REPORT

Unstable Areas Demonstration
\textit{Escalante Station Active Coal Combustion Residuals Landfill}

Submitted to:
\textbf{Tri-State Generation and Transmission Association, Inc.}
1100 West 116th Avenue, Westminster, Colorado 80234

Submitted by:
\textbf{Golder Associates Inc.}
44 Union Boulevard, Suite 300 Lakewood, Colorado 80228

\+1 303 980-0540
1783558

October 10, 2018
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1.0 INTRODUCTION

1.1 Background

Golder Associates Inc. (Golder) has prepared this report for Tri-State Generation and Transmission Association, Inc. (Tri-State) to summarize our assessment of the active coal combustion residuals (CCR) landfill (the Facility) at Tri-State’s Escalante Generating Station (the site) with respect to factors that could cause an area to be considered an unstable area, and to provide supporting information demonstrating that the Facility is not located in an unstable area. This report includes written certification by a qualified professional engineer registered in New Mexico stating that the Facility is not located in an unstable area and is in compliance with 40 CFR 257.64.

1.2 Facility Information

The Facility is located less than a mile east of the power block at Tri-State’s Escalante Generating Station, a 270-megawatt coal-fired electric generation plant located in McKinley County, New Mexico. It serves as the location for final deposition of CCRs generated at Escalante Generating Station and classifies as an existing CCR landfill under 40 CFR 257.

2.0 UNSTABLE AREA ASSESSMENT

2.1 Requirements

An unstable area is defined under 40 CFR 257.53 as follows:

- Unstable area means a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity, including structural components of some or all of the CCR unit that are responsible for preventing releases from such unit. Unstable areas can include poor foundation conditions, areas susceptible to mass movements, and karst terrains.

Under 40 CFR 257.64(b), the following factors, at a minimum, must be considered as part of the assessment to determine whether the Facility is located in an unstable area:

- On-site or local soil conditions that may result in significant differential settling
- On-site or local geologic or geomorphologic features
- On-site or local human-made features or events (both surface and subsurface)

2.2 Review of Available Information

Golder reviewed the following information in the course of completing the unstable area assessment:

- Groundwater monitoring plan for the site (Metric Corporation 1983)
- Engineering design report for the Facility (Metric Corporation 2006)
- Quaternary faults and folds dataset for the United States (United States Geological Survey and New Mexico Bureau of Mines and Mineral Resources 2006)
- Karst dataset for the United States (Weary and Doctor 2014)
- 2015 annual inspection report for the Facility (Golder 2016a)
- Drilling and monitoring well installation summary for the Facility (Golder 2016b)
2016 annual inspection report for the Facility (Golder 2017)
2017 annual inspection report for the Facility (Golder 2018)

In addition to the review of available information, the professional engineer overseeing the unstable area assessment has visited and observed the Facility on several occasions, including the site visits associated with annual inspections conducted for compliance with 40 CFR 257.84(b)(1) in 2015, 2016, and 2017, and has visually assessed the factors that could cause the area within and in close proximity to the Facility to be considered an unstable area.

2.3 Geotechnical and Geologic Information

Near-surface geology at the site is generally characterized by Quaternary alluvium underlain by bedrock of the Triassic Chinle Formation, Petrified Forest Member. Within the Chinle Formation is the Correo sandstone bed, which is confined on the top and bottom by Chinle claystone, upper part.

The surficial Quaternary alluvium generally ranges from approximately 10 to 25 feet thick near the Facility, and the Chinle claystone overlying the Correo sandstone bed ranges from approximately 100 to 200 feet thick in the area (Golder 2016b). The Correo sandstone bed is approximately 50 feet thick beneath the Facility, and the Chinle claystone underlying the Correo sandstone bed is several hundred feet thick (Golder 2016b).

Quaternary alluvium in the vicinity of the Facility consists primarily of clayey sand, silty sand, or sandy clay (Golder 2016c). For purposes of accumulating soil resources for Facility construction and closure, Tri-State has excavated the surficial soils to a nominal depth of 5 feet and stockpiled the excavated material before expanding the Facility footprint into a given area.

2.4 Findings

Golder’s review of available information and knowledge of the Facility indicate the following with respect to factors that could cause an area to be considered an unstable area:

- On-site or local soil conditions that may result in significant differential settling

  - The thickness of unconsolidated material (Quaternary alluvium) at the site prior to construction of the Facility is limited, generally ranging from 10 to 25 feet (Golder 2016b). Further reducing the thickness of unconsolidated material beneath the Facility, Tri-State has excavated the surficial soils to a nominal depth of 5 feet before constructing or expanding the Facility footprint into a given area.

