STRUCTURAL STABILITY ASSESSMENT

SPS INSTRUCTION

OPERATING RECORD DOCUMENT Required per §257.105(f)(10)

INTERNET POSTING Required per §257.107(f)(9)

PROFESSIONAL ENGINEER'S CERTIFICATION

40 CFR 257.73(d) Periodic Structural Stability Assessments.

I, Thomas R. Gredell, P.E., a professional engineer licensed in the State of Missouri, hereby certify in accordance with 40 CFR 257.73(d)(3) and 40 CFR 257.73(f)(3) that this periodic structural stability assessment for the Sikeston Board of Municipal Utilities, Sikeston Power Station, Bottom Ash Pond meets the requirements of 40 CFR 257.73(d) as found in federal regulation 40 CFR 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments and has been prepared using methods and procedures consistent with the professional standard of care and customary practice for engineering investigations of projects of this nature.

Name: Thomas R. Gredell, P.E.

Signature: Thomas R. Gredell

Date: 10-15-21

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GREDELL Engineering Resources, Inc.

Sikeston Board of Municipal Utilities
Sikeston Power Station
Bottom Ash Pond
Structural Stability Assessment

Prepared for:

Sikeston BMU
Board of Municipal Utilities

Sikeston Power Station
1551 West Wakefield Avenue
Sikeston, MO 63801

October 15, 2021

Sikeston Board of Municipal Utilities
Sikeston Power Station
Bottom Ash Pond
Periodic Structural Stability Assessment

October 15, 2021

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1.0 INTRODUCTION

In accordance with the scope of services outlined in the Sikeston Board of Municipal Utilities (SBMU) Work Order No. 39 dated August 11, 2021, GREDELL Engineering Resources, Inc. (Gredell Engineering) completed a periodic review and update of the 2016 structural stability assessment for the SBMU Sikeston Power Station (SPS) Bottom Ash Pond, a coal combustion residual (CCR) surface impoundment update as specified under 40 CFR 257.73(f)(3). The purpose of this assessment was to determine if the Bottom Ash Pond was designed, constructed, operated, and maintained in a manner consistent with recognized and generally accepted good engineering practices under the Federal CCR rule, section (§) 40 CFR 257.73(d). This report describes Gredell Engineering's assessment for the Bottom Ash Pond and includes the required certification by a qualified professional engineer stating the periodic review of the 2021 structural stability assessment was conducted in accordance with §257.73(d).

1.1 40 CFR §257.73(d) Periodic Structural Stability Assessment

§257.73(d), which requires the initial and periodic review of the initial structural stability assessment completed by Gredell Engineering, is provided for reference below.

(d)(1) The owner or operate of the CCR unit must conduct initial and periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with:*

(d)(1)(i) Stable foundations and abutments;

(d)(1)(ii) Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;

(d)(1)(iii) Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;

(d)(1)(iv) Vegetated slopes of dikes and surrounding areas not to exceed a height of six inches above the slope of the dike, except for slopes which have an alternate form or forms of slope protection; [** SEE COMMENT ON APPLICABILITY AT THE END OF SECTION 1.1.]

(d)(1)(v) A single spillway or combination of spillways configured as specified in paragraph (d)1(v)(A) of this section. The combined capacity of all spillways must be designed, constructed,

operated, and maintained to adequately manage flow during and following the peak discharge from the event specified in paragraph (d)(1)(v)(B) of this section;

(d)(1)(v)(A) All spillways must be either: (1) of non-erodible construction and designed to carry sustained flows; or (2) Earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected.;

(d)(1)(v)(B) The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a: (1) Probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or (2) 1000-year flood for a significant hazard potential CCR surface impoundment; or (3) 100-year flood for a low hazard potential CCR surface impoundment;

(d)(1)(vi) Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure;

(d)(1)(vii) For CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body;

(d)(2) The periodic assessment described in paragraph (d)(1) of this section must identify any structural stability deficiencies associated with the CCR unit in addition to recommending corrective measures. If a deficiency or a release is identified during the periodic assessment, the owner or operator unit must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken;*

(d)(3) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the initial assessment and each subsequent periodic assessment was conducted in accordance with the requirements of this section.

