

2016 ANNUAL LANDFILL INSPECTION REPORT

FOR

GRAND RIVER DAM AUTHORITY LANDFILL

GRAND RIVER ENERGY CENTER

MAYES COUNTY, OKLAHOMA

SOLID WASTE PERMIT NO. 3549012

PREPARED FOR:

**GRAND RIVER DAM AUTHORITY
VINITA, OKLAHOMA**

JANUARY 13, 2017

A&M PROJECT NO. 1986-013

PREPARED BY:

A&M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

10010 E. 16TH STREET

TULSA, OKLAHOMA 74128-4813

PHONE (918) 665-6575 & FAX (918) 665-6576

EMAIL: aandm@aandmengineering.com

**2016 ANNUAL LANDFILL INSPECTION REPORT
 GRAND RIVER DAM AUTHORITY LANDFILL
 GRAND RIVER ENERGY CENTER
 MAYES COUNTY, OKLAHOMA**

TABLE OF CONTENTS

| SECTION | PAGE |
|--|-------------|
| CERTIFICATION STATEMENT..... | ii |
| 1.0 INTRODUCTION..... | 1 |
| 2.0 LANDFILL INFORMATION..... | 2 |
| 2.1 GENERAL HISTORY | 2 |
| 2.2 DESIGN AND CONSTRUCTION HISTORY..... | 2 |
| 2.3 OPERATIONAL METHODS | 3 |
| 2.4 VOLUME OF CCR..... | 4 |
| 2.5 WEEKLY LANDFILL INSPECTIONS..... | 5 |
| 2.6 QUARTERLY DEQ LANDFILL INSPECTIONS..... | 5 |
| 3.0 LANDFILL INSPECTION..... | 5 |
| 3.1 LANDFILL GEOMETRY | 6 |
| 3.2 INSPECTION OBSERVATIONS..... | 6 |
| 3.3 OBSERVED CHANGES IN GEOMETRY..... | 7 |
| 4.0 SUMMARY OF FINDINGS | 7 |
| 5.0 LIMITATIONS | 7 |
| 6.0 REFERENCES..... | 8 |

APPENDICES

APPENDIX A Figures

APPENDIX B Landfill Inspection Form



CERTIFICATION STATEMENT

I certify that this document was prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly observe, gather and evaluate the information submitted. The information submitted in this document is relevant to the annual inspection of the Grand River Dam Authority Coal Ash Landfill, located within the Grand River Energy Center complex in Mayes County, Oklahoma, that was performed on November 7, 2016. Based on the facility records reviewed and the on-site inspection performed, this report is to the best of my knowledge and belief, true, accurate and complete.

A&M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.



Deren M. Engel, P.E.

1/13/2017

Date

Oklahoma Registration No. 24595



**2016 ANNUAL LANDFILL INSPECTION REPORT
GRAND RIVER DAM AUTHORITY LANDFILL
GRAND RIVER ENERGY CENTER
MAYES COUNTY, OKLAHOMA**

1.0 INTRODUCTION

The Grand River Dam Authority (GRDA) owns and operates an electric generating station, referred to as the Grand River Energy Center (GREC), approximately three (3) miles east of the City of Chouteau in Mayes County, Oklahoma. Two (2) coal fired boilers are operated at GREC which produce Coal Combustion Residuals (CCRs) consisting of fly ash and bottom ash. Fly ash comprises greater than 80% of CCRs generated at the facility and is largely sold for beneficial use purposes. Excess fly ash and bottom ash is disposed at a permitted coal ash landfill, herein referred to as the GRDA Landfill, located within the GREC complex.

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published a final rule for the Disposal of CCRs from Electric Utilities. This new rule regulates the disposal of CCRs under Title 40 of the Code of Federal Regulations (CFR), Parts 257 and 261. The rule applies both to new and existing CCR landfills and surface impoundments at coal burning electric utility sites. The State of Oklahoma also approved new regulations for the disposal of CCRs from Electrical Utilities under Oklahoma Administrative Code (OAC), Title 252, Chapter 517 which went into effect on September 15, 2016. The requirements of OAC 252:517 largely mirror the requirements of the Federal regulations.

As required by 40 CFR Part 257.84(b) and OAC 252:517-13-5(b), existing CCR landfills and any lateral expansion of a CCR landfill must be inspected on a periodic basis by a qualified Professional Engineer to ensure that the design, construction, operation and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering standards (USEPA, 2015). A&M Engineering and Environmental Services, Inc. (A&M Engineering) was retained by GRDA to perform the annual inspection of the existing landfill and provide this report for compliance with 40 CFR Part 257.84 and OAC 252:517-13-5(b).



