INDEX AND CERTIFICATION

Public Service Company of Colorado, an Xcel Energy Company
Location Restrictions Criteria Certification Report
Project No. 98286

Report Index

<table>
<thead>
<tr>
<th>Section Number</th>
<th>Section Title</th>
<th>Number of Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Introduction</td>
<td>2</td>
</tr>
<tr>
<td>2.0</td>
<td>Soil Conditions That May Cause Differential Settlement</td>
<td>1</td>
</tr>
<tr>
<td>3.0</td>
<td>Geologic and Geomorphic Features</td>
<td>2</td>
</tr>
<tr>
<td>4.0</td>
<td>Man-Made Features</td>
<td>1</td>
</tr>
<tr>
<td>5.0</td>
<td>Conclusion</td>
<td>1</td>
</tr>
<tr>
<td>6.0</td>
<td>References</td>
<td>1</td>
</tr>
</tbody>
</table>

Qualified Professional Engineer Certification

In accordance with 40 CFR Section 257.64(c), I hereby certify, as a Professional Engineer in the State of Colorado, that the information in this document was assembled under my direct personal charge and is true and accurate to the best of my knowledge. This report is not intended or represented to be suitable for reuse by Public Service Company of Colorado, an Xcel Energy Company or others without specific verification or adaptation by the Engineer.

Bradley A. Coleman, PE
Colorado License No. 28723

Date: October 17, 2018
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>INTRODUCTION</td>
<td>1-1</td>
</tr>
<tr>
<td>1.1</td>
<td>Facility Description</td>
<td>1-1</td>
</tr>
<tr>
<td>1.2</td>
<td>Regulatory Requirements</td>
<td>1-1</td>
</tr>
<tr>
<td>2.0</td>
<td>SOIL CONDITIONS THAT MAY CAUSE DIFFERENTIAL SETTLING</td>
<td>2-1</td>
</tr>
<tr>
<td>3.0</td>
<td>ON-SITE GEOLOGIC AND GEOMORPHIC FEATURES</td>
<td>3-1</td>
</tr>
<tr>
<td>3.1</td>
<td>Unconsolidated Materials</td>
<td>3-1</td>
</tr>
<tr>
<td>3.2</td>
<td>Consolidated Materials</td>
<td>3-1</td>
</tr>
<tr>
<td>3.3</td>
<td>Geologic Structure</td>
<td>3-2</td>
</tr>
<tr>
<td>3.4</td>
<td>Geologic Hazards</td>
<td>3-2</td>
</tr>
<tr>
<td>3.5</td>
<td>Hydrogeology</td>
<td>3-2</td>
</tr>
<tr>
<td>3.6</td>
<td>Geomorphology</td>
<td>3-2</td>
</tr>
<tr>
<td>4.0</td>
<td>MAN-MADE FEATURES</td>
<td>4-1</td>
</tr>
<tr>
<td>5.0</td>
<td>CONCLUSION</td>
<td>5-1</td>
</tr>
<tr>
<td>6.0</td>
<td>REFERENCES</td>
<td>6-1</td>
</tr>
</tbody>
</table>

## LIST OF FIGURES

- Figure 1-1: Site Location Map
- Figure 1-2: Facility Site Plan
- Figure 3-1: Generalized Stratigraphy
# LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Term/Phrase/Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCR</td>
<td>coal combustion residual</td>
</tr>
<tr>
<td>CFR</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>PSCo</td>
<td>Public Service Company of Colorado, an Xcel Energy Company</td>
</tr>
<tr>
<td>RCRA</td>
<td>Resource Conservation and Recovery Act</td>
</tr>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
</tr>
</tbody>
</table>
1.0 INTRODUCTION

This Location Restrictions Criteria Certification Report has been prepared for the existing CCR landfill located at the Public Service Company of Colorado’s (PSCo) Hayden Station. Hayden Station is a 446-megawatt coal-fired, steam turbine power plant owned and operated by PSCo. The station is located at 13125 U.S. Highway 40, Hayden, Colorado 81639. The CCR landfill facility location is shown on Figure 1-1.

