LOCATION RESTRICTIONS CERTIFICATION REPORT
FOR EXISTING COMBUSTION BYPRODUCT LANDFILL
REGISTRATION NO. 31575

LCRA FAYETTE POWER PROJECT
FAYETTE COUNTY, TEXAS

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June 2017
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1. INTRODUCTION

1.1 Purpose

This report presents an evaluation of the Combustion Byproduct Landfill (CBL) at LCRA’s Fayette Power Project (FPP) with respect to compliance with the United States Environmental Protection Agency’s (USEPA’s) location restrictions regulations for existing coal combustion residuals (CCR) landfills. Of the location restrictions listed in 40 CFR §257.60 to §257.64, the only one applicable to existing CCR landfills is the one related to unstable areas (40 CFR §257.64). The report was prepared by Geosyntec Consultants (Geosyntec) under the direction of Dr. Beth A. Gross, P.E., a qualified professional engineer.

1.2 Background

The FPP is a coal-fired power plant located east of La Grange in Fayette County, Texas. CCR generated at the facility are disposed in the CBL, a CCR landfill located south of the power plant and north of the railroad that borders the FPP site (Drawing 1). The existing CBL consists of Cell 1 and Subcell 2D (Drawing 2). At final buildout, the CBL may consist of up to three cells, Cells 1 to 3 (Drawing 2); however, future development phases may not be needed and are not addressed herein.

Cell 1 was constructed in 1988 with a recompacted clay liner installed over natural clay subgrade. The northern slope of Cell 1 was closed with a final cover system in 1992 (Drawing 2). From October 2014 to May 2015, Subcell 2D was constructed with a 3-foot thick compacted clay liner. A final cover grading plan for Cell 1 and Subcell 2D is shown in Drawing 3.

1.3 Organization of Report

The remainder of this report is organized as follows:

- Section 2 presents an evaluation of the CBL with respect to the unstable area location restriction (40 CFR §257.64);

- Section 3 presents a certification by a qualified professional engineer that this Location Restrictions Certification Report for the existing CBL meets the requirements of 40 CFR §257.64; and

- Section 4 provides a list of references cited in the report.
2. UNSTABLE AREAS

2.1 Location Restriction

In accordance with 40 CFR §257.64, an existing CCR landfill or the lateral expansion of a CCR landfill must not be located in an unstable area unless it is demonstrated that recognized and generally accepted good engineering practices have been incorporated into the design of the landfill to ensure that the integrity of the structural components of the landfill will not be disrupted. To assess whether an area is unstable, the following factors must be considered:

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

“Unstable area” is defined in 40 CFR §257.53 as “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.” “Structural components” refers to “liners, leachate collection and removal systems, final covers, run-on and run-off systems, inflow design flood control systems, and any other component used in the construction and operation of the CCR unit that is necessary to ensure the integrity of the unit and that the contents of the unit are not released into the environment.”

2.2 Unstable Areas Information

2.2.1 Geotechnical Investigations

Geotechnical investigations were conducted at the CBL site by McClelland Engineers, Inc. (1983), Brytest, Inc. (1984), Jones and Neuse, Inc. (1992), and Geosyntec [2011]. The investigations included logging soil borings, conducting standard penetration tests, and collecting soil samples for geotechnical laboratory testing. Based on the results of the geotechnical investigations, soils within the upper 100 feet of the subsurface are predominantly classified as clay (CL or CH) and clayey sand (SC and SM) in accordance with the Unified Soil Classification System (USCS). Natural water contents of clays were generally near the plastic limits, and consequently the clays are characterized as stiff to hard. Sands were generally characterized as medium to very dense.

Based on the low compressibility of the site soils, these soils will provide a good foundation for liner system construction and will be able to support the load of the CBL without significant differential settlement.
2.2.2 Slope Stability

The slope stability of the existing CBL at final grade and the associated perimeter berm were evaluated. The critical cross sections for slope stability analyses were found to occur where the landfill or the berm was the tallest. For the existing CBL, the critical cross is located along the south slope of the landfill. For the perimeter berm, it is located along the north side of the landfill. The locations of the critical cross sections are shown in Appendix A. The materials in the existing CBL were conceptualized as CCR on a clay liner or clay subgrade and abutted by a clay perimeter berm. The near surface soils and perimeter berm material are predominantly classified as high plasticity clays (CH).

