 lbf
Pullout Force per Length: \(33.7298 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 2.4493945 ft
Required Length: 1.2451897 ft
Governing Component: Tensile Capacity

\section*{Points}
\begin{tabular}{|c|c|c|}
\hline & X & Y \\
\hline Point 1 & 1,100 ft & 1,466.63 ft \\
\hline Point 2 & 1,200 ft & 1,474.66 ft \\
\hline Point 3 & 1,300 ft & 1,475.83 ft \\
\hline Point 4 & 1,300 ft & 1,480.24 ft \\
\hline Point 5 & 1,400 ft & 1,470.97 ft \\
\hline Point 6 & 1,400 ft & 1,500.94 ft \\
\hline Point 7 & 1,500 ft & 1,464.71 ft \\
\hline Point 8 & 1,500 ft & 1,515.61 ft \\
\hline Point 9 & 1,600 ft & 1,513.31 ft \\
\hline Point 10 & 1,600 ft & 1,438.5 ft \\
\hline Point 11 & 1,700 ft & 1,511.02 ft \\
\hline Point 12 & 1,700 ft & 1,432.79 ft \\
\hline Point 13 & 1,800 ft & 1,508.73 ft \\
\hline Point 14 & 1,800 ft & 1,433.38 ft \\
\hline Point 15 & 1,900 ft & 1,501.96 ft \\
\hline Point 16 & 1,900 ft & 1,433.98 ft \\
\hline Point 17 & 2,000 ft & 1,477.09 ft \\
\hline Point 18 & 2,000 ft & 1,434.58 ft \\
\hline Point 19 & 2,100 ft & 1,458.83 ft \\
\hline Point 20 & 2,200 ft & 1,462 ft \\
\hline Point 21 & 2,300 ft & 1,462 ft \\
\hline Point 22 & 1,000 ft & 1,465.92 ft \\
\hline Point 23 & 1,260.15 ft & 1,478.67 ft \\
\hline Point 24 & 1,279.59 ft & 1,478.67 ft \\
\hline Point 25 & 1,468.17 ft & 1,516.33 ft \\
\hline Point 26 & 1,541.66 ft & 1,458.07 ft \\
\hline Point 27 & 1,618.54 ft & 1,432.33 ft \\
\hline Point 28 & 1,879.7 ft & 1,507 ft \\
\hline Point 29 & 2,019.04 ft & 1,434.67 ft \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 30 & 2,075.44 ft & 1,458.67 ft \\
\hline Point 31 & 2,090.22 ft & 1,455.67 ft \\
\hline Point 32 & 2,108.27 ft & 1,460.92 ft \\
\hline Point 33 & 2,370 ft & 1,459.33 ft \\
\hline Point 34 & 2,084.21 ft & 1,455.67 ft \\
\hline Point 35 & 2,082.95 ft & 1,456.08 ft \\
\hline Point 36 & 2,370 ft & 1,410 ft \\
\hline Point 37 & 1,000 ft & 1,410 ft \\
\hline Point 38 & 1,000 ft & 1,430 ft \\
\hline Point 39 & 1,000 ft & 1,415 ft \\
\hline Point 40 & 2,370 ft & 1,435 ft \\
\hline Point 41 & 1,400 ft & 1,499.94 ft \\
\hline Point 42 & 1,400 ft & 1,497.94 ft \\
\hline Point 43 & 1,468.17 ft & 1,515.33 ft \\
\hline Point 44 & 1,468.17 ft & 1,514.33 ft \\
\hline Point 45 & 1,468.17 ft & 1,513.33 ft \\
\hline Point 46 & 1,500 ft & 1,514.61 ft \\
\hline Point 47 & 1,500 ft & 1,513.61 ft \\
\hline Point 48 & 1,500 ft & 1,512.61 ft \\
\hline Point 49 & 1,600 ft & 1,512.31 ft \\
\hline Point 50 & 1,600 ft & 1,511.31 ft \\
\hline Point 51 & 1,600 ft & 1,510.31 ft \\
\hline Point 52 & 1,700 ft & 1,510.02 ft \\
\hline Point 53 & 1,700 ft & 1,509.02 ft \\
\hline Point 54 & 1,700 ft & 1,508.02 ft \\
\hline Point 55 & 1,800 ft & 1,507.73 ft \\
\hline Point 56 & 1,800 ft & 1,506.73 ft \\
\hline Point 57 & 1,800 ft & 1,505.73 ft \\
\hline Point 58 & 1,879.7 ft & 1,506 ft \\
\hline Point 59 & 1,879.7 ft & 1,505 ft \\
\hline Point 60 & 1,879.7 ft & 1,504 ft \\
\hline Point 61 & 1,900 ft & 1,500.96 ft \\
\hline Point 62 & 1,900 ft & 1,498.96 ft \\
\hline Point 63 & 2,000 ft & 1,476.09 ft \\
\hline Point 64 & 2,000 ft & 1,474.09 ft \\
\hline Point 65 & 2,075.44 ft & 1,457.67 ft \\
\hline Point 66 & 2,075.44 ft & 1,455.67 ft \\
\hline Point 67 & 1,300 ft & 1,479.24 ft \\
\hline Point 68 & 1,300 ft & 1,477.24 ft \\
\hline Point 69 & 1,284.2223 ft & 1,478.0254 ft \\
\hline Point 70 & 1,293.4767 ft & 1,476.7377 ft \\
\hline Point 71 & 2,081.4818 ft & 1,455.5881 ft \\
\hline Point 72 & 2,078.5396 ft & 1,454.6025 ft \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|c|c|c|c|}
\hline & Material & Points & Area \\
\hline Region & Municipal & & 40,219
\end{tabular}

Not Factor of Safety Dependent
\begin{tabular}{|l|l|l|l|}
1 & \begin{tabular}{l} 
Solid \\
Waste
\end{tabular} & \(3,5,7,26,10,27,12,14,16,18,29,72,66,64,62,60,57,54,51,48,45,42,68,70\) & \(\mathrm{ft}^{2}\) \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} & \(24,69,67,41,43,46,49,52,55,58,61,63,65,71,35,30,17,15,28,13,11,9,8,25,6,4\) & \begin{tabular}{l}
800.31 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
3
\end{tabular} & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} & \(70,68,42,45,48,51,54,57,60,62,64,66,72,71,65,63,61,58,55,52,49,46,43,41,67,69\) & \begin{tabular}{l}
\(1,582.3\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
4
\end{tabular} & \begin{tabular}{l} 
Very \\
Weathered \\
Shale
\end{tabular} & \(39,36,40,38\) & \begin{tabular}{l}
27,400 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
5
\end{tabular} & \begin{tabular}{l} 
Lean Clay
\end{tabular} & \(22,38,40,33,21,20,32,19,31,34,35,71,72,29,18,16,14,12,27,10,26,7,5,3,70,69,24,23,2,1\) & \begin{tabular}{l}
30,900 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
6
\end{tabular} & \begin{tabular}{l} 
Shale \\
Bedrock
\end{tabular} & \(37,36,39\) & \begin{tabular}{l}
3,425 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 2299 of 2646 converged

\section*{Current Slip Surface}

Slip Surface: 2,084
Factor of Safety: 3.649
Volume: 1,976.6144 ft \({ }^{3}\)
Weight: 153,573.58 lbf
Resisting Moment: 26,971,653 Ibffft
Activating Moment: 7,391,522.8 lbf•ft
Resisting Force: 106,948.38 lbf
Activating Force: 29,303.544 lbf
Slip Rank: 1 of 2,646 slip surfaces
Exit: (1,301.9371, 1,480.641) ft
Entry: (1,473.6644, 1,516.2057) ft
Radius: 242.35306 ft
Center: (1,341.9821, 1,719.6628) ft

\section*{Slip Slices}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{Y} & \multicolumn{1}{c|}{ PWP } & \begin{tabular}{l} 
Base \\
Normal \\
Stress
\end{tabular} & \begin{tabular}{l} 
Frictional \\
Strength
\end{tabular} & \begin{tabular}{l} 
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{l} 
Suction \\
Strength
\end{tabular} & \multicolumn{1}{c|}{\begin{tabular}{c} 
Base \\
Material
\end{tabular}} \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
\(1,303.2932\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,480.4217\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,153.3932\) \\
psf
\end{tabular} & \begin{tabular}{l}
79.609372 \\
psf
\end{tabular} & \begin{tabular}{l}
14.03728 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
2
\end{tabular} & \begin{tabular}{l}
\(1,307.5003\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,479.7926\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,115.0748\) \\
psf
\end{tabular} & \begin{tabular}{l}
309.88092 \\
psf
\end{tabular} & \begin{tabular}{l}
106.70056 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
3
\end{tabular} & \begin{tabular}{l}
\(1,313.1528\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,479.0471\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,069.8209\) \\
psf
\end{tabular} & \begin{tabular}{l}
473.29052 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
4
\end{tabular} & \begin{tabular}{l}
\(1,318.7559\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,478.4416\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,033.3017\) \\
psf
\end{tabular} & \begin{tabular}{l}
581.1445 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline & & - & & & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & \[
\begin{aligned}
& 1,324.3589 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.9676 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,004.9853 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 679.74667 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 6
\end{aligned}
\] & \[
\begin{aligned}
& 1,329.962 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.6242 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,984.8233 \\
psf
\end{tabular} & \[
\begin{aligned}
& 769.25915 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& 1,335.565 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.4109 \\
& \mathrm{ft}
\end{aligned}
\] & \[
3,972.7811
\]
psf & \[
\begin{aligned}
& 852.82967 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 553.83406 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
8
\] & \[
\begin{aligned}
& 1,341.168 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.3273 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,968.8373 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 926.57964 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 601.72786 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
9
\end{tabular} & \[
\begin{aligned}
& \text { 1,346.7711 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.3732 \\
& \mathrm{ft}
\end{aligned}
\] & 3,972.9835
\[
\mathrm{psf}
\] & \[
\begin{aligned}
& 990.72398 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 643.38368 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & \[
\begin{aligned}
& 1,352.3741 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.5489 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,985.2242 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,045.4844 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 678.94552 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& 1,357.9772 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.8544 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,005.5772 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,091.0595 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 708.54233 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & \[
\begin{aligned}
& 1,363.5802 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.2904 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,034.0732 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,127.6264 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 732.28916 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & \[
\begin{aligned}
& \text { 1,369.1833 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.8576 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,070.7565 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,155.3426 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 750.28825 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 14
\end{aligned}
\] & \[
\begin{aligned}
& 1,374.7863 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,479.5568 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,115.6852
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,174.347 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 762.62989 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& 1,380.3893 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,480.3892 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,168.9315 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,184.7617 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 769.39326 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 1,385.9924 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,481.3563 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,230.5827 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,186.6924 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 770.64707 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 1,391.5954 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,482.4596 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,300.7417 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,180.2297 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 766.45011 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& 1,397.1985 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,483.7012 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,379.5278
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,165.4496 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 756.85182 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
19
\end{tabular} & \[
\begin{aligned}
& 1,402.8404 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,485.0937 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,467.7481 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,145.3612 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 743.80626 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 1,408.5213 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,486.6417 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,565.6857 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,119.8191 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 727.21906 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& 1,414.2021 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,488.3396 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,672.9784 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,085.7695 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 705.10698 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& 1,419.8829 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,490.1906 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,789.8342 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,043.236 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 677.4854 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline & & & & & & & & \\
\hline
\end{tabular}

\section*{Not Factor of Safety Dependent}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& 1,425.5638 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,492.1986 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,916.4866 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 992.22909 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 644.3611 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& 1,431.2446 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,494.3677 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,053.1977 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 932.74636 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 605.73257 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& 1,436.9254 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,496.7026 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,200.2615 } \\
& \text { psf }
\end{aligned}
\] & 864.77286 psf & \[
\begin{aligned}
& 561.59006 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
26
\end{tabular} & \[
\begin{aligned}
& 1,442.6063 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,499.2086 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,358.0071 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 788.28098 psf & \[
\begin{aligned}
& 511.91566 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
27
\end{tabular} & \[
\begin{aligned}
& 1,448.2871 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,501.8917 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,526.8036 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 699.81446 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
28
\end{tabular} & \[
\begin{aligned}
& 1,453.9679 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,504.7583 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,707.0653 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 600.55402 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
29
\end{tabular} & \[
\begin{aligned}
& 1,459.6488 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,507.8161 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,899.2583 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 491.09392 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.3296 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,511.0734 } \\
& \text { ft }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,103.9076 } \\
& \text { psf }
\end{aligned}
\] & 371.16256 psf & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
31
\end{tabular} & \[
\begin{aligned}
& 1,468.6239 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,513.0313 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,226.8864 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 291.79202 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
32
\end{tabular} & \[
\begin{aligned}
& 1,470.6188 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,514.2746 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,304.9618 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 146.35097 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 50.392679 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 33
\end{aligned}
\] & \[
\begin{aligned}
& 1,472.9121 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,515.7227 \\
& \mathrm{ft} \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& -6,395.891 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 28.157386 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 4.9649069 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Not FS Dependent Pseudo Static}

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\section*{File Information}

File Version: 9.01
Title: Section B
Created By: Administrative User
Revision Number: 21
Date: 01/08/2021
Time: 03:36:25 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section B (Left Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:36:42 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not FS Dependent Pseudo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Right to Left
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

\section*{Factor of Safety Convergence Settings}

Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Municipal Solid Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf

Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (1,101.6837, 1,466.7652) ft
Left-Zone Right Coordinate: \((1,350,1,490.59) \mathrm{ft}\)
Left-Zone Increment: 20
Right Type: Range
Right-Zone Left Coordinate: \((1,350,1,490.59) \mathrm{ft}\)
Right-Zone Right Coordinate: ( \(1,575.8426,1,513.8656\) ) ft
Right-Zone Increment: 20
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: (1,000, 1,465.92) ft
Right Coordinate: \((2,370,1,459.33) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,370 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: \((1,879.7,1,505) \mathrm{ft}\)
Inside Point: (1,800, 1,506.73) ft
Length: 79.718774 ft
Direction: \(358.76^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.02) \mathrm{ft}\)
Inside Point: \((1,800,1,506.73) \mathrm{ft}\)
Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: (1,600, 1,511.31) ft
Inside Point: \((1,700,1,509.02) \mathrm{ft}\)
Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.61) \mathrm{ft}\)
Inside Point: \((1,600,1,511.31) \mathrm{ft}\)
Length: 100.02645 ft
Direction: \(178.68^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic

Outside Point: \((1,468.17,1,514.33) \mathrm{ft}\)
Inside Point: (1,500, 1,513.61) ft
Slip Surface Intersection: (1,481.3113, 1,514.0327) ft
Length: 31.838142 ft
Direction: \(178.7^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 42 lbf
Pullout Force per Length: \(33.7298 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 13.144638 ft
Required Length: 1.2451897 ft
Governing Component: Tensile Capacity

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & \(1,100 \mathrm{ft}\) & \(1,466.63 \mathrm{ft}\) \\
\hline Point 2 & \(1,200 \mathrm{ft}\) & \(1,474.66 \mathrm{ft}\) \\
\hline Point 3 & \(1,300 \mathrm{ft}\) & \(1,475.83 \mathrm{ft}\) \\
\hline Point 4 & \(1,300 \mathrm{ft}\) & \(1,480.24 \mathrm{ft}\) \\
\hline Point 5 & \(1,400 \mathrm{ft}\) & \(1,470.97 \mathrm{ft}\) \\
\hline Point 6 & \(1,400 \mathrm{ft}\) & \(1,500.94 \mathrm{ft}\) \\
\hline Point 7 & \(1,500 \mathrm{ft}\) & \(1,464.71 \mathrm{ft}\) \\
\hline Point 8 & \(1,500 \mathrm{ft}\) & \(1,515.61 \mathrm{ft}\) \\
\hline Point 9 & \(1,600 \mathrm{ft}\) & \(1,513.31 \mathrm{ft}\) \\
\hline Point 10 & \(1,600 \mathrm{ft}\) & \(1,438.5 \mathrm{ft}\) \\
\hline Point 11 & \(1,700 \mathrm{ft}\) & \(1,511.02 \mathrm{ft}\) \\
\hline Point 12 & \(1,700 \mathrm{ft}\) & \(1,432.79 \mathrm{ft}\) \\
\hline Point 13 & \(1,800 \mathrm{ft}\) & \(1,508.73 \mathrm{ft}\) \\
\hline Point 14 & \(1,800 \mathrm{ft}\) & \(1,433.38 \mathrm{ft}\) \\
\hline Point 15 & \(1,900 \mathrm{ft}\) & \(1,501.96 \mathrm{ft}\) \\
\hline Point 16 & \(1,900 \mathrm{ft}\) & \(1,433.98 \mathrm{ft}\) \\
\hline Point 17 & \(2,000 \mathrm{ft}\) & \(1,477.09 \mathrm{ft}\) \\
\hline Point 18 & \(2,000 \mathrm{ft}\) & \(1,434.58 \mathrm{ft}\) \\
\hline Point 19 & \(2,100 \mathrm{ft}\) & \(1,458.83 \mathrm{ft}\) \\
\hline Point 20 & \(2,200 \mathrm{ft}\) & \(1,462 \mathrm{ft}\) \\
\hline Point 21 & \(2,300 \mathrm{ft}\) & \(1,462 \mathrm{ft}\) \\
\hline Point 22 & \(1,000 \mathrm{ft}\) & \(1,465.92 \mathrm{ft}\) \\
\hline Point 23 & \(1,260.15 \mathrm{ft}\) & \(1,478.67 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}

\section*{Not FS Dependent Pseudo Static}
\begin{tabular}{|l|l|l|} 
Point 24 & \(1,279.59 \mathrm{ft}\) & \(1,478.67 \mathrm{ft}\) \\
\hline Point 25 & \(1,468.17 \mathrm{ft}\) & \(1,516.33 \mathrm{ft}\) \\
\hline Point 26 & \(1,541.66 \mathrm{ft}\) & \(1,458.07 \mathrm{ft}\) \\
\hline Point 27 & \(1,618.54 \mathrm{ft}\) & \(1,432.33 \mathrm{ft}\) \\
\hline Point 28 & \(1,879.7 \mathrm{ft}\) & \(1,507 \mathrm{ft}\) \\
\hline Point 29 & \(2,019.04 \mathrm{ft}\) & \(1,434.67 \mathrm{ft}\) \\
\hline Point 30 & \(2,075.44 \mathrm{ft}\) & \(1,458.67 \mathrm{ft}\) \\
\hline Point 31 & \(2,090.22 \mathrm{ft}\) & \(1,455.67 \mathrm{ft}\) \\
\hline Point 32 & \(2,108.27 \mathrm{ft}\) & \(1,460.92 \mathrm{ft}\) \\
\hline Point 33 & \(2,370 \mathrm{ft}\) & \(1,459.33 \mathrm{ft}\) \\
\hline Point 34 & \(2,084.21 \mathrm{ft}\) & \(1,455.67 \mathrm{ft}\) \\
\hline Point 35 & \(2,082.95 \mathrm{ft}\) & \(1,456.08 \mathrm{ft}\) \\
\hline Point 36 & \(2,370 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Point 37 & \(1,000 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline Point 38 & \(1,000 \mathrm{ft}\) & \(1,430 \mathrm{ft}\) \\
\hline Point 39 & \(1,000 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Point 40 & \(2,370 \mathrm{ft}\) & \(1,435 \mathrm{ft}\) \\
\hline Point 41 & \(1,400 \mathrm{ft}\) & \(1,499.94 \mathrm{ft}\) \\
\hline Point 42 & \(1,400 \mathrm{ft}\) & \(1,497.94 \mathrm{ft}\) \\
\hline Point 43 & \(1,468.17 \mathrm{ft}\) & \(1,515.33 \mathrm{ft}\) \\
\hline Point 44 & \(1,468.17 \mathrm{ft}\) & \(1,514.33 \mathrm{ft}\) \\
\hline Point 45 & \(1,468.17 \mathrm{ft}\) & \(1,513.33 \mathrm{ft}\) \\
\hline Point 46 & \(1,500 \mathrm{ft}\) & \(1,514.61 \mathrm{ft}\) \\
\hline Point 47 & \(1,500 \mathrm{ft}\) & \(1,513.61 \mathrm{ft}\) \\
\hline Point 48 & \(1,500 \mathrm{ft}\) & \(1,512.61 \mathrm{ft}\) \\
\hline Point 49 & \(1,600 \mathrm{ft}\) & \(1,512.31 \mathrm{ft}\) \\
\hline Point 50 & \(1,600 \mathrm{ft}\) & \(1,511.31 \mathrm{ft}\) \\
\hline Point 51 & \(1,600 \mathrm{ft}\) & \(1,510.31 \mathrm{ft}\) \\
\hline Point 52 & \(1,700 \mathrm{ft}\) & \(1,510.02 \mathrm{ft}\) \\
\hline Point 53 & \(1,700 \mathrm{ft}\) & \(1,509.02 \mathrm{ft}\) \\
\hline Point 54 & \(1,700 \mathrm{ft}\) & \(1,508.02 \mathrm{ft}\) \\
\hline Point 55 & \(1,800 \mathrm{ft}\) & \(1,507.73 \mathrm{ft}\) \\
\hline Point 56 & \(1,800 \mathrm{ft}\) & \(1,506.73 \mathrm{ft}\) \\
\hline Point 57 & \(1,800 \mathrm{ft}\) & \(1,505.73 \mathrm{ft}\) \\
\hline Point 58 & \(1,879.7 \mathrm{ft}\) & \(1,506 \mathrm{ft}\) \\
\hline Point 59 & \(1,879.7 \mathrm{ft}\) & \(1,505 \mathrm{ft}\) \\
\hline Point 60 & \(1,879.7 \mathrm{ft}\) & \(1,504 \mathrm{ft}\) \\
\hline Point 61 & \(1,900 \mathrm{ft}\) & \(1,500.96 \mathrm{ft}\) \\
\hline Point 62 & \(1,900 \mathrm{ft}\) & \(1,498.96 \mathrm{ft}\) \\
\hline Point 63 & \(2,000 \mathrm{ft}\) & \(1,476.09 \mathrm{ft}\) \\
\hline Point 64 & \(2,000 \mathrm{ft}\) & \(1,474.09 \mathrm{ft}\) \\
\hline Point 65 & \(2,075.44 \mathrm{ft}\) & \(1,457.67 \mathrm{ft}\) \\
\hline Point 66 & \(2,075.44 \mathrm{ft}\) & \(1,455.67 \mathrm{ft}\) \\
\hline Point 67 & \(1,300 \mathrm{ft}\) & \(1,479.24 \mathrm{ft}\) \\
\hline Point 68 & \(1,300 \mathrm{ft}\) & \(1,477.24 \mathrm{ft}\) \\
\hline Point 69 & \(1,284.2223 \mathrm{ft}\) & \(1,478.0254 \mathrm{ft}\) \\
\hline Point 70 & \(1,293.4767 \mathrm{ft}\) & \(1,476.7377 \mathrm{ft}\) \\
\hline Point 71 & \(2,081.4818 \mathrm{ft}\) & \(1,455.5881 \mathrm{ft}\) \\
\hline Point 72 & \(2,078.5396 \mathrm{ft}\) & \(1,454.6025 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|l|l|}
\hline & Material & \multicolumn{1}{|c|}{ Points } & Area \\
\hline \(\begin{array}{l}\text { Region } \\
1\end{array}\) & \(\begin{array}{l}\text { Municipal } \\
\text { Solid } \\
\text { Waste }\end{array}\) & \(3,5,7,26,10,27,12,14,16,18,29,72,66,64,62,60,57,54,51,48,45,42,68,70\) & \(\begin{array}{l}40,219 \\
\mathrm{ft}^{2}\end{array}\) \\
\hline \(\begin{array}{l}\text { Region } \\
2\end{array}\) & \(\begin{array}{l}\text { Vegetation } \\
\text { Cover }\end{array}\) & \(24,69,67,41,43,46,49,52,55,58,61,63,65,71,35,30,17,15,28,13,11,9,8,25,6,4\) & \(\begin{array}{l}800,31 \\
\mathrm{ft}^{2}\end{array}\) \\
\hline \(\begin{array}{l}\text { Region } \\
3\end{array}\) & \(\begin{array}{l}\text { Compacted } \\
\text { Soil Liner }\end{array}\) & \(70,68,42,45,48,51,54,57,60,62,64,66,72,71,65,63,61,58,55,52,49,46,43,41,67,69\) & \(\begin{array}{l}1,582.3 \\
\mathrm{ft}^{2}\end{array}\) \\
\hline \(\begin{array}{l}\text { Region } \\
4\end{array}\) & \(\begin{array}{l}\text { Very } \\
\text { Weathered } \\
\text { Shale }\end{array}\) & \(39,36,40,38\) & \(\begin{array}{l}27,400 \\
\mathrm{ft}^{2}\end{array}\) \\
\hline \(\begin{array}{l}\text { Region } \\
5\end{array}\) & \(\begin{array}{lll}\text { Lean Clay }\end{array}\) & \(22,38,40,33,21,20,32,19,31,34,35,71,72,29,18,16,14,12,27,10,26,7,5,3,70,69,24,23,2,1\)
\end{tabular} \(\left.\begin{array}{l}30,900 \\
\mathrm{ft}^{2}\end{array}\right]\)\begin{tabular}{l}
3,425 \\
\(\mathrm{ft}^{2}\)
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 1983 of 2646 converged

\section*{Current Slip Surface}

Slip Surface: 2,090
Factor of Safety: 2.153
Volume: 2,477.8302 ft \({ }^{3}\)
Weight: 187,227.61 lbf
Resisting Moment: 6,906,107.4 lbffft
Activating Moment: 3,208,056.2 lbf•ft
Resisting Force: 133,385.77 lbf
Activating Force: 61,970.165 lbf
Slip Rank: 1 of 2,646 slip surfaces
Exit: (1,301.0602, 1,480.4595) ft
Entry: (1,484.4081, 1,515.9627) ft
Radius: 254.92953 ft
Center: \((1,378,1,524.25) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline & \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{Y} & \multicolumn{1}{c|}{ PWP } & \begin{tabular}{l} 
Base \\
Normal \\
Stress
\end{tabular} & \begin{tabular}{l} 
Frictional \\
Strength
\end{tabular} & \begin{tabular}{l} 
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{l} 
Suction \\
Strength
\end{tabular} & \multicolumn{1}{c|}{\begin{tabular}{c} 
Base \\
Material
\end{tabular}} \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
\(1,302.3504\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,480.2265\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,140.9951\) \\
psf
\end{tabular} & \begin{tabular}{l}
113.43982 \\
psf
\end{tabular} & \begin{tabular}{l}
20.002501 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
2
\end{tabular} & \begin{tabular}{l}
\(1,306.3347\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,479.5513\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(4,099.7459\) \\
psf
\end{tabular} & \begin{tabular}{l}
426.5213 \\
psf
\end{tabular} & \begin{tabular}{l}
146.86306 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline & & & - & & & & &
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 1,312.061 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.6815 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,046.7519 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 574.10736 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
4
\end{tabular} & \[
\begin{aligned}
& 1,318.1258 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.9007 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,999 \cdot 3848 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 703.3941 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 5
\end{aligned}
\] & \[
\begin{aligned}
& 1,324.1905 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,477.2671 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,961.2127 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 827.45131 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 537.35317 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 1,330.2553 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.7797 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,932.167 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 945.92495 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 614.29084 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,336.3201 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.4377 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,912.1952 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,049.9416 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 681.84002 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
8
\end{tabular} & \[
\begin{aligned}
& 1,342.3848 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.2404 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,901.2608 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,140.1897 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 740.44787 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
9
\end{tabular} & \[
\begin{aligned}
& 1,348.4496 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.1875 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,899.3428 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,217.3006 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 790.52426 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
10
\end{tabular} & \[
\begin{aligned}
& 1,354.5143 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.279 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,906.4356 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,281.8411 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 832.43737 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& 1,360.5791 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.515 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,922.5488 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,334.3215 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 866.51851 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12
\end{aligned}
\] & \[
\begin{aligned}
& 1,366.6438 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.8958 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,947.7076 \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,375.2015 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 893.06632 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 13
\end{aligned}
\] & \[
\begin{aligned}
& 1,372.7086 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,477.4222 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,981.9529 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,404.8964 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 912.35038 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 1,378.7734 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,478.0951 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,025.3412 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,423.7812 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 924.61431 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& 1,384.8381 \\
& \text { ft }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,478.9156 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,077.9459 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,432.1953 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 930.07851 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 1,390.9029 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,479.8851 \\
& \mathrm{ft}
\end{aligned}
\] & 4,139.8574 psf & \[
\begin{aligned}
& \text { 1,430.446 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 928.94251 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & \[
\begin{aligned}
& 1,396.9676 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,481.0055 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,211.1838 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,418.8117 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 921.38709 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& 1,403.0986 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,482.2943 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,293.0428 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,400.8833 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 909.74428 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
19
\end{tabular} & \[
\begin{aligned}
& 1,409.2959 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,483.7575 \\
& \mathrm{ft}
\end{aligned}
\] & 4,385.7994 psf & \[
\begin{aligned}
& \text { 1,376.5309 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 893.92962 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 1,415.4932 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,485.3856 } \\
& \mathrm{ft}
\end{aligned}
\] & 4,488.8567 psf & \[
\begin{aligned}
& \text { 1,342.3716 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 871.74629 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline & & & & & & & & \\
\hline
\end{tabular}

\section*{Not FS Dependent Pseudo Static}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 21
\end{aligned}
\] & \[
\begin{aligned}
& 1,421.6905 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,487.1821 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,602.4212
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,298.6082 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 843.32605 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& 1,427.8877 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,489.1506 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -4,726.727 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,245.4243 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 808.78798 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& 1,434.085 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,491.2954 \\
& \mathrm{ft}
\end{aligned}
\] & \[
4,862.0388
\]
psf & \[
\begin{aligned}
& \text { 1,182.9855 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 768.23974 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& 1,440.2823 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,493.6212 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,008.6552 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,111.4419 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 721.7788 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& 1,446.4795 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,496.1336 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,166.9121 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,030.9297 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 669.49361 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 1,452.6768 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,498.8384 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,337.1876 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 941.5731 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 611.46472 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& 1,458.8741 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,501.7426 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,519.9073 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 843.48575 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 547.76605 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.0714 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,504.8537 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -5,715.551 \\
& p s f
\end{aligned}
\] & \[
\begin{aligned}
& 735.07465 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& 1,471.0637 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,508.0635 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,917.3008 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 574.80093 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.8512 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,511.3665 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 6,124.8286 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 368.36793 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& 1,481.3113 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,514.0327 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 6,292.2983 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 133.16957 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 45.85396 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 32
\end{aligned}
\] & \[
\begin{aligned}
& 1,483.6428 \\
& \mathrm{ft}
\end{aligned}
\] & 1,515.48 ft & \[
\begin{aligned}
& \text { 6,383.1822 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 23.314746 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
4.1110188
\] \\
psf
\end{tabular} & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section B
Created By: Administrative User
Revision Number: 15
Date: 01/08/2021
Time: 03:24:03 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section B (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects \(\backslash 2020\) Geo Projects \(\backslash 2030-0598\) Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:24:12 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

\section*{Factor of Safety Convergence Settings}

Maximum Number of Iterations: 100
Tolerable difference in F of \(\mathrm{S}: 0.001\)
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of \(\mathrm{S}: 3\)
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Municipal Solid Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\author{
Shale Bedrock \\ Model: Bedrock (Impenetrable) \\ Pore Water Pressure \\ Piezometric Line: 1
}

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf

Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (1,793, 1,508.8903) ft
Left-Zone Right Coordinate: (1,938, 1,492.5094) ft
Left-Zone Increment: 20
Right Type: Range
Right-Zone Left Coordinate: \((1,938,1,492.5094) \mathrm{ft}\)
Right-Zone Right Coordinate: \((2,161,1,461.5408) \mathrm{ft}\)
Right-Zone Increment: 20
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: \((1,000,1,465.92) \mathrm{ft}\)
Right Coordinate: \((2,370,1,459.33) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,370 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic

Outside Point: \((1,879.7,1,505) \mathrm{ft}\)
Inside Point: \((1,800,1,506.73) \mathrm{ft}\)
Slip Surface Intersection: (1,876.8131, 1,505.0627) ft
Length: 79.718774 ft
Direction: \(358.76^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 20.832739 lbf
Pullout Force per Length: \(11.153716 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 2.8875348 ft
Required Length: 1.8677846 ft
Governing Component: Tensile Capacity

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.02) \mathrm{ft}\)
Inside Point: \((1,800,1,506.73) \mathrm{ft}\)
Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: ( \(1,600,1,511.31\) ) ft
Inside Point: \((1,700,1,509.02) \mathrm{ft}\)

Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.61) \mathrm{ft}\)
Inside Point: (1,600, 1,511.31) ft
Length: 100.02645 ft
Direction: \(178.68^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((1,468.17,1,514.33) \mathrm{ft}\)
Inside Point: (1,500, 1,513.61) ft
Length: 31.838142 ft
Direction: \(178.7^{\circ}\)
F of S Dependent: Yes

Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & \(1,100 \mathrm{ft}\) & \(1,466.63 \mathrm{ft}\) \\
\hline Point 2 & \(1,200 \mathrm{ft}\) & \(1,474.66 \mathrm{ft}\) \\
\hline Point 3 & \(1,300 \mathrm{ft}\) & \(1,475.83 \mathrm{ft}\) \\
\hline Point 4 & \(1,300 \mathrm{ft}\) & \(1,480.24 \mathrm{ft}\) \\
\hline Point 5 & \(1,400 \mathrm{ft}\) & \(1,470.97 \mathrm{ft}\) \\
\hline Point 6 & \(1,400 \mathrm{ft}\) & \(1,500.94 \mathrm{ft}\) \\
\hline Point 7 & \(1,500 \mathrm{ft}\) & \(1,464.71 \mathrm{ft}\) \\
\hline Point 8 & \(1,500 \mathrm{ft}\) & \(1,515.61 \mathrm{ft}\) \\
\hline Point 9 & \(1,600 \mathrm{ft}\) & \(1,513.31 \mathrm{ft}\) \\
\hline Point 10 & \(1,600 \mathrm{ft}\) & \(1,438.5 \mathrm{ft}\) \\
\hline Point 11 & \(1,700 \mathrm{ft}\) & \(1,511.02 \mathrm{ft}\) \\
\hline Point 12 & \(1,700 \mathrm{ft}\) & \(1,432.79 \mathrm{ft}\) \\
\hline Point 13 & \(1,800 \mathrm{ft}\) & \(1,508.73 \mathrm{ft}\) \\
\hline Point 14 & \(1,800 \mathrm{ft}\) & \(1,433.38 \mathrm{ft}\) \\
\hline Point 15 & \(1,900 \mathrm{ft}\) & \(1,501.96 \mathrm{ft}\) \\
\hline Point 16 & \(1,900 \mathrm{ft}\) & \(1,433.98 \mathrm{ft}\) \\
\hline Point 17 & \(2,000 \mathrm{ft}\) & \(1,477.09 \mathrm{ft}\) \\
\hline Point 18 & \(2,000 \mathrm{ft}\) & \(1,434.58 \mathrm{ft}\) \\
\hline Point 19 & \(2,100 \mathrm{ft}\) & \(1,458.83 \mathrm{ft}\) \\
\hline Point 20 & \(2,200 \mathrm{ft}\) & \(1,462 \mathrm{ft}\) \\
\hline Point 21 & \(2,300 \mathrm{ft}\) & \(1,462 \mathrm{ft}\) \\
\hline Point 22 & \(1,000 \mathrm{ft}\) & \(1,465.92 \mathrm{ft}\) \\
\hline Point 23 & \(1,260.15 \mathrm{ft}\) & \(1,478.67 \mathrm{ft}\) \\
\hline Point 24 & \(1,279.59 \mathrm{ft}\) & \(1,478.67 \mathrm{ft}\) \\
\hline Point 25 & \(1,468.17 \mathrm{ft}\) & \(1,516.33 \mathrm{ft}\) \\
\hline Point 26 & \(1,541.66 \mathrm{ft}\) & \(1,458.07 \mathrm{ft}\) \\
\hline Point 27 & \(1,618.54 \mathrm{ft}\) & \(1,432.33 \mathrm{ft}\) \\
\hline Point 28 & \(1,879.7 \mathrm{ft}\) & \(1,507 \mathrm{ft}\) \\
\hline Point 29 & \(2,019.04 \mathrm{ft}\) & \(1,434.67 \mathrm{ft}\) \\
\hline & & \\
\hline & 1,4 \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 30 & 2,075.44 ft & 1,458.67 ft \\
\hline Point 31 & 2,090.22 ft & 1,455.67 ft \\
\hline Point 32 & 2,108.27 ft & 1,460.92 ft \\
\hline Point 33 & 2,370 ft & 1,459.33 ft \\
\hline Point 34 & 2,084.21 ft & 1,455.67 ft \\
\hline Point 35 & 2,082.95 ft & 1,456.08 ft \\
\hline Point 36 & 2,370 ft & 1,410 ft \\
\hline Point 37 & 1,000 ft & 1,410 ft \\
\hline Point 38 & 1,000 ft & 1,430 ft \\
\hline Point 39 & 1,000 ft & 1,415 ft \\
\hline Point 40 & 2,370 ft & 1,435 ft \\
\hline Point 41 & 1,400 ft & 1,499.94 ft \\
\hline Point 42 & 1,400 ft & 1,497.94 ft \\
\hline Point 43 & 1,468.17 ft & 1,515.33 ft \\
\hline Point 44 & 1,468.17 ft & 1,514.33 ft \\
\hline Point 45 & 1,468.17 ft & 1,513.33 ft \\
\hline Point 46 & 1,500 ft & 1,514.61 ft \\
\hline Point 47 & 1,500 ft & 1,513.61 ft \\
\hline Point 48 & 1,500 ft & 1,512.61 ft \\
\hline Point 49 & 1,600 ft & 1,512.31 ft \\
\hline Point 50 & 1,600 ft & 1,511.31 ft \\
\hline Point 51 & 1,600 ft & 1,510.31 ft \\
\hline Point 52 & 1,700 ft & 1,510.02 ft \\
\hline Point 53 & 1,700 ft & 1,509.02 ft \\
\hline Point 54 & 1,700 ft & 1,508.02 ft \\
\hline Point 55 & 1,800 ft & 1,507.73 ft \\
\hline Point 56 & 1,800 ft & 1,506.73 ft \\
\hline Point 57 & 1,800 ft & 1,505.73 ft \\
\hline Point 58 & 1,879.7 ft & 1,506 ft \\
\hline Point 59 & \(1,879.7 \mathrm{ft}\) & 1,505 ft \\
\hline Point 60 & 1,879.7 ft & 1,504 ft \\
\hline Point 61 & 1,900 ft & 1,500.96 ft \\
\hline Point 62 & 1,900 ft & 1,498.96 ft \\
\hline Point 63 & 2,000 ft & 1,476.09 ft \\
\hline Point 64 & 2,000 ft & 1,474.09 ft \\
\hline Point 65 & 2,075.44 ft & 1,457.67 ft \\
\hline Point 66 & 2,075.44 ft & 1,455.67 ft \\
\hline Point 67 & 1,300 ft & 1,479.24 ft \\
\hline Point 68 & 1,300 ft & 1,477.24 ft \\
\hline Point 69 & 1,284.2223 ft & 1,478.0254 ft \\
\hline Point 70 & 1,293.4767 ft & 1,476.7377 ft \\
\hline Point 71 & 2,081.4818 ft & 1,455.5881 ft \\
\hline Point 72 & 2,078.5396 ft & 1,454.6025 ft \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|c|c|c|c|}
\hline & Material & Points & Area \\
\hline Region & Municipal & & 40,219
\end{tabular}

Factor of Safety Dependent
\begin{tabular}{|l|l|l|l|}
1 & \begin{tabular}{l} 
Solid \\
Waste
\end{tabular} & \(3,5,7,26,10,27,12,14,16,18,29,72,66,64,62,60,57,54,51,48,45,42,68,70\) & \(\mathrm{ft}^{2}\) \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} & \(24,69,67,41,43,46,49,52,55,58,61,63,65,71,35,30,17,15,28,13,11,9,8,25,6,4\) & \begin{tabular}{l}
800.31 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
3
\end{tabular} & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} & \(70,68,42,45,48,51,54,57,60,62,64,66,72,71,65,63,61,58,55,52,49,46,43,41,67,69\) & \begin{tabular}{l}
\(1,582.3\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
4
\end{tabular} & \begin{tabular}{l} 
Very \\
Weathered \\
Shale
\end{tabular} & \(39,36,40,38\) & \begin{tabular}{l}
27,400 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
5
\end{tabular} & \begin{tabular}{ll} 
Lean Clay
\end{tabular} & \(22,38,40,33,21,20,32,19,31,34,35,71,72,29,18,16,14,12,27,10,26,7,5,3,70,69,24,23,2,1\) & \begin{tabular}{l}
30,900 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
6
\end{tabular} & \begin{tabular}{l} 
Shale \\
Bedrock
\end{tabular} & \(37,36,39\) & \begin{tabular}{l}
3,425 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 2163 of 2646 converged

\section*{Current Slip Surface}

Slip Surface: 1,466
Factor of Safety: 3.024
Volume: 2,962.7351 ft \({ }^{3}\)
Weight: 222,268.46 lbf
Resisting Moment: 47,114,507 lbf•ft
Activating Moment: 15,581,016 lbf•ft
Resisting Force: 147,205.32 lbf
Activating Force: 48,673.662 lbf
Slip Rank: 1 of 2,646 slip surfaces
Exit: (2,081.9561, 1,456.4228) ft
Entry: (1,873.7178, 1,507.1299) ft
Radius: 306.17684 ft
Center: \((2,045.6941,1,760.4447) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & X & Y & PWP & Base Normal Stress & Frictional Strength & Cohesive Strength & Suction Strength & Base Material \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 1
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,874.4837 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,506.6132 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,918.6799 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 23.065737 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 4.0671118 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 2
\end{aligned}
\] & \[
\begin{aligned}
& 1,876.8131 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,505.0627 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,822.4086 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 127.85727 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 44.024788 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 3
\end{aligned}
\] & \[
\begin{aligned}
& 1,879.0383 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,503.5994 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,731.5638 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 280.297 psf & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
4
\] & \[
\begin{aligned}
& 1,883.0833 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,501.0491 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,573.2709 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \begin{tabular}{l}
\[
378.8904
\] \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline & & & - & & & & & \\
\hline
\end{tabular}

Factor of Safety Dependent
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
Slice \\
5
\end{tabular} & 1,889.85 ft & \[
\begin{aligned}
& \text { 1,496.9273 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,317.4844 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 523.24027 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& 1,896.6167 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,493.0402 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,076.3537 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 655.89505 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
7
\end{tabular} & \[
\begin{aligned}
& 1,903.5714 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,489.2821 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,843.3214
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 779.5251 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 506.22952 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 1,910.7143 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,485.6559 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,618.5645
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 889.03399 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 577.34542 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,917.8571 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,482.2603 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{array}{|l}
4,408.2074 \\
\text { psf } \\
\hline
\end{array}
\] & \[
\begin{aligned}
& 988.13854 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 641.70467 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & 1,925 ft & \[
\begin{aligned}
& \text { 1,479.0871 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,211.7281 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,076.8467 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 699.31241 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 11
\end{aligned}
\] & \[
\begin{aligned}
& 1,932.1429 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,476.1287 } \\
& \mathrm{ft}
\end{aligned}
\] & 4,028.6617
psf & \[
\begin{aligned}
& \text { 1,155.1533 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 750.16532 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & \[
\begin{aligned}
& \text { 1,939.2857 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,473.3785 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,858.593 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,223.0402 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
794.25159
\] \\
psf
\end{tabular} & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & \[
\begin{aligned}
& 1,946.4286 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,470.8305 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,701.1515 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,280.4752 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 831.55034 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& \text { 1,953.5714 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,468.4795 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,556.0063 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,327.4115 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 862.03114 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
15
\end{tabular} & \[
\begin{aligned}
& \text { 1,960.7143 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,466.3208 } \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
3,422.8623 \\
psf
\end{tabular} & \[
\begin{aligned}
& 1,363.7868 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 885.65352 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
16
\] & \[
\begin{aligned}
& 1,967.8571 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,464.3501 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,301.457 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,389.5225 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 902.36647 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & 1,975 ft & \[
\begin{aligned}
& 1,462.5636 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,191.557 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,404.5229 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 912.10786 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 18
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,982.1429 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.9582 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,092.9565 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,408.6744 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 914.80382 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 19
\end{aligned}
\] & \[
\begin{aligned}
& 1,989.2857 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.5308 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,005.4744 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,401.844 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 910.36813 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,996.4286 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,458.2791 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,928.9531 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,383.8787 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 898.70136 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
21
\end{tabular} & \[
\begin{aligned}
& \text { 2,003.4229 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,457.2196 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,864.4041 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,356.4019 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 880.85767 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & \[
\begin{aligned}
& \text { 2,010.2688 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,456.3437 } \\
& \mathrm{ft}
\end{aligned}
\] & 2,811.2802
\[
\mathrm{psf}
\] & \[
\begin{aligned}
& \text { 1,319.7349 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 857.04589 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline & & & & & & & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,017.1147 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.624 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,767.9108 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,272.3449 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 826.27046 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& \text { 2,023.9606 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.0595 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,734.2269 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,214.0148 \\
& \text { psf }
\end{aligned}
\] & 788.39045 psf & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,030.8064 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.6492 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,710.1749 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,144.5033 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 743.24913 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,037.6523 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.3926 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,695.7161 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,063.5425 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 690.6726 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
27
\end{tabular} & \[
\begin{aligned}
& \text { 2,044.4982 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,454.2893 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,690.8262 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 970.83595 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 630.46824 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,051.3441 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.3391 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,695.4956 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 866.05528 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 562.42287 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
29
\end{tabular} & 2,058.19 ft & \[
\begin{aligned}
& \text { 1,454.5421 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,709.729 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 750.00553 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
30
\end{tabular} & \[
\begin{aligned}
& \text { 2,065.0358 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.8986 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,733.5455 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 627.89575 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
31
\end{tabular} & \[
\begin{aligned}
& \text { 2,071.9494 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.4158 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,767.4055 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 492.02071 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 32
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,077.6137 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.9441 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,801.679 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 318.89506 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 109.80437 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \begin{tabular}{l}
Slice \\
33
\end{tabular} & \[
\begin{aligned}
& \text { 2,080.8717 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.2974 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,824.4763 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 82.833001 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 14.605693 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{FS Dependent Seismic Psuedo Static}

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\section*{File Information}

File Version: 9.01
Title: Section B
Created By: Administrative User
Revision Number: 15
Date: 01/08/2021
Time: 03:24:03 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section B (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:24:16 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{FS Dependent Seismic Psuedo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

\section*{Factor of Safety Convergence Settings}

Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Municipal Solid Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf

Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (1,793, 1,508.8903) ft
Left-Zone Right Coordinate: \((1,938,1,492.5094) \mathrm{ft}\)
Left-Zone Increment: 20
Right Type: Range
Right-Zone Left Coordinate: \((1,938,1,492.5094) \mathrm{ft}\)
Right-Zone Right Coordinate: ( \(2,161,1,461.5408\) ) ft
Right-Zone Increment: 20
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: (1,000, 1,465.92) ft
Right Coordinate: \((2,370,1,459.33) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(X\) & \(Y\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,370 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: \((1,879.7,1,505) \mathrm{ft}\)
Inside Point: (1,800, 1,506.73) ft
Slip Surface Intersection: (1,869.7269, 1,505.2165) ft
Length: 79.718774 ft
Direction: \(358.76^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 33.361818 lbf
Pullout Force per Length: \(17.861706 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 9.9754054 ft
Required Length: 1.8677846 ft
Governing Component: Tensile Capacity

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.02) \mathrm{ft}\)
Inside Point: (1,800, 1,506.73) ft
Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: (1,600, 1,511.31) ft
Inside Point: \((1,700,1,509.02) \mathrm{ft}\)
Length: 100.02622 ft
Direction: 178.69 \({ }^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: 0 lbf/ft
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.61) \mathrm{ft}\)
Inside Point: \((1,600,1,511.31) \mathrm{ft}\)
Length: 100.02645 ft
Direction: \(178.68^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic

Outside Point: \((1,468.17,1,514.33) \mathrm{ft}\)
Inside Point: \((1,500,1,513.61) \mathrm{ft}\)
Length: 31.838142 ft
Direction: \(178.7^{\circ}\)
F of S Dependent: Yes
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1
Force Orientation: 0
Max. Pullout Force: 63 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & \(1,100 \mathrm{ft}\) & \(1,466.63 \mathrm{ft}\) \\
\hline Point 2 & \(1,200 \mathrm{ft}\) & \(1,474.66 \mathrm{ft}\) \\
\hline Point 3 & \(1,300 \mathrm{ft}\) & \(1,475.83 \mathrm{ft}\) \\
\hline Point 4 & \(1,300 \mathrm{ft}\) & \(1,480.24 \mathrm{ft}\) \\
\hline Point 5 & \(1,400 \mathrm{ft}\) & \(1,470.97 \mathrm{ft}\) \\
\hline Point 6 & \(1,400 \mathrm{ft}\) & \(1,500.94 \mathrm{ft}\) \\
\hline Point 7 & \(1,500 \mathrm{ft}\) & \(1,464.71 \mathrm{ft}\) \\
\hline Point 8 & \(1,500 \mathrm{ft}\) & \(1,515.61 \mathrm{ft}\) \\
\hline Point 9 & \(1,600 \mathrm{ft}\) & \(1,513.31 \mathrm{ft}\) \\
\hline Point 10 & \(1,600 \mathrm{ft}\) & \(1,438.5 \mathrm{ft}\) \\
\hline Point 11 & \(1,700 \mathrm{ft}\) & \(1,511.02 \mathrm{ft}\) \\
\hline Point 12 & \(1,700 \mathrm{ft}\) & \(1,432.79 \mathrm{ft}\) \\
\hline Point 13 & \(1,800 \mathrm{ft}\) & \(1,508.73 \mathrm{ft}\) \\
\hline Point 14 & \(1,800 \mathrm{ft}\) & \(1,433.38 \mathrm{ft}\) \\
\hline Point 15 & \(1,900 \mathrm{ft}\) & \(1,501.96 \mathrm{ft}\) \\
\hline Point 16 & \(1,900 \mathrm{ft}\) & \(1,433.98 \mathrm{ft}\) \\
\hline Point 17 & \(2,000 \mathrm{ft}\) & \(1,477.09 \mathrm{ft}\) \\
\hline Point 18 & \(2,000 \mathrm{ft}\) & \(1,434.58 \mathrm{ft}\) \\
\hline Point 19 & \(2,100 \mathrm{ft}\) & \(1,458.83 \mathrm{ft}\) \\
\hline Point 20 & \(2,200 \mathrm{ft}\) & \(1,462 \mathrm{ft}\) \\
\hline Point 21 & \(2,300 \mathrm{ft}\) & \(1,462 \mathrm{ft}\) \\
\hline Point 22 & \(1,000 \mathrm{ft}\) & \(1,465.92 \mathrm{ft}\) \\
\hline Point 23 & \(1,260.15 \mathrm{ft}\) & \(1,478.67 \mathrm{ft}\) \\
\hline Point 24 & \(1,279.59 \mathrm{ft}\) & \(1,478.67 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 25 & 1,468.17 ft & 1,516.33 ft \\
\hline Point 26 & 1,541.66 ft & 1,458.07 ft \\
\hline Point 27 & 1,618.54 ft & 1,432.33 ft \\
\hline Point 28 & 1,879.7 ft & 1,507 ft \\
\hline Point 29 & 2,019.04 ft & 1,434.67 ft \\
\hline Point 30 & 2,075.44 ft & 1,458.67 ft \\
\hline Point 31 & 2,090.22 ft & 1,455.67 ft \\
\hline Point 32 & 2,108.27 ft & 1,460.92 ft \\
\hline Point 33 & 2,370 ft & 1,459.33 ft \\
\hline Point 34 & 2,084.21 ft & 1,455.67 ft \\
\hline Point 35 & 2,082.95 ft & 1,456.08 ft \\
\hline Point 36 & 2,370 ft & 1,410 ft \\
\hline Point 37 & 1,000 ft & 1,410 ft \\
\hline Point 38 & 1,000 ft & 1,430 ft \\
\hline Point 39 & 1,000 ft & 1,415 ft \\
\hline Point 40 & 2,370 ft & 1,435 ft \\
\hline Point 41 & 1,400 ft & 1,499.94 ft \\
\hline Point 42 & 1,400 ft & 1,497.94 ft \\
\hline Point 43 & 1,468.17 ft & 1,515.33 ft \\
\hline Point 44 & 1,468.17 ft & 1,514.33 ft \\
\hline Point 45 & 1,468.17 ft & 1,513.33 ft \\
\hline Point 46 & 1,500 ft & 1,514.61 ft \\
\hline Point 47 & 1,500 ft & 1,513.61 ft \\
\hline Point 48 & 1,500 ft & 1,512.61 ft \\
\hline Point 49 & 1,600 ft & 1,512.31 ft \\
\hline Point 50 & 1,600 ft & 1,511.31 ft \\
\hline Point 51 & 1,600 ft & 1,510.31 ft \\
\hline Point 52 & 1,700 ft & 1,510.02 ft \\
\hline Point 53 & 1,700 ft & 1,509.02 ft \\
\hline Point 54 & 1,700 ft & 1,508.02 ft \\
\hline Point 55 & 1,800 ft & 1,507.73 ft \\
\hline Point 56 & 1,800 ft & 1,506.73 ft \\
\hline Point 57 & 1,800 ft & 1,505.73 ft \\
\hline Point 58 & 1,879.7 ft & 1,506 ft \\
\hline Point 59 & \(1,879.7 \mathrm{ft}\) & 1,505 ft \\
\hline Point 60 & 1,879.7 ft & 1,504 ft \\
\hline Point 61 & 1,900 ft & 1,500.96 ft \\
\hline Point 62 & 1,900 ft & 1,498.96 ft \\
\hline Point 63 & 2,000 ft & 1,476.09 ft \\
\hline Point 64 & 2,000 ft & 1,474.09 ft \\
\hline Point 65 & 2,075.44 ft & 1,457.67 ft \\
\hline Point 66 & 2,075.44 ft & 1,455.67 ft \\
\hline Point 67 & 1,300 ft & 1,479.24 ft \\
\hline Point 68 & 1,300 ft & 1,477.24 ft \\
\hline Point 69 & 1,284.2223 ft & 1,478.0254 ft \\
\hline Point 70 & 1,293.4767 ft & 1,476.7377 ft \\
\hline Point 71 & 2,081.4818 ft & 1,455.5881 ft \\
\hline Point 72 & 2,078.5396 ft & 1,454.6025 ft \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|l|l|}
\hline & Material & \multicolumn{1}{|c|}{ Points } & Area \\
\hline \begin{tabular}{l} 
Region \\
1
\end{tabular} & \begin{tabular}{l} 
Municipal \\
Solid \\
Waste
\end{tabular} & \(3,5,7,26,10,27,12,14,16,18,29,72,66,64,62,60,57,54,51,48,45,42,68,70\) & \begin{tabular}{l}
40,219 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} & \(24,69,67,41,43,46,49,52,55,58,61,63,65,71,35,30,17,15,28,13,11,9,8,25,6,4\) & \begin{tabular}{l}
800,31 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
3
\end{tabular} & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} & \(70,68,42,45,48,51,54,57,60,62,64,66,72,71,65,63,61,58,55,52,49,46,43,41,67,69\) & \begin{tabular}{l}
\(1,582.3\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
4
\end{tabular} & \begin{tabular}{l} 
Very \\
Weathered \\
Shale
\end{tabular} & \(39,36,40,38\) & \begin{tabular}{l}
27,400 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
5
\end{tabular} & \begin{tabular}{lll} 
Lean Clay
\end{tabular} & \(22,38,40,33,21,20,32,19,31,34,35,71,72,29,18,16,14,12,27,10,26,7,5,3,70,69,24,23,2,1\) & \begin{tabular}{l}
30,900 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
6
\end{tabular} & \begin{tabular}{l} 
Shale \\
Bedrock
\end{tabular} & \(37,36,39\) & \begin{tabular}{l}
3,425 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 2170 of 2646 converged

\section*{Current Slip Surface}

Slip Surface: 1,358
Factor of Safety: 1.888
Volume: \(3,106.4253 \mathrm{ft}^{3}\)
Weight: 232,670.67 lbf
Resisting Moment: 57,574,999 Ibffft
Activating Moment: 30,489,919 lbf•ft
Resisting Force: 161,231.24 lbf
Activating Force: 85,377.844 lbf
Slip Rank: 1 of 2,646 slip surfaces
Exit: (2,082.6057, 1,456.1987) ft
Entry: \((1,866.3798,1,507.2891) \mathrm{ft}\)
Radius: 343.22769 ft
Center: (2,049.1698, 1,797.794) ft

\section*{Slip Slices}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline & \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{Y} & \multicolumn{1}{c|}{ PWP } & \begin{tabular}{l} 
Base \\
Normal \\
Stress
\end{tabular} & \begin{tabular}{l} 
Frictional \\
Strength
\end{tabular} & \begin{tabular}{l} 
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{l} 
Suction \\
Strength
\end{tabular} & \multicolumn{1}{c|}{\begin{tabular}{c} 
Base \\
Material
\end{tabular}} \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
\(1,867.2082\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,506.7712\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,926.8815\) \\
psf
\end{tabular} & \begin{tabular}{l}
23.267147 \\
psf
\end{tabular} & \begin{tabular}{l}
4.1026258 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
2
\end{tabular} & \begin{tabular}{l}
\(1,869.7269\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,505.2165\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,830.3968\) \\
psf
\end{tabular} & \begin{tabular}{l}
130.25853 \\
psf
\end{tabular} & \begin{tabular}{l}
44.851608 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
3
\end{tabular} & \begin{tabular}{l}
\(1,875.5586\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,501.7511\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,615.3826\)
\end{tabular} & \begin{tabular}{l}
391.23609 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & & & psf & & & & & \\
\hline \[
\begin{array}{|l|l}
\hline \text { Slice } \\
4
\end{array}
\] & \[
\begin{aligned}
& 1,883.0833 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,497.4515 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,348.6712 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 589.69029 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 5
\end{aligned}
\] & 1,889.85 ft & \[
\begin{aligned}
& \text { 1,493.8073 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,122.7074 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 710.99207 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 6
\end{aligned}
\] & \[
\begin{aligned}
& 1,896.6167 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,490.3553 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,908.7375 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 820.15674 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 532.61602 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,903.5714 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,487.0033 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,701.0582 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 921.63112 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 598.51425 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& 1,910.7143 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,483.7556 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,499.9293 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,017.7636 } \\
& \text { psf }
\end{aligned}
\] & 660.94341 psf & \[
0.043846762
\]
\[
\mathrm{psf}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 9
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,917.8571 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,480.702 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,310.9211 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,105.4905 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 717.91396 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & 1,925 ft & \[
\begin{aligned}
& 1,477.837 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 4,133.6865 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,184.6629 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 769.32911 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
11
\end{array}
\] & \[
\begin{aligned}
& \text { 1,932.1429 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,475.1556 \\
& \mathrm{ft}
\end{aligned}
\] & 3,967.9116
psf & \[
\begin{aligned}
& 1,255.1235 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 815.08673 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 12
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,939.2857 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,472.6532 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,813.3126 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,316.7052 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 855.07833 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
13
\end{array}
\] & \[
\begin{aligned}
& \text { 1,946.4286 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,470.3257 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,669.6333 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,369.2296 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 889.1881 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 1,953.5714 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,468.1694 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,536.6421 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,412.5057 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 917.29192 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline Slice 15 & \[
\begin{aligned}
& 1,960.7143 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,466.1809 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
3,414.1305
\]
psf & \[
\begin{aligned}
& 1,446.3279 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 939.25631 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\hline \text { Slice } \\
16
\end{array}
\] & \[
\begin{aligned}
& \text { 1,967.8571 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,464.3573 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,301.9108 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.4746 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 954.93736 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline Slice
\[
17
\] & 1,975 ft & \[
\begin{aligned}
& \text { 1,462.6959 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,199.815 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,484.7063 \\
& \text { psf }
\end{aligned}
\] & \[
964.17956
\]
psf & \[
0.043846762
\]
psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
18
\end{array}
\] & \[
\begin{aligned}
& \text { 1,982.1429 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,461.1942 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,107.693 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,488.7639 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 966.81458 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
19
\end{array}
\] & \[
\begin{aligned}
& \text { 1,989.2857 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,459.8502 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,025.4119 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,482.3663 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 962.65992 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& 1,996.4286 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,458.6619 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,952.8546 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,465.2083 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 951.51742 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline Slice & 2,003.772 & 1,457.6031 & \[
2,888.4275
\] & 1,437.0026 & 933.2004 & \[
0.043846762
\] & 0 psf & Municipal \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 21 & ft & ft & psf & psf & psf & psf & & Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
22
\end{tabular} & \[
\begin{aligned}
& 2,011.316 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.6812 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,832.5888 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,396.7299 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 907.04703 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
23
\end{tabular} & 2,018.86 ft & \[
\begin{aligned}
& 1,455.9282 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,787.2972 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 1,343.2775 \\
& \text { psf }
\end{aligned}
\] & 872.33459 psf & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
24
\end{tabular} & \[
\begin{aligned}
& 2,026.404 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.343 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,752.4829 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,276.1368 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 828.73293 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
25
\end{tabular} & \[
\begin{aligned}
& 2,033.948 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.9248 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,728.0923 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,194.7495 } \\
& \text { psf }
\end{aligned}
\] & 775.87939 psf & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& 2,041.492 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.6729 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,714.0874 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,098.5012 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 713.375 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 27
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,049.036 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.587 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,710.4451 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 986.71474 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 640.78004 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & 2,056.58 ft & \[
\begin{aligned}
& 1,454.667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,717.1578 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 858.64266 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 557.60906 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
29
\end{tabular} & \[
\begin{aligned}
& 2,064.124 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.913 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,734.2327 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 721.02972 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 30
\end{aligned}
\] & \[
\begin{aligned}
& \hline 2,071.668 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.3253 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,761.692 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 580.97527 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
31
\end{tabular} & \[
\begin{aligned}
& \text { 2,077.8865 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,455.7785 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,791.4034 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 431.7368 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 148.6589 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & \begin{tabular}{l}
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l}
Slice \\
32
\end{tabular} & \[
\begin{aligned}
& \text { 2,081.4694 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,456.0913 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,811.7498 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 112.72264 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 19.876042 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Not Factor of Safety Dependent}

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\section*{File Information}

File Version: 9.01
Title: Section B
Created By: Administrative User
Revision Number: 15
Date: 01/08/2021
Time: 03:24:03 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section B (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:24:22 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not Factor of Safety Dependent}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

\section*{Factor of Safety Convergence Settings}

Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Municipal Solid Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
```

Shale Bedrock
Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

```

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf

Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (1,793, 1,508.8903) ft
Left-Zone Right Coordinate: \((1,938,1,492.5094) \mathrm{ft}\)
Left-Zone Increment: 20
Right Type: Range
Right-Zone Left Coordinate: \((1,938,1,492.5094) \mathrm{ft}\)
Right-Zone Right Coordinate: ( \(2,161,1,461.5408\) ) ft
Right-Zone Increment: 20
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: (1,000, 1,465.92) ft
Right Coordinate: \((2,370,1,459.33) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,370 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic

Outside Point: \((1,879.7,1,505) \mathrm{ft}\)
Inside Point: (1,800, 1,506.73) ft
Slip Surface Intersection: \((1,876.8131,1,505.0627)\) ft
Length: 79.718774 ft
Direction: \(358.76^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 42 lbf
Pullout Force per Length: \(33.7298 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 2.8875348 ft
Required Length: 1.2451897 ft
Governing Component: Tensile Capacity

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: (1,700, 1,509.02) ft
Inside Point: (1,800, 1,506.73) ft
Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: (1,600, 1,511.31) ft
Inside Point: (1,700, 1,509.02) ft

Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.61) \mathrm{ft}\)
Inside Point: (1,600, 1,511.31) ft
Length: 100.02645 ft
Direction: \(178.68^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic
Outside Point: \((1,468.17,1,514.33) \mathrm{ft}\)
Inside Point: (1,500, 1,513.61) ft
Length: 31.838142 ft
Direction: \(178.7^{\circ}\)
F of S Dependent: No

Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 Ibf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & \(1,100 \mathrm{ft}\) & \(1,466.63 \mathrm{ft}\) \\
\hline Point 2 & \(1,200 \mathrm{ft}\) & \(1,474.66 \mathrm{ft}\) \\
\hline Point 3 & \(1,300 \mathrm{ft}\) & \(1,475.83 \mathrm{ft}\) \\
\hline Point 4 & \(1,300 \mathrm{ft}\) & \(1,480.24 \mathrm{ft}\) \\
\hline Point 5 & \(1,400 \mathrm{ft}\) & \(1,470.97 \mathrm{ft}\) \\
\hline Point 6 & \(1,400 \mathrm{ft}\) & \(1,500.94 \mathrm{ft}\) \\
\hline Point 7 & \(1,500 \mathrm{ft}\) & \(1,464.71 \mathrm{ft}\) \\
\hline Point 8 & \(1,500 \mathrm{ft}\) & \(1,515.61 \mathrm{ft}\) \\
\hline Point 9 & \(1,600 \mathrm{ft}\) & \(1,513.31 \mathrm{ft}\) \\
\hline Point 10 & \(1,600 \mathrm{ft}\) & \(1,438.5 \mathrm{ft}\) \\
\hline Point 11 & \(1,700 \mathrm{ft}\) & \(1,511.02 \mathrm{ft}\) \\
\hline Point 12 & \(1,700 \mathrm{ft}\) & \(1,432.79 \mathrm{ft}\) \\
\hline Point 13 & \(1,800 \mathrm{ft}\) & \(1,508.73 \mathrm{ft}\) \\
\hline Point 14 & \(1,800 \mathrm{ft}\) & \(1,433.38 \mathrm{ft}\) \\
\hline Point 15 & \(1,900 \mathrm{ft}\) & \(1,501.96 \mathrm{ft}\) \\
\hline Point 16 & \(1,900 \mathrm{ft}\) & \(1,433.98 \mathrm{ft}\) \\
\hline Point 17 & \(2,000 \mathrm{ft}\) & \(1,477.09 \mathrm{ft}\) \\
\hline Point 18 & \(2,000 \mathrm{ft}\) & \(1,434.58 \mathrm{ft}\) \\
\hline Point 19 & \(2,100 \mathrm{ft}\) & \(1,458.83 \mathrm{ft}\) \\
\hline Point 20 & \(2,200 \mathrm{ft}\) & \(1,462 \mathrm{ft}\) \\
\hline Point 21 & \(2,300 \mathrm{ft}\) & \(1,462 \mathrm{ft}\) \\
\hline Point 22 & \(1,000 \mathrm{ft}\) & \(1,465.92 \mathrm{ft}\) \\
\hline Point 23 & \(1,260.15 \mathrm{ft}\) & \(1,478.67 \mathrm{ft}\) \\
\hline Point 24 & \(1,279.59 \mathrm{ft}\) & \(1,478.67 \mathrm{ft}\) \\
\hline Point 25 & \(1,468.17 \mathrm{ft}\) & \(1,516.33 \mathrm{ft}\) \\
\hline Point 26 & \(1,541.66 \mathrm{ft}\) & \(1,458.07 \mathrm{ft}\) \\
\hline Point 27 & \(1,618.54 \mathrm{ft}\) & \(1,432.33 \mathrm{ft}\) \\
\hline Point 28 & \(1,879.7 \mathrm{ft}\) & \(1,507 \mathrm{ft}\) \\
\hline Point 29 & \(2,019.04 \mathrm{ft}\) & \(1,434.67 \mathrm{ft}\) \\
\hline & & \\
\hline & 1, \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 30 & 2,075.44 ft & 1,458.67 ft \\
\hline Point 31 & 2,090.22 ft & 1,455.67 ft \\
\hline Point 32 & 2,108.27 ft & 1,460.92 ft \\
\hline Point 33 & 2,370 ft & 1,459.33 ft \\
\hline Point 34 & 2,084.21 ft & 1,455.67 ft \\
\hline Point 35 & 2,082.95 ft & 1,456.08 ft \\
\hline Point 36 & 2,370 ft & 1,410 ft \\
\hline Point 37 & 1,000 ft & 1,410 ft \\
\hline Point 38 & 1,000 ft & 1,430 ft \\
\hline Point 39 & 1,000 ft & 1,415 ft \\
\hline Point 40 & 2,370 ft & 1,435 ft \\
\hline Point 41 & 1,400 ft & 1,499.94 ft \\
\hline Point 42 & 1,400 ft & 1,497.94 ft \\
\hline Point 43 & 1,468.17 ft & 1,515.33 ft \\
\hline Point 44 & 1,468.17 ft & 1,514.33 ft \\
\hline Point 45 & 1,468.17 ft & 1,513.33 ft \\
\hline Point 46 & 1,500 ft & 1,514.61 ft \\
\hline Point 47 & 1,500 ft & 1,513.61 ft \\
\hline Point 48 & 1,500 ft & 1,512.61 ft \\
\hline Point 49 & 1,600 ft & 1,512.31 ft \\
\hline Point 50 & 1,600 ft & 1,511.31 ft \\
\hline Point 51 & 1,600 ft & 1,510.31 ft \\
\hline Point 52 & 1,700 ft & 1,510.02 ft \\
\hline Point 53 & 1,700 ft & 1,509.02 ft \\
\hline Point 54 & 1,700 ft & 1,508.02 ft \\
\hline Point 55 & 1,800 ft & 1,507.73 ft \\
\hline Point 56 & 1,800 ft & 1,506.73 ft \\
\hline Point 57 & 1,800 ft & 1,505.73 ft \\
\hline Point 58 & 1,879.7 ft & 1,506 ft \\
\hline Point 59 & 1,879.7 ft & 1,505 ft \\
\hline Point 60 & 1,879.7 ft & 1,504 ft \\
\hline Point 61 & 1,900 ft & 1,500.96 ft \\
\hline Point 62 & 1,900 ft & 1,498.96 ft \\
\hline Point 63 & 2,000 ft & 1,476.09 ft \\
\hline Point 64 & 2,000 ft & 1,474.09 ft \\
\hline Point 65 & 2,075.44 ft & 1,457.67 ft \\
\hline Point 66 & 2,075.44 ft & 1,455.67 ft \\
\hline Point 67 & 1,300 ft & 1,479.24 ft \\
\hline Point 68 & 1,300 ft & 1,477.24 ft \\
\hline Point 69 & 1,284.2223 ft & 1,478.0254 ft \\
\hline Point 70 & 1,293.4767 ft & 1,476.7377 ft \\
\hline Point 71 & 2,081.4818 ft & 1,455.5881 ft \\
\hline Point 72 & 2,078.5396 ft & 1,454.6025 ft \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|c|c|c|c|}
\hline & Material & Points & Area \\
\hline Region & Municipal & & 40,219
\end{tabular}

Not Factor of Safety Dependent
\begin{tabular}{|l|l|l|l|}
1 & \begin{tabular}{l} 
Solid \\
Waste
\end{tabular} & \(3,5,7,26,10,27,12,14,16,18,29,72,66,64,62,60,57,54,51,48,45,42,68,70\) & \(\mathrm{ft}^{2}\) \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} & \(24,69,67,41,43,46,49,52,55,58,61,63,65,71,35,30,17,15,28,13,11,9,8,25,6,4\) & \begin{tabular}{l}
800.31 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
3
\end{tabular} & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} & \(70,68,42,45,48,51,54,57,60,62,64,66,72,71,65,63,61,58,55,52,49,46,43,41,67,69\) & \begin{tabular}{l}
\(1,582.3\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
4
\end{tabular} & \begin{tabular}{l} 
Very \\
Weathered \\
Shale
\end{tabular} & \(39,36,40,38\) & \begin{tabular}{l}
27,400 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
5
\end{tabular} & \begin{tabular}{l} 
Lean Clay
\end{tabular} & \(22,38,40,33,21,20,32,19,31,34,35,71,72,29,18,16,14,12,27,10,26,7,5,3,70,69,24,23,2,1\) & \begin{tabular}{l}
30,900 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
6
\end{tabular} & \begin{tabular}{l} 
Shale \\
Bedrock
\end{tabular} & \(37,36,39\) & \begin{tabular}{l}
3,425 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 2163 of 2646 converged

\section*{Current Slip Surface}

Slip Surface: 1,466
Factor of Safety: 3.025
Volume: 2,962.7351 ft \({ }^{3}\)
Weight: 222,268.46 lbf
Resisting Moment: 47,098,708 lbf•ft
Activating Moment: 15,570,139 lbffft
Resisting Force: 147,143.64 lbf
Activating Force: 48,635.609 lbf
Slip Rank: 1 of 2,646 slip surfaces
Exit: (2,081.9561, 1,456.4228) ft
Entry: (1,873.7178, 1,507.1299) ft
Radius: 306.17684 ft
Center: \((2,045.6941,1,760.4447) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{Y} & \multicolumn{1}{c|}{ PWP } & \begin{tabular}{l} 
Base \\
Normal \\
Stress
\end{tabular} & \begin{tabular}{l} 
Frictional \\
Strength
\end{tabular} & \begin{tabular}{l} 
Cohesive \\
Strength
\end{tabular} & \begin{tabular}{l} 
Suction \\
Strength
\end{tabular} & \multicolumn{1}{c|}{\begin{tabular}{c} 
Base \\
Material
\end{tabular}} \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
\(1,874.4837\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,506.6132\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,918.6799\) \\
psf
\end{tabular} & \begin{tabular}{l}
23.067905 \\
psf
\end{tabular} & \begin{tabular}{l}
4.0674941 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
2
\end{tabular} & \begin{tabular}{l}
\(1,876.8131\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,505.0627\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,822.4086\) \\
psf
\end{tabular} & \begin{tabular}{l}
128.95503 \\
psf
\end{tabular} & \begin{tabular}{l}
44.402779 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
3
\end{tabular} & \begin{tabular}{l}
\(1,879.0383\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,503.5994\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,731.5638\) \\
psf
\end{tabular} & \begin{tabular}{l}
280.32246 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
4
\end{tabular} & \begin{tabular}{l}
\(1,883.0833\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,501.0491\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,573.2709\) \\
psf
\end{tabular} & \begin{tabular}{l}
378.92309 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline & & - & & & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 5
\end{aligned}
\] & 1,889.85 ft & \[
\begin{aligned}
& 1,496.9273 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 5,317.4844 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 523.28206 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
6
\end{tabular} & \[
\begin{aligned}
& \text { 1,896.6167 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,493.0402 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 5,076.3537 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 655.94376 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 7
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,903.5714 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,489.2821 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,843.3214
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& 779.57565 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 506.26235 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 8
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,910.7143 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,485.6559 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 4,618.5645 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 889.08613 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 577.37928 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
9
\end{tabular} & \[
\begin{aligned}
& \text { 1,917.8571 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,482.2603 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
4,408.2074 \\
psf
\end{tabular} & \[
\begin{aligned}
& 988.19047 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 641.7384 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 10
\end{aligned}
\] & 1,925 ft & \[
\begin{aligned}
& 1,479.0871 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
4,211.7281
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,076.8968 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 699.34495 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
11
\end{tabular} & \[
\begin{aligned}
& \text { 1,932.1429 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,476.1287 \\
& \mathrm{ft}
\end{aligned}
\] & 4,028.6617 psf & \[
\begin{aligned}
& 1,155.2002 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 750.19576 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
12
\end{tabular} & \[
\begin{aligned}
& \text { 1,939.2857 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,473.3785 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,858.593 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,223.0826 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 794.27912 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
13
\end{tabular} & \[
\begin{aligned}
& \text { 1,946.4286 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,470.8305 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,701.1515 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,280.5121 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 831.57426 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
14
\end{tabular} & \[
\begin{aligned}
& 1,953.5714 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,468.4795 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,556.0063 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,327.442 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 862.05089 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 15
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,960.7143 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,466.3208 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,422.8623 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,363.8101 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 885.66864 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 16
\end{aligned}
\] & \[
\begin{aligned}
& 1,967.8571 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,464.3501 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,301.457 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,389.5381 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 902.37661 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
17
\end{tabular} & 1,975 ft & \[
\begin{aligned}
& 1,462.5636 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -3,191.557 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,404.5305 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 912.11276 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
18
\end{tabular} & \[
\begin{aligned}
& \text { 1,982.1429 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,460.9582 \\
& \mathrm{ft}
\end{aligned}
\] & 3,092.9565
psf & \[
\begin{aligned}
& 1,408.6737 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 914.80337 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
19
\end{tabular} & \[
\begin{aligned}
& \text { 1,989.2857 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,459.5308 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 3,005.4744 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,401.835 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 910.3623 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 20
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,996.4286 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,458.2791 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
2,928.9531 \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,383.8616 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 898.69026 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
21
\end{tabular} & \[
\begin{aligned}
& \text { 2,003.4229 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,457.2196 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,864.4041 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 1,356.3772 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 880.84162 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,010.2688 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.3437 \\
& \mathrm{ft}
\end{aligned}
\] & \begin{tabular}{l}
\[
2,811.2802
\] \\
psf
\end{tabular} & \[
\begin{aligned}
& \text { 1,319.7032 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 857.0253 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
\[
0.043846762
\] \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline & & & & & & & & \\
\hline
\end{tabular}

\section*{Not Factor of Safety Dependent}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,017.1147 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.624 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,767.9108 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,272.3069 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 826.24575 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,023.9606 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.0595 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,734.2269 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,213.9713 } \\
& \text { psf }
\end{aligned}
\] & 788.36218 psf & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 25
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,030.8064 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.6492 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,710.1749 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,144.4554 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 743.21799 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 0.043846762 \\
& \text { psf }
\end{aligned}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,037.6523 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.3926 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,695.7161 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,063.4915 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 690.63943 \\
& \text { psf }
\end{aligned}
\] & \begin{tabular}{l}
0.043846762 \\
psf
\end{tabular} & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
27
\end{tabular} & \[
\begin{aligned}
& \text { 2,044.4982 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.2893 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,690.8262 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 970.78325 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 630.43402 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,051.3441 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.3391 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,695.4956 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 866.00274 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 562.38876 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & 2,058.19 ft & \[
\begin{aligned}
& 1,454.5421 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,709.729 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 749.95679 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
30
\end{tabular} & \[
\begin{aligned}
& \text { 2,065.0358 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,454.8986 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,733.5455 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 627.84385 psf & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \begin{tabular}{l}
Slice \\
31
\end{tabular} & \[
\begin{aligned}
& \text { 2,071.9494 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.4158 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,767.4055 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 491.96671 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 32
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,077.6137 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.9441 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,801.679 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 318.81822 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \hline 109.77792 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \begin{tabular}{l}
Slice \\
33
\end{tabular} & \[
\begin{aligned}
& \text { 2,080.8717 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.2974 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,824.4763 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 82.809928 psf & 14.601625 psf & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{Not FS Dependent Pseudo Static}

