PLATTE RIVER POWER AUTHORITY – RAWHIDE ENERGY STATION
BOTTOM ASH TRANSFER (BAT) IMPOUNDMENTS

LARIMER COUNTY, CO

ENGINEER'S CERTIFICATION OF SEISMIC IMPACT ZONE DEMONSTRATION

(40 CFR §257.63)

FOR COAL COMBUSTION RESIDUALS (CCR)

EXISTING SURFACE IMPOUNDMENT

Prepared for

Platte River Power Authority

Platte River Power Authority
2700 East County Road 82
Wellington, CO 80549

October 16, 2018

Prepared by

AECOM

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1.0 INTRODUCTION

1.1 OBJECTIVE

The purpose of this demonstration is to document compliance with 40 CFR 257.63 of the Environmental Protection Agency Final Coal Combustion Residual Rule (EPA Final CCR Rule). This Seismic Impact Zone Demonstration is based on existing documentation such as construction drawings, record drawings, and other pertinent data and/or investigations to support historical conditions and operations at the Bottom Ash Transfer (BAT) Impoundments at Rawhide Energy Station.

1.2 RULE REQUIREMENTS

According to *40 CFR 257.63(a)* of the EPA Final CCR Rule, any new CCR landfills, existing, and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in seismic impact zones unless the owner or operator demonstrates that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the Maximum Horizontal Acceleration (MHA) in lithified earth material for the site.

Seismic impact zone means an area with a two percent or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10g in 50 years.

MHA in lithified earth material means the maximum expected horizontal acceleration at the ground surface as depicted on a seismic hazard map, with a 98% or greater probability that the acceleration will not be exceeded in 50 years, or the maximum expected horizontal acceleration based on a site-specific seismic risk assessment. This requirement translates to a 10% probability of exceeding the MHA in 250 years.

Lithified earth material means all rock, including all naturally occurring and naturally formed aggregates or masses of mineral or small particles of older rock that formed by crystallization of magma or by induration of loose sediments. This term does not include man-made materials, such as fill, concrete, and asphalt, or unconsolidated earth materials, soil, or regolith lying at or near the earth surface.

1.3 SITE BACKGROUND

Rawhide Energy Station (Rawhide) is a 4,560 acre facility located at 2700 East County Road 82 in Wellington, CO. Construction of Rawhide began in 1979 and it has operated as a coal-fired power plant since. The primary land use on the Rawhide property is related to utility service electric generation. Power generation at Rawhide produces coal combustion residuals (CCR). Rawhide places these residuals in the Solid Waste Management Facility (the Monofill), located in the northwest corner of the Rawhide site.

The BAT Impoundments are located northwest of the main plant, and north of the Cooling Pond. A site location plan of the Rawhide Energy Station is depicted on in **Figure 1**. An overview of the impoundments is presented in **Figure 2.**

Bottom ash is produced during the coal combustion process and is hydraulically sluiced from the boiler to one of the two incised BAT impoundments located northwest of the plant. These impoundments also receive resin filter backwash water from the demineralizer at the wastewater treatment plant. The impoundments were constructed in the early 1980s by excavating below grade into the underlying Pierre Shale and then lining the bottom with 18 inches of compacted clay. Each of the two impoundments measure approximately 725 feet by 225 feet at the surface (approximately 7.5 acres total) with a bottom elevation of 5,660 feet above mean sea level (amsl), a normal water elevation of 5,674 feet amsl, and a dike crest elevation ranging between 5,678 and 5,679 feet amsl. It takes approximately one to two years to fill one of the ponds. Once the ponds are filled, the solids are excavated by an outside contractor and disposed of in the on-site monofill. The bottom clay liner has been surveyed during the cleanout. The ponds are cleaned out in an alternating manner, approximately every three years, and the material is then transported to the Monofill.

A plant shutdown event at the Rawhide facility is planned to occur during Fall 2018. The existing BAT impoundments will be permanently taken out of service following this shutdown event.