This plan was prepared to address the location restrictions found in the federal coal combustion residual (CCR) regulations for disposal of CCR under 40 Code of Federal Regulation (CFR), Part 257 of the Resource Conservation and Recovery Act (RCRA). The final rule was published in the Federal Register, Volume 80 Number 74 on April 17, 2015, and became effective on October 19, 2015.

1.1 Facility Description

The CCR landfill is located on Routt County Road 27 approximately one mile south of Colorado Highway 40 in Routt County, Colorado. A facility site plan is included as Figure 1-2. The landfill is in an unincorporated portion of Routt County. The location is approximately 5 miles east of Hayden, Colorado and 20 miles west of Steamboat Springs, Colorado. The landfill is generally located in the west half of Section 16 and the east half of Section 17, Township 6 North, Range 87 West of the 6th Principal Meridian, Routt County, Colorado. The service area for the landfill is limited to the Hayden Station power plant. Wastes are not accepted from any other source.

The landfill is an unlined ash monofill and has been in operation since the mid-1980s. The wastes accepted at the landfill consist of coal ash, air emission control byproducts, water intake silt, excavation soils and coal impurities. The area inside the permitted boundary of the landfill consists of approximately 154 acres of which approximately 136 acres is used for ash disposal and approximately 18 acres for storm water control structures, access roads, and borrow area.

1.2 Regulatory Requirements

The location restrictions are given in Section 257.60 through 257.64 of the CCR regulations. Of the five areas covered by the location restrictions (placement above the uppermost aquifer, wetlands, fault areas, seismic impact zones, and unstable areas) only the unstable areas restriction given in Section 257.64 is applicable to existing CCR landfills. As such this document only addresses the unstable areas location restriction.
Section 257.64 requires that an existing CCR unit must not be located in an unstable area unless the owner or operator demonstrates that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure the integrity of the structural components of the CCR unit will not be disrupted. PSCo must consider the following factors when determining whether an area is unstable:

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

PSCo must obtain certification from a qualified professional engineer stating that the demonstration meets the above requirements. This report has been prepared to provide that certification. Each of the above bullets is addressed in Sections 2 through 4 below.
2.0 SOIL CONDITIONS THAT MAY CAUSE DIFFERENTIAL SETTLING

The CCR landfill is located on the side of a valley as shown on Figure 1-2. It does not have a liner system or leachate collection system. The near surface geology in the region consists of a 20- to 50-foot thick layer of alluvial soils overlying the Lewis Shale formation, which overlies the Twentymile Sandstone member of the Mesaverde Group. The bedrock formations dip substantially to the west with exposed portions of the Lewis Shale and Twentymile Sandstone outcropping on the eastern side of the valley wall that the landfill was constructed against. Prior to constructing the landfill, the site excavated and stockpiled the alluvium overlying the Lewis Shale formation and began CCR placement directly on top of the Lewis Shale.

The Lewis Shale is the first bedrock formation encountered below the site. The Lewis Shale is more readily eroded than adjacent formations and can be as thick as 1,900 feet; however, at the Hayden site it is believed to be between 100 and 200 feet thick (Robson and Stewart, 1990). The Lewis Shale is a solid unsaturated bedrock with little to no groundwater and essentially no compressibility. The Lewis Shale forms both the base of the landfill and the eastern valley wall that underlies the landfill. As such no soil conditions that may cause differential settlement of the landfill are present.
3.0 ON-SITE GEOLOGIC AND GEOMORPHIC FEATURES

Several investigations have occurred at the CCR landfill over the years. These are summarized below:

- Test holes of the landfill footprint were performed in 1983 by an unnamed contractor for Colorado-Ute Electrical Association, the owner of Hayden Station prior to purchase by PSCo.
- Groundwater monitoring wells W1, W-2, and W-3 were installed by Goodson & Associates in 2001.
- Groundwater monitoring wells W-4, W-5, and W-6 were installed in March of 2017 by AECOM.
- A field investigation of the landfill was performed by Burns & McDonnell in the Fall of 2017.

The information presented in this section is based on the results of the above investigations and published literature.