A&M Engineering performed a visual inspection of the GRDA Landfill and a review of information available within the landfill operating record on November 7, 2016. This report has been prepared to document the inspection performed and relevant information identified.

2.0 LANDFILL INFORMATION

The GRDA Landfill is currently permitted by the Oklahoma Department of Environmental Quality (DEQ) as a Non-Hazardous Industrial Waste Landfill that is allowed to accept fly ash, bottom ash and spent powdered activated carbon used to control flue gas emissions, generated at the GREC (DEQ, 2015). The GRDA Landfill is situated south of the coal fired boiler units within the GREC complex. The total landfill permit area consists of approximately 116 acres, of which only 47 acres have been utilized to date and remains active. The following subsections provide information regarding the general history of the landfill, design and construction of the landfill, operational methods employed, volume of CCRs placed in the landfill and other pertinent information identified during review of the landfill operating record.

2.1 GENERAL HISTORY

On January 13, 1981, the Oklahoma State Department of Health (OSDH) issued GRDA a permit to construct, operate and maintain a coal ash landfill at the GREC (OSDH, 1981). The purpose of the landfill was to provide a proper means of disposal for ash materials that would be generated as a by-product of coal combustion from the electric generating station that was under construction at the time. The initial permit stipulated that only fly ash and bottom boiler ash resulting from the burning of coal at the GREC could be disposed at the site and that the landfill would be constructed and operated in strict accordance with the engineering plans and specifications approved by the OSDH. Since initial permitting and construction, GRDA has operated and maintained the landfill in accordance with the developing Federal and State rules and regulations applicable to the site.

2.2 DESIGN AND CONSTRUCTION HISTORY

Prior to permit issuance and construction, it was established through the performance of soil borings and geotechnical testing that the proposed landfill site was underlain by an impermeable



clay layer that ranged in thickness from 11 to 23 feet across the site (Holway-United, 1979). The landfill was initially established by constructing a perimeter dike around a 70 acre portion of the permitted landfill area as shown in **Figure 1** and provided in **Appendix A**.

Based on documentation reviewed, it appears that the perimeter dikes were constructed of suitable clay materials from the site. Approved grading plans for the site indicate that the exterior slopes of the perimeter dike were designed to range between 3 feet Horizontal to 1 foot Vertical (3:1) and 2.5:1 while the interior slopes were designed to range between 2:1 and 2.5:1 (Holway-United, 1979).

A&M Engineering is not aware of nor has it reviewed any previously performed structural or slope stability analysis of the landfill. However, provided the pozzolanic properties of fly ash, proper placement of ash materials, adequate storm water drainage and covering of the landfill is expected to promote age hardening of the fill material thereby resulting in a stable landform with reduced permeability and leachate generation.

The landfill was designed so that all surface water drainage is routed around the landfill area and into a series of permitted Class III industrial wastewater treatment impoundments regulated under an Oklahoma Pollutant Discharge Elimination System (OPDES) permit. The industrial wastewater system consists of eleven (11) process water and storm water retention/treatment basins around the western and southern perimeter of the landfill. These surface impoundments provide a total holding capacity of 1,371,521,000 gallons as stated in the facility OPDES permit and receive process water; cooling tower water; and storm water run-off from the landfill, coal pile, and the operational areas of the plant.

2.3 OPERATIONAL METHODS

General operational activities employed at the GRDA Landfill include the transportation and placement of CCRs in the landfill; general maintenance of the landfill; and installation of soil cover as necessary.



CCR material to be disposed at the landfill is transferred from storage silos to transport vehicles utilizing dry loading methods. During loading, fly ash is moisture conditioned for the purposes of fugitive dust control and compaction in the landfill (GRDA, 2015). Bottom ash has a granular/gravel texture and is also dampened with water for fugitive dust control purposes prior to loading (GRDA, 2015). Once loaded, the transport vehicles then convey CCRs to the landfill for final disposal. At the landfill, water trucks are used to minimize fugitive dust as necessary. Application of daily soil cover is not generally necessary for the conditions at this landfill.

As design top of waste elevations are achieved, GRDA has applied either final or intermediate soil cover to the exterior landfill slopes and has established vegetation in order to minimize water infiltration into the landfill and reduce erosion and transport of soils and/or CCR materials from the landfill. Side slopes are regularly mowed, monitored and maintained. Precipitation run-off from the exterior slopes is collected within the wastewater impoundments around the landfill. Precipitation run-off from the active landfill area is collected within the permitted landfill area and evaporated or drained into the industrial wastewater treatment system.