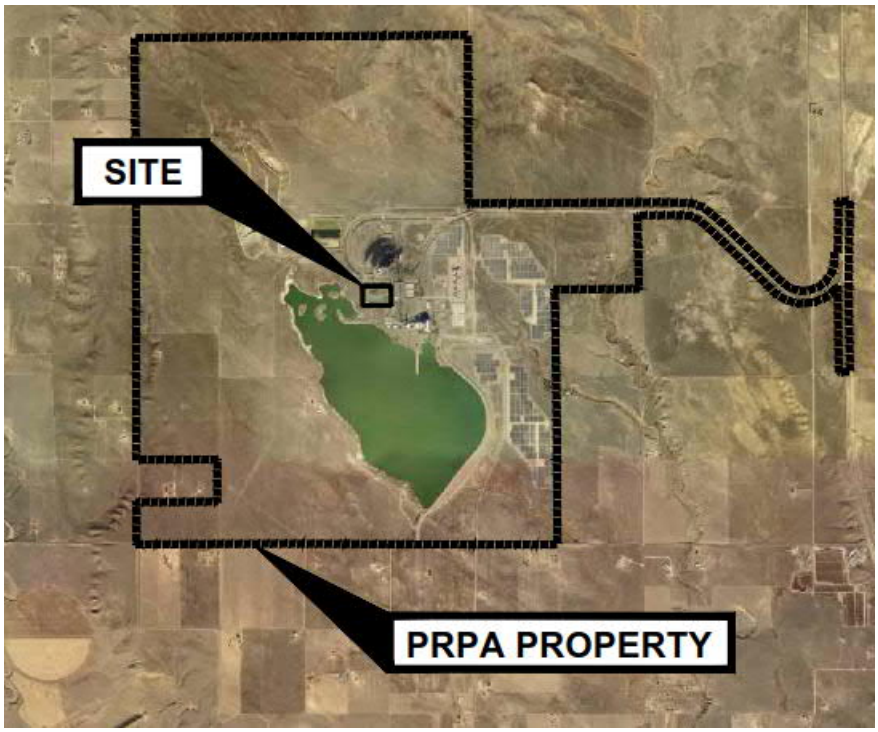


Figure 1: Site Location Map

Figure 2: CCR Unit Site Location

2.0 SEISMIC ANALYSIS

2.1 SITE STRATIGRAPHY AND GEOLOGIC SETTING

The geologic setting at Rawhide lies on the high plains located immediately east of the Colorado Front Range, where soil and bedrock units are incised by drainage from nearby mountains to the west, forming small, relatively minor valley and ridge topographic expressions, as discussed in the Annual Ash Monofill Inspection Report (AECOM, 2016). The most distinctive topographic feature at Rawhide is a broad basin that occupies the center of the site and extends from northwest to southeast. Smooth ridges and rounded bluffs surround this basin and mark the transition to uplands that are 50 to 70 feet (ft) higher.

According to the United States Geological Survey (USGS) geologic map, bedrock at Rawhide consists of Cretaceous units including the Upper Pierre Shale Formation. Specifically, the majority of the Rawhide site lies on the Upper Pierre Shale Formation transition zone, the eastern extent of which transitions to the Lower Fox Hills Sandstone downslope and east of the Rawhide site. The Pierre Shale transition zone is described as shale with interbedded sandstones. The portions 600 ft below the contact with the Fox Hills sandstone are mapped by the USGS as being the most permeable within the unit, yielding 5 to 15 gallons per minute in wells. The Fox Hills Sandstone is described as pale yellow, massive, silty, fine-grained sandstone with lenticular black shale partings but is not present on the Rawhide site.

The bedrock surface at the site is mapped as dipping east-southeast toward the Cooling Pond. The geologic map indicates bedrock bedding structure in the area striking roughly north-south with shallow dips 5 to 10 degrees to the east. The Rawhide site is considered to be in an area of overall minor seismicity.

According to historical drawings and logs, the BAT Impoundments were excavated down from the overburden silty clay into weathered shale and do not have constructed dikes, i.e., they are incised impoundments.

2.2 HISTORICAL SEISMIC EVENTS

Rawhide Energy Station is located in an area of relatively low seismic activity. No confirmed earthquakes of Modified Mercalli Intensity VII have been recorded within 200 miles of the site (Black & Veatch 1979). **Figure 3** below shows a map of all of the historical earthquakes recorded within a 50 mile radius of the site within Colorado.