  - Quaternary alluvium found at the site consists primarily of soils characterized as clayey sand, silty sand, or sandy clay (Golder 2016c). These soil types are not commonly prone to high compressibility.

  - No evidence of differential settlement has been observed at the Facility during annual inspections by a qualified professional engineer (Golder 2016a, Golder 2017, Golder 2018).

  - Given the limited thickness of unconsolidated material beneath the Facility, the characteristics of the unconsolidated material (i.e., not commonly prone to high compressibility), and site observations, Golder concludes that there are not on-site or local soil conditions that may result in significant differential settling.
On-site or local geologic or geomorphologic features

- The Facility is not located in an area with geological conditions that create the potential for karst terrain or features, as shown in Figure 1.
- The Facility is not located in an area with known faults or folds that demonstrate geological evidence of coseismic surface deformation during the Quaternary Period, as shown in Figure 1.
- Site topography is gentle, sloping at an average grade of 1 percent from west to east in the vicinity of the Facility. The Facility is higher in elevation than the surrounding topography around its east, south, and west sides. Along its north side, it abuts an inactive CCR landfill that shows no evidence of mass movement. As such, the Facility is not susceptible to instability related to mass movement (e.g., landslides, avalanches, debris flows, solifluction, block sliding, or rock fall) from adjacent areas.
- No evidence of faulting, rock fall, landslides, or local soil conditions that are conducive to downslope movement of soil, rock, or debris have been observed at the Facility during annual inspections by a qualified professional engineer (Golder 2016a, Golder 2017, Golder 2018).

On-site or local human-made features or events (both surface and subsurface)

- There are no known historical mine workings at the site. Geotechnical investigations at the site have not identified coal seams or other subsurface resources that may have motivated mining at the site.
- Slope stability analyses for the Facility indicate a factor of safety equal to 1.7 for static conditions and a factor of safety equal to 1.1 under design seismic loading. The slope stability analyses for the Facility are summarized in Appendix A.
- No human-made features having the potential to create unstable conditions have been observed at the Facility during annual inspections by a qualified professional engineer (Golder 2016a, Golder 2017, Golder 2018).

3.0 CONCLUSION

Based upon the assessment described in this report, the undersigned professional engineer registered in New Mexico certifies that the active CCR landfill at Escalante Generating Station is not located in an unstable area and is in compliance with 40 CFR 257.64.
4.0 REFERENCES


Signature Page

Golder Associates Inc.

Jason Obermeyer, P.E.
Associate and Senior Consultant

Todd Stong, P.E.
Associate and Senior Consultant

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https://golderassociates.sharepoint.com/sites/15537/g/deliverables/reports/escalante_unstable_areas_demolvision_fri_10oct18\1783558-0008-2-c-o-escalante_cdr_unstable_areas_demolvision_10oct18.docx
REFERENCES


APPENDIX A

Global Slope Stability Calculations
GLOBAL SLOPE STABILITY ANALYSIS

1.0 OBJECTIVE

Evaluate the global slope stability of the active coal combustion residuals (CCR) landfill at the Escalante Generating Station (the landfill) at final closure. The analysis assesses the stability of the landfill using grades shown in the Closure Plan (Golder 2016).

2.0 METHODOLOGY

A typical cross section at the landfill’s full design height (final closure grades) was developed for global slope stability analysis. Limit equilibrium slope stability analyses were performed using Spencer’s method in Slide 8.0, a two-dimensional slope stability modeling software platform (Rocscience 2018). Spencer’s method considers both moment and force equilibrium. It is common geotechnical practice to analyze the stability of embankment slopes using limit equilibrium methods.

The slope stability analyses focus on circular slip surfaces that pass into the CCRs contained in the landfill (minimum depth of 4 feet). Slope stability analyses were performed to evaluate the minimum factors of safety under static and seismic loading conditions.

2.1 Geometry

The cross section was taken through the longest existing embankment slope, which is also expected to be the longest embankment slope at final closure. A plan view showing the cross section location is included as Figure A-1.