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\section*{File Information}

File Version: 9.01
Title: Section B
Created By: Administrative User
Revision Number: 15
Date: 01/08/2021
Time: 03:24:03 PM
Tool Version: 9.1.1.16749
File Name: Altus Landfill Section B (Right Side).gsz
Directory: \\standardserver\Geotech\Oklahoma City\Projects\2020 Geo Projects\2030-0598 Cowan Group Engineering Altus Landfill Expansion Altus OK\Laboratory Results\SlopeW\}
Last Solved Date: 01/08/2021
Last Solved Time: 03:24:26 PM

\section*{Project Settings}

Unit System: U.S. Customary Units

\section*{Analysis Settings}

\section*{Not FS Dependent Pseudo Static}

Kind: SLOPE/W
Method: Spencer
Settings
PWP Conditions from: Piezometric Line
Apply Phreatic Correction: No
Use Staged Rapid Drawdown: No
Unit Weight of Water: 62.430189 pcf
Slip Surface
Direction of movement: Left to Right
Use Passive Mode: No
Slip Surface Option: Entry and Exit
Critical slip surfaces saved: 1
Optimize Critical Slip Surface Location: No
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 0.1 ft
Number of Slices: 30

\section*{Factor of Safety Convergence Settings}

Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.001
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

\section*{Materials}

\section*{Lean Clay}

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 1,200 psf
Phi': \(15{ }^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Compacted Soil Liner
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 600 psf
Phi': \(19^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Municipal Solid Waste
Model: Bilinear
Unit Weight: 63 pcf
Cohesion': 500 psf
Phi 1: \(0^{\circ}\)
Phi 2: \(33^{\circ}\)
Bilinear Normal: 770 psf
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Shale Bedrock}

Model: Bedrock (Impenetrable)
Pore Water Pressure
Piezometric Line: 1

\section*{Vegetation Cover}

Model: Mohr-Coulomb
Unit Weight: 115 pcf

Cohesion': 200 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1
Very Weathered Shale
Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 2,400 psf
Phi': \(10^{\circ}\)
Phi-B: \(0^{\circ}\)
Pore Water Pressure
Piezometric Line: 1

\section*{Slip Surface Entry and Exit}

Left Type: Range
Left-Zone Left Coordinate: (1,793, 1,508.8903) ft
Left-Zone Right Coordinate: \((1,938,1,492.5094) \mathrm{ft}\)
Left-Zone Increment: 20
Right Type: Range
Right-Zone Left Coordinate: \((1,938,1,492.5094) \mathrm{ft}\)
Right-Zone Right Coordinate: ( \(2,161,1,461.5408\) ) ft
Right-Zone Increment: 20
Radius Increments: 5

\section*{Slip Surface Limits}

Left Coordinate: (1,000, 1,465.92) ft
Right Coordinate: \((2,370,1,459.33) \mathrm{ft}\)

\section*{Piezometric Lines}

\section*{Piezometric Line 1}

Coordinates
\begin{tabular}{|c|c|c|}
\hline & \(\mathbf{X}\) & \(\mathbf{Y}\) \\
\hline Coordinate 1 & \(1,000 \mathrm{ft}\) & \(1,415 \mathrm{ft}\) \\
\hline Coordinate 2 & \(2,370 \mathrm{ft}\) & \(1,410 \mathrm{ft}\) \\
\hline
\end{tabular}

\section*{Seismic Coefficients}

Horz Seismic Coef.: 0.143
Vert Seismic Coef.: 0.09

\section*{Reinforcements}

\section*{Reinforcement 1}

Type: Geosynthetic
Outside Point: \((1,879.7,1,505) \mathrm{ft}\)
Inside Point: (1,800, 1,506.73) ft
Slip Surface Intersection: (1,869.7269, 1,505.2165) ft
Length: 79.718774 ft
Direction: \(358.76^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 42 lbf
Pullout Force per Length: \(33.7298 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 9.9754054 ft
Required Length: 1.2451897 ft
Governing Component: Tensile Capacity

\section*{Reinforcement 2}

Type: Geosynthetic
Outside Point: \((1,700,1,509.02) \mathrm{ft}\)
Inside Point: (1,800, 1,506.73) ft
Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 3}

Type: Geosynthetic
Outside Point: \((1,600,1,511.31) \mathrm{ft}\)
Inside Point: (1,700, 1,509.02) ft
Length: 100.02622 ft
Direction: \(178.69^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 4}

Type: Geosynthetic
Outside Point: \((1,500,1,513.61) \mathrm{ft}\)
Inside Point: (1,600, 1,511.31) ft
Length: 100.02645 ft
Direction: \(178.68^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Reinforcement 5}

Type: Geosynthetic

Outside Point: \((1,468.17,1,514.33) \mathrm{ft}\)
Inside Point: (1,500, 1,513.61) ft
Length: 31.838142 ft
Direction: \(178.7^{\circ}\)
F of S Dependent: No
Force Distribution: Concentrated
Face Anchorage: No
Interface Adhesion: 0 psf
Interface Shear Angle: \(8^{\circ}\)
Surface Area Factor: 1
Resistance Reduction Factor: 1
Tensile Capacity: 63 lbf
Reduction Factor: 1.5
Force Orientation: 0
Max. Pullout Force: 42 lbf
Pullout Force: 0 lbf
Pullout Force per Length: \(0 \mathrm{lbf} / \mathrm{ft}\)
Available Length: 0 ft
Required Length: 0 ft
Governing Component: (none)

\section*{Points}
\begin{tabular}{|l|l|l|}
\hline & \multicolumn{1}{|c|}{ X } & \multicolumn{1}{|c|}{ Y } \\
\hline Point 1 & \(1,100 \mathrm{ft}\) & \(1,466.63 \mathrm{ft}\) \\
\hline Point 2 & \(1,200 \mathrm{ft}\) & \(1,474.66 \mathrm{ft}\) \\
\hline Point 3 & \(1,300 \mathrm{ft}\) & \(1,475.83 \mathrm{ft}\) \\
\hline Point 4 & \(1,300 \mathrm{ft}\) & \(1,480.24 \mathrm{ft}\) \\
\hline Point 5 & \(1,400 \mathrm{ft}\) & \(1,470.97 \mathrm{ft}\) \\
\hline Point 6 & \(1,400 \mathrm{ft}\) & \(1,500.94 \mathrm{ft}\) \\
\hline Point 7 & \(1,500 \mathrm{ft}\) & \(1,464.71 \mathrm{ft}\) \\
\hline Point 8 & \(1,500 \mathrm{ft}\) & \(1,515.61 \mathrm{ft}\) \\
\hline Point 9 & \(1,600 \mathrm{ft}\) & \(1,513.31 \mathrm{ft}\) \\
\hline Point 10 & \(1,600 \mathrm{ft}\) & \(1,438.5 \mathrm{ft}\) \\
\hline Point 11 & \(1,700 \mathrm{ft}\) & \(1,511.02 \mathrm{ft}\) \\
\hline Point 12 & \(1,700 \mathrm{ft}\) & \(1,432.79 \mathrm{ft}\) \\
\hline Point 13 & \(1,800 \mathrm{ft}\) & \(1,508.73 \mathrm{ft}\) \\
\hline Point 14 & \(1,800 \mathrm{ft}\) & \(1,433.38 \mathrm{ft}\) \\
\hline Point 15 & \(1,900 \mathrm{ft}\) & \(1,501.96 \mathrm{ft}\) \\
\hline Point 16 & \(1,900 \mathrm{ft}\) & \(1,433.98 \mathrm{ft}\) \\
\hline Point 17 & \(2,000 \mathrm{ft}\) & \(1,477.09 \mathrm{ft}\) \\
\hline Point 18 & \(2,000 \mathrm{ft}\) & \(1,434.58 \mathrm{ft}\) \\
\hline Point 19 & \(2,100 \mathrm{ft}\) & \(1,458.83 \mathrm{ft}\) \\
\hline Point 20 & \(2,200 \mathrm{ft}\) & \(1,462 \mathrm{ft}\) \\
\hline Point 21 & \(2,300 \mathrm{ft}\) & \(1,462 \mathrm{ft}\) \\
\hline Point 22 & \(1,000 \mathrm{ft}\) & \(1,465.92 \mathrm{ft}\) \\
\hline Point 23 & \(1,260.15 \mathrm{ft}\) & \(1,478.67 \mathrm{ft}\) \\
\hline Point 24 & \(1,279.59 \mathrm{ft}\) & \(1,478.67 \mathrm{ft}\) \\
\hline & & \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|}
\hline Point 25 & 1,468.17 ft & 1,516.33 ft \\
\hline Point 26 & 1,541.66 ft & 1,458.07 ft \\
\hline Point 27 & 1,618.54 ft & 1,432.33 ft \\
\hline Point 28 & 1,879.7 ft & 1,507 ft \\
\hline Point 29 & 2,019.04 ft & 1,434.67 ft \\
\hline Point 30 & 2,075.44 ft & 1,458.67 ft \\
\hline Point 31 & 2,090.22 ft & 1,455.67 ft \\
\hline Point 32 & 2,108.27 ft & 1,460.92 ft \\
\hline Point 33 & 2,370 ft & 1,459.33 ft \\
\hline Point 34 & 2,084.21 ft & 1,455.67 ft \\
\hline Point 35 & 2,082.95 ft & 1,456.08 ft \\
\hline Point 36 & 2,370 ft & 1,410 ft \\
\hline Point 37 & 1,000 ft & 1,410 ft \\
\hline Point 38 & 1,000 ft & 1,430 ft \\
\hline Point 39 & 1,000 ft & 1,415 ft \\
\hline Point 40 & 2,370 ft & 1,435 ft \\
\hline Point 41 & 1,400 ft & 1,499.94 ft \\
\hline Point 42 & 1,400 ft & 1,497.94 ft \\
\hline Point 43 & 1,468.17 ft & 1,515.33 ft \\
\hline Point 44 & 1,468.17 ft & 1,514.33 ft \\
\hline Point 45 & 1,468.17 ft & 1,513.33 ft \\
\hline Point 46 & 1,500 ft & 1,514.61 ft \\
\hline Point 47 & 1,500 ft & 1,513.61 ft \\
\hline Point 48 & 1,500 ft & 1,512.61 ft \\
\hline Point 49 & 1,600 ft & 1,512.31 ft \\
\hline Point 50 & 1,600 ft & 1,511.31 ft \\
\hline Point 51 & 1,600 ft & 1,510.31 ft \\
\hline Point 52 & 1,700 ft & 1,510.02 ft \\
\hline Point 53 & 1,700 ft & 1,509.02 ft \\
\hline Point 54 & 1,700 ft & 1,508.02 ft \\
\hline Point 55 & 1,800 ft & 1,507.73 ft \\
\hline Point 56 & 1,800 ft & 1,506.73 ft \\
\hline Point 57 & 1,800 ft & 1,505.73 ft \\
\hline Point 58 & 1,879.7 ft & 1,506 ft \\
\hline Point 59 & \(1,879.7 \mathrm{ft}\) & 1,505 ft \\
\hline Point 60 & 1,879.7 ft & 1,504 ft \\
\hline Point 61 & 1,900 ft & 1,500.96 ft \\
\hline Point 62 & 1,900 ft & 1,498.96 ft \\
\hline Point 63 & 2,000 ft & 1,476.09 ft \\
\hline Point 64 & 2,000 ft & 1,474.09 ft \\
\hline Point 65 & 2,075.44 ft & 1,457.67 ft \\
\hline Point 66 & 2,075.44 ft & 1,455.67 ft \\
\hline Point 67 & 1,300 ft & 1,479.24 ft \\
\hline Point 68 & 1,300 ft & 1,477.24 ft \\
\hline Point 69 & 1,284.2223 ft & 1,478.0254 ft \\
\hline Point 70 & 1,293.4767 ft & 1,476.7377 ft \\
\hline Point 71 & 2,081.4818 ft & 1,455.5881 ft \\
\hline Point 72 & 2,078.5396 ft & 1,454.6025 ft \\
\hline
\end{tabular}

\section*{Regions}
\begin{tabular}{|l|l|l|l|l|}
\hline & Material & \multicolumn{1}{|c|}{ Points } & Area \\
\hline \begin{tabular}{l} 
Region \\
1
\end{tabular} & \begin{tabular}{l} 
Municipal \\
Solid \\
Waste
\end{tabular} & \(3,5,7,26,10,27,12,14,16,18,29,72,66,64,62,60,57,54,51,48,45,42,68,70\) & \begin{tabular}{l}
40,219 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
2
\end{tabular} & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} & \(24,69,67,41,43,46,49,52,55,58,61,63,65,71,35,30,17,15,28,13,11,9,8,25,6,4\) & \begin{tabular}{l}
800,31 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
3
\end{tabular} & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} & \(70,68,42,45,48,51,54,57,60,62,64,66,72,71,65,63,61,58,55,52,49,46,43,41,67,69\) & \begin{tabular}{l}
\(1,582.3\) \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
4
\end{tabular} & \begin{tabular}{l} 
Very \\
Weathered \\
Shale
\end{tabular} & \(39,36,40,38\) & \begin{tabular}{l}
27,400 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
5
\end{tabular} & \begin{tabular}{lll} 
Lean Clay
\end{tabular} & \(22,38,40,33,21,20,32,19,31,34,35,71,72,29,18,16,14,12,27,10,26,7,5,3,70,69,24,23,2,1\) & \begin{tabular}{l}
30,900 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline \begin{tabular}{l} 
Region \\
6
\end{tabular} & \begin{tabular}{l} 
Shale \\
Bedrock
\end{tabular} & \(37,36,39\) & \begin{tabular}{l}
3,425 \\
\(\mathrm{ft}^{2}\)
\end{tabular} \\
\hline
\end{tabular}

\section*{Slip Results}

Slip Surfaces Analysed: 2153 of 2646 converged

\section*{Current Slip Surface}

Slip Surface: 1,358
Factor of Safety: 1.888
Volume: \(3,106.4253 \mathrm{ft}^{3}\)
Weight: \(232,670.67 \mathrm{lbf}\)
Resisting Moment: 8,547,119.2 lbf•ft
Activating Moment: 4,525,840.6 lbf•ft
Resisting Force: 161,165.97 lbf
Activating Force: \(85,345.857 \mathrm{lbf}\)
Slip Rank: 1 of 2,646 slip surfaces
Exit: (2,082.6057, 1,456.1987) ft
Entry: \((1,866.3798,1,507.2891) \mathrm{ft}\)
Radius: 343.22769 ft
Center: \((1,949,1,516.5) \mathrm{ft}\)

\section*{Slip Slices}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|}
\hline \multicolumn{1}{|c|}{X} & \multicolumn{1}{|c|}{Y} & \multicolumn{1}{c|}{ PWP } & \begin{tabular}{l} 
Base \\
Normal \\
Stress
\end{tabular} & \begin{tabular}{l} 
Frictional \\
Strength
\end{tabular} & \multicolumn{1}{c|}{\begin{tabular}{l} 
Cohesive \\
Strength
\end{tabular}} & \begin{tabular}{l} 
Suction \\
Strength
\end{tabular} & \multicolumn{1}{|c|}{\begin{tabular}{l} 
Base \\
Material
\end{tabular}} \\
\hline \begin{tabular}{l} 
Slice \\
1
\end{tabular} & \begin{tabular}{l}
\(1,867.2082\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,506.7712\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,926.8815\) \\
psf
\end{tabular} & \begin{tabular}{l}
23.289864 \\
psf
\end{tabular} & \begin{tabular}{l}
4.1066314 \\
psf
\end{tabular} & 200 psf & 0 psf & \begin{tabular}{l} 
Vegetation \\
Cover
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
2
\end{tabular} & \begin{tabular}{l}
\(1,869.7269\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,505.2165\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,830.3968\) \\
psf
\end{tabular} & \begin{tabular}{l}
130.85652 \\
psf
\end{tabular} & \begin{tabular}{l}
45.057515 \\
psf
\end{tabular} & 600 psf & 0 psf & \begin{tabular}{l} 
Compacted \\
Soil Liner
\end{tabular} \\
\hline \begin{tabular}{l} 
Slice \\
3
\end{tabular} & \begin{tabular}{l}
\(1,875.5586\) \\
ft
\end{tabular} & \begin{tabular}{l}
\(1,501.7511\) \\
ft
\end{tabular} & \begin{tabular}{l}
- \\
\(5,615.3826\)
\end{tabular} & \begin{tabular}{l}
391.51965 \\
psf
\end{tabular} & 0 psf & 500 psf & 0 psf & \begin{tabular}{l} 
Municipal \\
Solid Waste
\end{tabular} \\
\hline
\end{tabular}
\begin{tabular}{|l|l|l|l|l|l|l|l|l|} 
& & & & \\
\hline
\end{tabular}

\section*{Not FS Dependent Pseudo Static}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline 21 & ft & ft & psf & psf & psf & psf & & Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 22
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,011.316 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,456.6812 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,832.5888 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,396.5478 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 906.92873 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 23
\end{aligned}
\] & 2,018.86 ft & \[
\begin{aligned}
& 1,455.9282 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,787.2972 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,343.0615 } \\
& \text { psf }
\end{aligned}
\] & 872.19435 psf & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 24
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,026.404 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.343 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,752.4829 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & 1,275.8895 psf & \[
\begin{aligned}
& 828.57235 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
25
\end{array}
\] & \[
\begin{aligned}
& 2,033.948 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.9248 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,728.0923 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,194.475 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 775.70114 \\
& \text { psf }
\end{aligned}
\] & \[
0.043846762
\]
psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 26
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,041.492 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.6729 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,714.0874 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& \text { 1,098.2057 } \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 713.18309 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\text { Slice } \\
27
\end{array}
\] & \[
\begin{aligned}
& \text { 2,049.036 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.587 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,710.4451 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 986.40697 \\
& \text { psf }
\end{aligned}
\] & 640.58018 psf & \[
0.043846762
\]
\[
\mathrm{psf}
\] & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 28
\end{aligned}
\] & 2,056.58 ft & \[
\begin{aligned}
& 1,454.667 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,717.1578 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 858.33456 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 557.40898 \\
& \text { psf }
\end{aligned}
\] & 0.043846762 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 29
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,064.124 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,454.913 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,734.2327 } \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 720.83726 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{array}{|l}
\hline \text { Slice } \\
30 \\
\hline
\end{array}
\] & \[
\begin{array}{|l|}
\hline 2,071.668 \\
\mathrm{ft} \\
\hline
\end{array}
\] & \[
\begin{aligned}
& \hline 1,455.3253 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& -2,761.692 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 580.75931 \\
& \text { psf }
\end{aligned}
\] & 0 psf & 500 psf & 0 psf & Municipal Solid Waste \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 31
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,077.8865 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,455.7785 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,791.4034 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 431.28126 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 148.50205 \\
& \text { psf }
\end{aligned}
\] & 600 psf & 0 psf & Compacted Soil Liner \\
\hline \[
\begin{aligned}
& \text { Slice } \\
& 32
\end{aligned}
\] & \[
\begin{aligned}
& \text { 2,081.4694 } \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 1,456.0913 \\
& \mathrm{ft}
\end{aligned}
\] & \[
\begin{aligned}
& 2,811.7498 \\
& \text { psf } \\
& \hline
\end{aligned}
\] & \[
\begin{aligned}
& 112.60307 \\
& \text { psf }
\end{aligned}
\] & \[
\begin{aligned}
& 19.854959 \\
& \text { psf }
\end{aligned}
\] & 200 psf & 0 psf & Vegetation Cover \\
\hline
\end{tabular}

\section*{APPENDIX L - Groundwater Elevation Report (by The Carel Corporation)}

\title{
SUBSURFACE INVESTIGATION REPORT
}

\title{
PROPOSED C\&D DISPOSAL AREA ALTUS MUNICIPAL LANDFILL MSW PERMIT NO. 3533005
}

\author{
Jackson County, Oklahoma
}

Project No: 22-02-18

Prepared for:


April 2022

Prepared by:


136 Pecan Street
Keller, Texas 76248
(817) 337-0112

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\section*{1 INTRODUCTION}

The City of Altus Municipal Landfill is located in the northeast quarter of Section 11, Township 2 North, Range 22 West, approximately eight (8) miles west and one and onehalf ( \(1 \frac{1}{2}\) ) miles north of the City of Altus at 16429 S. County Road 1960. The City of Altus (Altus) desires to permit a portion of the existing municipal solid waste landfill as a construction and demolition (C\&D) disposal area. The proposed C\&D disposal area is located in the north central portion of the existing permitted municipal solid waste disposal area and will be approximately 10 acres in size. Land use surrounding the site is agricultural. A site location map is provided as Figure 1.

A Subsurface Characterization Drilling Plan (SCDP) (Carel, 2020) was prepared to perform a subsurface investigation of the site. The SCDP was approved by the Oklahoma Department of Environmental Quality (ODEQ) in a letter dated December 29, 2020. A copy of the ODEQ approval letter is provided in Attachment 1. This Subsurface Investigation Report provides findings outlined in the approved SCDP and pertinent information required by Oklahoma Administrative Code (OAC) 252:515-7-1.

\section*{2 PREVIOUS SUBSURFACE INVESTIGATIONS}

This section summarizes previous subsurface investigations and well installations performed at the existing City of Altus municipal solid waste (MSW) Landfill. Available boring logs and completion diagrams for the borings discussed in this section are provided in Attachment 2.

\subsection*{2.1 Geotechnical Investigation - 1981}

Glenn Briggs and Associates, Inc. performed a geotechnical investigation at the site in 1981. The investigation involved the installation of eleven test holes at various locations in Section 11, Township 2 North, Range 22 West. Test holes 2A and 10A were located within the limits of the Altus MSW Landfill permit area. Test holes 4A, 5A and 9A were located proximal to the permit boundary and the remaining six test holes were located elsewhere in Section 11. The test hole depths ranged from 13 to 35 feet below ground surface (bgs). Groundwater observations were made during drilling and up to 24 hours thereafter.

\subsection*{2.2 Geotechnical Investigation - 1985}

In June 1985 Standard Testing and Engineering Co. drilled twenty-two (22) borings as part of a subsurface characterization of the current City of Altus MSW Landfill. Each boring was drilled using dry methods. During the investigation soil samples were collected and classified using Atterberg limits, sieve analyses, moisture content and permeability tests. The borings were also observed for groundwater. Only one boring (B-1) was observed to contain groundwater during drilling activities.

\subsection*{2.3 Geotechnical Investigation - 1988}

In August 1988 Shepherd Engineering Testing Company drilled three (3) borings and excavated two (2) test pits as part of a geotechnical investigation at the facility. Each boring was drilled using four-inch diameter flight augers. Soil samples were collected and visually classified according to the Unified Soil Classification System. In-situ permeability tests were performed on one boring but could not be conducted on the other two borings due to unanticipated subsurface conditions; therefore, laboratory permeability tests were performed on representative samples obtained during the field exploration.

\subsection*{2.4 Geologic Testing - 1992}

Terracon Consultants, Inc. drilled five (5) borings at the Altus Landfill site during May 1992. Four of the borings were drilled to depths of approximately 40 feet bgs and one of the borings extended to a depth of about 200 feet bgs. Geophysical logging was performed on each of the five borings. Boring logs prepared for the project included lithologic information, field test data and groundwater conditions.

\subsection*{2.5 Geotechnical Investigation - 2020}

In December 2020 Standard Testing and Engineering Co. installed nine (9) borings within Cell 6 of the Altus Landfill MSW Landfill and the proposed C\&D cell area. The borings depths ranged from 60 to 100 feet bgs. Standard penetration tests were performed during the project in order to estimate the shear strengths of the soils in their natural state. The tests were conducted as specified by ASTM D1586 "Penetration Test and Split-Barrel Sampling of Soils." Laboratory tests were performed on soil samples recovered and groundwater observations were recorded within the borings for a period of 24 hours.

\subsection*{2.6 Existing Subtitle D Groundwater Monitoring System}

The existing groundwater monitoring system consists of eight (8) monitoring wells MW-1 through MW-8. Wells MW-1 through MW-7 were installed in 1992 (Altus, 2021). Boring B-3, installed by Terracon in 1992, appears to have been converted to MW-8. Wells MW-1 through MW-7 are four (4) inches in diameter and each well is installed to depths of approximately 20 feet bgs. MW-8 is two (2) inches in diameter and is installed about 30 feet bgs. Wells MW-1, MW-2 and MW-7 are not used for routine semi-annual monitoring. MW-3, MW-4, and MW-6 are typically dry and MW-5 usually contains less than a foot of water. The absence of groundwater in MW-3, MW-4 and MW-6 and the thin water column in MW-5 is attributed to the shallow well installation depths. MW-8, which is installed about 10 feet deeper than the other monitor wells has a water column that is typically about six (6) feet thick.

\section*{3 REGIONAL HYDROGEOLOGIC STUDY}

Pursuant to OAC 252:515-7-38, information on the regional geology and hydrogeology in relation to the proposed \(\mathrm{C} \& \mathrm{D}\) cell is provided in this section.

\subsection*{3.1 Setting}

The area surrounding the proposed \(\mathrm{C} \& \mathrm{D}\) cell is in the Red Bed Plains Region of the Southern Great Plains. With the exception of the Wichita Mountains, the terrain is a gently rolling plain underlain by weakly consolidated reddish clays, shales and sandstones and unconsolidated alluvium. The Wichita Mountains constitute a drainage divide between the Washita River drainage basin to the northeast and the North Fork of the Red River to the west and southwest. Jackson County is drained largely by the North Fork of the Red River, the Salt Fork of the Red River and its tributaries. All surface water in the vicinity of the proposed facility ultimately drains to the Red River.

\subsection*{3.2 Climate}

The area has a warm, temperate, continental climate. It receives the warmer, moistureladen air from the Gulf of Mexico, which is regularly penetrated by the cooler, drier air moving down from the Arctic Zone or approaching from the Pacific. In the Altus area, the summers are hot, humid, and mostly clear and the winters are typically very cold, dry, windy, and partly cloudy. Over the course of a year, the temperature typically varies from \(30^{\circ} \mathrm{F}\) to \(98^{\circ} \mathrm{F}\) and is rarely below \(19^{\circ} \mathrm{F}\) or above \(105^{\circ} \mathrm{F}\). The thirty (30) year average climatological conditions for Jackson County, obtained from the records of the Oklahoma Climatological Survey are provided in Attachment 3. The average annual precipitation is 28.75 inches a year and the average annual temperature is 61.4 degrees Fahrenheit. There are typically 63 days of precipitation.

The nearest mesonet station to the proposed expansion area is the Altus (ALTU) station, which is located three miles south of Altus. Daily and monthly precipitation data obtained from the Altus climatological station for April 2021 through March 2022 are provided in Attachment 4 per OAC 252:515-7-55(a).

\subsection*{3.3 Topography}

A northwest to southeast trending ridge was the major topographic feature in the area of the proposed \(\mathrm{C} \& \mathrm{D}\) cell. The original ridge was situated just west and south of the proposed C\&D cell, however, much of the ridge has been removed by excavation and replaced by MSW disposal cells. The maximum elevation of the ridge was about 1,465 feet above sea level before excavation and it extended about 45 feet above the surrounding, gently sloping, ground surface. The ridge is bisected by two drainage courses. A broad drainage is located
north-northwest of the landfill property and north of Hollis and Eastern railway line, and a narrow drainage course is located approximately 0.4 miles south of the landfill entrance gate. A Topographic Quadrangle Map with the proposed expansion area illustrated is provided as Figure 2. Per OAC 252:515-3-54(b), the map contains the permit boundaries, access routes, homes and buildings, receiving waters and surface variations within onemile of the proposed facility. Public water facilities, wastewater facilities and water wells within one-mile of the proposed facility are also required to be illustrated on the topographic map, however none are present within that distance.

\subsection*{3.4 Regional Geology and Stratigraphy}

Regionally rock outcrops consist of predominantly Permian age rock formations and Quaternary alluvium. Formation outcrops within one-mile of the proposed C\&D area, from oldest to youngest, include the Flowerpot Shale, the Blaine Formation, and Quaternary Alluvium. The Flowerpot and the Blaine Formation are both Permian age rock formations. The Alluvium is being deposited and reworked during the current Quaternary Period. Formations occurring from surface to a depth of 500 feet below the proposed expansion area, from oldest to youngest, include the Hennessy Formation, the San Angelo Sandstone, the Flowerpot Shale, and the Blaine Formation. The Flowerpot is the deepest formation penetrated by boreholes or site monitor wells. A regional geologic column illustrating all rock formation occurring from surface to a depth of 500 feet bgs is provided as Figure 3. The surface distributions of the geologic formations are illustrated on the Regional Geologic Map, Figure 4 and their subsurface distributions and orientations are illustrated on the Regional Geologic Cross-Section, Figure 5.

The Permian age sediments originated from a vast shallow body of water called the Permian Sea, which extended from Southern Nebraska to Texas. During this time period the sea rose and fell many times creating different types of aquatic environments which in turn allowed for deposition of the sediments found in the vicinity of the proposed C\&D facility. These sediments include dolomite, gypsum, salt, sandstone, siltstone and shale.

The Hennessey Formation is a reddish-brown shale with some reddish-brown siltstone beds. In areas where the San Angelo Formation is missing (north of the proposed site) the top of the Hennessey is represented by the Brinkman Sandstone Bed. The Brinkman is a six- to ten-foot-thick sandstone with scattered coarse grains of quartz and feldspar.

The San Angelo Sandstone is a light gray to reddish-brown, fine-grained, cross-bedded sandstone with local interbeds of yellowish-gray and reddish-brown shale. It ranges in thickness up to 100 feet and is absent in the northern part of Jackson County.

The Flowerpot Shale is a reddish-brown, silty shale and contains thin interbeds of greenishgray shale and several thin layers of gypsum and dolomite in the upper part. According to the USGS, the Flowerpot shale covers approximately eight-percent of the surface area of Jackson County. It outcrops about 100 feet east of the northeast corner of proposed C\&D
cell at the nearest point and is exposed at the surface in the eastern and northeastern portions of the Altus Landfill property. From its outcrop, it plunges below the proposed C\&D cell. Its thickness varies from approximately 100 to 165 feet.

The Blaine Formation consists of interbedded dolomite, gypsum, salt and shale. The strata in the Blaine are laterally persistent and can be correlated throughout the region. The strata are grouped into nine cyclic sequences, each of which is comprised of, in ascending order, dolomite, gypsum, salt, reddish brown shale, and greenish-gray shale. The salt is typically dissolved at depths of less than 600-feet. The formation is divided into the lower Elm Fork Member and the upper Van Vacter Member. The Blaine Formation ranges in thickness from about 145 to 180 feet thick.

The Elm Fork Member (Elm Fork) of the Blaine Formation contains three beds of gypsum, each typically 5 to 30 feet thick and become thinner to the east. The dolomite beds typically range from about 1 inch to 3 feet thick and the shale intervals are typically about 10 to 30 feet thick. The Haystack Gypsum was penetrated by numerous borings at the site and outcrops on the landfill property. It is considered the base of the Blaine Formation in many areas, although the Gypsum Creek Dolomite forms the base of the Elm Fork in some areas. The Gypsum Creek Dolomite is not present at the Altus facility. The total thickness of the Elm Fork ranges from about 80 to 100 feet.

The Van Vacter Member of the Blaine Formation contains six beds of gypsum, each typically 3 to 16 feet thick becoming thinner or absent to the east. Dolomite and shale beds are from, 1 inch to 4 feet thick. The total thickness of the Van Vacter Member ranges from 65 to 82 feet thick.

The Blaine Formation is classified as a major aquifer in Oklahoma. Large quantities of irrigation water are produced at depths of 50 to 300 feet from cavernous gypsum and dolomite beds in the formation. The Blaine Aquifer is located west of the proposed C\&D cell, additional details are provided in Section 3.6.

The alluvial sediments located east of the proposed facility can be subdivided into older and younger alluvium. The Older Alluvium consists of unconsolidated sand, silt, clay, and gravel in stream and river channels, mainly between 0 to 40 feet above modern flood plains. The younger alluvial sediments (i.e., Alluvium) also consists of unconsolidated sand, silt, clay, and gravel but are situated within stream and river channels. According to Johnson, 1983, the proposed C\&D cell is not located within an area designated as alluvium or terrace deposits and their recharge areas.

\subsection*{3.5 Structural Setting}

Southwestern Oklahoma contains three major structural provinces the Wichita Uplift, Anadarko Basin and Hollis Basin. The Wichita Uplift separates the deep Anadarko Basin on the north from the shallower Hollis Basin to the south. The proposed facility is located
on the north flank of the Hollis Basin approximately 7 miles northeast of the axis of the basin.

The Hollis Basin is a sub-circular basin situated south of the Wichita Uplift. Throughout much of the Paleozoic Era it was part of the larger Eastern Palo Duro depositional basin that extended from the Wichita Uplift southward to the Red River uplift and westward into the Panhandle of Texas. The deeper parts of the Hollis Basin contain Upper Cambrian through Permian strata, which are 8,000 to 12,000 feet thick. The axis of the basin trends northwest to southeast and is located about seven miles southwest of the proposed C\&D facility at its nearest point. Six normal faults are mapped within a 25 -mile radius of the proposed site. With one exception, the faults trend northwest to southeast and dip \(60^{\circ}\) to \(65^{\circ}\) to the southwest. A monoclinal flexure, known as the Duke Flexure (Johnson, 1967), is situated near the proposed C\&D area. It is discussed in more detail in Section 5.1.

A Regional Geologic Cross-Section, Figure 5, illustrates the general location of the facility with respect to the three geologic provinces. Note the proposed facility does not lie on the line of the cross-section so the facility location on the cross-section is a projected location, not actual location.

\subsection*{3.6 Regional Hydrogeology}

The proposed C\&D facility is situated between the Blaine Aquifer on the west and the Southwestern Oklahoma Aquifer on the east. The eastern limit of the Blaine Aquifer is located approximately one-half mile west of the proposed facility. It is classified as a major bedrock aquifer in Oklahoma and covers portions of Greer, Harmon, and Jackson Counties in Oklahoma and Childress, Collingsworth, Hall, Hardeman, and Wilbarger counties in Texas. The Blaine Aquifer consists of cavernous gypsum and dolomite beds within the Blaine Formation. Groundwater from the Blaine Aquifer contains a calcium-sulfate type groundwater, which is suitable for irrigating salt-tolerant crops such as cotton and wheat. Groundwater from the Blaine Aquifer is high in dissolved solids and it is not used for human consumption.

A minor bedrock aquifer named the Southwestern Oklahoma Aquifer, also known as the Southwestern Oklahoma Groundwater Basin (SOGB) is located approximately one-quarter mile to the east and north of the proposed C\&D cell. The SOGB underlies the far southwestern corner of Caddo County, all of Kiowa County and approximately the east half of Jackson County. The SOGB covers approximately 1,593 square miles. Rock units that make up the OSGB include, from oldest to youngest the Wellington Formation, Garber Sandstone, Hennessey Shale, San Angelo Sandstone, Flowerpot Shale, Dog Creek Shale, Marlow and Rush Springs Sandstones. Alluvium adjacent to streams are believed to be in hydraulic communication with the underlying Permian sediments and are also considered part of the SOGB. Available aquifer parameters for the SOGB are provided below.
\begin{tabular}{lc}
\hline \hline \multicolumn{1}{c}{ Parameter } & SOGB \\
\hline Area (acres) & 1,019834 \\
Saturated Thickness (Ft.) & 108 \\
Specific Yield & 0.02 \\
Transmissivity (Ft. \({ }^{2} /\) day) & 513 \\
Recharge Rate (In./Yr.) & 2.25 \\
\hline \hline
\end{tabular}

A Groundwater Resource and Usage Map illustrating recharge areas is provided as Figure 6. Based on this map, the proposed \(\mathrm{C} \& \mathrm{D}\) cell is not located within a bedrock aquifer recharge area, an alluvial aquifer, terrace deposit or their recharge areas.

\subsection*{3.7 Local Water Wells}

Public and private water well information was obtained from the Oklahoma Water Resources Board (OWRB) Groundwater Wells, Standards, and Protection in Oklahoma Interactive Map \({ }^{1}\). Based on information provided on the OWRB website, no public, private or irrigation water wells are located within a one (1) mile radius of the proposed \(\mathrm{C} \& \mathrm{D}\) cell area. Figure 6 illustrates the water wells in the vicinity of the proposed \(C \& D\) facility.

\section*{Groundwater Quality}

As previously stated, the major bedrock aquifer in the area is the Blaine Aquifer, which is composed of cavernous gypsum and dolomite beds of the Blaine Formation. The groundwater within the Blaine Aquifer is a calcium-sulfate type, which is suitable for irrigating salt-tolerant crops it is mainly to irrigate cotton and wheat. Water from the Blaine Aquifer is high in dissolved solids and it is not used for human consumption. Based on information contained on Sheet 3 of Hydrologic Atlas 6, the dominant cations for groundwater in the Blaine Aquifer, west of the proposed C\&D facility, are calcium and magnesium and dominant anion is typically sulfate. Wells south-southwest of the proposed facility are also high in the cations sodium and potassium and the anion chloride. Most wells completed in the SOGB, east of the proposed facility, also produce groundwater with calcium and magnesium being the dominant cation and sulfate being the dominant anion. A summary of available water quality data for the Blaine Aquifer and SOGB is provided in the following table.

\footnotetext{
\({ }^{1}\) https://owrb.maps.arcgis.com/apps/webappviewer/index.html?id=ed61209c40ec4f53bc51d2ffd18aa39b
}
\begin{tabular}{l|c|c}
\hline \multicolumn{1}{c}{ Parameter } & Blaine \(^{(\mathbf{1})}\) & SOGB \(^{(3)}\) \\
\hline Hardness & 2500 & 520 \\
Sulfate & 2900 & 295 \\
Chloride & 1200 & 375 \\
Nitrate & 7.7 & 10 \\
Dissolved Solids & \(3,730^{(3)}\) & 1680 \\
pH & 7.1 & NA \\
Alkalinity & 187 & NA \\
Calcium & 590 & NA \\
Magnesium & 140 & NA \\
Sodium & 570 & NA \\
\hline \hline
\end{tabular}

Notes:
1. Source, Runkle, D.L., et.al., Hydrogeologic Data for the Blaine Aquifer and Associated Units in Southwestern Oklahoma and Northwestern Texas, 1997. USGS Open File Report 97-50. Data taken from a well located in Sec. 16, T2N, R23W.
2. All units \(\mathrm{mg} / \mathrm{L}\), except pH , which is standard units.
3. Source, Havens, John S. 1977. Reconnaissance of the Water resources of the Lawton Quadrangle, Southwestern Oklahoma. Hydrologic Atlas 6, Sheet 3
NA - Not Available

\section*{4 SUBSURFACE INVESTIGATION}

A notice of intent to conduct drilling activities was provided to the ODEQ in a letter dated October 21, 2020, per OAC 252:515-7-5(a). Drilling activities took place from March 9, 2021 to March 11, 2021. Per OAC 252:515-7-5(c), drilling activities were performed by a licensed water well drilling company, Standard Testing and Engineering Company of Oklahoma City, under the supervision of a qualified groundwater scientist employed by The Carel Corporation. The subsurface investigation involved five soil borings, installation of three piezometers, geophysical logging, depth to water measurements and slug testing. Details are provided below.

\subsection*{4.1 Soil Borings}

The proposed C\&D disposal cell will cover 10 acres in the north central portion of the existing City of Altus Landfill permit area, which requires a minimum of five borings and three piezometers for hydrogeologic characterization purposes. In accordance OAC 252:515-7-4(b)(3), the locations of the five borings (B21-1, BPZ21-2, BPZ21-3, BPZ214, and B21-5) were spaced within a grid pattern. Each boring location was staked by an Oklahoma licensed surveyor prior to drilling operations. After staking a modification to the location of BPZ-4 was made, with verbal approval by the ODEQ, due to wet weather access concerns. Minor adjustments were also made to some piezometer depths in order to install the screens within the saturated zone.

The borings were advanced, to depths equal to or greater than 30 feet below the deepest proposed placement of waste as required by OAC 252:515-7-4(b)(4)(A), using hollow stem auger (HSA), a dry drilling method. Each boring was continuously sampled in order to characterize the geologic strata per OAC 252:515-7-32 and OAC 252:515-7-33. Samples were obtained using five-foot core barrels, which is consistent with the methods listed in OAC 252:515-7-35(c). The samples were observed in the field, by a qualified groundwater scientist, for soil or rock type, color, texture, moisture and other relevant geologic features. The field observations were used to construct the boring logs, contained in Attachment 5. After field observations were made, the samples were placed in core boxes and are stored at the City of Altus Landfill where they will remain until final action on the permit application is taken by the ODEQ per OAC 252:515-7-35(b). Depth to water measurements were recorded at the time of drilling and after 24 hours for each boring/piezometer, per OAC 252:515-7-32(c). Boring details are provided in Table 1, their locations, along with previous site borings, are illustrated on Figure 7. Oklahoma Water Resources Board (OWRB) Multi-Purpose Well Completion Forms are located in Attachment 6.

OAC 252:515-7-4(b)(4)(C) requires that at least one boring be drilled to a depth of 100 feet. Given the number of borings previously installed by others, the ODEQ approved the substitution of boring B-9 installed by Standard Testing and Engineering in December 2020 to satisfy the 100 -foot boring requirement.

\subsection*{4.2 Piezometers}

Three of the borings (BPZ21-2, BPZ21-3, and BPZ21-4) were converted to piezometers per the approved drilling plan. Each piezometer was constructed according to ODEQ and OWRB regulations. Construction details are provided in the following table:

Piezometer Construction Details
\begin{tabular}{|c|l|}
\hline Well Materials & Two-inch diameter sched. 40 PVC, flush threaded with screw joints, and o-rings. \\
\hline Sediment Trap & One foot section. \\
\hline Screen & Ten-foot section, factory slotted with 0.010" slots. \\
\hline Filter Pack & Inert 20-40 silica sand extending approx. two feet above top of screen. \\
\hline Filter Pack Seal & A minimum of two feet hydrated sodium bentonite pellets. \\
\hline Annular Seal & Bentonite chips from top of filter pack seal to within two feet of ground surface. \\
\hline Concrete Pad & A 3' x 3' x 4" steel-reinforced concrete pad extending to grout below surface. \\
\hline \begin{tabular}{l} 
Top Cap, Protective \\
Casing and Bollards
\end{tabular} & \begin{tabular}{l} 
Two-inch compression seal top cap, locking steel protective casing, and four \\
yellow bollards.
\end{tabular} \\
\hline
\end{tabular}

Following installation, each piezometer was surveyed by an Oklahoma licensed surveyor for latitude, longitude, surface elevation, and top of PVC casing elevation. As built survey information is provided in Attachment 7. Identification tags with latitude, longitude, and surface elevation were permanently placed on the outer protective casing of each piezometer per OAC 252:515-7-3(4).

\subsection*{4.3 Surface Penetration Plugging}

Pursuant to OAC 252:515-7-71(a), all boreholes not converted to piezometers were plugged in accordance with OWRB regulations within thirty days of installation. Following the decision on the permit, all piezometers that will that will not become a part of the groundwater monitoring system will also be plugged in accordance with OAC 252:515-7-71(b).

\subsection*{4.4 Geophysical Logging}

In accordance with OAC 252:515-7-34(c), gamma ray and neutron geophysical logs were collected from three piezometers (BPZ-2, BPZ-3 and BPZ-4). Additionally, gamma ray
and neutron logs were also ran in PZ20-1, to aid in the subsurface characterization, The geophysical logs were obtained from total depth to surface within the cased holes per OAC 252:515-7-34(c). Geophysical logs are provided in Attachment 8, are plotted on the boring logs in Attachment 5 and contained in the geologic cross-sections Figures 8 and 9.

\subsection*{4.4.1 Gamma Ray Logs}

Gamma ray logs are a downhole measurement of the natural gamma ray radioactivity in the geologic strata penetrated by a boring or well. Natural gamma-ray activity in sediments arises from their potassium, uranium, and thorium content. Naturally occurring isotopes of these elements \(\left({ }^{40} \mathrm{~K},{ }^{238} \mathrm{U},{ }^{235} \mathrm{U}\right.\), and \(\left.{ }^{232} \mathrm{Th}\right)\) produce gamma rays as they decay to stable isotopes of argon and lead. The gamma-ray emissions can be used to distinguish sediment types (e.g., clay, sand, limestone). Clean sandstones (i.e., no clay or shale present) generally have low concentrations of radioactive material and result in low gamma ray counts; whereas, shale and clay typically have higher concentrations of radioactive material resulting in high gamma ray counts.

\subsection*{4.4.2 Neutron Logs}

Neutron logs are a type of porosity \(\log\) that measures the hydrogen concentration in geologic strata. High hydrogen concentrations and low porosity result in lower neutron counts. For example, shale and clay have low neutron counts due to hydrogen associated with the shale/clay structure and more limited porosity. Saturated sands have moderate neutron counts due the presence of hydrogen in the form of water and higher porosity. Dry sands have high neutron counts due to the absence of water and high porosity.

The geophysical logs obtained from BPZ-2, BPZ-3, BPZ-4 and PZ20-1 are useful in verifying contacts of various strata on the boring logs where sample recoveries were poor. They also aid in the correlation of the strata on the geologic cross-sections, provide confirmation of the saturated zone(s) and can be helpful with estimating the degree of saturation of the strata.

Additionally, gamma ray, porosity and resistivity geophysical logs were completed in 1992 in the five borings (B-1 through B-5) installed by Terracon. The gamma ray logs were found to be useful in identifying a previously unrecognized gypsum bed at 24.5 -feet bgs in B-3 (MW-8) as well as the Haystack and Chaney Gypsum beds in B-5. Neither the porosity or resistivity logs provide any useful information due to the scales used.

\subsection*{4.5 Monthly Groundwater Measurements}

Following the installation of the piezometers and in accordance with OAC 252:515-754(b), groundwater elevations in all piezometers plus piezometer PZ20-1 and monitor wells MW-5 and MW-8 were measured from April 12, 2021 through April 12, 2022. Hydrographs for all measured piezometers and wells is included in Attachment 9 and a

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tabular list of the monthly water levels is provided in Table 2. The highest average monthly elevation, used for the Potentiometric Map (Figure 10), is calculated on the right most column of Table 2 and the highest groundwater measurement for each piezometer, used for the Highest Groundwater Contour Map (Figure 11), is calculated at the bottom of the table.

Review of the hydrographs in Appendix 9 reveals a very slow rise in the water level in BPZ21-3, indicting it has lower hydraulic conductivity than other piezometers installed at the same time (BPZ21-2 and BPZ21-4). BPZ21-2 always had the highest groundwater elevation and MW-5 always had the lowest groundwater elevation.

\subsection*{4.6 Continuous Water Level Measurements}

To satisfy the requirements of OAC 252:515-7-54(b) a continuous water level monitoring system (i.e., a programmable Solinst \({ }^{\circledR}\) Levelogger pressure transducer) was installed in piezometer BPZ21-2. A hydrograph of the continuous groundwater elevation results is provided in Attachment 10. In addition, daily precipitation data from a weather station located 7.9 miles east of BPZ21-2 in Altus, Oklahoma is plotted on the hydrograph to illustrate the changes to the groundwater elevation after rainfall events per OAC 252:515-7-54(c). The greatest amount of precipitation took place in between June 26 and July 2, 2021. During that time, 10.13 inches of precipitation were recorded. The corresponding water level rise in BPZ21-2 was approximately 3.5 feet based on transducer measurements. A second rise in the groundwater elevation occurred between July 15 and 19, 2021, during which 1.87 inches of rain was recorded at the weather station. 3.67 inches of precipitation occurred between August 13 and 21, 2021, which resulted in a water level rise of approximately 0.44 -feet. A slow decline in the groundwater elevation has occurred since that time. The rise in the groundwater elevation from late June to mid-August is also observable in the hydrograph for BPZ21-2 in Attachment 9. Water levels in MW-5 and MW-8 also rose between June and July 2021 but at lower magnitudes.

\subsection*{4.7 Slug Testing}

A slug test is a type of aquifer test where a slug is quickly added or removed from a groundwater well, and the change in hydraulic head is monitored through time. Slug tests are used to estimate near well hydraulic properties of geologic strata (i.e., aquifers and aquitards). When a slug is added to a well the slug test is typically referred to as a fallinghead test. Whereas when a slug is removed from a well the test is referred to as a risinghead test. Three slug tests were conducted in piezometer BPZ-2 and three separate tests were performed in MW-8 on June 12 and 13, 2021 using procedures listed in ASTM Test D 4044.

For these tests, instantaneous displacement was achieved by a solid slug made of one-inch diameter PVC pipe that was lowered (falling-head test) or removed (rising-head test) from the wells. Static water levels were measured by hand using an electronic water level meter. Water level displacement during each slug test was measured using programmable Solinst \({ }^{\circledR}\)

Levelogger pressure transducers. The Leveloggers were programmed so that the readings varied with time during the tests.

The Bouwer and Rice slug test analysis was applied and hydraulic conductivities were calculated using AQTESOLV \({ }^{\circledR}\) software. Well specific construction parameters such as screen length, screen diameter, etc. were utilized for the calculations. Calculated hydraulic conductivities for BPZ21-2 are provided in the table below and the computer outputs are included in Attachment 11. The representative hydraulic conductivity for a groundwater bearing unit is considered to be the geometric mean of the performed slug tests.

\section*{Slug Test Results}
\begin{tabular}{crcc}
\hline \hline Piezometer & Date & Test Type & \begin{tabular}{c} 
Hydraulic \\
Conductivity \((\mathbf{c m} / \mathbf{s e c})\)
\end{tabular} \\
\hline BPZ21-2 & \(06 / 12 / 2021\) & Falling Head & \(3.478 \times 10^{-6}\) \\
& \(06 / 13 / 2021\) & Rising Head & \(3.885 \times 10^{-6}\) \\
& \(06 / 13 / 2021\) & Falling Head & \(4.511 \times 10^{-6}\) \\
\cline { 3 - 4 } & Geometric Mean C\&D Area: & \(\mathbf{3 . 9 3 5 \times 1 0} \mathbf{1 0}\) \\
\hline
\end{tabular}

Falling-head tests are only considered valid in cases where the well screen is completely submerged within the aquifer and all of the water level change induced by introduction of the slug occurs above the top of the well screen. In cases where the static water level occurs below the top of the well screen the water displaced by introduction of the slug goes into the unsaturated portion of the sand filter pack that surrounds the well screen. In such cases the rate of water level recovery following introduction of the slug are not representative of aquifer hydraulic conductivity and should not be used. The screen interval and filter pack for BPZ21-2 was completely saturated; therefore, both falling-head and rising-head slug tests are utilized. However, approximately two feet of the screen and five feet of the filter pack in MW-8 was unsaturated during the time of the test. Therefore, none of results for MW-8 were used to calculate the above geometric mean.

\section*{5 SITE GEOLOGIC SETTING}

This section summarizes site specific geologic characteristics of the Altus Landfill.

\subsection*{5.1 Site Surface Geology and Stratigraphy}

The Altus landfill property is situated over outcrops of the lower Blaine and upper Flowerpot Formations. The contact between the two units trends from northwest to southeast across the landfill property and across the proposed C\&D area. Based on the geologic map prepared by Stanley, et al., 2004, (see Figure 4) the lower member of the Blaine Formation (i.e., Elm Fork Member) outcrops in the west and southwest portions of the property and the C\&D area. The upper portion of the Flowerpot Shale outcrops in the north and east portions of the property and the proposed \(\mathrm{C} \& D\) area, see Figure 12. Regional geologic dip is to the southwest.

The Flowerpot Shale conformably underlies the Blaine Formation. It is reportedly 165 to 195 feet thick in the Hollis Basin. Boring B-5 installed by Terracon in 1992 encounters the Flowerpot at 60 feet bgs and does not appear to fully penetrated the formation at the total depth of 200 feet. The Flowerpot is typified by reddish-brown shale, but it also contains much interbedded greenish-gray shale and fewer beds of siltstone, sandstone, gypsum and dolomite. The some greenish-gray shales in the upper part of the Flowerpot contain copper minerals. Three greenish-gray shales layers are noted on the B-5 boring \(\log\) from 72 to 86 feet bgs. The Chaney Gypsum Bed, a regionally extensive gypsum bed in the Flowerpot appears to be located at a depth of 110.5 feet bgs in B-5.

Rock units within the Blaine Formation that outcrop or were encountered in borings at the Altus Landfill are comprised of, in ascending order, the Haystack Gypsum, the overlying unnamed shale bed and the Jester Dolomite. The Haystack Gypsum, which is the lowest strata in the Blaine Formation in the area of the site, can be found outcropping east of the proposed C\&D area. Larger pieces of the Haystack excavated from a surface impoundment are located near the eastern site boundary north of the site entrance gate. On outcrop the Haystack is a finely crystalline alabaster to coarsely crystalline selenitic gypsum. Whereas in the subsurface it is a finely granular light to medium gray gypsum or anhydrite. Outcrops of the Haystack are minimal and it is thin or missing at some boring locations where it is near the ground surface due to dissolution by groundwater. Where dissolved, the gypsum is replaced by shale, clay or clastic sediments. In several borings the Haystack consists of two gypsum beds separated by a relatively thin medial shale. The presence of the medial shale combined with thinning and dissolution makes correlation of the Haystack in site borings difficult.

Above the Haystack is an unnamed shale bed that is reportedly 20 to 25 -feet thick in the Hollis Basin area. It is typically a reddish-brown non-fissile shale; however, greenish-gray
shale layers also exist and are typically located below the Jester Dolomite and above the Haystack.

At the top of the basal shale is the Jester Dolomite, which is a gray-brown to brown argillaceous dolomite. It is more resistant to erosion than the underlying and overlying shales and is easily visible along the eastern portion of the site where its outcrop forms a small ledge in the hillside east and north of the landfill equipment yard. It is also visible in the north-south escarpment north of BPZ21-2 and west of the proposed C\&D cell. The surface trace of the Jester indicates an overall southwesterly dip to the southwest. However, an easterly dip of the Jester can also be observed where it is mildly folded in an anticlinal flexure east of the landfill equipment yard. Except for Terracon boring B-3, installed in 1992, the site boring logs do not note the presence of the Jester in the subsurface. This is because it is not present in the northeastern portion of the site where it has been removed by erosion or excavation. Where it is present in the subsurface it has apparently not been detected due to it thin nature as well as other factors.

Historical and recent site boring logs were used to construct two site specific geologic cross-sections. Cross-section A-A', Figure 8, is oriented from southwest to northeast, in the general direction of regional dip of the formations. Cross-section B-B', Figure 9, is oriented from west to east, perpendicular to geologic dip.

As previously discussed, a northwest to southeast monoclinal flexure, known as the Duke Flexure, is illustrated crossing the landfill property on published geologic maps of the area. A monocline is a bend in geologic strata that are otherwise uniformly dipping or horizontal. Neither observed surface outcrops or available site boring data indicate the presence of a monoclinal flexure at the site. Rather, a mild anticlinal flexure is visible in the surficial strata east and southeast of the proposed C\&D area and is illustrated in photograph below. Anticlinal flexures (i.e., anticlines) are fold-like structures in which strata dip away from the central hinge or apex. The ledge formed by the Jester Dolomite outcrop is represented by the white dashed line in the photo below. East (left) of the flexure apex the Jester dips to the east. On the west (right) side of the apex, the strata reflect regional dip to the westsouthwest.


Anticlinal Flexure in the Jester Dolomite, viewing south.

\subsection*{5.2 Uppermost Saturated Zone}

Soil and rock formations can have both primary porosity and secondary porosity. Primary porosity is the void space between sand and mineral grains present when a rock forms. Secondary porosity develops after the rock has formed, either by fracturing (e.g., joints, faults, and bedding planes) or dissolution, such as the solution channels and cavities found in karst limestone or gypsum. Sand or sandstone can have a relatively high primary porosity that allows fluids to move through it. In fractured rocks with low primary porosity, such as shale, fluid flow can occur in fractures or fracture networks.

During installation of the soil borings the soil and rock samples were observed to be dry and firm to hard. No free water was observed during installation of any of the borings. However, water was observed in each of the borings, with the exception of B21-5, after drilling was complete. Groundwater was observed to accumulate in piezometer BPZ21-2 at the quickest rate and in BPZ21-3 at the slowest rate. Borings B21-1 and B21-5 were allowed to remain open for 24 -hours to allow for groundwater observations. Water was detected in B21-1 (see boring log in Attachment 5 for details) but no water was ever detected in B21-5.

The data presented on cross-sections A-A' and B-B' (Figures 8 and 9) indicates that groundwater occurs in three different strata, the shale of the Blaine Formation, Haystack Gypsum and Flowerpot Shale. On cross-section A-A', the geophysical logs indicate good correlation between the neutron response and the measured water levels in PZ20-1 and BPZ21-4. In these piezometers the neutron has lower counts (curve shifts to the left) at depths that correspond to the measured water levels. The water in these two piezometers appears to be unconfined based on the correspondence between the neutron response and the measured water level. In piezometer BPZ21-3, the neutron indicates saturation or partial saturation below elevation 1,403. The groundwater elevation in BPZ21-3 is approximately 1,408 feet MSL. The difference in the water level and the neutron response suggests the water in BPZ21-3 is partially confined. Monitor well MW-3 is completed above the saturated zone. Thickness of the saturated zone is estimated to be at least 18 feet thick based on interpretation of the neutron log for PZ20-1.

On cross-section B-B', the neutron log does not provide a good correlation with the measured water level in BPZ21-2. This may be due to the hydration in the overlying bentonite seal which also suppresses the neutron log. Unlike other piezometers, the bentonite seal in BPZ21-2 is very close to the static water level and thus the low neutron counts from the bentonite seal blends in with the low counts from the static water level. Assuming the above is the case, the water in BPZ21-2 appears to be unconfined. Monitor well MW-8 is completed about four feet into the zone of saturation. Whereas MW-5 only penetrates the saturated zone a few inches. Monitor wells MW-4 and MW-6, which are not illustrated on either cross-section, are also completed above the zone of saturation.

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A Highest Groundwater Contour Map (Figure 11) was contoured using the highest overall readings recorded for each of the piezometers during the subsurface investigation monthly water level measurement events (see Table 2) per OAC 252:515-3-74(b)(1). Information pursuant to OAC 252:515-3-74(b)(2) is included on Figure 11. A Potentiometric map (Figure 10) was contoured using the month with the highest average water level (October 2021) recorded during monthly water level measurement events per OAC 252:515-375(b)(1). The potentiometric surface reveals a north-south trending groundwater divide whose orientation generally follows the original topographic ridge located at the site. The axis of the groundwater divide (and topographic ridge) is oriented roughly along the western boundary of the proposed \(\mathrm{C} \& \mathrm{D}\) area. Based on this map, the central portion of the north and south facility boundaries are located upgradient and the east and west site boundaries are down-gradient. Proposed groundwater monitoring wells for both the MSW landfill and proposed C\&D landfill are also depicted on Figure 10 pursuant to OAC 252:515-3-75(b)(2).

\subsection*{5.3 Groundwater Flow Gradient and Rate}

The average linear velocity of groundwater movement can be determined using the velocity equation (Driscoll, 1986):
\[
v=2,830 \mathrm{Ki} / n_{e}
\]

Where: \(\quad v=\) groundwater velocity ( \(\mathrm{ft} /\) day);
\(\mathrm{K}=\) hydraulic conductivity ( \(\mathrm{cm} / \mathrm{sec}\) );
\(\mathrm{i}=\) hydraulic gradient ( \(\mathrm{ft} / \mathrm{ft}\) );
\(\mathrm{n}_{\mathrm{e}}=\) effective porosity (percent); and
2,830 converts \(\mathrm{cm} / \mathrm{sec}\) to \(\mathrm{ft} / \mathrm{day}\).
The hydraulic gradient is determined by calculating the difference between the groundwater contours (head difference) and dividing by the horizontal distance between the contours. The values are unitless but can be multiplied by 5,280 to determine the gradient in feet per mile units. As discussed in Section 4.7 of this report, the mean hydraulic conductivity for the uppermost saturated zone is \(3.935 \times 10^{-6} \mathrm{~cm} / \mathrm{sec}\). The hydraulic gradient for the eastern side of the site is essentially equivalent to the hydraulic gradient between BPZ21-4 and MW-5 and the hydraulic gradient for the western side of the site is essentially equivalent to the hydraulic gradient between MW-8 and BPZ21-2. Based on the groundwater elevations contained on the Potentiometric Map, Figure 10, the hydraulic gradients for the east and west sides of the site are 0.0037 and \(0.0038 \mathrm{ft} . / \mathrm{ft}\), respectively. Effective porosity is the percentage of interconnected pore space in the water bearing zone. The effective porosity of the Haystack Gypsum is estimated to be 50 percent (Ciemnicka, et.al., 2019 and Bello, 2021). Using the equation described above, the estimated groundwater velocity for the east and west sides of the groundwater divide is:
\(v\) east \(=\)\begin{tabular}{cccc}
2,830 & x & \(3.935 \mathrm{E}-06\) & x \\
0.50 & 0.0037 \\
\(v\) east & \(=0.00008 \mathrm{ft} . /\) day (easterly) \\
\(v\) west & \(=\frac{2,830}{} \mathrm{x}\) & \(3.935 \mathrm{E}-06\) & x
\end{tabular} 00.0038

\(v\) west \(=\)

\subsection*{5.4 Groundwater Quality}

Site specific groundwater quality information was derived for the Second 2022 Groundwater Monitoring Report for the facility and review of the groundwater database. Monitor well MW-8 was the only site monitor well to produce sufficient water for sampling, piezometers BPZ21-2 and BPZ21-3 contained sufficient water and were also sampled for informational purposes.

The data indicated that no volatile organic compounds were detected in any of the three wells. Barium was the only heavy metal to be detected in MW-8. Lead was reported in the sample collected from BPZ21-2 at a concentration of \(0.008 \mathrm{mg} / \mathrm{L}\) and selenium was detected in both BPZ21-2 and BPZ21-3 at concentration of 0.047 and \(1.41 \mathrm{mg} / \mathrm{L}\), respectively. Antimony, arsenic, beryllium, cadmium, chromium, copper, cobalt, nickel, silver, thallium, vanadium and zinc were all below laboratory reporting limits in all three wells. Sulfate and calcium were the dominant ions in all three wells. Their concentrations are similar to those reported for the Blaine Aquifer.

\section*{6 GROUNDWATER MONITORING}

\subsection*{6.1 Existing Site Monitoring Wells and Piezometers}

The MSW landfill groundwater monitoring network is composed of eight groundwater monitoring wells MW-1 through MW-8. Wells MW-1, MW-2 and MW-7 are located approximately one-half mile to the southwest, west and south of the MSW permit boundary and are not used for routine groundwater monitoring. Wells MW-3, MW-4 and MW-6 typically do not contain groundwater and are generally not sampled during semi-annual groundwater monitoring events. MW-5 typically contains only a few inches of water and does not provide sufficient groundwater for sampling and analysis. MW-8, located in the northwest corner of the MSW landfill permit boundary, is the only well that routinely provides sufficient water for groundwater monitoring purposes.

\subsection*{6.2 Proposed Groundwater Monitoring System}

Site specific characteristics were considered while designing the proposed groundwater monitoring system. The new wells will be installed to allow determination of the quality of ground water passing the relevant point of compliance.

\subsection*{6.2.1 Well Identifications and Locations}

Per OAC 252:515-9-5(b)(1) land disposal facilities shall be equipped with at least one (1) monitoring well located hydraulically upgradient of the disposal facility and three (3) located hydraulically downgradient of the disposal facility. Because the C\&D cell is located within the boundary of the MSW facility, it is proposed to upgrade the site-wide groundwater monitoring network and integrate the monitoring network for the \(\mathrm{C} \& \mathrm{D}\) cell into it. The proposed groundwater system will consist of two upgradient wells and six downgradient wells. The new groundwater monitoring network will consist of one existing well (MW-8) and six new wells (MW-9 through MW-16). The proposed groundwater monitoring network is summarized on Table 3 and illustrated on Figures 10 and 11.

\subsection*{6.2.2 Well Construction}

Proposed monitor well construction details are provided on the following page. All wells will be constructed in accordance with OWRB requirements per OAC 252:515-9-6.

Well Construction Details
\begin{tabular}{|l|l|}
\hline Borehole Diameter & \begin{tabular}{l} 
A minimum of 3" greater than the diameter of the well \\
casing and screen from surface to total depth.
\end{tabular} \\
\hline Well Materials & \begin{tabular}{l}
2 or 4" diameter sched. 40 PVC, flush threaded with screw \\
joints, and o-rings.
\end{tabular} \\
\hline Sediment Trap & 1-ft. section. \\
\hline Screen & \begin{tabular}{l}
\(10-\mathrm{ft}\) section, factory slotted with 0.010" slots, 20-ft. may \\
be used if deemed necessary during drilling.
\end{tabular} \\
\hline Filter Pack & \begin{tabular}{l} 
Inert 20-40 silica sand extending approx. 2 ft above top of \\
screen.
\end{tabular} \\
\hline Annular and Casing Seal & \begin{tabular}{l} 
Hydrated sodium bentonite pellets from top of filter pack to \\
within two feet of ground surface.
\end{tabular} \\
\hline Concrete Pad & \begin{tabular}{l} 
A 4' x 4' x 6" steel-reinforced concrete pad extending to \\
grout below surface.
\end{tabular} \\
\hline \begin{tabular}{l} 
Top Cap, Protective Casing and \\
Bollards
\end{tabular} & \begin{tabular}{l} 
Locking protective casing, and two to four protective \\
yellow bollards.
\end{tabular} \\
\hline
\end{tabular}

Identification tags with latitude, longitude, and surface elevation will be permanently placed on the outer protective casing of each monitor well per OAC 252:515-7-3(4). The monitoring wells will be operated and maintained so that they perform to design specifications throughout the life of the monitoring program in accordance with OAC 252:515-9-7.

\subsection*{6.2.3 Plugging and Abandonment}

All wells and piezometers that will not become a part of the groundwater monitoring system will be plugged in accordance with OWRB regulations per OAC 252:515-7-71(b). Therefore, piezometers PZ20-1 and BPZ21-2, BPZ21-3, and BPZ21-4 will be decommissioned. It is also proposed to decommission existing wells MW-1 through MW7. Monitor wells MW-1, MW-2 and MW-7 are inactive and are being decommissioned in accordance with OWRB rule 785:35-7-1(3) and 785:35-7-2(3), which requires the plugging of unused wells. Monitor wells MW-3 through MW-6 are proposed to be decommissioned because they are either dry or do not contain sufficient water for groundwater monitoring purposes.

All wells will be decommissioned and new wells installed within 180 days of approval of the proposed landfill C\&D landfill, except for MW-12. It is proposed to install MW-12 at a later date when waste disposal operations are within 500 feet of its proposed location.

Quarterly background monitoring of the new wells will begin within 90 days of the well installations.

\subsection*{6.3 Groundwater Sampling and Analysis Plan}

Groundwater monitoring procedures will be conducted in accordance with ODEQ regulations and the Groundwater Sampling and Analysis Plan (GWSAP) provided as Attachment 12.

\section*{7 REFERENCES}

American Society for Testing and Materials (ASTM). 1996. Method D 4044: Standard Test Method (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers.

Becker, C.J., Overton, M.D., Johnson, K.S., and Luza, K.V. 1997. Geologic and Hydraulic Characteristics of Selected Shaly Geologic Units in Oklahoma. U.S. Geological Survey Water-Resources Investigations Report 96-4303.

Bello, Paul R., 2021. Estimating Formation Effective Porosity and Mineral Composition Using Common Geophysical Logs. MS Thesis, Rutgers University.

Butler, James, 1997. The Design, Performance and Analysis of Slug Tests. Lewis Publishers, Washington, D. C.

Ciemnicka, J., Jaskulski, R., Kubissa, W., and Pralat, K., 2019. Influence of selected micro additives content on Gypsum. Architecture Civil Engineering Environment. file:///Users/kevincarel/Documents/The\%20Carel\%20Corporation/Oklahoma/Altus\%20L F/2021/Subsurface\%20Investigation/Literature/gypsum\%20porosity.pdf

Driscoll, F. G. 1986. Groundwater and Wells. Johnson Division, St. Paul, Minnesota. 1089 p.
Freeze, R. A. and Cherry, J. A. 1979. Groundwater. Prentice-Hall, Inc. New Jersey. 604 p.
Havens, John S., 1977. Reconnaissance of the Water Resources of the Lawton Quadrangle, Southwestern Oklahoma. Oklahoma Geological Survey Map HA-6, Sheet 6 of 4.

Johnson, Kenneth S. 1967. Stratigraphy of the Permian Blaine Formation and Associated Strata in Southwestern Oklahoma. ProQuest Dissertations and Theses

Johnson, Kenneth S. 1983. Oklahoma Geological Survey, Maps Showing Principal Ground-Water Resources and Recharge Areas in Oklahoma, Sheet 1 - Unconsolidated Alluvium and Terrace Deposits.

Johnson, Kenneth S. 1983. Oklahoma Geological Survey, Maps Showing Principal Ground-Water Resources and Recharge Areas in Oklahoma, Sheet 2 - Bedrock Aquifers and Recharge Areas.

Johnson, Kenneth S. 2008. Oklahoma Geological Survey Education Publication 9 - Principal Ground-Water Resources of Oklahoma.

Oklahoma Administrative Code (OAC) Title 252 Department of Environmental Quality Chapter 515. Management of Solid Waste (effective September 15, 2018).

Oklahoma Administrative Code (OAC) Title 785 Oklahoma Water Resources Board Chapter 35. Well Driller and Pump Installer Licensing.

Oklahoma Climatological Survey, 2022. CLIMOCS. http://climate.ok.gov
Oklahoma Mesonet, http://www.mesonet.org/
Oklahoma Water Resources Board (OWRB) Water Information Mapping System (WIMS). http://www.owrb.ok.gov/maps/server/wims.php, accessed 2022.

Stanley, Thomas M. et. al., 2004. Geologic Map of the Oklahoma Part of the Altus 30'x60' Quadrangle. Greer, Harmon, Jackson, Kiowa, and Tillman Counties, Oklahoma. Oklahoma Geological Survey.

The Carel Corporation (Carel Corp). October 2020. Subsurface Characterization Drilling Plan. Proposed C\&D Disposal Area, City of Altus Landfill, MSW Permit No. 3533005, Jackson County, Oklahoma

The City of Altus, 2022. Groundwater Monitoring Report, First 2021 Semi-Annual Monitoring Event, Altus Municipal Landfill, Permit No. 3533005, 16429 S. County Road 196, Jackson County, OK.

Weather Underground, https://www.wunderground.com/weather/us/ok/altus/KOKALTUS27

\section*{TABLES}

TABLE 1

\section*{Boring and Piezometer Details}

\section*{City of Altus Landfill Proposed C\&D Disposal Area}
\begin{tabular}{|c|c|c|c|c|c||}
\hline \multicolumn{1}{|c|}{ B21-1 } & BPZ21-2 & BPZ21-3 & BPZ21-4 & B21-5 \\
\hline Northing & 487198.0526 & 487630.6628 & 487634.6968 & 486874.6219 & 487198.6664 \\
\hline Easting & 1523970.2 & 1523733.27 & 1524182.763 & 1523905.314 & 1524171.58 \\
\hline Latitude & \(34.6631333^{\circ}\) & \(34.6643123^{\circ}\) & \(34.6643415^{\circ}\) & \(34.6622421^{\circ}\) & \(34.6631431^{\circ}\) \\
\hline Longitude & \(-099.4783471^{\circ}\) & \(-099.4791560^{\circ}\) & \(-099.4776616^{\circ}\) & \(-099.4785471^{\circ}\) & \(-099.4776775^{\circ}\) \\
\hline Surface Elevation & 1436.55 & 1437.52 & 1433.92 & 1441.67 & 1437.44 \\
\hline Top of Casing Elevation & \(\mathrm{n} / \mathrm{a}\) & 1439.63 & 1436.54 & 1443.87 & \(\mathrm{n} / \mathrm{a}\) \\
\hline DPW Elevation & 1425 & 1425 & 1425 & 1425 & 1425 \\
\hline Boring Depth & 43 & 45 & 40 & 53 & 45 \\
\hline Borehole Bottom Elevation & 1393.55 & 1392.52 & 1393.92 & 1388.67 & 1392.44 \\
\hline Boring Depth Below DPW & 31.45 & 32.48 & 31.08 & 36.33 & 32.56 \\
\hline Top of Saturated Zone & \(\mathrm{n} / \mathrm{a}\) & 1410 & 1406 & 1407 & 1407.5 \\
\hline Elevation & \(\mathrm{n} / \mathrm{a}\) & 40 & 40 & 50.5 & \(\mathrm{n} / \mathrm{a}\) \\
\hline Piezometer Depth & \(\mathrm{n} / \mathrm{a}\) & 1397.52 & 1393.92 & 1391.17 & \(\mathrm{n} / \mathrm{a}\) \\
\hline Piezometer Bottom Elevation & \(\mathrm{n} / \mathrm{a}\) & 12.48 & 12.08 & 15.83 & \(\mathrm{n} / \mathrm{a}\) \\
\hline Piezometer Depth below \\
Saturated Zone & & & & & \\
\hline
\end{tabular}

Notes:
B - Boring; BPZ - Boring/Piezometer
DPW - Deepest Placement of Waste
All elevations are in feet Mean Sea Level
Top of Saturated Zone is the average groundwater elevation from April 2021 through January 2022
n/a - not applicable
Table 2
City of Altus Proposed C\&D Disposal Area
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline Monitor
Well/Piezometer & \multicolumn{2}{|l|}{BPZ21-2} & \multicolumn{2}{|l|}{BPZ21-3} & \multicolumn{2}{|l|}{BPZ21-4} & \multicolumn{2}{|l|}{PZ20-1} & \multicolumn{2}{|l|}{MW-3} & \multicolumn{2}{|l|}{MW-5} & \multicolumn{2}{|l|}{MW-8} & \multirow[t]{2}{*}{\begin{tabular}{l}
Average \\
Monthly \\
Elevation
\end{tabular}} \\
\hline Top of Casing Elevation, ft msl & \multicolumn{2}{|l|}{1439.63} & \multicolumn{2}{|l|}{1436.54} & \multicolumn{2}{|l|}{1443.87} & \multicolumn{2}{|l|}{1448.60} & \multicolumn{2}{|l|}{1429.18} & \multicolumn{2}{|l|}{1424.73} & \multicolumn{2}{|l|}{1433.07} & \\
\hline Measurement Date & \multicolumn{14}{|l|}{WATER LEVEL DEPTH (FT) / ELEVATION (FT MSL)} & \\
\hline 4/12/2021 & 29.90 & 1409.73 & 36.24 & 1400.30 & 39.36 & 1404.51 & 40.16 & 1408.44 & Dry & <1406.77 & 21.33 & 1403.40 & 26.20 & 1406.87 & 1405.54 \\
\hline 5/12/2021 & 30.37 & 1409.26 & 34.46 & 1402.08 & 35.59 & 1408.28 & 40.74 & 1407.86 & Dry & <1406.77 & 21.30 & 1403.43 & 26.45 & 1406.62 & 1406.26 \\
\hline 6/12/2021 & 30.18 & 1409.45 & 31.96 & 1404.58 & 35.37 & 1408.50 & 40.57 & 1408.03 & Dry & <1406.77 & 21.29 & 1403.44 & 26.44 & 1406.63 & 1406.77 \\
\hline 7/10/2021 & 27.12 & 1412.51 & 30.45 & 1406.09 & 35.63 & 1408.24 & 40.70 & 1407.90 & Dry & <1406.77 & 20.61 & 1404.12 & 25.10 & 1407.97 & 1407.81 \\
\hline 8/20/2021 & 26.80 & \(\underline{1412.83}\) & 28.85 & 1407.69 & 34.97 & 1408.90 & 39.49 & 1409.11 & Dry & <1406.77 & 20.76 & 1403.97 & 25.51 & 1407.56 & 1408.34 \\
\hline 9/24/2021 & 27.98 & 1411.65 & 28.55 & 1407.99 & 34.96 & 1408.91 & 39.44 & 1409.16 & Dry & <1406.78 & Dry & <1403.01 & 25.86 & 1407.21 & 1408.98 \\
\hline 10/24/2021 & 28.48 & 1411.15 & 28.15 & 1408.39 & 34.61 & 1409.26 & 38.72 & \(\underline{1409.88}\) & Dry & <1406.78 & 20.88 & 1403.85 & 25.96 & 1407.11 & 1409.16 \\
\hline 11/14/2021 & 29.20 & 1410.43 & 28.32 & 1408.22 & 35.07 & 1408.80 & 40.11 & 1408.49 & Dry & <1406.78 & 21.13 & 1403.60 & 26.25 & 1406.82 & 1407.73 \\
\hline 12/15/2021 & 29.92 & 1409.71 & 28.62 & 1407.92 & 35.08 & 1408.79 & 39.46 & 1409.14 & Dry & <1406.78 & 20.96 & 1403.77 & 26.41 & 1406.66 & 1407.67 \\
\hline 1/22/2022 & 29.80 & 1409.83 & 28.58 & 1407.96 & 35.44 & 1408.43 & 40.54 & 1408.06 & Dry & <1406.78 & 21.20 & 1403.53 & 26.57 & 1406.50 & 1407.39 \\
\hline 2/21/2022 & 29.89 & 1409.74 & 28.52 & 1408.02 & 35.36 & 1408.51 & 40.33 & 1408.27 & Dry & <1406.78 & 21.24 & 1403.49 & 26.87 & 1406.20 & 1407.37 \\
\hline 3/23/2022 & 30.41 & 1409.22 & 28.14 & 1408.40 & 35.62 & 1408.25 & 40.85 & 1407.75 & Dry & <1406.78 & 21.23 & 1403.50 & 27.28 & 1405.79 & 1407.15 \\
\hline 4/12/2022 & 30.31 & 1409.32 & 27.85 & 1408.69 & 35.45 & 1408.42 & 40.50 & 1408.10 & Dry & <1406.78 & Dry & <1403.01 & 27.26 & 1405.81 & 1408.63 \\
\hline Maximum Elevation & & 1412.83 & & 1408.69 & & 1409.26 & & 1409.88 & & NA & & 1404.12 & & 1407.97 & 1409.16 \\
\hline
\end{tabular}
table 3
City of Altus Landfill Proposed C\&D Disposal Area
\begin{tabular}{||l|c|c|c|c|c|c|c|c||}
\hline & MW-8 & MW-9 & MW-10 & MW-11 & MW-12 \({ }^{(\mathbf{1})}\) & MW-13 & MW-14 & MW-15 \\
\hline Stratum Monitored & Blaine Formation & Blaine Formation & Flowerpot Shale & Flowerpot Shale & Flowerpot Shale & Flowerpot Shale & Blaine Formation & Blaine Formation \\
\hline Unit Monitored & MSW & C\&D \& MSW & C\&D & C\&D & MSW & C\&D \& MSW & MSW & MSW \\
\hline Hydraulic Position & Downgradient & Upgradient & Downgradient & Downgradient & Downgradient & Upgradient & Downgradient & Downgradient \\
\hline Northing & 487268.2727 & 487896 & 487877 & 487194 & 486383 & 485288 & 485509 & 486475 \\
\hline Easting & 1522725.204 & 1523737 & 1524607 & 1525140 & 1525105 & 1524431 & 1522700 & 1522740 \\
\hline Surface Elevation & 1431.03 & 1435 & 1425.5 & 1425 & 1435 & 1455.5 & 1430 & 1435.5 \\
\hline \begin{tabular}{l} 
Top of Casing \\
Elevation
\end{tabular} & 1433.18 & TBD & TBD & TBD & TBD & TBD & TBD & TBD \\
\hline Total Depth (bgs) & 30.90 & 40 & 36 & 37 & 46 & 61 & 40 & 43 \\
\hline
\end{tabular}

\footnotetext{
Notes:
(1) - Future monitor well to be installed when disposal activities are within 1,000'

TBD - to be determined
Surface Elevations and total depths are estimated for proposed monitor wells
Well locations may be adjusted to avoid existing surface features
}

FIGURES












\section*{APPENDIX 1}

\section*{DRILLING PLAN APPROVAL LETTER} -

KEVIN STITT
SCOTI A. THOMPSON
Executive Director
OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

December 29, 2020

John A. Barron, P.E., CFM, Public Works Director
City of Altus Landfill
509 South Main Street
Altus, Oklahoma 73521

Re: Drilling Plan, City of Altus Landfill, Jackson County, Permit Number 3533005

Dear Mr. Barron:

The Oklahoma Department of Environmental Quality (DEQ) is in receipt of the above referenced Drilling Plan for City of Altus Landfill dated October 21, 2020, submitted by The Carel Corporation. The Drilling Plan encompasses an area of approximately 10 acres in the north central portion of the existing municipal solid waste (MSW) landfill for a proposed construction and demolition (C\&D) waste disposal area. The C\&D waste disposal area will need to be permitted as a new C\&D landfill under a Tier III permit application. Also, the area proposed for C\&D landfill will need to be removed from the existing landfill permit. The results from this Drilling Plan and subsurface investigation will be submitted as part of a Tier III permit application for the proposed C\&D landfill.