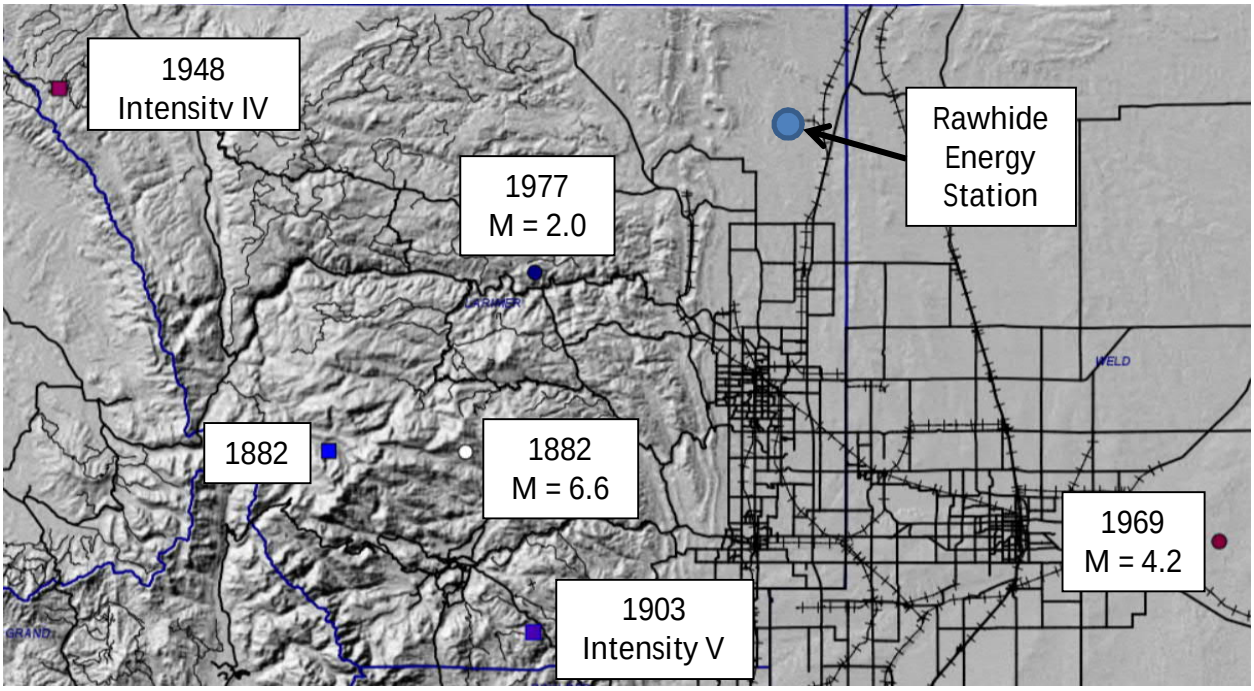


Figure 3: Historical Earthquakes within 50 Mile Radius of Project Site (Morgan 2017)

The largest earthquake to have occurred in Colorado was of magnitude 6.6 in the northern Front Range west of Fort Collins on November 7, 1882. The most damaging earthquake to have occurred in the state of Colorado is the August 9, 1967 M 5.3 earthquake in Denver and its northern suburbs, resulting in over one million dollars worth of damage. It is believed to have been caused by the deep injection of liquid waste into a borehole in the Rocky Mountain Arsenal (Colorado Geological Survey).

2.3 SEISMIC IMPACT ZONE

Seismic zones, which represent areas of the United States with the greatest seismic risk, are mapped by the U.S. Geological Survey (USGS) and readily available for all the U.S. (http://

earthquake.usgs.gov/hazards/apps/) and commonly used to determine the MHA in lithified earth material to evaluate if a site is located in a seismic impact zone.

Using the site address in the USGS (2014) seismic hazard map tool to represent the CCR surface impoundments at the Rawhide Energy Station, a MHA of 0.098 g is calculated as shown in **Appendix B**. Note that MHA is equivalent to the Peak Ground Acceleration (PGA) at the B-C boundary (firm rock) in the USGS maps. The USGS-generated MHA indicates that the site is not within a seismic impact zone (<0.1 g). Therefore, the Rawhide Energy Station site was not considered to be in a seismic impact zone for this evaluation.