2.2 Analysis

The slope stability analyses were predicated on the following assumptions:

- Factors of safety were computed using Spencer’s method (Spencer 1967).
- The seismic hazard analysis reported by the United States Geological Survey (2014) indicates a 2% probability of exceeding a peak ground acceleration (PGA) of 0.10 g in 50 years at the site (see Attachment A-1). Pseudo-static analyses were conducted using a horizontal seismic coefficient of 0.05, corresponding to half of the PGA, in accordance with the recommendations of Hynes-Griffin and Franklin (1984).
- Strength properties for cover soil and foundation soil (i.e., site soil) were selected based on the results of consolidated-undrained triaxial testing performed on soil sampled from a stockpile that serves as a borrow source for final cover system construction (refer to Attachment A-2).
GLOBAL SLOPE STABILITY ANALYSIS

- Site soil was assumed to exhibit drained strengths under static loading and undrained strengths under seismic loading. A 20% reduction was applied to site soil undrained strengths in the seismic analyses, as recommended by Hynes-Griffin and Franklin (1984).

- Site soil density was selected based on the average initial density in the consolidated-undrained triaxial test.

- The bedrock underlying the CCRs was assumed to have infinite strength, constraining slip surfaces to the cover soil, CCRs, and foundation soil.

- The top of the bedrock layer was assumed to be at a depth of 30 feet below the pre-landfill ground surface, based on findings from subsurface investigations conducted in the vicinity of the landfill. The floor grades for the landfill were assumed to involve excavation to a depth of 5 feet below the pre-landfill ground surface, based on Golder’s understanding and observation of typical construction practices for the landfill.

- Strength properties for CCRs were selected based on the results of consolidated-undrained triaxial testing performed on comingled ash sampled from the landfill (refer to Attachment A-3). CCRs were assumed to exhibit drained strengths under static and seismic loading conditions, and no strength reduction was applied for seismic analyses.

- Density of CCRs was selected based on the average initial density in the consolidated-undrained triaxial test.

- CCRs were assumed to be unsaturated based on site observation.

2.3 Material Properties

A summary of material properties used in the slope stability analyses is presented in Table A-1:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Material</th>
<th>Total Unit Weight (pcf)</th>
<th>Strength Type</th>
<th>Friction Angle (°)</th>
<th>Cohesion (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Static Loading</td>
<td>Bedrock</td>
<td>120</td>
<td>Infinite Strength</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Seismic Loading</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static Loading</td>
<td>CCRs</td>
<td>94</td>
<td>Mohr-Coulomb</td>
<td>32</td>
<td>0</td>
</tr>
<tr>
<td>Seismic Loading</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static Loading</td>
<td>Site Soil (Cover Soil and Foundation Soil)</td>
<td>115</td>
<td>Mohr-Coulomb</td>
<td>30</td>
<td>0</td>
</tr>
<tr>
<td>Seismic Loading</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:
1) The shear-normal function defining the undrained strength of site soil is based on the results of consolidated-undrained triaxial testing, with a 20% reduction for cyclic loading, as follows: shear strength of 80 psf under zero initial effective stress; shear strength of 179 psf under 864-psf initial effective stress; shear strength of 256 psf under 1,440-psf initial effective stress; shear strength of 2,213 psf under 7,200-psf initial effective stress.
3.0 RESULTS AND CONCLUSIONS

Results of the slope stability analyses are as follows:

- Minimum computed factor of safety = 1.7 under static loading
- Minimum computed factor of safety = 1.1 under seismic loading

The results are also illustrated graphically on the figures in Attachment A-4. The figures depict the critical slip surfaces and computed minimum factors of safety for the analyzed scenarios.

Based on the factors of safety computed using the methods and assumptions described herein, the landfill is expected to remain stable with an acceptable safety margin. A factor of safety greater than 1.5 was computed for critical slip surfaces passing into the CCRs under static loading. A factor of safety greater than 1.0 was computed for critical slip surfaces passing into the CCRs under seismic loading.

4.0 REFERENCES


FIGURE
ATTACHMENT A-1
TWO PERCENT PROBABILITY OF EXCEEDANCE IN 50 YEARS
MAP OF PEAK GROUND ACCELERATION

CLIENT
TRI-STATE GENERATION AND TRANSMISSION
ASSOCIATION, INC.