This Drilling Plan also requests the use of a previously drilled boring (BH-5) to replace the required \(100-\mathrm{ft}\) depth boring requirement. Oklahoma Administrative Code (OAC) 252:515-7-4(b)(3)(D) allows the use of a previously drilled boring, upon approval from DEQ, with the restriction that the previous drilling is within 200 feet of the proposed permit boundary. Please verify the distance of the previous boring to the proposed permit boundary of the \(\mathrm{C} \& \mathrm{D}\) cell before using it.

This Drilling Plan has been reviewed and is accepted by DEQ as a standalone document for the acquisition of data in support of a subsurface investigation and groundwater study for the proposed 10 -acre C\&D landfill. In accordance with OAC 252:515-7-5(a), please notify DEQ at least two

John A. Barron
December 29, 2020
Page 2 of 2
(2) weeks prior to initiating drilling. If you have any questions, please contact Martha Grafton at (405) 702-5144 or Martha.grafton@deq.ok.gov.

Sincerely,


Land Protection Division

HY/mg
cc: Kevin Carel, The Carel Corporation

\section*{APPENDIX 2}

\section*{HISTORICAL BORING LOGS}

\section*{GEOTECHNICAL INVESTIGATION REPORT}

\section*{MARCH 1981}

FIGURE C-1

Glenn Briggs \& Associates, Inc.
Consulting Engineers

\section*{TEST HOLE BORINGS}

\section*{ALTUS MUNICIPAL LANDFILL}

SITE NO. 9: NE \(\frac{1}{4}\) and \(S \frac{1}{2}\) of Section 11, T2N, R22W. ( \(75 \% \mathrm{P}-25 \% \mathrm{C}\) ) ( \(\mathrm{D}=9 \mathrm{mi}\). ) NOTE: Railroad \& 2 O.H. Trans. Lines cross this property

TEST HOLE NO. 1A:
\begin{tabular}{|c|c|c|}
\hline Location: & \multicolumn{2}{|l|}{Near SE Corner of Section 11, T2N, R22W} \\
\hline Elevation: & 1445 - & \\
\hline Date: & March 3, 1981 & \\
\hline \multirow[t]{4}{*}{Log:} & Depth & Description of Soil \\
\hline & \[
\begin{aligned}
& 0^{\prime}-3^{\prime} \\
& 3^{\prime}-9^{\prime}
\end{aligned}
\] & \begin{tabular}{l}
Brown Sandy Clay (Dry) \\
Reddish Brown Clay w/streaks of Gray Clay, and Gyp Rock (Dry)
\end{tabular} \\
\hline & \(9^{\prime}-11^{\prime}\) & Gray Clay w/Brown Streaks (Slightly Moist) \\
\hline & \(11^{\prime}-13^{\prime}\) & Gray Clay (Dry \& Hard) \\
\hline
\end{tabular}
* No Water Encountered.

TEST HOLE NO. 2A:
\begin{tabular}{|c|c|c|}
\hline Location: & \multicolumn{2}{|l|}{\(1320^{\prime}\) West and \(1320^{\prime}\) South of NE corner, Section 11, T2N, R22W.} \\
\hline Elevation: & 1440 - & \\
\hline Date: & March 6, 1981 & \\
\hline \multirow[t]{7}{*}{Log:} & Depth & Description of Soil \\
\hline & \(0^{\circ}-1^{\prime}\) & Reddish Brown Clay Top Soil (Dry) \\
\hline & \(1^{\prime}-6^{\prime}\) & Light Brown Clay w/some Gyp (Dry) \\
\hline & \(6^{\prime}-10^{\prime}\) & Greenish Gray Clay w/Brown Streaks \\
\hline & & \& small amount of Gyp Rock (Slightly Moist). \\
\hline & \(10^{\prime}-14^{\prime}\) & Light Brown Clay w/Greenish Gray \\
\hline & & Streaks, (Slightly Moist). \\
\hline
\end{tabular}
- No Water Encountered.

Glenn Briggs \& Associates, Inc.
Consulting Engineers

\section*{TEST HOLE NO. 3A:}

Location: \(\quad 50^{\prime}\) East and \(20^{\prime}\) North of SW corner, Section 11, T2N, R22W.
Elevation: 1397 -
Date: \(\quad\) March 6, 1981
\(\begin{array}{lll}\text { Log: } & \underline{\text { Depth }} & \\ & \begin{array}{l}\text { Description } \\ 0^{\prime}-3^{\prime} \\ 3^{\prime}-8^{\prime} \\ 8^{\prime}-12^{\prime} \\ \\ \\ \\ \end{array} 2^{\prime}-13^{\prime} & \\ & & \text { Brown Clay Top Soil (Slightly Moist) } \\ & \text { Brown Clay Clay (Slightly Moist) } \\ & \text { Greenish Gray Clay amount of Sand (Dry \& Hard) }\end{array}\)
* No Water Encountered.

TEST,HOLE NO. 4A:
Location: \(500^{\circ}\) West and \(500^{\circ}\) South of NE corner, Section 11, T2N, R22W.
Elevation: 1420 :
Date: \(\quad\) March 23, 1981
Log: Depth Description of Soil
\(0^{\prime}-6^{\prime} \quad\) Brown Clay (Moist)
6' \(6^{\prime}\) 17 \(\quad\) Red and Gray Clay, streaked (Slightly Moist)
17' \({ }^{\prime} 21^{\prime} \quad\) Gray Shale (Wet)
\(21^{\circ}-30^{\prime} \quad\) Red \& Gray Claÿ, streaked (Dry) 30 - 35 \(\quad\) Red Clay (Dry)
* Water at \(20^{\prime}\) after 23 hours.

\section*{TEST HOLE NO. 5A:}

Location: \(600^{\circ}\) South \& 600' East of NW corner NE \(\frac{1}{4}\), Section 11, T2N, R22W.
Elevation: \(\quad 7424\) 士
Date: \(\quad\) March 23, 1981
Log: Depth Description of Soil
\(0^{\prime}-7^{\prime} \quad\) Reddish Brown Clay (Moist)
7' \({ }^{\prime}\) 11 \(\quad\) Light Red Clay (Moist)
11' - 14 \(\quad\) Red \& Gray Clay, streaked (Moist)
14' - 27 \(\quad\) Solid Gyp Rock
27 \({ }^{\prime}\) - \(37^{\prime} \quad\) Gray Shale (Dry)
31' \(35^{\prime} \quad\) Red Shale and Clay (Dry)
* Water at \(19^{\prime}\) after 22 hours.

Glenr. Briggs \& Associates, Inc.
Consulting Engineers

TEST HOLE NO. 6A:

* No Water after 22 hours.

TEST HOLE NO. 7A:
Eocation: \(\quad 500^{\prime}\) North \& \(800^{\circ}\) West of SE corner, Section 11, T2N, R22W.
Elevation: 1437 士
Date: \(\quad\) March 23, 1981
Log: Depth Description of Soil
\(0^{\prime}-1^{\prime} \quad\) Red Clay (Dry)
\(1^{\prime}-24^{\prime} \quad\) Red \& Gray Clay, streaked (Dry)
24' - 35' Red Clay (Dry to Moist)
* Water at \(28^{\prime}\) after 22 hours.

TEST HOLE NO. 8A:
Location: \(2700^{\prime}\) West \& 350' North of SE corner, Section 11, T2N, R22W. NOTE: Dug Well 100' North of Hole 非 ( \(34^{\prime}\) to water).
Elevation: 1415 \({ }^{\text {+ }}\)
Date: \(\quad\) March 23, 1981
Log: Depth Description of Soil
\begin{tabular}{ll}
\(0^{\prime}-2^{\prime}\) & Brown Clay (Slightly Moist) \\
\(2^{\prime}-10^{\prime}\) & Red Clay (Dry) \\
\(10^{\prime}-19^{\prime}\) & Red \& Cray Clay, streaked (Dry) \\
\(19^{\prime}-20^{\prime}\) & Gray Clay w/Gyp Rock (Dry) \\
\(20^{\prime}-23^{\prime}\) & Red Clay (Dry) \\
\(23^{\prime}-35^{\prime}\) & Red \& Gray Clay, streaked (Dry)
\end{tabular}
* No water after 22 hours.

\section*{Glenn Briggs \& Associates, Inc.}

Consulting Engineers

TEST HOLE NO. 9A:

* No water after 22 hours.

TEST HOLE NO. 10A:
Location: \(\quad 1400^{\prime}\) East \& 500 North of Center Section 11, T2N, R22W.
Elevation: 1450 -
Date: \(\quad\) March 23, 1981
\begin{tabular}{lll} 
Log: & Depth & Description of Soil \\
& \\
& \(0^{\prime}-2^{\prime}\) & Brown Clay (Slightly Moist) \\
\(22^{\prime}-10^{\prime}\) & Red Clay (Dry) \\
\(10^{\prime}-19^{\prime}\) & Red \& Gray Clay, streaked (Dry) \\
\(19^{\prime}-20^{\prime}\) & Gray Clay w/Gyp Rock (Dry) \\
\(20^{\prime}-23^{\prime}\) & Red Clay (Dry) \\
\(23^{\prime}-35^{\prime}\) & Red \& Gray Clay, streaked (Dry)
\end{tabular}
* No water after 22 hours.

TEST HOLE NO. 11A:
Location: \(800^{\prime}\) North \& 800́ East of SW corner, Section 11, T2N, R22W.
Elevation: 1397
Date: \(\quad\) March 24, 1981
Log: Depth Description of Soil
\(0^{\prime}=2^{\prime} \quad\) Brown Clay Top Soil (Slightly Moist)
2' \(\mathbf{7}^{\prime \prime} \quad\) Greenish Gray Clay (Slightly Moist)
\(7^{\prime}-21^{\prime} \quad\) Red Clay (Slightly Moist)
21' \(\mathbf{2 6}^{\prime} \quad\) Gray Clay (Moist to Wet)
26'
* Water at 19' after 6 hours.


SUB-SURFACE EXPLORATION
PROPOSED LANDFILL
ALTUS, OKLAHOMA

FPOTOSED LANDFILL

\section*{ALTUS, ORLAHOMA}


\section*{LOG OF BORING}

PROPOSED LANDFILL
ALTUS, OKLAHOMA
FROM \({ }^{\text {DEPTH }}\) TO

\section*{BORING NO. 1}
\[
0.0^{\prime}-3.0^{\prime}
\]

Brown silty clay; medium to fairly high plasticity

Liquid Limit
Plastic Limit 46

Plasticity Index
Moisture Content
Percent Passing:
No. 10
No. 40
No. 200
Soil Classification:
Unified
THIN-WALL TUBE SAMPLE
\[
0.0^{\prime \prime}-27.0^{\prime \prime}
\]

THIN-WALL TUBE SAMPLE
\[
27.0^{n}-3.0^{\prime}
\]
\(3.0^{\prime}-12.0^{\prime} \quad\) Dark brown silty clay, slow seep at \({ }^{\circ}{ }^{\circ} 0^{\prime}\); fairly moist, medium plasticity
\(12.0^{\prime}-45.0^{\prime}\)
\(45.0^{\prime}-46.0^{\prime}\)

Reddish brown shale/sandstone; hard, medium plasticity

Gypsum

\section*{LOG OF BORING}

PROPOSED LANDFILL
ALTUS, OKLAHOMA

DEPTH
FROM TO
DESCRIPTIONS AND REMARKS

\section*{BORING NO. 2}


\title{
LOG OF BORINGS
}

PROPOSED LANDFILL
ALTUS, OKLAHOMA

DEPTH
FROM
TO
DESCRIPTIONS AND REMARKS

BORING NO. 4
143E MISC
\(0.0^{\prime}-1.5^{\prime} \quad\) Brown silty clay; medium to fairly high plasticity
1.5 \(5^{\circ}\) 4.0' Hard rock
4.0' \(-6.0^{\prime} \quad\) Gray shale
6.0' \(0^{\prime}\) 44.0' Brown and gray shale, fairly moist to moist, Medium to fairly high plasticity

Moisture Content 18.4\%
44.0' \(0^{\prime}\) 46.0' Gypsum rock

BORING NO. 5
0.0' \(\mathbf{- 2 . 0 ^ { \prime }} \quad\) Brown silty clay; medium to fairly high plasticity

\section*{THIN-WALL TUBE SAMPLES}
\(0.0^{\prime}-2.0^{\prime}\)
\(2.0^{\prime}-5.0^{\prime \prime} \quad\) Brown and gray shale; medium to fairly high plasticity
BORING NO. 6
\(0.0^{\prime}-6.0^{\prime \prime} \quad\) Brown silty clay; medium to fairly high plasticity
THIN-WALL TUBE SAMPLE
\(0.0^{\prime}-2.0^{\prime}\)
THIN-W.ALL TUBE SAMPLE
\[
2.0^{\prime}-4.0^{\circ}
\]
6.0' \(0^{\prime}\) 11.0' Reddish brown and gray shale; medium to fairly high plasticity

\section*{LOG OF BORING}

DEPTH
FROM TO
DESCRIPTIONS AND REMARKS

BORING NO. 7
145545
\(0.0^{\prime}-1.5^{\prime} \quad\) Brown silty clay; medium to fairly high plasticity
1.5' \({ }^{\prime}\) 23.0' Brown and gray shale; fairly moist, medium to fairly high plasticity

Moisture Content \(\quad 15.8 \%\)
BORING NO. 8
Brown silty clay; medium to fairly high plasticity
2.0' \(0^{\prime}\) 2.5 Rock
2.5' \(\mathbf{2 4 . 0 ^ { \prime }} \quad\) Reddish brown and gray shale; fairly moist to moist, medium to fairly high plasticity

Liquid Limit
Plastic Limit
40
20
Plasticity Index
Moisture Content
Percent Passing: No. 10 No. 40 No. 20020 17.9\%

100
98.1
85.9

Soil Classification:
Unified
CL
BORING NO. 9
\(0.0^{\prime}-1.5^{\prime}\)
Brown silty clay; medium plasticity
\(1.5^{\prime}-2.0^{\prime}\)
Rock
\(2.0^{\prime}-18.0^{\prime \prime} \quad \begin{aligned} & \text { Reddish brown and gray shale with layers of sandstone; fairly moist, } \\ & \text { medium plasticity }\end{aligned}\) medium plasticity

Moisture Content
18.5\%

\section*{LOG OF BORING}

DEPTH
FROM

BORING NO. 10
1く27M5 M
\(0.0^{\prime}-1.0^{\prime} \quad\) Brown silty clay; medium to fairly high plasticity
\(1.0^{\prime}-3.5^{\prime}\)
\(3.5^{\prime}-12.0^{\prime}\)
\(0.0^{\prime}-2.5^{\prime}\)
\(2.5^{\prime}-5.0^{\prime}\)
\(0.0^{\prime}-3.0^{\prime}\)
\(3.0^{\prime}-5.0^{\prime}\)
\(5.0^{\prime}\) - \(33.0^{\prime \prime}\)

Reddish brown shale with layers of sandstone; medium plasticity
THIN-WALL TUBE SAMPLE
\(2.5^{\prime \prime}-5.0^{\prime}\)

\section*{BORING NO. 12}

Brown silty clay and loose rocks; medium plasticity
Gray and brown silty clay; medium to fairly high plasticity
Reddish brown and gray shale; fairly moist to moist, medium to fairly high plasticity

Moisture Content 18.5\%
\[
10 A-1450
\]

\section*{LOG OF BORING}

\section*{PROPOSED LANDFILL}

ALTUS, OKLAHOMA

DEPTH
FROM
TO
DESCRIPTIONS AND REMARKS

BORING NO. 13

\(0.0^{\circ}-2.0^{\circ}\)
\(2.0^{\prime}-5.0^{\circ}\)
\(5.0^{\prime}-25.0^{\prime \prime}\)
-
\(0.0^{\prime}-2.0^{\prime}\)
\(2.0^{\prime}-5.0^{\prime}\)
\(5.0^{\prime}-15.0^{\prime \prime}\)

Brown silty clay; medium to fairly high plasticity
Gray and brown silty clay; medium to fairly high plasticity
Reddish brown and gray shale; moist, medium to fairly high plasticity

Liquid Limit 39
Plastic Limit
Plasticity Index
Moisture Content Percent Passing:

No. 10
No. 40
No. 200
18
21
18.2\%

Soil Classification:
Unified
CL
BORING NO. 14
100
97.1
90.4

Brown silty clay; medium to fairly high plasticity
Rock
Reddish brown and gray shale; fairly moist to moist, medium to fairly high plasticity

Moisture Content 16.1\%

\section*{LOG OF BORING}

PROPOSED LANDFILL ALTUS，OKLAHOMA

DEPTH
FROM TO
DESCRIPTIONS AND REMARKS

\section*{BORING NO． 15}
\(0.0^{\prime}-5.0^{\prime}\)
\(5.0^{\prime}-19.0^{\prime}\)
\(19.0^{\prime}-35.0^{\prime \prime}\)
\(35.0^{\prime}-46.0^{\prime \prime}\)
\(19.0^{\prime}-35.0^{\prime \prime}\)
\(35.0^{\prime}-46.0^{\prime \prime}\)
\(0.0^{\prime}-5.0^{\prime}\)
\(5.0^{\prime \prime}-10.0^{\prime \prime}\)

Brown silty clay；medium to fairly high plasticity
Reddish brown and gray shale；fairly moist， medium to fairly high plasticity

Moisture Content \(\quad 16.0 \%\)
Shale with traces of gypsum rock
Gypsum rock and shale
BORING NO． 16
Brown silty clay；moist to very moist， medium to fairly high plasticity

Dark brown silty clay；medium plasticity

Liquid Limit
Plastic Limit
Plasticity Index
Moisture Content Percent Passing：

No． 10
No． 40
No． 200
Soil Classification： Unified

34
16
18
19．6\％
100
98.3
96.0

CL

\section*{LOG OF BORINGS}

PROPOSED LANDFILL
ALTUS, OKLAHOMA

\section*{DEPTH}

FROM TO

\section*{BORING NO. 17}

0.0' \(-4.0^{\prime} \quad\) Brown silty clay; medium to fairly high plasticity
4.0' \(0^{\prime}\) 23.0 \(0^{\circ} \quad\) Reddish brown and gray shale; moist, medium to fairly high plasticity

Liquid Limit
37
Plastic Limit 17
Plasticity Index
20
Moisture Content
17.4\%

Percent Passing:
No. 10
100
No. 40
93.3

No. 200
64.4

Soil Classification: Unified

CL
\(23.0^{\prime}-25.0^{\prime}\)
\(0.0^{\prime}-14.0^{\prime}\)

Gypsum rock; hard
BORING NO. 18
Reddish brown and gray shale; moist, medium to fairly high plasticity

Moisture Content
18.2\%

\section*{LOG OF BORINGS}

PROPOSED LANDFILL
ALTUS, OKLAHOMA


\section*{LOG OF BORINGS}

\section*{PROPOSED LANDFILL}

\section*{ALTUS, OKLAHOMA}

\section*{DEPTH}

FROM TO

BORING NO. 21
\(0.0^{\prime}-13.0^{\prime}\)
\(13.0^{\prime}-19.0^{\prime}\)
Gypsum rock, white; dry to slightly moist, hard, no plasticity

Moisture Content 16.0\%
BORING NO. 22

\section*{1423 MS}

Reddish brown and gray shale; moist, medium to fairly high plasticity
Moisture Content \(\quad 18.6 \% \quad 2 A-1440 \mu s 4\)
-
\(0.0^{\prime}-22.0^{\prime}\)
Reddish brown and gray shale; moist, medium to fairly high plasticity

Liquid Limit
Plastic Limit
Plasticity Index
Moisture Content
Percent Passing:
No. 10
No. 40
No. 200
Soil Classification:
Unified

39
18 21
18.6\%

100
99.3
88.4

CL
```

GEOTECHNICAL INVESTIGATION REPORT
FOR THE
ALTUS MUNICIPAL LANDFILL
ALTUS, OKLAHOMA
G088106
FOR
CITY OF ALTUS
ALTUS, OKLAHOMA

```


\(\qquad\)
Datum \(\qquad\) Date 8-17-88
Elevation \(\qquad\)
\(\qquad\)
Type/Size Boring Solid Auger/4" Rig Type Ditch Witch Logged By \(\qquad\) DC Depth to Water \(\qquad\) Dry @ time of drilling ( \(\nabla\) ), \(\qquad\) -@ completion, @ --
\(\qquad\) hrs.

\(\qquad\) OF

LOG OF BORING NO.
Project \(\qquad\) Job. No. G088106

Elevation \(\qquad\) Datum \(\qquad\) Date 8-18-88 Type/Size Boring \(\qquad\) Rig Type Ditch Witch Date \(\qquad\) Depth to Water \(\qquad\) @ time of drilling ( \(\nabla\) ), -@ completion, @ -DC

\(\qquad\) 1 OF considerably between locations.

Project A1tus Landfill \(\qquad\) Job. No. G088106

Elevation \(\qquad\) Datum \(\qquad\) Date \(\qquad\)
Type/Size Boring Solid Auger/4"
Rig Type Ditch Witch Logged By \(\qquad\) DC Depth to Water \(\qquad\) @ time of drilling ( \(\nabla\) ), \(\qquad\) @ completion, @ \(\qquad\) hrs.

\(\qquad\) 1 OF \(\qquad\) considerably between locations.

Glenn Briggs And Associates, Inc. 111 Sequoyah Lane
Box 458
Altus, Oklahoma 73522
Attn: Mr. Gary Brickley

\section*{Gentlemen:}

In accordance with your request, Terracon Consultants, SC, Inc. has drilled five borings on the site. Four of the borings extended to depths of approximately 40 feet below existing grade and one boring extended to a depth of about 200 feet. In addition, geophysical loggings of each boring was performed.

Descriptions of the lithographic conditions, field test data and groundwater conditions are noted on the attached boring logs. Multi-purpose completion well reports have also been completed as required by the Oklahoma Water Resources Board and have been submitted to the State. Copies of the geophysical logs are also attached.

We appreciate the opportunity to be of service to you on this project. Please contact us if you have questions concerning this information.

Respectfully submitted,
TERRACON CONSULTANTS SC, INC.


Lewis Daniel Israel, P.E.
Oklahoma No. 16274


Gerald W. Finn, P.E. Oklahoma No. 12463

LDI/GWF/js
Enclosures


NOTES: • Boring location staked by others.
- Elevations shown on boring logs are interpolated from plan contours.










\section*{LOG OF BORING NO. B-5}


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES
BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|}
\hline \multicolumn{5}{|c|}{WATER LEVEL OBSERVATIONS} & \multirow[t]{4}{*}{} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{l} 
BORING STARTED \\
BORING COMPLETED \\
\hline
\end{tabular}}} & \multicolumn{3}{|c|}{5-5-92} \\
\hline WL & 咅 65.5 & WD & \(\underline{=}\) & AB & & & & & 12- & \\
\hline WL & & & & & & RIG CM & E-75 & FOREMA & N & RS \\
\hline WL & & & & & & APPROVED & DAP & JOB \# & 039 & 8518 \\
\hline
\end{tabular}


THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES
BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|}
\hline \multicolumn{5}{|c|}{WATER LEVEL OBSERVATIONS} & \multirow[t]{4}{*}{} & \multicolumn{5}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{|lc|}
\hline BORING STARTED & \(\mathbf{5 - 5 - 9 2}\) \\
\hline BORING COMPLETED & \(\mathbf{5 - 1 2 - 9 2}\)
\end{tabular}}} \\
\hline WL & 豆 65.5' & WD & \# & \multirow[t]{2}{*}{AB} & & & & & & \\
\hline WL & & & & & & RIG CM & E-75 & FOREM & AN & RS \\
\hline WL & \multicolumn{4}{|l|}{} & & APPROVED & DAP & \multicolumn{3}{|l|}{JOB \# 03928518} \\
\hline
\end{tabular}

\section*{LOG OF BORING NO. B-5}

Page 4 of 7



\section*{LOG OF BORING NO. B-5}

Page 6 of 7



MULTI-PURPOSE COMPLETIUN REPORT
OKLAHOMA WATER RESOURCES BOARD
600 N. HARVEY AVE
P.O. BOX 150
\#03928518


OKLAHOMA CITY. OK 73101-0150

\section*{Legal Description}



\section*{Certification}

The work described obove was done under my supervision. This report is correct to the best of my knowledge. Name Terracon Consultants SC, Inc. Lic. No DPC-0205
MULTI-PURPOSE COMPLETIUN REPORT
OKLAHOMA WATER RESOURCES BOARD
600 N. HARVEY AVE.
\#03928518

OKLAHOMA CITY, OK 73101-0150

\section*{Legal Description}
 County Jackson Well No: B-2
Well Owner City of Altus \(\qquad\) Phone \(\qquad\) Address
Finding location
Near existing landfill. Altus, Oklahoma

\begin{tabular}{c|c|c|c||c}
\hline \hline Lithologic Log & & & & Non- \\
\hline Moterial & From & To & \begin{tabular}{l} 
sotu-d \\
sotod
\end{tabular} & \begin{tabular}{l} 
If this \\
purpoun. \\
imotion
\end{tabular} \\
\hline
\end{tabular}

Red-Brown Lean Clay
01 ive Green Fat Clay
Red-Brown Lean Clay
Dark Red Shaley Lean Clay
Gray-Brown Shaley Lean Clay
Red-Brown Shaley Lean Clay
Gray Shaley Lean Clay
Blue-Gray Shale
Gray-Brown Shale
Blue-Gray Shale
Gray-Brown Shale


\section*{MULTI-PURPOSE COMPLe.IIuN REPORT}

\title{
OKLAHOMA WATER RESOURCES BOARD \\ 600 N. HARVEY AVE. \\ OKLAHOMA CITY. OK 73101-0150
}

03928518

गease plot well location


\section*{Legal Description}



Gray Brown Lean to Fat Clay
Dark Red Lean Clay
Gray to Red Shaley Clay
3" Sandstone Seam At 16 Ft.
Brown to Gray Lean Clay
Gray Brown Shale
Dark Red Shale with Gypsum Gravel

Gypsum
0
2
2


\section*{Plugging Data}

Date Plugged - 5-11-92
Bockfilled From \(\frac{0}{}\) feet \(\frac{37.1}{\text { feet feet Type Envirogrout }}\)
Reconditioning Work
Reploced Cosing/Screen From
Deepened Well From
Redeveloped Well By

\section*{Certification}

The work described above wos done under my supervision.
This report is correct to the best of my knowledge.
Name Terracon Consultants SC, Inc Lic. No. DPC-0205
Address \(832 \mathrm{~N} . \mathrm{W} .67\) th St. OKC, OK Phone Lic. No. \(848-1601\)
\[
600 \text { N. HARVEY AVE. }
\]
P.O. BOX 150
\#03928518


OKLAHOMA CITY, OK 73101-0150
. Legal Description


Dark Red Lean Clay
Gray Silt
Red-Brown Lean Clay
Gray Fat Clay Seam at 17.5
Gray-Brown Shaley Clay
Red-Brown Shaley Clay
Gray-Brown Shale
Gypsum
Gray-Green Shale
Red Shale
Red-Brown Shale
Gray Shale with Gypsum Streak
Gray-Green Shale
Red-Brown Shale
with Gypsum Seam
Gray-Green Shale
Red-Brown Shale
with Gypsum Streaks
Gray-Green Shale
Red-Brown Shale
Red-Gray Shale
Gray-Brown to Red-Brown Shale

Brown Shale
Gypsum \({ }^{-}\)







(918) 652-4925

ALL SERUICES PROUIDED SUBJECT TO STANDARD TERMS AND CONDITIONS








\section*{SUBSURFACE EXPLORATION}

Altus Landfill Expansion
N. 1960 Road

Duke, Oklahoma

PROJECT NO. 2030-0598

PREPARED FOR
Cowan Group
7100 N. Classen Blvd, Suite 500
Oklahoma City, OK 73116

PREPARED BY
STANDARD TESTING \& ENGINEERING, LLC
3400 N. Lincoln Blvd.
Oklahoma City, OK 73105
Certificate of Authorization No. 7933, Expiration 6/30/2021
(405) 528-0541

Prepared By:


Antonio Franco, E.I.
Staff Geotechnical Engineer


Reviewed By:


Roy Khalife, P.E.
Geotechnical Engineer
I certify my e-signature for the study entitled "Subsurface Exploration."
Dated 1/8/2021

January 8, 2021


\section*{- -40}





















\section*{APPENDIX 3}

\section*{30 YEAR AVERAGE CLIMATOLOGICAL DATA SUMMARY}

\section*{Jackson County Climate Summary}

\section*{Temperature}

Average Annual: \(61.4^{\circ} \mathrm{F}\)
Average Maximum: \(74.8^{\circ} \mathrm{F}\)
Average Minimum: \(48.1^{\circ} \mathrm{F}\)
Record High: \(120^{\circ} \mathrm{F}\)
Record Lowest: \(-11^{\circ} \mathrm{F}\)
Number of Days greater than \(90^{\circ}: 92\) Number of Days High less than \(32^{\circ}\) : 5

Winter Weather
Average Annual Snowfall: 4.3in
Days with snow on the Ground:
Greatest Seasonal Snowfall: 21.3in
(1918-1919)
Greatest Daily Snowfall: 10.5in
(12/23/18)
Date of Average Last Freeze in Spring: April 5
Date of Average First Freeze in Fall: Nov. 2
Length of Growing Season: 213213

\section*{Precipitation}

Average Annual: 28.57in
Number of Days with Precipitation: 63
Wettest Year:
49.31in (1941)
9.7in (1917)

Greatest Daily Rainfall: 7.1in
(10/20/83)

\section*{Other Facts}

Average Wind Speed: 10 mph
Sunshine: 60-80\%
Average Humidity: 53\%
Thunderstorm Days: 43
Hail Events (1950-2016): 583
Number of Tornadoes (1950-2016): 71



\section*{WINDS 1994-2015}

\section*{Sites: Altus Mesonet Site (ALTU)}

Wind Roses show the prevailing direction from which the wind is blowing. North is up in the image. The circles show the percentage of time from which the wind is blowing in that direction, as well as the percentage of time for different wind speed ranges. The wind speed ranges are represented by different shades of color. For example, Altus records a north wind about \(6 \%\) of the time, with winds blowing between 15 and 20 mph just over \(1 \%(\sim 5 \%-\) \(4 \%\) ) of the time from that direction. The table below shows the percentage of time the wind is blowing from each of the 16 -point compass headings, and the percent of time the prevailing wind is recorded in each speed bin.
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline  &  & Wind Spe
\(W_{s} \geq 25\)
\(20 \leq W_{s}\)
\(15 \leq w_{s}\)
\(10 \leq W_{s}\)
\(5 \leq W_{s}\)
\(0 \leq w_{s}\)
\(\ddots\) &  & Wind Rose 994-2015, All
\(\qquad\) & Months &  & \[
\mathrm{E}\left(90^{\circ}\right)
\] & \\
\hline Dir Range & Avg Dir & \(0-5 \mathrm{mph}\) & 5-10 mph & \(10-15 \mathrm{mph}\) & 15-20 mph & 20-25 mph & \(25+\mathrm{mph}\) & Total \\
\hline 348.75 to 11.25 & 0 & 0.84 & 1.55 & 1.41 & 1.22 & 0.69 & 0.37 & 6.08 \\
\hline 11.25 to 33.75 & 22.5 & 0.78 & 1.99 & 2.03 & 1.37 & 0.62 & 0.24 & 7.03 \\
\hline 33.75 to 56.25 & 45 & 0.85 & 2.73 & 2.04 & 0.92 & 0.30 & 0.08 & 6.92 \\
\hline 56.25 to 78.75 & 67.5 & 0.86 & 2.35 & 0.72 & 0.18 & 0.05 & 0.01 & 4.17 \\
\hline 78.75 to 101.25 & 90 & 0.99 & 2.87 & 0.66 & 0.14 & 0.02 & 0.01 & 4.69 \\
\hline 101.25 to 123.75 & 112.5 & 1.01 & 4.24 & 1.68 & 0.39 & 0.08 & 0.01 & 7.41 \\
\hline 123.75 to 146.25 & 135 & 0.91 & 5.10 & 3.82 & 1.13 & 0.27 & 0.05 & 11.28 \\
\hline 146.25 to 168.75 & 157.5 & 0.86 & 5.28 & 4.91 & 2.23 & 0.79 & 0.23 & 14.30 \\
\hline 168.75 to 191.25 & 180 & 0.83 & 3.66 & 3.63 & 2.36 & 0.95 & 0.25 & 11.69 \\
\hline 191.25 to 213.75 & 202.5 & 0.77 & 2.18 & 2.03 & 1.21 & 0.43 & 0.11 & 6.73 \\
\hline 213.75 to 236.25 & 225 & 0.67 & 1.14 & 0.69 & 0.30 & 0.12 & 0.05 & 2.97 \\
\hline 236.25 to 258.75 & 247.5 & 0.64 & 0.77 & 0.38 & 0.18 & 0.09 & 0.08 & 2.14 \\
\hline 258.75 to 281.25 & 270 & 0.68 & 0.76 & 0.29 & 0.14 & 0.07 & 0.05 & 1.98 \\
\hline 281.25 to 303.75 & 292.5 & 0.86 & 1.13 & 0.34 & 0.12 & 0.05 & 0.04 & 2.54 \\
\hline 303.75 to 326.25 & 315 & 1.02 & 1.45 & 0.51 & 0.26 & 0.14 & 0.10 & 3.47 \\
\hline 326.25 to 348.75 & 337.5 & 0.99 & 1.91 & 1.02 & 0.70 & 0.44 & 0.32 & 5.38 \\
\hline 0 to 360 & TOTAL & 13.56 & 39.10 & 26.14 & 12.86 & 5.13 & 2.00 & 98.80 \\
\hline Calm & Wind \(=0\) & & & & & & & 1.20 \\
\hline
\end{tabular}

\section*{APPENDIX 4}

\section*{ALTUS MESONET DAILY AND MONTHLY PRECIPITATION INFORMATION}

\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|}
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\hline & & MPER & TURE & ( F) & DEG D & AYS & HUMID & TY & & RAIN & PRESSU & E (i & WIND & SPEED & (mph ) & SOLAR & & L T & ERA & RES \\
\hline DAY & MAX & MIN & AVG & DEWPT & HDD & CDD & MAX & MIN & AVG & (in) & STN & MSL & DIR & AVG & MAX & ( MJ/m2) & SOD & BARE & MAX & MIN \\
\hline 1 & 78 & 56 & 66.1 & 60.8 & 0 & & 98 & 55 & 84 & 0.01 & 28.49 & 29.94 & SSE & 9.3 & 23.5 & 13.48 & 64.8 & 68.2 & 72 & 66 \\
\hline 2 & 84 & 63 & 71.2 & 60.9 & 0 & 8 & 93 & 45 & 72 & 0.00 & 28.11 & 29.55 & SSE & 13.9 & 29.8 & 23.47 & 66.5 & 70.8 & 77 & 66 \\
\hline 3 & 78 & 57 & 66.6 & 58.1 & 0 & 3 & 96 & 53 & 76 & 0.05 & 28.17 & 29.60 & NNE & 16.5 & 41.3 & 12.00 & 66.1 & 69.0 & 72 & 67 \\
\hline 4 & 74 & 47 & 60.0 & 45.0 & 5 & 0 & 89 & 29 & 62 & 0.01 & 28.56 & 30.01 & N & 14.1 & 31.1 & 25.56 & 65.0 & 67.9 & 74 & 63 \\
\hline 5 & 78 & 42 & 62.1 & 40.6 & 5 & 0 & 79 & 26 & 49 & 0.00 & 28.68 & 30.13 & SSE & 7.8 & 24.2 & 28.80 & 64.3 & 68.1 & 76 & 61 \\
\hline 6 & 82 & 57 & 67.6 & 50.8 & 0 & & 91 & 29 & 60 & 0.05 & 28.76 & 30.22 & ESE & 6.9 & 31.3 & 28.56 & 66.5 & 71.5 & 79 & 65 \\
\hline 7 & 90 & 52 & 72.5 & 53.0 & 0 & 6 & 87 & 28 & 55 & 0.00 & 28.57 & 30.02 & S & 15.2 & 35.8 & 28.02 & 67.0 & 72.0 & 78 & 66 \\
\hline 8 & 95 & 59 & 78.7 & 58.4 & 0 & & 82 & 30 & 52 & 0.00 & 28.23 & 29.67 & S & 20.1 & 41.9 & 27.79 & 68.5 & 74.4 & 80 & 69 \\
\hline 9 & 78 & 54 & 65.8 & 46.9 & 0 & 1 & 70 & 36 & 52 & 0.00 & 28.44 & 29.89 & N & 17.6 & 37.0 & 29.11 & 69.0 & 74.1 & 79 & 70 \\
\hline 10 & 66 & 50 & 56.5 & 46.6 & 7 & 0 & 80 & 56 & 70 & 0.00 & 28.61 & 30.06 & NE & 11.8 & 30.8 & 9.95 & 65.5 & 68.1 & 72 & 66 \\
\hline 11 & 59 & 50 & 54.7 & 48.5 & 11 & 0 & 97 & 73 & 80 & 0.13 & 28.65 & 30.11 & NNE & 14.4 & 41.2 & 6.78 & 63.5 & 64.4 & 67 & 62 \\
\hline 12 & 67 & 45 & 56.0 & 45.3 & 9 & 0 & 92 & 47 & 69 & 0.00 & 28.84 & 30.30 & NNE & 9.4 & 23.4 & 21.23 & 62.7 & 63.7 & 69 & 58 \\
\hline 13 & 75 & 42 & 59.7 & 46.3 & 7 & 0 & 93 & 37 & 65 & 0.00 & 28.82 & 30.28 & SE & 6.5 & 21.1 & 23.35 & 63.1 & 65.4 & 72 & 59 \\
\hline 14 & 83 & 51 & 67.0 & 55.0 & 0 & 2 & 94 & 43 & 68 & 0.00 & 28.66 & 30.11 & SSE & 14.0 & 37.0 & 18.32 & 64.1 & 67.1 & 71 & 63 \\
\hline 15 & 82 & 61 & 70.7 & 61.4 & 0 & 6 & 91 & 54 & 74 & 0.00 & 28.54 & 29.99 & SSE & 15.5 & 30.6 & 15.22 & 65.7 & 69.1 & 73 & 65 \\
\hline 16 & 82 & 63 & 69.6 & 64.0 & 0 & 7 & 96 & 52 & 83 & 1.22 & 28.45 & 29.90 & ESE & 10.4 & 24.6 & 15.23 & 67.6 & 70.2 & 74 & 68 \\
\hline 17 & 83 & 61 & 70.4 & 60.2 & 0 & 7 & 96 & 42 & 73 & 0.30 & 28.40 & 29.85 & ESE & 11.1 & 48.2 & 24.89 & 69.0 & 71.1 & 78 & 66 \\
\hline 18 & 78 & 59 & 67.0 & 58.7 & 0 & 4 & 94 & 46 & 77 & 0.09 & 28.40 & 29.84 & ESE & 9.3 & 36.5 & 19.04 & 69.6 & 69.7 & 75 & 66 \\
\hline 19 & 81 & 57 & 68.3 & 59.1 & 0 & 4 & 97 & 50 & 75 & 0.13 & 28.42 & 29.87 & SE & 7.4 & 23.3 & 25.42 & 70.1 & 70.8 & 77 & 65 \\
\hline 20 & 82 & 61 & 70.0 & 62.1 & 0 & 6 & 97 & 52 & 78 & 0.00 & 28.47 & 29.92 & SE & 11.4 & 27.0 & 19.57 & 70.9 & 71.6 & 77 & 67 \\
\hline 21 & 87 & 64 & 73.9 & 64.2 & 0 & 10 & 97 & 42 & 74 & 0.00 & 28.59 & 30.04 & SE & 15.0 & 31.7 & 22.20 & 71.3 & 73.7 & 81 & 69 \\
\hline 22 & 84 & 67 & 73.8 & 66.6 & 0 & 11 & 96 & 54 & 80 & 0.05 & 28.70 & 30.15 & SE & 14.1 & 30.2 & 18.37 & 71.8 & 74.5 & 78 & 71 \\
\hline 23 & 75 & 62 & 69.4 & 66.2 & 0 & 4 & 96 & 77 & 90 & 0.10 & 28.65 & 30.10 & SE & 15.8 & 28.2 & 6.87 & 71.0 & 71.9 & 74 & 69 \\
\hline 24 & 81 & 62 & 70.1 & 64.9 & 0 & 6 & 97 & 59 & 84 & 0.00 & 28.57 & 30.02 & SE & 14.2 & 28.9 & 12.48 & 70.0 & 70.3 & 75 & 67 \\
\hline 25 & 87 & 63 & 74.4 & 63.1 & 0 & 10 & 94 & 46 & 70 & 0.23 & 28.51 & 29.96 & SSE & 10.8 & 36.0 & 21.03 & 71.2 & 73.6 & 81 & 68 \\
\hline 26 & 91 & 68 & 77.8 & 69.3 & 0 & 14 & 97 & 51 & 77 & 0.02 & 28.57 & 30.02 & SSE & 11.9 & 29.5 & 20.84 & 73.1 & 76.3 & 82 & 72 \\
\hline 27 & 93 & 69 & 80.6 & 68.7 & 0 & 16 & 94 & 44 & 70 & 0.01 & 28.46 & 29.91 & SSW & 14.6 & 31.3 & 21.82 & 74.8 & 78.5 & 85 & 73 \\
\hline 28 & 76 & 59 & 67.0 & 57.2 & 0 & 3 & 95 & 45 & 73 & 0.01 & 28.58 & 30.03 & E & 11.1 & 38.8 & 15.03 & 72.9 & 74.5 & 79 & 71 \\
\hline 29 & 83 & 60 & 69.7 & 57.4 & 0 & 6 & 89 & 44 & 67 & 0.00 & 28.59 & 30.04 & E & 9.4 & 23.0 & 24.32 & 71.7 & 74.9 & 82 & 69 \\
\hline 30 & 81 & 61 & 69.9 & 60.3 & 0 & 6 & 83 & 55 & 72 & 0.00 & 28.63 & 30.08 & SE & 14.3 & 29.2 & 18.06 & 71.5 & 75.0 & 80 & 71 \\
\hline 31 & 75 & 59 & 66.7 & 62.4 & 0 & 2 & 97 & 67 & 87 & 0.97 & 28.61 & 30.06 & NNE & 11.9 & 26.9 & 10.61 & 70.6 & 71.7 & 75 & 69 \\
\hline & 80 & 57 & 68.2 & 57.5 & \multicolumn{6}{|l|}{<- Monthly Averages ->} & \multicolumn{2}{|l|}{28.5429 .99} & SE 12.4 48.2 & \multicolumn{2}{|l|}{12.4 48.2} & 19.59 & 68.4 & 71.0 & 76 & 67 \\
\hline \multicolumn{7}{|l|}{\[
\begin{array}{cc}
\text { Temperature - Highest: } & 95 \\
& \text { Lowest: }
\end{array}
\]} & \multicolumn{6}{|l|}{\begin{tabular}{rrr} 
Degree Days - Total HDD: & 43 \\
Total CDD: & 161
\end{tabular}} & \multicolumn{8}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{lllll} 
Number of Days & With: & \\
Tmax \(\geq 90:\) & 4 & Rainfall \(\geq 0.01\) inch: & 16 \\
Tmax \(\leq 32:\) & 0 & Rainfall \(\geq 0.10\) inch: & 7 \\
Tmin \(\leq 32:\) & 0 & Avg Wind Speed \(\geq 10 \mathrm{mph}:\) & 23 \\
Tmin \(\leq 0:\) & 0 & Max Wind Speed \(\geq 30 \mathrm{mph}:\) & 17
\end{tabular}}} \\
\hline \multicolumn{2}{|l|}{Rainfall:} & \multicolumn{3}{|l|}{Monthly Total: Greatest 24 Hr :} & \[
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\hline & TE & MPER & ATURE & ( F) & DEG DA & YS & HUMID & ITY & & RAIN & PRESSU & RE (in) & WIND & SPEED & (mph) & SOLAR & 4 " SO & IL TEMP & ERAT & JRES \\
\hline DAY & MAX & MIN & AVG & DEWPT & HDD & CDD & MAX & MIN & & (in) & STN & MSL & DIR & AVG & MAX & ( MJ/m2) & SOD & BARE & MAX & MIN \\
\hline 1 & 76 & 59 & 66.3 & 58.3 & 0 & 3 & 94 & 53 & & 0.00 & 28.64 & 30.10 & NNE & 7.3 & 16.2 & 15.71 & 70.1 & 70.0 & 74 & 66 \\
\hline 2 & 82 & 58 & 68.4 & 60.0 & 0 & 5 & 97 & 43 & 77 & 0.04 & 28.55 & 30.00 & ESE & 6.0 & 20.9 & 25.52 & 71.0 & 72.4 & 80 & 66 \\
\hline 3 & 82 & 60 & 70.7 & 62.8 & 0 & 6 & 97 & 53 & 78 & 0.24 & 28.54 & 29.99 & ESE & 7.7 & 30.2 & 17.34 & 71.5 & 72.9 & 77 & 69 \\
\hline 4 & 88 & 62 & 74.9 & 60.8 & & 10 & 98 & 32 & 66 & 0.01 & 28.54 & 29.99 & SSE & 9.1 & 23.3 & 29.76 & 73.0 & 75.2 & 83 & 68 \\
\hline 5 & 83 & 62 & 72.3 & 62.8 & 0 & 7 & 97 & 43 & 74 & 0.00 & 28.44 & 29.88 & SSE & 10.0 & 23.6 & 19.98 & 73.2 & 75.6 & 80 & 71 \\
\hline 6 & 91 & 65 & 77.1 & 66.0 & & 13 & 96 & 42 & 71 & 0.00 & 28.32 & 29.76 & SE & 12.1 & 26.2 & 26.09 & 73.7 & 77.8 & 85 & 71 \\
\hline 7 & 87 & 68 & 77.2 & 67.0 & & 12 & 90 & 53 & 72 & 0.01 & 28.34 & 29.78 & ESE & 10.3 & 36.5 & 23.07 & 75.0 & 79.8 & 86 & 75 \\
\hline 8 & 96 & 66 & 80.9 & 64.2 & & 16 & 93 & 28 & 61 & 0.00 & 28.41 & 29.85 & SE & 10.2 & 23.8 & 25.71 & 75.8 & 81.2 & 88 & 76 \\
\hline 9 & 97 & 74 & 85.1 & 74.1 & & 20 & 96 & 47 & 72 & 0.00 & 28.45 & 29.90 & SE & 14.0 & 26.8 & 28.72 & 77.6 & 84.0 & 90 & 78 \\
\hline 10 & 99 & 74 & 86.0 & 74.0 & & 22 & 94 & 45 & 70 & 0.00 & 28.41 & 29.85 & SSE & 13.1 & 27.6 & 28.62 & 79.1 & 86.0 & 92 & 80 \\
\hline 11 & 100 & 73 & 86.8 & 72.7 & 0 & 22 & 92 & 42 & 66 & 0.00 & 28.33 & 29.77 & SE & 13.2 & 29.3 & 28.59 & 80.0 & 86.9 & 93 & 81 \\
\hline 12 & 93 & 70 & 82.3 & 71.5 & & 17 & 95 & 49 & 72 & 0.17 & 28.49 & 29.94 & ESE & 10.1 & 39.2 & 25.18 & 80.2 & 86.0 & 91 & 81 \\
\hline 13 & 85 & 68 & 75.2 & 66.8 & & 11 & 94 & 53 & 76 & 0.14 & 28.56 & 30.01 & E & 10.5 & 38.4 & 9.54 & 77.9 & 80.9 & 85 & 77 \\
\hline 14 & 96 & 67 & 81.9 & 66.6 & & 17 & 96 & 33 & 64 & 0.00 & 28.59 & 30.04 & ESE & 6.5 & 15.8 & 28.23 & 77.5 & 81.4 & 90 & 74 \\
\hline 15 & 98 & 69 & 83.8 & 63.8 & & 19 & 93 & 23 & 57 & 0.00 & 28.60 & 30.06 & E & 6.6 & 17.2 & 29.88 & 78.9 & 84.9 & 92 & 78 \\
\hline 16 & 100 & 68 & 84.4 & 62.6 & & 19 & 87 & 22 & 53 & 0.00 & 28.58 & 30.03 & SSE & 8.8 & 26.2 & 30.00 & 79.5 & 85.8 & 92 & 79 \\
\hline 17 & 102 & 66 & 84.9 & 60.4 & & 19 & 94 & 15 & 51 & 0.00 & 28.53 & 29.98 & SSE & 9.3 & 25.0 & 28.86 & 80.1 & 86.1 & 92 & 80 \\
\hline 18 & 101 & 66 & 85.5 & 61.2 & & 18 & 86 & 21 & 49 & 0.00 & 28.46 & 29.90 & SSE & 11.1 & 31.3 & 29.85 & 80.7 & 86.6 & 93 & 80 \\
\hline 19 & 101 & 67 & 85.8 & 63.2 & & 19 & 90 & 24 & 52 & 0.00 & 28.38 & 29.82 & SSE & 10.4 & 25.9 & 29.38 & 81.5 & 87.4 & 94 & 81 \\
\hline 20 & 101 & 71 & 87.0 & 61.4 & & 21 & 74 & 22 & 46 & 0.00 & 28.28 & 29.71 & SSE & 13.8 & 33.2 & 29.31 & 82.0 & 87.4 & 93 & 82 \\
\hline 21 & 78 & 62 & 71.5 & 58.7 & 0 & 5 & 90 & 42 & 65 & 0.10 & 28.49 & 29.94 & NE & 14.7 & 43.0 & 12.08 & 78.9 & 82.0 & 88 & 78 \\
\hline 22 & 88* & 56* & 72.9* & 57.4* & 0 * & 7* & 90* & 30* & 62* & 0.00* & 28.55* & 30.00* & SSE* & 11.0* & 28.5* & NA & 75.9* & 79.0* & 86* & 73 * \\
\hline 23 & 100 & 71 & 85.2 & 68.6 & & 20 & 95 & 31 & 62 & 0.00 & 28.42 & 29.87 & S & 17.8 & 39.5 & 29.27 & 78.5 & 83.4 & 89 & 78 \\
\hline 24 & 101 & 77 & 88.2 & 68.4 & & 24 & 76 & 33 & 54 & 0.00 & 28.41 & 29.85 & SSE & 17.2 & 34.3 & 29.74 & 80.5 & 85.8 & 91 & 81 \\
\hline 25 & 99 & 78 & 88.3 & 68.9 & 0 & 24 & 75 & 35 & 54 & 0.00 & 28.36 & 29.80 & S & 17.5 & 36.2 & 27.59 & 81.8 & 86.9 & 92 & 82 \\
\hline 26 & 86 & 68 & 75.6 & 69.7 & & 12 & 96 & 58 & 83 & 2.19 & 28.39 & 29.83 & ESE & 12.9 & 54.2 & 11.27 & 79.7 & 82.5 & 87 & 76 \\
\hline 27 & 81 & 66 & 73.2 & 66.8 & 0 & 9 & 97 & 61 & 81 & 1.30 & 28.51 & 29.95 & NE & 7.2 & 25.9 & 17.78 & 75.8 & 77.0 & 82 & 73 \\
\hline 28 & 79 & 69 & 72.9 & 69.3 & 0 & 9 & 98 & 69 & 89 & 1.01 & 28.57 & 30.02 & NE & 8.0 & 32.7 & 12.30 & 76.6 & 76.9 & 79 & 75 \\
\hline 29 & 83 & 70 & 75.1 & 70.9 & & 12 & 97 & 66 & 87 & 0.23 & 28.61 & 30.06 & SE & 6.2 & 15.5 & 15.93 & 77.3 & 77.5 & 82 & 74 \\
\hline 30 & 90 & 70 & 79.5 & 70.8 & & 15 & & 50 & 77 & 0.00 & 28.62 & 30.07 & S & 6.8 & 18.0 & 24.46 & 79.4 & 79.5 & 84 & 75 \\
\hline & \multicolumn{4}{|l|}{91* 67* 79.3* 65.6*} & \multicolumn{6}{|l|}{<- Monthly Averages ->} & \multicolumn{2}{|l|}{28.48* 29.93*} & \multicolumn{3}{|l|}{SSE* 10.6* 54.2*} & 23.78* & \multicolumn{2}{|l|}{77.4* 81.3*} & 87* & 76 * \\
\hline \multicolumn{7}{|l|}{\multirow[t]{3}{*}{Temperature - Highest: 102*}} & \multicolumn{6}{|l|}{\multirow[t]{3}{*}{\begin{tabular}{rrr} 
Degree Days - Total HDD: & \(0 *\) \\
Total CDD: 433*
\end{tabular}}} & \multicolumn{8}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{l}
Number of Days With: \\
Tmax > 90: 17* Rainfall > 0.01 inch: 11*
\end{tabular}}} \\
\hline & & & & & & & & & & & & & & & & & & & & \\
\hline & & & & & & & & & & & & & \multicolumn{2}{|l|}{\multirow[t]{3}{*}{\[
\begin{aligned}
& \operatorname{Tmax}<32: \\
& \operatorname{Tmin}<32: \\
& \operatorname{Tmin}<0:
\end{aligned}
\]}} & \multirow[t]{3}{*}{\[
\begin{aligned}
& 0 \text { * } \\
& 0 \text { 0 }
\end{aligned}
\]} & Rainf & \(11>0\) & 10 inch & & * \\
\hline \multicolumn{2}{|l|}{\multirow[t]{2}{*}{Rainfall:}} & \multicolumn{3}{|l|}{\multirow[t]{2}{*}{Monthly Total: Greatest 24 Hr :}} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\[
\begin{aligned}
& 5.44 * \text { in. } \\
& 2.19 * \text { in. }
\end{aligned}
\]}} & \multicolumn{4}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{l}
Humidity - Highest: \\
Lowest:
\end{tabular}}} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\[
\begin{aligned}
& 98 * \\
& 15 *
\end{aligned}
\]}} & & & & \multirow[t]{2}{*}{Avg Wind Max Wind} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{l}
Speed \(\geq 10 \mathrm{mph}\) \\
Speed \(>30 \mathrm{mph}\)
\end{tabular}}} & \multicolumn{2}{|l|}{: 18*} \\
\hline & & & & & & & & & & & & & & & & & & & & * \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|}
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\end{aligned}
\] & AL DAT & SUMM & RY & & \begin{tabular}{l}
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2 \\
\text { ity: } \\
\hline 99-2
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\] & \[
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-17
\end{array}
\] & ltus & & & Time Coun Elev & \begin{tabular}{l}
Zone: \\
y: Jac \\
ation:
\end{tabular} & \begin{tabular}{l}
night \\
n \\
65 fee
\end{tabular} & nigh & CST & \\
\hline & & PER & TURE & ( F ) & DEG D & AYS & HUMID & ITY & & RAIN & PRESSU & E (in) & WIND & SPEED & (mph ) & SOLAR & & L TEM & RA & JRES \\
\hline DAY & MAX & MIN & AVG & DEWPT & HDD & CDD & MAX & MIN & AVG & (in) & STN & MSL & DIR & AVG & MAX & ( MJ/m2) & SOD & BARE & MAX & MIN \\
\hline 1 & 93 & 73 & 79.3 & 71.1 & & & 95 & 46 & 78 & 0.06 & 28.55 & 30.00 & NE & 7.7 & 29.7 & 21.93 & 80.9 & 80.7 & 86 & 76 \\
\hline 2 & 84 & 71 & 75.7 & 70.8 & & & 98 & 62 & 86 & 1.59 & 28.58 & 30.03 & ENE & 5.9 & 20.0 & 18.37 & 79.3 & 79.5 & 86 & 76 \\
\hline 3 & 84 & 70 & 76.3 & 69.9 & 0 & & 97 & 62 & 82 & 0.00 & 28.56 & 30.01 & ESE & 8.7 & 22.1 & 18.79 & 79.5 & 79.7 & 83 & 77 \\
\hline 4 & 88 & 69 & 77.8 & 68.6 & & & 93 & 55 & 74 & 0.00 & 28.52 & 29.97 & SE & 8.1 & 20.5 & 24.33 & 79.5 & 79.7 & 85 & 75 \\
\hline 5 & 89 & 69 & 78.4 & 68.6 & & & 94 & 51 & 74 & 0.00 & 28.52 & 29.97 & ESE & 9.8 & 21.4 & 24.04 & 79.6 & 81.5 & 88 & 76 \\
\hline 6 & 90 & 70 & 79.8 & 68.7 & 0 & & 94 & 45 & 71 & 0.00 & 28.54 & 29.99 & ESE & 7.7 & 20.5 & 27.74 & 80.2 & 84.4 & 92 & 78 \\
\hline 7 & 94 & 71 & 79.5 & 69.2 & 0 & 17 & 95 & 33 & 74 & 0.27 & 28.51 & 29.96 & ENE & 4.8 & 22.7 & 27.51 & 81.6 & 85.6 & 94 & 80 \\
\hline 8 & 92 & 71 & 80.9 & 71.0 & & 16 & 97 & 51 & 74 & 0.72 & 28.50 & 29.95 & SSE & 6.3 & 29.6 & 25.27 & 82.2 & 84.7 & 92 & 79 \\
\hline 9 & 89 & 71 & 80.8 & 69.8 & 0 & & 91 & 53 & 71 & 0.00 & 28.54 & 29.99 & SSE & 10.5 & 24.8 & 29.49 & 82.3 & 82.9 & 88 & 78 \\
\hline 10 & 94 & 71 & 82.4 & 71.5 & 0 & 17 & 96 & 46 & 72 & 0.68 & 28.49 & 29.94 & S & 9.5 & 36.7 & 25.98 & 82.4 & 84.5 & 92 & 78 \\
\hline 11 & 88 & 70 & 78.8 & 66.3 & 0 & & 96 & 37 & 69 & 0.14 & 28.55 & 30.00 & N & 7.0 & 35.0 & 28.99 & 81.3 & 82.8 & 87 & 79 \\
\hline 12 & 87 & 67 & 77.1 & 66.2 & 0 & & 96 & 48 & 71 & 0.00 & 28.61 & 30.06 & SE & 5.3 & 18.2 & 28.06 & 81.5 & 82.3 & 90 & 76 \\
\hline 13 & 91 & 69 & 80.2 & 68.0 & 0 & 15 & 94 & 42 & 69 & 0.00 & 28.64 & 30.09 & S & 10.0 & 24.9 & 27.57 & 81.9 & 84.4 & 91 & 78 \\
\hline 14 & 90* & 70* & 80.6* & 66.9 * & & 15* & 89* & * 4** & 65* & 0.00* & 28.60* & 30.05* & S * & 14.3* & 33.8* & NA & 81.3* & 84.5* & 91* & 79* \\
\hline 15 & 90 & 72 & 81.5 & 69.0 & 0 & & 85 & 51 & 67 & 0.00 & 28.52 & 29.96 & S & 12.6 & 24.1 & 21.24 & 80.9 & 84.9 & 90 & 80 \\
\hline 16 & 90 & 73 & 80.7 & 71.5 & & & 96 & 51 & 75 & 0.39 & 28.49 & 29.94 & S & 7.7 & 25.4 & 24.60 & 81.6 & 84.1 & 89 & 80 \\
\hline 17 & 94 & 71 & 80.2 & 71.2 & 0 & 18 & 95 & 47 & 76 & 0.00 & 28.55 & 30.00 & SE & 7.1 & 25.4 & 21.71 & 82.4 & 84.8 & 92 & 79 \\
\hline 18 & 92 & 71 & 77.1 & 71.6 & & 16 & 96 & 54 & 85 & 1.16 & 28.62 & 30.07 & E & 7.1 & 34.8 & 15.66 & 80.8 & 82.1 & 87 & 79 \\
\hline 19 & 88 & 69 & 77.5 & 69.7 & 0 & 14 & 97 & 50 & 79 & 0.02 & 28.64 & 30.09 & NE & 7.2 & 17.3 & 25.27 & 80.5 & 81.3 & 87 & 76 \\
\hline 20 & 87 & 66 & 76.8 & 65.5 & 0 & 11 & 94 & 45 & 71 & 0.00 & 28.63 & 30.09 & NE & 6.9 & 19.0 & 28.53 & 80.3 & 82.1 & 90 & 76 \\
\hline 21 & 87 & 66 & 76.3 & 64.3 & 0 & 12 & 93 & 39 & 69 & 0.00 & 28.64 & 30.09 & ENE & 4.8 & 10.7 & 24.29 & 80.3 & 83.5 & 91 & 77 \\
\hline 22 & 89 & 67 & 78.7 & 66.3 & 0 & 13 & 93 & 42 & 68 & 0.00 & 28.64 & 30.09 & SE & 8.8 & 19.7 & 25.63 & 80.6 & 84.3 & 91 & 78 \\
\hline 23 & 92 & 70 & 81.2 & 69.7 & 0 & 16 & 94 & 47 & 70 & 0.00 & 28.58 & 30.03 & SE & 9.9 & 22.7 & 26.12 & 81.3 & 85.7 & 92 & 79 \\
\hline 24 & 96 & 73 & 84.5 & 69.7 & 0 & 19 & 88 & 42 & 63 & 0.00 & 28.53 & 29.98 & SE & 9.9 & 23.8 & 27.52 & 82.2 & 87.6 & 95 & 81 \\
\hline 25 & 100 & 71 & 82.3 & 68.9 & & 21 & 92 & 38 & 67 & 0.66 & 28.50 & 29.95 & ESE & 8.0 & 70.4 & 24.56 & 82.0 & 88.3 & 97 & 82 \\
\hline 26 & 94 & 72 & 81.8 & 69.6 & & 18 & 95 & 40 & 69 & 0.00 & 28.53 & 29.98 & E & 7.0 & 24.4 & 19.62 & 80.8 & 84.1 & 88 & 80 \\
\hline 27 & 98 & 73 & 85.1 & 69.3 & & 21 & 91 & 33 & 63 & 0.00 & 28.54 & 29.99 & SSE & 6.9 & 14.5 & 25.73 & 82.2 & 86.0 & 94 & 80 \\
\hline 28 & 98 & 73 & 84.8 & 70.7 & 0 & 20 & 94 & 39 & 66 & 0.00 & 28.58 & 30.03 & ESE & 8.2 & 18.4 & 27.47 & 83.2 & 88.7 & 97 & 82 \\
\hline 29 & 97 & 73 & 84.8 & 69.5 & 0 & & 92 & 36 & 63 & 0.00 & 28.60 & 30.06 & ESE & 6.8 & 16.7 & 27.32 & 83.5 & 90.2 & 98 & 83 \\
\hline 30 & 97 & 73 & 85.4 & 68.8 & 0 & & 89 & 34 & 61 & 0.00 & 28.60 & 30.06 & SE & 6.7 & 19.3 & 26.60 & 83.6 & 90.8 & 98 & 84 \\
\hline 31 & 100 & 73 & 86.4 & 67.6 & & & 86 & 30 & 57 & 0.00 & 28.56 & 30.01 & SSE & 6.8 & 15.1 & 27.85 & 83.9 & 91.4 & 99 & 85 \\
\hline & \multicolumn{4}{|l|}{92* 71* 80.4* 69.0*} & \multicolumn{6}{|l|}{<- Monthly Averages ->} & \multicolumn{2}{|l|}{28.56* 30.01*} & \multicolumn{3}{|l|}{SE * 8.0* 70.4*} & 24.93* & \multicolumn{2}{|l|}{81.4* 84.4*} & 91* & 79* \\
\hline \multicolumn{7}{|l|}{\[
\begin{array}{r}
\text { Temperature - Highest: } 100 * \\
\text { Lowest: } 66 *
\end{array}
\]} & \multicolumn{6}{|l|}{Degree Days - Total HDD: \begin{tabular}{r} 
0* \\
Total CDD: 500 *
\end{tabular}} & \multicolumn{8}{|l|}{} \\
\hline \multicolumn{2}{|l|}{Rainfall:} & \multicolumn{3}{|l|}{Monthly Total: Greatest 24 Hr :} & \multicolumn{2}{|l|}{\[
\begin{aligned}
& 5.69 * \text { in. } \\
& \text { 1.59* in. }
\end{aligned}
\]} & \multicolumn{4}{|l|}{\[
\begin{aligned}
& \text { Humidity }- \text { Highest: } \\
& \text { Lowest: }
\end{aligned}
\]} & \multicolumn{2}{|l|}{\[
\begin{aligned}
& 98 * \\
& 30 \text { * }
\end{aligned}
\]} & \multicolumn{2}{|l|}{} & & \multicolumn{3}{|l|}{} & \multicolumn{2}{|l|}{\begin{tabular}{lrrrr} 
Number of & Days & With: & & \\
Tmax \(\geq 90:\) & \(20 *\) & Rainfall \(\geq 0.01\) inch: & \(10 *\) \\
Tmax \(\leq 32:\) & \(0 *\) & Rainfall \(\geq 0.10\) inch: & \(8 *\) \\
Tmin \(\leq 32:\) & \(0 *\) & Avg Wind Speed \(\geq 10\) mph: & \(4 *\) \\
Tmin \(\leq 0:\) & \(0 *\) & Max Wind Speed \(\geq 30 \mathrm{mph}:\) & \(5 *\)
\end{tabular}} \\
\hline
\end{tabular}
MESONET CLIMATOLOGICAL DATA SUMMARY
\begin{tabular}{|c|c|}
\hline \multicolumn{2}{|l|}{\multirow[t]{2}{*}{}} \\
\hline & \\
\hline & \\
\hline \multicolumn{2}{|l|}{\multirow[t]{2}{*}{}} \\
\hline & \\
\hline \multicolumn{2}{|l|}{\multirow[t]{4}{*}{}} \\
\hline & \\
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\hline & \[
\begin{aligned}
& 0 \\
& 0 \\
& 0
\end{aligned}
\] \\
\hline
\end{tabular}



\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
MESO \\
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\end{tabular} & \[
\begin{aligned}
& \text { ET CL } \\
& \text { Alt }
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\]
de: & \[
\begin{aligned}
& \text { IMAT } \\
& \text { 4S } \\
& 34-3
\end{aligned}
\] & 13 & AL DATA & SUMM & & & Sept Near Long & ember est itud &  & \[
\begin{aligned}
& 21 \\
& 0 \\
& 0-17
\end{aligned}
\] & Altus & & & Time Coun Elev & Zone: M ty: Jack ation: & night65 fee & \[
\begin{aligned}
& -M i d n i g h t \\
& \text { eet }
\end{aligned}
\] & CST & \\
\hline & & MPER & ATURE & F) & DEG D & AYS & HUMID & ITY & & RAIN & PRESSUR & RE (in) & WIND & SPEED & (mph) & SOLAR & \(4{ }^{\prime \prime}\) S & SOIL TEMPE & ERAT & URES \\
\hline DAY & MAX & MIN & AVG & DEWPT & HDD & CDD & MAX & MIN & AVG & (in) & STN & MSL & DIR & AVG & MAX & ( MJ/m2) & SOD & BARE M & MAX & MIN \\
\hline 1 & 100 & 71 & 85.6 & 67.5 & & & 90 & 31 & 59 & 0.00 & 28.36 & 29.80 & SE & 8.1 & 24.4 & 23.68 & 81.3 & 87.4 & 94 & 81 \\
\hline 2 & 98 & 74 & 86.1 & 68.4 & & 21 & 83 & 37 & 58 & 0.00 & 28.42 & 29.86 & SSE & 11.3 & 28.1 & 20.04 & 81.7 & 88.0 & 93 & 83 \\
\hline 3 & 99 & 75 & 86.6 & 67.5 & 0 & 22 & 81 & 33 & 56 & 0.00 & 28.45 & 29.90 & SSE & 11.3 & 24.6 & 21.71 & 81.8 & 88.3 & 94 & 83 \\
\hline 4 & 98 & 72 & 82.8 & 69.1 & & 20 & 86 & 36 & 65 & 0.03 & 28.46 & 29.91 & SSE & 8.5 & 26.0 & 18.54 & 81.6 & 87.6 & 93 & 83 \\
\hline 5 & 92 & 69 & 79.8 & 64.6 & & 16 & 81 & 35 & 62 & 0.00 & 28.55 & 30.00 & NE & 8.6 & 22.1 & 22.61 & 80.5 & 87.8 & 95 & 83 \\
\hline 6 & 94 & 63 & 79.2 & 63.2 & & 13 & 91 & 35 & 61 & 0.00 & 28.55 & 30.00 & SE & 6.6 & 18.7 & 23.46 & 79.7 & 86.7 & 93 & 80 \\
\hline 7 & 98 & 72 & 83.2 & 65.1 & 0 & 20 & 83 & 32 & 57 & 0.00 & 28.47 & 29.92 & SSE & 9.2 & 20.8 & 22.44 & 80.7 & 87.4 & 93 & 82 \\
\hline 8 & 94 & 66 & 79.9 & 54.7 & 0 & 15 & 80 & 18 & 46 & 0.00 & 28.58 & 30.03 & NE & 11.7 & 30.2 & 22.59 & 79.3 & 87.6 & 94 & 82 \\
\hline 9 & 93 & 56 & 76.0 & 52.2 & 0 & 10 & 87 & 26 & 47 & 0.00 & 28.60 & 30.05 & SSE & 8.4 & 27.3 & 22.67 & 77.9 & 84.5 & 90 & 79 \\
\hline 10 & 97 & 65 & 80.5 & 53.9 & 0 & 16 & 66 & 24 & 42 & 0.00 & 28.56 & 30.01 & SSE & 10.8 & 23.7 & 20.15 & 78.3 & 83.7 & 89 & 79 \\
\hline 11 & 98 & 64 & 80.1 & 54.2 & 0 & 16 & 71 & 23 & 44 & 0.00 & 28.58 & 30.03 & SSE & 11.4 & 25.1 & 20.72 & 78.4 & 83.2 & 88 & 78 \\
\hline 12 & 95 & 60 & 77.3 & 53.6 & & 13 & & 22 & 49 & 0.00 & 28.59 & 30.05 & SE & 9.3 & 23.5 & 22.54 & 78.1 & 82.5 & 89 & 77 \\
\hline 13 & 95 & 61 & 78.0 & 57.8 & 0 & 13 & 84 & 26 & 55 & 0.00 & 28.54 & 29.99 & SSE & 10.0 & 25.7 & 22.48 & 78.2 & 82.6 & 89 & 77 \\
\hline 14 & 92* & 64* & 78.4* & 62.8* & 0* & 13* & 88* & 36* & 61* & 0.00* & 28.48* & 29.93* & SE * & 10.0* & 22.1* & NA & 78.8* & * 83.6* & 90* & \(78 *\) \\
\hline 15 & 91 & 66 & 77.8 & 62.5 & & 13 & & 35 & 63 & 0.00 & 28.50 & 29.95 & SE & 6.1 & 15.6 & 19.98 & 78.9 & 84.3 & 90 & 80 \\
\hline 16 & 93 & 63 & 78.6 & 61.2 & 0 & 13 & 91 & 32 & 59 & 0.00 & 28.47 & 29.91 & SE & 8.1 & 21.0 & 20.37 & 78.9 & 84.0 & 89 & 79 \\
\hline 17 & 96 & 67 & 81.1 & 62.9 & 0 & 16 & 85 & 33 & 57 & 0.00 & 28.53 & 29.98 & ESE & 9.1 & 21.4 & 21.73 & 79.1 & 84.8 & 91 & 80 \\
\hline 18 & 94 & 65 & 79.2 & 60.2 & & 14 & 88 & 30 & 56 & 0.00 & 28.62 & 30.07 & ESE & 5.4 & 14.4 & 20.11 & 79.5 & 85.2 & 91 & 80 \\
\hline 19 & 96 & 65 & 80.5 & 57.1 & 0 & 16 & 79 & 24 & 49 & 0.00 & 28.46 & 29.91 & SSE & 8.3 & 21.0 & 22.08 & 79.4 & 84.7 & 90 & 79 \\
\hline 20 & 101 & 72 & 83.9 & 57.6 & & 21 & 77 & 23 & 45 & 0.00 & 28.36 & 29.80 & N & 11.7 & 36.6 & 17.88 & 79.2 & 84.4 & 89 & 80 \\
\hline 21 & 83 & 54 & 70.9 & 41.1 & 0 & 3 & & 18 & 36 & 0.00 & 28.78 & 30.24 & NNE & 16.9 & 41.8 & 20.63 & 74.9 & 81.5 & 85 & 78 \\
\hline 22 & 81 & 44 & 63.8 & 37.8 & 2 & 0 & 82 & 18 & 44 & 0.00 & 28.83 & 30.30 & NNW & 5.2 & 14.6 & 22.58 & 74.0 & 77.8 & 84 & 71 \\
\hline 23 & 88 & 48 & 68.7 & 38.0 & 0 & 3 & 70 & 16 & 37 & 0.00 & 28.62 & 30.07 & SE & 8.7 & 23.0 & 21.35 & 74.0 & 76.9 & 82 & 71 \\
\hline 24 & 90 & 52 & 69.6 & 41.1 & 0 & 6 & & 17 & 40 & 0.00 & 28.57 & 30.03 & SE & 7.7 & 20.2 & 17.15 & 73.8 & 76.1 & 81 & 71 \\
\hline 25 & 92 & 55 & 73.4 & 45.0 & 0 & 8 & 71 & 17 & 41 & 0.00 & 28.62 & 30.07 & SSE & 8.0 & 19.8 & 21.24 & 74.2 & 77.2 & 84 & 71 \\
\hline 26 & 93 & 54 & 75.1 & 45.0 & 0 & 9 & 73 & 16 & 38 & 0.00 & 28.54 & 29.99 & SSE & 9.8 & 27.1 & 21.31 & 75.0 & 77.8 & 83 & 72 \\
\hline 27 & 93 & 58 & 76.3 & 50.5 & & 11 & & 26 & 42 & 0.00 & 28.47 & 29.91 & SE & 9.8 & 23.3 & 17.05 & 75.4 & 78.3 & 83 & 73 \\
\hline 28 & 95 & 62 & 74.1 & 57.7 & 0 & 13 & 91 & 23 & 61 & 0.28 & 28.38 & 29.83 & ESE & 9.2 & 32.3 & 17.34 & 76.2 & 79.1 & 85 & 74 \\
\hline 29 & 90 & 64 & 74.3 & 65.1 & & 12 & 95 & 44 & 75 & 0.00 & 28.35 & 29.79 & SE & 12.0 & 34.4 & 18.04 & 75.6 & 77.8 & 83 & 74 \\
\hline 30 & 82 & 66 & 71.7 & 65.2 & & 9 & & 55 & 81 & 0.06 & 28.52 & 29.97 & SE & 9.1 & 24.4 & 9.42 & 74.8 & 76.8 & 80 & 74 \\
\hline & \multicolumn{4}{|l|}{93* 63* 77.7* 56.8*} & \multicolumn{6}{|l|}{<- Monthly Averages ->} & \multicolumn{2}{|l|}{28.53* 29.98*} & \multicolumn{3}{|l|}{SSE* 9.3* 41.8*} & 20.41* & 78.0* & * 82.9* & 89* & 78* \\
\hline \multicolumn{7}{|l|}{\multirow[t]{2}{*}{\[
\begin{array}{rr}
\text { Temperature - Highest: } & \text { 101* } \\
\text { Lowest: } & 44 *
\end{array}
\]}} & \multicolumn{3}{|l|}{\multirow[t]{2}{*}{Degree Days}} & Total & HDD : & 2* & \multicolumn{8}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{l}
Number of Days With: \\
Tmax > 90: 26* Rainfall > 0.01 inch: 3*
\end{tabular}}} \\
\hline & & & & & & & & & & Total & CDD : 39 & 96 * & & & & & & & & \\
\hline \multicolumn{2}{|l|}{\multirow[t]{2}{*}{Rainfall:}} & \multicolumn{3}{|l|}{\multirow[t]{2}{*}{Monthly Total: Greatest 24 Hr :}} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\[
\begin{aligned}
& 0.37 * \text { in. } \\
& 0.28 * \text { in. }
\end{aligned}
\]}} & \multicolumn{4}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{l}
Humidity - Highest: \\
Lowest:
\end{tabular}}} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\[
\begin{aligned}
& 95 * \\
& 16 *
\end{aligned}
\]}} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\[
\begin{aligned}
& \operatorname{Tmax}<32: \\
& \operatorname{Tmin}<32: \\
& \operatorname{Tmin}<0:
\end{aligned}
\]}} & \multirow[t]{2}{*}{\[
\begin{aligned}
& 0 * \\
& 0 * \\
& 0 *
\end{aligned}
\]} & \multirow[t]{2}{*}{Avg Wind Max Wind} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{Speed \(\geq 10 \mathrm{mph}:\)}} & \multicolumn{2}{|l|}{: 10*} \\
\hline & & & & & & & & & & & & & & & & & & & & 5* \\
\hline
\end{tabular}