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* § 257.73(f)(3) For Haz Class, Structural, & Safety factor indicates that the periodic assessments must be completed once every five (5) years.

**COMMENT ON APPLICABILITY OF 40 CFR §257.73(d)(1)(iv):

> **§257.73(d)(1)(iv) was remanded with vacatur by the United States Court of Appeals for the District of Columbia Circuit on June 14, 2016. EPA published a proposed rule in the March 15, 2018 Federal Register with the stated intent, among three (3) other items, to "determine the requirement for proper height of woody and grassy vegetation for slope protection". A public hearing on the rule was held in April 2018. However, EPA's final rule

published in the July 30, 2018 Federal Register stated, "In this action, Agency will not be taking final action on any of the proposed amendments. As explained previously, provisions from the proposed rule that are not addressed in this action will be addressed in a subsequent rule-making action." However, there is no public record that a "subsequent rule-making action" was ever proposed. Based on the above information, and recollection of the development of CCR requirements since 2016, Gredell Engineering's understanding and conclusion is that the Bottom Ash Pond is currently not subject to the maximum vegetation height requirement stipulated in §257.73(d)(1)(iv).

2.0 BOTTOM ASH POND DESCRIPTION

SPS is located west of the City of Sikeston, south of West Wakefield Avenue, and east of Route BB in Scott County, Missouri. The Bottom Ash Pond at SPS resides to the southeast of SPS, and directly south of SPS's coal pile and inactive Fly Ash Pond.

The maximum water surface of the Bottom Ash Pond is approximately 61 acres. Based on an aerial survey conducted by Surdex Corporation on May 06, 2012, the top of berm elevation was found to be consistent with a minimum berm elevation of 322.3 feet and a maximum berm elevation of 322.6. Visual observations of the entire top of berm made during a site visit on September 16, 2021, indicate that top of berm has not been modified and has not noticeably settled in the past 5-years. An updated ground survey was completed by Bowen Engineering and Surveying on October 14, 2021, the top of berm elevations were spot checked and found the minimum elevation on the top of the berm to be 322.2 feet.

Bottom Ash Pond has an approximate remaining capacity of 304 acre-feet (ac-ft) or 13,231,000 cubic feet (ft^3).

SPS is located at a transition between agricultural and urban areas and the Bottom Ash Pond is located southeast of the main facility. Agricultural, commercial, and residential areas surround the Bottom Ash Pond. Residential areas are located approximately 150 feet east/southeast of the Bottom Ash Pond. Commercial areas are located approximately 700 feet south of the Bottom Ash Pond. The main SPS facility is located to the east/northeast and north of the eastern half of the Bottom Ash Pond. The Fly Ash Pond is located north of the western half of the Bottom Ash Pond. Areas to the east and north of the main SPS facility are agricultural land. There is City-owned property to the east, south, and west of the Bottom Ash Pond. Reference Figure 1 – Aerial Overview, for an aerial image of the SPS facility with focus on the Bottom Ash Pond.

3.0 STRUCTURAL STABILITY ASSESSMENT

The Federal CCR Rule requires an initial and periodic structural stability assessment for existing CCR surface impoundments. Periodic structural stability assessments shall be conducted every five years. Structural stability assessments must document whether the design, construction, operation, and maintenance of the CCR surface impoundment is consistent with recognized and generally accepted good engineering practices.

3.1 Foundations and Abutments

The SPS facility was designed in the 1970s and construction was completed circa 1980. Gredell Engineering reviewed design documents (plans and specifications) and construction records in 2016. A summary of this review may be found in the Sikeston Board of Municipal Utilities, Sikeston Power Station, Bottom Ash Pond, History of Construction, Appendix C – Historical Construction Specifications (Gredell Engineering 2016c).

The foundation soils for the Bottom Ash Pond consist of existing soils or fills compacted to support the finished construction of the Bottom Ash Pond. Topsoil and soil with unsuitable material was stripped to a minimum depth of 6 inches. The stripped surface was further excavated or filled to the desired grades. The foundation soils beneath the berms of the Bottom Ash Pond consist of silty sand (SM) and fine to medium course sand (SP) (Geotechnology 2011).

The foundation soils where designed to be compacted in accordance with the construction specifications to a 95 percent (%) maximum density at optimum moisture for silty sands and 70% relative density for sands prior to the construction of any features of the Bottom Ash Pond.