2.4 VOLUME OF CCR

It is reported that CCRs generated at the GREC have been placed in the landfill since 1982. Based on historical records of CCR disposal at the landfill and the expected compaction density of these materials, GRDA estimates that approximately 4,317,456 cubic yards of CCRs have been placed within the landfill through December 31, 2016.

The initial landfill inspection report incorrectly stated that 3,672,712 cubic yards of CCRs had been placed in the landfill through December 31, 2015. The document should have stated that the 4,297,533 cubic yards of CCR had been placed in the landfill through December 31, 2015. As a result, it is estimated that approximately 19,923 cubic yards of airspace capacity was utilized during 2016.



2.5 WEEKLY LANDFILL INSPECTIONS

GRDA personnel perform weekly inspections of the GRDA Landfill in accordance with 40 CFR 257.84 and OAC 252:517-13-5(b). The primary purpose of the weekly inspections is to examine the landfill for any appearances of actual or potential structural weaknesses that have the potential to affect the safety of the landfill. Items to inspect for include: surface cracks, both transverse and longitudinal; slides, sinkholes or depressions; missing vegetative cover; vegetation larger than two (2) inches in diameter; accumulated liquid; and surface discoloring indicating ash discharge from the landfill. Review of weekly landfill inspection forms do not indicate any safety or stability concerns.

2.6 QUARTERLY DEQ LANDFILL INSPECTIONS

DEQ personnel inspect GRDA Landfill on a quarterly basis for compliance of permit and regulatory requirements. Review of documentation from DEQ inspections performed in 2016 does not indicate any compliance issues.

3.0 LANDFILL INSPECTION

A visual field inspection of the GRDA Landfill was conducted by A&M Engineering staff member, Deren M. Ertugrul, P.E, on November 7, 2016. Mr. Ertugrul is a licensed Professional Engineering in the State of Oklahoma and has over 10 years of experience as a civil/environmental engineer dealing with the design, inspection and construction of landfills, impoundments and other earthwork projects.

GRDA personnel accompanied Mr. Ertugrul during an initial walk through of the landfill facility and provided operating record documents for review. Mr. Ertugrul then performed a visual inspection of the landfill perimeter dikes, side slopes and top. Mr. Ertugrul inspected the landfill by driving around the perimeter dike and making observations regarding the condition of the dike and exterior side slopes. Mr. Ertugrul stopped as conditions warranted or at every 400 to 500 feet to inspect the perimeter dike and exterior side slopes by foot. The crest of the landfill slope was similarly inspected. The visual inspection focused on identifying any actual or potential structural weakness of the landfill by the identification of indicators such as surface



cracks, slides, slumping, sinkholes, depressions, missing vegetative cover, excessive animal burrows, or leachate seepage. Photographic documentation was collected and filed in the landfill operating record for the purposes of comparison during the next annual inspection. A landfill inspection form completed during the inspection is provided in **Appendix B**.

3.1 LANDFILL GEOMETRY

The current landfill consists of a perimeter dike that encompasses a 70 acre portion of the permitted landfill area as shown in **Figure 1**. Approximately 47 acres of this area has been utilized and remains active to date. The southern half of this area is near the maximum design elevation according to the facility Closure Plan. The elevation of the crest along the southern edge of the landfill is reported to be approximately 675 feet above mean sea level (AMSL). The lowest point along the toe of dike is reported to be at approximately 610 feet AMSL. An intermediate or final cover has been installed on the southern and western exterior slopes of the landfill. These slopes are well vegetated and maintained. Precipitation run-off from the exterior slopes is collected within the wastewater impoundments around the landfill. . The eastern and northern slopes of the active landfill are within the limits of the landfill perimeter dike. Precipitation run-off from the active landfill area is collected within the permitted landfill area and evaporated or drained into the permitted industrial wastewater treatment system.

3.2 INSPECTION OBSERVATIONS

The perimeter dikes and exterior slopes were generally observed to be well maintained and in good structural condition. Vegetation was generally well established on exterior slopes and no signs of instability were observed. Prior to the inspection, GRDA performed some maintenance work on portions of the southwestern exterior slopes by correcting areas of developing erosion. The areas were observed to be repaired and seeded at the time of inspection.