PROJECT
ESCALANTE GENERATING STATION
ACTIVE COAL COMBUSTION RESIDUALS LANDFILL

TITLE
TWO PERCENT PROBABILITY OF EXCEEDANCE IN 50 YEARS
MAP OF PEAK GROUND ACCELERATION

CONSULTANT
GOLDER

PREPARED
JEO

DESIGN
JEO

REVIEW
CCS

APPROVED
TJS

YYYY-MM-DD
2018-06-14

PROJECT No.
1783558

ATTACHMENT
A-1
<table>
<thead>
<tr>
<th>Sample</th>
<th>Site Soil</th>
<th>Site Soil</th>
<th>Site Soil</th>
</tr>
</thead>
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<tr>
<td>Depth</td>
<td>1 ft</td>
<td>1 ft</td>
<td>1 ft</td>
</tr>
<tr>
<td>Point No.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Initial</th>
<th>Initial</th>
<th>Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>5.737 in</td>
<td>5.769 in</td>
</tr>
<tr>
<td>Diameter</td>
<td>2.859 in</td>
<td>2.872 in</td>
</tr>
<tr>
<td>Wet Mass</td>
<td>2.480 lb</td>
<td>2.480 lb</td>
</tr>
<tr>
<td>Area</td>
<td>6.420 in²</td>
<td>6.478 in²</td>
</tr>
<tr>
<td>Volume</td>
<td>36.830 in³</td>
<td>37.373 in³</td>
</tr>
</tbody>
</table>

Specific Gravity = 2.68 (ASTM D854)

Dry Mass of Solids = 2.371 lb
Moisture Content = 4.6%
Wet Unit Weight = 116.4 pcf
Dry Unit Weight = 111.2 pcf
Void Ratio = 0.50
Percent Saturation = 25%

<table>
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<tr>
<th>After Consolidation</th>
<th>After Consolidation</th>
<th>After Consolidation</th>
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</thead>
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<td>Length</td>
<td>5.786 in</td>
<td>5.674 in</td>
</tr>
<tr>
<td>Diameter</td>
<td>2.854 in</td>
<td>2.881 in</td>
</tr>
<tr>
<td>Area</td>
<td>6.399 in² (Method B)</td>
<td>6.519 in² (Method B)</td>
</tr>
<tr>
<td>Volume</td>
<td>37.027 in³</td>
<td>36.990 in³</td>
</tr>
</tbody>
</table>

Moisture Content = 19.0%
Wet Unit Weight = 131.7 pcf
Dry Unit Weight = 110.7 pcf
Void Ratio = 0.51
Percent Saturation = 100%

B Parameter = 0.95
Shear Rate = 0.084% /min.
\( t_{50} \) = (not computed)
Strain at Failure = 8.6%
Cell Pressure = 106 psi
Back Pressure = 100 psi
Confining Pressure = 6 psi

Notes:
- USCS description (ASTM D 2487): Clayey sand, dry, red
- Atterberg limits: LL = 22, PL = 13, PI = 9
- Percent finer:
  - 3/4 in. = 100%
  - No. 4 = 99%
  - No. 200 = 41%
- Specimen type: Intact X Reconstituted X Remold
- Moisture from: Cuttings X Entire specimen
- Saturation method: X Wet X Dry
- Failure criterion: \( (\sigma'_f/\sigma'_c)_{max} \) = % strain
- Membrane effect: X Corrected

Golder Associates Inc.
Denver, Colorado

Title: ASTM D4767
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT
SAMPLE AND TEST DATA

Job Short Title: Tri-State/escalante Station/CO
Sample: Site Soil
Technician: BC
Reviewed: JO
Date: 1/21/2016
Job Number: 1533418CCR
Figure: 1
CONSORTIUM UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

Golder Associates Inc.
Denver, Colorado

Job Short Title: Tri-State/Escalante Station/CO
Sample: Site Soil

Title: ASTM D4767
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT
q AND EXCESS PORE PRESSURE PLOTS

Technician: BC
Reviewed: JO
Date: 1/21/2016
Job Number: 1533418CCR
Figure: 2
Stress Path (p' - q) Plot

<table>
<thead>
<tr>
<th>Confining Pressure (psi)</th>
<th>p at failure (psi)</th>
<th>p' at failure (psi)</th>
<th>q at failure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>7.6</td>
<td>5.3</td>
<td>1.6</td>
</tr>
<tr>
<td>10</td>
<td>12.2</td>
<td>9.0</td>
<td>2.2</td>
</tr>
<tr>
<td>50</td>
<td>69.2</td>
<td>35.9</td>
<td>19.2</td>
</tr>
</tbody>
</table>
## Mohr's Circle Diagram