During the September 16, 2021 site visit, no changes were observed to the berms and abutments, indicating that no change has occurred in the foundation soils. Also, no modifications to the berms or abutments were noted. Based on this information and referenced prior reports, no deficiencies were found during the current review of the assessment of the foundations and abutments of the Bottom Ash Pond. Therefore, no corrective measures are recommended.

3.2 Slope Protection

The Bottom Ash Pond has sufficient slope protection on the interior and exterior slopes to protect against various methods of erosion which may cause detrimental effects to the berms of the Bottom Ash Pond. The interior slopes of the bottom ash are protected from surface erosion and wave action by vegetative growth and riprap. Aerial photography obtained by Surdex Corporation on May 06, 2012 depicted riprap along the interior slopes to an observed water line elevation of 315 feet). On September 16, 2021, riprap was visible from the top of the berms to a water line elevation of 318.5 feet. No deterioration or modifications to the interior slopes of the berm was noted. The exterior slopes of the Bottom Ash Pond berms are protected from erosion by a hardy, consistent grassy vegetative cover.

No deficiencies were found during the assessment of the slope protection measures for the Bottom Ash Pond, therefore, no corrective measures are recommended.

3.3 Berm Stability

As stated in the Initial Structural Stability Assessment in 2016:

> *The berms of the Bottom Ash Pond were constructed on top of the prepared foundation soils. The berm fill material consists of fine sands and silty sands (SP and SM) (Geotechnology 2011). The berm fill materials were designed to be placed and compacted in accordance with the construction specifications to 70 percent relative density. The berms were constructed with 2 horizontal to 1 vertical slopes (2H:1V). The design finished top elevation of the berms was 322 feet.*
>
> *A global stability evaluation was conducted by Geotechnology in 2011 on the Bottom Ash Pond berms provide information on the stability of the berms for decision making purposes. The evaluation included four borings in the berms of the Bottom Ash Pond. The standard penetration tests for the borings equates to an average N value of 22 which correlates to a medium-dense compaction for the berm material. An N value of 22 indicates the berms were mechanically compacted during construction.*
>
> *The global stability evaluation, assessed a range of loading conditions in the Bottom Ash Pond. The evaluation was conducted for steady state seepage at normal pool (elevation 317 feet), steady state seepage at maximum pool (elevation 321.5 feet), and pseudo-static conductions for seismic loading (elevation 317 feet). The calculated factors of safety for each condition were determined to be 2.1 (steady state, normal pool) and 1.5 (steady state, maximum pool), and 1.3 (pseudo-static, normal pool) (Geotechnology 2011). A factor of safety less than 1 would indicate an unstable condition in the berms.*
>
> *Based on the available geotechnical data and analyses of the Bottom Ash Pond, it is determined the dikes of the Bottom Ash Pond were mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit. Additionally, no evidence has been found or observed that leads Gredell Engineering to believe the specifications were not followed.*

Based on an aerial survey conducted by Surdex Corporation on May 06, 2012, the top of berm elevation was found to be consistent with a minimum berm elevation of 322.3 feet and a maximum berm elevation of 322.6. Visual observations of the entire top of berm made during a site visit on September 16, 2021, indicate that top of berm has not been modified and has not noticeably settled in the past 5-years. An updated ground survey was completed by Bowen Engineering and Surveying on October 14, 2021, the top of berm elevations were spot checked and found the minimum elevation on the top of the berm to be 322.2 feet.

A visual inspection of the berms of the Bottom Ash Pond completed on September 16, 2021 identified an area of saturated soil along the northern berm of the Bottom Ash Pond and west of the Fly Ash Pond. The area was previously identified by SPS personnel as an area of persistent wet conditions from rainfall due to the lack of drainage along the toe of the slope of the Bottom Ash Pond. It was also identified by Gredell Engineering in 2016 during the initial Structural Stability Assessment and has also been noted annually by Gredell Engineering during annual pond inspections. The wet ground conditions have been observed to begin approximately midway on the exterior slope of the berm (approximate elevation of 314 feet) and continued to the toe of the exterior slope of the berm. The type of grass vegetation has been visually observed to change along a horizontal line along the exterior slope of the berm that generally matched the beginning of the wet conditions. Simple manual field techniques were also used to confirm the observations and conclusion of the wet conditions.