2.4 STRUCTURAL ANALYSIS

Since the Rawhide Energy Station location has an MHA of 0.098 g, the site was not considered to be in a seismic impact zone. It is noted, however, that the BAT impoundments are incised, which means they have been excavated entirely below the ground surface and have no constructed dikes, and additionally no significant structures were constructed within the footprint of the BAT impoundments.

3.0 CONCLUSIONS

In accordance with §257.63, the results of the engineering assessment performed on the BAT Impoundments indicate that the units are not located within a seismic impact zone.

Pursuant to 40 C.F.R. § 257.63 (c)(1), for an existing surface impoundment, the owner or operator must complete the demonstration no later than October 17, 2018. Certification by a qualified professional engineer is included in **Appendix A**.

4.0 REFERENCES

- Black & Veatch Consulting Engineers, Geotechnical Analysis Report, Platte River Power Authority Rawhide Project: July 23, 1979.
- Colorado Geological Survey. Colorado's Largest Earthquakes. Retrieved September 28, 2018 from http://coloradogeologicalsurvey.org/geologic-hazards/earthquakes/colorados-largest-earthquakes/
- Morgan, M. L., 2017, Colorado Earthquake Map Server: http://dnrwebmapgdev.state.co.us/CGSOnline/
- United States Geological Survey (USGS) seismic hazard map (2014), https://earthquake.usgs.gov/hazards/interactive/

APPENDIX A
ENGINEER'S CERTIFICATION

ENGINEER'S CERTIFICATION OF SEISMIC IMPACT ZONES DEMONSTRATION
CCR SURFACE IMPOUNDMENT: RAWHIDE ENERGY STATION
CCR UNIT: BOTTOM ASH TRANSFER IMPOUNDMENTS

AECOM ("Consultant") has been retained by Platte River Power Authority to prepare a demonstration of whether the above-referenced existing coal combustion residuals ("CCR") surface impoundment meets the location restriction for seismic impact zones requirements set out in 40 C.F.R. § 257.63(a). Presented below are the project background, summary of findings, limitations, and certification.

1.0 BACKGROUND

Pursuant to 40 C.F.R. § 257.63(a), new CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in seismic impact zones unless the owner or operator demonstrates that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

Pursuant to 40 C.F.R. § 257.63(b) and (c)(1), for an existing surface impoundment, the owner or operator must obtain a certification from a qualified professional engineer stating that the owner or operator has demonstrated that the CCR unit meets the requirements for seismic impact zones no later than October 17, 2018.

Consultant completed a desktop evaluation of the location of the CCR unit and determined that sufficient information is available to document the required seismic impact zones demonstration.

2.0 SUMMARY OF FINDINGS

Based upon a review of U.S. Geological Survey (USGS) seismic hazard map tool, existing structural design analysis, and 2016 CCR Safety Factor demonstrations, Consultant concludes as follows:

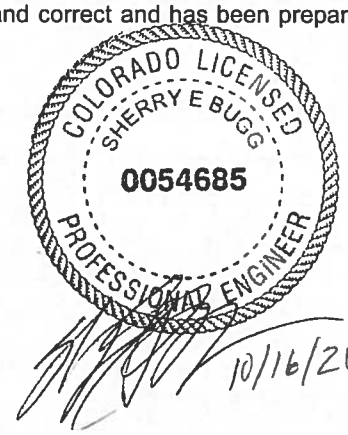
CCR Unit	Seismic Impact Zones
BAT Impoundments	*Meets the requirements of* 40 C.F.R. *§ 257.63(a)*

3.0 LIMITATIONS

The signature of Consultant's authorized representative on this document represents that to the best of Consultant's knowledge, information, and belief in the exercise of its professional judgment, it is Consultant's professional opinion that the aforementioned information is accurate as of the date of such signature. Any opinion or decisions by Consultant are made on the basis of Consultant's experience, qualifications, and professional judgment and are not to be construed as warranties or guaranties. In addition, opinions relating to environmental, geologic, and geotechnical conditions or other estimates are based on available data, and actual conditions may vary from those encountered at the times and locations where data are obtained, despite the use of due care.