![Mohr's Circle Diagram](image)

<table>
<thead>
<tr>
<th>Confining Pressure (psi)</th>
<th>( \sigma'_1 ) at failure (psi)</th>
<th>( \sigma'_3 ) at failure (psi)</th>
<th>( \sigma_1 ) at failure (psi)</th>
<th>( \sigma_3 ) at failure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>6.9</td>
<td>3.7</td>
<td>9.1</td>
<td>6.0</td>
</tr>
<tr>
<td>10</td>
<td>11.2</td>
<td>6.8</td>
<td>14.4</td>
<td>10.0</td>
</tr>
<tr>
<td>50</td>
<td>55.1</td>
<td>16.7</td>
<td>88.4</td>
<td>50.0</td>
</tr>
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</table>

---

**Golder Associates Inc.**  
**Denver, Colorado**

**Job Short Title:**  
Tri-State/Escalante Station/CO

**Sample:**  
Site Soil

**Title:**  
ASTM D4767  
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT  
MOHR'S CIRCLE DIAGRAM

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<th>Date</th>
<th>Job Number</th>
<th>Figure</th>
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<tr>
<td>BC</td>
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Golder Associates Inc.
Denver, Colorado

Title: ASTM D4767
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT
SPECIMEN PHOTOGRAPH - 10 psi

Job Short Title: Tri-State/Escalante Station/CO
Sample: Site Soil

Technician: BC
Reviewed: JO
Date: 1/21/2016
Job Number: 1533418CCR
Figure: 6
Golder Associates Inc.  
Denver, Colorado

Title:  
ASTM D4767  
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT  
SPECIMEN PHOTOGRAPH - 50 psi

Sample:  
Site Soil

Job Short Title:  
Tri-State/Escalante Station/CO

Technician:  
BC

Reviewed:  
JO

Date:  
1/21/2016

Job Number:  
1533418CCR

Figure:  
7
<table>
<thead>
<tr>
<th>Boring or Test Pit:</th>
<th>--</th>
<th>Boring or Test Pit:</th>
<th>--</th>
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<tbody>
<tr>
<td>Sample: LF Ash</td>
<td></td>
<td>Sample: LF Ash</td>
<td></td>
<td>Sample: LF Ash</td>
<td></td>
</tr>
<tr>
<td>Depth: 3 ft</td>
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<td>Depth: 3 ft</td>
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<tr>
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<td></td>
<td>Point No.: 2</td>
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</table>