Although precipitation may have occurred in the two weeks preceding the most recent observation, overall the past 6 to 8 weeks have been dry. Due to the sparsity of recent precipitation, the saturated condition of the soil observed again on September 16, 2021 may be the result of limited seepage through the northern berm from the Bottom Ash Pond. However, no visible flow, erosion or slope movement was observed. It is noted that Reitz & Jens, Inc., Gredell Engineering's subconsultant recently re-analyzed the stability of a critical section of the Bottom Ash Pond berm using an unsaturated condition as a part of this periodic Safety Factor Assessment. The calculated minimum Factors of Safety exceeded the minimum required by the CCR rule.

Based on the continued observations, rationale described above and the recent stability analysis, the saturated area of the exterior of the northern berm of the Bottom Ash Pond is not considered deficient under the rule. Consistent with recognized and generally accepted good engineering practices, as well as observations over the past 6 years by Gredell Engineering, it is recommended that routine observation of this area continue. Should future, observed conditions change (e.g., more seepage, soil erosion or movement of the exterior slope), corrective measures should be undertaken by SBMU to eliminate or minimize the potential seepage or to stabilize the northern berm of the Bottom Ash Pond. Any future evaluation should recommend appropriate corrective measures to stabilize and/or repair the northern berm of the Bottom Ash Pond. At a minimum, future actions should be taken, as required, to maintain the conditions for future routine maintenance (i.e., mowing) and ongoing observations.

3.4 Maximum Vegetation Height Requirement

As stated above, §257.73(d)(1)(iv) was remanded with vacatur by the United States Court of Appeals for the District of Columbia Circuit on June 14, 2016. EPA published a proposed rule in the March 15, 2018 Federal Register with the stated intent, among three (3) other items, to "determine the requirement for proper height of woody and grassy vegetation for slope protection". A public hearing on the rule was held in April 2018. However, EPA's final rule published in the

July 30, 2018 Federal Register stated “In this action, Agency will not be taking final action on any of the proposed amendments. As explained previously, provisions from the proposed rule that are not addressed in this action will be addressed in a subsequent rule-making action.” However, there is no public record that a “subsequent rule-making action” was ever proposed. Based on the above information, and recollection of the development of CCR requirements since 2016, Gredell Engineering’s understanding and conclusion is that the Bottom Ash Pond is currently not subject to the maximum vegetation height requirement stipulated in §257.73(d)(1)(iv).

3.5 Spillway Design and Capacity*

Discharge from the Bottom Ash Pond is through a concrete stop-log structure with dimensions of 6 feet wide, 11 feet long, and 8.5 feet deep with a top elevation of 322.53 feet (the active spillway). The active spillway does not currently utilize stop-logs. The active discharge pipe is a single, 10-inch carbon fiber pipe that discharges Bottom Ash Pond effluent into the Process Waste Pond. The discharge pipe inlet and outlet invert elevations are 314.53 feet and 304.97 feet, respectively. The discharge pipe is routed from the discharge structure to a control valve with an invert elevation of approximately 306.3 feet. The distance from the discharge structure to the control valve is approximately 80 feet and the slope of the discharge pipe is approximately 10.3%. From the control valve, the discharge pipe flows to the Process Waste Pond over a distance of approximately 1,820 feet with a slope of approximately 0.07%. Average daily and monthly maximum flow rates from the Bottom Ash Pond to the Process Waste Pond are reported to be 1.22 million gallons per day (MGD) and 2.13MGD, respectively, as identified in SBMU’s NPDES permit process flow diagram.

The Bottom Ash Pond was built with a second overflow structure that includes a concrete inlet on the north berm of the pond that connects to a 30-inch corrugated metal discharge pipe that flows north through the berm and originally discharged in the inactive Fly Ash Pond. The overflow structure originally discharged into the inactive Fly Ash Pond. However, the overflow structure is currently inoperable due to excess CCR deposits within the inactive Fly Ash Pond that obstruct the north (discharge) end of the 30-inch pipe. This condition has been noted during site inspections in the past.

*[The specific information above was primarily taken from the 2016 History of Construction prepared by GREDELL Engineering Resources, Inc. Noted observations are from September 16, 2021.]