There were no observed appearances of actual or potential structural weakness or existing conditions that are disrupting or have a potential to disrupt the operation and safety of the landfill.



3.3 OBSERVED CHANGES IN GEOMETRY

Based on the visual inspection of the landfill, the geometry does not appear to have changed significantly compared to the conditions documented in the 2015 annual landfill inspection report or the aerial photograph depicted in **Figure 1**. Primary fill activities remain at the top of the landfill and within the northern half of the active area. Intermediate or final cover was observed on the western and southern exterior slopes of the landfill with established and maintained vegetation.

4.0 SUMMARY OF FINDINGS

As required by 40 CFR 257.84(b) and OAC 252:517-13-5(b), A&M Engineering performed a visual inspection of the GRDA Landfill and a review of information available within the landfill operating record on November 7, 2016. The landfill appears to have been constructed in accordance with the engineering plans approved by the OSDH in the early 1980's. On-going operations and maintenance of the GRDA Landfill appear to be conducted in a manner consistent with current DEQ regulations and generally accepted good engineering standards. A&M Engineering did not observe any maintenance issues. The landfill was generally observed to be well maintained and in good structural condition. No observations were found that would indicate an imminent danger or instability of the landfill.

5.0 LIMITATIONS

The conclusions and recommendations presented in this report are based upon a review of relevant and available documents provided by GRDA as well as a visual inspection of the landfill that was performed by driving and walking around the majority of the landfill site. The purpose of this inspection was to ensure that the design, construction, operation and maintenance of the landfill is consistent with recognized and generally accepted good engineering standard with specific regards to the safety or adequacy of the facility against catastrophic failure during normal operation or during unusual events. The conclusions and recommendations presented in this report were based on generally accepted engineering principles and practices at the time services were provided. No warranties, expressed or implied, are intended to be made.



6.0 REFERENCES

Holway-United, *Grand River Dam Authority 490-MW Coal-Fired Generating Station Ash Disposal Site Permit Application, Chouteau, Oklahoma.* August 22, 1979.

Oklahoma State Department of Health (OSDH), *Permit for a Coal Ash Disposal Site.* January 13, 1981.

Oklahoma Department of Environmental Quality (DEQ), *Permit Modification to add an additional Solid Waste Stream, Grand River Dam Authority, Mayes County, Permit 3549012.* February 20, 2015.

State of Oklahoma, *Oklahoma Administrative Code, Title 252, Chapter 517, Disposal of CCR from Electric Utilities.* September 15, 2016.