3.1 Unconsolidated Materials

Unconsolidated materials at and near the landfill consist of alluvial and colluvial deposits. Soil materials identified during subsurface investigations by Woodward-Clyde Consultants at the landfill in 1984 were classified as brown, silty clays of medium plasticity from the surface to a maximum depth of approximately 25 feet. The thickness of unconsolidated materials ranged between approximately three and 25 feet across the entire site and generally increased from east to west across the site. These soils were then excavated ahead of ash placement and stockpiled on the eastern side of the landfill.

3.2 Consolidated Materials

The first remaining native layer beneath the landfill is the Lewis Shale, a consolidated dark gray to black, homogeneous, shale bedrock of marine origin, which acts as an aquitard and confining layer. The Lewis Shale beneath the landfill is estimated to be more than 100 feet thick (Robson and Stewart, 1990). Stratigraphically underlying the Lewis Shale and overlying the Twentymile Sandstone is the intervening Upper Williams Fork Formation. The Upper Williams Fork Formation represents the uppermost member of the Mesaverde Group and consists of interbedded dark-gray mudstones, siltstones, coal seams, and limey shale beds with 20-30-foot thick sandstones. The Twentymile Sandstone is a regressive, shoreface deposit composed of white ledge forming quartz arenite sandstone with minor beds of siltstone and shale. Aquifer tests performed by the United States Geological Survey (USGS) in the region indicate that the
Twentymile Sandstone has a mean hydraulic conductivity of $2.1 \times 10^{-2}$ feet per day (Robson and Stewart, 1990).

### 3.3 Geologic Structure

Figure 3-1 provides the general stratigraphy of the area surrounding the landfill. The Lewis Shale and the Mesaverde Group were deposited horizontally during the Late Cretaceous period. The Laramide Orogeny started in the Late Cretaceous and continued into the Late Eocene which resulted in the creation of the Rocky Mountains. Because of the orogeny, folding and faulting occurred. The site lies within the Hayden Syncline, a northwest plunging syncline that formed because of the Laramide Orogeny. East of Hayden, the Tow Creek Anticline was folded up creating the uplift where the landfill resides on the western flank. As the structure uplifted, the thickness of the Lewis Shale was reduced via erosion to the limited thickness overlying the Williams Fork at the crest of the folded structure. Sometime in the geologic past the ancestral Grassy Creek formed within a major structural joint along the western limb of the Tow Creek Anticline and cut the valley to the east of the site.

### 3.4 Geologic Hazards

Investigations of the immediate area did not identify any geologic hazards on or near the landfill.

### 3.5 Hydrogeology

Based upon field observations, the Lewis Shale beneath the footprint of the landfill has been found to be unsaturated. Groundwater is present in the alluvium west of the site and is hydraulically connected with Sage Creek.

### 3.6 Geomorphology

The only significant geomorphic feature is the valley wall that the landfill abuts against. The top of the valley wall consists of the Lewis Shale and Twentymile Sandstone outcrops. No signs of instability of the site geomorphology has been observed.
4.0 MAN-MADE FEATURES

The primary man-made feature at the CCR landfill is the landfill configuration itself. The overall stability of the landfill was evaluated both statically and seismically and found to be stable. Exterior earthen embankments on the southern, western, and northern side of the landfill have been constructed as well as drainage channels within the embankments. The overall slope of the embankments is 25 percent. No signs of instability that would cause mass movements of CCR materials have been observed in the man-made features.
5.0 CONCLUSION

Based on site reconnaissance and information provided in this report, there is no evidence of unstable conditions that may result in significant differential settling due to on-site soils, or unstable conditions resulting from geologic/geomorphologic features and/or man-made features at the site.
6.0 REFERENCES


Subpart D – Standards for the disposal of Coal Combustion Residuals in Landfills and Surface Impoundments, 40 CFR. § 257.64. (2018)

FIGURE 1-1

FACILITY LOCATION
HAYDEN STATION
ASH DISPOSAL FACILITY
HAYDEN, COLORADO

0 1 Miles

ASH DISPOSAL FACILITY
Figure 3-1

Generalized Stratigraphy
Hayden Station Ash Disposal Facility
Hayden, Colorado