<table>
<thead>
<tr>
<th>Initial</th>
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<th>Initial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length  = 5.705 in</td>
<td>Length  = 5.737 in</td>
<td>Length  = 5.713 in</td>
</tr>
<tr>
<td>Diameter = 2.879 in</td>
<td>Diameter = 2.877 in</td>
<td>Diameter = 2.876 in</td>
</tr>
<tr>
<td>Wet Mass = 2.016 lb</td>
<td>Wet Mass = 2.024 lb</td>
<td>Wet Mass = 2.019 lb</td>
</tr>
<tr>
<td>Area = 6.510 in²</td>
<td>Area = 6.501 in²</td>
<td>Area = 6.496 in²</td>
</tr>
<tr>
<td>Volume = 37.139 in³</td>
<td>Volume = 37.295 in³</td>
<td>Volume = 37.113 in³</td>
</tr>
<tr>
<td>Specific Gravity = 2.28 (ASTM D854)</td>
<td>Specific Gravity = 2.28 (ASTM D854)</td>
<td>Specific Gravity = 2.28 (ASTM D854)</td>
</tr>
<tr>
<td>Dry Mass of Solids = 1.676 lb</td>
<td>Dry Mass of Solids = 1.699 lb</td>
<td>Dry Mass of Solids = 1.691 lb</td>
</tr>
<tr>
<td>Moisture Content = 20.3%</td>
<td>Moisture Content = 19.1%</td>
<td>Moisture Content = 19.4%</td>
</tr>
<tr>
<td>Wet Unit Weight = 93.8 pcf</td>
<td>Wet Unit Weight = 93.8 pcf</td>
<td>Wet Unit Weight = 94.0 pcf</td>
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<tr>
<td>Dry Unit Weight = 78.0 pcf</td>
<td>Dry Unit Weight = 78.7 pcf</td>
<td>Dry Unit Weight = 78.7 pcf</td>
</tr>
<tr>
<td>Void Ratio = 0.82</td>
<td>Void Ratio = 0.80</td>
<td>Void Ratio = 0.80</td>
</tr>
<tr>
<td>Percent Saturation = 56%</td>
<td>Percent Saturation = 54%</td>
<td>Percent Saturation = 55%</td>
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<table>
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<tr>
<th>After Consolidation</th>
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</tr>
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<tbody>
<tr>
<td>Length  = 5.670 in</td>
<td>Length  = 5.669 in</td>
<td>Length  = 5.636 in</td>
</tr>
<tr>
<td>Diameter = 2.828 in</td>
<td>Diameter = 2.792 in</td>
<td>Diameter = 2.789 in</td>
</tr>
<tr>
<td>Area = 6.283 in² (Method B)</td>
<td>Area = 6.123 in² (Method B)</td>
<td>Area = 6.111 in² (Method B)</td>
</tr>
<tr>
<td>Volume = 35.627 in³</td>
<td>Volume = 34.712 in³</td>
<td>Volume = 34.441 in³</td>
</tr>
<tr>
<td>Moisture Content = 32.8%</td>
<td>Moisture Content = 29.8%</td>
<td>Moisture Content = 29.6%</td>
</tr>
<tr>
<td>Wet Unit Weight = 108.0 pcf</td>
<td>Wet Unit Weight = 109.8 pcf</td>
<td>Wet Unit Weight = 109.9 pcf</td>
</tr>
<tr>
<td>Dry Unit Weight = 81.3 pcf</td>
<td>Dry Unit Weight = 84.6 pcf</td>
<td>Dry Unit Weight = 84.8 pcf</td>
</tr>
<tr>
<td>Void Ratio = 0.75</td>
<td>Void Ratio = 0.68</td>
<td>Void Ratio = 0.67</td>
</tr>
<tr>
<td>Percent Saturation = 100%</td>
<td>Percent Saturation = 100%</td>
<td>Percent Saturation = 100%</td>
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<table>
<thead>
<tr>
<th>After Consolidation</th>
<th>After Consolidation</th>
<th>After Consolidation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B Parameter = 0.96</td>
<td>B Parameter = 0.96</td>
<td>B Parameter = 0.97</td>
</tr>
<tr>
<td>Shear Rate = 0.033% /min.</td>
<td>Shear Rate = 0.033% /min.</td>
<td>Shear Rate = 0.034% /min.</td>
</tr>
<tr>
<td>tₕₙ = -- (not computed)</td>
<td>tₕₙ = -- (not computed)</td>
<td>tₕₙ = -- (not computed)</td>
</tr>
<tr>
<td>Strain at Failure = 1.1%</td>
<td>Strain at Failure = 3.1%</td>
<td>Strain at Failure = 7.6%</td>
</tr>
<tr>
<td>Cell Pressure = 125 psi</td>
<td>Cell Pressure = 150 psi</td>
<td>Cell Pressure = 199 psi</td>
</tr>
<tr>
<td>Back Pressure = 100 psi</td>
<td>Back Pressure = 100 psi</td>
<td>Back Pressure = 100 psi</td>
</tr>
<tr>
<td>Confining Pressure = 25 psi</td>
<td>Confining Pressure = 50 psi</td>
<td>Confining Pressure = 99 psi</td>
</tr>
</tbody>
</table>

Notes:
- USCS description (ASTM D2487): Silt with sand, gray, moist
- Atterberg limits: LL = NP, PL = NP, PI = NP (ASTM D4318)
- Percent finer: 3/4 in. = 100%, No. 4 = 100%, No. 200 = 70% (ASTM D422, refer to separate report for gradation curve)
- Specimen type: X Intact Reconstituted Remold targets: 78.4 pcf (dry) at 20.0% moisture
- Moisture from: X Cuttings X Entire specimen
- Saturation method: X Wet Dry
- Failure criterion: (σ’₁/σ’₃)ₘₙ X (σ’₁-σ’₃)ₘₙ % strain
- Membrane effect: X Corrected Not Corrected

---

Golder Associates Inc.