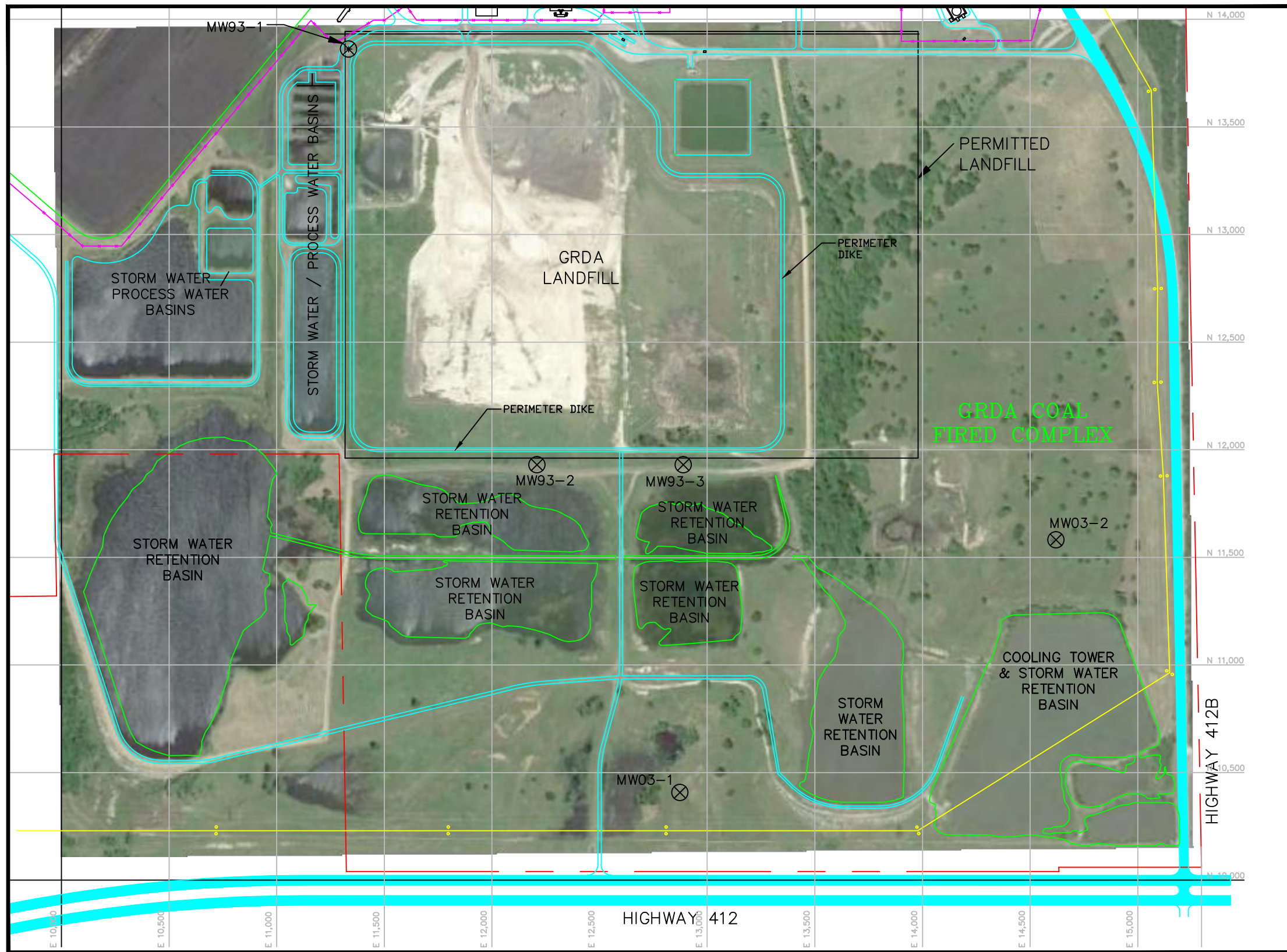
United States Environmental Protection Agency (USEPA), *40 CFR Part 257, Subpart D, Disposal of CCR from Electric Utilities.* April 17, 2015.

Grand River Dam Authority (GRDA), *Coal Combustion Residual Fugitive Dust Control Plan for Grand River Energy Center.* October 2015

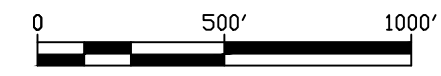


APPENDIX A

FIGURES



SCALE



DJR 4/13/06

GENERAL NOTES

- 1) BASE MAP PROVIDED BY GRDA.
- 2) AERIAL PHOTO PROVIDED BY GOOGLE EARTH, DATED JUNE 10, 2013.

REVISIONS

| NO. | DESCRIPTION | BY | CHECKED | DATE | NO. | DESCRIPTION | BY | CHECKED | DATE |
|-----|-------------|----|---------|------|-----|-------------|----|---------|------|
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |



| | | | |
|------------------|------------------|---------------|-----------|
| DRAWN: BAG | CHECKED BY: DME | MATERIALS BY: | ENGINEER: |
| DATE: 11/28/2016 | DATE: 11/28/2016 | DATE: | DATE: |

SITE MAP
GRAND RIVER DAM AUTHORITY LANDFILL
CHOUTEAU, OKLAHOMA

| | | | | |
|------------------|-----------------|--------------------------|--------------------------|------|
| APPROVED BY: DME | SCALE: AS SHOWN | PROJECT NUMBER: 1986-013 | DRAWING NUMBER: FIGURE 1 | REV: |
| DATE: 11/28/2016 | | | | |

APPENDIX B

LANDFILL INSPECTION FORM



LANDFILL INSPECTION FORM

| | |
|---|--|
| Facility Name GRDA LANDFILL | Facility Location MAYES COUNTY, OK |
| Inspector Name DEREN ERTUGROL | Inspection Date 11/7/2016 |

| LOCAL WEATHER CONDITIONS | |
|--------------------------|--|
| Weather: | <input type="checkbox"/> Brite Sun <input type="checkbox"/> Clear <input checked="" type="checkbox"/> Overcast <input type="checkbox"/> Rain <input type="checkbox"/> Snow |
| Temp: | <input type="checkbox"/> <32 <input type="checkbox"/> 32-50 <input checked="" type="checkbox"/> 50-70 <input type="checkbox"/> 70-85 <input type="checkbox"/> >85 |
| Wind: | <input type="checkbox"/> Still <input checked="" type="checkbox"/> Mod. <input type="checkbox"/> High |
| Notes: | |