\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline \multicolumn{7}{|l|}{MESONET CLIMATOLOGICAL DATA SUMMARY (ALTU) Altus Latitude: 34-35-13} & \multicolumn{5}{|l|}{\[
\begin{aligned}
& \text { November } 2021 \\
& \text { Nearest City: } 3.0 \mathrm{~S} \\
& \text { Longitude: } 99-20-17
\end{aligned}
\]} & \multicolumn{3}{|l|}{Altus} & \multicolumn{6}{|l|}{\begin{tabular}{l}
Time Zone: Midnight-Midnight CST County: Jackson \\
Elevation: 1365 feet
\end{tabular}} \\
\hline & & MPER & ATURE & F) & DEG DA & & HUMID & ITY & & RAIN & PRESS & RE (in) & WIND & SPEED & (mph) & SOLAR & \(4{ }^{\prime \prime}\) S & SOIL TEMPE & ERAT & URES \\
\hline DAY & MAX & MIN & AVG & DEWPT & HDD & & MAX & MIN & AVG & (in) & STN & MSL & DIR & AVG & MAX & ( MJ/m2) & SOD & BARE & MAX & MIN \\
\hline 1 & 66 & 47 & 54.0 & 39.9 & 9 & 0 & 76 & 43 & 60 & 0.00 & 28.76 & 30.21 & NE & 10.6 & 30.0 & 15.41 & 60.1 & 61.8 & 67 & 58 \\
\hline 2 & 47 & 42 & 44.3 & 40.0 & 20 & 0 & 96 & 75 & 85 & 0.10 & 28.86 & 30.32 & NE & 12.7 & 26.5 & 2.63 & 58.1 & 58.0 & 61 & 56 \\
\hline 3 & 48* & 42* & 44.9* & 42.3* & 20* & 0* & 96* & 81* & 91* & 0.00* & 28.85* & 30.32* & NE & 8.3* & 16.2* & NA & 56.7* & * 55.1* & 56* & 54 * \\
\hline 4 & 56 & 41 & 48.2 & 44.0 & 17 & 0 & 97 & 64 & 86 & 0.00 & 28.81 & 30.27 & SE & 5.4 & 17.6 & 8.05 & 57.5 & 56.1 & 59 & 55 \\
\hline 5 & 63 & 37 & 48.7 & 41.5 & 15 & 0 & 99 & 49 & 79 & 0.01 & 28.72 & 30.17 & SE & 9.4 & 23.7 & 14.90 & 57.1 & 55.6 & 61 & 51 \\
\hline 6 & 72 & 38 & 53.1 & 43.2 & 10 & 0 & 95 & 37 & 73 & 0.00 & 28.71 & 30.16 & SE & 8.7 & 22.9 & 15.50 & 57.6 & 57.2 & 63 & 52 \\
\hline 7 & 80 & 43 & 59.2 & 43.9 & 4 & 0 & 97 & 21 & 64 & 0.00 & 28.62 & 30.07 & SE & 10.9 & 28.4 & 15.70 & 58.7 & 59.1 & 64 & 54 \\
\hline 8 & 79 & 47 & 61.5 & 49.4 & 2 & 0 & 94 & 37 & 68 & 0.00 & 28.61 & 30.07 & SE & 11.3 & 25.9 & 14.66 & 59.6 & 60.5 & 65 & 56 \\
\hline 9 & 72 & 53 & 61.0 & 51.8 & 3 & 0 & 89 & 50 & 73 & 0.00 & 28.62 & 30.07 & ENE & 6.7 & 15.9 & 13.17 & 61.2 & 63.0 & 68 & 60 \\
\hline 10 & 77 & 51 & 60.7 & 50.9 & 1 & 0 & 98 & 37 & 73 & 0.00 & 28.40 & 29.84 & NNW & 10.6 & 27.0 & 7.58 & 61.1 & 62.1 & 65 & 60 \\
\hline 11 & 67 & 44 & 53.3 & 37.4 & 10 & 0 & 85 & 28 & 58 & 0.00 & 28.65 & 30.10 & NNW & 6.3 & 15.5 & 13.91 & 59.8 & 60.4 & 65 & 57 \\
\hline 12 & 63 & 35 & 49.9 & 24.4 & 16 & 0 & 75 & 12 & 42 & 0.00 & 28.76 & 30.21 & NNW & 10.9 & 36.0 & 14.98 & 57.6 & 57.9 & 62 & 55 \\
\hline 13 & 72 & 30 & 49.2 & 26.0 & 14 & 0 & 76 & 18 & 46 & 0.00 & 28.70 & 30.15 & S & 8.1 & 24.3 & 14.65 & 55.9 & 55.6 & 61 & 51 \\
\hline 14 & 65 & 38 & 52.1 & 32.5 & 13 & 0 & 76 & 28 & 49 & 0.00 & 28.67 & 30.13 & NE & 8.8 & 38.1 & 13.94 & 56.2 & 57.1 & 62 & 53 \\
\hline 15 & 80 & 37 & 55.8 & 36.9 & 7 & 0 & 79 & 23 & 54 & 0.00 & 28.58 & 30.04 & S & 6.1 & 15.8 & 14.08 & 56.4 & 57.3 & 63 & 52 \\
\hline 16 & 89 & 41 & 64.2 & 39.1 & 0 & 0 & 97 & 14 & 50 & 0.00 & 28.34 & 29.78 & S & 11.9 & 32.2 & 14.61 & 58.1 & 59.6 & 65 & 54 \\
\hline 17 & 61 & 39 & 53.3 & 27.1 & 15 & 0 & 74 & 21 & 39 & 0.00 & 28.56 & 30.01 & NNE & 15.8 & 38.1 & 11.69 & 57.3 & 58.5 & 61 & 56 \\
\hline 18 & 57 & 33 & 43.1 & 13.1 & 20 & 0 & 48 & 15 & 32 & 0.00 & 29.02 & 30.48 & NNW & 7.3 & 17.2 & 14.28 & 54.7 & 54.7 & 59 & 51 \\
\hline 19 & 66 & 30 & 48.3 & 22.5 & 17 & 0 & 57 & 17 & 38 & 0.00 & 28.79 & 30.24 & SSE & 12.6 & 28.6 & 13.13 & 53.5 & 52.9 & 57 & 49 \\
\hline 20 & 77 & 40 & 56.5 & 33.1 & 7 & 0 & 71 & 20 & 45 & 0.00 & 28.51 & 29.96 & ESE & 8.8 & 17.3 & 13.25 & 55.2 & 56.0 & 62 & 51 \\
\hline 21 & 65 & 36 & 52.2 & 30.7 & 14 & 0 & 64 & 22 & 46 & 0.00 & 28.76 & 30.22 & N & 12.8 & 31.1 & 8.77 & 55.9 & 56.8 & 59 & 54 \\
\hline 22 & 70 & 28 & 47.0 & 27.0 & 16 & 0 & 81 & 21 & 51 & 0.00 & 28.82 & 30.28 & SW & 7.9 & 23.7 & 13.61 & 53.9 & 53.5 & 59 & 49 \\
\hline 23 & 75 & 32 & 55.3 & 29.3 & 12 & 0 & 73 & 17 & 41 & 0.00 & 28.54 & 29.99 & S & 12.6 & 33.5 & 13.39 & 54.3 & 54.4 & 59 & 49 \\
\hline 24 & 69 & 49 & 58.8 & 37.0 & 6 & 0 & & 25 & 45 & 0.00 & 28.46 & 29.90 & SSE & 13.8 & 35.1 & 4.55 & 55.9 & 56.9 & 59 & 55 \\
\hline 25 & 54 & 29 & 43.3 & 21.8 & 23 & 0 & 61 & 23 & 44 & 0.00 & 28.95 & 30.42 & N & 14.2 & 36.7 & 13.24 & 53.6 & 54.0 & 57 & 51 \\
\hline 26 & 70 & 24 & 45.4 & 18.0 & 18 & 0 & 70 & 15 & 38 & 0.00 & 28.75 & 30.21 & SSW & 8.3 & 24.3 & 13.35 & 51.9 & 50.8 & 56 & 46 \\
\hline 27 & 65 & 39 & 50.5 & 22.7 & 13 & 0 & & 20 & 35 & 0.00 & 28.58 & 30.03 & SE & 5.7 & 13.6 & 7.51 & 53.1 & 52.7 & 56 & 50 \\
\hline 28 & 64 & 31 & 49.1 & 27.2 & 17 & 0 & 71 & 24 & 44 & 0.00 & 28.78 & 30.24 & SSE & 6.6 & 19.4 & 12.96 & 53.0 & 53.0 & 58 & 48 \\
\hline 29 & 78 & 34 & 53.5 & 31.0 & 9 & 0 & 72 & 18 & 47 & 0.00 & 28.62 & 30.07 & SSW & 6.3 & 14.0 & 12.86 & 53.4 & 53.6 & 59 & 48 \\
\hline 30 & 80 & 36 & 55.6 & 35.3 & 7 & 0 & & 20 & 51 & 0.00 & 28.54 & 29.99 & S & 6.3 & 18.5 & 12.86 & 54.8 & 55.4 & 61 & 50 \\
\hline & 68* & 38* & 52.4 * & 34.0* & & M & hly & Aver & ges & & 28.68* & 30.13* & SE * & 9.5* & 38.1* & 12.39* & 56.4* & * 56.7* & \(61 *\) & 53* \\
\hline \multicolumn{7}{|l|}{\multirow[t]{2}{*}{Temperature - Highest: 89*}} & \multicolumn{6}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{rrr} 
Degree Days - Total HDD: & \(354 *\) \\
Total CDD: & \(0 *\)
\end{tabular}}} & \multicolumn{8}{|l|}{\multirow[t]{2}{*}{}} \\
\hline & & & & & & & & & & & & & & & & & & & & \\
\hline \multicolumn{7}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{lll} 
Rainfall: & Monthly Total: \(0.11 *\) in. \\
& Greatest \(24 \mathrm{Hr}:\) & \(0.10 *\) in.
\end{tabular}}} & \multicolumn{4}{|l|}{\multirow[t]{2}{*}{Humidity - Highest:}} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\[
\begin{aligned}
& 99 * \\
& 12 *
\end{aligned}
\]}} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\[
\begin{aligned}
& \operatorname{Tmax}<32: \\
& \operatorname{Tmin}<32: \\
& \operatorname{Tmin}<0:
\end{aligned}
\]}} & \multirow[t]{2}{*}{\[
\begin{aligned}
& 0 * \\
& 7 * \\
& 0 *
\end{aligned}
\]} & \multirow[t]{2}{*}{Avg Wind Max Wind} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{Speed \(\geq 10 \mathrm{mph}\)}} & \multicolumn{2}{|l|}{\[
: \quad 13 *
\]} \\
\hline & & & & & & & & & & & & & & & & & & & & 9* \\
\hline
\end{tabular}


\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline \multicolumn{7}{|l|}{\begin{tabular}{l}
MESONET CLIMATOLOGICAL DATA SUMMARY (ALTU) Altus \\
Latitude: 34-35-13
\end{tabular}} & \multicolumn{5}{|l|}{\begin{tabular}{ll} 
February & 2022 \\
Nearest City: 3.0 \\
Longitude: \\
& \\
\hline\(-20-17\)
\end{tabular}} & \multicolumn{3}{|l|}{Altus} & \multicolumn{6}{|l|}{\begin{tabular}{l}
Time Zone: Midnight-Midnight CST County: Jackson \\
Elevation: 1365 feet
\end{tabular}} \\
\hline & & MPER & TURE & F) & DEG D & & HUMID & ITY & & RAIN & PRESSU & E (in) & WIND & SPEED & (mph) & SOLAR & 4 " & IL TEMPE & ERA & URES \\
\hline DAY & MAX & MIN & AVG & DEWPT & HDD & & MAX & MIN & AVG & (in) & STN & MSL & DIR & AVG & MAX & ( MJ /m2) & SOD & BARE & MAX & MIN \\
\hline 1 & 65 & 41 & 51.6 & 38.9 & 12 & 0 & 97 & 22 & 67 & 0.00 & 28.34 & 29.78 & S & 15.1 & 33.3 & 10.79 & 48.6 & 49.9 & 53 & 47 \\
\hline 2 & 41 & 18 & 26.2 & 21.1 & 36 & 0 & 90 & 62 & 81 & 0.00 & 28.63 & 30.08 & NNE & 22.0 & 39.7 & 2.33 & 43.9 & 43.5 & 49 & 41 \\
\hline 3 & 18 & 14 & 16.3 & 11.5 & 49 & 0 & 88 & 74 & 81 & 0.00 & 28.86 & 30.33 & N & 19.9 & 35.1 & 7.62 & 42.1 & 39.9 & 41 & 39 \\
\hline 4 & 36 & 5 & 20.1 & 11.4 & 45 & 0 & 87 & 52 & 69 & 0.06 & 29.09 & 30.57 & WNW & 8.9 & 23.1 & 16.89 & 41.9 & 38.0 & 39 & 37 \\
\hline 5 & 44 & 12 & 28.4 & 19.4 & 37 & 0 & 94 & 41 & 71 & 0.02 & 28.87 & 30.33 & S & 9.7 & 27.2 & 17.08 & 40.9 & 37.0 & 37 & 37 \\
\hline 6 & 57 & 22 & 37.8 & 26.3 & 26 & 0 & 91 & 35 & 67 & 0.00 & 28.72 & 30.18 & NNE & 9.9 & 26.7 & 16.67 & 40.5 & 36.2 & 37 & 36 \\
\hline 7 & 58 & 23 & 38.9 & 24.7 & 24 & 0 & 90 & 24 & 62 & 0.00 & 28.90 & 30.37 & NW & 8.7 & 20.2 & 16.76 & 41.7 & 38.1 & 43 & 35 \\
\hline 8 & 69* & 26* & 44.9* & 23.1* & 17* & 0* & 78* & 16* & 48* & 0.00* & 28.66* & 30.12* & SW * & 8.1* & 27.1* & 16.63* & 43.1* & 40.7* & 47* & 36 * \\
\hline 9 & 68 & 25 & 45.2 & 20.4 & 18 & 0 & 82 & 11 & 45 & 0.00 & 28.64 & 30.09 & NW & 7.9 & 18.2 & 17.21 & 44.3 & 42.8 & 49 & 38 \\
\hline 10 & 67 & 38 & 50.5 & 26.5 & 13 & 0 & 61 & 18 & 41 & 0.00 & 28.61 & 30.06 & NNE & 7.8 & 19.4 & 14.81 & 45.9 & 45.7 & 52 & 41 \\
\hline 11 & 66 & 34 & 48.8 & 28.4 & 15 & 0 & 70 & 24 & 47 & 0.00 & 28.47 & 29.92 & NE & 13.7 & 39.8 & 16.91 & 46.3 & 46.2 & 52 & 41 \\
\hline 12 & 46 & 26 & 37.5 & 13.1 & 29 & 0 & 56 & 22 & 37 & 0.00 & 28.97 & 30.44 & NNE & 15.3 & 47.0 & 16.69 & 45.2 & 45.8 & 49 & 43 \\
\hline 13 & 62 & 20 & 41.1 & 16.6 & 24 & 0 & 70 & 16 & 42 & 0.00 & 28.89 & 30.35 & SE & 6.5 & 16.4 & 17.90 & 44.2 & 43.9 & 51 & 38 \\
\hline 14 & 71 & 29 & 49.1 & 21.0 & 15 & 0 & 63 & 15 & 37 & 0.00 & 28.69 & 30.14 & SSE & 7.7 & 20.9 & 17.97 & 45.8 & 46.6 & 53 & 41 \\
\hline 15 & 75 & 32 & 55.2 & 29.6 & 11 & 0 & 66 & 20 & 40 & 0.00 & 28.47 & 29.92 & S & 18.6 & 41.6 & 17.78 & 47.3 & 48.5 & 53 & 44 \\
\hline 16 & 82 & 50 & 63.4 & 42.7 & 0 & 1 & 90 & 10 & 54 & 0.14 & 28.27 & 29.71 & SSE & 16.1 & 55.3 & 15.64 & 50.5 & 52.7 & 58 & 49 \\
\hline 17 & 54 & 25 & 33.3 & 27.1 & 26 & 0 & 94 & 65 & 78 & 0.39 & NA & NA & N & 19.7 & 45.3 & 8.86 & 48.0 & 46.6 & 55 & 41 \\
\hline 18 & 52 & 22 & 35.1 & 26.1 & 28 & 0 & 93 & 38 & 73 & 0.00 & NA & NA & SSW & 7.1 & 20.5 & 18.74 & 44.4 & 42.3 & 47 & 38 \\
\hline 19 & 64 & 27 & 43.8 & 28.0 & 20 & 0 & 93 & 23 & 60 & 0.00 & 28.83 & 30.29 & SSE & 7.3 & 23.5 & 19.09 & 45.6 & 44.8 & 52 & 39 \\
\hline 20 & 77 & 35 & 54.0 & 28.9 & 9 & 0 & 72 & 15 & 43 & 0.00 & 28.48 & 29.93 & SSE & 15.0 & 30.2 & 17.68 & 47.1 & 47.4 & 54 & 42 \\
\hline 21 & 79 & 43 & 59.2 & 39.3 & 4 & 0 & 84 & 12 & 54 & 0.00 & 28.27 & 29.71 & S & 13.1 & 45.9 & 11.30 & 49.2 & 50.7 & 55 & 47 \\
\hline 22 & 60 & 19 & 30.4 & 11.7 & 26 & 0 & 89 & 30 & 47 & 0.00 & 28.67 & 30.12 & NNE & 19.6 & 42.5 & 19.17 & 46.7 & 47.3 & 53 & 43 \\
\hline 23 & 23 & 14 & 17.7 & 7.2 & 46 & 0 & 79 & 40 & 64 & 0.00 & 28.91 & 30.38 & NNE & 16.7 & 33.4 & 7.57 & 41.3 & 38.8 & 43 & 37 \\
\hline 24 & 27 & 17 & 21.6 & 17.8 & 43 & 0 & 92 & 73 & 85 & 0.00 & 28.79 & 30.25 & NNE & 7.2 & 16.7 & 9.05 & 38.7 & 35.8 & 37 & 35 \\
\hline 25 & 32 & 16 & 23.9 & 15.5 & 41 & 0 & 90 & 55 & 71 & 0.03 & 29.02 & 30.49 & NE & 7.4 & 19.2 & 17.39 & 37.8 & 35.9 & 38 & 34 \\
\hline 26 & 39 & 22 & 28.6 & 19.3 & 35 & 0 & 89 & 46 & 69 & 0.06 & 28.94 & 30.41 & NNE & 6.1 & 12.9 & 9.66 & 38.5 & 36.8 & 40 & 35 \\
\hline 27 & 55 & 19 & 36.0 & 20.6 & 28 & 0 & 89 & 19 & 60 & 0.12 & 28.93 & 30.40 & NW & 7.3 & 14.5 & 20.80 & 39.8 & 39.4 & 46 & 35 \\
\hline 28 & 64 & 26 & 44.1 & 25.8 & 20 & 0 & & 22 & 53 & 0.00 & 28.78 & 30.24 & SSE & 6.3 & 16.4 & 15.75 & 42.3 & 42.2 & 47 & 37 \\
\hline & 55* & 25* & 38.7* & 22.9* & & M & thly & Aver & ages & & 28.72* & 30.18* & NNE* & 11.7* & 55.3* & 14.81* & 44.0* & 43.0* & 47 & 40 * \\
\hline \multicolumn{7}{|l|}{\multirow[t]{2}{*}{\[
\begin{array}{cr}
\hline \text { Temperature - } & \text { Highest: } \\
& \text { Lowest: }
\end{array} \text { 5* }
\]}} & \multicolumn{6}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{rr} 
Degree Days - Total HDD: & \(695 *\) \\
Total CDD: & \(1 *\)
\end{tabular}}} & \multicolumn{8}{|l|}{\multirow[t]{3}{*}{\begin{tabular}{lccll} 
Number of & Days & With: & & \\
Tmax \(\geq 90:\) & \(0 *\) & Rainfall \(\geq 0.01\) & inch: & \(7 *\) \\
Tmax \(\leq 32:\) & \(4^{*}\) & Rainfall \(\geq 0.10\) inch: & \(3 *\)
\end{tabular}}} \\
\hline & & & & & & & & & & & & & & & & & & & & \\
\hline \multicolumn{5}{|l|}{\multirow[t]{2}{*}{Rainfall: \begin{tabular}{rl} 
Monthly Total: \\
& Greatest \(24 \mathrm{Hr}:\)
\end{tabular}}} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\[
\begin{aligned}
& 0.82 * \text { in. } \\
& 0.39 * \text { in. }
\end{aligned}
\]}} & \multicolumn{4}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{l}
Humidity - Highest: \\
Lowest:
\end{tabular}}} & \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\[
\begin{aligned}
& 97 * \\
& 10 \text { * }
\end{aligned}
\]}} & & & & & & & & \\
\hline & & & & & & & & & & & & & \multicolumn{2}{|l|}{\[
\begin{aligned}
& \operatorname{Tmax} \leq 32: \\
& \operatorname{Tmin} \leq 32: \\
& \operatorname{Tmin} \leq 0:
\end{aligned}
\]} & \[
22 \text { * }
\]
\[
0 \text { * }
\] & Avg Wind Max Wind & \multicolumn{2}{|l|}{\begin{tabular}{l}
Speed \(\geq 10 \mathrm{mph}\) : \\
Speed \(\geq 30 \mathrm{mph}\) :
\end{tabular}} & \multicolumn{2}{|l|}{\[
\begin{array}{ll}
: & 12 * \\
: & 12 *
\end{array}
\]} \\
\hline
\end{tabular}


\section*{APPENDIX 5}

\section*{2021BORING AND PIEZOMETER LOGS}






\section*{APPENDIX 6}

\section*{OWRB MULTI-PURPOSE WELL COMPLETION AND PLUGGING REPORTS}


\title{
MULTI-PURPOSE WELL COMPLETION \& PLUGGING REPORT
}

\author{
Oklahoma Water Resources Board 3800 North Classen Boulevard Oklahoma City, OK 73118 \\ Telephone (405) 530-8800
}


County Jackson
Variance Request No. (if applicable) \(n / a\)
WELL OWNER - NAME AND ADDRESS
Well Owner Altus Landfill
Address/City/State Altus OK
Finding Location \(\qquad\)
Well Name B21-1 B21-5
TYPE OF WORK: Geotechnical Boring_

Phone \(\qquad\)
Zip \(\qquad\)

Water Rights \#: \(\qquad\)
USE OF WELL: Soil Evaluation

\section*{NEW WELL CONSTRUCTION DATA}

Date Well or Boring Was Completed 03/09/2021
Number of wells or borings represented by this \(\log \underline{2}\)
* (Borings are within the same 10 acre-tract and with the same general depths and lithologies)

Hole Diameter \(\underline{43}\) inches to a depth of \(\underline{43} \mathrm{ft}\).

CASING INFORMATION *Note: If surface casing is used please indicate that on the appropriate well casing information line.
Surface Pipe Material: \(\qquad\) Surface Pipe Diameter \(\qquad\) inches Surface Pipe From \(\qquad\) ft to \(\qquad\) ft

\section*{SCREEN OR PERFORATION INFORMATION}

\section*{FILTER PACK INFORMATION}

Filter Pack Material: \(\qquad\)

\section*{WELL SEAL INFORMATION}

Type of Surface Seal n/a
Type of Annular Seal n/a
Filter Pack Seal Material n/a
\[
\begin{aligned}
& \text { Surface Seal Interval: From } \frac{\mathrm{n} / \mathrm{a}}{\mathrm{ft}} \text { to } \underline{\mathrm{n} / \mathrm{a}} \mathrm{ft} \\
& \text { Annular Seal Interval: From } \underline{\mathrm{n} / \mathrm{a}} \mathrm{ft} \text { to } \xlongequal[\mathrm{n} / \mathrm{a}]{\mathrm{ft}} \\
& \text { Filter Pack Seal Interval: From } \frac{\mathrm{n} / \mathrm{a}}{\mathrm{ft}} \text { to } \mathrm{n} / \mathrm{a} \mathrm{ft}
\end{aligned}
\]

\section*{TYPE OF COMPLETION:}
\(\qquad\)

\section*{HYDROLOGIC INFORMATION}

Depth to water at time of drilling 40 ft
Estimated yield of well 1 gm
First water zone \(\underline{40} \mathrm{ft}\)

\section*{LITHOLOGY DESCRIPTION}
\begin{tabular}{|l|r|r|c|}
\hline \multirow{2}{*}{\multicolumn{1}{|c|}{ MATERIAL }} & \multicolumn{2}{|c|}{ ENCOUNTERED } & \multirow{2}{*}{} \\
\cline { 2 - 3 } & \multicolumn{2}{|c|}{\begin{tabular}{c} 
FROM \\
(ft.)
\end{tabular}} & \begin{tabular}{c} 
TO \\
(ft.)
\end{tabular} \\
SATURATED \\
\hline red brown grey shale & 0 & 18 & N \\
\hline white gypsum & 18 & 32.5 & N \\
\hline red brown grey shale & 32.5 & 43 & Y \\
\hline
\end{tabular}

\section*{WELL LOCATION TO POTENTIAL SOURCES OF POLLUTION}

Has this well been disinfected after completion of work? \(\mathrm{n} / \mathrm{a}\)
Are than any potential sources of pollution or wastewater lagoons within 300 ft . of the well? \(\mathrm{n} / \mathrm{a}\)
Distance of Well is \(n / \mathrm{a}\) from possible source. Type of possible source: \(\underline{n} / \mathrm{a}\)

\section*{PLUGGING INFORMATION}

Date Well or Boring Was Plugged 03/10/2021
Total Depth of well being plugged \(\underline{10} \mathrm{ft}\).
Was the well contaminated or was it plugged as though it was contaminated? No
If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? No
Was the grout tremied? No
Backfilled with Native Materials \(\quad\) Backfilled from \(\underline{14} \mathrm{ft}\) to \(\underline{43} \mathrm{ft}\).
Grouted with Bentonite - Hole Plug_
Grouted with Cement
Grouted from \(\underline{4 \mathrm{ft} . \text { to } \underline{14} \mathrm{ft} \text {. } \mathrm{f} \text {. } \mathrm{fl}}\)
Grouted from __ft. to __ft.
\begin{tabular}{lll} 
Firm Name STANDARD TESTING AND ENGINEERING & & D/PC No. DPC-0244 \\
Operator Name JOHNNY JARMAN & & OP No, OP-1364
\end{tabular}

Operator Name JOHNNY JARMAN
Date 03/22/2021
Comments: brings were continuous sampled to a depth of 43 . bore hole was left open for 24 water level, bore was backfilled with clean cuttings to 14 feet then bent hole plug from 14 to 4 feet then clean cuttings to surface.


\title{
MULTI-PURPOSE WELL COMPLETION \& PLUGGING REPORT
}

\author{
Oklahoma Water Resources Board 3800 North Classen Boulevard Oklahoma City, OK 73118 \\ Telephone (405) 530-8800
}


County Jackson
Variance Request No. (if applicable) \(n / a\)
WELL OWNER - NAME AND ADDRESS
Well Owner Altus landfill
Address/City/State OK
Finding Location \(\qquad\)
Well Name BPZ21-2
TYPE OF WORK: Monitoring Well
WELL ID NUMBER:
\(\underline{205039}\)

Quarters SE-NW-NE Section 11 Township 02N Range 22WI Latitude 34.6642167 Longitude \(\begin{aligned} & \text {-99.4790167 }\end{aligned}\)

Date collected(latitude and longitude), if different from date the well was drilled: 03/10/2021 Method latitude and longitude was collected: GPS - corrected data (WAAS)_

\section*{NEW WELL CONSTRUCTION DATA}

Date Well or Boring Was Completed 03/10/2021
Number of wells or borings represented by this log 1
* (Borings are within the same 10 acre-tract and with the same general depths and lithologies)

Hole Diameter \(7 \underline{7}\) inches to a depth of \(\underline{40} \mathrm{ft}\).

CASING INFORMATION *Note: If surface casing is used please indicate that on the appropriate well casing information line.
Surface Pipe Material: \(\underline{\text { PVC / Plastic }}\) Surface Pipe Diameter \(\underline{2}^{2}\) inches Surface Pipe From \(\underline{0} \mathrm{ft}\) to \(\underline{35} \mathrm{ft}\)
1) Well Casing Material PVC_Casing Diameter \(\underline{2}\) inches Casing From \(\underline{30} \mathrm{ft}\) to \(\underline{40} \mathrm{ft}\)

\section*{SCREEN OR PERFORATION INFORMATION}

Type of Screen: PVC Type of Slots or Openings: Factory Slotted - 10 slot \((\underline{0.010 \text { inch }) ~ F r o m ~} \underline{30} \mathrm{ft}\) to \(\underline{40} \mathrm{ft}\).

\section*{FILTER PACK INFORMATION}

Filter Pack Material: Sand 20-40 (medium)_
Filter Pack Interval: \(\quad\) From \(\underline{26} \mathrm{ft}\) to \(\underline{40}\)

\section*{WELL SEAL INFORMATION}

Type of Surface Seal Bentonite - Hole Plug_
Type of Annular Seal Bentonite/Cement Grout Filter Pack Seal Material Cement Grout

Surface Seal Interval: From \(\underline{22} \mathrm{ft}\) to \(\underline{26 \mathrm{ft}}\)
Annular Seal Interval: From \(\underline{2} \mathrm{ft}\) to \(\underline{22 \mathrm{ft}}\)
Filter Pack Seal Interval: From \(\underline{0} \mathrm{ft}\) to \(\underline{2} \mathrm{ft}\)

TYPE OF COMPLETION: Above Ground

\section*{HYDROLOGIC INFORMATION}

Depth to water at time of drilling \(\quad \mathbf{3 5} \mathrm{ft}\)
Estimated yield of well 1 gpm
First water zone \(\qquad\) _ft

\section*{LITHOLOGY DESCRIPTION}
\begin{tabular}{|l|r|r|c|}
\hline \multirow{2}{*}{\multicolumn{2}{|c|}{ MATERIAL }} & \multicolumn{2}{|c|}{ ENCOUNTERED } \\
\multirow{2}{*}{ SATURATED } \\
\cline { 2 - 3 } & \begin{tabular}{c} 
FROM \\
(ft.)
\end{tabular} & \begin{tabular}{c} 
TO \\
(ft.)
\end{tabular} & \\
\hline red brown shale & 0 & 18 & N \\
\hline white gypsum & 18 & 32 & N \\
\hline red brown grey shale & 32 & 40 & Y \\
\hline
\end{tabular}

\section*{WELL LOCATION TO POTENTIAL SOURCES OF POLLUTION}

Has this well been disinfected after completion of work? n/a
Are than any potential sources of pollution or wastewater lagoons within 300 ft . of the well? \(\mathrm{n} / \mathrm{a}\)
Distance of Well is \(n / a\) from possible source. Type of possible source: \(\underline{n} / \mathrm{a}\)

\section*{PLUGGING INFORMATION}

Date Well or Boring Was Plugged n/a
Total Depth of well being plugged __f.
Was the well contaminated or was it plugged as though it was contaminated? \(\mathrm{n} / \mathrm{a}\)
If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? \(\mathrm{n} / \mathrm{a}\)
Was the grout tremied? \(\mathrm{n} / \mathrm{a}\)
Backfilled with \(\mathrm{n} / \mathrm{a}\)
Backfilled from ___ft. to ___ ft.
Grouted with \(\mathrm{n} / \mathrm{a}\)
Grouted with Cement
Grouted from __ ft. to __ ft .
Grouted from __f. to __ft.

Firm Name STANDARD TESTING AND ENGINEERING
Operator Name JOHNNY JARMAN
Date 03/22/2021
Comments: bore was continuous sampled to 40 feet .then installed a 2 inch monitor well with concrete pad and 2 protective bollards


\title{
MULTI-PURPOSE WELL COMPLETION \& PLUGGING REPORT
}

\author{
Oklahoma Water Resources Board 3800 North Classen Boulevard Oklahoma City, OK 73118 \\ Telephone (405) 530-8800
}


County Jackson
Variance Request No. (if applicable) \(n / a\)
WELL OWNER - NAME AND ADDRESS
Well Owner Altus landfill
Address/City/State OK
Finding Location \(\qquad\)
Well Name BPZ21-3
TYPE OF WORK: Monitoring Well
Phone \(\qquad\)

Quarters NE-SW-NE Section 11 Township 02N Range 22WI Latitude 34.6622 Longitude \(\begin{aligned} & -99.4787167\end{aligned}\)

Date collected(latitude and longitude), if different from date the well was drilled: 03/10/2021 Method latitude and longitude was collected: GPS - corrected data (WAAS)_

\section*{NEW WELL CONSTRUCTION DATA}

Date Well or Boring Was Completed 03/10/2021
Number of wells or borings represented by this \(\log \underline{1}\)
* (Borings are within the same 10 acre-tract and with the same general depths and lithologies)

Hole Diameter \(7 \underline{\text { inches }}\) to a depth of \(\underline{37} \mathrm{ft}\).

CASING INFORMATION *Note: If surface casing is used please indicate that on the appropriate well casing information line.
Surface Pipe Material: \(\underline{\text { PVC / Plastic }}\) Surface Pipe Diameter \(\__{2}\) inches Surface Pipe From \(\underline{0} \mathrm{ft}\) to \(\underline{37} \mathrm{ft}\)


\section*{SCREEN OR PERFORATION INFORMATION}

Type of Screen: \(\underline{\text { PVC }}\) Type of Slots or Openings: Factory Slotted - 10 slot \((\underline{0.010 \text { inch }) ~ F r o m ~} \underline{27} \mathrm{ft}\) to \(\underline{37} \mathrm{ft}\).

\section*{FILTER PACK INFORMATION}

Filter Pack Material: Sand 20-40 (medium)_
Filter Pack Interval: \(\quad\) From \(\underline{22} \mathrm{ft}\) to \(\underline{37}\)

\section*{WELL SEAL INFORMATION}

Type of Surface Seal Bentonite - Hole Plug_
Type of Annular Seal Bentonite/Cement Grout Filter Pack Seal Material Other

Surface Seal Interval: From \(\underline{16} \mathrm{ft}\) to \(\underline{22} \mathrm{ft}\)
Annular Seal Interval: From \(\underline{2} \mathrm{ft}\) to \(\underline{16 \mathrm{ft}}\)
Filter Pack Seal Interval: From \(\underline{0} \mathrm{ft}\) to \(\underline{2} \mathrm{ft}\)

TYPE OF COMPLETION: Above Ground

\section*{HYDROLOGIC INFORMATION}

Depth to water at time of drilling \(\quad 32 \mathrm{ft}\)
Estimated yield of well 1 gpm
First water zone \(\qquad\) _ft

\section*{LITHOLOGY DESCRIPTION}
\begin{tabular}{|l|r|r|c|}
\hline \multirow{2}{*}{\multicolumn{1}{|c|}{ MATERIAL }} & \multicolumn{2}{|c|}{ ENCOUNTERED } & \multirow{2}{*}{ SATURATED } \\
\cline { 2 - 3 } & \begin{tabular}{c} 
FROM \\
(ft.)
\end{tabular} & \begin{tabular}{c} 
TO \\
(ft.)
\end{tabular} & \\
\hline Brown clay & 0 & 15 & N \\
\hline gypsum wth innerbedded shale & 15 & 32 & Y \\
\hline red brown shale & 32 & 37 & N \\
\hline
\end{tabular}

\section*{WELL LOCATION TO POTENTIAL SOURCES OF POLLUTION}

Has this well been disinfected after completion of work? n/a
Are than any potential sources of pollution or wastewater lagoons within 300 ft . of the well? \(\mathrm{n} / \mathrm{a}\)
Distance of Well is \(n / a\) from possible source. Type of possible source: \(\underline{n} / \mathrm{a}\)

\section*{PLUGGING INFORMATION}

Date Well or Boring Was Plugged n/a
Total Depth of well being plugged __f.
Was the well contaminated or was it plugged as though it was contaminated? \(\mathrm{n} / \mathrm{a}\)
If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? \(\mathrm{n} / \mathrm{a}\)
Was the grout tremied? \(\mathrm{n} / \mathrm{a}\)
Backfilled with \(\mathrm{n} / \mathrm{a}\)
Backfilled from ___ft. to ___ ft.
Grouted with \(\mathrm{n} / \mathrm{a}\)
Grouted from __ft to __ft.
Grouted with Cement
Grouted from __f. to __ft.

Firm Name STANDARD TESTING AND ENGINEERING
Operator Name JOHNNY JARMAN
Date 03/22/2021
Comments: bore was continuous sampled to 37 feet.then a 2 inch pve well was installed with concrete well pad and 2 protective bollards.


\title{
MULTI-PURPOSE WELL COMPLETION \& PLUGGING REPORT
}

\author{
Oklahoma Water Resources Board 3800 North Classen Boulevard Oklahoma City, OK 73118 \\ Telephone (405) 530-8800
}


County Jackson
Variance Request No. (if applicable) n/a

\section*{WELL OWNER - NAME AND ADDRESS}

Well Owner Altus landfill
Address/City/State OK
Finding Location \(\qquad\)
Well Name BPZ21-4
TYPE OF WORK: Monitoring Well
Section 11
Township \(\underline{02 N}\)
Range 22WI
Quarters NE-SW-NE

Longitude -99.4786667
Latitude 34.6621667 Longitude \(\underline{-99.4786667}\)

Date collected(latitude and longitude), if different from date the well was drilled: 03/10/2021 Method latitude and longitude was collected: GPS - corrected data (WAAS)_

\section*{NEW WELL CONSTRUCTION DATA}

Date Well or Boring Was Completed 03/10/2021
Number of wells or borings represented by this \(\log 1\)
* (Borings are within the same 10 acre-tract and with the same general depths and lithologies)

Hole Diameter 7 inches to a depth of \(\underline{50} \mathrm{ft}\).

CASING INFORMATION *Note: If surface casing is used please indicate that on the appropriate well casing information line.
Surface Pipe Material: \(\underline{\text { PVC / Plastic }}\) Surface Pipe Diameter \(\underline{2}^{2}\) inches Surface Pipe From \(\underline{0} \mathrm{ft}\) to \(\underline{40} \mathrm{ft}\)
1) Well Casing Material PVC Casing Diameter \(\underline{2}\) inches Casing From \(\underline{40} \mathrm{ft}\) to \(\underline{50} \mathrm{ft}\)

\section*{SCREEN OR PERFORATION INFORMATION}

Type of Screen: PVC Type of Slots or Openings: Factory Slotted - 10 slot \((\underline{0.010 \text { inch }) ~ F r o m ~} \underline{40} \mathrm{ft}\) to \(\underline{50} \mathrm{ft}\).

\section*{FILTER PACK INFORMATION}

Filter Pack Material: Sand 20-40 (medium)_
Filter Pack Interval: \(\quad\) From \(\underline{40} \mathrm{ft}\) to \(\underline{50}\)

\section*{WELL SEAL INFORMATION}

Type of Surface Seal Bentonite - Hole Plug_
Type of Annular Seal Bentonite/Cement Grout Filter Pack Seal Material Cement Grout

Surface Seal Interval: From 31 ft to \(\underline{38 \mathrm{ft}}\)
Annular Seal Interval: From 2 ft to \(\underline{31 \mathrm{ft}}\)
Filter Pack Seal Interval: From \(\underline{0} \mathrm{ft}\) to \(\underline{2} \mathrm{ft}\)

TYPE OF COMPLETION: Above Ground

\section*{HYDROLOGIC INFORMATION}

Depth to water at time of drilling \(\underline{45} \mathrm{ft}\)
Estimated yield of well 1 gpm
First water zone \(\qquad\) _ft

\section*{LITHOLOGY DESCRIPTION}
\begin{tabular}{|c|c|c|c|}
\hline \multirow[b]{2}{*}{MATERIAL} & \multicolumn{2}{|l|}{ENCOUNTERED} & \multirow[b]{2}{*}{SATURATED} \\
\hline & \begin{tabular}{l}
FROM \\
(ft.)
\end{tabular} & \[
\begin{aligned}
& \text { TO } \\
& \text { (ft.) }
\end{aligned}
\] & \\
\hline red brown grey shale & 0 & 26.5 & N \\
\hline white gypsum & 26.5 & 41 & N \\
\hline red brown grey shale & 41 & 50 & Y \\
\hline
\end{tabular}

\section*{WELL LOCATION TO POTENTIAL SOURCES OF POLLUTION}

Has this well been disinfected after completion of work? n/a
Are than any potential sources of pollution or wastewater lagoons within 300 ft . of the well? \(\mathrm{n} / \mathrm{a}\)
Distance of Well is \(n / a\) from possible source. Type of possible source: \(\underline{n} / \mathrm{a}\)

\section*{PLUGGING INFORMATION}

Date Well or Boring Was Plugged n/a
Total Depth of well being plugged __f.
Was the well contaminated or was it plugged as though it was contaminated? \(\mathrm{n} / \mathrm{a}\)
If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? \(\mathrm{n} / \mathrm{a}\)
Was the grout tremied? \(\mathrm{n} / \mathrm{a}\)
Backfilled with \(\mathrm{n} / \mathrm{a}\)
Backfilled from ___ft. to ___ ft.
Grouted with \(\mathrm{n} / \mathrm{a}\)
Grouted from __ft to __ft.
Grouted with Cement
Grouted from __f. to __ft.

Firm Name STANDARD TESTING AND ENGINEERING
Operator Name JOHNNY JARMAN
Date 03/22/2021
Comments: bore was continuous sampled to 50 foot then a 2 inch monitor well was installed with concrete pad and 2 protective bollards.

\section*{APPENDIX 7}

\section*{AS-BUILT SURVEY INFORMATION}
As Built Gas Monitoring Probe Survey Data
City of Altus Landfill


\section*{APPENDIX 8}

\section*{GEOPHYSICAL LOGS}


1:60, GAMMA - NEUTRON api BPZ21-2 04/15/21

LOG PARAMETERS
MATRIX DENSITY: 2.65 NEUTRON MATRIX : SANDSTONE MATRIX DELTA T : 54 MAGNETIC DECL: 0 ELECT. CUTOFF : 99999 BIT SIZE :6.25 IN
PRESENTATION : 9067_1-60_Gamma - Neutron_api linear scale_AltusDISPLAY7_JL614/17/2021



MATRIX DENSITY : 2.65
MAGNETIC DECL : 0
MAGNETIC DECL: O ELECT. CUTOFF : 99999
PRESENTATION: 0067 100 ELECT. CUTOFF : 99999


,60, GAMMA - NEUTRON api BPZ21-3 04/15/21

LOG PARAMETERS
- MATRIX DENSITY: 2.65 NEUTRON MATRIX : SANDSTONE MATRIX DELTA T : 54 MAGNETIC DECL: 0 ELECT. CUTOFF : 99999 BIT SIZE :6.25 IN
PRESENTATION : 9067_1-60_Gamma - Neutron_api linear scale_AltusDISPLAY7 JL614/17/2021

\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & \multicolumn{4}{|l|}{TOOL CALIBRATION BPZ21-3 04/15/21 12:40 TOOL 9067A TM VERSION 2002 SERIAL NUMBER 529} & \multicolumn{2}{|l|}{STANDARD} & \multicolumn{2}{|l|}{RESPONSE [CPS]} \\
\hline & DATE & TIME & SENSOR & & Point1 & Point2 & Point1 & Point2 \\
\hline 1 & Apr14,21 & 13:11:00 & GAMMA & [API-GR] & 1.000 & 340.000 & 0.000 & 100.000 \\
\hline 2 & Apr14,21 & 13:11:10 & NEUTRON & [CPS] & Default & 271.000 & Default & 52.000 \\
\hline
\end{tabular}


1:60, GAMMA - NEUTRON api BPZ21-4 04/15/21
LOG PARAMETERS
- MATRIX DENSITY : 2.65 NEUTRON MATRIX: SANDSTONE MATRIX DELTA T: 54 MAGNETIC DECL: 0 ELECT. CUTOFF : 99999 BIT SIZE : 6.25 IN
PRESENTATION : 9067_1-60_Gamma - Neutron_api linear scale_AltusDISPLAY7_JL614/17/2021


1:60, GAMMA - NEUTRON api BPZ21-4 04/15/21
LOG PARAMETERS
\(\begin{array}{lll}\text { MATRIX DENSITY : } 2.65 & \text { NEUTRON MATRIX: SANDSTONE } & \text { MATRIX DELTA T: } 54 \\ \text { MAGNETIC DECL:0 } & \text { ELECT. CUTOFF : } 99999 & \text { BIT SIZE }: 6.25\end{array}\)
PRESENTATION : 9067_1-60_Gamma - Neutron_api linear scale_AltusDISPLAY7_JL614/17/2021
\begin{tabular}{||lllllll||}
\hline \hline \multicolumn{9}{|l|}{ TOOL CALIBRATION BPZ21-4 04/15/21 10:48 } & & & & \\
& TOOL 9067A & TM VERSION 2002 & & STANDARD & RESPONSE [CPS] \\
& SERIAL NUMBER & 529 & & Point1 & Point2 & Point1 \\
& DATE & TIME & SENSOR & & 1.000 & 340.000 \\
1 & Apr14,21 & \(13: 11: 00\) & GAMMA & [API-GR] & 0.000 & 100.000 \\
2 & Apr14,21 & 13:11:10 & NEUTRON & [CPS] & Default & 271.000 \\
Default & 52.000 \\
\hline
\end{tabular}


1:60, GAMMA - NEUTRON api PZ20-1 04/15/21
LOG PARAMETERS
- MATRIX DENSITY: 2.65 NEUTRON MATRIX: SANDSTONE MATRIX DELTA T : 54 MAGNETIC DECL: 0 ELECT. CUTOFF : 99999 BIT SIZE : 6.25 IN
PRESENTATION : 9067_1-60_Gamma - Neutron_api linear scale_AltusDISPLAY7_JL614/17/2021

MATRIX DENSITY: 2.65
MAGNETIC DECL : 0
LOG PARAMETERS
PRESENTATION : 9067 _1-60 ELECT. CUTOFF : 99999 BIT SIZE \(: 6.25\)
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline & \multicolumn{4}{|l|}{TOOL CALIBRATION PZ2O-1 04/15/21 13:19 TOOL 9067A TM VERSION 2002 SERIAL NUMBER 529} & \multicolumn{2}{|l|}{STANDARD} & \multicolumn{2}{|l|}{RESPONSE [CPS]} \\
\hline & date & time & SENSOR & & Point1 & Point2 & Point1 & Point2 \\
\hline 1 & Apr14,21 & 13:11:00 & GAMMA & [API-GR] & 1.000 & 340.000 & 0.000 & 100.000 \\
\hline 2 & Apr14,21 & 13:11:10 & NEUTRON & [CPS] & Default & 271.000 & Default & 52.000 \\
\hline
\end{tabular}

\section*{APPENDIX 9}

\section*{PIEZOMETER HYDROGRAPHS}
Appendix 9
Monthly Hydrographs Piezometers and Monitor Wells


\section*{APPENDIX 10}

\section*{BPZ21-2 DAILY WATER LEVEL HYDROGRAPH WITH PRECIPITATION INFORMATION}


\section*{APPENDIX 11}

\section*{SLUG TEST RESULTS}


\section*{TEST 1 - SLUG IN}

Data Set: R:\OKLAHOMA\Altus\2021\Subsurface Investigation\Slug Tests\April Prelim\Bpz21-2 T1.aqt Date: 02/24/22 Time: 09:51:54

\section*{PROJECT INFORMATION}

Company: The Carel Corporation
Client: City of Altus Landfill
Project: 21-04-20
Location: Altus, OK
Test Well: BPZ21-2
Test Date: \(\underline{6 / 12 / 2021}\)

\section*{AQUIFER DATA}

Saturated Thickness: \(\underline{12.84 \mathrm{ft}}\)
Anisotropy Ratio (Kz/Kr): 1.
WELL DATA (BPZ21-2)

Initial Displacement: 0.8957 ft
Total Well Penetration Depth: 42.58 ft Casing Radius: 0.0861 ft

Static Water Column Height: 12.84 ft
Screen Length: 10. ft
Well Radius: \(\underline{0.29 \mathrm{ft}}\)

Aquifer Model: Unconfined
\(\mathrm{K}=\underline{3.478 \mathrm{E}-6 \mathrm{~cm} / \mathrm{sec}}\)

Solution Method: Bouwer-Rice
\(\mathrm{y} 0=\underline{0.7312} \mathrm{ft}\)


\section*{TEST 2 - SLUG OUT}

Data Set: R:IOKLAHOMA\Altus\2021\Subsurface Investigation\Slug Tests\April Prelim\Bpz21-2 T2.aqt Date: 02/24/22 Time: 09:46:32

PROJECT INFORMATION
Company: The Carel Corporation
Client: City of Altus Landfill
Project: 21-04-20
Location: Altus, OK
Test Well: BPZ21-2
Test Date: \(\overline{6 / 12 / 2021}\)

\section*{AQUIFER DATA}

Saturated Thickness: 12.81 ft
Anisotropy Ratio (Kz/Kr): 1.
WELL DATA (BPZ21-2)

Initial Displacement: 0.7992 ft
Total Well Penetration Depth: 42.58 ft Casing Radius: \(\underline{0.0861 \mathrm{ft}}\)

Static Water Column Height: 12.81 ft
Screen Length: 10. ft
Well Radius: 0.29 ft
Gravel Pack Porosity: \(\underline{0}\)

Aquifer Model: Unconfined
Solution Method: \(\underline{\text { Hvorslev }}\)
\(\mathrm{K}=\underline{3.885 \mathrm{E}-6 \mathrm{~cm} / \mathrm{sec}}\)
\(\mathrm{y} 0=\underline{0.7432} \mathrm{ft}\)


\section*{TEST 3}

Data Set: R:\OKLAHOMA\Altus\2021\Subsurface Investigation\Slug Tests\April Prelim\Bpz21-2 T3.aqt Date: 02/24/22

Time: 09:51:17

\section*{PROJECT INFORMATION}

Company: The Carel Corporation
Client: City of Altus Landfill
Project: 21-04-20
Location: Altus, OK
Test Well: BPZ21-2
Test Date: \(\underline{6 / 12 / 2021}\)

\section*{AQUIFER DATA}

Saturated Thickness: \(\underline{12.99 \mathrm{ft}}\)
Anisotropy Ratio (Kz/Kr): 1.
WELL DATA (BPZ21-2)

Initial Displacement: 0.7786 ft
Total Well Penetration Depth: 42.58 ft Casing Radius: \(\underline{0.0861 \mathrm{ft}}\)

Static Water Column Height: 12.99 ft
Screen Length: 10. ft
Well Radius: \(\underline{0.29 \mathrm{ft}}\)

Aquifer Model: Unconfined
\(\mathrm{K}=\underline{3.511 \mathrm{E}-6 \mathrm{~cm} / \mathrm{sec}}\)

Solution Method: Bouwer-Rice
\(\mathrm{y} 0=\underline{0.7223} \mathrm{ft}\)


\section*{TEST 1}

Data Set:
Date: 06/24/21

Time: 13:38:26
PROJECT INFORMATION
Company: The Carel Corporation
Client: City of Altus Landfill
Project: 21-04-20
Location: Altus, OK
Test Well: MW-8
Test Date: 6/12/2021

\section*{AQUIFER DATA}

Anisotropy Ratio (Kz/Kr): 1.
WELL DATA (MW-8)

Initial Displacement: 0.2825 ft
Total Well Penetration Depth: 34. ft Casing Radius: \(\underline{0.08612} \mathrm{ft}\)

Static Water Column Height: 6.59 ft
Screen Length: 10. ft
Well Radius: \(\underline{0.29 \mathrm{ft}}\)

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
\(\mathrm{K}=\underline{7.526 \mathrm{E}-5 \mathrm{~cm} / \mathrm{sec}}\)
\(\mathrm{y} 0=\underline{0.1747} \mathrm{ft}\)


\section*{TEST 2}

\section*{Data Set:}

Date: 06/24/21

\section*{PROJECT INFORMATION}

Company: The Carel Corporation
Client: City of Altus Landfill
Project: 21-04-20
Location: Altus, OK
Test Well: MW-8
Test Date: 6/12/2021

\section*{AQUIFER DATA}

Saturated Thickness: 6.55 ft
Anisotropy Ratio (Kz/Kr): 1.
WELL DATA (MW-8)

Initial Displacement: 0.3996 ft
Total Well Penetration Depth: 34. ft Casing Radius: \(\underline{0.08612} \mathrm{ft}\)

Static Water Column Height: 6.55 ft
Screen Length: 10. ft
Well Radius: \(\underline{0.29 \mathrm{ft}}\)

Aquifer Model: Unconfined
\(\mathrm{K}=\underline{1.79 \mathrm{E}-5 \mathrm{~cm} / \mathrm{sec}}\)

Solution Method: Bouwer-Rice
\(\mathrm{y} 0=\underline{0.1766} \mathrm{ft}\)


\section*{TEST 3}

Data Set:
Date: 06/24/21

Time: 20:07:06
PROJECT INFORMATION
Company: The Carel Corporation
Client: City of Altus Landfill
Project: 21-04-20
Location: Altus, OK
Test Well: MW-8
Test Date: 6/12/2021

\section*{AQUIFER DATA}

Anisotropy Ratio (Kz/Kr): 1.
WELL DATA (MW-8)

Initial Displacement: 0.1585 ft
Total Well Penetration Depth: 34. ft Casing Radius: \(\underline{0.08612 \mathrm{ft}}\)

Static Water Column Height: 6.53 ft
Screen Length: 10. ft
Well Radius: \(\underline{0.29 \mathrm{ft}}\)

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
\(\mathrm{K}=\underline{7.955 \mathrm{E}-5 \mathrm{~cm} / \mathrm{sec}}\)
\(\mathrm{y} 0=\underline{0.1486} \mathrm{ft}\)

\section*{APPENDIX 12}

\section*{GROUNDWATER SAMPLING AND ANALYSIS PLAN}

\title{
ALTUS MUNICIPAL LANDFILL \\ JACKSON COUNTY, OKLAHOMA MSW PERMIT NO. 3533005
}

\section*{GROUNDWATER SAMPLING AND ANALYSIS PLAN (GWSAP)}

\section*{Prepared for:}


April 2022

Prepared by:

136 Pecan Street
Keller, Texas 76248 (817) 337-0112

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\section*{Tables}

1 Background/Detection Monitoring Parameters - Altus Municipal Landfill

\section*{1 INTRODUCTION}

This Groundwater Sampling and Analysis Plan (GWSAP) has been prepared for the Altus Municipal Landfill (Oklahoma Department of Environmental Quality [ODEQ] Permit No. 3533005). The Altus Municipal Landfill is a Type I Municipal Solid Waste Disposal Facility located in the southeast corner of Section 11, Township 2 North, Range 22 West, approximately eight miles west of the City of Altus in Jackson County, Oklahoma.

The following plan is submitted as required under Oklahoma Administrative Code (OAC) 252.510 and 40 Code of Federal Regulations (CFR) Part 258. This plan covers the procedures for collecting representative samples from groundwater monitoring wells and the basic laboratory requirements for obtaining valid, defensible data. The plan is limited to sampling and analysis requirements and does not include monitoring well placement, design and construction, or well development procedures.

\section*{2 FIELD PROCEDURES}

\subsection*{2.1 Sample Event Preparation and QA/QC}

\subsection*{2.1.1 General Event Preparation}

The laboratory performing the groundwater analysis shall supply all necessary coolers, precleaned containers, trip blanks, chemical preservatives, labels, custody seals, and chain-ofcustody forms. All field data shall be entered on a Field Data Sheet, similar to the example provided in Appendix A or an equivalent form. Any changes to the monitoring plan and/or procedures need to be given to the laboratory prior to the field sampling personnel arriving on the site.

\subsection*{2.1.2 Sample Container Selection}

Each sample container needs to be constructed of materials compatible and non-reactive with the sample it is to contain. Consult Appendix B, Containerization and Preservation of Samples, to determine the number, type, and volume of appropriate containers. As noted in Section 2.1.1, the contract laboratory performing the analysis shall supply all the required containers. In special circumstances when the facility must obtain its own containers, these containers will be purchased from local container distributors with the exception of the septum vials and PTFE (e.g., Teflon \({ }^{\circledR}\) ) lined caps required for organic analyses which are available from laboratory supply companies. Metal lids shall not be utilized for any sample containers.

\subsection*{2.1.3 Sample Container Preparation}

Sample containers will be purchased as a pre-cleaned product or cleaned in the laboratory in a manner consistent with EPA protocol.

\subsection*{2.1.4 Equipment Preparation Prior to Site Arrival}

This section outlines the equipment preparation prior to site arrival for a specific monitoring event. This equipment preparation includes, at a minimum, decontamination procedures for water level indicator(s) and field parameter (temperature, pH , specific conductivity, turbidity) measurement device(s). Operation and calibration of field instruments will be performed per the manufacturer's instructions.
- Water Level Indicator(s) - Water level indicator(s) will be decontaminated prior to initial site arrival by hand washing with a laboratory grade non-phosphate detergent followed by rinsing with deionized water.
- Field Parameter (Temperature, pH , Specific Conductivity, Turbidity) Measuring Device(s) - Field parameter measuring device(s) will be decontaminated by hand washing the sample cells in a laboratory grade non-phosphate detergent followed by rinsing with deionized water. Meters will then be checked for proper calibration and operation as per the manufacturer's instructions. Any malfunctioning meters will be replaced prior to packing.

\subsection*{2.1.5 Field QA/QC Samples}

Field QA/QC samples consist of two (2) primary areas of quality control. The first area is the quality control designed to prevent sample contamination from occurring in the field and/or shipping procedures. This is monitored in the trip blank(s) and field blank(s). A basic description of each is as follows:
- Trip Blank - These samples will be prepared in the laboratory by filling the appropriate clean sample containers with organic free water and adding the applicable chemical preservative, if any, as indicated in Appendix B. These containers are to be labeled "Trip Blank", in the analyses to be performed on each container indicated, and then shipped in the typical transportation cooler to the field and back to the laboratory along with the other sample set containers for a given event. This blank is tested to detect any contamination that may occur as a result of the containers, sample coolers, cleaning procedures, or chemical preservatives used. Trip blanks will be limited to the analysis of volatile organics and shall be taken and analyzed at a minimum of one per sampling event.
- Field Blank - Field blank containers will be prepared in the field at a routine sample collection point during a monitoring event by filling the appropriate sample containers from the field supply of organic free water. This blank is tested to detect contamination that may occur as a result of the site ambient air conditions and serves as an additional check for contamination in the containers, sample transport coolers, cleaning procedures, and any chemical preservatives. Field blanks will consist of analysis of volatile organic compounds. A minimum of one field blank shall be collected each sampling day.

A second area of standard field QA/QC samples are field duplicates.
- Field Duplicates are an extra set of samples taken at a particular monitoring point, generally from a designated downgradient well, and labeled so that the laboratory is unaware at what monitoring point the sample was collected. These are independent samples which are collected as close as possible to the same point
in space and time. Field duplicates are useful in documenting the precision of the sampling and analytical process. Samples shall be collected in proper alternating order for the sample point and field duplicate for each parameter (e.g., VOA - VOA, metals - metals, etc.) Field duplicates shall be taken and analyzed at a batch minimum of one (1) per twenty (20) wells per monitoring event.

Appropriate field QA/QC documentation should be recorded on the Field Data Sheet (e.g., location where field blank and duplicate were collected).

\subsection*{2.2 Monitor Well Inspection}

Inspection of the monitoring well integrity will be performed at each sampling event by utilizing the Field Data Sheet (see Appendix A) or equivalent form. Visual problems with the monitor well integrity should be noted on the Field Data Sheet and site personnel informed. If insects are found in or on the casing, do not use organic sprays or other potential contaminants to remove them. Similarly, organic lubricants should not be used on well components such as locks.

\subsection*{2.3 Well Purge}

\subsection*{2.3.1 General Well Purge Information}

Purging a monitoring well is just as important as the subsequent sampling of the well. Water standing in a monitoring well over a certain period of time may become unrepresentative of formation water because of chemical and biochemical changes which may cause water quality alterations.

\subsection*{2.3.2 Water Level Measurement}

Prior to any purge or sampling activities at a given monitoring well, a water level measurement is required. Water level indicator equipment will be constructed of chemically inert materials and will be decontaminated at each well with a non-phosphate detergent solution followed with a deionized water rinse. Water levels will be measured with a precision of \(+/-0.01\) foot.

Each monitoring well has a reference elevation point located at the top of the well casing. This reference elevation point has been measured by a licensed surveyor in relation the Mean Sea Level (MSL). Basic procedures for water level measurement are indicated in Appendix D.

Groundwater elevations in wells which monitor the same waste management area must be measured within a twenty-four (24) hour period to avoid temporal variations in groundwater flow which could preclude accurate determination of groundwater flow rate and direction.

\subsection*{2.3.3 Well Purge Procedures}

Unless passive sampling devices are employed, groundwater wells will be purged prior to sample collection. Section 2.3.3.1 describes fixed volume purging procedures. Well purging using low-flow procedures for non-dedicated pumps or dedicated pumps, in the event they are installed, are described in Section 2.3.3.2. Passive sampling procedures are discussed in Sections 2.3.3.3 and 2.4.3.3.

\subsection*{2.3.3.1 Fixed Volume Purging}

Wells will be purged by means of either a disposable or dedicated bailer or a portable pump. Purging will be performed by removing three well-casing volumes of water from the well. Purging will be deemed complete if the well goes dry prior to removal of three well-casing volumes of water. Field parameters will be measured after each well-casing volume of water removed.

\section*{Equipment:}
- Pump/bailer
- Pump controller (if required)
- Generator or other power source/driving mechanism for pumps / appropriate disposable string or rope for bailer, downrigger (optional)
- New or dedicated disposable tubing
- New disposable gloves of appropriate material (nitrile).
- Graduated pail or another appropriate container.
- Field parameter measurement device(s)
- Container for laboratory grade, nonphosphate soap/water solution
- Container for water rinse

Operating Instructions (Specific operating instructions vary depending on the type of portable equipment used. The steps listed below are generalized procedures)
- Appropriate disposable gloves are to be worn during purging procedures.
- Cleanse portable pump/bailer with a non-phosphate, laboratory grade detergent solution followed by a water rinse.
- Attach new disposable tubing to pump or new disposable string to bailer.
- Insert pump and tubing/bailer into well.
- Start the portable pump by the appropriate method and adjust flow to desired rate / initiate removal of water from well with bailer. Ensure bailer and string do not touch ground during purging.

When purging with a bailer, introduce bailer into water column slowly (i.e., do not "drop" into water column) to avoid agitation of water in the well and immediate formation area.

Non-dedicated equipment will be constructed of chemically inert materials and will be decontaminated at each well with a non-phosphate detergent followed with a water rinse. Additional cleaning procedures will be performed as deemed necessary.

\subsection*{2.3.3.2 Low-Flow Purging}

Low-flow purging will be employed using dedicated or non-dedicated pumps. Well purging will be conducted at a rate of approximately 1 liter per minute or less to ensure minimal drawdown. Purging is deemed complete after a minimum of two pump and tubing volumes of water have been removed and stabilization of field parameters is achieved. Field parameters include temperature, specific conductivity, pH , and turbidity.
- Parameter stabilization is defined as:
- \(\quad\) Specific Conductivity \(= \pm 10 \%\) for three (3) consecutive measurements
- \(\mathrm{pH}= \pm 0.2\) standard pH units for three (3) consecutive measurements
- Temperature \(= \pm 10 \%\) for three (3) consecutive measurements
- Turbidity (optional) \(= \pm 10 \%\) for three ( 3 ) consecutive measurements

Measurements will be recorded on the field data sheet every three to five minutes. Water level measurement will also be taken every three to five minutes and recorded on the field data sheet.

\section*{Equipment:}
- Pump
- Pump controller
- Power source
- New disposable gloves of appropriate material (nitrile)
- Graduated pail and/or cylinder
- Field parameter measurement device/s

Installation Instructions:
- Appropriate disposable gloves are to be worn during installation and purging.
- - Connect the power source to the pump fitting at the top of the well.
- - Start the power source.
- Turn on the pump controller and adjust the discharge to the appropriate settings.
- Adjust the pump controller as needed to the desired flow rate.

Continue pumping until the necessary volume of water (two pump and tubing volumes minimum) has been purged from the well and field parameters have stabilized.

\subsection*{2.3.3.3 Passive (No Purge) Equipment Deployment}

Passive groundwater sample containers will be deployed a minimum of two weeks in advance of sampling and left open to the sampled environment during equilibration. Sampler bottles should be positioned in the screen interval of the well and have openings on both ends, allowing advective or diffusive analyte exchange with the surrounding well screen environment.

To follow the manufacturer's recommendation, a minimum deployment period of 2 weeks will be employed to allow time for both chemical equilibration and for the well to reestablish natural flow-through and water exchange following the disturbance of inserting equipment into the well. For routine periodic monitoring, passive sampling equipment is left in the sample position for the entire time between sampling events.

\subsection*{2.3.4 Purge Water Management}

On an individual monitor well basis, if purge water is known or suspected to be contaminated based on prior monitoring analytical data, the purge water shall be stored in appropriate containers until analytical results are available. After review of these analyses, proper arrangements for disposal or treatment of the water shall be made. Otherwise, purge water will be discarded on the ground surface away from the immediate monitor well area.

\subsection*{2.4 Monitoring Well Sample Collection}

\subsection*{2.4.1 General Sample Collection}

Sampling should take place as soon as purging is complete. If the well was purged dry or significant drawdown of the water level exists immediately after purge, the monitor well should be sampled as soon as practical after sufficient water is present for all analytes to be collected. The time interval between the completion of well purge and sample collection normally should not exceed twenty-four hours.

Based on water level measurements taken prior to well purging, sampling should proceed from the well with the highest groundwater elevation to the successively lower elevations. If contamination is known to be present, wells which are known not to be contaminated will be sampled prior to contaminated wells to avoid potential cross-contamination.

\subsection*{2.4.2 Sample Collection Order}

Samples will be collected and containerized according of the volatility of the requested analyses. Under normal conditions, sample bottles will be filled in the order of decreasing volatilization sensitivity. Generally, that will be in the following order, as applicable:
- Field Parameters (Temperature, Specific Conductivity, pH, Turbidity)
- Volatile Organics
- Metals
- Inorganics

\subsection*{2.4.3 Sampling Procedures}

Groundwater wells will be sampled using either non-dedicated, dedicated or passive equipment. Sampling procedures to be used when fixed volume purging is used are described in Section 2.4.3.1. Sampling procedures when low-flow purging is are described in Section 2.4.3.2.

\subsection*{2.4.3.1 Fixed Volume Purge}

When wells are purged using the fixed volume procedures, samples will be collected by means of a dedicated or disposable bailer as per the following procedure:
a. Remove any non-dedicated purge equipment from well.
b. Attach new string to a new disposable or dedicated bailer.
c. Insert bailer into well. Do not "drop" bailer into water column to avoid agitation of water.
d. Remove bailer from well and slowly discharge water from bailer directly into required sample containers in accordance with the sample collection order described in Section 2.4.2. Repeat as necessary to collect sufficient sample for analysis. Ensure bailer and string do not touch the ground during sampling or use plastic sheeting around well area as deemed necessary.

\subsection*{2.4.3.2 Low Flow Procedures}

Standard procedures for collecting representative groundwater samples after completion of low flow purging are as follows:
- The field parameters (temperature, specific conductivity, pH and turbidity) shall be collected and sampled per Section 2.4.7. All field parameter measurements will be recorded on a standard field data sheet in accordance with Section 2.5.1.
- The groundwater samples will be collected by pumping directly into each of the required containers in accordance with sample collection order described in Section 2.4.2.

\subsection*{2.4.3.3 Passive Sampling Procedures}

To passively capture a groundwater sample, the passive sampler is activated to close mechanically from the surface, either through a manual pull trigger system for shallow applications (less than 40ft) or by possibly using a pneumatic triggering system for deeper applications. The passive sampler is then retrieved and the sample(s) are discharged from it directly into required sample containers in accordance with the sample collection order described in Section 2.4.2. The passive groundwater sampler is then redeployed into the well in preparation for the subsequent sampling event.

\subsection*{2.4.4 VOC Sample Collection}

Filling VOC sample containers involves extra care. The water should be gently discharged into each vial until a positive meniscus is formed over the top of the container to ensure no headspace is present in the sample vial upon replacing the cap.

\subsection*{2.4.5 Sample Filtration}

All efforts must be made to delete or minimize controllable factors to allow the collection of as representative and turbid-free sample as possible. Oklahoma DEQ, Oklahoma Administrative Code, Municipal Solid Waste Regulations do not currently allow for field sample filtration of constituents listed in OAC 252:510 Appendix A and C prior to laboratory analysis (OAC 252:510-11-7 (d)). The facility may collect samples for laboratory filtration and analysis of dissolved metals when deemed necessary. Otherwise, metal and inorganic indicator analyses will be for total concentrations.

\subsection*{2.4.6 Sample Preservation}

All samples will be containerized and preserved according to Appendix B, Sample Containerization and Preservation of Samples. Preservation acids may be added to the applicable sample container in the field or pre-preserved to the applicable empty containers at the laboratory prior to sample collection. Methods of preservation are intended to retard biological action, retard hydrolysis of chemical compounds and complexes, and reduce the volatility of constituents.

Samples requiring refrigeration to four degrees Centigrade, according to Appendix B, will be accomplished by placing the sample containers immediately into coolers containing wet ice or the equivalent and delivering to the analytical laboratory as soon as practical.

\subsection*{2.4.7 Field Measurements}

Required field measurements include water levels, temperature, pH and specific conductivity. Turbidity measurements are recommended but not required. Field parameters will be measured using either hand held instruments placed directly into discharged water or a flow cell. Water level measurement procedures are described in Section 2.3.3. All instruments shall be properly calibrated and checked with standards according to the manufacturer instructions. Any improperly operating instruments must be replaced prior to continuing sample collection operations.

\subsection*{2.5 Record Keeping}

\subsection*{2.5.1 Field Data Sheets}

All field notes must be completely and accurately documented. All field information will be entered on a standard Field Data Sheet (see example provided in Appendix A) or equivalent form. All entries should be legible and made in indelible ink. Entry errors will be crossed out with a single line and initialed by the person making the corrections.

\subsection*{2.5.2 Chain-of-Custody/Sample Container Labels}

Proper chain of custody records are required to ensure the integrity of the samples and the conditions of the samples upon receipt at the laboratory, including the temperature of the samples at the time of log-in. The sample collector shall fill in all applicable sections and forward the original, with the respective sample(s), to the laboratory performing the analysis. Upon receipt of the samples at the laboratory, the sample coordinator is to complete the chain of custody, make a copy for his/her files, and make the original documents part of the final analytical report.

All sample containers will be labeled to prevent misidentification. The following will be indicated on an adhesive label with waterproof pen:
- Collector's name, date, and time of sampling.
- Sample source.
- Sample Identification number.
- Sample preservatives (if any).
- Test(s) to be performed on the sample.

\subsection*{2.6 Sample Transport}

Samples shall be shipped from the field back to the analytical laboratory either by hand delivery or utilizing an overnight courier service. Samples are to be shipped in sealed insulated containers which maintain the samples at approximately \(4^{\circ} \mathrm{C}\). Shipping containers must be of sturdy water-proof design (ice chests are commonly used) equipped with cushion material to prevent breakage during shipment. The field crew shall contact the laboratory each time samples are sent to identify the samples being sent and the transportation carrier along with the shipping identification number.

\section*{3 LABORATORY PROCEDURES / PERFORMANCE STANDARDS}

\subsection*{3.1 Analytical Methods}

Methods and reporting limits will conform to Table 1 and will be performed in accordance with test procedures presented in USEPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, September 1986 and any subsequent revisions or additions.

Alternative methods that provide equivalent or better performance than those listed in EPA publication SW-846 and analytical methods for constituents not listed in EPA publication SW-846 may be implemented.

\subsection*{3.2 Deliverables (General and Supplemental QA/QC)}

General deliverables are to be submitted for QA/QC review to the operator and/or operators' consultant. Supplemental QA/QC data is to be available upon request and to be maintained on file at the contract laboratory for a minimum period as set per laboratory policy.

\subsection*{3.2.1 General Requirements}

For general reporting of quantitative results for Subtitle D groundwater monitoring projects, the following reporting requirements apply:
- Methodology Summary - a table will be required listing all the analytical test methods used in the analyses of the samples with a reference made for each to the method manual and the test method number to confirm compliance with Table 1.
- Summary of the analytical results, indicating appropriate unit, and reporting limit (RL), and supervisor approval - concentration units must be consistently applied throughout report. Data can not be method blank corrected. It must be appropriately flagged.
- Chain-of-Custody Form - As per Section 2.5.2.
- Field Data Sheets (see Appendix A) or equivalent form.

\subsection*{3.2.2 Laboratory QA/QC Requirements}
- Laboratory Chronicles - must include date of sampling, sample receipt, preservation, preparation, analysis, supervisor approval signature.
- Non-Conformance Summary for GC/MS Data Reports - must state if the following do not meet \(\mathrm{QA} / \mathrm{QC}\) requirements:

GC/MS Tune Specifications
GC/MS Tune Frequency
Calibration Requirements - System Performance Check
Compounds, Calibration Check Compounds
Blank Contamination
Surrogate Recoveries
Sample Holding Times
Minimum Detection Limits

\subsection*{3.2.3 Laboratory Requirements for Volatile Organics}
1. Quality Assurance (QA) Data Form - must include minimum detection limits, method blanks, field/trip blanks if specified in Sampling Plan, lab replicate. All blanks and replicates must be run once per batch. Quality Control (QC) samples may be other than project samples, but must be of same batch and similar matrix. A single QA Data Form should be used for a number of samples; however, pertinent sample numbers must be listed on the form.
2. Surrogate Compound Recovery Summary - for samples and blanks - as per most recent version of applicable SW-846 method 8260.
3. Other requirements per Laboratory Quality Assurance Plan and regulatory requirements.

\subsection*{3.2.4 Laboratory Requirements for Metals}

At a minimum, analytical results, method detection limits must be established and method blank results are mandatory.

\subsection*{3.2.5 Laboratory Requirements for Inorganics - General Chemistry}

Quality Assurance (QA) Data Form - must include minimum detection limits, method blanks, field/trip blanks as specified in Sampling Plan, lab replicate. All blanks and replicates must be run once per batch. Quality Control (QC) samples may be other than project samples, but must be of same batch and similar matrix. A single QA Data Form
should be used for a number of samples, however, pertinent sample numbers must be listed on the form. In addition, spiked sample results must be included.

\subsection*{3.3 Data Quality Objectives}

\subsection*{3.3.1 Required Reporting Limits}

Data reported must be such that the method used shall achieve the reporting limits (RLs) listed in Table 1.

\subsection*{3.3.2 Precision}

Precision refers to the reproducibility of method results when a second aliquot of the same sample undergoes duplicate analysis. The degree of agreement is expressed as the Relative Percent Difference (RPD).

\subsection*{3.3.3 Accuracy}

Accuracy refers to the agreements between the amount of a constituent measured by a test method and the amount actually known to be present. Accuracy is usually expressed as a percent Recovery (R).

Recommended surrogate standards must be added to each organic sample processed to monitor method performance. Surrogate Recovery limits are generally published in the applicable method.

\section*{4 SAMPLING FREQUENCY - DETECTION MONITORING}

\subsection*{4.1 Background}

The Altus Municipal Landfill will monitor for the list of parameters as listed in Table 1.
As per OAC 252:510.11.7(h), the number of samples to be collected to establish groundwater quality shall be consistent with the appropriate statistical procedures determined pursuant to OAC 252:510.11.7(i). Due to the seasonal and temporal variations natural in groundwater analytical data, eight (8) independent quarterly samples from each well shall be collected and analyzed for the constituents listed in Table 1 to establish background water quality.

Inter-well statistical procedures are not recommended at this facility due to the variable strata (gypsum and shale) in the saturated zone. Wells completed in gypsum strata may have significantly different water chemistry than wells completed in shale strata. This spatial variability will result in false positive test results. However, if inter-well statistical comparisons are used, they will commence after completion of the initial eight (8) quarterly background events. Analytical data from upgradient monitor wells will be incorporated in to the background after each monitoring event. Data will be evaluated for potential outliers prior to incorporation into background.

For intra-well statistical comparisons, after completion of the initial eight (8) quarterly background events, new quarterly or semi-annual data may be incorporated into background at a minimum frequency of once every two years. New data will be evaluated for any significant trends and potential outliers (or by alternative tests that provide equivalent or better evaluation of data) and appropriate data incorporated into background.

\subsection*{4.2 Detection Monitoring Events}

Within six (6) months after completion of background, sampling and analysis for both upgradient and downgradient monitoring wells will be conducted on a semi-annual basis (approximately every six (6) months) for constituents listed in Table 1.

\subsection*{4.3 Groundwater Analysis Result Submittals}

A report of all groundwater sampling and analysis results will be submitted to the ODEQ no later than sixty (60) days after each sampling event (OAC 252:510.11.7(k)(2)).

In the event that statistical analysis of the groundwater analytical results indicate an initial Statistically Significant Increase (SSI) from background of a tested constituent at a
downgradient monitoring well, a notice in writing to the ODEQ will be submitted within sixty (60) days after each sampling event (OAC 252:510.11.7(k)(2)). The notification to the ODEQ and notice in the operating record will be in the format of a statistical analysis report with any SSI appropriately identified. Verification resampling to confirm the initial SSI or declare a false positive may be performed in accordance with Section 5.1.

\section*{5 STATISTICAL METHODOLOGY - GROUNDWATER DATA ANALYSIS}

Statistical comparisons will be performed using Sanitas \({ }^{\mathrm{TM}}\), a commercial software program developed by Intelligent Decision Technologies, Inc. or another comparable computer program. Statistical analyses of groundwater data will be performed in accordance with OAC 252:510.11.7(i).

\subsection*{5.1 Statistically Significant Constituents and Verification Resampling}

Statistical Analysis of constituents in GWSAP Table 1, will commence within six (6) months after completion of the eight (8) quarterly background events as referenced in Section 4.1 of this plan. An initial Statistically Significant Increase (SSI) will be based on any compound detected in any downgradient monitor well at a concentration above the specific constituent's statistical limit. If an initial SSI of any constituent is indicated at any downgradient monitoring well, a notice will be made to the ODEQ in the form of a statistical analysis report within sixty (60) days of the sampling event as referenced in Section 4.3 of this plan.

As previously mentioned, inter-well statistical procedures are not recommended at this facility due to the variable strata (gypsum and shale) in the saturated zone. Wells completed in gypsum strata may have significantly different water chemistry than wells completed in shale strata. This spatial variability will result in false positive test results.

Verification resampling is an integral part of the presented statistical methodology. In the event of an initial SSI, verification resampling may be performed and the results reported to the ODEQ within 90 days of the determination.

In the event that one or more constituents listed in Table 1 in any downgradient monitor well are confirmed through verification resampling as a SSI and/or no source other than the MSWLF, error, or natural variation is demonstrated per OAC 252:510.11.8(e)(3) then within 90 days of the initial determination, assessment monitoring will be initiated under OAC 252.510.11.9.