4.0 CERTIFICATION

I, Sherry Bugg, being a Registered Professional Engineer, in accordance with the Colorado Professional Engineer's Registration, do hereby certify to the best of my knowledge, information, and belief, that the CCR unit that is the subject of this report dated October 16, 2018 meets the location restriction for seismic impact zones requirements pursuant to 40 C.F.R. § 257.63(a), and that this report is true and correct and has been prepared in accordance with generally accepted good engineering practices.



SIGNATURE _____ DATE 10/16/2018

Rev.0

APPENDIX B
USGS UNIFIED HAZARD TOOL

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (v4.1.

Spectral Period

Peak ground acceleration

Latitude

Decimal degrees

40.863

Time Horizon

Return period in years

2475

Longitude

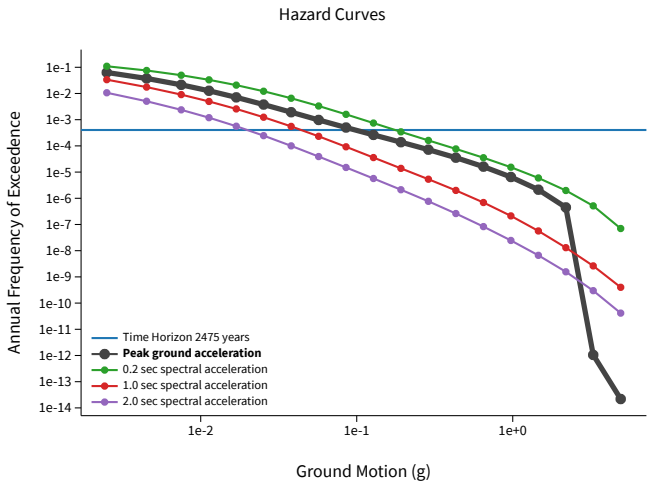
Decimal degrees, negative values for western longitudes

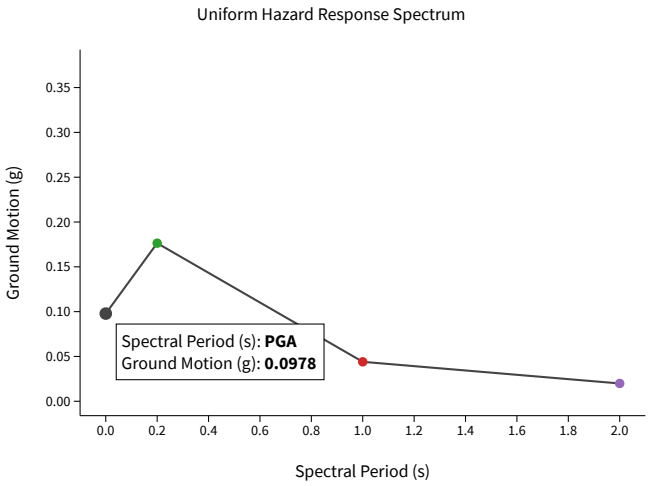
-105.03

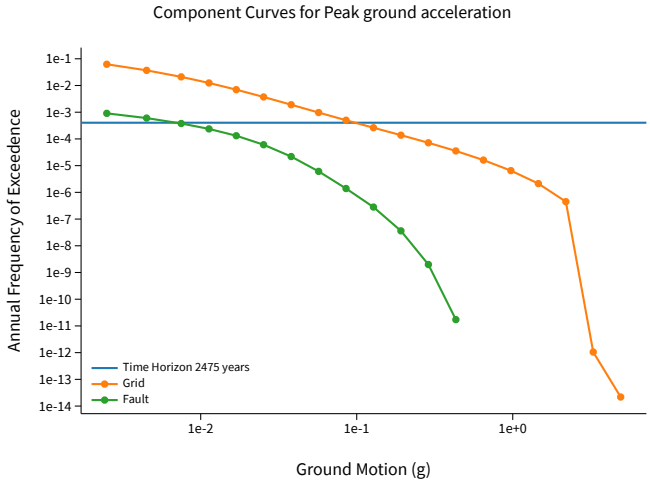
Site Class

760 m/s (B/C boundary)

Hazard Curve







View Raw Data