Job Short Title: Tri-State/Escalante Station/CO

Sample: LF Ash

Title: ASTM D4767

CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT

SAMPLE AND TEST DATA

Technician: BC
Reviewed: JO
Date: 12/22/2015
Job Number: 1533418CCR
Figure: 1
<table>
<thead>
<tr>
<th>Confining Pressure</th>
<th>p at failure (psi)</th>
<th>p' at failure (psi)</th>
<th>q at failure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 psi</td>
<td>37.9</td>
<td>27.6</td>
<td>12.9</td>
</tr>
<tr>
<td>50 psi</td>
<td>83.2</td>
<td>62.4</td>
<td>33.2</td>
</tr>
<tr>
<td>99 psi</td>
<td>170.1</td>
<td>131.3</td>
<td>71.1</td>
</tr>
</tbody>
</table>
Mohr's Circle Diagram

<table>
<thead>
<tr>
<th>Confining Pressure (psi)</th>
<th>$\sigma'_1$ at failure (psi)</th>
<th>$\sigma'_3$ at failure (psi)</th>
<th>$\sigma_1$ at failure (psi)</th>
<th>$\sigma_3$ at failure (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>40.4</td>
<td>14.7</td>
<td>50.7</td>
<td>25.0</td>
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<tr>
<td>50</td>
<td>95.6</td>
<td>29.3</td>
<td>116.3</td>
<td>50.0</td>
</tr>
<tr>
<td>99</td>
<td>202.4</td>
<td>60.3</td>
<td>241.2</td>
<td>99.0</td>
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</tbody>
</table>
Golder Associates Inc.

Title: ASTM D4767
CONSOLIDATED UNDRAINED TRIAXIAL COMPRESSION TEST REPORT
SPECIMEN PHOTOGRAPH - 25 psi

Job Short Title: Tri-State/Escalante Station/CO
Sample: LF Ash

Technician: BC
Reviewed: JO
Date: 12/22/2015
Job Number: 1533418CCR
Figure: 5
ASTM D4767
CONSOLIDATED UNDRained TRIAXIAL COMPRESSION TEST REPORT

SPEcimen PHOTOGRAPh - 99 psi
<table>
<thead>
<tr>
<th>Material Name</th>
<th>Color</th>
<th>Unit Weight (lbs/ft³)</th>
<th>Strength Type</th>
<th>Cohesion (psf)</th>
<th>Phi (deg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCRs</td>
<td></td>
<td>94</td>
<td>Mohr-Coulomb</td>
<td>0</td>
<td>32</td>
</tr>
<tr>
<td>Cover Soil</td>
<td></td>
<td>115</td>
<td>Mohr-Coulomb</td>
<td>0</td>
<td>30</td>
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<tr>
<td>Foundation Soil</td>
<td></td>
<td>115</td>
<td>Mohr-Coulomb</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>Bedrock</td>
<td></td>
<td>120</td>
<td>Infinite strength</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Analysis Description**

- **Static Loading**

**Company**
- Golder Associates Inc.

**Drawn By**
- Jason Obermeyer

**Date**
- 9/14/2018, 8:35:18 AM

**File Name**
- Static.slim
<table>
<thead>
<tr>
<th>Material Name</th>
<th>Color</th>
<th>Unit Weight (lbs/ft³)</th>
<th>Strength Type</th>
<th>Cohesion (psf)</th>
<th>Phi (deg)</th>
<th>Shear Normal Function</th>
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</thead>
<tbody>
<tr>
<td>CCRs</td>
<td>orange</td>
<td>94</td>
<td>Mohr-Coulomb</td>
<td>0</td>
<td>32</td>
<td></td>
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<tr>
<td>Cover Soil</td>
<td>yellow</td>
<td>115</td>
<td>Shear Normal function</td>
<td></td>
<td></td>
<td>Site Soil</td>
</tr>
<tr>
<td>Foundation Soil</td>
<td>purple</td>
<td>115</td>
<td>Shear Normal function</td>
<td></td>
<td></td>
<td>Site Soil</td>
</tr>
<tr>
<td>Bedrock</td>
<td>green</td>
<td>120</td>
<td>Infinite strength</td>
<td></td>
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</tr>
</tbody>
</table>

**Analysis Description**
Seismic Loading

**Project**
Escalante Generating Station
Active Coal Combustion Residuals Landfill

**Drawn By**
Jason Obermeyer

**Company**
Golder Associates Inc.

**Date**
9/14/2018, 8:35:18 AM

**File Name**
Pseudostatic2.slim