\subsection*{5.2 Updating Background Data}

As monitoring continues, the background mean and variance will be updated periodically to incorporate new data. At a minimum of every two (2) years all new data that are in control will be pooled with the initial eight (8) background samples and the mean and variance will be recomputed and used in constructing future statistical limits.

American Society of Testing and Materials (ASTM), 1986. Standard Guide for Sampling Groundwater Monitoring Wells. D 448-850.

American Society of Testing and Materials (ASTM), 1998. Provisional Standard Guide for Developing Appropriate Statistical Approaches for Groundwater Detection Monitoring Programs. PS 64-96.

Gibbons, Robert, D. 1994. Statistical Methods for Groundwater Monitoring, John Wiley \& Sons, Inc. New York.

Gibbons, Robert, D. and Coleman, David, E. 2001. Statistical Methods for Detection and Quantification of Environmental Contamination. John Wiley \& Sons. New York. 384 p.

Intelligent Decision Technologies (IDT), 1999. Sanitas For Groundwater User's Guide. Longmont, Colorado.
U.S. Environmental Protection Agency, 1986. RCRA Groundwater Monitoring Technical Enforcement Guidance Document. OSWER - 99550.1, Office of Waste Programs Enforcement, Office of Solid Waste and Emergency Response, Washington, D.C.
U.S. Environmental Protection Agency, 1989. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington D.C.
U.S. Environmental Protection Agency, 1992. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Addendum to Interim Final Guidance. Office of Solid Waste Management Division, U.S. Environmental Protection Agency, Washington D.C.
U.S. Environmental Protection Agency, 1992. RCRA Groundwater Monitoring: Draft Technical Guidance. EPA/530-R-93-001, NTIC \#PB93-139-350, Office of Solid Waste and Emergency Response, Washington D.C.
U.S. Environmental Protection Agency, 1991b. Handbook - Groundwater, Volume II: Methodology. EPA/625/6-90/0166.
U.S. Environmental Protection Agency, November 1986. Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, Third Edition (revised), SW-846. Office of Solid Waste and Emergency Response, Washington, D.C.
U.S. Environmental Protection Agency, November 1993. Solid Waste Disposal Facility Criteria Technical Manual. EPA/530-R-93-017, NTIC \#PB94-100-450, Office of Solid Waste and Emergency Response, Washington, D.C.

Oklahoma Department of Environmental Quality. Title 252 Oklahoma Administrative Code Chapter 510. Municipal Solid Waste Landfills 1996 Annotated.

\section*{TABLE}

Table 1
Background/Detection Monitoring Parameters Altus Municipal Landfill
\begin{tabular}{|c|c|c|}
\hline Inorganic Constituents & Method \({ }^{(1)}\) & RL (mg/l) \\
\hline Antimony & 6010 or 6020 & 0.003 \\
\hline Arsenic & 6010 or 6020 & 0.005 \\
\hline Barium & 6010 or 6020 & 0.005 \\
\hline Beryllium & 6010 or 6020 & 0.003 \\
\hline Cadmium & 6010 or 6020 & 0.002 \\
\hline Calcium & 6010 or 6020 & 0.05 \\
\hline Chromium & 6010 or 6020 & 0.004 \\
\hline Cobalt & 6010 or 6020 & 0.003 \\
\hline Copper & 6010 or 6020 & 0.002 \\
\hline Iron & 6010 or 6020 & 0.05 \\
\hline Lead & 6010 or 6020 & 0.002 \\
\hline Magnesium & 6010 or 6020 & 0.05 \\
\hline Manganese & 6010 or 6020 & 0.01 \\
\hline Nickel & 6010 or 6020 & 0.005 \\
\hline Potassium & 6010 or 6020 & 0.1 \\
\hline Selenium & 6010 or 6020 & 0.005 \\
\hline Silver & 6010 or 6020 & 0.003 \\
\hline Sodium & 6010 or 6020 & 1 \\
\hline Thallium & 6010 or 6020 & 0.001 \\
\hline Vanadium & 6010 or 6020 & 0.002 \\
\hline Zinc & 6010 or 6020 & 0.01 \\
\hline Chloride & 9251 & 3 \\
\hline Fluoride & 340.2 & 0.1 \\
\hline Sulfate & 375.4 & 5 \\
\hline Nitrogen, Nitrate-Nitrite & 353.2 & 0.1 \\
\hline Chemical Oxygen Demand & 410.4 & 5 \\
\hline Total Dissolved Solids & 160.1 & 10 \\
\hline Alkalinity, Carbonate ( CaCO ) & 310.1 & 3 \\
\hline Total Alkalinity & 310.1 & 3 \\
\hline
\end{tabular}

Table 1 (cont.)
Background/Detection Monitoring Parameters Altus Municipal Landfill
\begin{tabular}{|c|c|c|}
\hline Volatile Organic Compounds & Method \({ }^{(1)}\) & RL ( \(\mu \mathrm{g} / \mathrm{l}\) ) \\
\hline Acetone & 8260 & 20 \\
\hline Acrylonitrile & 8260 & 100 \\
\hline Benzene & 8260 & 4 \\
\hline Bromochloromethane & 8260 & 5 \\
\hline Bromodichloromethane & 8260 & 5 \\
\hline Bromoform & 8260 & 5 \\
\hline Carbon Disulfide & 8260 & 5 \\
\hline Carbon Tetrachloride & 8260 & 5 \\
\hline Chlorobenzene & 8260 & 5 \\
\hline Chloroethane & 8260 & 10 \\
\hline Chloroform & 8260 & 5 \\
\hline Dibromochloromethane & 8260 & 5 \\
\hline 1,2-Dibromo-3-chloropropane & 8260 & \(5^{(2)}\) \\
\hline 1,2-Dibromoethane & 8260 & \(5^{(2)}\) \\
\hline 1,2-Dichlorobenzene & 8260 & 5 \\
\hline 1,4-Dichlorobenzene & 8260 & 5 \\
\hline Trans-1,4-Dichloro-2-Butene & 8260 & 5 \\
\hline 1,1-Dichloroethane & 8260 & 5 \\
\hline 1,2-Dichloroethane & 8260 & 5 \\
\hline 1,1-Dichloroethylene & 8260 & 5 \\
\hline Cis-1,2-Dichloroethylene & 8260 & 5 \\
\hline Trans-1,2-Dichloroethylene & 8260 & 5 \\
\hline 1,2-Dichloropropane & 8260 & 5 \\
\hline Cis-1,3-Dichloropropene & 8260 & 5 \\
\hline
\end{tabular}

Table 1 (cont.)
Background/Detection Monitoring Parameters Altus Municipal Landfill
\begin{tabular}{|c|c|c|}
\hline Volatile Organic Compounds & Method \(^{\mathbf{( 1 )}}\) & RL-( \(\mu \mathrm{g} / \mathbf{l})\) \\
\hline Trans-1,3-Dichloropropene & 8260 & 5 \\
\hline Ethylbenzene & 8260 & 5 \\
\hline 2-Hexanone & 8260 & 10 \\
\hline Bromomethane & 8260 & 10 \\
\hline Chloromethane & 8260 & 10 \\
\hline Methylene Bromide & 8260 & 5 \\
\hline Methylene Chloride & 8260 & 5 \\
\hline Methyl ethyl ketone & 8260 & 10 \\
\hline Iodomethane & 8260 & 5 \\
\hline 4-Methyl-2-Pentanone & 8260 & 10 \\
\hline Styrene & 8260 & 5 \\
\hline 1,1,1,2-Tetrachloroethane & 8260 & 5 \\
\hline 1,1,2,2-Tetrachloroethane & 8260 & 5 \\
\hline Tetrachloroethylene & 8260 & 5 \\
\hline Toluene & 8260 & 5 \\
\hline 1,1,1-Trichloroethane & 8260 & 5 \\
\hline 1,1,2-Trichloroethane & 8260 & 5 \\
\hline Trichloroethylene & 8260 & 5 \\
\hline Trichlorofluoromethane & 8260 & 5 \\
\hline 1,2,3-Trichloropropane & 8260 & 5 \\
\hline Vinyl Acetate & 8260 & 10 \\
\hline Vinyl Chloride & 8260 & 2 \\
\hline Xylene (Total) & 8260 & 5 \\
\hline
\end{tabular}
(1) Analyses will be performed using the above listed methods or an alternative approved method with equivalent or better performance.
(2) RL is above the established MCL, detectable amounts below the RL and above the MCL will be flagged.

\section*{APPENDIX A}

\section*{EXAMPLE FIELD DATA SHEET}
\begin{tabular}{|c|c|}
\hline Altus Municipal Landfill Altus, Oklahoma & \begin{tabular}{l}
GROUNDWATER SAMPLING FIELD DATA SHEET \\
Well Number: \(\qquad\) \\
Sample I.D.: \(\qquad\) (if different from well no.)
\end{tabular} \\
\hline \begin{tabular}{l}
Project: \(\qquad\) \\
Personnel: \(\qquad\)
\end{tabular} & \begin{tabular}{l}
Date: \(\qquad\) \\
Weather Conditions: \(\qquad\) Air Temp: \(\qquad\)
\end{tabular} \\
\hline \begin{tabular}{l}
WELL DATA: \\
Casing Diameter: \(\qquad\) (in) Other: DEPTH TO: \\
Static Water Level (WL): \(\qquad\) (ft) \\
DATUM: \(\square\) Top of Well Casing Top of Protective Casi CONDITION: Is well clearly labeled? Yes
\(\square\)
\(\square\) No Is prot. casing in good cond.? (not bent or corroded) Is concrete pad intact? (not cracked or frost heaved) Is padlock functional? Yes \(\square\) No Is inne Is inner casing properly capped and vented? \(\square\)
\end{tabular} & \begin{tabular}{l}
ing
Yes \(\square\) No
Yes \(\square\) No \\
er casing intact? Yes \(\square\) No
\(\square\) No
\end{tabular} \\
\hline \begin{tabular}{l}
PURGE DATA: \\
METHOD: \(\square\) Bladder Pump Bailer Other: \(\qquad\) \\
MATERIALS: Type of Pump: _ \\
Tubing: \(\quad \square\) Teflon \({ }^{\circledR} \quad \square\) Polyethylene \\
PURGING EQUIPMENT: Dedicated Prepared Off-Site \\
PROCEDURES: Pump \& Tubing Vol.: \(\qquad\) (ml) \\
CALIBRATION: pH Meter Model: \(\qquad\) Meter S/N: Cond. Meter Model: \(\qquad\)
\(\qquad\)
\end{tabular} & \begin{tabular}{l}
Low-Flow Purging Used? \(\square\) Yes \(\square\) No
Polypropylene Other: \(\qquad\)
Field-Cleaned \\
ping Rate: \(\qquad\) (ml/min) \\
Time: \(\qquad\) \\
S/N: \(\qquad\)
\(\qquad\)
\end{tabular} \\
\hline \begin{tabular}{l}
TIME SERIES DATA: \\
Time: \(\qquad\) \\
Cum. Volume(ml) Start \(\qquad\) \\
Temperature ( \({ }^{\circ} \mathrm{C}\) ) \(\qquad\)
\(\qquad\) pH (s.u.): \(\qquad\)
\(\qquad\) \\
Spec. Cond. \\
( \(\mu \mathrm{mhos} / \mathrm{cm}\) ): \(\qquad\)
\(\qquad\)
\(\qquad\) \\
Turbidity (NTU): \(\qquad\)
\(\qquad\)
\(\qquad\) \\
Water Level (ft.): ---
\end{tabular} & \(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\)
\(\qquad\) \\
\hline \begin{tabular}{l}
SAMPLING DATA: \\
Sample Collection Time: \\
Water Level at Time of Sample: \(\qquad\) \\
METHOD: \(\quad\) Bladder Pump \(\qquad\) Bailer \(\square\) - Other: \(\qquad\) SAMPLING EQUIPMENT: \(\square\) Dedicated Prepared Off-Site APPEARANCE: \(\square\) Clear Turbid (NTU): \(\qquad\) Color: FIELD DETERMINATIONS: Temp. \(\left({ }^{\circ} \mathrm{C}\right)\) : \(\qquad\) pH (s.u.): REMARKS:
\(\qquad\)
\(\qquad\)
\end{tabular} & DField-Cleaned
Contains Immiscible Liquid Spec. Cond. ( \(\mu \mathrm{mhos} / \mathrm{cm}\) ): \(\qquad\) \\
\hline I certify that this sample was collected and handled in accordance
Signature: & \begin{tabular}{l}
with applicable regulatory and project protocols. \\
Date:
\end{tabular} \\
\hline
\end{tabular}

\section*{APPENDIX B}

\section*{CONTAINERIZATION AND PRESERVATION OF SAMPLES}

\section*{RECOMMENDED CONTAINERIZATION AND PRESERVATION OF SAMPLES}
\begin{tabular}{|c|c|c|c|c|c|}
\hline Measurement & \begin{tabular}{c} 
Volume \\
\((\mathbf{m L})\)
\end{tabular} & Containera & Preservative & Holding Times & Reference \\
\hline Physical Properties & \multicolumn{4}{|l|}{} \\
\hline Specific Cond. (Field) & 100 & P,G & Cool, \(4^{\circ} \mathrm{C}\) & Det. on Site & 1 \\
\hline Specific Cond. (Lab) & 100 & \(\mathrm{P}, \mathrm{G}\) & Cool, \(4^{\circ} \mathrm{C}\) & 28 Days & 1 \\
\hline pH (Field) & 50 & P,G & None & Det. on Site & 1,2 \\
\hline pH (Lab) & 50 & P,G & None & 24 Hrs & 1,2 \\
\hline Temperature & 1000 & P,G & None & Det. On Site & 1 \\
\hline Turbidity & 100 & P,G & Cool, \(4^{\circ} \mathrm{C}\) & Det. On Site & 1 \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|}
\hline Measurement & Volume (mL) & Container \({ }_{\text {a }}\) & Preservative & Holding Times & Reference \\
\hline Inorganics, Non-Metallics & & & & & \\
\hline Carbonate/Bicarbonate & 200 & P,G & Cool, \(4{ }^{\circ} \mathrm{C}\) & 14 days & 1 \\
\hline Chloride & 200 & P,G & None & 28 Days & 1,2 \\
\hline Nitrate plus Nitrite & 200 & P,G & \[
\begin{gathered}
\mathrm{Cool}, 4^{\circ} \mathrm{C} \\
\mathrm{H}_{2} \mathrm{SO}_{4} \text { to } \mathrm{pH}<2 \\
\hline
\end{gathered}
\] & 28 days & 1,2 \\
\hline COD & 50 & P,G & \(\mathrm{H}_{2} \mathrm{SO}_{4}\) to \(\mathrm{pH}<2\) & 28 days & 1 \\
\hline Sulfate & 100 & P,G & Cool, \(4{ }^{\circ} \mathrm{C}\) & 28 days & 1,2 \\
\hline
\end{tabular}

\section*{RECOMMENDED CONTAINERIZATION AND PRESERVATION OF SAMPLES}
\begin{tabular}{|c|c|c|c|c|c|}
\hline Measurement & \begin{tabular}{c} 
Volume \\
\((\mathbf{m L})\)
\end{tabular} & Containera & Preservative & Holding Times & Reference \\
\hline Metals (except mercury) & \multicolumn{6}{|l|}{} \\
\hline Total & 500 & \(\mathrm{P}, \mathrm{G}\) & \(\mathrm{HNO}_{3}\) to \(\mathrm{pH}<2\) & 6 Mos & 1,2 \\
\hline Dissolved & 500 & \(\mathrm{P}, \mathrm{G}\) & \begin{tabular}{c} 
Filt. \(+\mathrm{HNO}_{3}\) to \\
\(\mathrm{pH}<2\)
\end{tabular} & 6 Mos & 1,2 \\
\hline Mercury - Total & 500 & \(\mathrm{P}, \mathrm{G}\) & \(\mathrm{HNO}_{3}\) to \(\mathrm{pH}<2\) & 28 days & 1,2 \\
\hline Mercury - Dissolved & 300 & \(\mathrm{P}, \mathrm{G}\) & \begin{tabular}{c} 
Filt. \(+\mathrm{HNO}_{3}\) to \\
\(\mathrm{pH}<2\)
\end{tabular} & 28 days & 1,2 \\
\hline
\end{tabular}
\begin{tabular}{|c|c|c|c|c|c|}
\hline Measurement & \begin{tabular}{c} 
Volume \\
\((\mathbf{m L})\)
\end{tabular} & Containera & Preservative & Holding Times & Reference \\
\hline Organics & \multicolumn{4}{|c|}{} \\
\hline \begin{tabular}{c} 
Volatile Organics by \\
GC/MS
\end{tabular} & \begin{tabular}{c}
100 \\
\((2\) vials @ 40ml)
\end{tabular} & \begin{tabular}{c} 
G, Teflon \\
septum cap
\end{tabular} & \begin{tabular}{c} 
Cool, \(4^{\circ} \mathrm{C}\) \\
HCL to \(\mathrm{pH}<2\)
\end{tabular} & 14 days & 2,3 \\
\hline Herbicides & 1000 & Glass Only & Cool, \(4^{\circ} \mathrm{C}\) & \begin{tabular}{c}
7 days \({ }^{\mathrm{b}}\) \\
40 days \(^{\mathrm{c}}\)
\end{tabular} & 2,3 \\
\hline Pesticides and PCB's & 1000 & Glass Only & Cool, \(4^{\circ} \mathrm{C}\) & \begin{tabular}{c}
7 days \(^{\mathrm{b}}\) \\
40 days \(^{\mathrm{c}}\)
\end{tabular} & 2,3 \\
\hline \begin{tabular}{c} 
Semi-Volatiles \\
Acid and Base/Neutral \\
Compounds
\end{tabular} & 2000 & Glass Only & Cool, \(4^{\circ} \mathrm{C}\) & \begin{tabular}{c}
7 days \(^{\mathrm{b}}\) \\
40 days \(^{\mathrm{c}}\)
\end{tabular} & 2,3 \\
\hline
\end{tabular}

\section*{NOTES:}
a Plastic (P) or Glass (G). For metals, polyethylene with an all polypropylene cap is preferred.
b Maximum holding time from sampling to extraction.
c Maximum holding time from extraction to analysis.

\section*{REFERENCES:}

1 Methods for Chemical Analysis of Water and Wastes, March, 1983, USEPA, 600/4-79-020 and additions thereto.

2 Test Methods for Evaluating Solid Waste, Physical/Chemical Method, November, 1986, Third Edition, USEPA, SW-846 and additions thereto.

3 "Guidelines Establishing Test Procedures for the Analysis of Pollutant Under the Clean Water Act", Environmental Protection Agency, Code of Federal Regulations (CFR), Title 40, Part 136.

\section*{APPENDIX C}

\section*{BASIC WATER LEVEL INDICATOR PROCEDURES}

\section*{BASIC WATER LEVEL INDICATOR PROCEDURES}

The following outlines standard procedure for taking monitor well water levels:
1. Unlock and remove the monitor well protective casing cap. Note and document any problems with the locking cap or lock itself.
2. Put on a pair of clean new disposable gloves and remove the PVC well cap or well seal access port from the top of the PVC riser. Store the PVC well cap or access port in a clean location.
3. Check the on/off button and sensitivity switch with the test button located on the side of the water indicator. An audible beep and light indicate that the devise is working properly. The sensitivity switch should be turned to the highest setting and then lowered if required due to highly conductive water (e.g. if the sensitivity is too high the water indicator buzzer will fail to turn off when removed from water column. On the other hand, if the sensitivity is too low the indicator will not detect the water column in water with low conductivity.)
4. Slowly lower the indicator probe into the well until the audible beep/light indicates the probe has contacted the water column. Carefully work the probe up and down to find the exact spot the probe senses the water level.
5. Read the tape measure numbers on the indicator line at the top of the PVC casing. These numbers are in \(1 / 100\) of a foot increments. Record the measurement to the closest \(1 \backslash 100\) of a foot. This number reflects the distance from the top of the PVC casing down to the water column. A permanent point is notched in the PVC casing or etched on the permanent well head seal so that the same surveyed reference point is always used. To convert this number to water level relative to Mean Sea Level, subtract the measurement from the surveyed elevation of the monitor well riser reference point.

\section*{APPENDIX M - 1989 Permit Application}

\section*{PERMIT APPLICATION}

\section*{SOLID WASTE DISPOSAL FACILITY}

\author{
TYPE I - B METROPOLITAN SANITARY LANDFILL
}

SUBMITTED BY:

CITY OF ALTUS
P. O. BOX 1840

ALTUS, OKLAHOMA 73522
( 405 ) 477-1950
HONORABLE BOOZIE MCMAHAN, MAYOR

JOE COURTNEY, CITY ADMINISTRATOR

OCTOBER 1988

PREPARED BY:

GLENN BRIGGS \& ASSOCIATES INC.
P. O. Box 458

Altus, Oklahoma 73522
( 405 ) 482-3011

\title{
PERMIT APPLICATION \\ SOLID WASTE DISPOSAL FACILITY
}

\author{
TYPE I - B METROPOLITAN SANITARY LANDFILL
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\section*{ATTACHMENT 1. ENGINEERING PLANS -9 SHEETS}

\section*{FORM 850}

\section*{APPLICATION FOR A SOLID WASTE DISPOSAL}

FACILITY PERMIT.

\section*{APPLICATION FOR A}

Date: November 15, 1388


City of Altus (Applicant's name)
the Altus :unicipal Landfill
(Facility name) , locatedat (see attached)
(Exact legal description: metes and bounds, platted lot, or public land survey. Append extra sheets as necessary.)
in Jackson County, Oklahoma, and hereby makes application for a permit to establish, construct, operate, and maintain a solid waste disposal facility as required by the Oklahoma Solid Waste Management Act, Title 63, O.S. 1981, Sections 2251-2265 (as amended), and Rules and Regulations pursuant thereto.
Remarks: This application is for an upgrade of an existing landfill. The


Submit four (4) copies of this and all accompanying reports, maps, plans, and other documents to the Solid Waste Division of the Oklahoma State Department of Health.

\section*{ATTACHMENT:}

\section*{LEGAL DESCRIPTION}

THE NORTHEAST QUARTER LYING SOUTH OF THE HOLLIS \& EASTERN R.R. (100.1 ACRES); AND, THE NORTH 650 FEET OF THE SOUTHEAST QUARTER (39.4 ACRES); ALL IN SECTION ELEVEN (11), TOWNSHIP TWO (2) NORTH, RANGE TWENTY TWO (22) WEST OF THE INDIAN MERIDIAN, JACKSON COUNTY, OKLAHOMA.

\section*{NOTICE OF OPPORTUNITY}

\section*{FOR PUBLIC HEARING.}

\section*{NOTICE OF OPPORTUNITY FOR PUBLIC HEARING}
"Regulations Governing Solid Waste and Sludge Management " (OSDH Bulletin 0524), Amended by the Oklahoma State Board of Health, April 2, 1987;

Section 4.4.4.1 states as follows:
"Publication of notice shall not be required in cases where the application is for upgrading an existing permitted area, if said upgrade involves no additional disposal are, or increase in design height of the disposal are, or other major modification to the original permit application (and its existing modifications ), and if no variance is requested in the application."

This application for an upgrade to the permit for the Altus Municipal Landfill meets the requirements of the regulation cited above; therefore, a "notice of opportunity for public hearing" is not required.

\section*{INTRODUCTION.}

\section*{INTRODUCTION}

This application is to upgrade the existing Altus Municipal Landfill to a Type I B, Metropolitan Sanitary Landfill, as defined by the Oklahoma State Department of Health in, "Regulations Governing Solid Waste and Sludge Management " (OSDH Bulletin 0524 ), Amended April 2, 1987. The landfill was permitted under previous regulations, permit number 3533005 issued May 21, 1982.

The one hundred forty (140) acre site is located eight (8) miles west and \(11 / 2\) miles north of the City of Altus, Jackson County, Oklahoma. The site provides disposal for solid wastes generated by Altus, Jackson County and the other small communities in the county.

The site is located on land owned by the City of Altus which owns additional adjacent properties. These additional properties are not included in the permit area.

Technically the site appears to meet all of the requirements for a Type I - B, Metropolitan Sanitary Landfill. It is currently operated according to regulations of the OSDH.

The site does not lie over any identified major groundwater aquifers. However, Class I groundwater protection is required. The site does lie west of the "water balance" line as identified by the OSDH. Therefore, liners are not required.

Soils test borings were made in March of 1981 by the city of Altus, in June of 1985 by Standard Testing and engineering Company and in August of 1988 by Shepherd Engineering and Testing Company. The test borings of June 1985 were were made after consultation with personnel of OSDH. The borings of

August of 1988 were made to determine in - situ horizontal and vertical permeabilities. Findings of all soils borings and testing are contained in APPENDIX C. GEOTECHNICAL REPORTS.

The City has operated a landfill for many years in compliance with the regulations of the OSDH. At this time no City operated landfills exist which have not been closed according to the requirements of the regulations. Therefore, a bond is not required as a precursor to obtaining this permit for landfill upgrade.

Within the proposed permit boundary Altus has and is currently operating a landfill. The previously closed areas are satisfactory and in accordance with the closure plans.

This application addresses information, design, construction, operation, maintenance, liner installation, closure and testing requirements of the Oklahoma State Department of Health (OSDH) regulations.

\section*{SECTION I.}

\section*{GENERAL INFORMATION,}

\section*{I. GENERAL INFORMATION}

\section*{A. NAME OF SITE:}

\section*{ALTUS MUNICIPAL LANDFILL.}

\section*{B. TYPE OF SITE:}

The site is a Type I - B, Metropolitan Sanitary Landfill, as defined by the "Regulations Governing Solid Waste and Sludge Management", OSDH Bulletin 0524; Amended by the Oklahoma State Board of Health April 2, 1987, serves a population equivalent of thirty thousand ( 30,000 ) or more. Figures released by the Research and Planning Section of the Oklahoma Employment Security Commission in July of 1985 project the population of Jackson County in the year 2000 at 32,550 persons. TABLE 1. POPULATION PROJECTIONS FOR JACKSON COUNTY, gives the details of population projections as follows:
\begin{tabular}{|c|c|c|c|c|c|}
\hline & 1980 & 1985 & 1990 & 1995 & 2000 \\
\hline Jackson County & 30,356 & 32,700 & 33,900 & 35,400 & 36,500 \\
\hline Altus & 23,101 & 25,100 & 25,800 & 26,900 & 27,400 \\
\hline Blair & 1,092 & 1,300 & 1,450 & 1,550 & 1,700 \\
\hline East Duke & 484 & 550 & 600 & 700 & 800 \\
\hline Eldorado & 688 & 750 & 800 & 900 & 950 \\
\hline Elmer & 131 & 150 & 150 & 150 & 200 \\
\hline Headrick & 223 & 250 & 300 & 350 & 400 \\
\hline Martha & 219 & 200 & 200 & 200 & 200 \\
\hline Olustee & 721 & 800 & 900 & 1,000 & 1,100 \\
\hline
\end{tabular}

SOURCE: "POPULATION PROJECTIONS 1980-2000", Research and Planning, Oklahoma Employment Security Commission, July 1985.

TABLE 1. POPULATION PROJECTIONS FOR JACKSON COUNTY.

The site under consideration in this application was previously permitted May

21, 1982. Permit number 3533005. This application is to upgrade the permit to meet current OSDH regulations.

\section*{C. BRIEF DESCRIPTION OF PROPOSED OPERATION:}

The proposed operation is a municipal sanitary landfill in which domestic household waste, commercial wastes and industrial wastes allowed under OSDH regulations for Type I - B landfills will be disposed of by burial in prepared disposal cells. Wastes will be collected in the municipalities by public or private collectors and haulers and carried to the landfill for disposal. The site will be open to accept wastes brought to the landfill by residents of the county. Operations at the landfill are funded through the municipal budgets of Altus and other participating cities and towns which collects fees from residents through utility assessments. The landfill operators also assess tipping fees at the gate when individual or private haulers bring wastes to the site.

Currently the City of Altus along with the Towns of Blair, Olustee, Eldorado, Duke, Martha and the Altus Air Force Base utilize the Altus landfill. Private haulers, Midland and Lopez also utilize the site on a regular basis such that their substantial tonnage is included in the calculations.

Operational practices at the site include excavation of a disposal area; sorting and stockpiling the soils removed; placing wastes at the bottom of the working face, mixing the wastes with soil, working the waste up the slope of the working face with dozers providing compaction; and periodically covering the compacted wastes with daily, intermediate and final cover. The development of the site will be in accordance with the development plans contained in the engineering drawings ATTACHMENT I. ENGINEERING PLANS.

Day to day operating practices relating to litter control, safety, record keeping, site
maintenance, monitoring, etc. are detailed in subsequent sections of this application.

\section*{D. NAME AND ADDRESS OF APPLICANT:}

City of Altus
P. O. Box 914

Altus, Oklahoma 73521
Joe Courtney, City Administrator
(405) 477-1950

\section*{E. DISTANCETO:}

\section*{1. Nearest Residence:}

The nearest residence to the project site is 1 mile southwest (see FIGURE 1. SITE LOCATION MAP).

\section*{2. Nearest Airport:}

The nearest airport is the Altus Municipal Airport which is ten (10) east of the site (see FIGURE 2. MAP OF CENTRAL JACKSON COUNTY).

\section*{3. Nearest Flood Prone Area:}

The location of the nearest flood prone area is believed to be approximately three (3) miles south along Turkey Creek. The elevation at this point is 1350 MSL according to the U. S. G. S. Quadrangle Map. The surface elevation of the site varies from 1420 MSL to 1465 MSL. No other flood prone area information is know to exist.


FIGURE 1. SITE LOCATION MAP



\section*{F. ACCESS ROAD:}

\section*{1. Off Site Access Road:}

The site is accessed via a section line road of asphaltic type construction. This road was constructed by Jackson County.The road is maintained by Jackson County crews and is currently in good condition.

\section*{2. On Site Access Road:}

On site access roads include a more permanent type asphaltic type construction entrance road which runs from the entrance to the scales and employee shelter. Temporary roads will be constructed of on site materials and advanced across the site as the site is developed. The entrance road and the proposed temporary disposal area access roads are shown on SHEET 3. SITE DEVELOPMENT PLAN of the engineering plans attached.

\section*{G. LAND USE:}

The site is located eight miles west and \(11 / 2\) miles north of the city limits of Altus which is the nearest urban area. The site is located off of major highways on a rural type road section line road which is common in rural Oklahoma. Land uses adjacent to and in the vicinity of the site reflect the agrarian nature of the county.

\section*{1. Adjacent Properties:}

Properties adjacent to the project site reflect the agrarian nature of the area. Properties on the east and west sides are utilized for farming and ranching
operations. On the north side of the site is a commercial cattle feeding operation and on the south side of the permit area the land is owned by the City of Altus and used for cattle operations. Some permanently constructed animal handling equipment is located on this property.

\section*{2. Within Two Miles:}

Land uses within two miles are given to farming and ranching operations. Some scattered homesites which serve as farm headquarters do exist along with associated out buildings. No high density commercial or residential developments are known to exist.

\section*{H. LEGAL DESCRIPTION:}

THE NORTHEAST QUARTER LYING SOUTH OF THE HOLLIS \& EASTERN R.R. (100.1 ACRES); AND, THE NORTH 650 FEET OF THE SOUTHEAST QUARTER (39.4 ACRES); ALL IN SECTION ELEVEN (11), TOWNSHIP TWO (2) NORTH, RANGE TWENTY TWO (22) WEST OF THE INDIAN MERIDIAN, JACKSON COUNTY, OKLAHOMA.

\section*{I. OWNERSHIP INTEREST:}

The project site is owned in fee simple by the City of Altus. Copies of the ownership instruments are provided as APPENDIX A. OWNERSHIP DOCUMENTS.

\section*{J. OPERATION:}

The site has operated as a municipal landfill for many years and was permitted as
a landfill May 21, 1982; permit number 3533005. The purpose of this application is to upgrade the status of the permit and the landfill to meet current regulations. Generally the site is currently being operated and will continue to be operated in accordance with the Regulations of the OSDH as they relate to Type I - B, Metropolitan Sanitary Landfills.

\section*{1. Hours:}

The hours of operation of the landfill are as follows:

8:00 a.m. to 5:00 p.m. Monday through Saturday

\section*{2. Equipment:}

Equipment permanently located at the site for operation of the landfill include as follows:

1 each D-8 Dozer
1 each 10 Yd. Scraper

As this is a municipal operation other departments of the city have various scrapers, graders, loaders and other earth moving equipment available for temporary use at the site. The permanent equipment at the site is adequate for day to day operations including compacting and covering of wastes.

\section*{3. Wastes Accepted:}

Wastes accepted by the Altus Municipal landfill include domestic residential, commercial and industrial wastes generated in the county. These wastes include
"industrial waste", "other industrial waste", "semi - solid waste", solid waste"and "special wastes. It will not accept wastes that are excluded, solely on the bases of volume, from classification as "controlled industrial waste".

\section*{4. Waste Sources:}

Sources of the wastes accepted by the Altus Municipal Landfill include the entirety of Jackson County. Specifically from, the City of Altus; the Towns of Blair, Olustee, Eldorado, Duke and Martha; and Altus Air Force Base.

\section*{5. Daily Quantities:}

The daily quantity of wastes received by the Altus landfill is approximately 102 tons.

\section*{6. Population Served:}

The population served by the Altus Municipal landfill is the entirety of Jackson County. The population of Jackson County according to the 1980 census was 30,356 persons. Projections made by the OESC until the year 2000 advance the population of Jackson County to 36,500 . See TABLE 1. POPULATION PROJECTIONS FOR JACKSON COUNTY.

\section*{7. Estimated Life:}

Estimated life of the site is a function of population served, generation rates, industrial wastes received, size of waste disposal areas and cover materials available. The estimated life of the Altus landfill is 20 years.

\section*{SECTION II.}

\section*{TECHNICAL INFORMATION,}

\section*{II. TECHNICAL INFORMATION}

\section*{A. FLOOD PLAIN LOCATION:}

The nearest flood plain location is believed to be south approximately three (3) miles. The elevation of Turkey Creek at that point is 1350 MSL. See FIGURE 3. FLOOD PRONE AREA MAP for location of the nearest flood prone area. Elevations of the bottom of the disposal areas range from 1425 MSL to 1435 MSL. No solid waste will be disposed of lower than one (1) foot above the elevation of the flood plain.

\section*{B. GEOLOGY:}

The project site lies approximate eight (8) miles west of the City of Altus. The site is in the geologic province known as the "Hollis Basin" (see FIGURE 4. MAJOR GEOLOGIC PROVINCES OF OKLAHOMA.) which is a part of the geomorphic province called the "Central Redbed Plains"( see FIGURE 5. GEOMORPHIC PROVINCES OF OKLAHOMA.) The site lies approximately on the boundary between the Central Redbed Plains and the Mangum Gypsum Hills. The scale of available maps is such that the exact location of the site in relation to the boundary between the two provinces is indeterminate. Descriptions of the two provinces are as follows:

Central Redbed Plains - Red Permian shales and sandstones forming gently rolling hills and broad, flat plains.

Mangum Gypsum Hills - Gently rolling hills to steep bluffs and badlands developed on Permian sequence of interbedded gypsum and shale.


FIGIJRE 4. MAJOR GEOLOGIC PROVINCES OF OKLAHOMA.


Central Redbed Plains-Red Permian shales and sandstones forming gently rolling hills and broad, flat plains.

\section*{1. General Geology:}

The generalized geologic profile of the Hollis Basin is as follows:
Permian
Pennsylvanian
Mississippian, Devonian, Silurian
Ordivician, Cambrian (Sedimentary)
Cambrian (igneous and metamorphic)
Pre Cambrian
Depths range from 1500 feet above sea level to 20,000 below sea level where the Cambrian interfaces with the Pre Cambrian.

The surface of the project site is described by the Generalized Geologic map of Oklahoma as Permian in age (see FIGURE 6. GENERALIZED GEOLOGIC MAP OF OKLAHOMA.).
"Permian. Dominantly shallow-marine, deltaic, and alluvial deposits of red sandstone and shale. Gypsum outcrops (white) are conspicuous, and thick salt units are widespread in subsurface. Generally 1,000 to 4,500 feet thick."

The site lies in the Elm Fork Member of the El Reno Group. This group is described as having three (3) dolomite - gypsum sequences with total thickness of eighty (80) to one hundred (100) feet thick. The Permian age layers dip gently west or southwest in this area.

Source for the preceding section is Kenneth S. Johnson, Carl C. Branson, Neville M. Curtis Jr., William E. Ham, William E. Harrison, Melvin V. Marcher, and John F. Roberts; GEOLOGY AND EARTH RESOURCES OF OKLAHOMA ; Oklahoma Geological Survey_1979.
a. Specific Geology - Oklahoma Geological Survey Bulletin 95 Basement Rocks and Structural Evolution Southern Oklahoma; Plate I


PERMIAN. Dominantly shallow-marine, deltaic, and alluvial deposits of red sandstone and shale. Gypsum outcrops (white) are conspicuous, and thick salt units are widespread in subsurface. Generally 1,000 to 4,500 feet thick.
\[
2-5
\]
"Geologic Map and Section of Basement Rocks In Southern Oklahoma"; describes the geologic cross section of the area of the project site as follows:

1500 to -2000 Permian - Mostly reddish - brown shaley sandstone, arkose, and conglomerate locally as much as 5000 feet thick. Unconformably overlies basement rocks throughout much of Wichita Mountain region.
-2000 to -8000 Pennsylvanian, Ordivician - Marine shale, sandstone and carbonate rocks ranging in age from late Pennsylvanian through Early Ordivician and locally having a thickness as much as 30,000 feet.
-8000 to -8500 Late Cambrian - Lower part of Arbuckle Group, Honey Creek Limestone, and Reagan Sandstone. Each is locally unconformable upon uneven floor of all basement rocks except gabbro. Honey Creek Limestone contains abundant trilobites of Franconian (Middle Late Cambrian age). Cambrian strata in contact with basement rocks shown at outcrop and in subsurface only where truncated at unconformities beneath younger strata.
-8500 to - 10,000 Late PreCambrian or Early Cambrian - Tillman Metasedimentary Group, In subsurface chiefly low-rank metagraywacke and argillite but including also hornfels and biotite shist near contacts with Wichita granites. Includes Meers Quartzite of outcrop, which occurs as inclusions in gabbro and granite. Rocks are of marine geosynclinal origin.

The previous section lies southeast of the project site. Another section lying northeast of the site has a slightly different formation at the interface of the Late Cambrian and the Middle Cambrian sections. This formation replaces the Tillman Metasedimentary Group with the Wichita Granite Group. This group is described as follows:

Wichita Granite Group - Leucogranites of various textures representing multiple intrusions, in part having the form of extensive thick sills intruding the lower part of the Carlton Rhyolite, and in part occurring as irregular plutons and sills cutting all other rocks of the Wichita province.

The upper geologic cross sections are described in the Soil Survey Jackson County Oklahoma; published by the United States Department of Agriculture, Soil Conservation Service and the Oklahoma Agricultural Experiment Station, 1961. The site lies in a Permian age formation identified as the Blaine Gypsum. The Blaine Gypsum is described as:
"...alternating beds of red and bluish clay-shale and of numerous deposits of gray to white gypsum. In some places, dolomite or gypsum forms a hard caprock on the hilltops or outcrops in ledges. The Blaine Gypsum is considered by several geologists to be the most consistent of any Permian formation in this part of Oklahoma. The entire Blaine gypsum formation average 200 feet in thickness. A typical section of the upper part of the Blaine Gypsum formation, which also applies to this formation in Jackson, Greer, and Beckham Counties, is given by Gouin as follows:"

Dolomite, honeycombed
Shale, red and blue
Gypsum massive, white Shale, red
Gypsum, massive, white

3 feet thick
20 feet thick
18 feet thick
5 feet thick
15 feet thick

In the Hollis Basin and into the Wichita Mountain region a series of faults run northeast southwest. The Burch Fault runs in the vicinity of the project site. This fault as described in the Oklahoma Geological Survey Bulletin 95, Basement Rock and Structural Evolution, Southern Oklahoma, Plate II "Contour Map Of Basement Rock Surface in Southern Oklahoma", runs from northwest of Frederick to the Texas border in northern Harmon County (see FIGURE 7. BASEMENT ROCK AND STRUCTURAL EVOLUTION , SOUTHERN OKLAHOMA.).

The exact location of the Burch Fault in relation to the project site is difficult to determine but it appears to lie one (1) to two (2) miles to the southwest.


FIGURE 7. BASEMENT ROCK AND STRUCTURAL EVOIUTION OF SOUTHFRN OKI AHOMA
b. Sources - Sources utilized in the preparation of the preceding sections on geology include as follows:

Kenneth S. Johnson, Carl C. Branson, Neville M. Curtis Jr., William E. Ham, William E. Harrison, Melvin V. Marcher, and John F. Roberts; GEOLOGY AND EARTH RESOURCES OF OKLAHOMA; Oklahoma Geological Survey 1979.

Wiliiam E. Ham, Rodger E. Denison and Clifford A. Merritt; Bulletin 95, Basement Rocks and Structural Evolution of Southern Oklahoma; Oklahoma Geological Survey, 1964.

Soil Survey, Jackson County Oklahoma; United States Department of Agriculture, Soil conservation Service and the Oklahoma Agricultural Experiment Station, 1961.

John S. Havens, Hydrologic Atlas 6, Reconnaissance of the Water Resources of the Lawton Quadrangle Southwestern Oklahoma; Oklahoma Geological survey, 1977.

Kenneth S. Johnson; Maps Showing Principal Ground-Water Resources and Recharge Areas in Oklahoma; Oklahoma State Department of Health and the Oklahoma Geological Survey; 1983.
M. Charles Gilbert; Petrology of the Cambrian Wichita Mountains Igneous Suite; Oklahoma Geological Survey Guidebook 23.

\section*{2. Characteristics \& Engineering Properties:}

The Soil Survey, Jackson County, Oklahoma prepared by the United States Department of Agriculture and the Oklahoma State Experiment Station Classifies soil types and gives engineering properties of the various soil types. FIGURE 8. GENERALS SOIL MAP shows the that the project site lies in the Hollister Tillman soils association. FIGURE 9. SOILS MAP shows that soil types on the site include:


Glenn Briggs \& Associates, Inc.
Consulting Engineers


Ha Harmon stoney loam
LaB La Casa clay loam 1 to \(3 \%\) slopes
Rg Rough broken land
Ve Vernon

Descriptions of these soil types and their engineering properties are included in subsequent sections.
a. Soil Types - Specific soil types on site are those of the Hollister Tillman series and descriptions of those soils taken from the soils manual are included here.

\section*{HARMON SERIES}

The Harmon series is made up of very shallow, undulating to rolling soils on uplands where dolomitic limestone outcrops or lies within a few inches of the surface. The soil is brown or dark-brown stony loam about 4 inches thick. Many small fragments of limestone are on the surface. Beneath the surface soil are beds of dolomitic limestone, averaging about 26 inches in thickness, that are interbedded with red and gray calcareous clays of the red beds.

The vegetation on Harmon soils consists chiefly of sideoats grama, blue grama, buffalograss, and some little bluestem. Also, a few shrubby mesquites dot the landscape.

The Harmon soils formed chiefly on convex slopes. The principal soils near or adjacent are those of the Weymouth and Vernon series. Harmon soils are not so deep as either the Weymouth or the Vernon soils; those soils formed in clayey redbeds that do not contain thick layers of dolomitic limestone.

Typical profile of Harmon stony loam, in a virgin area, 400 feet east of the south quarter corner of sec. 9, T. 1 N., R. 23 W.:

A1 0 to 4 inches brown; 10 YR 5/3, dry: 4/3, moist) stoney loam; the stone consists of fragments of dolomitic limestone ranging up to 8 inches in diameter and comprising 10 to 30 percent of the layer; granular structure; friable when moist; strongly calcareous; abrupt boundary.
\(\mathrm{D}_{\mathrm{r}} \quad 4\) to 30 inches, level-bedded dolomitic limestone, with beds ranging in thickness from \(1 / 2\) to 3 inches.

C 30 inches + , beds of red and grayish calcareous clay.
The depth to parent rock varies from 2 to 12 inches. The level-bedded dolomitic limestone, of the Permian system, ranges from 2 to 10 feet in thickness.

\section*{HARMON STONY LOAM (Ha)}

This undulating to rolling soil ranges in slope from 2 to 15 percent. The profile described as typical of the series is on a convex surface. This is the only soil of the Harmon series that is mapped in Jackson County.

In places, small pockets of deeper soils lie within large areas of Harmon stony loam. Also included are areas of a very shallow soil developed over deposits of gypsum. The surface layer of the gypsiferous soil is dark-brown, friable, granular, calcareous clay loam or loam that ranges from \(1 / 2\) to 12 inches in thickness. This layer rests abruptly on white, nearly pure gypsum. This soil is used for grazing and at one time was a source of gypsum for industrial uses. Gyp sinks, or caves, are common where the soil occurs. The soil is not extensive; principal areas are north of Eldorado.

Almost all of Harmon stony loam is used for range and is suited only to that use. It affords good grazing when properly managed. The Main problems in using the soil are to maintain stands of the more desirable grasses under pressure of grazing and to get uniform use. Capability unit VIs-2 (dryland), not suited to irrigation; range site, Shallow prairie.

\section*{LA CASA SERIES}

In this series are deep soils that have a dark-brown surface layer about 12 inches thick. The subsoil, about 26 inches thick, is reddish-brown, light clay or heavy clay loam. The parent material, below about 38 inches, is light reddish-brown to red clay that contains a considerable amount of free lime.

The La Casa soils have formed on uplands from moderately clayey
red beds, which are mostly highly calcareous. In most places, the parent material contains thin layers of dolomitic limestone.
The native vegetative cover for the soils consisted principally of blue grama, buffalograss, side-oats grama, and some taller grasses.

Commonly mapped near or adjacent to the La Casa soils are the Weymouth, Tillman, and Hollister soils. La Casa soils are deeper, less friable, and not so limy as the Weymouth soils. Also, they contain a B horizon, which the Weymouth soils do not have. La Casa soils have a less pronounced, less firm, less clayey and more permeable \(B\) horizon than the Tillman soils. Compared to the Hollister soils, the La Casa soils are calcareous at shallower depths, are less compact, and are more permeable in the lower part of the \(B\) horizon.

Typical profile of La Casa clay loam, in a gently sloping, cultivated field, three-tenths of a mile north and 100 feet east of the southwest corner of Section 3, Township 2 North, Range 22 West:

A1 0 to 12 inches, dark-brown ( 7.5 YR 4/2, dry; \(3 / 2\) moist) clay loam; brown ( 7.5 YR \(4 / 3\), dry; 3/3, moist) throughout the plowed layer to 5 inches, or when crushed; strong, medium, granular structure below the plowed layer; friable when moist; noncalcareous ( pH 7.5 ); gradual boundary.
\(B_{2} 12\) to 30 inches, reddish-brown (5 YR 4/3, dry; 3/3, moist), light clay or heavy clay loam; moderate, medium, subangular blocky structure; distinct, continuous clay skins; firm when moist; calcareous; gradual boundary.
\(\mathbf{B}_{\text {ca }} \quad 30\) to 38 inches, reddish-brown ( 5 YR 5/4 dry; 4/4, moist), light clay or heavy clay loam; weak, blocky structure; this, patchy clay skins; firm when moist; highly calcareous; contains a few friable concretions of segregated calcium carbonate; gradual boundary.
\(\mathrm{C}_{\mathrm{Ca}} 38\) to 52 inches, light reddish-brown (5 YR 6/4, dry; 4/4, moist), light clay or heavy clay loam; contains numerous friable masses of segregated calcium carbonate; almost structureless; friable when moist; relatively porous and permeable; calcareous; estimated 30 percent content of calcium carbonate; grades through a transition layer more than a foot thick to the layer below.

C \(\quad 52\) to 72 inches, red, strongly calcareous light clay or heavy clay loam that contains a few masses of segregated calcium carbonate and shows obscure bedding planes. This is little altered parent material of Permian sediments, here presumably marine.

In color, the a horizon ranges from brown to grayish brown, and the B horizon, from reddish brown to very dark brown. In thickness, the A horizon ranges from 7 to 15 inches, and the B horizon, from 8 to 20 inches. In some places calcareous material is on the surface; in others, it is 24 inches deep. Apparently the calcareous areas on the surface have been covered by material dug up by prairie dogs. In places, a few fragments of dolomitic limestone as much as 6 inches in length are on the surface.

\section*{LA CASA CLAY LOAM, 1 TO 3 PERCENT SLOPES (LaB)}

This soil is on convex surfaces to plane surfaces on undulating, eroded uplands. It occurs west of the Salt Fork of the Red River in the western part of the County. A profile of the soil is described for the series.

Within areas of this soil or in areas of adjacent soils, large round holes, many feet deep, form. These are called gyp sinks and result from soil slipping into underground caverns. The sinks are most likely to form during wet periods. Gypsum deposits at one time occupied the spaces now taken by the underground caverns. The gypsum dissolved gradually and was carried away in the underground water, leaving a deep cavity beneath the surface.

Included with La Casa Clay loam, 1 to 3 percent slopes, are small areas of Weymouth and Tillman soils. These inclusions, however, comprise less than 5 percent of the area. The Weymouth soils are in small areas, less than 5 acres in size. The La Casa soil occurs in areas that are gradational toward the Tillman soils, and accurate delineation is difficult.

Most of the La Casa soils are used for crops, of which wheat is the main one. Cotton, grain sorghum, and alfalfa are suitable, but good yields of these crops are less certain because of the limited supply of good moisture. The soil is suitable for irrigation, and a small acreage is irrigated. Under irrigation, very good yields are obtained. Controlling water erosion, maintaining good surface tilth, and conserving moisture are the main problems in using this soil for
tilled crops. Capability unit \(\Pi \mathrm{e}-1\) (dryland and irrigated); range site, Hardland.

\section*{VERNON SERIES}

The Vernon series consists of shallow, undulating to sloping soils on uplands. They are locally described as "red, tight land." The surface soil is compact, reddish-brown, calcareous clay loam or clay that is only about 6 inches thick. The underlying material, from 6 to 15 inches, grades into red, very compact, calcareous clay that contains a few white spots or concretions of lime. Below the surface layer, the soil breaks into very hard, intractable clods that have slick, glistening surfaces when moist. The parent material is residuum from red, calcareous shales or clays of the red beds.

The soils formed under a cover of native grasses that consisted chiefly of buffalograss, side-oats grama, blue grama, and some little bluestem.

Typical profile of Vernon soils on sloping, native range about 300 feet west of the south quarter corner of Section 20, Township 3 North, Range 23 West:

A1 0 to 6 inches, reddish-brown (2.5 YR 5/4, dry; 4/4, moist) clay loam or clay; weak, granular structure; firm when moist; calcareous; gradual boundary.

C 6 to 15 inches, red ( 10 YR 4/6, dry:3/6, moist) clay; massive (structureless); very firm; calcareous with few concretions of calcium carbonate.

15 inches + , similar to layer above but less weathered; contains a few small, round spots of bluish-gray material.

The surface soil varies in texture from clay loam to clay; in thickness, from 3 to 12 inches. In some areas in the western part of the county, thin layers of dolomitic limestone are interbedded with the parent material. Because they are shallow droughty, and susceptible to erosion, Vernon soils are not suited to crops.

\section*{VERNON SOILS (Ve)}

Vernon soils are mostly on slopes of more than 3 percent and range from gently sloping to steep. A typical profile is described for the series. The surface texture ranges from clay loam to clay, and the thickness, from 3 to 12 inches. In some places in the western part of the county, thin layers of dolomitic limestone are interbedded in the parent material. Also included in this mapping unit are minor areas of severely eroded, clayey soils that are cultivated or have been previously cropped. This inclusion comprises less than 2 percent of the Vernon soils.

These soils are not suited to crops. Most areas are used for range. They are only fair for this use and require careful management. Capability unit VIs-1 (dry-land), not suited to tillage and irrigation; range site, Red clay prairie.

\section*{ROUGH BROKEN LAND}

In this miscellaneous land type are steep escarpments, canyons, and extremely dissected or gullied areas in which mostly red beds are exposed. These areas support a scant growth of native vegetation, but they have very low value for grazing. A typical area is in the southwest quarter of Sec. 18, T. 1 N., R 23 W . Layers of limestone are exposed in an area at the north quarter corner of Sec. 31 T. 1 N., R. 22 W.

\section*{ROUGH BROKEN LAND (Rg)}

This is the only unit of this miscellaneous land type mapped in the county. Included are some areas of eroded, raw, red clay. Also exposed in some areas is shale that is not extremely broken. In the southwestern part of the county. Rough broken land includes areas in which are exposed layers of dolomitic limestone and beds of gypsum that are intermingled to a lesser extent with clays of the red beds. Capability unit VIIs-2 (dryland), not suited to cultivation or irrigation; range site, Breaks.

Glenn Briggs \& Associates, Inc. Consulting Engineers.

b. Engineering Properties - Engineering properties of the soils listed in the preceding section are given in a series of "Soil Survey Interpretations", from the soil manual. These are included here as FIGURE 10. through 12. While the soil survey manual gives a general expectation of the top five (5) feet of soils on site, specific details of surface soil properties and soils to forty (40) feet along with their properties are determined by soils borings and analyses. Subsequent sections contain the results of soils test borings and analyses.

\section*{C SOILS:}

Soil borings for this landfill site were made initially in 1981 by the City of Altus (dry auger) and by Moore Drilling Company (air rotary).

More recently in June, 1985, additional soil borings were made by Standard Testing and Engineering Company. Twenty-two (22) additional borings were made (see FIGURE 13. BORING PATTERN). The location and depth of these borings were selected after consultation with personnel of the OSDH. In August of 1988 additional borings were made to test in - situ and undisturbed samples for horizontal and vertical permeability. Again, these testing locations were selected after consultation with personnel of the OSDH. A copy of each soils boring report is included in APPENDIX C. GEOTECHNICAL REPORTS.

Materials encountered consist of medium to high plasticity silty clay underlain by a hard shale and gypsum from the Blaine formation. The shale stratum was interbedded with relatively this layers of sandstone in boring No. 1 which was the only boring where water was encountered. A slow seepage of water was encountered approximately five (5) feet below surface in boring No. 1, probably seeping from an adjacent farm pond.

The primary soil strata encountered at the site are reddish-brown silty clays and
ha harmon stony loam
THIS MAPPIMG OWIT COMPRISES SHALLOW OR VEAY SHALLOW, WELL DRAIMED, MODERATELY PEMREABLE, GEMTLY SLOPIMG TO HILLY SOILS OR UPLANDS. THE SOIL



Jeckson County January 1977

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FIGURE 12. VERNON SOILS
reddish brown and gray shales. Permeabilities range from \(1.8 * 10^{-7}\) to \(1.2 * 10^{-8}\) cm . / sec. Soil profiles and cross sections are included in the engineering plans ATTACHMENT 1. The Unified Soil classification is CL.

\section*{1. Boring Plan:}

Eleven soils test borings were made in 1981. These borings made by the City of Altus were spread over an area which included all of the land which the City owns in Section 11. Several of these test borings did reach ground water and serve as the basis for establishing the groundwater contours.

In 1985 after consultation with personnel of the OSDH, twenty two (22) soils test borings were made by Standard Testing and Engineering Company. These borings are all located inside the permit area as proposed by this application. The boring equipment utilized was a Simco rotary drilling unit equipped with a 20 foot derrick, a 4 inch diameter continuous flight auger and air circulation drag bits. Selected disturbed samples and thin wall push tube samples were taken to the laboratory for testing.The test holes were surveyed and staked. The top of each test hole was located on the \(\mathrm{X}, \mathrm{Y}\) and Z axis.

The 140 acre site is nearly rectangular in dimension and a grid boring pattern was utilized. The soils boring pattern is a 5 * 5 grid with one boring omitted due to the shape of the site. FIGURE 13. BORING PATTERN shows the location of the test holes.

In 1988 four additional borings were made by Shepherd Engineering and Testing Company which serve as the basis for establishing horizontal and vertical permeabilities. Both in - situ and push tube samples were utilized to establish test results.

\section*{2. Logs:}
a. Boring Log - The soils testing companies have prepared complete soil boring logs which are contained in APPENDIX C. GEOTECHNICAL INVESTIGATION REPORTS. A boring log summary of the twenty two (22) borings is included in the following TABLE 2. BORING LOG SUMMARY.
\begin{tabular}{|c|c|c|c|c|}
\hline TEST & SURFACE & DEPTH & BOTTOM & DEPTH BELOW \\
\hline HOLE & ELEVATION & OF BORING & ELEVATION & SOLID WASTE \\
\hline NO. & MSL* & (feet) & MSL & (feet) \\
\hline 1 & 1440 & 46.0 & 1394 & 45 \\
\hline 2 & 1456 & 21.0 & 1435 & 5 \\
\hline 3 & 1448 & 19.0 & 1429 & 4 \\
\hline 4 & 1438 & 46.0 & 1392 & 40 \\
\hline 5 & 1429 & 5.0 & 1424 & 6 \\
\hline 6 & 1443 & 11.0 & 1432 & 6 \\
\hline 7 & 1455 & 23.0 & 1432 & 6 \\
\hline 8 & 1456 & 24.0 & 1432 & 1 \\
\hline 9 & 1446 & 18.0 & 1428 & 4 \\
\hline 10 & 1437 & 12.0 & 1425 & 6 \\
\hline 11 & 1429 & 5.0 & 1424 & 14 \\
\hline 12 & 1465 & 33.0 & 1432 & 7 \\
\hline 10A & 1450 & 35.0 & 1415 & 20 \\
\hline 13 & 1452 & 25.0 & 1427 & 6 \\
\hline 14 & 1442 & 15.0 & 1427 & 5 \\
\hline 15 & 1428 & 46.0 & 1382 & 44 \\
\hline 16 & 1437 & 10.0 & 1427 & 0 \\
\hline 17 & 1445 & 25.0 & 1420 & 9 \\
\hline 18 & 1435 & 14.0 & 1421 & 13 \\
\hline 19 & 1435 & 46.0 & 1389 & 44 \\
\hline 20 & 1423 & 5.0 & 1418 & 7 \\
\hline 21 & 1423 & 19.0 & 1413 & 14 \\
\hline 2A & 1440 & 13.0 & 1427 & 0 \\
\hline 22 & 1448 & 22.0 & 1426 & 9 \\
\hline
\end{tabular}
* MSL - Mean Sea Level

TABLE 2. BORING LOG SUMMARY.

From the boring log summary is is apparent that 22 soils test boring are within the permit area. Of these, 8 are 10 feet below the lowest level at which solid waste will be places for disposal and 4 are 20 feet below the lowest level at which solid waste be placed.

\section*{GLENN BRIGGS \& ASSOCIATES, INC., ENGINEERS} GBA ARCHITECTS

b. Site Map - A map of the site showing the test borings, contour intervals, monitor wells, etc. in included as FIGURE 13. BORING PATTERN.

\section*{3. Water Levels:}

During the soils test boring process in 1981 groundwater was encountered which serves as the basis for establishing groundwater contours. In later soils test borings no groundwater was encountered with the exception of test boring No. 1. See FIGURE 13. BORING PATTERN for location. A slow seepage of water was encountered in boring No. 1, which is believed to be from a pond located 300 feet south of the test hole (see FIGURE 13. BORING PATTERN). Analyses of groundwater hydrology indicates the groundwater is 25 to 30 feet below the lowest level at which solid waste will be placed for disposal.

\section*{4. Plugging:}

When the soils test drilling was completed the test holes not developed as monitor wells were plugged with a sand - cement grout. The grout mixture contained nine sacks of cement per cubic yard.The holes were filled to within 3 feet of the surface. The top three feet was filled with local soils.

\section*{5. Testing Report:}

Complete geotechnical testing and analysis reports are contained in APPENDIX C. Generally soils on the site are alternating layers of clay and shale overlying a bed of gypsum rock at about 30 feet deep. The depth of the gypsum layer varies across the site. SHEET 7. through 9. SOILS PROFILES of the engineering plans, illustrate the soils on site.

\section*{6. Permeability:}

Permeability tests were conducted on disturbed samples and thin wall tube samples taken to the laboratory. Disturbed samples were compacted to an in place density of \(95 \%\) of maximum dry density at a moisture content equal to optimum moisture plus \(2 \%\). Permeability tests were conducted in falling head permeability in accordance ASTM Special Technical Publication 479. Permeabilities ranged from \(1.8 * 10^{-7}\) to \(1.2 * 10^{-8} \mathrm{~cm}\). \(\ \mathrm{sec}\). See APPENDIX C. GEOTECHNICAL REPORTS for complete details on soils investigation.

In - situ permeabilities as determined by the testing accomplished in August of 1988 range from \(2.4^{*} 10^{-6}\) to \(1^{*} 10^{-8} \mathrm{~cm}\). \(\backslash \mathrm{sec}\). These were established as the result of in - situ and push tube laboratory tests.

\section*{7. Cover Material:}

As development areas are excavated soil of various types will be segregated for later use in the landfilling process. Soils in the upper horizons will be stockpiled for use as final cover to restore vegetative cover. As subsequent layers of shale or clay soils are excavated they will be segregated and stockpiled for use as daily cover, intermediate cover or final cover. The clayey soils with higher cohesive characteristics and higher permeabilities will be utilized for intermediate and final cover. The more shaly soils will be utilized for daily cover and for bulking with liquid wastes.

\section*{D. SURFACE WATER HYDROLOGY:}

A division between geomorphic provinces divides Jackson County. The project site lies at the far southwest corner of the Central Redbed Plains. The County
averages 28 inches of precipitation per year. The site lies between the 1.0 inch and the 1.5 inch lines indicating areas of equal runoff. Many of the surface streams in the area are dry for much of the year.

\section*{1. Drainage Network:}

The project site lies on a ridge dividing the drainage basins for Turkey Creek and Horse Creek see (FIGURE 15. U.S.G.S QUADRANGLE MAP). Horse Creek and Turkey Creek converge Three (3) miles downstream from the site. From the point of convergence Turkey Creek runs seven (7) miles downstream to a convergence with the Salt Fork of the Red River. From the point where Turkey Creek enters the Salt Fork it is seven (7) miles down stream to the Red River. Stream meanders increase these distances.

The project site generally sheet drains into each receiving stream and no drainage channels exist which will affect development of the site.

\section*{2. Receiving Waters:}

As indicated by FIGURE 15. U.S.G.S. QUADRANGLE MAP., the receiving waters from the project site are Turkey Creek and Horse Creek. In this area Turkey Creek and Horse Creek are dry for part of each year.

\section*{3. Receiving Water Use:}
"OKLAHOMA WATER QUALITY STANDARDS 1985" as prepared by the Oklahoma Water Resources Board divide the state into water quality planning districts. The project site is in Planning Basin \#3 "Upper Red River". The stream segments which are the receiving waters for runoff from the project site are the Salt Fork which reaches from the Red River to the Texas state line and Turkey


Control by USGS, USC\&GS, and Oklahoma Geological Survey

Creek. These use segments are designed No. 311600. The uses are slightly different and are listed in TABLE 3. DESIGNATED STREAM USES which follows:

\section*{SALTEORK}

Public and Private Water Supply Primary Warm Water Fishery Agriculture - Class III Irrigation* Mining and Industrial Process and

Cooling water
Primary Recreation
Aesthetics

\section*{TURKEY CREEK}

Public and Private Water Supply Primary Warm Water Fishery Agriculture - Class I Irrigation Mining and Industrial Process and Cooling water
Primary Recreation Aesthetics
* Class I irrigation is a goal if natural conditions permit.

TABLE 3. DESIGNATED STREAM USES.

\section*{4. Receiving Water Quality:}

HYDROLOGIC ATLAS \# 6 "Reconnaissance of the Water Resources of the Lawton Quadrangle Southwestern Oklahoma", shows that surface quality monitoring stations operate on Turkey Creek near the town of Olustee, which is down stream from the project site and on Salt Fork near the town of Elmer which is down stream from the project site. No monitoring stations operate upstream from the project site on Turkey Creek. Stations do operate upstream from the site on the Salt Fork. The nearest is near Mangum which is twenty three (23) miles upstream from the confluence of Turkey Creek and the Salt Fork. The distance is further with stream meanders.

TABLE 4. GENERALIZED SURFACE WATER QUALITY gives the quality of water in Turkey Creek and the Salt Fork as indicated by the HYDROLOGIC ATLAS \# 6. Generally the water quality is of poor quality due to high dissolved solids and high sodium absorption ratios.

\section*{SALT FORK}
\begin{tabular}{lll} 
Total Dissolved Solids & \(>1,000 \mathrm{mg} / 1\) & \(>1,000 \mathrm{mg} / 1\) \\
Sodium Absorption ratio & \(4-8\) & \(>8\)
\end{tabular}

TABLE 4. GENERALIZED SURFACE WATER QUALITY.

Surfacewater monitoring points have been established on or near the site. These are shown on SHEET 6. CROSS SECTIONS of the development plans attached hereto. Background surface sampling will be carried out prior to excavating any additional disposal areas.

\section*{5. Impoundments:}

As indicated by FIGURE 14. SITE PLAN several surface water impoundments exist on and downstream from the project site. These take the form of privately constructed storage tanks. The purpose of these tanks is for flood control, stock water and irrigation water. Some of the on site tanks will be eliminated as the development of the site takes place. Other on site and off site tanks have been designated as surface water monitor locations. No impoundments of Turkey Creek, Horse Creek, Salt Fork or the Red River are known to exist between the project site and Lake Texoma, which is approximately 180 miles downstream from the site.

\section*{E. GROUND WATER HYDROLOGY:}

According to Kenneth S. Johnson, "Maps showing Principal Groundwater Resources and Recharge areas in Oklahoma", 1983, the project lies approximately one (1) to two (2) miles east of the eastern limit of the Blaine and Dog Creek Formation and recharge area. The Blaine and Dog Creek Formation is identified
as a major aquifer by Johnson. Within the same work Johnson also identifies alluvium and terrace deposits which have potential for groundwater. The site does not lie within an identified alluvial or terrace area. Groundwater contours for the project site have been developed and will be discussed in subsequent sections.

\section*{1. Potentiometric Water Surface Elevation:}

Hydrologic Atlas \# 6 has some data on potentiometric water surface elevation for selected wells in the region of the project site. A summary of that information is given in TABLE 5. GROUNDWATER LEVEL SUMMARY as follows:
\begin{tabular}{|c|c|c|c|c|}
\hline \multicolumn{2}{|l|}{WELL LOCATION*:} & \multicolumn{2}{|r|}{ELEVATION*:} & GEOLOGIC FORMATION: \\
\hline Direction: & Distance: & High: & Low: & \\
\hline SE & 24 miles & 26 & 31 & Terrace deposits \({ }^{\text {` }}\) \\
\hline NW & 12 miles & 28 & 58 & Dog Creek - Blaine - Flowerpot \\
\hline SW & 21 miles & 48 & 100 & Dog Creek - Blaine - Flowerpot \\
\hline
\end{tabular}

The following wells do not have monitoring history. The information provided is from HA \#6 but no date of elevation check is given.
\begin{tabular}{llll} 
NW & 2 miles & 57 & Dog Creek - Blaine - Flowerpot \\
NW & 3 miles & 38 & Dog Creek - Blaine - Flowerpot \\
NW & 4 miles & 50 & Dog Creek - Blaine - Flowerpot \\
SW & 2 miles & 94 & Dog Creek - Blaine - Flowerpot \\
S & 4 miles & 36 & no identified formation \\
E & 3 miles & 10 & no identified formation \\
NE & 4 miles & 9 flowing & Alluvium and terrace deposits \\
N & 2 miles & 10 & no identified formation \\
* From project site. & & \\
\(* *\) & & \\
& Feet below surface. & &
\end{tabular}

SOURCE: Havens, John S. "Reconnaissance of the Water Resources of the Lawton Quadrangle Southwestern Oklahoma", Oklahoma Geological Survey; 1977.

TABLE 5. GROUNDWATER LEVEL SUMMARY.

Groundwater contours have been established for the site which range from a high of 1405 MSL near the center of the site and a low of 1380 MSL in the southwest corner of the site.

\section*{2. Recharge and Discharge Areas:}

Kenneth S. Johnson in "MAPS SHOWING PRINCIPAL GROUND - WATER RESOURCES AND RECHARGE AREAS IN OKLAHOMA", indicates that the project site does not lie within or over a principal aquifer or recharge area.

\section*{3. Ground Water Sources:}
a. Domestic or Private Wells Within \(\mathbf{1 / 2}\) Mile - No domestic or private wells are known to exist within \(1 / 2\) mile of the project site
b Municipal or Public Wells Within 1 Mile - No municipal or public wells are known to exist within one (1) mile of the project site.
c. General Description of Groundwater Quality in Area - General descriptions of groundwater in the area are given in the Hydrologic Atlas \# 6. Specific groundwater quality was established from the results of the background test carried out when the monitor wells were completed. General information is given in below in TABLE 6. GENERAL GROUND WATER QUALITY.
\begin{tabular}{|c|c|c|c|}
\hline \multicolumn{2}{|l|}{WELL LOCATION*:} & TOTAL DISSOLVED & GEOLOGIC FORMATION: \\
\hline Direction: & Distance: & SOLIDS mg/l. & \\
\hline West & 3 miles & 3650 & Dog Creek - Blaine - Flowerpot \\
\hline West & 8 miles & 3730 & Dog Creek - Blaine - Flowerpot \\
\hline NW & 6 miles & 4330 & No identified formation \\
\hline NE & 10 miles & 4050 & No identified formation \\
\hline NE & 4 miles & 3170 & Alluvium terrace deposits \\
\hline SE & 8 miles & 2766 & Alluvium terrace deposits \\
\hline
\end{tabular}
* From project site.

SOURCE: Havens, John S. "Reconnaissance of the Water Resources of the Lawton Quadrangle Southwestern Oklahoma", Oklahoma Geological Survey; 1977.

BACKGROUND TEST RESULTS ON MONITORING WELLS.
\begin{tabular}{|c|c|c|c|c|}
\hline WELL: & \[
\frac{\mathrm{pH}:}{\mathrm{gm} . / \mathrm{l} .}
\] & \[
\frac{\text { Initial D.O. }}{\mathrm{gm} \cdot / \mathrm{l} .}
\] & \[
\frac{\text { Final D.O. }}{\mathrm{gm} \cdot / 1 .}
\] & COD \\
\hline 1. & 6.8 & 8.6 & 7.2 & 14.6 \\
\hline 2. & 6.8 & 9.2 & 7.4 & 11.1 \\
\hline 3. & 7.1 & 8.8 & 7.3 & 28.4 \\
\hline 4. & 7.0 & 8.8 & 7.3 & 19.8 \\
\hline
\end{tabular}

TABLE 6. GENERAL GROUND WATER QUALITY.

\section*{SECTION III.}

\section*{SITE DESIGN.}

\section*{III. SITE DESIGN}

\section*{A. EQUIPMENT:}

Equipment available for permanent use at the site includes as follows:
\begin{tabular}{ll}
1 each & \(D-8\) Dozer \\
1 each & 10 Yd. Scraper
\end{tabular}

The Dozer is utilized for excavating disposal areas stockpiling earthen materials, moving wastes and earth short distances, placing wastes, mixing wastes with soils, compacting wastes, placing cover materials and constructing access roads.

The Scraper is utilized for excavating disposal areas, moving wastes and earth longer distances, stockpiling materials, placing soils and wastes for disposal and constructing roads.

\section*{B. ROADS:}

\section*{1. Off Site Access Roads:}

Off site access roads are of asphaltic construction of the type that is commonly utilized in rural Oklahoma. The roads were constructed by Jackson County and are maintained by Jackson County crews. The roads are currently well maintained.

\section*{2. On Site Access Roads:}

On site access roads include a more permanent type asphaltic type construction
entrance road which runs from the entrance to the scales and employee shelter. Temporary roads will be constructed of on site materials and advanced across the site as the site is developed. They are constructed of coarse sand and gravel materials excavated from disposal areas and stockpiled for such purposes.The entrance road and the proposed temporary disposal area access roads are shown on SHEET 3. SITE DEVELOPMENT PLAN of the engineering plans attached. The roads are and will remain passable during inclement weather by normal vehicular traffic.

\section*{C SURFACE WATERS:}

A ridge line crosses the site from north to south in approximately the center of the site. The site slopes away from the ridge line in all directions; therefore, no surface runoff originating off site runs onto the site. The site slopes from the ridge line to the northeast and southwest with no natural drainage channels of sufficient size to affect the development of the site (see FIGURE 15. U. S. G. S. QUADRANGLE MAP and SHEET 2. PERMIT MAP of the engineering plans.)

\section*{1. General:}

The project site is designed and will be constructed and operated in such a manner as to prevent contamination of surface waters.

\section*{2. Surface Contour:}

As disposal areas are developed temporary earthen berms will be constructed to control surface runoff such that no runoff will enter the active working face. Runoff which originates in wastes at the active working face will be retained in temporary catchment basins and held until evaporation removes the water. Residues will be reincorporated into the working face.

As disposal areas are completed and final cover put in place surface runoff will as much as practicable be handled via sheet runoff. However, closed disposal area caps will be protected from erosion by channeling runoff around such areas. Design for such channels, dikes, terraces, embankments and other structures is at a minimum for the 50 year rain event. SHEET 3. SITE DEVELOPMENT PLAN of the engineering plans-shows details of the completed surface drainage system and design calculations are given in APPENDIX B. CALCULATIONS. No drainage structures are are anticipated at this time.

Surface runoff will be controlled to prevent surface waters from entering the the active working face or from eroding areas that are filled. Daily, intermediate and tinal cover will be protected from erosion to maintain their integrity.

\section*{3. Natural Contour:}

During the development of the site the natural contours will be altered substantially. In this process a surface drainage system will be designed to preserve the integrity of the covered disposal areas.

\section*{4. Final Grading:}

Final grading will be accomplished such that no ponding occurs on completed disposal areas and surface runoff channels do not erode the closed areas.

\section*{5. Waste Placement:}

Wastes will not be placed in waters that communicate with ground waters or surface waters.

\section*{6. Discharge:}

Neither leachate, contaminated water nor water which has come in contact with wastes on site will be allowed to be discharged from the site.

\section*{7. Sedimentation Control:}

Sedimentation control ponds and other structures will be constructed as necessary to retain leachate, sediment laden water and water which has come in contact with wastes. This water will be allowed to evaporate and the residues reincorporated into the waste disposal areas.

\section*{8. Remediation:}

If waters which have come in contact with wastes or leachate should be discharged from the site immediate actions will be taken to stop such flows. If necessary operational practices will be modified and remediation of ground or surface waters will be initiated.

\section*{9. Leachate Treatment:}

At this time a leachate collection system is not anticipated.

\section*{D. GROUND WATERS:}

The groundwater contours in the area show groundwater levels in excess of thirty (30) feet below the lowest elevation at which wastes will be places for disposal (see SHEET 5. GROUNDWATER CONTOURS of the engineering plans in ATTACHMENT 1). This site lies west of the "water balance" line as
established by the OSDH which means transevaporation exceeds rainfall to such an extent that water will not percolate downward through the waste disposal areas and carry leachate to the groundwater table.

\section*{1. General:}

The solid waste disposal areas and system of the Altus landfill are designed and will be constructed and operated in such a manner that will prevent contamination of groundwater. No wastes will be disposed of lower that five feet above the phreatic groundwater level.

\section*{2. Class of Groundwater Protection:}

Johnson, K.S., compiler, 1983, "Maps Showing Principal Ground - Water Resources and Recharge Areas in Oklahoma", Sheet 2, Bedrock Aquifers and Recharge Areas, published by the Oklahoma Geological Survey, Norman, Oklahoma, indicates that the eastern edge of the Blaine - Dog Creek Formation lies between one (1) and two (2) mile west of the project site. As the exact limit of this aquifer is difficult to determine Class 1 groundwater protection will be employed.

\section*{3. Groundwater Protection Standards:}

Class 1 groundwater protection for a Type I-B Metropolitan Sanitary Landfill consists of separation and containment of wastes by one of the following methods:
a. Liners - A natural or in-situ liner, a minimum of three (3) feet in thickness which has a hydraulic conductivity of no greater than \(1 * 10^{-7} \mathrm{~cm}\). / sec.
b. Admixture - If available soils cannot meet the hydraulic conductivity requirements an admixture of sodium bentonite or other additive approved by the OSDH may be utilized.
c. "Water Balance Line" - The site of the Altus Municipal Landfill is west of the "water balance" line as established by the OSDH; therefore, no liner is required. However, no wastes will be disposed of lower than five (5) feet above the highest seasonal phreatic ground water level.

\section*{E. MONITORING:}

\section*{1. Surface Water Monitoring:}

Several impoundments of surface water exist within the runoff area of the project site. Some of these have been selected as surface water monitoring points. The monitoring points are identified and their location is shown on SHEET 6. CROSS SECTIONS of the engineering plans attached hereto. Background surface water monitoring samples will be taken and analyzed prior to opening additional development areas. A surface monitoring plan is included as APPENDIX D. MONITORING PLAN.

\section*{2. Groundwater Monitoring:}

Groundwater contours indicate that the groundwater table is thirty (30) to forty (40) feet below the bottom of the proposed disposal area excavations in the area of the Altus landfill. Seven groundwater monitoring wells are proposed. Their location is such that at least one (1) well is up gradient and and two (2) wells are down gradient from the disposal areas. The location of existing and proposed groundwater monitoring wells are shown on SHEET 5. GROUNDWATER CONTOUR MAP of the engineering plans attached hereto.
b. Admixture - If available soils cannot meet the hydraulic conductivity requirements an admixture of sodium bentonite or other additive approved by the OSDH may be utilized.
c. "Water Balance Line" - The site of the Altus Municipal Landfill is west of the "water balance" line as established by the OSDH; therefore, no liner is required. However, no wastes will be disposed of lower than five (5) feet above the highest seasonal phreatic ground water level.

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\section*{2. Groundwater Monitoring:}

Groundwater contours indicate that the groundwater table is thirty (30) to forty (40) feet below the bottom of the proposed disposal area excavations in the area of the Altus landfill. Seven groundwater monitoring wells are proposed. Their location is such that at least one (1) well is up gradient and and two (2) wells are down gradient from the disposal areas. The location of the groundwater monitoring wells are shown on SHEET 6. CROSS SECTIONS of the engineering plans attached hereto.

Details of the design of the monitor wells are included on SHEET 9. MISCELLANEOUS DETAILS of the engineering plans, ATTACHMENT 1. When the wells are completed as - constructed drawings will be submitted to the OSDH.

Four groundwater monitor wells were constructed in 1985. The results of the background testing is included in previous sections of this report. Additional groundwater monitor wells will be constructed prior to excavating additionial disposal areas. Within thirty (30) days of completion water samples will be taken for background purposes. Background sampling will establish the static water level and the samples will be tested for \(\mathrm{pH}, \mathrm{COD}\), conductivity, drinking water standards, metals and a GC/MS scan for organics. The test results will be submitted to the OSDH prior to excavating new disposal areas.

Groundwater monitor wells will be tested quarterly with the test results submitted the OSDH within fifteen (15) days of receipt by the City. A copy of the test results will be maintained at city hall for public inspection throughout the life of the facility and the post closure period.