| PERIMETER BERMS | |
|----------------------------------|---|
| Cover: | <input checked="" type="checkbox"/> Veg. <input type="checkbox"/> Soil <input type="checkbox"/> Gravel <input type="checkbox"/> Other: |
| Issues: | <input checked="" type="checkbox"/> None <input type="checkbox"/> Animal Burrows <input type="checkbox"/> Veg. >2" dia. <input type="checkbox"/> Bare Spots <input type="checkbox"/> Poor Veg. Cover <input type="checkbox"/> Erosion <input type="checkbox"/> Seepage <input type="checkbox"/> Drainage <input type="checkbox"/> Settlement <input type="checkbox"/> Cracks <input type="checkbox"/> Mass Movement <input type="checkbox"/> Other: |
| Comments/Action Required: | Exterior dike slopes range between 2.5:1 and 3:1 per design drawings. Dikes appear stable. |

| EXTERIOR SLOPES | |
|----------------------------------|---|
| Cover: | <input checked="" type="checkbox"/> Veg. <input type="checkbox"/> Soil <input type="checkbox"/> Gravel <input type="checkbox"/> Other: |
| Slopes: | <input type="checkbox"/> 2:1 <input checked="" type="checkbox"/> 3:1 <input checked="" type="checkbox"/> 4:1 <input type="checkbox"/> 5:1 |
| Issues: | <input checked="" type="checkbox"/> None <input type="checkbox"/> Animal Burrows <input type="checkbox"/> Veg. >2" dia. <input type="checkbox"/> Bare Spots <input type="checkbox"/> Poor Veg. Cover <input type="checkbox"/> Erosion <input type="checkbox"/> Seepage <input type="checkbox"/> Drainage <input type="checkbox"/> Settlement <input type="checkbox"/> Cracks <input type="checkbox"/> Mass Movement <input type="checkbox"/> Other: |
| Comments/Action Required: | Exterior slopes appear stable. Areas of erosion have recently been repaired by landfill crew and seeded. |


| LEACHATE SYSTEM | |
|----------------------------------|--|
| Type: | <input checked="" type="checkbox"/> None <input type="checkbox"/> Sump/Pump <input type="checkbox"/> Sump/Gravity <input type="checkbox"/> Sump/Pump <input type="checkbox"/> Impoundment <input type="checkbox"/> Tank <input type="checkbox"/> Other: |
| Issues: | <input checked="" type="checkbox"/> None <input type="checkbox"/> Leaks <input type="checkbox"/> Pumps <input type="checkbox"/> Piping <input type="checkbox"/> Impoundment <input type="checkbox"/> Tank <input type="checkbox"/> Other: |
| Comments/Action Required: | N/A |

| STORM WATER CONTROL | | | |
|--|--|-----------------------------------|--|
| Issues: | <input checked="" type="checkbox"/> None | <input type="checkbox"/> Erosion | <input type="checkbox"/> Washouts |
| | <input type="checkbox"/> Culverts | <input type="checkbox"/> Ditches | <input type="checkbox"/> Riprap: |
| | <input type="checkbox"/> Other: | <input type="checkbox"/> Sediment | <input type="checkbox"/> Diversions |
| Are Erosion or Sediment Controls Sufficient and Good Repair? | | | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| Are Storm Water Run-On Measures Sufficient and in Good Repair? | | | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| Are Storm Water Run-Off Measures Sufficient and in Good Repair? | | | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| Comments/Action Required: Areas of erosion have been recently repaired and seeded by G.R.O.A. | | | |

| MONITORING WELLS | | | |
|---|--|--|--|
| Are all wells in satisfactory condition? | | | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| Are all wells easily accessible? | | | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| Are all wells properly locked and secured? | | | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| Comments/Action Required: None | | | |

| GAS WELLS AND VENTS | | | |
|---|--|--|--|
| Are all wells and vents in satisfactory condition? | | | <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A |
| Are all wells and vents easily accessible? | | | <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A |
| Are all wells and vents properly locked and secured? | | | <input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> N/A |
| Comments/Action Required: N/A | | | |

| GENERAL SITE CONDITIONS | |
|-------------------------------------|--|
| Overall Site Conditions: | Site is well maintained. No signs of instability. |
| Security and Access Control: | Security provided by fence and restricted site access at GREC guard house. |
| Other Comments: | |

| | |
|--------------------------------------|--|
| Inspector Signature and Date: | |
| |  11/7/2016 |