For long-term (drained) slope stability analyses of soil slopes in high plasticity clays, analyses using fully-softened strength parameters are recommended (e.g., Skempton, 1970; Wright, 2005). The fully-softened strength parameters of the subgrade, liner system, and perimeter berm soils were estimated based on the site-specific geotechnical data in the vicinity of Cell 1 and Subcell 2D and, as applicable, the correlations presented in Wright (2005). The slope stability of the existing CBL was also evaluated considering the development of residual strengths in the clay. Residual strengths (representing the lower-bound shear strength envelope for a soil experiencing large strains) generally develop under conditions which is unlikely to occur at the existing CBL, but were considered in this analysis as an added measure of safety. The residual strength parameters were also estimated using the correlations presented in Wright (2005). The shear strength of the CCR was estimated based on the results of consolidated undrained triaxial compression tests conducted on CCR from FPP and on published data (e.g., Kim et al., 2005). The geotechnical properties used in the slope stability evaluation are summarized in Table 1.

<table>
<thead>
<tr>
<th>Material</th>
<th>Unit Weight (lbs/ft³)</th>
<th>Fully-Softened Effective-Stress Friction Angle (°)</th>
<th>Residual Effective-Stress Friction Angle (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay Liner/Subgrade</td>
<td>105</td>
<td>20</td>
<td>13</td>
</tr>
<tr>
<td>CCR</td>
<td>105</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Perimeter Berm</td>
<td>120</td>
<td>24</td>
<td>16</td>
</tr>
</tbody>
</table>

The slope stability of Section A was analyzed using a method of slices coded in the computer program SLIDE®, Version 6.029 [Rocscience, 2014]. SLIDE® is a two-dimensional slope stability program that can be used to evaluate the factor of safety of circular and non-circular (block-type) slip surfaces using the simplified Bishop method (1955). The simplified Bishop procedure satisfies moment equilibrium conditions, which is suitable for circular slip surfaces.
Three slope stability scenarios were considered: (i) potential circular slip surfaces through the CCR at the south landfill slope; (ii) potential circular slip surfaces through the CCR and into the underlying clay liner/subgrade at the south landfill slope; and (iii) potential circular slip surfaces through the CCR and perimeter berm and into the underlying subgrade clay on the north landfill slope. The results of SLIDE analysis for each of the critical cross-sections are summarized in Table 2 and in Appendix A. Table 2 also lists the minimum slope stability factor of safety recommended by the Texas Commission on Environmental Quality (TCEQ) for a Class 2 nonhazardous industrial waste landfill like the CBL (TCEQ, 2015).

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Fully-Softened Strength</th>
<th>Residual Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circular Slip Surface Through CCR</td>
<td>1.77</td>
<td>1.77</td>
</tr>
<tr>
<td>Circular Slip Surface Into Subgrade Clay</td>
<td>1.56</td>
<td>1.17</td>
</tr>
<tr>
<td>Circular Slip Surface Through CCR and North Perimeter Berm</td>
<td>1.65</td>
<td>1.09</td>
</tr>
</tbody>
</table>

For the conditions analyzed, the critical slip surface using fully-softened strengths is a circular surface passing through the CCR material and into the subgrade clay at the south side of the landfill. The calculated slope stability factor of safety for this scenario is 1.56 using fully-softened strengths. The critical slip surface using residual strengths is a circular surface passing through the CCR material and the north perimeter berm. The calculated slope stability factor of safety for this scenario is 1.09 using residual strengths. All of the calculated factor of safety values exceed the TCEQ guidelines of 1.3 using fully-softened strengths and 1.0 using residual strengths.

2.2.3 Local Geologic Features

There are no known local geologic features that would classify the CBL site as an unstable area. Such features include active faults, seismic events, landslides, debris slides, karst terrain, and erosion by rivers. Further, the CBL is not located within the 500-year floodplain (FEMA FIRM 48149C0270C, October 2006).