Monitoring well sampling procedures, sample preservation, record keeping and reporting are detailed in APPENDIX D. MONITORING PLAN.

\section*{3. Gas Monitoring:}

At this time gas monitoring is not anticipated. If at some future date gas monitoring is deemed necessary a monitoring system will be designed and installed according to requirements.

\section*{F. CLOSURE:}

Operation of the landfill will be a continuous process of excavating disposal
areas; sorting and stockpiling excavated materials; placing, mixing and compacting wastes; and placing and compacting daily, intermediate and final cover. The process will proceed in a continuum across the site (see SHEET 3. SITE DEVELOPMENT PLAN of the engineering plans attached). Final closure will come at the end of this process with a small area remaining to close.

\section*{1. Schedule:}

Final cover will be placed within one week of placing the final wastes in a disposal area. When the final disposal area is filled the OSDH will be notified fifteen (15) days prior to final closure so that inspections can be made. The site will be maintained and monitored for eight (8) years after final closure.

\section*{2. Cover Amounts:}

Final cover will consist of at least fifty four (54) inches of cohesive materials and at least six (6) inches of topsoils suitable for establishing and maintaining vegetative cover. During the excavation of disposal areas select materials will be sorted and stockpiled for this purpose. The following TABLE 7. FINAL COVER MATERIALS sets out quantities of cover materials required and materials available.
\begin{tabular}{lllll} 
TYPE OF MATERIAL: & AREA I & & AREA II & \\
\hline AREA III \\
Cover material yds. 3: & 612,714 & 247,769 & & 169,273 \\
Topsoil yds. \(3:\) & 68,079 & & 27,529 & \\
\hline
\end{tabular}

TABLE 7. FINAL COVER MATERIALS.

\section*{3. Procedures for Final Cover:}

Within one week of placing the final wastes in a disposal the final cover will be placed. Final cover will consist of at least fifty four (54) inches of cohesive materials placed in eight (8) inch lifts and compacted. The top six (6) inches of final cover will consist of topsoils capable of establishing and maintaining vegetative cover.

The final cover or cap of each disposal area will be shaped to a final grade no greater than a \(25: 1\) slope with the edges shaped to a \(4: 1\) slope. Elevations of the cap will not exceed seventy five (75) feet above the original ground elevations. These were established by topographic surveys conducted prior to site development. SHEET 3. DEVELOPMENT PLANS and SHEET 9. MISCELLANEOUS DETAILS show he details of construction, final cover and final elevations of the disposal areas.

Vegetative cover will be established within the first growing season after the disposal area is closed and in no case more than one year after the closing of a disposal area. Grasses utilized for final cover will be selected for their ability to become established quickly and for their ability to prevent erosion.

\section*{4. Drainage System:}

The drainage system for the site is designed to maintain the integrity of the closed disposal areas and prevent erosion of the caps. As much as is practicable sheet drainage will be utilized. However, some drainage diversion is necessary to keep runoff from eroding final cover. The proposed final drainage system is illustrated on SHEET 4. DEVELOPMENT PLANS of the engineering plans attached to this application. Design criteria for the drainage system is the fifty (50) year rain event. Design calculations are given in APPENDIX B. CALCULATIONS.

\section*{5. Costs}

Closure costs are set our in TABLE 8. CLOSURE COSTS below.
\begin{tabular}{|c|c|c|c|}
\hline ITEM: & AREA 1 & AREA 2 & AREA 3 \\
\hline Earthwork: & \$141,800 & \$57,350 & \$39,200 \\
\hline Shaping and Grading: & 14,707 & 5,500 & 3,920 \\
\hline Topsoil: & 14,175 & 5,700 & 3,900 \\
\hline Seeding and Sprigging: & 28,130 & 11,400 & 7,780 \\
\hline TOTAL: & \$198,175 & \$80,200 & \$54,800 \\
\hline
\end{tabular}

TABLE 8. CLOSURE COSTS.

\section*{SECTION IV.}

SITE CONSTRUCTION.

\section*{IV. SITE CONSTRUCTION}

The Altus Municipal Landfill has been permitted as a landfill since May 1982 and facilities that are in place generally meet the requirements of the OSDH regulations. The permanent structures exist such as the employee shelter, scales, litter fencing, boundary, fencing, locking gate, signs and equipment maintenance facilities. The development plans show the existing features and structures as well as those which are proposed.

\section*{A. EXISTING TOPOGRAPHY:}

The existing site topography is shown in two graphic illustrations. A U.S.G.S . Quadrangle Map with 10 - foot contour intervals is included as Figure 14. U.S.G.S. QUADRANGLE MAP. A two-foot contour map was surveyed and prepared in anticipation of this application. It is included as SHEET 2. in the engineering plans.

Generally the site is the high point for the immediate vicinity. A ridge line crosses the site from north to south and the surface topography slopes from that ridge to the northeast and the south west. This ridge is the dividing line between the drainage basin for Horse Creek and Turkey Creek with the southwest sloping side of the site draining into Turkey Creek. No surface drainage originating off site runs onto the site.

The nearest flood prone area is shown on FIGURE 3. FLOOD PRONE AREA MAP.

\section*{B. GENERAL SITE PLAN:}

The general site plan contained in the engineering drawings illustrates all natural features and man made features which will affect the operation of the site as a landfill.

\section*{1. Permit Boundary:}

The landfill permit boundary is delineated on the site development plan SHEET 2. of the engineering plans. The one hundred forty (140) acre site as illustrated on the plans and described on Form 850 at the beginning of this application is described by Section call and includes to the center of the adjacent access road which is a section line. This method of description includes the statutory right-of-way within the permit boundary. This right-of-way will not be in the development area and the 50 foot setback zone along the east side will start with the fence. This is illustrated on the site development plans.

\section*{2. Bore Hole Locations:}

The location of the twenty two (22) soils test borings, the location of the seven (7) monitor wells and the location of the surface water monitor locations are illustrated on SHEET 2. of the engineering plans.

\section*{3. Existing Contours:}

The existing topography is illustrated on SHEET 2. of the development plans. A two-foot contour interval was utilized for the site development plans and design purposes.

\section*{4. Sequence of Excavation, Landfill and Cover:}

The sequence of site utilization will begin with development Area 1. and continue across the site. The progression will then be from Area 1 to 2 to 3 . The sequence and direction of utilization within each development area is shown on SHEET 3. DEVELOPMENT PLANS. As each disposal area is excavated materials will be sorted and stockpiled for use in road construction, compacted cover and top soil. After the first section of the first disposal area is excavated deposition of wastes will begin. The cover materials will be excavated from the next section of the disposal area as they are required for periodic cover. In this manner a continuous process of excavating, stockpiling and filling will take place as the site is utilized. Final cover will be placed and shaped within one week of placing the final wastes in a disposal area.

\section*{5. Surface Drainage:}

Surface drainage will be controlled on a temporary basis and after filling operations are completed in a disposal area, it will be controlled on a permanent basis. As much as is practicable sheet drainage will be utilized. The active working face will be will be protected by temporary drainage structures to divert surface runoff from entering or crossing the face. Runoff originating in the working face will be retained. The completed disposal areas will be protected from erosion by drainage diversion. Details of the temporary and permanent drainage system are shown on the development plans.

\section*{6. Fencing, Utility Lines and Easements:}

Fencing and locking gates for the site are in place and will be retained. Details of these structures are shown on the development plans. A utility easement exists
along the west side of the site. This is illustrated on the development plans. The development areas have been designed such that this will not interfere with utilization of the site.
7. Access Road:

The proposed on-site access road is shown on the development plans. This road will be constructed such that disposal operations can continue in inclimate weather.

\section*{8. Sequence of Filling Operations:}

The sequence of filling operations will begin with Area 1. and continue across the site. The operations will utilize the site as a continuous fill area rather than trench fill methods to gain maximum utilization.

\section*{9. Cover Material Borrow Areas:}

Sufficient cover material will be generated by on-site excavation. No borrow areas are proposed at this time.

\section*{10. Employee and Equipment Shelters:}

The employee and equipment maintenance area is constructed on site at this time. No alterations in this structure is contemplated. The location of this structure is shown in the site development plans.

\section*{C. TYPICAL FILL CROSS SECTION:}

Typical fill cross sections are illustrated on SHEET 6. of the engineering plans.
D. GROUND AND SURFACE WATER PROTECTION MEASURES:

Ground and surface water protection measures include the construction of diversion ditches, placement of compacted final cover, construction of temporary retainage ponds, establishing vegetative cover to retard erosion, construction of monitor wells, testing of groundwater and surface water in accordance with the monitoring plan in the appendix. The construction details of these measures are contained in the attached engineering plans.

\section*{E. COMPLETION MAP:}

A map showing final contours at completion of the landfill operations is included as SHEET 4. in the engineering plans attached hereto.

\section*{SECTION V.}

\section*{SITE OPERATION.}

\section*{V. SITE OPERATION}

\section*{A. ACCESS ROAD:}

Access roads on site are constructed to be all weather access roads. Additional roads will be constructed as shown in the development plans. The additional roads will be constructed as necessary to reach the unloading areas as various disposal areas are utilized. The access roads be constructed such that the disposal areas are accessible in inclimate weather.

\section*{B. EMPLOYEE SHELTER:}

The employee shelter is already in place on the site. Its location is indicated on the site development plans. The shelter includes safe drinking water, sanitary hand washing facilities, toilet facilities, lighting, heating facilities, and proper screening is provided for landfill employees and collection personnel who are unloading vehicles at the site. The domestic water supply is furnished from the Jackson County Rural Water District.

\section*{C. MEASUREMENT PROCEDURE:}

Measurement of incoming loads of wastes is by weight basis. A truck scales has been constructed at the entrance to the site. Records on volumes, weights and types wastes for disposal are kept by landfill crews and provide the basis for monthly reports to the OSDH.

\section*{D. FIRE PROTECTION:}

Fire protection is a combination of operator vigilance and protective measures. Fire extinguishers are maintained on all equipment, in the employee shelter and equipment maintenance areas. Loads of wastes which have a potential for spontaneous combustion will be spread and mixed with earth. Daily cover tends to smother embers which may be in loads of wastes. A stockpile of earth is maintained close to the working face of the fill for fire prevention. Fire trucks from Altus will provide fire protection when called. The City of Altus has recently tapped into the Altus/Duke water transmission line which runs along the south side of Section 11 and have constructed a 4 " water line for additional fire protection. The location of this line is shown on the development plans.

\section*{E. ACCESS CONTROL:}

The site is fenced and a locked gate provides access control during closed hours. A sign at the gate notes hours of operation, the permit number, the identity of the site, the types of wastes accepted and the types of wastes not accepted. Operators are on duty at all times when the site is open to record loads of wastes received and to control the types of wastes received. Wastes to be received during non-operating hours may be arranged in advance and an operator will be present to record the loads and provide daily cover. Signs within the site direct traffic to the unloading areas.

\section*{F. UNLOADING:}

Traffic on site and unloading is controlled by the operators. Traffic is directed to control congestion, provide for operator safety and to insure that wastes are unloaded in the appropriate areas. This also prevents delays in compacting and covering wastes.

\section*{G. WORKING FACE:}

The size of the working face is maintained such that adequate area is available for unloading of wastes and that daily cover can be placed with available equipment. Generally the working face is maintained at three (3) times the width of the equipment working the face.

\section*{H. LITTER CONTROL:}

Litter is controlled by a combination of policing of the site, restriction of the area for unloading and litter fencing. Litter fencing is constructed around the disposal areas on a routine basis.

\section*{I. SPREADING AND COMPACTING REFUSE:}

Wastes are unloaded at the bottom of the working face, mixed with earth and spread and compacted while being worked up the face. Slopes are maintained at 2:1 and no more than 4:1. Should the City acquire a compactor slopes may be lowered to 6:1. Wastes are compacted in layers no more than two feet thick.

\section*{J. CELL DEPTH:}

Cell depth, measured perpendicular to the working face is no more than eight (8) feet. The height of lifts, measured vertically will vary with the excavation depth of the disposal area and is not restricted by cell depth. Details of cell construction are included in the development plans.

\section*{K. DAILY COVER:}

Daily cover will consist of six (6) inches of materials excavated from the disposal area and stockpiled for such purposes. Daily cover will be placed and compacted at the end of each day of operation. When in place the cover will be free of litter or refuse such that insects and rodents do not become a problem, refuse is not dispersed by wind and water does not infiltrate.

Construction / demolition disposal areas and areas for disposal of bulky items are segregated and if putrescible materials are not present these areas are covered every two (2) weeks.

\section*{L. INTERMEDIATE COVER:}

On disposal areas where final cover or additional waste will not be deposited for two (2) weeks an additional six (6) inch layer of cohesive earthen materials wii: be placed and compacted. Materials for this purpose are stockpiled during the excavation of disposal areas. The purpose of intermediate cover is to prevent insects and animals from burrowing into the disposal cells and the infiltration of water.

\section*{M. FINAL COVER:}

Final cover will be placed within one week of placing the last wastes in a disposal area. Final cover will consist of four and one-half ( \(41 / 2\) ) feet of cohesive material compacted in eight (8) inch lifts and six (6) inches of topsoil. Final cover will be graded to the lines and grades shown on the development plans. The top of each disposal area cap will be graded to a slope of no more than \(25: 1\) and the sides of the cap will be graded to slopes of no more than 4:1.

The top six (6) inches of the final cover will consist of soils suitable for establishing and maintaining vegetative cover. The vegetative cover will be established in the first growing season after the final cover is placed but no more than one year later.

\section*{N. EQUIPMENT MAINTENANCE:}

Equipment on the site is of sufficient size to handle incoming wastes on a daily basis. Equipment is maintained according to manufactures recommendations. The maintenance program is such that equipment is functional as necessary to provide assistance with placing wastes, compacting wastes and cover. If equipment should become inoperable extra equipment will be brought in from other city departments.

\section*{O. CO-DISPOSAL:}

Co-disposal of liquid waste is not allowed. Semi-solid waste and Type II and Type III municipal sewage sludge may be disposed in the landfill provided it contains at least \(18 \%\) solids and does not exceed \(10 \%\) of the total volume of wastes received in the same day. In Type I facilities the volume of liquid wastes (sludges) may be increased to twenty five (25) percent of the daily volume if provisions are made in the development plans.

Liquid wastes containing less than \(18 \%\) solids are placed in a separate area and bulked with earthen materials to provide mechanical strength. Bulking is required to support equipment, maintain slopes and to keep liquids from being expelled when wastes are compacted.

\section*{P. INDUSTRIAL WASTE:}

Disposal of "controlled industrial waste" is not allowed. "Other industrial wastes" may be accepted if volumes do not exceed ten (10) percent of the average monthly volume. This volume may be increased with approval of the OSDH.

\section*{Q. SPECIAL WASTES:}
"Special wastes" are accepted at the site and are covered with other domestic wastes immediately upon disposal. Liquid wastes are bulked prior to placement on the working face."Special wastes" are those wastes that are not controlled industrial wastes but which because of their nature or volume require special or additional handling.

\section*{R. LARGE OR BULKYITEMS:}

Large or bulky items require special handling. If putrescible wastes are not present they are disposed of in a separate area and covered every two weeks. If putrescible wastes are present they are covered daily. If they are disposed of in the working face they are not placed immediately on top of cover materials.

\section*{S. BURNING:}

No burning is allowed at the landfill site.

\section*{T. SALVAGE:}

Scavenging is not allowed. Salvaging or recycling operations may take place after the OSDH has approved an operations plan for such activities and they must take place in a separate area.

\section*{U. VECTOR CONTROL:}

Vector control measures, in addition to the application of cover and final grading, are instituted whenever necessary to prevent the transmission of disease, prevent bird hazards to aircraft, and otherwise prevent and reduce hazards created by rats, flies, snakes, insects, birds dogs and skunks. Supplemental vector control measures will be performed or instituted within twenty four (24) hours if they become necessary.

\section*{v. DUST CONTROL:}

Dust control measures are instituted whenever dust generated by operations becomes a problem.

\section*{W. ANIMAL FEEDING:}

Garbage feeding of animals is not allowed at the site. Domestic animals are excluded from the site. Guard dogs are allowed for security purposes.

\section*{X. ACCIDENT PREVENTION AND SAFETY:}

Employees are instructed in the correct operational procedures of the site and equipment in a effort to reduce accidents. An adequately stocked first aid kit is maintained at the employee shelter. Accident prevention measures are employed where appropriate. At least one person trained in first aid shall be on duty during operating hours.

\section*{Y. RECORDKEEPING AND REPORTING:}

Daily record keeping includes logs of volumes and types of wastes received.

These records are maintained on form No. 854 provided by the OSDH and submitted to the department by the 10 th of each month. Monitor data are maintained in records at city hall and copies are submitted to the department as they becomes available. Daily logs will include information on the landfill site used, any deviations from the plans and specifications and other daily activities of interest such as weather, equipment breakdowns, employee problems, fire, etc.

\section*{Z. GROUNDWATER PROTECTION:}

Groundwater protection at the site is in accordance with the development plans approved by the OSDH. Test data will be submitted to the department as soon as it becomes available.

The landfill is designed to prevent infiltration into and seepage out of the landfill to prevent contamination of the groundwater. Compaction tests will be conducted on development area covers to prevent percolation into the disposal areas.

The site location is west of the "water balance line"; therefore, the bottom of disposal areas do not require liners.

\section*{AA. MONITORING:}

\section*{1. Groundwater Monitoring:}

Seven (7) groundwater monitor wells are proposed on the site such that at least one well is upgradient and two are hydraulically downgradient from the site. Four of the wells have been installed. The remaining wells will be located and constructed according to the construction detail in the development plans.

The wells will be sampled to provide background water quality information in accordance with the sampling plan in the appendix. This initial sampling will be accomplished within two weeks of well installation. The wells will be will be sampled for static water level, \(\mathrm{pH}, \mathrm{COD}\), conductivity, drinking water standards, metals, and a GC/MS scan for organics will be run. Every quarter thereafter the static water level, \(\mathrm{pH}, \mathrm{COD}\) and conductivity will be tested. The testing results will be sent to the OSDH within fifteen (15) days of receipt by the city and a copy of the test results will be maintained at city hall for public inspection. Background sampling of the existing wells is already accomplished.

\section*{2. Surfacewater Monitoring:}

Two (2) surface water monitoring sites are located downstream from the site and two (2) are located upstream from the site. These locations are shown on the development plans. Background water quality samples will be taken according to the sampling protocol set out in the monitoring plan in APPENDIX D. MONITOR PLAN. Surface water quality samples will be taken and analyzed quarterly thereafter.

\section*{3. Gas Monitoring :}

Gas monitoring is not contemplated at this time.

\section*{BB. WASTE PLACEMENT:}

Wastes will be placed at the bottom of the working face, mixed with earth, and compacted into the working face. The constructions details of the disposal cells and areas are provided in the development plans.

Wastes will not be placed within five (5) feet of the highest seasonal phreatic
groundwater level. Contaminated surface water or leachate will not be allowed to exit the site.

\section*{CC. SURFACE DRAINAGE:}

Temporary surface drainage structures will be placed above and below the active working face to prevent surface runoff from entering the working face and to prevent surface runoff which originates in the working face from leaving the site. This runoff will be retained in temporary ponds until transevaporation removes the liquid and the residues will be reincorporated in the working face.

Permanent surface drainage will as much as practicable be designed for sheet runoff. The closed disposal areas will be protected from erosion by runoff. Complete surface drainage construction details are shown in the development plans. Design calculations are based at least on the fifty (50) year rain event and given in the appendix.

\section*{DD. FINAL GRADING:}

Final grading shall be to the lines and grades established in the development plans approved by the OSDH. The final elevations will not exceed seventy five (75) feet above original ground contours as established by the site surveys prepared prior to development of the site.

Slopes of the top of closed development areas will not exceed \(25: 1\) and the side slopes of the completed development areas will not exceed \(4: 1\). Vegetative cover will be established the first growing season after the final grading is complete but not more than one year later.

\section*{EE. CLOSURE:}

The department will be notified fifteen (15) days before final closure of the site. The site will be maintained for eight (8) years after closure. Monitoring samples will be collected and tested quarterly during the eight (8) year period. Results of the test will be forwarded to the OSDH.

\section*{SECTION VI.}

\section*{SITE MAINTENANCE.}

\section*{VI. SITE MAINTENANCE}

\section*{A. POST - CLOSURE CARE:}

After closure the site will be inspected on a routine basis by the City to insure the site is not used for anything that will conflict with the intended uses or which may be detrimental to the integrity of the closed cells. Intended post - closure land uses are agriculture in nature, primarily improved pasture.

\section*{B. POST - CLOSURE MAINTENANCE:}

The site will be utilized for agriculture purposes and necessary mowing and/or revegetation will be performed by City forces. Final cover will be replaced or regraded should erosion or differential settling damage the disposal area cap.

\section*{C POST-CLOSURE MONITORING:}

Post - closure groundwater and surface water monitoring will be carried out according to the monitoring plan for a period of eight (8) years after closure. Test results will be forwarded to the OSDH as they are received and copies will be retained at city hall for public inspection.

\section*{D. ESTIMATED POST - CLOSURE COSTS:}

Estimated post closure costs for the eight (8) year monitor period are set out in the following TABLE 9. ESTIMATED POST CLOSURE MAINTENANCE COSTS. As this application is submitted by a governmental entity with no previous sites improperly closed a bond is not required.

ITEM:
Testing:
Inspection:
Repair:
Mowing:
TOTAL:*

AREA 1
\(\begin{array}{rl}\$ 1,600 \\ 2 & 500\end{array}\)
2,500
12,800
12,800
\$29,760

AREA 2
\$ 800
1,280
5,800
\(\begin{array}{r}5,800 \\ \hline\end{array}\)
\(\$ 13,680\)

AREA 3
\$ 600
960
3,900
3,900
\$9,360
*Total is for the eight (8) year monitor period.
TABLE 9. ESTIMATED POST CLOSURE MAINTENANCE COSTS.

\section*{APPENDIX A. OWNERSHIP DOCUMENTS.}

\section*{KNOW ALL MEN BY THESE PRESENTS:}

That ABBIE HEIDEBRECHT and ALVIN HEIDEBRECHT, her husband; DOROTHY ABBOTT and JOE ABBOTT, her husband; AGNES WHITTINGTON and DUFFIE WHITTINGTON, her husband; MADGE BILLS and GEORGE E. BILLS, her husband; JOE BOALDIN and BETTY BOALDIN, his wife; A.C. BOALDIN, JR. and OLETA BOALDIN, his wife; LEALAND BOALDIN and PYRENE BOALDIN, his wife; WILMER BOALDIN and BARBARA BOALDIN, his wife; and ROBERT BOALDIN, a single man, of Jackson County, State of Oklahoma, parties of the first part, in consideration of the sum of Ten and more Dollars in hand paid, the receipt of which is hereby acknowledi,ed, do hereby Grant, Bargain, Sell and Convey unto ALTUS MUNICIPAL AUTHORITY, a Municipal Trust of Jackson County. State of Oklahoma, party of the second part, the following described real property and premises situate in Jackson County, state of Oklahoma, to-wit:

All that part of Section Eleven (11) in Township Two (2) North of Range Twenty-two (22) West of the I.M. lying South of the right-of-way of Hollis \& Eastern Railway Company containing 469.5 acres, more or less;
together with all the improvements thereon and the appurtenances there unto belonging, and warrant the title to the same.

TO HAVE AND TO HOLD said described premises unto the said party of the second part, its successors and assigns forever, free, clear and discharged of and from all former grants, charges, taxes, judgments, mortgages and other liens and incumbrances of whatsoever nature.


DOROTHY ABBoTT
had re Yoiles
MADGE BOILS


TVilmeV Borlchin WILMER BOALDIN.
AG OE of ow Whithigtom \(\qquad\)

S'IATE OF OKLAHOMA )
COUNTY DF JACKSON j
Before me the undersigned, a Notary Public in and for said County and State on this \(/ 1^{\lambda}\) day of May, 1981, personally appeared ABBIE HEIDEBRECHT and ALVIN HEIDEBRECHT, husband and wife, DOROTHY ABBOTT and JOE ABBOTT, husband and wife, MADGE BILLS and GEORGE E. BILLS, husband and wife, JOE BOALDIN and BETTY BOALDIN, husband and wife, A.C. BOALDIN, JR. and OLETA BOALDIN, husband and wife, LEALAND BOALDIN and PYRENE BOALDIN, husband and wife, WILMER BOALDIN and BARBARA BOALDIN, husband and wife, and ROBERT BOALDIN, a single man, to me known to be the identical persons who executed the within and foregoing instrument and acknowledged to me that they executed the same as their free and voluntary act and deed for the ruses and purposes therein set forth.

Given under my hand and seal the day and year last above


My commission expires
August 28, 1984


STATE OF TEXAS ) COUNTY OF HARRIS )

Before me the undersigned, a Notary Public, in and for said County and State, on this 15 th day of May, 1981 , personally appeared AGNES WHITTINGTON and DUFFIE WHITTINGTON, her husband, to me known to be the identical persons who executed the within and foregoing instrument and acknowledged to me that they executed the same as their free and voluntary act and deed for the uses and purposes therein set forth.
- Given under my hand and seal the day and year last above written.

My commissiun expires APRIL 13, 1985


\section*{APPENDIX B.}

\section*{CALCULATIONS.}

Glenn Briggs \& Associates, Inc.
Consulting Engineers

\section*{APPENDIX B \\ ALTUS LANDFILL - PHASE I \\ DESIGN INFORMATION AND CALCULATIONS}
I. DESIGN DATA:
A. Proposed Landfill Area
B. Average Population to be served during

Life of Landfill (Year 2010)
C. Solid Waste Density (assumed)
D. Losses in Gross Landfill Volume

Due to Trench Walls, etc.
\(20 \%\)
II. DESIGN COMPUTATIONS:
A. Landfill Volume Required:

Solid Waste Generated from City of Altus Records = 333 c.y./day
Required Soil Cover Estimated at 44 cu. yds. \(47.5 \times 1.2=\) 57 c.y./day Plus 20\% Compaction
TOTAL LANDFILL VOLUME REQUIRED: 390 c.y./day
B. Final Soil Cover Required:
\(\frac{70.33 \mathrm{ac} . \times 43,560 \mathrm{sq} . \mathrm{ft} . \times 5 \mathrm{ft} . \times 1.20 \text { (shrinkage) }}{27 \mathrm{cu} . \mathrm{ft} . / \mathrm{c} . \mathrm{y} .}=\quad 680,794 \mathrm{cu} . \mathrm{yds}\).
C. Gross Landfill Volume Provided:

By Excavations (See Cross-Sections)
By Fill Above Existing Grade (See Cross-Sections)
TOTAL:
\(1,247,565 \mathrm{cu}\). yds. 1,665,548 cu. yds. 2,913,113 cu. yds.
D. Reduction From Gross Volume:

Volume Loss Due to Final Cover
680,794 cu. yds.
Volume Loss Due to Trench Walls and Intermediate Cover
NET LANDFILL VOLUME:
\(446,464 \mathrm{cu} . \mathrm{yds}\).
1,785,855 cu. yds.
E. Estimated Landfill Life:

1,785,855 cu. yds. 12.55 yrs.

\section*{Glenn Briggs \& Associates, Inc.} Consulting Engineers
F. Daily Cover Required For Life of Landfill:

57 cu . yds. \(\times 365 \times 12.55 \mathrm{yrs}\). \(=\)
261,010 cu. yds.
G. Total Soil Required For Life of Landfill: \(261,010 \mathrm{cu}\). yds. \(+680,794 \mathrm{cu}\). yds. \(=\quad 941,804 \mathrm{cu} . \mathrm{yds}\).
H. Total Soil Provided From Excavation

See Cross-Sections 1,247,565 divided by 1.2(comp) =
998,052 cu. yds.

EXCESS EXCAVATION:
\(-56,248 \mathrm{cu} . \mathrm{yds}\).

\title{
APPENDIX B \\ ALTUS LANDFILL - PHASE 2 \\ DESIGN INFORMATION AND CALCULATIONS
}

\section*{I. DESIGN DATA:}
A. Proposed Landfill Area
B. Average Population to be served during

Life of Landfill (Year 2010)
C. Solid Waste Density (assumed)
D. Losses in Gross Landfill Volume Due to Trench Walls, etc.

\section*{II. DESIGN COMPUTATIONS:}
A. Landfill Volume Required:

Solid Waste Generated from City of Altus Records = 333 c.y./day
Required Soil Cover Estimated at 44 cu. yds. \(47.5 \times 1.2=\) 57 c.y./day Plus 20\% Compaction
TOTAL LANDFILL VOLUME REQUIRED:
B. Final Soil Cover Required:
\(\frac{28.44 \mathrm{ac} . \times 43,560 \mathrm{sq} . \mathrm{ft} . \times 5 \mathrm{ft} . \times 1.20 \text { (shrinkage) }}{27 \mathrm{cu} . \mathrm{ft} . / \mathrm{c} . \mathrm{y}_{0}}=\quad 275,299 \mathrm{cu} . \mathrm{yds}\).
C. Gross Landfill Volume Provided:

By Excavations (See Cross-Sections) 540,382 cu. yds.
By Fill Above Existing Grade (See Cross-Sections) TOTAL:
D. Reduction From Gross Volume:

Volume Loss Due to Final Cover
275,299 cu. yds.
Volume Loss Due to Trench Walls and Intermediate Cover
NET LANDFILL VOLUME:
197,303 cu. yds.
\(789,211 \mathrm{cu} . \mathrm{yds}\).
E. Estimated Landfill Life:
\(789,211 \mathrm{cu} . y d \mathrm{~s}\). \(=\)

Glenn Briggs \& Associałes, Inc. Consulting Engineers
F. Daily Cover Required For Life of Landfill:
\(57 \mathrm{cu} . \mathrm{yds} . \times 365 \times 5.54 \mathrm{yrs}\). \(=\)
\(115,346 \mathrm{cu} . \mathrm{yds}\).
G. Total Soil Required For Life of Landfill:
\(115,346 \mathrm{cu}\). yds. \(+275,299 \mathrm{cu}\). yds. \(=\)
390,645 cu. yds.
H. Total Soil Provided From Excavation

See Cross-Sections 540,382 divided by 1.2(comp) =

EXCESS EXCAVATION:
432,306 cu. yds.
\(-41,660 \mathrm{cu} . \mathrm{yds}\).

\title{
APPENDIX B \\ ALTUS LANDFILL - PHASE 3 \\ DESIGN INFORMATION AND CALCULATIONS
}
I. DESIGN DATA:
A. Proposed Landfill Area
B. Average Population to be served during

Life of Landfill (Year 2010)
C. Solid Waste Density (assumed)
D. Losses in Gross Landfill Volume

Due to Trench Walls, etc.
II. DESIGN COMPUTATIONS:
A. Landfill Volume Required:

Solid Waste Generated from City of Altus Records = 333 c.y./day
Required Soil Cover Estimated at 44 cu. yds. \(47.5 \times 1.2=\) Plus 20\% Compaction

TOTAL LANDFILL VOLUME REQUIRED:
390 c.y./day
B. Final Soil Cover Required:
\(\underline{19.34 \mathrm{ac} . \times 43,560 \mathrm{sq} . \mathrm{ft} . \times 5 \mathrm{ft} . \times 1.20 \text { (shrinkage) }}=188,082 \mathrm{cu} . \mathrm{yds}\).
C. Gross Landfill Volume Provided:

By Excavations (See Cross-Sections)
By Fill Above Existing Grade (See Cross-Sections) TOTAL:
D. Reduction From Gross Volume:

Volume Loss Due to Final Cover
Volume Loss Due to Trench Walls and Intermediate Cover

NET LANDFILL VOLUME:
E. Estimated Landfill Life:
\(\frac{200,044 \mathrm{cu} . \text { yds. }}{390 \mathrm{cu} . \text { yds. } \times 365 \text { days/yr. }}=\)

\section*{Glenn Briggs \& Associałes, Inc. Consulting Engineers}
F. Daily Cover Required For Life of Landfill:
\(57 \mathrm{cu} . \mathrm{yds} . \times 365 \times 1.40 \mathrm{yrs} .=\)
G. Total Soil Required For Life of Landfill:

29,127 cu. yds. \(+188,082 \mathrm{cu} . \mathrm{yds} .=\)
H. Total Soil Provided From Excavation

See Cross-Sections 187,652 divided by 1.2(comp) =
154,311 cu. yds.

EXCESS EXCAVATION:

\section*{APPENDIX C.}

\section*{GEOTECHNICAL INVESTIGATION REPORTS.}

\section*{GEOTECHNICAL INVESTIGATION REPORT OCTOBER 1988}
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GEOTECHNICAL INVESTIGATION REPORT
FOR THE
ALTUS MUNICIPAL LANDFILL
ALTUS, OKLAHOMA
G088106
FOR
CITY OF ALTUS
ALTUS, OKLAHOMA

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\section*{SHEPHERD ENGINEERING Testing Co., Inc.}

2014 SOUTH NICKLAS AVENUE / OKLAHOMA CITY, OK 73128-3011 / (405) 685-0215
October 28, 1988

Glenn Briggs \& Associates
Post Office Box 458
Sequoyah Building
Altus, Oklahoma 73521
Attn: Mr. Glenn Briggs
Re: Field Investigation
Altus Municipal Landfill
Altus, Oklahoma
G088106
Dear Mr. Briggs:
We are submitting, herewith, the results of the field investigation performed for the Altus Municipal Landfill. The project site is located near Altus, Oklahoma.

In summary, a total of one (1) in-situ and three (3) laboratory permeability tests were performed at the locations specified and as indicated on the attached test location diagram. The in-situ test was performed using an inflatable packer to seal the desired interval of the test hole while maintaining water flow into the test interval at a constant pressure. Measurements are then taken to determine the amount of water which is transmitted. The subsurface material and conditions encountered in the test holes were logged and described in the field at the time of drilling.

This report summarizes the field and laboratory investigation, provides an analysis of field data obtained, and provides a description of the subsurface conditions encountered. Recommendations are presented based on the results of the field and laboratory data obtained.

We appreciate the opportunity to be of service to you on this project. If you have any questions, or require further assistance, please do not hesitate to contact us.

Sincerely,
SHEPHERD ENGINEERING TESTING CO.. INC.


Douglas N. Cantrell, E.I.T. Geotechnical Specialist


Randall A. Neuhaus, P.E. Geotechnical Engineer

DNC/RAN/lmj

\title{
SHEPHERD ENGINEERING Testing Co., Inc.
}

2014 SOUTH NICKLAS AVENUE / OKLAHOMA CITY, OK 73128-3011 / (405) 685-0215 October 28, 1988

\section*{GEOTECHNICAL INVESTIGATION REPORT}

FOR THE
ALTUS MUNICIPAL LANDFILL
ALTUS, OKLAHOMA
G088106

\subsection*{1.0 GENERAL}

The geotechnical investigation for the Altus Municipal Landfill in Altus, Oklahoma has been completed. The purpose of this report is to describe the subsurface conditions encountered in the borings, and to analyze and evaluate the data obtained from the permeability tests. The analysis presented in this report is with regard to the in-situ soil conditions as they existed at the time of the field exploration.

\subsection*{2.0 FIELD EXPLORATION}

The field exploration was conducted on August 17 through 19, 1988, and an additional field inspection was performed in September of 1988. The investigation included the drilling of three (3) borings at the locations specified and the performance of one (1) in-situ permeability test. The field inspection consisted of the excavation of two (2) test pits near borings \(\mathrm{B}_{2}\) and \(B 3\), and a visual inspection of the material with sample retrieval for soil classifications and permeability determinations.

The borings were accomplished using an all-terrain auger drilling rig advancing four (4) inch diameter continuous flight solid stem augers. Representative samples of the subsurface materials encountered were obtained using shelby tube sampling procedure ASTM D1587. In the shelby tube sampling procedure, a thin-walled, seamless, steel tube is hydraulically pushed into cohesive or moderately cohesive soils in order to obtain a relatively undisturbed sample. Disturbed samples were also retrieved from the auger cuttings in order to gain a more accurate determination of the engineering properties of the onsite materials.

All samples obtained in the field were sealed and returned to the laboratory for further examination, classification, and testing.

\subsection*{3.0 SUBSURFACE CONDITIONS}

The material encountered at the project site consists primarily of clayey silt and sandy/silty to shaley clay. The material encountered was described as firm to very stiff, and very dry to slightly moist. No bedrock was encountered.

A more detailed profile showing the depth, thickness, consistency, and material description is given on the attached boring logs. Stratification lines shown on the boring logs represent the approximate boundaries between soil types. Insitu, the transitions may be gradual.
accordance with ASTM standards and accepted laboratory procedures.

As part of the testing program, all samples were examined by a geotechnical engineer or geologist and visually classified according to the Unified soil Classification System. A brief description of the Unified Soil Classification System is included with this report. Results of all laboratory tests performed are given on the boring logs or on attached tables entitled "Laboratory Test Results".

\subsection*{6.0 ANALYSIS AND EVALUATION}

A total of three (3) in-situ permeability tests were attempted on-site. Permeability tests were attempted on borings B1, B2, and B3. The purpose of the tests is to determine the approximate permeability of the in-situ soils along the horizontal, as well as the vertical, axis.

The test is performed utilizing an inflatable packer to seal off the desired interval of the test hole while maintaining water flow into the test interval at a constant pressure. Measurements are then taken to determine the amount of water which is transmitted. The test is conducted until a near-steady state is achieved (dQ/dt=0).

Boring \(B 1\) was tested over the interval of 10 to 20 feet and achieved a permeability of \(2.0 \times 10 \mathrm{e}-7 \mathrm{~cm} / \mathrm{sec}\) at assumed steady state. In-situ permeability tests were attempted on borings B2 and B3. However, unanticipated subsurface conditions were such that the tests could not be performed. The cause of these conditions is not immediately apparent, and so we recommend the
landfill liner be thoroughly inspected and/or tested upon excavation to ensure adequate environmental protection.

Due to the inability to perform the in-situ testing, laboratory permeability tests were performed on representative samples obtained during the field exploration and the field inspection. These tests were performed on samples oriented on the horizontal and the vertical axis. The samples tested achieved a coefficient of permeability ranging from \(2.4 \times 10 \mathrm{e}-6\) to \(1 \times 10 \mathrm{e}-8\) \(\mathrm{cm} / \mathrm{sec}\). These tests were performed according to ASTM specification D2434.

Based on the results of the field inspection and laboratory tests, the on-site material is suitable for use as an in-situ liner for a Type I-B or Type II Municipal Sanitary Landfill with Class 3 protection. In areas where the cell is terminated in the underlying shaley clay, a reconstructed liner may not be necessary. However, a liner may be necessary in areas where the bottom or sidewalls consist of overburden silts or other materials deemed unsuitable upon on-site inspection.

According to the OSDH Bulletin 0524, on a landfill utilizing an in-situ liner, after excavation and prior to disposal, a series of tests must be performed in accordance with a previously submitted Liner Installation and Testing (LIT) Plan. These tests are to assure that the natural in-situ materials will meet the required groundwater protection standards. The tests are to include a visual inspection, subsurface probes, moisture and density tests, and laboratory or in-situ permeability tests.

In the event a liner is required, a geotechnical engineer should verify the suitability of the on-site soils and determine
compaction and moisture content requirements for effective installation of the soil liner. We further recommend that any operations dealing with earthwork be observed and/or tested by a geotechnical engineer or his representative to ensure the design requirements are fulfilled.

\subsection*{6.0 GENERAL CONDITIONS}

The soil samples obtained during the subsurface exploration will be retained for a period of thirty (30) days. These samples will be disposed of at that time, unless prior instructions are received.

The analysis and recommendations presented in this report are based upon the data obtained from the soil borings performed at the locations indicated on the boring location diagram and from any other information discussed in this report. This report does not reflect any variations which may occur between borings. Subsurface conditions, such as groundwater levels, may vary from time to time. The nature and extent of the variations may not become evident until the course of construction. If variations then appear evident, on-site observation will be necessary for re-evaluation of the recommendations of this report.

We recommend all construction operations dealing with earthwork be observed and/or tested by a Geotechnical Engineer or his representative to ensure the design requirements are fulfilled. We also suggest the Geotechnical Engineer be given the opportunity to review the plans and specifications when they have been prepared so comments can be made regarding the effects of soil conditions on the design.

This report has been prepared in order to aid in evaluation of this property and to assist the engineer in the design of this project. The scope is limited to the specific project and location of the proposed structure as outlined in this report. If any changes in the nature, design, or location
of the proposed structures are planned, the changes should be reviewed, and where appropriate, the conclusions of this report modified or approved in writing by the Geotechnical Engineer.


County Road


Altus Landfill
Altus, Oklahoma

Test Location Diagram

Soil Classification - ASTM D4318
\(\left.\begin{array}{lccccccc}\hline \begin{array}{l}\text { Boring } \\
\text { Number }\end{array} & \begin{array}{c}\text { Depth } \\
\text { (ft.) }\end{array} & \text { LL } & \text { PL } & \text { PI } & \begin{array}{c}\text { \% Passing } \\
\text { \# }\end{array} \text { 40 } & \text { 非200 }\end{array}\right]\)\begin{tabular}{c} 
Soil \\
Group
\end{tabular}
\begin{tabular}{llc} 
& \multicolumn{2}{c}{ Coefficient of Permeability } \\
\hline \begin{tabular}{l} 
Boring \\
Number
\end{tabular} & \begin{tabular}{c} 
Depth \\
\((\mathrm{ft})\).
\end{tabular} & \begin{tabular}{c} 
Coefficient of Permeability \\
\((\mathrm{cm} / \mathrm{sec})\)
\end{tabular} \\
\hline *B1 & \(10-20\) & \(2.0 \times 10^{-7}\) \\
B3 & \(15-16\) & \(1 \times 10^{-8}\) \\
TP1H & 12 & \(2.4 \times 10^{-6}\) \\
TP2 & 14 & \(1.3 \times 10^{-6}\) \\
\hline \hline *Indicates Coefficient of Permeability determined by Packer test. \\
H Indicates permeability test performed on horizontal axis.
\end{tabular}

A1tus Landfill
Altus, Oklahoma
G088106

TEST RESULTS
SHEPHERD
engineering
```

Boring B1 Test Interval: 10-20 feet
Depth of Packer: 9 feet

```

Gauge Pressure: variable Gauge Height: 3.2 feet
```

Water Level: Dry
Depth to Center of Test Interval: 15 feet Radius of Hole: 0.167 feet
(10 psi)Differential Pressure Head: $3.2+15+23.1=41.3$
(20 psi)Differential Pressure Head: $3.2+15+46.2=64.4$
Coefficient of Permeability, $k=\frac{Q}{2 \pi L H} \log \left(\frac{L}{r}\right)$

$$
\text { where: } \quad \begin{aligned}
\mathrm{Q} & =\text { Rate of Discharge } \\
\mathrm{L} & =\text { Length of Test Interval } \\
\mathrm{H} & =\text { Differential Pressure Head } \\
\mathrm{r} & =\text { Radius of Test Hole }
\end{aligned}
$$

```
\begin{tabular}{cccccc}
\begin{tabular}{c} 
Gauge Pressure \\
\((\mathrm{psi})\)
\end{tabular} & \begin{tabular}{c} 
Volume of Water \\
\(\left(\mathrm{ft}^{3}\right)\)
\end{tabular} & \begin{tabular}{c} 
Elapsed Time \\
\((\mathrm{min})\)
\end{tabular} & \begin{tabular}{c} 
Q \\
\((\mathrm{cfm})\)
\end{tabular} & \begin{tabular}{c}
\(\mathrm{ft} / \mathrm{min})\)
\end{tabular} & \begin{tabular}{c}
\(\mathrm{fm} / \mathrm{sec})\)
\end{tabular} \\
\hline 10 & 0.014 & 10.0 & \(1.4 \times 10^{-3}\) & \(9.6 \times 10^{-7}\) & \(4.9 \times 10^{-7}\) \\
20 & 0.028 & 20.0 & \(1.4 \times 10^{-3}\) & \(6.1 \times 10^{-7}\) & \(3.1 \times 10^{-7}\) \\
20 & 0.028 & 30.0 & \(9.3 \times 10^{-4}\) & \(4.1 \times 10^{-7}\) & \(2.1 \times 10^{-7}\)
\end{tabular}
*See graph for permeability at assumed steady state.
Altua Landflll
Altus, Oklahoma
G088106

\(\qquad\)
Datum \(\qquad\) Date 8-17-88
Elevation \(\qquad\)
\(\qquad\)
Type/Size Boring Solid Auger/4" Rig Type Ditch Witch Logged By \(\qquad\) DC Depth to Water \(\qquad\) Dry @ time of drilling ( \(\nabla\) ), \(\qquad\) -@ completion, @ --
\(\qquad\) hrs.

\(\qquad\) OF

LOG OF BORING NO.
Project \(\qquad\) Job. No. G088106

Elevation \(\qquad\) Datum \(\qquad\) Date 8-18-88 Type/Size Boring \(\qquad\) Rig Type Ditch Witch Date \(\qquad\) Depth to Water \(\qquad\) @ time of drilling ( \(\nabla\) ), -@ completion, @ -DC

\(\qquad\) 1 OF considerably between locations.

Project A1tus Landfill \(\qquad\) Job. No. G088106

Elevation \(\qquad\) Datum \(\qquad\) Date \(\qquad\)
Type/Size Boring Solid Auger/4"
Rig Type Ditch Witch Logged By \(\qquad\) DC Depth to Water \(\qquad\) @ time of drilling ( \(\nabla\) ), \(\qquad\) @ completion, @ \(\qquad\) hrs.

\(\qquad\) 1 OF \(\qquad\) considerably between locations.

\section*{METHOD OF SOIL CLASSIFICATION (ASTM D 2437)}

COARSE-GRAINED SOILS
LESS THAN 50\% FINES*
\begin{tabular}{|c|c|c|}
\hline \[
\begin{array}{c|}
\hline \text { CROUP } \\
\text { SYMBOLS }
\end{array}
\] & DESCRIPTION & MAJOR DIVISHNS \\
\hline CW & well-craded cravels or cravelSAND MIXTURES, LESS THAN 5\% FINES & \multirow{4}{*}{CRaVELS More than half of coarse fraction is larger than No. 4 sieve size} \\
\hline CP & POORLY-CRADED CRAVELS OR CRAVELSAND MIXTURES, LESS THAN 5\% FINES & \\
\hline CM & SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, MORE THAN \(12 \%\) FINES & \\
\hline CC & Clayey cravels, cravel-sand-clay MIXTURES, MORE THAN \(12 \%\) FINES & \\
\hline SW & well-craded sands or cravelly SANDS, LESS THAN 5\% FINES & \multirow{4}{*}{\begin{tabular}{l}
SANDS \\
More than half of coarse fraction is smaller than No. 4 sieve size
\end{tabular}} \\
\hline SP & POORLY-CRADED SANDS OR CRAVELLY SANDS. LESS THAN 5\% FINES & \\
\hline SM & SILTY SANDS, SAND-SILT MIXTURES, MORE THAN \(12 \%\) FINES & \\
\hline SC & CLAYEY SANDS, SAND-CLAY MIXTURES. MORE THAN 12\% FINES & \\
\hline
\end{tabular}

NOTE:
Coarse grained soils receive dual symbols if they contain 5 to \(12 \%\) fines (e.g. SW-SM, CP-GC, etc.)

FINE-GRAINED SOILS
MORE THAN SOT FINES*
\begin{tabular}{|c|c|c|}
\hline \[
\begin{aligned}
& \text { GROUP } \\
& \text { sYMSOLS }
\end{aligned}
\] & DESCRIPTION & \[
\begin{aligned}
& \text { Major } \\
& \text { ovisont }
\end{aligned}
\] \\
\hline ML & INORCANIC SILTS, VERY FINE SANOS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS & \multirow{3}{*}{SILTS AND Clays Liquid limit less then 50} \\
\hline CL & INORCANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS. SiLTY CLAYS, LEAN CLAYS & \\
\hline OL & ORCANIC SILTS OR ORGANIC SILTY-CLAYS OF LOW PLASTICITY & \\
\hline MH & INORCANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS & \multirow{3}{*}{\begin{tabular}{l}
SILTS \\
ANO \\
CLAYS \\
Liquid Limia more than 50
\end{tabular}} \\
\hline CH & INORGANIC CLAYS OF HICH PLASTICITY, FAT CLAYS & \\
\hline OH & ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY & \\
\hline PT & PEAT, MUCK, AND OTHER HICHLY ORGANIC SOILS & HICHLY ORGANIC SOILS \\
\hline
\end{tabular}

NOTE:
Fine grained soils receive dual symbols if their limits plot in the hatched zone on the Plasticity Chart (ML-CL)

SOIL SIZES
\begin{tabular}{|l|l|}
\hline \multicolumn{1}{|c|}{ COMPONENT } & \multicolumn{1}{|c|}{ SIZE RANGE } \\
\hline \hline BOULDERS & ABOVE 12 in. \\
\hline COBBLES & 3 in. to 12 in. \\
\hline CRAVEL & No. 4 to 3 in. \\
Coarse & \%/4 in. to 3 in. \\
Fine & No. 4 to \(\% \mathrm{in}\). \\
\hline SAND & No. 200 to No. 4 \\
Coarse & No. 10 to No. 4 \\
Medium & No. 40 to No. 10 \\
Fine & No. 200 to No. 40 \\
\hline FINES (Silt or Clay) & BELOW No. 200 \\
\hline
\end{tabular}

NOTE:
Only sizes smaller than three inches are used to classify soils.

PLASTICITY CHART


\section*{GEOTECHNICAL INVESTIGATION REPORT \\ AUGUST 1985}


SUB-SURFACE EXPLORATION
PROPOSED LANDFILL
ALTUS, OKLAHOMA
\begin{tabular}{lcc} 
& Field Offices & \\
E02 Trails West Loop & Enid. OK 73701 & (405) 237-3130 \\
800 S.E. 2nd & Lowton, OK 73501 & (405) 353-0872 \\
200 Eestside Bivd. & Muskogeo. OK 74401 & (918) 682.7853
\end{tabular}

August 7, 1985
Glenn Briggs \& Associates, Inc.
P.O. Box 458

Altus, OK 73521
Attention: Mr. Glenn Briggs, P.E.
Re: Proposed Landfill
Altus, Oklahoma
Dear Mr. Briggs:
Enclosed herewith is a copy of the test results and the log of borings drilled during June 12 through 14, 1985 at the site of the above referenced project. Approximate location of the borings are shown on PLATE "A", attached.

In this investigation, a total of twenty-two (22) borings were drilled. The borings were dry-drilled with a truck mounted Simco rotary drilling unit equipped with a 20 -foot derrick, with a 4 -inch diameter continuous flight auger and/or air circulation drag bits. The soils encountered essentially consist of a medium to fairly high plasticity silty clay underlain by a hard shale and gypsum. The shale stratum was interbedded with relatively thin layers of sandstone in boring no. 1.

No water was encountered in any of the borings at the time of drilling except for boring no. 1. In this boring a slow seepage of water was encountered at a depth of approximately 5.0 feet below the existing grade.

In order to properly classify the soils encountered and to aid in the evaluation of their engineering properties, Atterberg (liquid and plastic) limits, sieve analysis and .moisture content tests were performed on typical soil horizons. General descriptions of the soils encountered together with visual and laboratory classification is shown on the boring logs.

A total of seven permeability tests, 4 on undisturbed samples and 3 on remolded samples, were performed on typical soil horizons. The coefficient of permeability was calculated based on the following formula:

\[
K=2.3 \frac{d^{2}}{D^{2}} \quad \frac{L}{\left(t_{f}-t_{i}\right)} \log \frac{h_{i}}{h_{f}}
\]

Where:
\(K=\) Coefficient of permeability \(-\mathrm{cm} . / \mathrm{sec}\).
\(d=\) Diameter of the standpipe -cm .
\(D=\) Diameter of the sample -cm .
\(L=\) Height of the sample -cm .
\(\left(t_{f}-t_{i}\right)=\) Elapsed time - sec.
\(h_{i}=\) Initial head - cm.
\(h_{f}=\) Final head -cm.
The results of these tests are shown on "PT - 1" attached.
We appreciate the opportunity to assist on this project. Please call on us if we can be of further service.

Respectfully submitted,
STANDARD TESTING AND ENGINEERING COMPANY


Perry Soltani, P.E.
Foundation Consultant
PS:vdb
Lab No. F-591
File No. AL75-1
Acct. No. 3AL75

\section*{LOG OF BORING}

PROPOSED LANDFILL
ALTUS, OKLAHOMA
FROM \({ }^{\text {DEPTH }}\) TO

\section*{BORING NO. 1}
\[
0.0^{\prime}-3.0^{\prime}
\]

Brown silty clay; medium to fairly high plasticity

Liquid Limit
Plastic Limit 46

Plasticity Index
Moisture Content
Percent Passing:
No. 10
No. 40
No. 200
Soil Classification:
Unified
THIN-WALL TUBE SAMPLE
\[
0.0^{\prime \prime}-27.0^{\prime \prime}
\]

THIN-WALL TUBE SAMPLE
\[
27.0^{n}-3.0^{\prime}
\]
\(3.0^{\prime}-12.0^{\prime} \quad\) Dark brown silty clay, slow seep at \({ }^{\circ}{ }^{\circ} 0^{\prime}\); fairly moist, medium plasticity
\(12.0^{\prime}-45.0^{\prime}\)
\(45.0^{\prime}-46.0^{\prime}\)

Reddish brown shale/sandstone; hard, medium plasticity

Gypsum

\section*{LOG OF BORING}

PROPOSED LANDFILL
ALTUS, OKLAHOMA

DEPTH
FROM TO
DESCRIPTIONS AND REMARKS

\section*{BORING NO. 2}


\title{
LOG OF BORINGS
}

PROPOSED LANDFILL
ALTUS, OKLAHOMA

DEPTH
FROM
TO
DESCRIPTIONS AND REMARKS

BORING NO. 4
143E MISC
\(0.0^{\prime}-1.5^{\prime} \quad\) Brown silty clay; medium to fairly high plasticity
1.5 \(5^{\circ}\) 4.0' Hard rock
4.0' \(-6.0^{\prime} \quad\) Gray shale
6.0' \(0^{\prime}\) 44.0' Brown and gray shale, fairly moist to moist, Medium to fairly high plasticity

Moisture Content 18.4\%
44.0' \(0^{\prime}\) 46.0' Gypsum rock

BORING NO. 5
0.0' \(\mathbf{- 2 . 0 ^ { \prime }} \quad\) Brown silty clay; medium to fairly high plasticity

\section*{THIN-WALL TUBE SAMPLES}
\(0.0^{\prime}-2.0^{\prime}\)
\(2.0^{\prime}-5.0^{\prime \prime} \quad\) Brown and gray shale; medium to fairly high plasticity
BORING NO. 6
\(0.0^{\prime}-6.0^{\prime \prime} \quad\) Brown silty clay; medium to fairly high plasticity
THIN-WALL TUBE SAMPLE
\(0.0^{\prime}-2.0^{\prime}\)
THIN-W.ALL TUBE SAMPLE
\[
2.0^{\prime}-4.0^{\circ}
\]
6.0' \(0^{\prime}\) 11.0' Reddish brown and gray shale; medium to fairly high plasticity

\section*{LOG OF BORING}

DEPTH
FROM TO
DESCRIPTIONS AND REMARKS

BORING NO. 7
145545
\(0.0^{\prime}-1.5^{\prime} \quad\) Brown silty clay; medium to fairly high plasticity
1.5' \({ }^{\prime}\) 23.0' Brown and gray shale; fairly moist, medium to fairly high plasticity

Moisture Content \(\quad 15.8 \%\)
BORING NO. 8
Brown silty clay; medium to fairly high plasticity
2.0' \(0^{\prime}\) 2.5 Rock
2.5' \(\mathbf{2 4 . 0 ^ { \prime }} \quad\) Reddish brown and gray shale; fairly moist to moist, medium to fairly high plasticity

Liquid Limit
Plastic Limit
40
20
Plasticity Index
Moisture Content
Percent Passing: No. 10 No. 40 No. 20020 17.9\%

100
98.1
85.9

Soil Classification:
Unified
CL
BORING NO. 9
\(0.0^{\prime}-1.5^{\prime}\)
Brown silty clay; medium plasticity
\(1.5^{\prime}-2.0^{\prime}\)
Rock
\(2.0^{\prime}-18.0^{\prime \prime} \quad \begin{aligned} & \text { Reddish brown and gray shale with layers of sandstone; fairly moist, } \\ & \text { medium plasticity }\end{aligned}\) medium plasticity

Moisture Content
18.5\%

\section*{LOG OF BORING}

DEPTH
FROM

BORING NO. 10
1く27M5 M
\(0.0^{\prime}-1.0^{\prime} \quad\) Brown silty clay; medium to fairly high plasticity
\(1.0^{\prime}-3.5^{\prime}\)
\(3.5^{\prime}-12.0^{\prime}\)
\(0.0^{\prime}-2.5^{\prime}\)
\(2.5^{\prime}-5.0^{\prime}\)
\(0.0^{\prime}-3.0^{\prime}\)
\(3.0^{\prime}-5.0^{\prime}\)
\(5.0^{\prime}\) - \(33.0^{\prime \prime}\)

Reddish brown shale with layers of sandstone; medium plasticity
THIN-WALL TUBE SAMPLE
\(2.5^{\prime \prime}-5.0^{\prime}\)

\section*{BORING NO. 12}

Brown silty clay and loose rocks; medium plasticity
Gray and brown silty clay; medium to fairly high plasticity
Reddish brown and gray shale; fairly moist to moist, medium to fairly high plasticity

Moisture Content 18.5\%
\[
10 A-1450
\]

\section*{LOG OF BORING}

\section*{PROPOSED LANDFILL}

ALTUS, OKLAHOMA

DEPTH
FROM
TO
DESCRIPTIONS AND REMARKS

BORING NO. 13

\(0.0^{\circ}-2.0^{\circ}\)
\(2.0^{\prime}-5.0^{\circ}\)
\(5.0^{\prime}-25.0^{\prime \prime}\)
-
\(0.0^{\prime}-2.0^{\prime}\)
\(2.0^{\prime}-5.0^{\prime}\)
\(5.0^{\prime}-15.0^{\prime \prime}\)

Brown silty clay; medium to fairly high plasticity
Gray and brown silty clay; medium to fairly high plasticity
Reddish brown and gray shale; moist, medium to fairly high plasticity

Liquid Limit 39
Plastic Limit
Plasticity Index
Moisture Content Percent Passing:

No. 10
No. 40
No. 200
18
21
18.2\%

Soil Classification:
Unified
CL
BORING NO. 14
100
97.1
90.4

Brown silty clay; medium to fairly high plasticity
Rock
Reddish brown and gray shale; fairly moist to moist, medium to fairly high plasticity

Moisture Content 16.1\%

\section*{LOG OF BORING}

PROPOSED LANDFILL ALTUS，OKLAHOMA

DEPTH
FROM TO
DESCRIPTIONS AND REMARKS

\section*{BORING NO． 15}
\(0.0^{\prime}-5.0^{\prime}\)
\(5.0^{\prime}-19.0^{\prime}\)
\(19.0^{\prime}-35.0^{\prime \prime}\)
\(35.0^{\prime}-46.0^{\prime \prime}\)
\(19.0^{\prime}-35.0^{\prime \prime}\)
\(35.0^{\prime}-46.0^{\prime \prime}\)
\(0.0^{\prime}-5.0^{\prime}\)
\(5.0^{\prime \prime}-10.0^{\prime \prime}\)

Brown silty clay；medium to fairly high plasticity
Reddish brown and gray shale；fairly moist， medium to fairly high plasticity

Moisture Content \(\quad 16.0 \%\)
Shale with traces of gypsum rock
Gypsum rock and shale
BORING NO． 16
Brown silty clay；moist to very moist， medium to fairly high plasticity

Dark brown silty clay；medium plasticity

Liquid Limit
Plastic Limit
Plasticity Index
Moisture Content Percent Passing：

No． 10
No． 40
No． 200
Soil Classification： Unified

34
16
18
19．6\％
100
98.3
96.0

CL

\section*{LOG OF BORINGS}

PROPOSED LANDFILL
ALTUS, OKLAHOMA

\section*{DEPTH}

FROM TO

\section*{BORING NO. 17}

0.0' \(-4.0^{\prime} \quad\) Brown silty clay; medium to fairly high plasticity
4.0' \(0^{\prime}\) 23.0 \(0^{\circ} \quad\) Reddish brown and gray shale; moist, medium to fairly high plasticity

Liquid Limit
37
Plastic Limit 17
Plasticity Index
20
Moisture Content
17.4\%

Percent Passing:
No. 10
100
No. 40
93.3

No. 200
64.4

Soil Classification: Unified

CL
\(23.0^{\prime}-25.0^{\prime}\)
\(0.0^{\prime}-14.0^{\prime}\)

Gypsum rock; hard
BORING NO. 18
Reddish brown and gray shale; moist, medium to fairly high plasticity

Moisture Content
18.2\%

\section*{LOG OF BORINGS}

PROPOSED LANDFILL
ALTUS, OKLAHOMA


\section*{LOG OF BORINGS}

\section*{PROPOSED LANDFILL}

\section*{ALTUS, OKLAHOMA}

\section*{DEPTH}

FROM TO

BORING NO. 21
\(0.0^{\prime}-13.0^{\prime}\)
\(13.0^{\prime}-19.0^{\prime}\)
Gypsum rock, white; dry to slightly moist, hard, no plasticity

Moisture Content 16.0\%
BORING NO. 22

\section*{1423 MS}

Reddish brown and gray shale; moist, medium to fairly high plasticity
Moisture Content \(\quad 18.6 \% \quad 2 A-1440 \mu s 4\)
-
\(0.0^{\prime}-22.0^{\prime}\)
Reddish brown and gray shale; moist, medium to fairly high plasticity

Liquid Limit
Plastic Limit
Plasticity Index
Moisture Content
Percent Passing:
No. 10
No. 40
No. 200
Soil Classification:
Unified

39
18 21
18.6\%

100
99.3
88.4

CL

PROPOSED LANDFILL
ALTUS, OKLAHOMA
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline Boring No. & Depth range "ft." & Description of the soil & Initial moisture content \% & Natural Density pcf. & Density as molded pcf. & Final moisture content \% & Coefficient of permeability "k" cm./sec. & Remarks \\
\hline 1 & 0.0' - \(2.3{ }^{\prime}\) & Brown silty
clay & 16.5 & 133.3 & ---- & 21.2 & \(6.7 \times 10^{-8}\) & Undisturbed \\
\hline 1 & \(3.0{ }^{\prime}-12.0{ }^{\prime}\) & Dark brown . silty clay & 10.0 & ---- & 107.2 & 29.8 & \(1.1 \times 10^{-7}\) & Remolded \\
\hline 9 & \(10.0{ }^{\prime}-13.0{ }^{\prime}\) & Brown and gray shale & 15.0 & ----- & 112.6 & 24.0 & \(1.8 \times 10^{-7}\) & Remolded \\
\hline 10 & 3.5-7.0 & Reddish brown and gray shale & 15.0 & ---- & 108.2 & 30.0 & \(1.7 \times 10^{-8}\) & Remolded \\
\hline 11 & 2.5-5.0 & Reddish brown shale/layers of sandstone & 15.1 & 133.6 & ----- & 19.9 & \(1.4 \times 10^{-7}\) & Undisturbed \\
\hline 20 & 0.0-2.5 & Brown silty clay & 15.3 & 123.5 & ---- & 20.9 & \(1.2 \times 10^{-8}\) & Undisturbed \\
\hline 20 & 2.5-5.0 & Brown silty clay & 18.5 & 124.8 & ---- & 20.2 & \(1.4 \times 10^{-8}\) & Undisturbed \\
\hline
\end{tabular}

FPOTOSED LANDFILL

\section*{ALTUS, ORLAHOMA}


\section*{GEOTECHNICAL INVESTIGATION REPORT}

\section*{MARCH 1981}

FIGURE C-1

Glenn Briggs \& Associates, Inc.
Consulting Engineers

\section*{TEST HOLE BORINGS}

\section*{ALTUS MUNICIPAL LANDFILL}

SITE NO. 9: NE \(\frac{1}{4}\) and \(S \frac{1}{2}\) of Section 11, T2N, R22W. ( \(75 \% \mathrm{P}-25 \% \mathrm{C}\) ) ( \(\mathrm{D}=9 \mathrm{mi}\). ) NOTE: Railroad \& 2 O.H. Trans. Lines cross this property

TEST HOLE NO. 1A:
\begin{tabular}{|c|c|c|}
\hline Location: & \multicolumn{2}{|l|}{Near SE Corner of Section 11, T2N, R22W} \\
\hline Elevation: & 1445 - & \\
\hline Date: & March 3, 1981 & \\
\hline \multirow[t]{4}{*}{Log:} & Depth & Description of Soil \\
\hline & \[
\begin{aligned}
& 0^{\prime}-3^{\prime} \\
& 3^{\prime}-9^{\prime}
\end{aligned}
\] & \begin{tabular}{l}
Brown Sandy Clay (Dry) \\
Reddish Brown Clay w/streaks of Gray Clay, and Gyp Rock (Dry)
\end{tabular} \\
\hline & \(9^{\prime}-11^{\prime}\) & Gray Clay w/Brown Streaks (Slightly Moist) \\
\hline & \(11^{\prime}-13^{\prime}\) & Gray Clay (Dry \& Hard) \\
\hline
\end{tabular}
* No Water Encountered.

TEST HOLE NO. 2A:
\begin{tabular}{|c|c|c|}
\hline Location: & \multicolumn{2}{|l|}{\(1320^{\prime}\) West and \(1320^{\prime}\) South of NE corner, Section 11, T2N, R22W.} \\
\hline Elevation: & 1440 - & \\
\hline Date: & March 6, 1981 & \\
\hline \multirow[t]{7}{*}{Log:} & Depth & Description of Soil \\
\hline & \(0^{\circ}-1^{\prime}\) & Reddish Brown Clay Top Soil (Dry) \\
\hline & \(1^{\prime}-6^{\prime}\) & Light Brown Clay w/some Gyp (Dry) \\
\hline & \(6^{\prime}-10^{\prime}\) & Greenish Gray Clay w/Brown Streaks \\
\hline & & \& small amount of Gyp Rock (Slightly Moist). \\
\hline & \(10^{\prime}-14^{\prime}\) & Light Brown Clay w/Greenish Gray \\
\hline & & Streaks, (Slightly Moist). \\
\hline
\end{tabular}
- No Water Encountered.

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\section*{TEST HOLE NO. 3A:}

Location: \(\quad 50^{\prime}\) East and \(20^{\prime}\) North of SW corner, Section 11, T2N, R22W.
Elevation: 1397 -
Date: \(\quad\) March 6, 1981
\(\begin{array}{lll}\text { Log: } & \underline{\text { Depth }} & \\ & \begin{array}{l}\text { Description } \\ 0^{\prime}-3^{\prime} \\ 3^{\prime}-8^{\prime} \\ 8^{\prime}-12^{\prime} \\ \\ \\ \\ \end{array} 2^{\prime}-13^{\prime} & \\ & & \text { Brown Clay Top Soil (Slightly Moist) } \\ & \text { Brown Clay Clay (Slightly Moist) } \\ & \text { Greenish Gray Clay amount of Sand (Dry \& Hard) }\end{array}\)
* No Water Encountered.

TEST,HOLE NO. 4A:
Location: \(500^{\circ}\) West and \(500^{\circ}\) South of NE corner, Section 11, T2N, R22W.
Elevation: 1420 :
Date: \(\quad\) March 23, 1981
Log: Depth Description of Soil
\(0^{\prime}-6^{\prime} \quad\) Brown Clay (Moist)
6' \(6^{\prime}\) 17 \(\quad\) Red and Gray Clay, streaked (Slightly Moist)
17' \({ }^{\prime} 21^{\prime} \quad\) Gray Shale (Wet)
\(21^{\circ}-30^{\prime} \quad\) Red \& Gray Claÿ, streaked (Dry) 30 - 35 \(\quad\) Red Clay (Dry)
* Water at \(20^{\prime}\) after 23 hours.

\section*{TEST HOLE NO. 5A:}

Location: \(600^{\circ}\) South \& 600' East of NW corner NE \(\frac{1}{4}\), Section 11, T2N, R22W.
Elevation: \(\quad 7424\) 士
Date: \(\quad\) March 23, 1981
Log: Depth Description of Soil
\(0^{\prime}-7^{\prime} \quad\) Reddish Brown Clay (Moist)
7' \({ }^{\prime}\) 11 \(\quad\) Light Red Clay (Moist)
11' - 14 \(\quad\) Red \& Gray Clay, streaked (Moist)
14' - 27 \(\quad\) Solid Gyp Rock
27 \({ }^{\prime}\) - \(37^{\prime} \quad\) Gray Shale (Dry)
31' \(35^{\prime} \quad\) Red Shale and Clay (Dry)
* Water at \(19^{\prime}\) after 22 hours.

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TEST HOLE NO. 6A:

* No Water after 22 hours.

TEST HOLE NO. 7A:
Eocation: \(\quad 500^{\prime}\) North \& \(800^{\circ}\) West of SE corner, Section 11, T2N, R22W.
Elevation: 1437 士
Date: \(\quad\) March 23, 1981
Log: Depth Description of Soil
\(0^{\prime}-1^{\prime} \quad\) Red Clay (Dry)
\(1^{\prime}-24^{\prime} \quad\) Red \& Gray Clay, streaked (Dry)
24' - 35' Red Clay (Dry to Moist)
* Water at \(28^{\prime}\) after 22 hours.

TEST HOLE NO. 8A:
Location: \(2700^{\prime}\) West \& 350' North of SE corner, Section 11, T2N, R22W. NOTE: Dug Well 100' North of Hole 非 ( \(34^{\prime}\) to water).
Elevation: 1415 \({ }^{\text {+ }}\)
Date: \(\quad\) March 23, 1981
Log: Depth Description of Soil
\begin{tabular}{ll}
\(0^{\prime}-2^{\prime}\) & Brown Clay (Slightly Moist) \\
\(2^{\prime}-10^{\prime}\) & Red Clay (Dry) \\
\(10^{\prime}-19^{\prime}\) & Red \& Cray Clay, streaked (Dry) \\
\(19^{\prime}-20^{\prime}\) & Gray Clay w/Gyp Rock (Dry) \\
\(20^{\prime}-23^{\prime}\) & Red Clay (Dry) \\
\(23^{\prime}-35^{\prime}\) & Red \& Gray Clay, streaked (Dry)
\end{tabular}
* No water after 22 hours.

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TEST HOLE NO. 9A:

* No water after 22 hours.

TEST HOLE NO. 10A:
Location: \(\quad 1400^{\prime}\) East \& 500 North of Center Section 11, T2N, R22W.
Elevation: 1450 -
Date: \(\quad\) March 23, 1981
\begin{tabular}{lll} 
Log: & Depth & Description of Soil \\
& \\
& \(0^{\prime}-2^{\prime}\) & Brown Clay (Slightly Moist) \\
\(22^{\prime}-10^{\prime}\) & Red Clay (Dry) \\
\(10^{\prime}-19^{\prime}\) & Red \& Gray Clay, streaked (Dry) \\
\(19^{\prime}-20^{\prime}\) & Gray Clay w/Gyp Rock (Dry) \\
\(20^{\prime}-23^{\prime}\) & Red Clay (Dry) \\
\(23^{\prime}-35^{\prime}\) & Red \& Gray Clay, streaked (Dry)
\end{tabular}
* No water after 22 hours.

TEST HOLE NO. 11A:
Location: \(800^{\prime}\) North \& 800́ East of SW corner, Section 11, T2N, R22W.
Elevation: 1397
Date: \(\quad\) March 24, 1981
Log: Depth Description of Soil
\(0^{\prime}=2^{\prime} \quad\) Brown Clay Top Soil (Slightly Moist)
2' \(\mathbf{7}^{\prime \prime} \quad\) Greenish Gray Clay (Slightly Moist)
\(7^{\prime}-21^{\prime} \quad\) Red Clay (Slightly Moist)
21' \(\mathbf{2 6}^{\prime} \quad\) Gray Clay (Moist to Wet)
26'
* Water at 19' after 6 hours.

\section*{APPENDIX D.}

\section*{MONITORING PLAN.}

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\section*{APPENDIX D MONITORING PLAN.}

This monitoring plan and sampling protocol is prepared by the City of Altus, Oklahoma in accordance with guidelines promulgated by the Oklahoma State Department of Health, October 1986. The purpose of this plan is to insure that sampling procedures utilized result in accurate samples from which decisions are made regarding the operating procedures and groundwater and surface water protection measures at the site.

The Solid Waste Division of the OSDH will attempt to sample wells at newly permitted sites to establish a background of ground water quality. Subsequently the OSDH will try to sample groundwater every three years.

\section*{SECTION ONE: SURFACEWATER MONITORING}

\section*{I. SAMPLING SCHEDULE:}

\section*{A. Background Sampling:}

Background sampling shall be carried out prior to starting operations at the proposed landfill site. In the case of the Altus site background samples shall be taken before additional disposal areas are opened.

\section*{B. Periodic Sampling:}

After the initial background samples are taken surface water sampling points
will be sampled quarterly throughout the life of the site and for eight (8) years after closing.

\section*{II. SAMPLE PRESERVATION:}

Sample size and preservation methods shall be according to TABLE D 1. PRESERVATION OF SAMPLES which follows:
\begin{tabular}{|c|c|c|c|c|}
\hline \multirow[t]{2}{*}{Parameter:} & \multirow[t]{2}{*}{\begin{tabular}{l}
Minimum \\
Sample Size:(ml.)
\end{tabular}} & \multirow[t]{2}{*}{Preservation Methods:} & \multicolumn{2}{|l|}{Maximum Storage Time:} \\
\hline & & & Recommended: & Regulatory: \\
\hline COD & 100 & Analyze ASAP or add \(\mathrm{H}_{2} / \mathrm{SO}_{4}\) & 7 da. & 28 da. \\
\hline Conductivity & 500 & Refrigerate
\[
\left(4^{0} \mathrm{C}\right)
\] & 28 da. & 28 da. \\
\hline pH & --- & Analyze Immediately & 2 hr . & 2 hr . \\
\hline
\end{tabular}

TABLE D 1. PRESERVATION OF SAMPLES.

Use plastic (polyethylene) or glass containers for determinations. Samples should be labeled as soon as they are collected. Labeling information includes the foilowing:
A. Date,
B. Name of site and permit number,
C. Name of person collecting samples,
D. Sampling location point number,
E. Preservative used.

\section*{III. ANALYSES TO BE PERFORMED:}

The analyses to be performed include \(\mathrm{pH}, \mathrm{COD}\), specific conductivity, temperature and turbidity.

\section*{IV. RECORDKEEPING AND REPORTING:}

Results of surface water sampling will be in a field log book and later transferred to the forms provided by the OSDH. Results of surface water sampling will be forwarded to the OSDH within fifteen (15) days of receipt by the City. Copies of the testing results will be maintained at city hall for public inspection.

\section*{SECTION TWO: GROUNDWATER MONITORING}

\section*{I. SAMPLING SCHEDULE:}

\section*{A. Background Sampling:}

Background sampling was carried out for the four (4) wells which have been constructed. Three additional monitor wells will be constructed prior to opening new disposal areas. Additional background sampling shall be carried out within two weeks of completing the monitor wells. Background sampling will establish static water levels and samples will be tested for \(\mathrm{pH}, \mathrm{COD}\), conductivity, drinking water standards, metals and a GC/MS scan for organics. The Solid Waste Division of the OSDH will attempt to collect background samples from newly permitted sites and every three years thereafter. This is in addition to the sampling required of the owner.

\section*{B. Periodic Sampling:}

Periodic samples shall be collected quarterly to determine if the quality of the surface water is deteriorating. Quarterly sampling will be carried out throughout the life of the site and for eight (8) years thereafter. Quarterly sampling will include static water levels, ph, COD and conductivity.

\section*{III. SAMPLING EQUIPMENT:}

Groundwater monitor well sampling equipment utilized by the OSDH requires a minimum well diameter of two (2) inches or greater. If monitor wells are constructed with well casings of smaller diameter, dedicated well sampling equipment must be provided by the owner.

\section*{A. Teflon Bailer:}

A teflon bailer is the sampler of choice. It has a low initial cost, is easily decontaminated and requires no special support equipment or personnel training. The rate of water removal is low; therefore a high degree of physical labor is required if the wells are deep.

The City of Altus does their own testing and they utilize a sample bottle on a monofilament line.

\section*{B. Pumps:}

Pumps may be utilized for purging wells if caution is utilized not to aerate the sample. Types of acceptable pumps include peristaltic pumps and bladder pumps which use pressurized air or bottled gasses such as nitrogen. Submergible pumps may be used if they are dedicated and approved as a part of the application.

\section*{C. Containers:}

Sample containers and required preservatives should be provided by the laboratory which will perform the analyses.

\section*{D. Water Level Indicators:}

Dedicated electronic water level indicators should be used to record water levels. A bench mark should be placed on the well casing. The water level is used to determine the amount of water to be purged from the well casing prior to collecting the samples.

\section*{E. Field Logs:}

A field log book should be maintained to record information gathered in the field and to provide a reference for future sampling procedures.

\section*{III. SAMPLING PROCEDURES :}

To avoid contamination of the background wells the up gradient wells must always be sampled first.

\section*{A. Well Sampling:}

At each well the following steps of procedure must be used:
1. Measure the depth to water with water level indicator and record in the log book.
2. Measure the depth of well and record. Compare measured depth with "as completed" monitoring well logs. Note any discrepancy.
3. Measure the inside diameter of the casing.
4. Using data obtained thus far and the data in TABLE D 2. WELL CASING VOLUMES calculate the volume of water in the casing.
5. Purge the well by removing by pump or bailer, at least one casing volume of water and discarding it. Removal of three to five casing volumes of water is recommended, but this may not be possible in extremely low yield formations.

It is important to sample the water in the formation, not water
standing in the casing. The removal of at least one volume of water is essential. If the formation is a high yield aquifer it will recharge as fast as it is pumped or bailed, therefore a record in the log book that tells if the well can or has been pumped dry is important. In a low yield formation it is sometimes necessary to allow the well some time to recover and produce enough water for a sample. It may be necessary to return to a low yield well the day after purging to obtain an adequate sample.

Before purging the well with a pump, determine the depth at which to place the pump. If the well yield is low to moderate, the pump should be placed at the bottom of the screened interval. Place the pump near the top of the water column in high yielding wells, rather than in the screened area, so as to force water up the well casing to the pump. Otherwise, water directly from the formation may be pumped during the purging cycle, and water standing in the well above the screen may not be evacuated. This standing water may be taken during sample collection and may not be representative of subsurface conditions. This will not occur, though, if the pumping rate is high enough to cause significant drawndown in the well.
6. Collect samples, preferably with a bailer. Fill sample bottles to the required level, being careful not to contaminate the sample containers or lids. Label the sample bottles at the well site.
7. Recap and lock the monitoring well.