2.2.4 Local Manmade Features or Events

There are no known local manmade features or events that would classify the CBL site as an unstable area. Such features and events include mining, cut and fill activities during construction, excessive drawdown of groundwater, and construction over fill.
2.3 **Compliance Assessment**

Based on the information provided in this section, the CBL is not situated in an unstable area and is therefore in compliance with the requirements of the location restriction for unstable areas.
3. PROFESSIONAL ENGINEER CERTIFICATION

Based on the demonstrations and evaluations presented in this Location Restrictions Certification Report for the existing Combustion Byproduct Landfill at LCRA’s Fayette Power Project, it is my professional opinion that the report meets the requirements of 40 CFR §257.64.

Beth Ann Gross, Ph.D., P.E., D.GE

6/2/2017

Date
4. REFERENCES


DRAWINGS
NOTES:
1. THE EXISTING CONTOUR BASE MAP SHOWN ON THIS DRAWING WAS COMPILED USING AN AERIAL SURVEY BASED ON PHOTOGRAPHY PERFORMED ON 29 SEPTEMBER 2014 BY SURDEX CORPORATION AND LIDAR DATA PUBLISHED DECEMBER 2008 AND PROVIDED BY LCRA SURVEYING, MAPPING, AND GIS.
2. ELEVATIONS AND IN FEET (FT) AS DEFINED BY THE NORTH AMERICAN VERTICAL DATUM (NV) OF THE STATE PLANE COORDINATE SYSTEM, TEXAS CENTRAL ZONE (T2S), NORTH AMERICAN DATUM 1983 (NAD-83).
3. THE STORMWATER MANAGEMENT SYSTEM SHOWN FOR THE CBL IS GENERALIZED AND NEEDS TO BE DESIGNED PRIOR TO CBL CLOSURE.
APPENDIX A

Slope Stability Analyses Results
Approximate Location of Critical Cross Section on Final Cover Grading Plan.
Approximate Location of Critical Cross Section on Base Grading Plan (Base Grades are from Drawing SK-00G-032, prepared by Black & Veatch in 1984)
### Circular Slip Surface Into Subgrade Clay (Fully-Softened Shear Strengths)

<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>Water Surface Ru</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCR</td>
<td></td>
<td>105</td>
<td>Mohr-Coulomb</td>
<td>0</td>
<td>30</td>
<td>None</td>
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<tr>
<td>Subgrade Clay</td>
<td></td>
<td>105</td>
<td>Mohr-Coulomb</td>
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### Circular Slip Surface Through CCR Material (Fully-Softened Shear Strengths)

<table>
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<th>Strength Type</th>
<th>Cohesion (psf)</th>
<th>Phi (deg)</th>
<th>Water Surface Ru</th>
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<tbody>
<tr>
<td>CCR</td>
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<td>105</td>
<td>Mohr-Coulomb</td>
<td>0</td>
<td>30</td>
<td>None</td>
</tr>
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<td>Subgrade Clay</td>
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Circular Slip Surface Through CCR Material and North Perimeter Berm (Fully-Softened Shear Strengths)

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<td>605</td>
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<td>Perimeter Berm</td>
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<td>Mohr-Coulomb</td>
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Safety Factor

- 0.000
- 0.500
- 1.000
- 1.500
- 2.000
- 2.500
- 3.000
- 3.500
- 4.000
- 4.500
- 5.000
- 5.500
- 6.000+

Circular Slip Surface Into Subgrade Clay (Residual Shear Strengths)

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<th>Unit Weight (lbs/ft³)</th>
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Safety Factor

- 0.000
- 0.500
- 1.000
- 1.500
- 2.000
- 2.500
- 3.000
- 3.500
- 4.000
- 4.500
- 5.000
- 5.500
- 6.000+
Circular Slip Surface Through CCR Material (Residual Shear Strengths)

<table>
<thead>
<tr>
<th>Material Name</th>
<th>Color</th>
<th>Unit Weight (lbs/ft³)</th>
<th>Strength Type</th>
<th>Friction Angle (deg)</th>
<th>Cohesion (psf)</th>
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<td>Subgrade Clay</td>
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Circular Slip Surface Through CCR Material and North Perimeter Berm (Residual Shear Strengths)

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<th>Material Name</th>
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<td>Subgrade Clay</td>
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