\section*{B. Cleanliness of Sampling Equipment:}

Extreme care should be taken to guard against contamination of sampling equipment, particularly by handing. All sampling equipment should be rinsed with deionized water before it is used, and between each use. After sampling the last well the equipment may be washed with tap water but all cleaners and soaps are to be avoided. Do not allow sampling equipment to come into contact with the ground as a well is being purged or sampled. Not only will contaminated equipment contaminate the sample, it may also contaminate the well itself.

\section*{IV. PRESERVATION AND TESTING:}

\section*{A. Preservation:}

Samples which are to be refrigerated should be placed in an ice chest immediately after they are collected and labeled. Some samples must be kept in a dark place, out sunlight. Samples which are to be preserved by the addition of acid may be held until the end of the sampling day when all samples to be preserved by that method may have acid added. Follow instructions of the laboratory which will be preforming the analyses.

\section*{B. Labeling:}

Labeling with use of a permanent, waterproof marker includes the following information:
1. Date,
2. Name of Site and Permit Number,
3. Name of Person Collecting Samples,
4. Well Number,
5. Preservative Used

\section*{C. Laboratory Coordination:}

Close coordination with the laboratory which will be conducting the analyses is necessary as they will provide the following:
1. Sample containers,
2. Amount of sample water necessary for analysis,
3. Preservative and preservation techniques,
4. Quality control in the form of both field and laboratory blanks,
5. Coordination with sample collection and analysis.

In the case of Altus, City forces carry out the sampling and perform the analysis in the city laboratory. Coordination between the lab and the personnel who collect the samples is a simple matter.

\section*{D. Field Testing:}

Field testing for certain parameters (such as pH , temperature, specific conductance and dissolved oxygen) is recommended in some cases. These tests should be performed only be trained technicians. Equipment should be tested and calibrated as recommended by the manufacturer. Test results are to be recorded in the field log book.

\section*{IV. RECORDKEEPING AND REPORTING:}

Results of surface water sampling will be forwarded to the OSDH within fifteen (15) days of receipt by the City. Copies of the testing results will be maintained at city hall for public inspection.

TABLE D 2. WELL CASING VOLUMES
\begin{tabular}{|c|c|c|c|}
\hline Casing Size & Height & Inches \({ }^{3}\) & Gallons \(\mathrm{H}_{\underline{2}} \underline{\mathrm{O} / \mathrm{ft} \text {. casing }}\) \\
\hline \(1{ }^{\prime \prime}\) & 12" & 9.42 & 0.042 \\
\hline 2" & 12" & 37.68 & 0.16 \\
\hline \(3 "\) & 12 " & 84.74 & 0.36 \\
\hline \(4 "\) & 12 " & 150.72 & 0.65 \\
\hline \(6 "\) & 12 " & 339.12 & 1.46 \\
\hline 8" & 12" & 602.88 & 2.60 \\
\hline 10" & 12 " & 942.00 & 4.07 \\
\hline 12" & 12" & 1356.48 & 5.87 \\
\hline
\end{tabular}

\section*{SECTION THREE: GAS MONITORING}

Gas monitoring is not contemplated at the Altus landfill; therefore, monitoring protocol is not included as a part of this application.

\section*{APPENDIX E.}

\section*{LINER INSTALLATION AND TESTING PLAN.}

\section*{APPENDIX D. LINER INSTALLATION AND TESTING PLAN.}

This application is for a Type I-B, Metropolitan Sanitary Landfill which lies west of the "water balance" line as established by OSDH. By definition transevaporation takes place at a rate faster than the annual rainfall amounts; therefore, a liner is not required. However at no time will wastes be permanently disposed of within five (5) feet of the highest seasonal phreatic groundwater level.

Based on this a Liner Installation and Testing Plan is not required.

\section*{CONTRACT DOCUMENTS}

\section*{AND}

\title{
TECHNICAL SPECIFICATIONS \\ Altus Municipal Landfill - C\&D Debris Cell
}

Project No. 22-117


October 2022

Prepared By:
Cowan Group Engineering, LLC
7100 N. Classen Blvd., Suite 500
Oklahoma City, OK 73116
Phone: 405-463-3369
CA \# 6414 Expires 6/30/24

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\section*{Responsible Registrant}

Cowan Group Engineering, LLC
CA No. 6414 (Expires 6/30/24)


\section*{ADVERTISEMENT FOR BIDS}

Notice is hereby given that the City of Altus will receive and open sealed Bids for the construction of:

\section*{Altus Municipal Landfill - C\&D Debris Cell}

Sealed bids will be received until 9:30 AM, , 2022, in the Altus City Clerk's Office on the 2nd Floor of City Hall at 509 S. Main Street, Altus, Oklahoma, 73521-3135. A public bid-opening will be held at 10:00 AM on the same date in the same location. Bids shall be opened at the above stated time for receipt of Bids or as soon thereafter as practicable. This project consists of furnishing all required materials, supplies, equipment, tools, and personnel to perform all necessary labor for the construction of the Altus Municipal Landfill - C\&D Debris Cell. This project is eligible for sales tax exemption.

Questions regarding this solicitation must be submitted by 3:00 PM,
2022. Questions should be submitted to the City Engineer who can be reached as follows:

Johnny Barron
City Engineer
580-481-3518
jbarron@altusok.gov

Questions submitted after this deadline might not be answered. Written responses to questions will be sent to potential bidders who have requested a bid package. Interested persons may be added to the list of potential bidders by emailing a request to the City Engineer.

\section*{Pre-Bid Meeting}

Bidders are invited to attend a non-mandatory pre-bid meeting to be held at:

> 10:00 AM, 16250 N1960 Road, Duke, Oklahoma 73532 1.5 miles north of the intersection of US Hwy 62 \& N1960 Road

Attendance is not mandatory. Bids will be accepted from bidders who are not able to attend the pre-bid meeting.

The work shall be done in accordance with plans and specifications on file in the City Engineer's Office. Plans, specifications and other bidding documents are available for public inspection, and copies may be obtained by visiting the City Engineer's Office or the Consulting Engineer's Office, Cowan Group Engineering, LLC, 7100 N. Classen Blvd., Suite 500, Oklahoma City, OK 73116; phone: 405.463.3369.

Complete digital project bidding documents are available for a non-refundable fee of \(\mathbf{\$ 5 0 . 0 0}\) by going to QuestCDN - www.questcdn.com and by entering Quest Project \# \(\qquad\) on the website's project search page. Please contact QuestCDN.com at 952-233-1632 or info@questcdn.com for assistance in free membership registration, downloading and working with this digital project information.

Hardcopy plans and specifications are available for a non-refundable fee of \(\mathbf{\$ 1 5 0 . 0 0}\) payable to Cowan Group Engineering. No documents will be mailed until payment is received in full.

Each bid must be submitted in a sealed envelope bearing on the outside: the name of the bidder, his/her address and the name of the project for which the bid is submitted. If forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope addressed as specified in the bid form. All blank spaces for bid prices must be completed in ink, or typewritten and in both words and figures.

Bids received more than ninety-six (96) hours, excluding Saturdays, Sundays and holidays, before the time set for opening of bids, as well as bids received after the time set for receipt of bids, WILL NOT be considered and will be RETURNED UNOPENED.

A cashier's check, a certified check or a surety bond in the amount of five percent (5\%) of the bid shall accompany the sealed proposal of each bidder. Deposits will be returned to unsuccessful bidders. Each bid submitted is a legal offer and when accepted by the City, constitutes a FIRM AND BINDING CONTRACT. The City reserves the right to REJECT ANY or ALL BIDS. The City of Altus Municipal Trust Authority reserves the unconditional right to cancel all or any portion of this project within thirty (30) days from the date of the opening of the bids, for any reason and at its sole discretion.

\section*{INSTRUCTION TO BIDDERS}

The City of Altus, herein after called the "City," is seeking bids to construct one (1) approximately 10 acre construction and demolition debris cell with an access road at the Altus Municipal Landfill located on the west side of N1960 Rd. approximately 1.5 miles north of the intersection of US Hwy. 62 and N1960 Rd.

Sealed bids will be received until 9:30 AM,
2022, in the Altus City Clerk's Office on the \(2^{\text {nd }}\) Floor of City Hall at 509 S. Main Street, Altus, Oklahoma, 73521-3135. A public bid-opening will be held 10:00 AM on the same date in the same location.

Questions regarding this solicitation must be submitted by 3:00 PM,
2022. Questions should be submitted to the City Engineer who can be reached as follows:

Johnny Barron
City Engineer
580-481-3518
jbarron@altusok.gov

Questions submitted after this deadline might not be answered. Written responses to questions will be sent to potential bidders who have requested a bid package. Interested persons may be added to the list of potential bidders by emailing a request to the City Engineer.

\section*{PRE-BID MEETING}

Bidders are invited to attend a non-mandatory pre-bid meeting to be held at:
10:00 AM, 2022
Altus Municipal Landfill
16250 N1960 Road, Duke, Oklahoma 73532
1.5 miles north of the intersection of US Hwy 62 \& N1960 Road

Attendance is not mandatory. Bids will be accepted from bidders who are not able to attend the pre-bid meeting.

\section*{BID SUBMITTAL}

Bids must be sealed and must include "Project No. 22-117" on the bottom left hand corner of the bid envelope and be mailed or delivered to the Clerk's Office on the second floor of the Altus City Hall City at 509 S. Main Street, Altus, OK 73521-3135. Bidders must include a return address on the top left hand corner of the envelope.

Bids shall consist of returning the following completed forms, all of which are found in this solicitation package:
- Bid Form
- Bid Bond
- Business Relationship Affidavit
- Non-Collusion Affidavit

The City reserves the right to reject any or all bids and to study all bids for thirty (30) days prior to bid award.

Bids received more than ninety six (96) hours before the time set for opening of bids, or any bid received after the time set for the opening of bids, shall not be considered and shall be returned unopened.

The City does not discriminate on the basis of race, color, national origin, sex, religion, age or handicap status, in; employment decisions, the procurement of services, the selection of suppliers or awarding of bids and/or contracts.

Awards shall be based on a determination of the lowest qualified bid. "Qualified" is a determination by the City regarding the capability of the bidder to perform the work in good faith, with integrity and reliability as well as the materiality of the bidder's errors, omissions, or exceptions (if any).

\section*{SCOPE OF WORK}

The Contractor shall provide labor, equipment, materials and incidentals needed to perform the following work:
- Construct one (1) approximately 10 acre construction and demolition debris cell with an access road:
- Unclassified Soil Excavation and On-Site Stockpile
- Clay Liner Excavation / Re-compaction
- Grading for Access Road
- Protective Sand Layer Construction - 1' thickness
- In-situ liner borings
- In-site liner post excavation/pre-disposal tests

\section*{BONDS}

The following bonds will be required for this project. Bond forms are included in this solicitation.
1. Bid Bond - a bond to protect the City against unqualified bidders. Each bidder shall include a bid bond along with the bid. Bonds shall be in the amount of \(5 \%\) of the total bid. A cashier check or certified letter of credit may be submitted in lieu of a bid bond. Failure to submit this along with
the bid may result in the bid being rejected as not complete. Within 10-days of the project being awarded by the City Council, bid bonds will be returned to unsuccessful bidders.

In the event that the successful bidder fails to execute a contract or to submit required bonds and insurance, the Bid Bond will be cashed and retained by the City as compensation and the project will be offered to the next lowest qualified bidder.
2. Performance Bond - a bond to protect the City against failure to complete the project. This bond shall be for the total bid amount and shall be in force until the project is accepted by the City. To be submitted by the winning contractor after the bid is awarded.
3. Statutory Bond (Payment Bond) - a bond to protect the City against Contractors failure to pay suppliers, vendors, or subcontractors. This bond shall be for the total amount of the project. To be submitted by the winning contractor after the bid is awarded.
4. Maintenance Bond - a bond to protect the City from faulty work. This bond shall be for the total bid price and shall be in force until 24 months after the date of acceptance. To be submitted by the winning contractor after the bid is awarded.

\section*{INSURANCE}

The Contractor shall purchase and maintain such insurance as will protect himself and the Owner from claims which may arise out of or result from the Contractor's execution of the work, whether such execution be by himself or by any Subcontractor or by anyone directly or indirectly employed by any of them.

The required insurance shall cover the following claims which may arise thru execution of the Contract:
1. Claims under Workman's Compensation, disability benefit and other similar employee benefit acts;
2. Claims for damages because of bodily injury, occupational sickness or disease, or death of the employees;
3. Claims for damages because of bodily injury, sickness or disease, or death of any person other than the employees;
4. Claims for damages because of injury to or destruction of tangible property, including loss of use resulting therefrom.

The Contractor shall purchase and maintain, during the contract time, General Public Liability and Property Damage insurance including vehicle coverage. The insurance shall be in an amount of not less than \(\$ 200,000.00\) for injuries, including accidental death, to any one person, and subject to the same limit for each person in an amount of not less than \(\$ 200,000.00\) for injuries, including accidental death, to any one person, and subject to the same limit for each person in an amount of not less than \(\$ 200,000.00\) for injuries, including accidental death, to any one person, and subject to the same limit for each person in an amount of not less than \(\$ 1,000,000.00\) on account of one accident and Property Damage Insurance in an amount of not less than \(\$ 200,000.00\).

The Contractor shall furnish to the Owner Certificates of Insurance prior to execution of the Agreement. These certificates shall contain a provision that coverage's afforded under the policies will not be
cancelled unless at least fifteen (15) days prior written notice has been given to the Owner. Only companies that have been approved by the Oklahoma Insurance Commission will be accepted.

\section*{HOLD HARMLESS}

The Contractor shall save harmless the Owner from all suits, actions or claims brought on account of any injuries or damages sustained by any person or property in consequence of any neglect or misconduct by the Contractor including any and all employees, agents or subcontractors.

\section*{WARRANTIES}

Bidders shall declare manufacturer warranty information on the bid form. The Contractor will be expected to obtain and follow manufacturer specifications as needed to qualify for this warranty. If there is a discrepancy between this document and the manufacturer specifications, the manufacturer specifications shall govern.

\section*{BID FORM}

TO: City of Altus
DATE: \(\qquad\)
509 S. Main Street
Altus, OK 73521-3135

In compliance with your Invitation to Bid, we, the undersigned hereby propose to furnish all labor, materials, equipment and incidentals necessary to perform and complete all work for:

\section*{Altus Municipal Landfill - C\&D Debris Cell - Project No. 22-117}

The Bidder hereby agrees that if a contract is awarded, he will enter into an Agreement with the City of Altus and will commence work on the date specified in the Notice to Proceed and fully complete the work within one hundred twenty (120) consecutive calendar days thereafter.

Bidder acknowledges receipt of the following Addenda (if any):

Addendum No. \(\qquad\) Date Issued: \(\qquad\)

Addendum No. \(\qquad\) Date Issued: \(\qquad\)
The Bidder agrees to perform all the work herein described in the Contract Documents for the fees entered into the following Bid Schedule.

By submitting this Bid, the Bidder acknowledges that he has had sufficient opportunity to review the Contract Documents and visit each property to familiarize himself with all requirements, limitations and site conditions. The Bidder agrees that this Bid shall be good and may not be withdrawn for a period of 30 (thirty) calendar days after the date of the bid opening.

\section*{Bid Schedule}
\begin{tabular}{|c|l|c|c|c|c|}
\hline ITEM & \multicolumn{1}{|c|}{ DESCRIPTION } & QTY & UNIT & UNIT PRICE & TOTAL COST \\
\hline 1 & MOBILIZATION & 1 & LSUM & & \\
\hline 2 & \begin{tabular}{l} 
UNCLASSIFIED EXCAVATION AND ON- \\
SITE STOCKPILE
\end{tabular} & 88,700 & CY & & \\
\hline 3 & \begin{tabular}{l} 
PROTECTIVE SAND LAYER (1' \\
THICKNESS)
\end{tabular} & 15,600 & CY & & \\
\hline 4 & GRADING, ACCESS ROAD & 1,400 & CY & & \\
\hline 5 & \begin{tabular}{l} 
EXCAVATION AND RECOMPACTION OF \\
\(3^{\prime}\) CLAY LINER
\end{tabular} & 50 & CY & & \\
\hline 7 & \begin{tabular}{l} 
IN-SITU LINER BORINGS
\end{tabular} & EA & & \\
\hline 7 & \begin{tabular}{l} 
IN-SITU LINER POST EXCAVATION/PRE- \\
DISPOSAL TESTS
\end{tabular} & 1 & LSUM & & \\
\hline
\end{tabular}

TOTAL BASE BID
\$ \(\qquad\)
TOTAL BASE BID \(\qquad\)
\(\qquad\) DOLLARS
Upon written receipt of the Notice of Award, the Bidder agrees that within 5 (five) days they will furnish to the City a Certificate of Insurance and a W-9 Form as required in Contract Documents.

The Bidder understands that the City reserves the right to reject any or all bids, to waive any informalities in the bidding, and to accept what is determined to be the lowest qualified Bid.

Submitted By:
SEAL - if bid
by Corporation
Name of Firm: \(\qquad\)

Authorized Signature: \(\qquad\)
Title: \(\qquad\)
Address: \(\qquad\)
Telephone Number: \(\qquad\)
E-mail Address: \(\qquad\)

\section*{BID BOND}

Know all men by these presents, that we \(\qquad\) _, hereinafter called the "Principal", and \(\qquad\) hereinafter called the "Surety", are held and firmly bound unto the City of Altus, Oklahoma, hereinafter called the "Obligee", in the sum of \$ \(\qquad\) Dollars (\$ \(\qquad\) ),
for payment of which sum well and truly to be made, the said Principal and Surety jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns, by these presents.

The condition of the above obligation is such that, whereas the Principal has submitted a bid for the Full Altus Municipal Landfill - C\&D Debris Cell (Project No. 22-117) which is attached hereto and hereby made a part hereof.

NOW, THEREFORE, if said bid shall be accepted and the Principal shall execute and deliver a contract and shall furnish bonds and insurance as specified in the contract documents, then this obligation shall be void. Otherwise, the same shall remain in force and effect, it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall be limited to the penal amount of the obligation as stated herein.

The Surety, for value received, hereby stipulates that the obligations of said Surety and its bond shall in no way be impaired or affected by any extension of the time within which the Obligee may accept such bid and said Surety does hereby waive notice of any such extension.

IN WITNESS THEREOF, the Principal and the Surety have hereunto set their hands and seals and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers.

SIGNED AND SEALED THIS \(\qquad\) day of \(\qquad\) 20 \(\qquad\) .
(SEAL)

Signature for Principal

Attest (if by Corporation)
Printed Name and Title
(SEAL)

\section*{Signature for Surety}

\section*{Attest (if by Corporation)}

Printed Name and Title

\section*{BUSINESS RELATIONSHIP AFFIDAVIT}

\section*{state of okalhoma)}

\section*{)SS}

COUNTY OF JACKSON)
of lawful age, being first duly sworn, on oath says
that he/she is the agent authorized by the bidder to submit the attached bid, affiant further states that the nature of any partnership, joint venture or other business relationship presently in effect or existed within 1 (one) year prior to the date of this statement with the architect, engineer, or other party to the project is as follows:

Affiant further states that any such business relationship presently in effect or which existed within 1 (one) year prior to the date of this statement between any officer or director of the bidding company and any officer or director of the architectural or engineering firm or other party to the project is as follows:

Affiant further states that the names of all persons having any such business relationships and the positions they hold with their respective companies or firms are as follows:
(If none of the business relationships hereinabove mentioned exist, affiant should so state.)

\section*{Affiant's Name \& Signature}

Subscribed and sworn to before me this \(\qquad\) day of \(\qquad\) 20 \(\qquad\) .

My Commission Expires \(\qquad\)
Seal

\section*{NON-COLLUSION AFFIDAVIT}

STATE OF OKLAHOMA)
)SS
COUNTY OF JACKSON)
\(\qquad\) of lawful age, being first duly sworn, on oath says that he/she is the agent authorized by the bidder to submit the attached bid. Affiant further states that the bidder has not been a party to any collusion among bidders in restraint of freedom of competition by agreement to bid at a fixed price or to refrain from bidding; or with any state or city official or employee as to quantity, quality, or price in the prospective contract; or in any discussions between bidders and any state or city official concerning exchange of money or any other thing of value for special consideration in the letting of a contract.

Affiant's Name \& Signature

Subscribed and sworn to before me this \(\qquad\) day of \(\qquad\) 20 \(\qquad\) .

Notary Public

My Commission Expires: \(\qquad\)

SEAL

\section*{AGREEMENT}

This Agreement, made this \(\qquad\) day of \(\qquad\) , 2022, by and between the City of Altus ("City") a municipal corporation public trust, and ("Contractor").

\section*{WITNESSETH:}

That for and in consideration of the payments and agreements hereinafter mentioned:
1. The Project. The Contractor shall commence and complete the construction of Altus Municipal Landfill - C\&D Debris Cell (Project No. 22-117).
2. Materials. The Contractor shall furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of the project described herein.
3. Commencement and Completion. The Contractor shall commence the work required by the Contract Documents within ten (10) calendar days after the date of the Notice to Proceed and shall complete the same within one hundred and twenty (120) calendar days unless the period for completion is otherwise extended by the Contract Documents.
4. Work and Total Payment. The Contractor agrees to perform, and shall perform, the entirety of the work described in the Contract Documents and shall comply with the terms therein for the total sum of \(\qquad\) as shown on the Contractor's Bid Form.
5. Liquidated Damages. The Contractor shall pay liquidated damages at the rate of \(\mathbf{\$ 1 , 0 0 0 . 0 0}\) per each and every calendar day required by him to complete the contract in excess of the contract time.
6. Agreement Terms and Documents. The term "Contract Documents" means the Project No. 22-117, which includes the following:
6.01. Instructions to Bidders
6.02. Bid Submittal
6.03. Scope of Work
6.04. Conditions
6.05. Bonds
6.06. Insurance
6.07. Hold Harmless
6.08. Technical Specifications
6.09. Bid Review \& Award
6.10. Warranties
6.11. Bid Form
6.12. Bid Bond
6.13. Business Relationships

Affidavit
6.14. Non-Collusion Affidavit
6.15. Agreement
6.16. Performance Bond
6.17. Statutory Bond
6.18. Maintenance Bond
6.19. Location Maps
\&
Photographs
The Contract Documents also include the following:
6.20. Contractor's Bid
6.21. Notice of Award
6.22. Notice to Proceed
6.23. Change Orders (if Any)
7. Payment. The City will pay the contract amount in full to the Contractor after the work is completed in such amount as required by the Contract Documents and after approval of the work by the City of Altus ("City"). Partial payments may also be approved on a monthly basis for work completed or materials purchased during that month. Retainage shall apply to partial payments to the Contractor.
8. Retainage. Five percent (5\%) of all partial payments made shall be held by the City as retainage, or, in the alternative, the maximum amount allowed by Oklahoma law. See Title 61 O.S. §113.1. Retainage shall be paid upon project completion and approval of the work by qualified City
9. Execution. This Agreement shall be executed by both parties no later than sixty (60) days from the date of the Notice of Award. See Title 61 O.S. §113(A).
10. Bonds. The Contractor shall obtain all bonds required by Oklahoma law, including without limitation the bonds set forth in Title 61 O.S. \(\S \S 107\) and 113. The Contractor shall provide documentary proof of the bonds, at the time of the execution of this Agreement, and to Johnny Barron, the Engineer for the City of Altus.
11. Remedies upon Default:
10.01. Upon default, and in addition to any other remedies available to it on account of such event or default, either party may terminate this Agreement, in writing, without further notice.
10.02. No right or remedy herein conferred upon or reserved to either of the parties is intended to be exclusive of any other right or remedy, and each and every right and remedy shall be cumulative to any other right or remedy given hereunder or now or hereafter legally existing upon default.
10.03. The failure of either party to insist upon the strict observance or performance of any of the provisions of this Agreement or to exercise any right or remedy provided in this Agreement shall not impair any such right or remedy nor be construed as a waiver or relinquishment thereof with respect to subsequent defaults. Every right and remedy given by this Agreement to the parties may be exercised from time to time and as often as may be deemed expedient by the parties.
10.04. Contractor acknowledges that it is contracting with a political subdivision of the State of Oklahoma. If the City and/or AMA brings any action because of any event of default, and if the City and/or AMA is successful in any such action, Contractor agrees to pay the costs and fees, including reasonable attorney's fees, incurred by the City and/or AMA. If the City and/or AMA is unsuccessful in any such action, or if the action is brought by Contractor as a result of City and/or AMA's default, both parties agree to pay its own costs and fees.
12. Severability. If a court of competent jurisdiction determines that any term of this Agreement is invalid or unenforceable to any extent under applicable law, the remainder of this Agreement (and the application of this Agreement to other circumstances) shall not
be affected thereby, and each remaining term shall be valid and enforceable to the fullest extent permitted by law.
13. Integration, Amendments and Interpretation. This Agreement constitutes the entire agreement between the parties and may not be amended, altered, modified or changed in any way except in writing signed by all parties to this Agreement and which specifically references this Agreement. There are no other agreements, representations or warranties, whether oral or written, regarding the subject matter of this Agreement. No course of dealings involving the parties hereto and no usage of trade shall be relevant or admissible to interpret, supplement, explain or in any way vary any of the terms of this Agreement. Any amendment to this Agreement shall be attached to this Agreement and all of the terms in this Agreement not addressed in the amendment shall remain in full force and effect.
14. Compliance with Laws. Contractor shall comply with all applicable federal, state and local laws, codes, ordinances, rules and regulations in performing its duties, responsibilities and obligations pursuant to this Agreement.
15. Governing Law. This Agreement shall be deemed to have been made in the State of Oklahoma and shall be construed and interpreted in accordance with the laws of the State of Oklahoma.
16. Venue. Any action or proceeding seeking to enforce any provision of, or based on any right arising out of, this Agreement may be brought against any of the parties in the courts of the State of Oklahoma, County of Jackson or, if it has or can acquire jurisdiction, in the United States District Court for the Western District of Oklahoma. The parties consent to the jurisdiction of such courts, and of the appropriate appellate courts, in any such action or proceeding and waives any objection to venue laid therein.
17. Relationship of Parties. Contractor and the City and/or the AMA acknowledge and agree that they are not joint venturers, partners, or joint owners with respect to the Leased Premises, and nothing contained in this Agreement shall be construed as creating a partnership, joint venture or similar relationship between the City and/or the AMA and the Contractor. All persons working for Contractor under this Agreement shall be employees of Contractor and shall not be considered employees of the City and/or the AMA for any reason. The hiring, discharge, supervision, and management of the employees of Contractor who provide services under this Agreement and the establishment, revision, and administration of wage scales, rates of compensation, conditions of employment, and job position descriptions with respect to Contractor shall be within the sole discretion and responsibility of the Contractor.
18. Counterparts. This Agreement may be executed in any number of counterparts, and when each party has signed and delivered to the other at least one (1) such counterpart, each counterpart shall be deemed an original and, when taken together with other signed counterparts, shall constitute one Agreement; provided, however, this Agreement shall not be binding upon either party hereto until executed by both parties.
19. Third-Party Beneficiaries. Nothing in this Agreement, expressed or implied, is intended to confer upon any person, other than the parties hereto and their respective assigns, any rights or remedies under or by reason of this Agreement.
20. Binding Effect. This Agreement binds the parties hereto and any successors and assigns of the parties.
21. Governmental Tort Claims Act. As may be applicable, by entering into this Agreement, City and/or the AMA and its "employees," as defined by the Governmental Tort Claims Act, 51 O.S. § 151 et seq., do not waive sovereign immunity, any defenses or any limitations of liability as may be provided for by law. No provision of this Agreement modifies and/or waives any provision of the Governmental Tort Claims Act.
22. Construction and Interpretation. Captions and other headings contained in this Agreement are for reference and identification purposes only and do not alter, modify, amend, limit or restrict the contractual obligations of the parties.
23. Notices. Whenever notice is required to be given in writing, such notice shall be hand delivered or mailed by certified mail, return receipt requested, and directed to the respective parties at the following addresses:

As to the City/AMA: City of Altus/Altus Municipal Authority
Attn: City Clerk/Treasurer
509 S. Main St.
Altus, Oklahoma 73521
AND
City of Altus/Altus Municipal Authority
Attn: Johnny Barron
509 S. Main St.
Altus, Oklahoma 73521
As to the Contractor:
Attn:
Address: \(\qquad\)
City, ST Zip: \(\qquad\)
or at such other addresses as a party shall specify by like notice to the other party hereto. Notices shall be effective on the date of delivery.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be executed on the day and year last written below.
** SEPARATE SIGNATURE PAGES FOLLOW **

\section*{SIGNATURE PAGE OF THE CITY OF ALTUS}

Date Signed: \(\qquad\)
(SEAL)

\section*{ATTEST:}

Debbie Davis, City Clerk

Approved as to Form and Legality:

Michael T. Beason, City Attorney
Approved as to Eormand Legaity:
-
"City of Altus" an Oklahoma Municipal Corporation

Jack Smiley, Mayor

\section*{SIGNATURE PAGE OF CONTRACTOR}

Date Signed: \(\qquad\)

Signature
Printed Name and Title

\section*{ACKNOWLEGMENT}

State of Oklahoma )
) ss.
County of Jackson )
On this \(\qquad\) day of \(\qquad\)
\(\qquad\) before me, a Notary Public in and for
said county and state, personally appeared \(\qquad\) , to me known or proved on the basis of satisfactory evidence to be the person whose name is subscribed to the foregoing instrument on behalf of \(\qquad\) and acknowledged that he/she executed the same as the voluntary act and deed of said corporation.

In Witness Whereof, I have hereunto subscribed my name and affixed my official seal on the day and year last above written.

Notary Public
My Commission Expires: \(\qquad\)
My Commission Number: \(\qquad\)

\section*{PERFORMANCE BOND}

That \(\qquad\) as Principal, and \(\qquad\) corporation organized under the laws of the State of \(\qquad\) and authorized to transact business in the State of Oklahoma, as surety, are held and firmly bound unto the City of Altus in the sum of Dollars (\$ \(\qquad\) ) in lawful money of the United States of America, for the payment of which, well and truly to be made, we bind ourselves and each of us, our heirs, executors, administrators, trustees, successors, and assigns, jointly and severally, firmly by these presents.

Dated this \(\qquad\) day of \(\qquad\) 20 \(\qquad\) .

The conditions of this obligation is such that:

Whereas, said principal entered into a written contract with the City of Altus, dated \(\qquad\) 20 \(\qquad\) for Altus Municipal Landfill - C\&D Debris Cell (Project No. 22-117).

All in compliance with the plans and specifications therefore, made a part of said contract and on file in the office of the City of Altus, 509 S. Main Street, Altus, OK 73521-3135.

Now, Therefore, if said principal shall, in all particulars, well, truly, and faithfully perform and abide by said contract and each and every covenant, condition, and part thereof and shall fulfill all obligations resting upon said principal by the terms of said contract and said specifications; and said principal shall promptly pay, or cause to be paid, all labor, materials and/or repairs and all bills for labor performed on said work, whether by subcontractor or otherwise; and if said principal shall protect and save harmless said City of Altus from all loss, damage, and expense to life or property suffered or sustained by any person, firm or corporation caused by said principal or his/her agents, servants, or employees in the construction of said work, or by or in consequence of any negligence, carelessness or misconduct in guarding and protecting the same, or from any act or omission of said principal or his / her or its agents, servants, or employees, and if said principal shall protect and save City of Altus harmless from all suits and claims of infringement or patent rights or processes, then this obligation shall be null and void, otherwise to be and remain in full force and effect.

It is further expressly agreed and understood by the parties hereto that no changes or alterations in said contract and no deviations from the plan or mode of procedure herein fixed shall have the effect of releasing the sureties, or any of them, from the obligations of this bond.

In witness whereof, the said principal has caused these presents to be executed in its name and its corporate seal to be hereunto affixed by its duly authorized officers, and the said surety has caused these
presents to be executed in its name and its corporate seal to be hereunto affixed by its attorney-in-fact, duly authorized so to do, the day and year first above written.

Principal:

By:

Title
Attest:

Surety:

By:

Attorney-in-Fact

\section*{STATUTORY BOND}

KNOW ALL MEN THESE PRESENTS:
That we, \(\qquad\) as Principal, and \(\qquad\) a Corporation
organize under laws of \(\qquad\) , as Surety, are held and firmly bound unto the City of Altus in the amount of \(\qquad\) Dollars
(\$ \(\qquad\) ) for the payment of which we hereby bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

Dated this \(\qquad\) .day of \(\qquad\) 20 \(\qquad\) .

Whereas, the said \(\qquad\) did on \(\qquad\) enter into a certain contract with the City of Altus for construction of:

\section*{Altus Municipal Landfill - C\&D Debris Cell}

Whereas, this bond is given in compliance with Oklahoma Statutes Annotated, 1941, Title 61, Sections 1 and 2 , as amended.

NOW THEREFORE, the condition of the above obligation is such, that if the Principal shall pay all indebtedness incurred for labor or material or rental of machinery or equipment furnished in the construction of said public construction project and while making said public improvements, then this obligation shall be void, otherwise to remain in full force and effect.

IN WITNESS WHEREOF, we have hereunto set our hands and seals the day first above written.
Principal:

\section*{Attest:}

By:
\(\qquad\)
Title

Surety:

By:
\(\qquad\)
Attorney-in-Fact

\section*{KNOW ALL MEN BY THESE PRESENTS:}
That we, as Surety, are held and firmly bound unto the City of

Altus, a Municipal Corporation, as Owner in full and just sum of \(\qquad\)
Dollars (\$ \(\qquad\) ) for
the payment of which well and truly to be made, we, and each of us, bind ourselves, our heirs, executors, administrators, devisees, trustees, successors or assigns, jointly and severally, firmly by these presents.

The conditions of this obligation are such, that whereas, said Principal has by a certain contract, between himself and the Owner dated the \(\qquad\) day of \(\qquad\) 20 \(\qquad\) , agreed to construct the improvements described in said contract and to maintain the said improvements in good condition for a period of one (1) year from the date of final acceptance of the job by the Owner. Principal and Surety further guarantee the repair of any and all damage and or loss resulting from faulty materials or workmanship provided or done by said Principal.

NOW, THEREFORE, if said Principal for the period of one (1) year from and after the completion and acceptance of said improvements, shall maintain in good condition the said improvements, then this obligation shall be void, otherwise to remain in full force and effect. It is further agreed that if the said Principal and Surety, herein shall fail to maintain said improvements in good condition for the said period of one (1) year, and at any time repairs shall be necessary the Owner will make the necessary repairs and the cost of making said repairs shall be determined by the Owner or someone or persons designated by them to ascertain the same, and, upon fifteen (15) days' notice, the said amount ascertained shall become due and payable to the Owner by the Principal or the Surety.

IN WITNESS WHEREOF, instrument is executed in \(\qquad\) counterparts, each one shall be deemed original, this \(\qquad\) day of \(\qquad\) 20 \(\qquad\) .

Attest:
Principal
\(\mathrm{By}:\) \(\qquad\)

\section*{Secretary}

\section*{Attest:}
Surety
\(\mathrm{By}:\) \(\qquad\)
Contract Documents and Technical Specifications
Page 23 of 27

\section*{SPECIAL CONDITIONS}

\subsection*{1.1 SCOPE}

These Special Conditions are supplemental to and shall be considered as a part of the Specifications and Contract. In case of conflict between stipulations of the Special Conditions and the General Specifications or Plans, the Special Conditions shall take precedence and govern Interpretation of the Plans and Specifications shall be made by the Engineer.

The work herein consists of furnishing all tools, labor, equipment, materials and performing all work necessary for the construction, complete, for the following work in strict accordance with detailed Plans and Specifications

The Base Bid is as follows:
Construct one (1) approximately 10 acre construction and demolition debris cell with an access road.

It is the intent of these Plans and Specifications to prescribe a complete work and improvement. Where items of work are necessary for the satisfactory completion of the project for which specific contract prices are not provided in the Proposal and Contract, then such work shall be considered as incidental, and the costs involved shall be included in the Unit Price Bid for items which are classified for payment.

\subsection*{1.2 LAYOUT OF WORK AND SURVEYS}

The Engineer will establish base lines and benchmarks at the site of the work. From the base lines and benchmarks established by the Engineer, the Contractor shall complete the layout of the work and shall be responsible for all measurements that may be required for the execution of the work to the location and limit marks prescribed in the specifications or on the contract drawings, subject to such modifications as the Engineer may require to meet changed conditions or as a result of necessary modifications to the contract work.

The Contractor shall furnish at his own expense, such stakes, templates, platform equipment, tools, and materials, and all labor as may be required in laying out any part of the work from the base lines and benchmarks established by the Engineer. It shall be the responsibility of the Contractor to maintain and preserve all stakes and other marks established by the Engineer until authorized to remove them and if such marks are destroyed by the Contractor through his negligence prior to their authorized removal, they may be replaced by the Engineer, at his discretion, and the expense of replacement will be charged to the Contractor. The Engineer may require that work be suspended at any time when location and limit marks established by the Contractor are not reasonably adequate to permit checking of the work.

\subsection*{1.3 QUALITY CONTROL/QUALITY ASSURANCE}

Quality Control/Quality Assurance (QC/QA) procedures for earthwork is included in the Specifications and is hereby made a part of the Specifications. The contractor and subcontractors shall familiarize themselves with the requirements of these procedures, coordinate and cooperate with the QC/QA project representative, furnish samples for testing, repair test sections and/or locations as called for in the Specifications and the QC/QA Procedures. The contractor may submit five (5) copies of their QC/QA Procedures to the Engineer for approval, if changes are needed from the QC/QA Procedures bound in these Specifications.

The Contractor shall be responsible for disseminating info to the City, the Engineer, and the CQA Engineer of the scheduling and occurrence of all construction activities and for coordination and scheduling of all testing. The CQA Engineer will be directly responsible to the City and will have independent oversight of all testing necessary for liner certification.

It is the intent of these specifications to conform to the EPA (U.S. Environmental Protection Agency) Technical Guidance Document "Quality Control and Quality Assurance for Waste Containment Facilities", EPA/600/R-93/182, dated September 1993. In the event of conflicting requirements, the EPA Document will govern. The Engineer will resolve items not covered in the EPA document. Copies of the EPA Document will be available for review at the Office of the Engineer and at the Landfill office during construction.

The Oklahoma Department of Environmental Quality may sample and/or perform tests on the liner to assure its integrity.

Any reference to an ASTM method refers to the latest published revision.

\subsection*{1.4 PAYMENT FOR TESTING}

The Contractor(s) shall be responsible for any testing or samples required for project approval and as specifically called for in these specifications and the QC/QA procedures.

Contractors shall pay for all failed tests.

\subsection*{1.5 INCREASED OR DECREASED QUANTITIES OR WORK}

The Owner reserves the right to alter the quantities of the work to be performed or to extend or shorten the improvements at any time when it is found necessary, and the Contractor shall perform the work as altered, increased or decreased, at the contract unit prices. No allowance will be made for anticipated profits nor shall such changes be considered as waiving or invalidating any condition or provision of the contract.

This provision shall not be construed to permit the Contractor to perform additional work not included or contemplated in the original proposal.

\subsection*{1.6 TESTING REQUIREMENTS FOR NON-PERFORATED LEACHATE COLLECTION LINES}

The Contractor shall test the full length of the line for infiltration and exfiltration. The infiltration or exfiltration shall not exceed 10 GAL/24 HR/INCH of diameter of pipe/mile of sewer.

A deflection test using a rigid ball or mandrel with a diameter equal to 95 percent of the inside diameter of the pipe shall be performed without mechanical pulling devices. The deflection shall not exceed 5 percent of pipe diameter.

\section*{TECHNICAL SPECIFICATIONS}

Work shall comply with the technical specifications provided by the manufacturer of materials to be installed. The Contractor shall coordinate the project with the Manufacturer's representative to obtain additional specifications as needed.

\section*{ATTACHMENT 'A’ - PROJECT LOCATION}


\section*{DIVISION 01 - GENERAL REQUIREMENTS}

\section*{SECTION 010000 - GENERAL CONDITIONS}

\section*{PART 1 - GENERAL}

\subsection*{1.1 DESCRIPTION}

The General Conditions shall govern and control all work to which they apply; however, since these specifications are of a general nature, they may refer to work not found in this project, in which case such non-applicable stipulations will have no meaning in this Contract. In case of conflict between the General Conditions and the Special Conditions, the Special Conditions shall govern. In case of conflict with either the General or Special Conditions by Supplemental Conditions of a funding agency such as EPA, FMHA, EDA or HUD, the Supplemental Conditions will govern.

\section*{PART 2 - DEFINITIONS}

\subsection*{2.1 DEFINITIONS}

DEFINITIONS: Whenever the words defined below, or pronouns used in their stead occur hereinafter, they shall have the meanings given as follows:
A. "OWNER" shall mean the City of Altus or Altus Municipal Trust Authority.
B. "ENGINEER" shall mean Cowan Group Engineering, LLC, who has been employed by the OWNER for this work, or his duly authorized agent.
C. "Inspector" shall mean the engineering or technical inspector or inspectors duly authorized by the ENGINEER, limited to the particular duties entrusted to him or them.
D. "CONTRACTOR" shall mean the person, persons, partnership, company, firm or corporation entering into this contract for the performance of the work, or the agent appointed to act for such party.
E. "Specification" shall mean, collectively, all of the terms and stipulations contained in the written portion of information furnished.
F. "Drawings or Plan Sheets" shall mean, collectively, all of the drawings pertaining to the contract and made a part thereof, and also such supplementary drawings as the ENGINEER may issue from time to time in order to clarify the drawings, or for the purpose of showing authorized changes in the work, or for showing details which are not shown thereon.
G. The term "Grade" used in these Specification is understood to refer to and indicate the established elevations of the paving, flow line of waterlines and other appurtenances as shown on the drawings.
H. Whenever in these CONTRACT DOCUMENTS the words "as ordered", "as directed", "as permitted", "as allowed", or words or phrases of like import are used, it shall
be understood that the order, direction, requirements, permission, or allowance of the OWNER and ENGINEER is intended.
I. Similarly, the words "approved", "reasonable", "suitable", "acceptable", "properly", "satisfactory", or words of like effect and import, unless otherwise particularly specified herein, shall mean approved, reasonable, suitable, acceptable, proper, or satisfactory in the judgment of the OWNER and ENGINEER.
J. Whenever the term "or equal" is used in the drawings and/or Specification it shall refer to a material which will adequately perform the same function, in the opinion of the ENGINEER, as the material specified or shown on the drawings.

\section*{PART 3 - SCOPE OF WORK}

The work to be covered under these contracts in accordance with the drawings listed herein and, in these specifications, consists of the furnishing of all materials, equipment, tools, labor, transportation and services necessary to complete the construction as outlined herein and as shown on the drawings. The complete installation shall not lack any part which can be reasonably implied as necessary to its proper functioning nor any subsidiary which is customarily furnished.

\section*{PART 4 - EXAMINATION OF SITE OF WORK}

It is the obligation of the bidder to examine carefully the site of the proposed work; to ascertain for himself all the facts concerning conditions therein, including all physical characteristics above, on and below the surface of the ground; to investigate the subsurface conditions and to determine for his information the character and proportionate quantities of soils, rock and other subsurface material which may be encountered in the work; to inform himself by independent research of the difficulties to be encountered and judge for himself the accessibility of the work and all other circumstances affecting the cost of doing the work or the time required for its completion; and the bidder agrees to this obligation in signing the proposal. When provided, the soils boring and testing report is attached to these Specification for the CONTRACTOR'S information and is not a part of the contract. No guarantee is made as to their accuracy or completeness. The OWNER assumes no responsibility whatsoever with respect to ascertaining for the bidder such facts covering physical characteristics at the site of the work. The bidder agrees that, if awarded the contract, he will make no claim for, and will have no right to, additional payment or extension of time for completion of the work or any other concession because of any failure on his part to fully acquaint himself with all conditions relating to the work. The bidder shall rely exclusively upon his own estimate, investigation and evaluation of site conditions.

\section*{PART 5 - SITE CONDITIONS}

Where connections to existing utilities are shown on the drawings, the work may be required to be done at night or at a time which will least interfere with the operation of the existing facility.

The tie to existing utilities will be coordinated with personnel of the OWNER of the existing lines and will be done at a time to least inconvenience their operation. The work may be required to be done at night or weekends or both.

Where possible the existing utilities (water, gas, etc.) have been noted on the drawings. There may be additional buried lines that are not shown and if such is encountered, said lines will be left in service. CONTRACTOR shall take all precautions available prior to construction to locate, identify, and verify utilities. If said lines are broken by the CONTRACTOR, they shall be repaired as soon as possible.

The work along or across state highways shall be done in accordance with the permit from Division Engineer, Department of Transportation. The right-of-way shall be maintained in a satisfactory manner at all times. All roads, streets, drives, etc., cut during construction shall be properly protected by barricades, flashing lights, etc., and shall be made passable as soon as possible after laying of lines during the day and always at night. CONTRACTOR shall maintain the above cut roads in a passable condition until the wearing surface is replaced and then kept in a satisfactory condition for five (5) years after job is completed.

\section*{PART 6 - EXPLOSIVES}

In handling explosives used during the construction of the project, the CONTRACTOR shall adhere to all Federal and State laws and City ordinances regulating the purchase, transportation, storage, handling, and use of such explosives. No blasting shall be done without 12 -hour notification of the OWNER and ENGINEER, proof of insurance, and the presence of the Inspector. All equipment, tools, and materials used shall be of the correct type and in good condition for the operation. The CONTRACTOR shall take all necessary precautions to avoid damage to property resulting from the transportation, storage, handling and use of explosives. Before blasting, the CONTRACTOR shall take all necessary precautions to ensure that rock and debris will be confined to the excavation. Any blasting within 10 ft . of a water, sewer, gas or pipeline shall be done with very light charges, and utmost care shall be taken to avoid disturbance to these lines.

\section*{PART 7 - SUBMITTALS}

Engineering data covering all equipment and fabricated materials to be furnished under this contract shall be submitted to the ENGINEER for review. This data shall include drawings and operation of component materials and devices; the external connections; anchorages and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment. Data submitted shall include drawings showing essential details of any changes proposed by CONTRACTOR and all required structural layout and wiring diagrams.

No work shall be performed in connection with the fabrication or manufacture of materials and equipment, nor shall any accessory or appurtenance be purchased until the drawings and data therefore have been reviewed, except at the CONTRACTOR'S own risk and responsibility.

At least five (5) copies of each drawing and necessary data with statement of approval by the CONTRACTOR, shall be submitted to the ENGINEER. Each drawing or data sheet shall be clearly marked with the name of the project, the ENGINEER'S name, CONTRACTOR'S name and references to applicable specification paragraphs and drawing sheets. When catalog pages are submitted, the applicable items shall be identified.

The ENGINEER'S review of drawings and data submitted by the CONTRACTOR will cover only general conformity to the drawings and specifications, external connections and
dimensions which affect the layout. The ENGINEER'S review of drawings returned marked NO EXCEPTIONS NOTED or EXCEPTIONS NOTED does not indicate a thorough review of all dimensions, quantities and details of the material, equipment, device or items shown and does not relieve the CONTRACTOR from any responsibility for errors, omissions, or deviations from the contract requirements.

All drawings and data, after final processing by the ENGINEER, shall become a part of the contract documents, and the work shown or described thereby shall be performed in conformance therewith unless otherwise authorized by the OWNER or the ENGINEER.

After drawings and data have been accepted by OWNER or ENGINEER, the CONTRACTOR shall submit three (3) additional copies of all data and one (1) set of reproducibles of all drawings to OWNER for file records. Also, CONTRACTOR shall keep accurate "record drawings" records of the work and turn these records over to the OWNER at the completion of the work.

\section*{PART 8 - SURVEYS}

The OWNER shall establish base lines or control points for the location of the principal component parts of the work together with benchmarks adjacent to the work as shown or indicated on the Drawings. The CONTRACTOR shall develop and make all detail surveys necessary for construction. The CONTRACTOR shall be responsible for the accuracy of all lines and grades for all parts of the work. He shall do all field work necessary to lay out and maintain the work and shall make available to the OWNER all facilities and information necessary for properly checking the accuracy of such field work. Such checking shall in no way relieve the CONTRACTOR of his responsibility of the correctness of all field work.

The OWNER will provide survey of property including reference points, property corners and benchmarks where necessary in the opinion of the ENGINEER. If necessary, the CONTRACTOR shall transfer these reference points and benchmarks to permanent locations where they will not be disturbed. If disturbed, the CONTRACTOR shall re-install them to OWNER'S satisfaction, at CONTRACTOR'S cost.

\section*{PART 9 - PERMITS AND REGULATIONS}

The CONTRACTOR shall secure and pay for all construction permits required to carry out the work unless otherwise specified and shall produce same upon demand of the OWNER. The CONTRACTOR shall give all notices and pay all fees and shall, before starting work, ascertain whether the drawings and specification are at variance with any codes or regulations applying at the site. The CONTRACTOR shall obtain completion survey, certificate of completion or occupancy if required by local regulations.

All features of design and construction shall comply with the local building regulations and/or other lawful or public regulations which apply at the site. If any features of construction as shown on the OWNER'S plan, do not conform to the regulations, the CONTRACTOR shall notify the OWNER of such discrepancy, and shall base his quotation and work on features of construction which do conform to the regulations.
If the CONTRACTOR performs any work contrary to such laws, ordinances, rules and regulations and without such notice to the OWNER, he shall bear all costs arising therefrom.

\section*{PART 10 - INSPECTION}

The CONTRACTOR will provide access to the work site and facilities for representatives of the Environmental Protection Agency, Oklahoma Department of Environmental Quality and other agencies, as well as, OWNER and ENGINEER, as required whenever the work is in progress.

\section*{PART 11 - SATURDAY, SUNDAY, HOLIDAY AND NIGHT WORK}

No work shall be done between the hours of 7:00 p.m. and 7:00 a.m., nor on Saturday, Sunday or legal holidays without the written approval or permission of the ENGINEER in each case, except such work as may be necessary for the proper care, maintenance and protection of work already done, or of equipment, or in the case of an emergency.

\section*{PART 12 - PROTECTION OF PROPERTY}
A. The protection of City, State and Government monuments, street signs and other OWNER's property is of prime importance, and if the same be damaged, destroyed or removed, they shall be repaired, replaced or paid for by the CONTRACTOR. Disturbance to this property must first be approved by the agency which controls it.
B. No valves or other control on any utility main or building service line shall be operated for any purpose by the CONTRACTOR.
C. At places where the CONTRACTOR'S operations are adjacent to the plant of railway, telegraph, telephone, electric and gas companies, or water, sanitary sewers and storm sewers, damage to which might result in expense, loss or inconvenience, work shall not be commenced until all arrangements necessary for the protection thereof have been made.
D. The OWNER has attempted to locate all storm sewers, culverts, buried telephone or electrical conduits, sanitary sewers and water mains that might interfere with the construction of this project. The CONTRACTOR shall cooperate with the owners of any underground or overhead utility lines in their removal and rearrangement operations in order that these operations may progress in a reasonable manner and duplication or rearrangement work may be reduced to a minimum and that services rendered by those parties will not be unnecessarily interrupted. The revision and crossings of the various types of lines shall be made as follows:
1. Storm sewers and culverts may be removed at the time of crossing or may be adequately braced and held in position while the pipe is placed beneath them. If the storm sewer or culvert is removed, it shall be replaced with pipe of the same type and size as that removed and it shall be re-joined to the undisturbed line with a joint satisfactory to the ENGINEER. Backfill over the main up to and around the storm sewer shall be thoroughly compacted in order that no settlement will occur. The revision and crossing of said lines shall be at the expense of the CONTRACTOR.
2. All overhead and buried telephone and electrical conduits, to be revised or crossed by the construction of this project shall be protected in accordance with the directions of the utility company owning the conduits and/or mains. The CONTRACTOR shall notify the companies and obtain their permission before
making any crossing or revisions. The revision and crossing of said lines shall be at the expense of the CONTRACTOR. Any overhead cables or buried cables or conduits damaged by the CONTRACTOR shall be repaired at his expense to the satisfaction of the ENGINEER and of the OWNER.
3. The CONTRACTOR shall not remove any water or sanitary sewer lines except as directed by the ENGINEER or as required by the Drawings and specifications and shall adequately brace and protect them from any damage during construction. Any existing water main or sewer main or lateral damage caused by the CONTRACTOR'S operations will be repaired by the CONTRACTOR. The repairs will be made at the CONTRACTOR'S expense.
E. The location of utility service lines serving individual properties may or may not be shown on the Drawings, but the CONTRACTOR shall assume that such service lines exist whether or not they are shown on the Drawings, and it shall be the responsibility of the CONTRACTOR to make any necessary changes in the line and/or grade of such services, or to secure the necessary changes therein to be made by the particular utility company involved or other OWNER thereof, or by an agent or individual CONTRACTOR approved by such utility company or other OWNER. CONTRACTOR shall pay the cost of all such revisions whether performed by CONTRACTOR, the utility company or other OWNER, or an approved CONTRACTOR. In the event of interruption of a utility service as a result of accidental breakage, CONTRACTOR shall promptly notify the ENGINEER and the OWNER of the utility and shall repair or cause the same to be repaired, in the same manner as necessary changes above are provided for, the CONTRACTOR shall do all things necessary to see that the restoration of services is done as promptly as may be reasonably done. All sanitary sewer service lines damaged shall be replaced with cast iron pipe regardless of type or kind damaged.
F. In the event the CONTRACTOR in any way fails to comply with the requirements of protecting, repairing and restoring of any utility or utility service, the OWNER may, upon forty-eight (48) hours written notice proceed to protect, repair, rebuild or otherwise restore such utility or utility service as may be deemed necessary, and the cost thereof will be deducted from any money due, or which may become due the CONTRACTOR pursuant to the terms of his contract.

\section*{PART 13 - FIELD OFFICE}

Copies of the drawings, specification, and other contract documents shall be kept at the site of the work available for use at all times.

\section*{PART 14 - ALTERATION OF QUANTITIES}

The CONTRACTOR agrees that the quantities of work as stated in the Bid Schedule or indicated on the drawings are only approximate, and that the OWNER shall have the right to omit portions of the work and to increase or decrease the quantities of any item of work. Final payment will be based on the actual quantities used and installed in accordance with the drawings and Specification.

\section*{PART 15 - QUALITY CONTROL}

When required in writing by the ENGINEER, the CONTRACTOR shall make such tests as may be necessary to show that the requirements of the Specification have been fulfilled.

All tests shall be made under the supervision and direction of the ENGINEER, and the CONTRACTOR will provide all required materials, labor and apparatus, etc., or so directed, engage an approved testing laboratory for making same. Any work found defective shall be removed, replaced and retested until satisfactory to the ENGINEER, all at the CONTRACTOR'S expense.

Should tests required by the ENGINEER, except those specifically called for elsewhere in these General Requirements or in the Specification show that the requirements of the Specification have been fulfilled, then the costs of such tests shall be paid for by the OWNER.

\section*{PART 16 - MEASUREMENT AND FITTING OF PARTS}

The CONTRACTOR, without extra charge, shall make such slight alterations as may be necessary to make adjustable parts fit the fixed parts, leaving all complete and in proper shape when done. The CONTRACTOR shall verify all dimensions given in the drawings and shall report any error or inconsistency to the ENGINEER before commencing work.

\section*{PART 17 - CONTRACTOR'S SUPERINTENDENT}

The CONTRACTOR shall keep a competent Superintendent and any necessary assistants at the site throughout the progress of the work. All directions given to said Superintendent shall be as binding as if given to the CONTRACTOR. Upon request, such directions will be confirmed, in writing, to the CONTRACTOR.

The CONTRACTOR'S Superintendent and/or any of his assistants shall be promptly replaced in the event he or they shall prove to be incompetent and/or unsatisfactory to the ENGINEER.

\section*{PART 18 - ASSISTANCE BY ENGINEER}

It is distinctly understood and agreed that such assistance as the ENGINEER may render to the CONTRACTOR in connection with the interpretation of drawings and specification shall not relieve the CONTRACTOR from any responsibility for the work. Any work which proves faulty shall be made right by the CONTRACTOR without delay. The failure of the ENGINEER, or his Inspectors to call the CONTRACTOR'S attention to faulty work or work done which is not in accordance with drawings and specification shall not prevent the OWNER from insisting that the CONTRACTOR make all work right.

\section*{PART 19 - INCIDENTAL WORK}

Work called for on the drawings and/or specifications and are not set forth in the Bid Schedule as pay items, shall be considered as incidental work and will not be paid for directly, but shall be included in the price bid for the various pay items.

\section*{PART 20 - TERMINATION OF CONTRACT}

If the CONTRACTOR shall be adjudged bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency, or if he should persistently or repeatedly refuse, or should fail, except in cases for which
extension of time is provided, to supply enough properly skilled workmen, equipment or proper materials, or if he should fail to make prompt payment to SUBCONTRACTOR or for material or labor, or persistently disregard laws, ordinances or the instructions of the ENGINEER, or otherwise be guilty of a substantial violation of any provision of the Contract, then the OWNER upon the certificate of the ENGINEER that sufficient cause exists to justify such action, may without prejudice to any other right or remedy and after giving the CONTRACTOR seven days written notice, terminate the employment of the CONTRACTOR and take possession of the premises and of all materials, tools and appliances thereon and finish the work by whatever method the OWNER may deem expedient. In such case, the CONTRACTOR shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the Contract Price shall exceed the expense of finishing the work, including compensation for additional managerial and administrative services, such excess shall be paid to the CONTRACTOR. If such expense shall exceed such unpaid balance, the CONTRACTOR shall pay the difference to the OWNER as herein provided, and the damage incurred through the CONTRACTOR's default shall be certified by the ENGINEER.

In the event of termination of Contract before completion of the work, due to abandonment of the project or discontinuance thereof, the CONTRACTOR will be paid in proportion to the work completed and in progress as per scope of work described in the drawings and specification and in accordance with the unit price schedule.

\section*{PART 21 - PROGRESS PAYMENTS, ACCEPTANCE AND FINAL PAYMENT}

Basis for Progress Payments: The Schedule of Quantities as shown in the Plans will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period. The amount of retainage with respect to progress payments will be \(5 \%\) until 50 percent completion after which retainage shall be \(2.5 \%\).

Upon receipt of written notice from the CONTRACTOR that the work is ready for final inspection and acceptance, the ENGINEER shall promptly make such inspection and when he finds the work acceptable under the Contract and the Contract fully performed, he shall promptly issue a final certificate over his own signature, stating that the work provided for in this Contract has been completed and is accepted by him under the terms and conditions thereof, and the entire balance found to be due the CONTRACTOR, including the retained percentage, shall be paid to the CONTRACTOR, as approved by the OWNER, at the office of the OWNER within 30 days after the date of said final certificate.

If, after receipt of written notice from CONTRACTOR requesting final inspection and the performance of said final inspection by ENGINEER, additional inspections are necessary in order for ENGINEER to issue a final certificate; the OWNER shall withhold the cost associated with said additional inspections from the final payment due the CONTRACTOR.

Before issuance of final certificate, the CONTRACTOR shall submit evidence satisfactory to the ENGINEER that all payrolls, material bills, equipment rentals, and all other indebtedness connected with the work have been paid.

\section*{PART 22 - PLACING WORK IN SERVICE}

If desired by the OWNER, portions of the work may be placed in service when completed and the CONTRACTOR shall give prior access to the work for this purpose, but such use and operation shall not constitute an acceptance of the work.

\section*{PART 23 - SCHEDULES}

The CONTRACTOR shall furnish the ENGINEER with a tentative schedule, in a format approved by the ENGINEER, setting forth in detail the procedure he proposes to follow, and giving the dates on which he expects to start and to complete separate portions of the work. If at any time, in the opinion of the ENGINEER, proper progress is not being maintained, such changes shall be made in the schedule of operations which will satisfy the ENGINEER that the work will be completed within the period stated in the proposal, or extension thereof made as herein provided.

CONTRACTOR is to prepare list of proposed SUBCONTRACTORS including material suppliers; submit to ENGINEER for approval before subcontracts are awarded. No SUBCONTRACTOR is to be employed on work unless approved by OWNER and ENGINEER.

\section*{PART 24 - PROJECT SIGN}

NOT REQUIRED FOR THIS PROJECT.

\section*{PART 25 - INSURANCE}

The CONTRACTOR shall protect, indemnify, save and hold harmless the OWNER, their officers, agents, and employees from all suits, actions or claims of any kind or character brought because of bodily injuries, sickness, disease or personal injury, or damages received or sustained by any person, persons, or property on account of any operations of the CONTRACTOR, his agents, employees, his subcontractors or any others authorized by the CONTRACTOR to perform work on the project.

Third Party Beneficiary Clause. It is specifically agreed by and between the parties executing this Contract, that it is not intended by any of the provisions of any part of the Contract to create in the public or any member thereof any third-party beneficiary provisions or to authorize anyone not a party to this Contract to maintain a suit for personal injuries or property damage pursuant to the terms or provisions of this Contract.

The CONTRACTOR shall carry insurance of the following kinds and amounts on all City Contracts:
A. CONTRACTOR'S Public Liability, Auto Liability and Property Damage Liability Insurance. The CONTRACTOR shall provide regular CONTRACTOR'S Public Liability Insurance for a combined amount of one million ( \(\$ 1,000,000\) ) dollars of coverage for all damages arising out of bodily injury, death, and property damage for each occurrence with an aggregate limit of two million \((\$ 2,000,000)\) dollars.

The CONTRACTOR shall provide business auto liability coverage for an aggregate limit of one million \((\$ 1,000,000)\) dollars of coverage for bodily injury and property
damage arising out of the operation or maintenance of any vehicle including owned, non-owned and hired vehicles, and employee non-ownership use.
B. Insurance for SUBCONTRACTOR'S and CONTRACTOR'S Protective Public Liability and Property Damage Liability Insurance. In the event that any of the work to be performed by the CONTRACTOR on the project is sublet or assigned or is otherwise to be performed by anyone other than the CONTRACTOR'S own employees, then the insurance specified above shall extend to cover such work.
C. Workmen's Compensation Insurance and Employer's Liability Insurance. The CONTRACTOR shall furnish satisfactory evidence to the City that, with respect to the work to be performed by him on the project, he carries regular Workmen's Compensation and Employers Liability Insurance covering his liability under the "Workmen's Compensation Law of the State of Oklahoma". The CONTRACTOR shall maintain the aforementioned insurance in full force and effect for the duration of the Contract. Should the CONTRACTOR fail or neglect to maintain the aforementioned insurance, the City specifically reserves the right to withhold all funds due and owing the CONTRACTOR until such time as the required insurance is in effect.

In addition to the aforementioned insurance coverage, on any project in which the CONTRACTOR shall perform any Railway-Highway work, the CONTRACTOR shall also secure the following: "Railroads' Protective Liability and Property Damage Insurance".
D. Railroads' Protective Liability and Property Damage Insurance. In addition to the above, the CONTRACTOR shall furnish satisfactory evidence to the City that, with respect to the work to be performed by him under the Contract, he has provided for and on behalf of the Railway Company or Railway Companies involved, Protective Public Liability Insurance in an amount as may be required by the Railway Company, which amount shall be specified in the bid documents. Policies shall not include liability for negligence on the part of the Railway Company, its agents or employees, except as set out in Coverage A, B, or C of the form of policy, or amendments thereto, referred to under paragraph 6 below. This insurance applies to each and all Railway Companies involved in the work.
E. General. The insurance hereinbefore specified shall be carried in Insurance Companies approved by the City, and where applicable the Railway Company, during all times when work is being carried on under the terms of the Contract, until all work required to be performed under the Contract is satisfactorily completed as evidenced by the formal acceptance by the City.
F. Certificates of Insurance. Required insurance shall be documented by Certificates of Insurance which provide that the OWNER shall be notified at least thirty (30) days in advance of cancellation, non-renewal or adverse change. The Certificate of Insurance shall show the OWNER as the named insured.

For general liability, the CONTRACTOR shall provide an indication of the amounts of claims, payments or reserves chargeable to the aggregate amount of liability coverage.

\section*{PART 26 - SAFETY STANDARDS AND ACCIDENT PREVENTION}

With respect to all work performed under this Contract, the CONTRACTOR shall:
A. Comply with the safety standards provisions of applicable laws, building and construction codes and the Manual of Accident Prevention in Construction published by the Associated General Contractors of America, the requirements of the Occupational Safety and Health Act of 1970 (Public Law 91-596), and the requirements of Title 29 of the Code of Federal Regulations, Section 1910 or 1926 as applicable.
B. Exercise every precaution at all times for the prevention of accidents and the protection of persons (including employees) and property.
C. Trench Excavation and Safety System: All work under this item shall be in accordance with the current edition of the OSHA Standard for Excavation and Trench Safety Systems, 29 CFR 1926 Subpart P.

The CONTRACTOR shall notify all utility companies and OWNERS in accordance with the OSHA requirements given in 29 CFR 1926.651 (b) (2) for the purpose of locating utilities and underground installations.

Where the trench or excavation endangers the stability of a building, wall, street, highway, utilities, or other facility, the CONTRACTOR shall provide support systems such as shoring, bracing, or underpinning to ensure the stability of such facility. The CONTRACTOR may elect to remove and replace or relocate such facilities with the written approval of the facility owner, the ENGINEER, and the OWNER.

Payment for the work required by this item shall be included in the lump sum price bid. With each periodic payment request, CONTRACTOR shall submit a certification that the CONTRACTOR has complied with the provisions of the OSHA standards.

\section*{PART 27 - WAGE RATES}

\section*{NO SPECIFIC REQUIREMENTS FOR THIS PROJECT.}

\section*{PART 28 - WORKMEN}

The CONTRACTOR shall employ foreman and skilled laborers where necessary, and if any person employed on the work shall refuse or neglect to obey orders of the ENGINEER or Inspector when such orders are in keeping with the provisions of these specifications or shall appear to the ENGINEER or his Inspector to be incompetent, disorderly or unfaithful, he shall, upon order of the ENGINEER, be at once discharged and not again employed upon any part of the work. It shall be the responsibility of the superintendent representing the CONTRACTOR to transmit all necessary orders and instructions. If requested by the ENGINEER, the CONTRACTOR shall submit, in written form, qualifications including work experience of any workman used on the project.

\section*{PART 29 - NUMBER OF WORKING DRAWINGS AND SPECIFICATIONS}

The ENGINEER will furnish to the CONTRACTOR not more than two (2) sets of drawings and specifications for construction. The CONTRACTOR may procure additional copies of drawings
and specifications for construction at cost of reproduction. Such costs are reimbursable by the ENGINEER.

\section*{PART 30 - PRECONSTRUCTION CONFERENCE}

Prior to the commencement of work at the site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by:
A. CONTRACTOR and his superintendent.
B. Principal SUBCONTRACTORS.
C. Representatives of principal suppliers and manufacturers as appropriate.
D. ENGINEER and its Resident Project Representative.
E. Representatives of OWNER.
F. Government representatives as appropriate.
G. Others as requested by CONTRACTOR, OWNER, or ENGINEER.
H. Unless previously submitted to ENGINEER, CONTRACTOR shall bring to the conference a preliminary schedule for each of the following:
1. Progress.
2. Procurement.
3. Values for progress payment purposes.
4. Shop Drawings and other submittals.

The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda will include:
A. CONTRACTOR'S preliminary schedules.
B. Transmittal, review, and distribution of CONTRACTOR'S submittals.
C. Processing applications for payment.
D. Maintaining record documents.
E. Critical work sequencing.
F. Field decisions and change orders.
G. Use of premises, office and storage areas, security, housekeeping, and OWNER'S needs.
H. Major equipment deliveries and priorities.
I. CONTRACTOR'S assignments for safety and first aid.

ENGINEER will preside at the conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

\section*{PART 31 - PROGRESS MEETINGS}

CONTRACTOR shall schedule and hold regular progress meetings at least monthly and at other times as requested by ENGINEER or required by progress of the work. CONTRACTOR, ENGINEER, and all SUBCONTRACTORS active on the site shall be represented at each meeting. CONTRACTOR may at its discretion request attendance by representatives of its suppliers, manufacturers, and other SUBCONTRACTORS.

CONTRACTOR shall preside at the meetings. Meeting minutes will be prepared and distributed by CONTRACTOR. The purpose of the meetings will be to review the progress of the work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.

\section*{PART 32 - SUBSTANTIAL AND FINAL COMPLETION}

All work including site restoration shall be finished within the time called out on the Bid Form for final completion.

\section*{PART 33 - EXCAVATION}

All excavation shall be unclassified. No additional payment shall be made for rock, groundwater, or other natural formations encountered. Payment for excavation shall be included in other items of work.

\section*{PART 34 - SUBCONTRACTORS}

CONTRACTOR is to prepare a list of proposed SUBCONTRACTORS including material suppliers and submit to ENGINEER for approval before SUBCONTRACTORS are awarded.

No SUBCONTRACTOR is to be employed on work unless approved by OWNER and ENGINEER.

\section*{PART 35 - RIGHT-OF-WAYIPROJECT VIDEO}

CONTRACTOR shall video the complete right-of-way of the project prior to initiating construction and deliver video tape to the ENGINEER at the pre-construction conference. The video shall be taken in such a way to document pre- construction conditions for use in documenting satisfactory right-of-way restoration and other issues relative to initial conditions prior to construction.

\section*{PART 36 - RECORD DRAWINGS}

\subsection*{36.1 GENERAL}
A. The CONTRACTOR shall be responsible for accumulation and maintenance of a complete set of Project Record Documents and upon completion and acceptance of the project shall submit these documents to the ENGINEER, as the OWNER'S representative, for a permanent record.
B. The Project Record Documents shall consist of:
1. One complete set of drawings, with revisions.
2. One complete Project Manual with all addenda, field bulletins and change orders.
3. Complete set of all field test data.
4. Complete set of approved shop drawings, product data brochures and samples.
5. Six complete sets of maintenance and operating instructions, parts lists and supplier identification on all operating fixtures and equipment.

\subsection*{36.2 MAINTENANCE OF RECORD DOCUMENTS}
A. The CONTRACTOR shall maintain, on the site, one complete set of contract documents, other than those used for construction, throughout the life of the job.
1. This set of documents shall be marked "Record Set" and shall be maintained up to date at all times and available to the ENGINEER for inspection.
2. The only notations or other markings to be made on this set are notations of field variations made from the work shown on the drawings for purposes of "Record Drawings" revisions when the project is complete. Failure to record revisions by each CONTRACTOR, shall be considered a breach of contract.
3. This set of Documents will be turned over to the ENGINEER for preparation of "Record Drawings" prior to approval of final application for payment.

\subsection*{36.3 MAINTENANCE AND OPERATING INSTRUCTIONS}
A. A complete set of maintenance and operating instructions on the project shall be prepared for the OWNER'S continual use.
1. To be bound in booklet form, \(8-1 / 2\) " \(\times 11\) " in size, labeled "Operating Manual".
2. To be indexed for quick reference use.
3. To contain manufacturer's printed data, record forms, diagrams, parts lists, maintenance procedures, start-up procedures, operating procedures, service requirements and schedules, and names, addresses and phone numbers of SUBCONTRACTOR, manufacturer and local service agent.
4. To contain all written warranties and guarantees.
B. Each CONTRACTOR shall submit six complete copies of this "Operating Manual" material from his trade to the ENGINEER at the completion of the project.
C. The ENGINEER shall assemble, bind, label and index this material for the OWNER as stated above. Failure to submit the data listed on the part of any CONTRACTOR may be considered cause to withhold final payment until all such information is received.

PART 37 - CHANGES IN THE WORK
ALL CHANGES SHALL BE MADE IN WRITING AND APPROVED BY THE OWNER OR ENGINEER. THIS INCLUDES CHANGES INVOLVING COST OR THOSE NOT INVOLVING COST. NO CHANGE WILL BE ACCEPTABLE UNLESS APPROVED IN WRITING.

The OWNER, without invalidating the Contract, may order extra work or make changes by altering, adding to or deducting from the work with the Contract Total being adjusted accordingly. All changes involving cost shall be made using a written modification order and shall be supported with necessary documentation as to the increase or decrease in cost and time. No increase or decrease in cost or time will be made without an approved modification order that is completed at or before the change is made. Increases in cost or time will not be allowed at the end of the job for work completed earlier without an approved change order. The OWNER shall have authority to make minor changes in the work which do not involve extra cost, and which do not significantly change the design. All such changes shall be made with a written field order.

\section*{END OF SECTION 010000}

\section*{SECTION 011100 - SUMMARY OF WORK}

\section*{PART 1 - GENERAL}

\subsection*{1.1 DESCRIPTION}
A. The work covered by these specifications and drawings shall consist of all materials, transportation costs, equipment, and tools that are related to, or are to be incorporated in this contract and must be received, unloaded, stored, installed, erected, service connections provided, and coordinated with the construction by the CONTRACTOR under this contract. Installation of equipment and materials shall mean furnishing of all labor and materials as required to place the improvements in successful operation. The CONTRACTOR shall be responsible for all equipment and materials and shall replace at his own expense all such equipment and materials found defective in manufacture or damaged in handling after delivery by the manufacturer. The improvements are as listed:

\section*{CITY OF ALTUS / ALTUS MUNICIPAL TRUST AUTHORITY ALTUS MUNICIPAL LANDFILL - C\&D DEBRIS CELL}
B. This contract shall include minor items not specifically mentioned herein but shown on the accompanying plans or obviously necessary to provide a complete job.
C. The following description, while not intended to cover all details, outlines some items of the work to be accomplished under this Contract:

Construct one (1) approximately 10 acre construction and demolition debris cell with access road including the following:
1. Unclassified excavation and on-site stockpile
2. Protective sand layer (1' thickness)
3. Grading for access road
4. Excavation and re-compaction of 3' clay liner
5. In-situ liner borings
6. In-situ liner post excavation/pre-disposal tests

Note: The Municipal Solid Waste Landfill must stay in operation throughout construction. Temporary operational coordination shall be considered incidental and included in the cost of other bid items.
D. The price named in the Proposal shall include the furnishing of all labor, material, transportation costs, equipment rental, etc., necessary to construct the project as herein specified and as shown on the accompanying plans.
E. The CONTRACTOR shall cooperate with the OWNER during construction so as to place the improvements in operation at minimum inconvenience and without significant disruption of the OWNER. The CONTRACTOR shall minimize his area of operation. Any areas disturbed will be restored to the OWNER'S satisfaction.

\section*{END OF SECTION 011100}

\section*{SECTION 012119 - TESTING LABORATORY-SERVICES (CONTRACTOR-Employed Lab)}

\section*{PART 1 - GENERAL}

\subsection*{1.1 REQUIREMENTS INCLUDED}
A. CONTRACTOR shall employ and pay for the services of an independent testing laboratory to perform specified services and testing.

\subsection*{1.2 RELATED REQUIREMENTS}
A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders, or approvals of public authorities.
B. Respective sections of specifications: Certification of products.
C. Respective sections of specifications, laboratory tests required, and standards for testing.

\subsection*{1.3 QUALIFICATION OF LABORATORY}
A. Meet "Recommended Requirements for Independent Laboratory Qualification," published by American Council of Independent Laboratories.
B. Meet basic requirements of ASTM E329, "Standards of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction."
C. Authorized to operate in the state in which the project is located.
D. Submit copy of report of inspection of facilities made by Materials Reference Laboratory of National Bureau of Standards during the most recent tour of inspection, with memorandum of remedies of any deficiencies reported by the inspection.
E. Testing Equipment
1. Calibrated at reasonable intervals by devices of accuracy traceable to either
a. National Bureau of Standards.
b. Accepted values of natural physical constants.

\subsection*{1.4 LABORATORY DUTIES}
A. Cooperate with OWNER'S REPRESENTATIVE and CONTRACTOR; provide qualified personnel after due notice.
B. Perform specified inspections, sampling and testing of materials and methods of construction:
1. Comply with specified standards.
2. Ascertain compliance of materials with requirements of Contract Documents.
C. Promptly notify OWNER'S REPRESENTATIVE and CONTRACTOR of observed irregularities or deficiencies of work or products.
D. Promptly submit written report of each test and inspection; one copy each to OWNER'S REPRESENTATIVE, OWNER, CONTRACTOR, and one copy to Record Document File. Each report shall include:
1. Date issued.
2. Project title and number.
3. Testing laboratory name, address, telephone number.
4. Name and signature of laboratory inspector.
5. Date and time of sampling or inspection.
6. Record of temperature and weather conditions.
7. Date of test.
8. Identification of product and specification section.
9. Location of sample or test in the project.
10. Type of inspection or test.
11. Results of tests \& compliance with Contract Documents.
12. Interpretation of test results, when requested by OWNER'S REPRESENTATIVE.
E. Perform additional tests as required by OWNER'S REPRESENTATIVE or the OWNER.

\subsection*{1.5 LIMITATIONS OF AUTHORITY OF TESTING LABORATORY}
A. Laboratory is not authorized to:
1. Release, revoke, alter or enlarge on requirements of Contract Documents.
B. Approve or accept any portion of the work.
C. Perform any duties of the CONTRACTOR.

\subsection*{1.6 CONTRACTOR'S RESPONSIBILITIES}
A. Cooperate with laboratory personnel, provide access to work, to manufacturer's operations.
B. Secure and deliver to the laboratory adequate quantities of representation samples of materials proposed to be used and which require testing.
C. Provide to the laboratory the preliminary design mix proposed to be used for concrete, and other materials mixes which require control by the testing laboratory.
D. Furnish copies of products test reports as required.
E. Furnish incidental labor and facilities:
1. To provide access to work to be tested.
2. To obtain and handle samples at the project site or at the source of the product to be tested.
3. To facilitate inspections and tests.
4. For storage and curing of test samples.
F. Notify laboratory sufficiently in advance of operations to allow for laboratory assignment of personnel and scheduling of tests.
1. When tests or inspections cannot be performed after such notice, reimburse OWNER for laboratory personnel and travel expenses incurred due to CONTRACTOR'S negligence.
G. Employ and pay for the services of a separate, equally qualified independent testing laboratory to perform additional inspections, sampling and testing required:
1. For the CONTRACTOR'S convenience.
2. When initial tests indicate work does not comply with Contract Documents.

\subsection*{1.7 CONTRACTOR'S GENERAL RESPONSIBILITIES}
A. No failure of test agencies to perform adequate inspections or tests or to properly analyze or report results shall relieve CONTRACTOR of responsibility for fulfillment of requirements of contract documents. It is recognized that required inspection and testing program is intended to assist the CONTRACTOR, OWNER, ARCHITECT, ENGINEER, and governing authorities in nominal determination of probable compliances with requirements for certain elements of work. The program is not intended to limit the CONTRACTOR'S regular quality control program, as needed for general assurance of compliances.

\section*{END OF SECTION 012119}

\section*{SECTION 013300 - SUBMITTALS AND SUBSTITUTIONS}

\section*{PART 1 - GENERAL}

\subsection*{1.1 DESCRIPTION}
A. Work Included
1. Wherever possible throughout the contract documents, the minimum acceptable quality of workmanship and materials has been defined by manufacturer's name and catalog number, reference to recognized industry and government standards, or description of required attributes and performance.
2. To ensure that the specified products are furnished and installed in accordance with design intent, procedures have been established for advance submittal of design data and for their review by the ENGINEER.
3. Make all submittals required by the contract documents, and revise and resubmit as necessary to establish compliance with the specified requirements.
B. Related Work Described Elsewhere: Individual requirements for submittals are described in pertinent other Sections of these specifications.

\subsection*{1.2 QUALITY ASSURANCE}
A. Coordination of Submittals: Prior to each submittal, carefully review and coordinate all aspects of each item being submitted and verify that each item and the submittal for it conforms in all respects with the requirements of the contract documents. By affixing the CONTRACTOR'S signature to each submittal, certify that this coordination has been performed.
B. Certificates of Compliance
1. When requested, certify that materials used in the work comply with specified provisions thereof. Certification shall not be construed as relieving the CONTRACTOR from furnishing satisfactory materials if, after tests are performed on selected samples, the material is found to not meet specified requirements.
2. Show on each certification the name and location of the work, name and address of CONTRACTOR, quantity and date or dates of shipment or delivery to which the certificate applies, and name of the manufacturing or fabricating company. Certification shall be in the form of letter or company-standard forms containing all required data. Certificates shall be signed by an officer of the manufacturing or fabricating company.
3. In addition to the above information, all laboratory test reports submitted with certificates of compliance shall show the date or dates of testing, the specified requirements for which testing was performed, and results of the test or tests.

\subsection*{1.3 SUBMITTALS}
A. Submittal Schedule: Within 10 days after award of Contract, and before any items are submitted for approval, submit to the ENGINEER two copies of the schedule described in Article 2.1 of this Section.
B. Certificates of Compliance: Upon completion of the work, and as a condition of its acceptance, submit to the ENGINEER all Certificates of Compliance.
C. Procedures: Make submittals in strict accordance with the provisions of this Section.
D. Schedule of Values: Within 10 days of the Pre-Construction Conference, submit a schedule of values for lump sum bid items indicating the cost breakdown of lump sum bid items for use in progress payment preparation. Submit to the ENGINEER two copies of the schedule described in Article 2.2 of this Section.

\section*{PART 2 - PRODUCTS}

\subsection*{2.1 SUBMITTAL SCHEDULE}
A. General: Compile a complete and comprehensive schedule of all submittals anticipated to be made during progress of the work. Include a list of each type of item for which CONTRACTOR'S drawings, Shop Drawings, Certificates of Compliance, material samples, guarantees, Operations and Maintenance manuals or other types of submittals are required. Upon approval by the ENGINEER this schedule will become part of the Contract and the CONTRACTOR will be required to adhere to the schedule except when specifically otherwise permitted.
B. Coordination: Coordinate the schedule with all necessary subcontractors and materials suppliers to ensure their understanding of the importance of adhering to the approved schedule and their ability to so adhere. Coordinate as required to ensure the grouping of submittals as described in Article 1.3.
C. Revisions: Revise and update the schedule on a monthly basis as necessary to reflect conditions and sequences. Promptly submit revised schedules to the ENGINEER for review and comment.

\subsection*{2.2 SCHEDULE OF VALUES}
A. The ENGINEER will review the tentative schedule of values to determine whether, in his judgment, the schedule of values is of sufficient detail and if the prices included are "unbalanced" or "front-end loaded", in an effort to inflate the prices of those items of work to be completed in the early stages of the work.
B. Breakdown cost to list major products or operations for each line item which has an installed value of more than \(\$ 5,000.00\). The sum of the items listed on the schedule of values shall equal the contract lump sum price.
C. The ENGINEER will provide the CONTRACTOR with his comments and/or may request additional information from the CONTRACTOR to justify certain item quantities and prices, therefore. On the basis of the ENGINEER'S comments, the CONTRACTOR shall revise and resubmit the tentative schedule for further review and/or approval.
D. Once the ENGINEER accepts the tentative schedule, it shall become the schedule of values to be used in determining partial payment estimates. Two (2) copies of this schedule shall be submitted to the ENGINEER for distribution and his use. No modifications will be made to the schedule of values, except as required by approved change orders.
E. No partial payment request (including the first) shall be approved until the schedule of values has been approved by the OWNER and ENGINEER.

\subsection*{2.3 SHOP DRAWINGS AND COORDINATION DRAWINGS}
A. Shop Drawings
1. Scale and Measurements: Make all Shop Drawings accurately to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the work.
2. Type of Prints Required: Submit all Shop Drawings in the form of electronic (.pdf) or hardcopy, minimum of \(81 / 2^{\prime \prime}\) by 11 ".

\subsection*{2.4 MANUFACTURERS' LITERATURE}
A. General: Where contents of submitted literature from manufacturers includes data not pertinent to the submittal, clearly indicate which portion of the contents is being submitted for review.
B. Number of Copies Required: Submit the number of copies which are required to be returned plus two copies which will be retained by the ENGINEER. Under no circumstances shall less than five copies be submitted.

\subsection*{2.5 SAMPLES}
A. Accuracy of Samples: Samples shall be of the precise article proposed to be furnished. Samples shall have stickers or tags which bear identification of the project, the subcontractor, the vendor or manufacturer, the product color name or number, model, style or series, and the size and thickness of components.
B. Number of Samples Required: Unless otherwise specified, submit all Samples in the quantity which is required to be returned plus one which will be retained by the ENGINEER.
C. Reuse of Samples: In situations specifically so approved by the ENGINEER, the ENGINEER'S retained sample may be used in the construction as one of the installed items.
D. Match Existing Materials: Brick or other materials that are to match existing materials shall require a "test panel" to be erected adjacent to the existing material to allow the OWNER to approve the match in size, color, and texture.

\subsection*{2.6 COLORS AND PATTERNS}
A. Unless the precise color and pattern is specifically described in the contract documents, and whenever a choice of color or pattern is available in a specified product, submit accurate color and pattern charts to the ENGINEER for review and selection.

\subsection*{2.7 SUBSTITUTIONS}
A. Approval Required
1. The Contract is based on the standards of quality established in the contract documents.
2. All products proposed for use, including those specified by required attributes and performance, shall require approval by the ENGINEER before being incorporated into the work.
3. Do not substitute materials, equipment, or methods unless such substitution has been specifically approved for this work by the ENGINEER.
B. "Or Equal":
1. Where the phrase "or equal" or "approved or equal" occurs in the contract documents, do not assume that materials, equipment, or methods will be approved as equal unless the item has been specifically approved for this work by the ENGINEER.
2. The decision of the ENGINEER shall be final.

\section*{PART 3 - EXECUTION}

\subsection*{3.1 IDENTIFICATION OF SUBMITTALS}
A. General: Bind submittals with cover label that identifies project, division of work, subcontractor, and vendor/manufacturer. Consecutively number all submittals. Accompany each submittal with a letter of transmittal containing all pertinent information required for identification and checking of submittals.
B. Internal Identification: On at least the first page of each copy of each submittal, and elsewhere as required for positive identification, clearly indicate the submittal number in which the item was included.
B. Resubmittals: When material is resubmitted for any reason, transmit under a new letter of transmittal and with a new submittal number.

\subsection*{3.2 COORDINATION OF SUBMITTALS}
A. General: Prior to submittal for approval, use all means necessary to fully coordinate all material including, but not necessarily limited to:
1. Determine and verify all interface conditions, catalog numbers, and similar data.
2. Coordinate with other trades as required.
3. Clearly indicate all deviations from requirements of the contract documents.
B. Grouping of Submittals: Unless otherwise specified, make all submittals in groups containing all associated items to ensure that information is available for checking each item when it is received. Partial submittals may be rejected as not complying with the provisions of the contract documents and the CONTRACTOR shall be strictly liable for all delays so occasioned.

\subsection*{3.3 TIMING OF SUBMITTALS}
A. General: Make all submittals far enough in advance of scheduled dates for installation to provide all time required for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery.
B. ENGINEER'S Review Time: In scheduling, allow at least 21 calendar days for review by the ENGINEER following his receipt of the submittal. Should unanticipated circumstances prevent the normal review time, a minimum of 10 working days review time must be allowed for reviews.
C. Delays: Delays caused by tardiness in receipt of submittals will not be an acceptable basis for extension of the contract completion date.

\subsection*{3.4 ENGINEER'S REVIEW}
A. CONTRACTOR'S approval: Prior to submission to the ENGINEER, all submittals shall have been reviewed and approved by the CONTRACTOR.
B. General: Review by the ENGINEER shall not be construed as a complete check, but only that the general method of construction and detailing is satisfactory. Review shall not relieve the CONTRACTOR from responsibility for errors which may exist.
C. Authority to Proceed: The notations "Reviewed, No Exceptions Noted" or "Reviewed, Exceptions Noted" authorize the CONTRACTOR to proceed with fabrication, purchase, or both, of the items so noted, subject to the revisions, if any, required by the ENGINEER'S review comments.
D. Revisions: Make all revisions required by the ENGINEER. If the CONTRACTOR considers any required revision to be a change, he shall so notify the ENGINEER as provided for under "Changes" in the General Considerations. Show each drawing revision by number, date, and subject in a revision block on the drawing. Make only those revisions directed or approved by the ENGINEER.
E. Revisions After Approval: When a submittal has been reviewed by the ENGINEER, resubmittal for substitution of materials or equipment will not be considered unless accompanied by an acceptable explanation as to why the substitution is necessary.

\section*{SECTION 014500 - QUALITY CONTROL}

\section*{PART 1-GENERAL}

\subsection*{1.1 DESCRIPTION}
A. Section Includes
1. Quality assurance - control of installation.
2. Tolerances
3. References and standards.
4. Mock-up.
5. Testing laboratory services.
6. Inspection services.
7. Manufacturers' field services.
8. Subcontracting.
B. Related Sections
1. Section 013300 - Submittals and Substitutions: Submission of manufacturers' instructions and certificates.

\subsection*{1.2 QUALITY ASSURANCE}
A. The CONTRACTOR will be held strictly to the intent of the contract documents in regard to the quality of materials, workmanship, and execution of the work. Inspections may be made at the factory or fabrication plant of the source of material supply.
B. The ENGINEER will not be responsible for the construction means, controls, techniques, sequences, procedure, or construction safety.
C. The CONTRACTOR shall monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
D. The CONTRACTOR will supervise and direct the work. He will be solely responsible for the means, methods, techniques, sequences, and procedures of construction. The CONTRACTOR will employ and maintain on the work a qualified supervisor or superintendent who shall have been designated in writing by the CONTRACTOR as the CONTRACTOR'S representative at the site. The supervisor shall have full authority to act on behalf of the CONTRACTOR and all communications given to the supervisor shall be as binding as if given to the CONTRACTOR. The supervisor shall be present on the site at all times as required to perform adequate supervisor and coordination of the work.
E. The CONTRACTOR shall comply with manufacturers' instructions, including each step in sequence.
F. Should the manufacturers' instructions conflict with Contract Documents, the CONTRACTOR shall request clarification from ENGINEER before proceeding.
G. The CONTRACTOR shall comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
H. The CONTRACTOR shall perform work by persons qualified to produce required and specified quality.
I. The CONTRACTOR shall verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
J. The CONTRACTOR shall secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

\subsection*{1.3 IMPROPER COVERAGE OF BURIED CONSTRUCTION}
A. If any work is covered contrary to the written instructions of the ENGINEER, it must, if requested by the ENGINEER, be uncovered for the ENGINEER'S observation, and replaced at the CONTRACTOR'S expense.
B. If the ENGINEER considers it necessary or advisable that covered WORK be inspected or tested by others, the CONTRACTOR, at the ENGINEER'S request, will uncover, expose or otherwise make available for observation, inspection or testing as the ENGINEER may require, that portion of the work in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such work is defective, the CONTRACTOR will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction; if, however, such work is not found to be defective, the CONTRACTOR will be allowed an increase in the contract price or an extension of the contract time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate change order shall be issued.
C. Defect Assessment
1. Replace the work, or portions of the work, not conforming to specified requirements.
2. If, in the opinion of the ENGINEER it is not practical to remove and replace the work, the ENGINEER will direct an appropriate remedy or adjust payment.
D. Tolerances
1. The CONTRACTOR shall monitor fabrication and installation tolerance control of all products to produce acceptable work. Do not permit products and installation outside of allowable tolerances to accumulate.
2. The CONTRACTOR shall comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from ENGINEER before proceeding.
3. The CONTRACTOR shall adjust products to appropriate dimension and position before securing products in place.
E. References and Standards
1. For products or workmanship specified by association, trade, or other consensus standards, the CONTRACTOR shall comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
2. The CONTRACTOR shall conform to reference standard by date of issue current date for receiving bids, except where a specific date is established by code.
3. The CONTRACTOR shall obtain copies of standards where required by product specification sections.
4. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the ENGINEER shall be altered from the Contract Documents by mention or inference otherwise in any reference document.
F. Mock-Up
1. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.
2. The CONTRACTOR shall assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
3. Accepted mock-ups shall be a comparison standard for the remaining work.
4. Where mock-up has been accepted by ENGINEER and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so.
G. Testing Services
1. The OWNER will appoint and employ services of an independent firm to perform testing. OWNER shall pay for services.
2. The independent firm will perform tests and other services specified in individual specification sections and as required by the ENGINEER.
3. Testing and source quality control may occur on or off the project site. Perform offsite testing as required by the ENGINEER or the OWNER.
4. Reports will be submitted by the independent firm to the ENGINEER and CONTRACTOR, in duplicate indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
5. The CONTRACTOR shall cooperate with the independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
a. Notify ENGINEER and independent firm 24 hours prior to expected time for operations requiring services.
b. Make arrangements with independent firm and pay for additional samples and tests required for CONTRACTOR'S use.
6. Testing does not relieve CONTRACTOR to perform work to contract requirements.
7. Re-testing required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the ENGINEER. Payment for re-testing will be charged to the CONTRACTOR or by deducting testing charges from the Contract Sum/Price.
J. Removal of Defective and Unauthorized Work
1. All work which has been rejected or condemned shall be repaired, or, if it cannot be satisfactorily repaired it shall be removed and replaced at the CONTRACTOR'S expense. Defective materials shall be removed immediately from the site of the work.
2. Work done without lines and grades having been given, work done beyond the lines or not in conformity with the grades shown on the plans or as given, save as herein provided, work done without proper inspection will be done at the contractor's risk and will be considered unauthorized and at the option of the ENGINEER may not be accepted and may be ordered removed at the CONTRACTOR'S expense.
3. If any work is covered contrary to the written instructions of the ENGINEER it must, if requested by the ENGINEER, be uncovered for the ENGINEER'S observation, and replaced at the CONTRACTOR'S expense.
4. If the ENGINEER considers it necessary or advisable that covered work be inspected or tested by others, the CONTRACTOR, at the ENGINEER'S request, will uncover, expose or otherwise make available for observation, inspection or testing as the ENGINEER may require, that portion of the work in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such work is defective, the CONTRACTOR will bear all the expenses of such uncovering, exposure, observation, inspection and testing and of satisfactory reconstruction; if, however, such work is not found to be defective, the CONTRACTOR will be allowed an increase in the contract price or an extension of the contract time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing and reconstruction and an appropriate change order shall be issued.
K. Inspection Services
1. OWNER will appoint, employ, and pay for specified services of an independent firm to perform inspection.
L. Manufacturers' Field Services
1. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of
equipment, test, adjust and balance of equipment as applicable, and to initiate instructions when necessary.
2. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
3. Refer to Section 013300 - Submittals and Substitutions, Manufacturers' Field Reports article.
4. Coordination of Plans, Specifications, and Special General Conditions: The plans, these specifications, Special General Conditions, and all supplementary documents are intended to describe a complete work and are essential parts of the contract. A requirement occurring in any of them is binding. In case of discrepancies, figured dimensions shall govern over scaled dimensions; plans shall govern over specifications. Special General Conditions shall govern over both General and Standard Specifications, and the plans and quantities shown on the plans shall govern over those shown on the proposal. The CONTRACTOR shall take no advance of any apparent error or omission in the plans and specifications, and the ENGINEER shall be permitted to make such corrections or interpretations as may be deemed necessary for the fulfillment of the intent of the plans and specification.

In the event the CONTRACTOR discovers any apparent error or discrepancy, he shall immediately bring such error or discrepancy to the attention of the ENGINEER, and request in writing an interpretation thereof by the ENGINEER.
M. Subcontracting
1. The CONTRACTOR may utilize the services of specialty SUBCONTRACTORS on those parts of the work which, under normal contracting practices, are performed by specialty SUBCONTRACTORS.
2. The CONTRACTOR shall not award work to SUBCONTRACTOR(S) in excess of fifty (50) percent of contract price, or in excess of fifty (50) percent of the labor and equipment required to install the project, without prior written approval of the OWNER.
3. The CONTRACTOR shall be fully responsible to the OWNER for the acts and omissions of its SUBCONTRACTORS, and of persons either directly or indirectly employed by them, as the CONTRACTOR is for the acts and omissions of persons directly employed by the CONTRACTOR.
4. The CONTRACTOR shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind SUBCONTRACTORS to the CONTRACTOR by the terms of the contract documents insofar as applicable to the work of SUBCONTRACTORS and to give the CONTRACTOR the same power as regards terminating any subcontract that the OWNER may exercise over the CONTRACTOR under any provision of the CONTRACT DOCUMENTS.
5. Nothing contained in this CONTRACT shall create any contractual relationship between the SUBCONTRACTOR and the OWNER.

\section*{PART 2 - PRODUCTS}

NOT USED.

\section*{PART 3 - EXECUTION}

\subsection*{3.1 EXAMINATION}
A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
C. Examine and verify specific conditions described in individual specification sections.
D. Verify that utility services are available, of the correct characteristics, and in the correct locations.

\subsection*{3.2 PREPARATION}
A. Clean substrate surfaces prior to applying next material or substance.
B. Seal cracks or openings of substrate prior to applying next material or substance.
C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

END OF SECTION 014500

\section*{SECTION 017839 - PROJECT RECORD DOCUMENTS}

\section*{PART 1-GENERAL}

\subsection*{1.1 DESCRIPTION OF WORK}
A. Maintain at the site for the OWNER one record copy of:
1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the contract.
5. Approved shop drawings, product data and samples.
6. Field test records.
B. Related Requirements in other parts of the Project Manual:
1. Conditions of the Contract.

\subsection*{1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES}
A. Store documents and samples in CONTRACTOR'S field office apart from documents used for construction.
1. Provide files and racks for storage of documents.
2. Provide locked cabinet or secure storage space for storage of samples.
B. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
C. Make documents and samples available at all times for inspection by OWNER'S REPRESENTATIVE.

\subsection*{1.3 RECORDING}
A. Label each document "PROJECT RECORD" in neat large printed letters.
B. Record information concurrently with construction progress.
1. Do not conceal work until required information is recorded.
C. Drawings: Legibly Mark to Record Actual Construction:
1. Location of \(\mathrm{C} \mathrm{\& D}\) debris cell, referenced to permanent improvements.
2. Actual construction of \(\mathrm{C} \mathrm{\& D}\) debris cell.
3. Actual construction of permanent installation.
D. Specifications and Addenda; Legibly Mark Each Section to Record:
1. Manufacturer, trade name, catalog number, and supplier of Representative for the OWNER.
2. Changes made by Change Order.
E. Drawings and Specifications: Post addenda items, whether written or drawn, on the pages affected such that:
1. Cut-outs of items are securely attached to the sheet that the addenda modified.
2. The addenda number is reflected in each posted item.
3. Completely revised sheets are posted over the sheet revised and the outdated sheet is labeled "void".

\subsection*{1.4 SUBMITTALS}
A. At contract close-out, deliver Record Documents to OWNER'S REPRESENTATIVE.
B. Accompany submittal with transmittal letter in duplicate, containing:
1. Date.
2. Project title and number.
3. CONTRACTOR'S name and address.
4. Title and number of each Record Document.
5. Signature of CONTRACTOR or his authorized REPRESENTATIVE.

\section*{END OF SECTION 017839}

\section*{DIVISION 31 - EARTHWORK}

\section*{SECTION 310000 - GENERAL EARTHWORK}

\section*{PART 1 - GENERAL}

\subsection*{1.1 DESCRIPTION}

This section covers the requirements and procedures for excavation and backfill for structures.

\subsection*{1.2 STANDARD SPECIFICATIONS}
A. The following is a list of standard specifications with the accompanying abbreviations used in this specification section:
1. American Association of State Highway and Transportation Officials Standard Specifications - AASHTO.

\subsection*{1.3 QUALITY ASSURANCE}
A. Compaction shall be in accordance with Section \(312333-70\) Trenching, Backfilling and Compaction.
B. The OWNER shall be the sole and final judge of suitability of all materials.
C. Materials in question, pending test results, shall not be used in the work. The CONTRACTOR shall remove all materials that fail to meet the requirements of the specifications, whether in stockpiles or in place.
D. Fills, embankments, backfills or subgrades which do not meet the specification requirements shall be removed or recompacted until the requirements are satisfied.

\subsection*{1.4 PROTECTION}
A. Protection of Existing Improvements
1. Protection shall be provided to prevent damage to existing improvements indicated to remain in place on the OWNER'S property and adjoining properties.
2. Damaged improvements shall be restored to their original condition, as acceptable to parties having jurisdiction.
3. Land areas outside the limits of permanent work performed under this contract shall be preserved in their present condition. The CONTRACTOR shall confine his construction activities to areas defined for work on the Drawings.
B. Protection of Existing Utilities
1. The CONTRACTOR shall verify all existing utility locations either shown or not shown on the drawings.
2. The CONTRACTOR shall immediately notify the OWNER and applicable utility company of any damages to existing utilities.
3. Repairs to damaged utilities shall be made in accordance with the requirements of the OWNER and applicable utility company at no extra cost to the OWNER.
4. The CONTRACTOR shall coordinate with the OWNER and the applicable utility company for shutoff of or connection to active utilities. Existing utility services shall not be interrupted except as authorized in writing by the OWNER.
C. Protection of Work Site: Barricades or other type protectors shall be provided to prevent unauthorized personnel from entering work sites.

\subsection*{1.5 JOB CONDITIONS}
A. Classification of Excavation
1. No classification shall be made to differentiate the various surface and subsurface conditions the CONTRACTOR may encounter during his performance under this contract.
2. It is the CONTRACTOR'S sole responsibility to verify the site surface and subsurface conditions.
B. Dewatering
1. Excavation and embankment shall be performed in such manner that the area of the site and the area immediately surrounding the site will be continually and. effectively drained by gravity or temporary pumps.
2. Water shall not be permitted to accumulate in excavations or other areas of the site.
3. The excavation shall be drained by methods which prevent the softening of subgrades and embankments.
C. Blasting shall not be allowed.
1. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities.
2. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

\section*{PART 2 - PRODUCTS}

\subsection*{2.1 SUITABLE MATERIALS}
A. Suitable materials for fill and, backfill include materials that are free of debris, roots, organic or frozen materials, stones having a maximum dimension of four (4) inches in the upper six (6) inches of fill or six (6) inches in the remainder of fill.
B. Otherwise, suitable material which is unsuitable due to excess moisture content will not be classified as unsuitable material unless it cannot be dried by manipulation, aeration or blending with other materials to the satisfaction of the OWNER.
C. Unsuitable materials shall include those materials that are determined by the OWNER to be inadequate for providing a stable slope, fill, subgrade, or foundation for structure.
D. Expansive clay soils shall be classified as unsuitable unless treated or mixed in a manner approved by the OWNER.

\subsection*{2.2 CAPILLARY WATER BARRIER}
A. Coarse Aggregate (Gravel) Capillary Water Barrier.
1. Coarse aggregate shall meet the requirements of AASHTO M80.
2. Coarse aggregate shall consist of gravel, crushed gravel, or crushed stone.
3. Gradation of coarse aggregate shall conform to the requirements of AASHTO M 43, Size Number 57:
\begin{tabular}{|c|c|}
\hline Sieve & Mass-Percent Passing \\
\hline \(11 / 2\) inches & \((38 \mathrm{~mm}) 100\) \\
\hline 1 inch & \(95-100\) \\
\hline \(1 / 2\) inch \((13 \mathrm{~mm})\) & \(25-60\) \\
\hline No. 4 & \(0-10\) \\
\hline No. 8 & \(0-5\) \\
\hline
\end{tabular}
4. Maximum allowable percent of deleterious substances shall meet the requirements of AASHTO M 80, Class B.
B. Fine Aggregate (Sand) Capillary Water Barrier:
1. Fine aggregate shall meet the requirements of AASHTO M6.
2. In general, fine aggregate shall consist of natural sand having hard, strong, durable particles free from deleterious substances and meeting the following gradation requirements:
\begin{tabular}{|c|c|}
\hline Sieve & Mass-Percent Passing \\
\hline \(3 / 8\) inch \((9.5 \mathrm{~mm})\) & 100 \\
\hline No. 4 & \(95-100\) \\
\hline No. 16 & \(45-80\) \\
\hline No. 50 & \(10-30\) \\
\hline No. 100 & \(2-10\) \\
\hline
\end{tabular}

\subsection*{2.3 FINE AGGREGATE (SAND) BACKFILL}
A. Fine aggregate backfill shall meet the requirements of Paragraph 2.2.B.

\subsection*{2.4 SELECTION OF BORROW MATERIAL}
A. Borrow material, if required, shall be selected to meet requirements and conditions of the particular fill for which it is to be used.
B. For borrow material obtained outside the limits of the project site, the CONTRACTOR shall obtain the right to procure material and shall pay all royalties and other charges involved.

\section*{PART 3 - EXECUTION}

\subsection*{3.1 EXCAVATION}
A. Excavation, regardless of material encountered, shall conform to the dimensions and elevations indicated on the Drawings for each building and structure, and shall include trenching for utility and foundation drainage systems to a point five (5) feet beyond the building line of each building and structure.
B. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services, and for inspection, except where the concrete for walls and footings is authorized by the OWNER to be deposited directly against excavated surfaces.
C. Suitable excavated material shall be transported to and placed to fill areas within the limits of the work.
D. Unsuitable materials encountered within the limits of the work shall be excavated below grade and replaced with suitable materials as directed by the OWNER, except that concrete footings shall be increased in thickness to the bottom of the over-depth excavations and over-break in rock excavation.
E. No excavated material shall be wasted without the authorization of the OWNER.
1. Surplus excavated material and unsuitable material shall be disposed of by the CONTRACTOR at his own expense and responsibility.
2. Material authorized to be wasted shall be disposed of in such manner as not to obstruct the flow characteristics of any stream or to impair the efficiency or appearance of any structure.
F. No excavated material shall be deposited in a manner that may endanger a partly finished structure by direct pressure or by overloading banks contiguous to the operations or that may otherwise be detrimental to the completed work.
G. Blasting shall not be allowed.

\subsection*{3.2 PREPARATION OF GROUND SURFACE FOR FILL}
A. Areas upon which fills are to be placed shall be cleared and grubbed before the fill is started.
B. Sloped ground surfaces steeper than one (1) vertical to four (4) horizontal on which fill is to be placed shall be plowed, stepped, or benched, or broken up as directed by the OWNER, in such a manner that the fill material will bond with the existing surface.
C. When surfaces on which fills are to be placed do not meet the specified density requirements, the ground surface shall be broken up, pulverized, and compacted to the specified density.
D. When surfaces on which fills are to be placed do not meet the specified moisture content requirements, the ground shall be wetted, aerated, or dried to the specified density.
E. When the subgrade is part fill and part excavation, the excavated portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill.

\subsection*{3.3 FILL AND BACKFILL}
A. Fills and backfills shall conform to the dimensions and elevations indicated on the Drawings for each building and structure.
B. Placing Fill and Backfill
1. Suitable material shall be placed in successive horizontal uniformly spread layers of loose material not more than six (6) inches thick, except that in areas not accessible or permitted for the use of self-propelled rollers or vibrators, the loose layer shall be four (4) inches thick.
2. Fills and backfills shall not be placed in wet or frozen areas.
C. Backfill
1. Backfill shall not begin until construction below finish grade has been completed, underground utility systems have been inspected and tested, form removed, and the excavation cleaned of trash and debris.
2. Fine aggregate backfill shall be placed to the dimensions and elevations indicated on the Drawings.
3. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted by power-driven hand tampers suitable for the material being compacted.
4. Backfill shall be placed carefully around pipes to avoid damage to coatings.
5. Backfill shall not be placed against foundation walls prior to 7 days after placement of the walls.
6. As far as practical, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.
7. Where fill or backfill is to be placed and compacted against structure walls, the walls shall be supported laterally as necessary to prevent damaging or displacing the walls. Any wall so damaged as a result of the CONTRACTOR'S operation shall be completely and promptly replaced.

\subsection*{3.4 COMPACTION}
A. For fill and backfill compaction densities and moisture contents, see Section 3123 33.
B. Compaction shall be accomplished by those methods listed in Section 312333. Material shall be aerated or moistened to maintain the required moisture content.
C. Fine aggregate backfill shall be compacted with a minimum of two (2) passes of a power-driven hand tamper.

\subsection*{3.5 CAPILLARY WATER BARRIER}
A. Either coarse aggregate (gravel) or fine aggregate (sand) capillary water barriers shall be installed under slabs-on-grade as indicated on the Drawings.
B. The capillary water barrier shall be placed directly on the subgrade after the subgrade has been compacted to the required density and placed to the elevation indicated on the Drawings.
C. The barrier shall be constructed to the thickness shown in layers not exceeding six (6) inches in compacted thickness.
D. Each layer shall be compacted to the required density, with a minimum of two passes of a plate-type vibratory compactor.

\subsection*{3.6 FINISH GRADING}
A. Excavated and filled sections, and adjacent transition areas, shall be uniformly smoothly graded. The finished surface shall be reasonably smooth, compacted, and free from irregular surface changes.
B. The degree of finish shall be that ordinarily obtainable from blade-grader operations, except as otherwise specified.
C. The surface of fills or excavated areas for slabs-on-grade shall not vary more than 0.05 foot from the established grade.
D. Other finished surfaces shall not vary more than 0.15 foot from the established grade and cross section and shall be free of depressed areas where water would pond.

\section*{END OF SECTION 310000}

\section*{SECTION 312200 - SITE GRADING}

\section*{PART 1 - GENERAL}

\subsection*{1.1 DESCRIPTION}
A. The work covered under this item includes all supervision, labor, equipment, and materials required for rough and final site grading. Included in this item are any stripping, filling, excavating, backfilling and compaction required to complete the grading as shown on the plans or as specified herein.

\subsection*{1.2 DUST AND BLOWING MATERIAL CONTROL}
A. The CONTRACTOR shall use all means necessary to control dust on and near the site and on and near all off-site borrow areas if such dust is caused by the CONTRACTOR'S operations during performance of the work or if resulting from the condition in which the CONTRACTOR leaves the site.
B. All surfaces shall be thoroughly moistened as required to prevent dust being a nuisance to the public, neighbors, and concurrent performance of other work on the site.
C. Any landfilled material which is uncovered during any construction operation will immediately be covered with a minimum of 12 inches of soil and compacted to \(90 \%\) Standard Proctor Density. The CONTRACTOR will be responsible for ensuring that existing landfilled material is not allowed to be blown or carried off the site and will clean up any material uncovered by his operations which is blown from the site.
D. Protection of Existing Utilities
1. The CONTRACTOR shall verify all existing utility locations either shown or not shown on the Drawings.
2. The CONTRACTOR shall immediately notify the OWNER and applicable utility company of any damages to existing utilities.
3. Repairs to damaged utilities shall be made in accordance with the requirements of the OWNER and applicable utility company at no extra cost to the OWNER.
4. The CONTRACTOR shall coordinate with the OWNER and the applicable utility company for shutoff of or connection to active utilities. Existing utility services shall not be interrupted except as authorized in writing by the OWNER.
E. Protection of Work Site: Barricades or other type protectors shall be provided to prevent unauthorized personnel from entering work sites.

\section*{PART 2 - PRODUCTS}

\subsection*{2.1 FILL MATERIAL, GENERAL}
A. All fill material shall be subject to the approval of the ENGINEER.

\subsection*{2.2 ON-SITE FILL MATERIAL}
A. All on-site fill material used shall be soil or soil-rock mixture which is free from organic matter and other deleterious substance. It shall contain no rocks or lumps over 6 inches in greatest dimension, and not more than 15 percent of the rocks or lumps shall be larger than 2-1/2 inches in greatest dimension.

\subsection*{2.3 IMPORTED FILL MATERIAL (BORROW)}
A. All imported fill material shall meet the requirements stated in Section 310000 and, in addition, shall be predominantly granular with a maximum particle size of 2 inches and a plasticity index of 12 or less.
B. Any fill material, including topsoil, must be approved by the ENGINEER prior to placement. The CONTRACTOR shall notify the ENGINEER at least four working days in advance of intention to import material, designating the location of proposed borrow material. The CONTRACTOR shall be responsible for obtaining any permits or permission required for ENGINEER to sample, as necessary, from the borrow area for the purpose of making acceptance tests to prove the quality of proposed borrow material.

\subsection*{2.4 OTHER MATERIALS}
A. All other materials, not specifically described but required for a complete and proper installation, shall be as selected by the CONTRACTOR subject to the approval of the ENGINEER.

\section*{PART 3 - EXECUTION}

\subsection*{3.1 FINISH ELEVATIONS AND LINES}
A. Grade stakes will be set by the CONTRACTOR and approved by OWNER'S REPRESENTATIVE establishing rough and finish elevations and lines. The CONTRACTOR shall take care to preserve all survey control data and monuments set by the ENGINEER and, if displaced or lost, immediately replace to the approval of the ENGINEER and at no additional cost to the OWNER.

\subsection*{3.2 GRADING}
A. General Requirements
1. The CONTRACTOR will perform all rough and finish grading required to obtain the elevations shown in the Drawings.

\section*{B. Grading Tolerances}
1. All rough and finished grading shall be performed with approved equipment to a tolerance of plus or minus 0.1 ft .
C. Compaction
1. Existing cover material will be compacted prior to the placement of any additional fill material. Two passes, at right angles to each other, will be made on existing cover with a sheep's foot roller, to obtain this compaction.
2. New fill material and material disturbed by grading will be compacted to a minimum of \(90 \%\) Standard Proctor Density using approved compaction equipment.
D. Treatment after Completion of Grading
1. After grading is completed and the ENGINEER has finished his inspection, no further excavating, filling, or grading except with the approval of an inspection of the ENGINEER will be allowed.
2. The CONTRACTOR shall use all means necessary to prevent erosion of freshly graded areas during construction and until such time as permanent drainage and erosion control measures have been installed.

\section*{END OF SECTION 312200}

\section*{SECTION 312319 - DEWATERING}

\section*{PART 1 - GENERAL}

\subsection*{1.1 RELATED DOCUMENTS}
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specifications sections, apply to this section.

\subsection*{1.2 SUMMARY}
A. This section includes construction dewatering.
B. Related sections include the following:
1. Division 31-Section 310000 - Earthwork

\subsection*{1.3 PERFORMANCE REQUIREMENTS}
A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control ground water flow into excavations and permit construction to proceed on dry, stable subgrades.
1. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Accomplish dewatering without damaging existing buildings adjacent to excavation.
4. Remove dewatering system if no longer needed.

\subsection*{1.4 SUBMITTALS}
A. Shop Drawings for Information: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of headers and discharge lines; and means of discharge and disposal of water.
1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
2. Include a written report outlining control procedures to be adopted if dewatering problems arise.
3. Include shop drawings signed and sealed by the qualified professional engineer responsible for their preparation.
B. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.
C. Record drawings at project closeout identifying and located capped utilities and other subsurface structural, electrical, or mechanical conditions performed during dewatering.
1. Note locations and capping depth of wells and well points.

\subsection*{1.5 QUALITY ASSURANCE}
A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction. Discharge water into existing storm drainage system.
B. Pre-installation Conference: Conduct conference at project site to comply with requirements in Division 01.

\subsection*{1.6 PROJECT CONDITIONS}
A. Existing Utilities: Do not interrupt utilities serving facilities occupied by OWNER or others unless permitted in writing by OWNER and then only after arranging to provide temporary utility services according to requirements indicated.
B. Project Site Information: Boring logs have been prepared for this Project and are available for information only. OWNER / ENGINEER will not be responsible for interpretations or conclusions drawn from this data.
1. Make additional test borings and conduct other exploratory operations necessary for dewatering.
C. Survey adjacent structures and improvements, employing a qualified professional engineer or land surveyor, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.
1. During dewatering, regularly re-survey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify ENGINEER if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

\section*{PART 2 - PRODUCTS}

NOT USED.

\section*{PART 3 - EXECUTION}

\subsection*{3.1 PREPARATION}
A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks or other adjacent occupied or used facilities without permission from OWNER and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

\subsection*{3.2 INSTALLATION}
A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until sewers and structures have been constructed and fill materials have been placed, or until dewatering is no longer required.
C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
1. Maintain piezometric water level a minimum of 24 inches below surface of excavation.
E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction of completed. Dispose of water in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities.
F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to OWNER.
1. Remove dewatering system from project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches ( 900 mm ) below overlying construction.
G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

END OF SECTION 312319

\section*{SECTION 3123 33-TRENCHING, BACKFILLING \& COMPACTION}

\section*{PART 1 - GENERAL}

\subsection*{1.1 SCOPE}
A. The work under this item shall include all earth, shale, gravel, loose rock, solid rock, debris, junk and/or other material excavated or otherwise removed in the preparation of the trench; all work in connection with the excavation, removal and subsequent handling and disposal of such material, regardless of its type, character, composition, or condition; subgrade preparation, all sheeting, piling, shoring, bracing; dewatering of trenches; protection of adjacent property; backfilling; standard bedding material; grade base stabilization; all specified backfill consolidation; and other work necessary or required.

\section*{PART 2 - PRODUCTS}

\subsection*{2.1 STANDARD BEDDING MATERIAL}
A. Standard Bedding Material (SBM) shall meet the requirements of ASTM D-2321 for the class of materials described in this subsection.
1. Class I shall be an angular, \(1 / 4 \mathrm{in}\). to \(1-1 / 2 \mathrm{in}\). graded crushed stone.
2. Class IB shall be crushed stone or gravel and shall be well graded containing several sizes of particles ranging from \(3 / 4\) inch maximum to No. 4. Unless otherwise approved by the ENGINEER, the material shall meet the requirements of ASTM C33, Gradation 67.
2. Class II shall include coarse sands and gravels with maximum particle size of 1-1/2 inch. These materials may have small percentages of fines but shall be generally granular and non-co-adhesive, either wet or dry. Class II materials shall include Unified Soil Classification System (USCS) Soil Types GW, GP, SW and SP.
3. Class III shall include fine sands, sand-clay mixtures and gravel-clay mixtures. USCS Soil Types GM, GC, SM and SC are included in this class.

\section*{PART 3 - EXECUTION}

\subsection*{3.1 TRENCH EXCAVATION}
A. The trench shall be excavated so that the pipe can be laid to the alignment and grades shown on the drawings, or as directed by the OWNER'S REPRESENTATIVE. It shall be excavated a maximum of 100 feet in advance of pipe laying, or less, as permitted by the OWNER'S REPRESENTATIVE. Opening of trenches in excess of the maximum requires specific approval of the ENGINEER.
B. Trenches shall be dry when the trench bottom is prepared. The trench bottom shall be shaped so that even bearing is obtained for the barrel of the pipe, with the bells unsupported.
C. The standard trench width as shown on the Standard Details, shall not be exceeded at any elevation below a point 12 inches above the top of the pipe. If, for any reason this portion of the trench exceeds the permitted width and if the OWNER'S REPRESENTATIVE shall determine that cradling or encasement then is required, said concrete cradle or encasement shall be installed.
D. Any part of the bottom of the trench excavated more than 4 inches below the specified grade shall be corrected with approved material as directed by the OWNER'S REPRESENTATIVE. In the event suitable material is not available, standard bedding material shall be used. When rock is encountered and concrete cradle is required, it shall be excavated 4 inches below the bottom of the pipe and the trench refilled to grade with standard bedding material.
E. When quicksand or other unstable earth is encountered, the ENGINEER shall inform the CONTRACTOR of the construction procedures and materials to use.

\subsection*{3.2 STANDARD BEDDING MATERIAL}
A. Standard Bedding Material (SBM) shall be used for embedding all pipe as shown on the Standard Details. SBM shall be carefully placed and compacted along the entire length of the pipe to be installed to the limits of trench excavation until the thickness specified in the Standard Details is obtained. This layer of bedding material shall be smoothed by flat bottomed shovel or other appropriate means prior to the placement of pipe.
1. Gravity Pipelines: SBM shall be placed simultaneously on each side of pipe and shall be carefully compacted in accordance with the SPECIFICATIONS for the type of pipe to be installed.
a. Class I SBM requires little or no compaction due to the nature of the angular particles.
b. Class II SBM shall be compacted to a minimum \(85 \%\) Standard Proctor Density using hand or mechanical tamping methods. Slightly damp material will generally result in maximum compaction with minimum effort. Avoid saturation of Class II SBM.
c. Class III SBM shall be compacted to a minimum 90\% Standard Proctor Density using hand or mechanical methods. Take care to avoid excessive moisture in using Class III SBM.
2. Pressure Pipelines (except Rural Water): SBM shall be placed simultaneously on each side of pipe and compacted by hand sufficiently to maintain proper grade and alignment.

\subsection*{3.3 BACKFILL}
A. When the type of backfill material to be placed above the standard bedding material is not indicated on the drawings or specified, the backfill may be made with the excavated material, provided that such material, in the opinion of the OWNER'S REPRESENTATIVE, is suitable for backfilling. In the event the excavated material is not suitable, standard bedding material or other approved material shall be used.
B. From 6 inches to 18 inches above the pipe, the trench shall be backfilled by hand or by other methods approved by the OWNER'S REPRESENTATIVE. Special care shall be used in placing this portion of the backfill to avoid damaging or moving the pipe. The remainder of the trench may be backfilled by mechanical methods. Backfilling operation shall be completed within 100 feet or less of the finished line at all times as directed by the OWNER'S REPRESENTATIVE.
C. ALL clearing requiring proposed underground sewer line trench backfill materials and its placement must meet referenced ASTM D 2321, in accordance with OAC 252:656-53(b).

\subsection*{3.4 EXCAVATION ACROSS PAVEMENT}
A. All trenches excavated across any paved street or alley, across any travelled portion of unpaved streets or alleys, across any proposed roadways or proposed roadway fills, and as shown on the drawings shall be backfilled and compacted to the same density as the existing soil adjacent to the side of the trench but shall not be less than \(95 \%\) Standard Proctor Density, provided the excavated materials consist of soil that can be readily compacted at the optimum moisture. If the excavated material consists of mostly clay or silt containing an excess of moisture, such excavated material shall be removed from the site of the work and the trench filled with Standard Bedding Material, Class I. If the backfilling has been completed and the backfill material does not meet the requirements for compaction, all the material shall be removed and hauled from the job site and the trenches refilled with material as specified above. All trenches excavated across and/or along paved or unpaved streets shall be replaced in accordance with the Standard Details for the type paving excavated.

END OF SECTION 312333

\section*{SECTION 312500 - EROSION AND SEDIMENTATION CONTROL}

\section*{PART 1 - GENERAL}

\subsection*{1.1 SUMMARY}
A. Section Includes:
1. Temporary and permanent erosion control systems.
2. Slope protection systems.

\subsection*{1.2 REFERENCES}
A. United States Environmental Protection Agency (EPA):
1. NPDES - National Pollutant Discharge Elimination System.
B. Oklahoma Department of Environmental Quality (ODEQ):
1. DEQ General Storm Water Permit (OKR10 and OKR05)
C. Oklahoma Department of Transportation (ODOT):
1. ODOT - State of Oklahoma Department of Transportation Standard Specifications for Highway Construction, Section 735 - Material for Roadside Development and Erosion Control.

\subsection*{1.3 QUALITY ASSURANCE}
A. Perform Work in accordance with the following ODOT standards:
1. Section 220 - Management of Erosion Sedimentation, and Storm Water Pollution Prevention and Control
2. Section 221 - Temporary Sediment
3. Section 230 - Sodding and Sprigging.
B. Regulatory Requirements: Conform to requirements of local Authority Having Jurisdiction for prevention of erosion and sediment control.
1. Conform to NPDES and ODEQ requirements, where required.

\subsection*{1.4 PROJECT CONDITIONS}
A. Environmental Requirements: Protect adjacent properties and water resources from erosion and sediment damage throughout work. Take all necessary measures to prevent sedimentation from construction operations to enter adjacent property. Offsite discharge of sedimentation is not permitted.
B. Storm Water Pollution Prevention Plan: Maintain plan at project site at all times available for inspection during contract duration.

\section*{PART 2 - PRODUCTS}

\subsection*{2.1 MATERIALS}
A. Quick Growing Grasses: Wheat, rye, or oats.
B. Straw Bales: Free of weed seed.
C. Fencing for Siltation Control: UV resistant geotextile fabric.
D. Slab Sod: Rectangular slabs of Bermuda grass.
E. Temporary Mulches: Loose straw, netting, wood cellulose, or agricultural silage free of seed.
F. Bale Stakes:
1. Minimum 3 feet length.
2. 2 No. 4 steel reinforcing bars or,
3. 2 steel pickets or,
4. 2-2x2 inch hardwood stakes driven 18 inches to 24 inches into ground.

\section*{PART 3 - EXECUTION}

\subsection*{3.1 EXAMINATION}
A. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive work.
B. Report in writing to ENGINEER prevailing conditions that will adversely affect satisfactory execution of the work of this section. Do not proceed with work until unsatisfactory conditions have been corrected.
C. By beginning work, CONTRACTOR accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the OWNER.

\subsection*{3.2 EROSION CONTROL AND SLOPE PROTECTION}
A. Provide erosion control and slope protection measures to prevent sediment from site entering adjacent property or public right-of-way to include but not be limited to:
1. Temporary silt fences.
2. Straw bales placed around culvert openings or inlets.
3. Diked area with earth berm and silt trap for draining dredged material.
B. Install erosion control and slope protection in accordance with ODOT standards.
C. Place all erosion and siltation control measures before start of earthwork and grading construction operations.
D. Mulch and seed all storm and sanitary sewer trenches not in streets no later than 10 days after backfill. Do not permit more than 500 feet of trench to be open at any one time.
E. Place all excavated material on uphill side of trenches where possible. Do not place materials in stream beds. Seed any stockpiled material which remains in place longer than 30 days with temporary vegetation and mulch.
F. Mulch and seed all temporary earth berms, diversions, erosion barriers and temporary stockpiles with temporary vegetative cover with 10 days after grading.
G. Do not stockpile or otherwise place dredged, excavated or other material, at any time, in or near stream bed which may increase turbidity of water. If turbidity producing materials are present, hold surface drainage from cuts and fills within construction area and from borrow and waste disposal areas in suitable sedimentation ponds or grade surface drainage to control erosion within acceptable limits. Provide and maintain temporary erosion and sediment control measures such as berms, dikes, drains, or sedimentation basins, if required, until permanent damage and erosion control facilities are completed and operative. Hold to minimum area of bare soil exposed at any one time by construction operations.
H. Drain dredged material minimum 7 days. Store material for drainage to a maximum height of 4 feet.
I. OWNER'S REPRESENTATIVE may direct CONTRACTOR to limit surface area of erodible earth material exposed by clearing and grubbing, excavation, borrow and embankment operations and may direct CONTRACTOR to provide immediate permanent or temporary erosion control measures.
J. Maintain temporary erosion control systems as directed by OWNER'S Representative to control siltation during construction. Provide maintenance or additional work directed by OWNER'S REPRESENTATIVE immediately upon notification by OWNER'S REPRESENTATIVE.

\section*{END OF SECTION 312500}

\section*{SECTION 3135 26.13 - RECONSTRUCTED CLAY LINER (LANDFILLS)}

\section*{PART 1 -GENERAL}

\subsection*{1.1 SCOPE}
A. The CONTRACTOR shall furnish all labor, materials, supervision and equipment to complete the excavation, embankment and a reconstructed clay liner with a minimum thickness of two (2) feet, as shown on the Plans and as included in these Specifications.

\subsection*{1.2 DEFINITIONS}

The following list of definitions is provided for reference:
A. "Authorized Representation" shall mean a duly named individual who has the authority to execute a change order on behalf of the City.
B. "City" shall mean the City of Altus, Oklahoma.
C. "Classification System" shall mean the soil classification system shall be in accordance with the standard test method for classification of soils for engineering purposes (ASTM D2487-83).
D. "Compaction" shall mean the process of increasing the density of soil by rolling, tamping, vibrating, or other mechanical means.
E. "Contractor" shall mean the party entering into this general contract.
F. "Atterberg Limits" includes the liquid limit, plastic limit, and shrinkage limit for soils (ASTM D4318-84 and D427-83, respectively). The water content when the soil behavior changes from the liquid to the plastic state is the liquid limit; from the plastic to the semi- solid state is the plastic limit; and from the semi-solid to the solid state is the shrinkage limit.
G. "Density" shall mean the mass density of a soil is its weight per unit volume; usually reported in pounds per cubic foot.
H. "Department" shall mean the Oklahoma Department of Environmental Quality, Land Protection Service (ODEQ/LPS).
I. "Engineer" shall mean the consulting engineering firm providing design and general supervision, monitoring of earthwork and liner construction, construction surveillance, and surveying services and who is responsible interpreting for and enforcing the Specifications outlined herein.
J. "EPA Document" shall mean the EPA (U.S. Environmental Protection Agency) Technical Guidance Document "Quality Control and Quality Assurance for Waste Containment Facilities", EPA/600/R-93/182, dated September 1993.
K. "Gas Well" shall mean a vertically installed slotted, perforated, or porous pipe with a solid riser pipe surrounded by a gravel-packed zone over the perforated pipe section to allow removal of landfill gas and any intercepted leachate.
L. "Geomembrane" shall mean an impermeable membrane liner or barrier used in civil engineering for geotechnical products. It can also be reinforced with a fabric scrim for added strength.
M. "Geotextile" shall mean a relatively porous construction or reinforcement fabric used in civil engineering for geotechnical projects. The fabric structure may be knit, woven, or nonwoven. Filter geotextile is a material, which provides separation of materials with different pore size openings to prevent clogging. Drainage geotextiles are materials with adequate transmissivity to provide planar flow of fluid. Reinforcing geotextile is a material with sufficient in-plane strength to support some or all of the load applied to a composite system (such as soil-geotextile).
N. "In Situ" shall mean ","as is", or as it exists in-place naturally.
O. "Moisture Content" shall mean the ratio of quantity of water in the soil (by weight) to the weight of the soil solids (dry soil), expressed in percentage; also referred to as water content.
P. "Optimum Moisture Content (OMC)" shall mean the moisture content corresponding to maximum dry density as determined in the Standard Proctor (ASTM D-698) or Modified Proctor (ASTM D-1557) Test.
Q. "OAC" shall mean the Oklahoma Administrative Code.
R. "Permeability" shall mean the ability of pore fluid to travel through a soil mass via interconnected void. "High" permeability indicates relatively rapid flow of pore fluid and vice versa. Coefficients of permeability are generally reported in centimeters per second.
S. "Plasticity" shall mean the ability of soil mass to be remolded without raveling or breaking apart. The plasticity index, numerically equal to the difference between the liquid and plastic limit, is a comparative number, which describes the range of moisture contents over which a soil behavior is plastic.
T. "QCA Engineer" shall mean an independent consulting engineer and/or testing firm, working directly for the City, providing subsurface soil investigations, soil testing laboratory, oversight of earthwork and liner construction, and assisting in the construction surveillance, who is responsible for final approval of cell liner construction according to the Plans and Specifications outlined herein.

\section*{PART 2 - PRODUCTS}

\subsection*{2.1 RECONSTRUCTED CLAY LINER}
A. Preliminary Liner Soil Testing (Furnished by QAQC Firm)
1. Suitability determination. The OWNER shall collect samples and test soil proposed to be used as liner material.
2. Sample collection. At least one sample shall be collected for each type of material proposed for use as liner material. One composite sample shall be taken for every

10,000 cubic yards of soil or more frequently if visual observations indicate a change in material characteristics. At least five natural or in-place moisture and density tests per acre shall be taken.
3. Testing. The soil samples shall be tested by a soil's laboratory under the direction of an independent professional ENGINEER registered in the State of Oklahoma. The test samples and report shall be sealed by a Registered Professional ENGINEER.
4. Tests. The following tests shall be conducted on each type of soil samples:
a. Soil Classification
b. Particle-Size Analysis of Soil
c. Sieve Analysis for the Following:
d. Percent Fines (- \#200 sieve)
e. Atterberg Limits
f. Moisture Content
g. Moisture-Density Relationship
h. Hydraulic Conductivity

ASTM D-2487
ASTM D-422
\#4, \#10, \#40, \#200
ASTM 1140
ASTM D-4318
ASTM D-2216 or ASTM D-4643
ASTM D698 or ASTM D1557
ASTM D-5084
5. Test Pad. A test pad for the liner can be constructed and used to verify that the construction methods to produce the hydraulic conductivity of \(1.0 \times 10^{-7} \mathrm{~cm} . / \mathrm{sec}\). or less throughout the reconstructed area. However, hydraulic conductivity tests shall be performed in the top 12 inches of the finished liner per Part 3.6 below.
6. Soils Report. A laboratory report of soil and rock characteristics shall be submitted as part of the application. All test results shall indicate the type of test used the method of testing and the condition, preparation, and orientation of each sample.

\subsection*{2.2. PERFORMANCE STANDARDS OF LINER MATERIAL}
A. The soil tests required for preconstruction shall meet or exceed OAC 252:515-11-32. These tests shall be conducted at a minimum rate of one sample per 4,000 cubic yards and for each soil type or visual change in soil appearance.
B. The minimum performance standards required of recompacted liner material include:
1. Plasticity Index must be no less than 10 percent and should be less than 30 percent
2. Liquid Limit must be no less than 24 percent.
3. Percent Fines Passing \#200 Mesh Sieve shall be at least 50 percent.
4. The amount of gravel (dry-weight percentage retained on the No. 4 sieve) must be less than or equal to 20 percent.
5. The largest particle size allowed must be less than one (1) inches in diameter.
6. The water content of the soil must be wet of optimum at the time the soil is compacted. The recommended range is 1 to 3 percent wet of optimum moisture or as determine by field geotechnical testing.
7. After the soil is compacted, it must have a hydraulic conductivity that is no greater than \(1.0 \times 10^{-7} \mathrm{~cm} . / \mathrm{sec}\).

\section*{PART 3 - EXECUTION}

\subsection*{3.1 SEQUENCE OF CONSTRUCTION}
A. The two (2) foot reconstructed clay liner shall be constructed to the lines and elevations shown on the Contract Drawings and in accordance with these Specifications.
B. The recompacted liner shall be constructed in the following sequence:
1. Removal of Overburden
2. Subgrade Preparation
3. Two (2) Foot Reconstructed Clay Liner
C. During all phases of the project, construction will be tested, inspected, and evaluated prior to approval.

\subsection*{3.2 REMOVAL OF OVERBURDEN}
A. CONTRACTOR shall remove and stockpile overburden on-site in a location coordinated with the OWNER.

\subsection*{3.3 SUBGRADE PREPARATION FOR RECOMPACTED LINER}
A. The upper six (6) inches of the surface on which the clay liner is to be placed must be scarified and recompacted to a minimum density of 95 percent of the standard proctor density.

\subsection*{3.4. RECOMPACTED LINER PLACEMENT AND COMPACTION}
A. The steps shall be followed in constructing each lift of a recompacted liner.
1. Internal side slopes of disposal areas where liner shall be constructed shall be no steeper than 3:1 (run: rise).
2. Liner material shall be placed at 1 to 3 percent wet of optimum moisture, or as indicated by soil tests. If the soil must be moistened to achieve the proper level of water content, then the water must be distributed equally throughout, and a full hydration of the soil must take place. This may require that the soil be moistened in a separate area and allowed to hydrate for some time before it is placed in the liner. Moisture content must be verified by either a 95\% Standard Proctor Test or a 90\% Modified Proctor test.
3. Scarify the surface on which the lift shall be placed to a nominal depth of approximately one (1) inch.
4. Place a lift of soil at a loose depth of nine (9) inches or less. On the final lift, no more than 5 percent of the final lift thickness determinations can exceed this requirement and no lift thickness can exceed the maximum allowable lift thickness by more than I inch.
5. Compact the lift to a depth of six (6) inches or less by the use of a heavy-footed roller with feet that fully penetrate the loose lift of soil and at least 1 " into the underlying layer. The minimum weight of roller shall be 3,000 pounds per liner foot along the axis of the drum(s). The soil test results, and the type of compaction equipment used shall determine the minimum number of passes. A pass shall be constituted as one pass for a self-propelled roller or one pass of the drums(s) for a towed roller. The minimum compaction coverage (C) anticipated to meet compaction is 150 to 200 percent, where the Number of passes (N) can be estimated from the following:
\[
N=C^{*} A_{d} / A_{f} / 100
\]

Where:
\begin{tabular}{lll}
\(C=\) & Percent of coverage \\
\(\mathrm{A}_{d}\) & \(=\) & Surface area drum \\
\(\mathrm{A}_{f}\) & \(=\) & Sum of the area of the feet on the drums
\end{tabular}
6. At least 5 to 15 passes may be necessary to remold and compact the clay liner sufficiently to achieve the required permeability. The minimum density of the lift shall be greater than or equal to 95 percent of the standard proctor density or \(90 \%\) of modified proctor density. Heavy compaction equipment may require the minimum density to be 95 percent of the modified proctor density, at the discretion of the ENGINEER. The required number of passes shall be observed/determine at least one time, per acre, per lift.
7. Inspect for and remove all rocks, cobbles, roots, and other foreign objects over one inch in diameter, as well as all surface rocks, regardless of size.
8. Inspect for flaws, cracks, and other defects; and,
9. Corrective action will be required in all areas that do not conform with specifications. The defective area must be repaired out to the limits defined by passing soils tests unless the limits are determined by additional field tests.
*The required inspections and removals must be continual as part of the placement of liner material.

\subsection*{3.5. RECOMPACTED LINER CONSTRUCTION TESTS}
A. The following moisture and density tests shall be performed on each compacted lift at a rate of at least three per acre for each approximately six-inch compacted lift. A minimum of two tests shall be performed on the bottom and one on side-slope areas.
1. Determination of moisture values of each lift by one of the following methods:
a. Nuclear density method
b. Drive-cylinder method
c. Rubber balloon method
d. Sand-cone method
e. Microwave drying method
f. Conventional oven drying method

ASTM D-2922
ASTM D-2937
ASTM D-2167
ASTM D-1556
ASTM D-4643
ASTM D-2216
B. As part of the QC/QA procedures, every tenth sample tested with the above methods; must be tested by the conventional oven drying method (ASTM D2216). The results of these tests must be compared with field tests to identify any significant or systematic calibration errors.
1. Determination of density values of each lift by one of the following methods:
a. Nuclear density method

ASTM D-2922
b. Drive-cylinder method

ASTM D-2937
C. As part of the QC/QA procedures, every twentieth sample tested with ASTM D-2922 must be tested with the sand cone method (ASTM D-155, rubber balloon method (ASTM D2167) or undisturbed sample method (ASTM D-1587). The results of these tests must be compared with field tests to identify any significant or systematic calibration errors.
D. Sampling patterns will be based on a grid system establish by the ENGINEER. Tests will be randomly staggered in successive lifts so that sampling points vary in successive lifts. Areas missed by randomly sampling will require additional tests for liner verification.

\subsection*{3.6. RECOMPACTED LINER CONSTRUCTION VERIFICATION TESTS}
A. After completion of recompacted liner construction, the following quality control measures shall be performed and documented.
1. A control survey shall be performed on a 100 -foot grid which verifies the thickness of the constructed liner.
2. A visual inspection shall be performed to ensure liner integrity.
3. Hydraulic conductivity shall be tested with at least one test per acre performed on the side-slopes and two per acre on the bottom, at DEQ approved locations, in the top 12 " of the liner using one of the following methods:
a. Laboratory testing of undisturbed soil sample can be done according to ASTM Test Method D-5084 with a maximum confining stress of 35 kPa ( 5 psi ). ASTM Method D-1587 shall be used to retrieve the undisturbed soil sample for an insitu laboratory test.
b. A field test for hydraulic conductivity shall be according to the sealed double ring infiltrometer test (ASTM D-5093).
c. Any other method approved in advance by the ENGINEER and/or the OWNER.
4. Liner Test Holes
a. All test holes deeper than three feet shall be plugged in accordance with OAC 252 :515-7-3 and OAC 785:35-11-2 (b).
(1) If no contaminated soil and groundwater is encountered in the boring, uncontaminated drill cuttings, uncontaminated surface clay, cement, and/or high solids (a minimum of twenty percent (20\%) solids by dry weight) bentonite grout, pellets, or granules shall be placed from the bottom of the boring to an elevation fourteen (14) feet below land surface and a minimum of ten (10) feet shall be filled with cement grout to an elevation four (4) feet
below land surface. The remaining four (4) feet to land surface shall be backfilled with compacted uncontaminated soil.
(2) If contaminated soil or contaminated groundwater is encountered in the boring, or if the boring is located at an underground storage tank site or within 300 feet of the outside perimeter of an existing wastewater lagoon or is located on a tract of land where a wastewater lagoon is proposed, cement grout shall be placed from the bottom of the borehole to an elevation four (4) feet below land surface. Cement grout shall be placed in the borehole through a tremie pipe and filled r pumped from the bottom upward. The remaining four (4) feet to land surface shall be backfilled with compacted uncontaminated soil.
(3) If the boring is twenty (20) feet or less in total depth and groundwater has not been encountered, the boring shall, at a minimum, be filled with compacted uncontaminated cuttings from the bottom of the boring to land surface.
(4) Direct push geotechnical borings. Direct push geotechnical borings shall be plugged to prevent pollution of groundwater within thirty (30) days after completion of drilling or immediately if drilled by an unlicensed or uncertified person or if the Board determines that the well does not meet the minimum construction standards set forth in this Chapter as follows:
(a) Bentonite chips shall be placed and effectively compressed within the annulus space from the bottom of the borehole to within ten (10) feet of the land surface.
(b) Cement grout shall be installed through a tremie pipe in the remaining annulus space from ten (10) feet to land surface, provide that no cement grout shall be required if the boring is less than ten feet (10') in total depth and no groundwater and no contaminated soil was encountered.
b. All holes, three feet or less in depth shall be plugged in accordance with OAC 252:515-11-74. All boreholes must be plugged with pelletized or chipped bentonite and rehydrated after the core sampling is completed.
c. Maximum allowable percentages of failing materials tests shall be as follows:

Test

\section*{Maximum Percentage of Outliers}
\begin{tabular}{ll}
\hline Atterberg Limits & \(5 \%\) \\
Percent fines & \(5 \%\) \\
Percent Gravel & \(10 \%\) \\
Clod Size & \(10 \%\) \\
Hydraulic Conductivity of & \\
Laboratory Compacted Soil & \(5 \%\) \\
Water Content & \(3 \%^{* 1}\) \\
Dry Density & \(3 \%^{* 2}\) \\
Number of Passes Required & \(5 \%\) \\
\hline
\end{tabular}
*1 No water content less than \(2 \%\) nor more than \(3 \%\) of the allowable value
*2 No dry density values less than 5 lbs. per cubic foot below the allowable Value

Failing tests concentrated in one lift or one area will not be acceptable even if the above percentages are met.
f. A report, prepared by QCA ENGINEER, of the above quality control measures shall be submitted to the ENGINEER for approval of the Recompacted Clay Liner. All soil property values as required by OAC regulation or this specification shall also be included as well as a summary of all construction testing.

\subsection*{3.7. REPAIR ANDIOR REPLACEMENT OF FLAWED RECOMPACTED CLAY LINER}
A. If the liner fails any construction verification tests, the liner shall be repaired or replaced until it meets the requirement. The defective area must be repaired out to the limits defined by passing soils tests unless the limits are determined by additional field tests.
B. The CONTRACTOR may proceed, at his own risk, to place additional lifts before all test results are available; however, if the QCA ENGINEER rejects the lift based on completed test reports, the defective soil and all overlying materials that have been replaced will be removed and replaced.

\subsection*{3.8. PROTECTION OF RECOMPACTED CLAY LINER}
A. The recompacted clay liner must be protected from desiccation, freezing, and excess surface water after construction and until the geomembrane liner is completely installed. The Quality Assurance ENGINEER shall certify that the moisture content was maintained in the liner until placement of the geomembrane liner.
1. The CONTRACTOR shall prevent the desiccation of the recompacted clay by any of the following methods or any other method approved by the ENGINEER and QCA ENGINEER:
a. Water the soil periodically (preferred).
b. Rolling the surface of the recompacted clay liner smooth with a drummed roller to produce a thin, dense layer of soil on the surface to minimize water transfer in and out of the liner.
c. Cover the recompacted clay liner, temporarily with a geomembrane, moist geotextile, or with moist soil.
2. Damage from freezing is not anticipated, however, should freezing temperatures occur, the recompacted clay liner shall be inspected as outlined in Section 2.9.2.3 of the EPA Document.
3. The CONTRACTOR shall provide adequate equipment to prevent ponding of water on the recompacted liner. Soils softened by excess rain, shall be removed, or allowed to dry by natural processes until the proper water content has been
restored. The soil shall be disked and/or recompacted as necessary to restore the soils to meet the requirements of this section.
4. No additional payment shall be made for protecting and reworking the recompacted clay liner as outlined above. Costs to be included in the unit price bid for recompacted clay liner.

\section*{SECTION 314100 - SHEET PILING, SHEETING, SHORING AND BRACING}

\section*{PART 1 - GENERAL}

\subsection*{1.1 DESCRIPTION}
A. General provisions of the Contract Documents including General and Supplementary Conditions and Division 01 specifications sections apply to all work in this section.
B. Work included: Furnishing and installing lateral restraint within trenches and excavations as required.

\subsection*{1.2 SUBMITTALS}
A. Submit under provisions of Section 013300 - Submittals and Substitutions.
B. Submit design of sheet piling, sheeting, shoring and bracing.

\subsection*{1.3 REGULATORY REQUIREMENTS - LATERAL RESTRAINT}
A. Materials and installation work shall conform to all applicable federal, state and local regulations.
B. Provide material for sheet piling, sheeting, shoring and bracing. Drive or set in place in accordance with federal, state and local regulations for excavations and construction, and as may be required to protect the workers and the public, or to maintain the trench widths as specified.
C. Design Requirements:
1. The CONTRACTOR shall retain the services of a registered PROFESSIONAL ENGINEER to design lateral restraint facilities. This design will include any necessary sheet piling, sheeting, shoring or bracing to protect any facilities, stockpiles, excavations or construction materials adjacent to the excavation and/or personnel required to be in or near the excavation. The CONTRACTOR shall retain the services of a registered PROFESSIONAL ENGINEER to design all aspects of shoring and bracing.
D. Bracing elements shall not be cast into or included in the permanent concrete work, except where directed by the ENGINEER, in which case the proper keys, cutoffs, water stops and waterproofs must be provided.
E. The CONTRACTOR shall indemnify and save harmless the ENGINEER and the OWNER from any and all personal injuries or property damages resulting from his failure to provide and properly maintain the previously mentioned lateral restraints.

\subsection*{1.4 QUALITY ASSURANCE}
A. Prior to installation, review methods and procedures related to excavation support and protection system including, but not limited to, the following:
1. Geotechnical report
2. Existing utilities and subsurface conditions
3. Proposed excavations
4. Proposed equipment
5. Monitoring of excavation support and protection system
6. Working area location and stability
7. Coordination with waterproofing
8. Abandonment or removal of excavation support and protection system

\section*{PART 2 - MATERIALS}

\subsection*{2.1 MATERIAL REQUIREMENTS}
A. Materials, wales and braces shall be new or of sound material. If steel, they shall be stand structural steel sections, as listed in the American Institute of Steel Construction's "Manual of Steel Construction," current edition. If timber, they shall be of structural grade southern pine or Douglas fir.
B. The steel sections used shall have no more than surface rust and shall conform to the requirements of the ASTM Specification A36 or A572, "Requirements for Delivery of Structural Steel," current edition, in respect to straightness, defect deformations, camber and any other condition which would affect efficient performance in the bracing system.

\section*{PART 3 - EXECUTION}

\subsection*{3.1 PREPARATION}
A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
1. Shore, support, and protect utilities encountered.
B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from OWNER and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protections system remain stable.
E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

\subsection*{3.2 SOLDIER PILES AND LAGGING}
A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches ( 50 mm ) from a horizontal line and not more than 1:120 out of vertical alignment.
B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

\subsection*{3.3 SHEET PILING}
A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames unless otherwise recommend in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches ( 1500 mm ). Accurately align exposed faces of sheet piling to vary not more than 2 inches ( 50 mm ) from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

\subsection*{3.4 TIEBACKS}

Most tieback systems are proprietary. Insert material requirements in Part 2 if a particular tieback is required. If tiebacks are permanent, consider level of corrosion protection of tendons and anchorage connections.
A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks
1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

\subsection*{3.5 BRACING}
A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by ENGINEER.
2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

\subsection*{3.6 REMOVAL AND REPAIRS}
A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
1. Remove excavation support and protection systems to a minimum depth of 48 inches ( 1200 mm ) below overlaying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Division 2 Section "Earthwork."
3. Repair or replace, as approved by ENGINEER, adjacent work damaged or displaced by removing excavation support and protection systems.
4. Leave excavation support and protection systems permanently in place.

\section*{END OF SECTION 314100}

\section*{SECTION 329200 - TURF AND GRASSES}

\section*{PART 1 - GENERAL}

\subsection*{1.1 DESCRIPTION}
A. Restore all disturbed grass and landscaped areas to conditions equal to or better than before the work began and to the satisfaction of OWNER.

\subsection*{1.2 SUBMITTALS}
A. Manufacturer's product data:
1. Complete materials list of all materials proposed to be furnished and installed under this section.
2. Specifications and other data required to demonstrate compliance with the specified requirements.
B. Pre-Construction Photos
1. Provide pre-construction photos of the existing conditions prior to disturbance of proposed areas of construction.

\subsection*{1.3 GUARANTEE}
A. If a satisfactory stand of lawn/grass has not been produced, the CONTRACTOR shall renovate and reseed the lawn and unsatisfactory portions thereof immediately or during the next planting season if proper weather conditions do not exist for germination. A satisfactory stand is defined as a section of lawn that has:
1. No bare spots larger than 3 square feet.
2. Not more than 10 percent of total area with bare spots larger than 1 square foot.
B. Disturbed areas that will be exposed in excess of 10 days shall be temporarily mulched until proper weather conditions exist for establishment of permanent vegetative cover.

\subsection*{1.4 DISTURBED AREAS}
A. All areas disturbed will have erosion controls in place during and after all construction efforts and until permanent restorations are completed and approved.BMPs to be maintained daily and modified as site conditions change. SWPP reports logging changes in BMP controls, bi-weekly and weather driven inspections and modifications are to be submitted with daily reports. Refer to the Oklahoma Department of Environmental Quality OKR10, for requirements applicable for ground stabilization methods.
B. All areas that have been disturbed by construction activities shall be returned to equal or better conditions by the use of Solid Slab Sod, Seeding, or Hydro-Mulching to achieve substantial \(70 \%\) coverage over the entire disturbed area to the satisfaction of OWNER.
C. Restore and replace shrubbery, fencing, or other disturbed surfaces or structures to conditions equal to or better that before the work began and to the satisfaction of OWNER.

\section*{PART 2 - PRODUCTS}

\subsection*{2.1 TOPSOIL}
A. Topsoil shall not contain more than 40 percent clay in that portion passing a No. 10 sieve. Topsoil shall contain between 4 percent and 20 percent organic matter as determined by loss on ignition of samples oven-dried to constant weight at \(212^{\circ} \mathrm{F}\).

\subsection*{2.2 FERTILIZER}
A. Provide a commercial fertilizer consisting of the standard materials of the grade required by Contract and by recommendation of the grower for the season and climate. Fertilizer grade refers to the percentage of total nitrogen, available phosphate, and soluble potash, in accordance with the Oklahoma Department of Agriculture, Food and Forestry. Provide fertilizer in standard, factory-sealed containers, labeled in accordance with the Oklahoma Department of Agriculture, Food and Forestry. Broadcast dry fertilizer in a pellet or other granular form.
1. Fertilizer for Solid Slab Sod shall be composed of a ratio of 17-6-6.
2. Fertilizer for Seeded Areas shall be composed of a ratio 10-20-10.
3. Or as by recommendation of Oklahoma Department of Agriculture, the grower and approved by OWNER.

\subsection*{2.3 SOD and SEED}
A. Sod
1. Provide a dense source of Bermuda grass sod, or other acceptable type as approved by AW, containing a deep-rooted stand of fertile topsoil. Ensure the source for sod is free of weeds classified as "Prohibited Noxious" and legally "Restricted Noxious" plant materials in accordance with Oklahoma Department of Agriculture Seed Law.
2. Sodding consists of the roots (stolon and rhizome) and the visible stem and blades. Ensure grass vegetative parts exist throughout the slab. Provide slabs of dense vegetative growth capable of being transported in its original state. Insure that slabs are a minimum of 16 inches in width.
B. Seed
1. In the growing season, seed all disturbed areas with Bermuda Seed using the seed type "Cynodon Dactylon". In the non-growing months mix the Bermuda (Cynodon Dactylon) with Rye Grass (Gulf) to stabilize area. Other stabilization methods may be required until \(70 \%\) growth has been achieved.

\subsection*{2.4 SOIL EROSION CONTROL BLANKETS}
A. When or if required for use, soil erosion control blankets shall be machine produced mat of wood excelsior formed from a web of interlocking wood fibers, covered on one side with either plastic netting or twisted Kraft paper cord netting. Soil erosion control blankets shall not be installed on flat surfaces and sloped surfaces up to and including 10:1 slopes. Soil erosion control blankets shall be used on surfaces with a slope greater than 10:1 as per the manufacturer's installation guidelines.

\subsection*{2.5 MULCH}
A. Mulch shall be straw, reasonably free of weed seed and foreign materials which may affect plant growth. Other materials may be used if approved by OWNER.

\section*{PART 3 - EXECUTION}

\subsection*{3.1 PREPARATION OF SEED BED}
A. Topsoil Areas
1. Topsoil shall be replaced with adequate amounts of topsoil material to restore the disturbed area to its original pre-disturbance grade and depth of topsoil but not less than 4 inches.
2. Topsoil shall be placed where excavation and backfill operations have left soil unsuitable for sod or seed establishment. Topsoil must be free from weeds, rocks, roots, and other debris. When available, topsoil can be segregated from the excavation and re-used. If the existing area is void of topsoil, then topsoil must be imported. Remove, store, and use suitable topsoil available from the excavated material to backfill the top 4 inches of the excavation. Remove and dispose of all imported granular fill, grass, weeds, roots, sticks, stones, and other debris 1 -inch or greater in diameter. Prepare the topsoil to a smooth surface devoid of pits or bumps in a manner that matches surrounding grades, slopes and drainage by means of hand raking. Ensure slopes will allow proper cut angles for mowing equipment.
3. When there is insufficient topsoil available from the site excavated materials, furnish 4 inches of topsoil to be used as a seed bed as described in, Paragraph Part 3.1.A of this Section.

\section*{B. Non-Topsoil Areas}
1. The trench backfill may be used as a seed bed, where excavated soil may be classified as topsoil, or when approved by AW. After the backfill has been given a reasonable time to settle, bring to finished grade and harrow to a depth of 3 inches. Remove and dispose of all grass, weeds, roots, sticks, stones and other debris 1 inch or greater in diameter. Carefully smooth the topsoil to match surrounding slopes, grades and drainage by hand raking. Ensure slopes will allow proper cut angles for mowing equipment.
C. Hydromulch/Hydroseed
1. In the appropriate growing season Hydroseed disturbed areas with an approved seed mix as recommended by local conditions and meeting regulatory requirements. Fertilization to be determined by installer for best results. Topsoil and maintenance per Part 3 Execution; 3.1 and 3.6.

\subsection*{3.2 FERTILIZING}
A. Apply fertilizer uniformly to all areas to be seeded at the rate of 1 pound per 100 square feet in topsoil and 2 pounds per 100 square feet in non-topsoil. Disk, harrow, or rake the fertilizer thoroughly into the soil to a depth of not less than 2 inches. Immediately before sowing the seed, rework the surface until it is a fine, pulverized, smooth seed bed varying not more than 1 inch in 10 feet.

\subsection*{3.3 SEEDING}
A. Seed immediately after preparation and fertilization of the seed bed. Mix the seed thoroughly and sow it evenly over the prepared areas at the rate of 3 pounds per 1,000 square feet. Sow the seed dry or hydraulically. After sowing, rake or drag the area to cover the seed to a depth of approximately \(1 / 4\) inch. Sod all areas with slopes greater than \(10 \%\).

\subsection*{3.4 SODDING}
A. Sod all areas disturbed by construction activities. At a minimum, sod shall be fibrous, well rooted approved grass type. The grass shall be cut to a height of less than three (3) inches. Edges of sod shall be cleanly cut, either by hand or machine, slab is to a uniform thickness of not less than one (1) inch (plus or minus \(1 / 4\) "), to a uniform width of not less than sixteen (16) inches, and in strips of not less than three (3) feet in length. Sod shall be free from all primary noxious weeds. Keep the sod moist from harvesting at the source until planting.

DO NOT USE SOD THAT IS COMPLETELY DRIED OUT OR HAS LESS THAN 1/2" OF SLAB.
B. Lay sod with tight staggered joints. On slopes, start placement at the foot of the incline. Use wood pegs driven flush to hold sod in place on slopes 4:1 or greater. Use
two wood pegs per strip of sod. Roll the sod lightly after placement. Fill any open joints with topsoil and/or sod. When installed, all sod edges must be slightly excavated and tucked to mitigate any potential trip hazards. Provide rolling equipment of a size and weight capable of firmly compacting the sod into the topsoil and removing air voids. In non- growing months, Rye grass (Gulf) can be used to stabilize Bermuda grass until rooted.
C. Around walkways, driveways, grass, or other existing borders, remove sufficient soil so that the surface of the sod will be level with the existing surfaces and will not pose a tripping hazard.

\subsection*{3.5 MULCHING}
A. Place mulching material evenly over all seeded areas within 48 hours of seeding. Place mulch at the rate of approximately 2 tons per acre, when seeding is performed in recognized growing season and at the approximate rate of 3 tons per acre when seeding is performed in a recognized non-growing season if applicable.

\subsection*{3.6 MAINTENANCE}
A. Carefully maintain, tend, and water all seeded and sodded areas necessary to secure a good, well-established turf, matching adjacent areas. As needed, fill, grade, re-seed or re-sod and maintain all areas where remediation efforts are deficient or otherwise fail. Maintain the condition of seeded and sodded areas until area meets final stabilization requirements per OKR10, Part 9.12.1. and OWNER approval.

\section*{END OF SECTION 329200}```