The hazard potential classification for the Bottom Ash Pond was determined by modeling a worst-case probable scenario breach of the Bottom Ash Pond Berms and its resulting floodwaters impact on the surrounding land using HydroCAD. The most recent HydroCAD model results are found in Gredell Engineering’s Periodic Hazard Potential Classification Assessment report dated October 15, 2021. The most recent HydroCAD model results are summarized below:

- The Bottom Ash Pond at SPS was classified as Significant. As stated above, §257.73(d)(1)(v)(B)(2) requires the inflow design flood for CCR surface impoundments with significant hazard potential classifications to be the 1,000-year flood (Gredell Engineering Resources, 2016a, 2021a). The 1,000-year flood is the volume of runoff generated by the 1,000-year rainfall event for a given location. The 1,000-year, 24-hour rainfall event was modeled to determine if the existing Bottom Ash Pond and its associated discharge structures are negatively impacted by the discharge from the Bottom Ash Pond. From the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 8, Version 2, the 1,000-year, 24-hour precipitation event for Sikeston, Missouri is 12 inches of rainfall.
- The peak discharge from the combined process wastewaters and the 1,000-year flood was determined to be 967 cubic feet per second (CFS) with a total influent volume of 2,622,500 ft^3 (19.6 MG). The maximum water elevation in the Bottom Ash Pond from the combined influents was determined to be 320.3 feet, 1.7 feet below the top of the Bottom Ash Pond berms (elevation 322 feet).
- The current capacity of the Bottom Ash pond with 61 acres area and 1.7 feet of storage is approximately 4,517,000 ft^3. The peak discharge from the Bottom Ash Pond during the 1,000-year inflow design flood was determined to be 1.78 CFS (1.15 MGD).
- The Bottom Ash Pond active discharge pipe has adequate hydrologic and hydraulic capacity to manage flow during and following the peak discharge from the inflow design flood (1000-yr flood), as required by §257.73(d)(1)(v) (Gredell Engineering Resources, 2016b, 2021b). Therefore, no regulatory or engineering deficiencies were found during the assessment of active spillway of the Bottom Ash Pond.
- The overflow structure (emergency spillway) between the Bottom Ash Pond and the Fly Ash Pond was found to be deficient in 2016 because it is inoperable due to excess fly ash at the discharge of the 30-inch corrugated metal pipe impeding the flow path of water from the Bottom Ash Pond. Consistent with recognized and generally accepted good engineering practices, it would normally be recommended that corrective measures be taken to either remove the accumulated CCR from the discharge end of the overflow structure, or construct an alternate overflow structure capable of adequately managing flow during and following the peak discharge from the design flood event. However, due to the requirements of current federal CCR rules to close the Bottom Ash Pond in the next few years, as well as the ability of the active discharge pipe to manage the flow of the 1000-yr flood, the inoperable overflow structure is not considered deficient at this time.

3.6 Structural Integrity of Hydraulic Structures

As stated above, §257.73(d)(1)(vi) requires the structural integrity of hydraulic structures passing through or beneath a CCR surface impoundment to be maintained in a manner to prevent conditions which negatively affect the operation of the hydraulic structure.

3.6.1 Identified Hydraulic Structures

The Bottom Ash Pond has multiple hydraulic structures pass through the upper portions of the berms (generally above operating water levels in the pond) and one hydraulic structure passing beneath the CCR surface impoundment. Hydraulic structures passing through the berms of the Bottom Ash Pond Include:

- Overflow Structure: 30-inch corrugated metal pipe passing through the northern berm between the Bottom Ash Pond and the Fly Ash Pond (approximate 318.25 feet invert elevation). ***The invert elevation of this pipe was observed to be above the pond elevation on September 16, 2021.***
- Primary Discharge Pipe: 10-inch carbon fiber pipe passing through the northern berm of the Bottom Ash Pond, discharging into the Process Waste Pond (approximate 314.5 feet invert elevation).
- Makeup Water Inlet: 8-inch iron pipe passing through the northern berm of the Bottom Ash Pond from the Fly Ash Pond (approximate 321.5 feet invert elevation).

Multiple hydraulic structures are buried on top of, or lie on top of the berm along the interior of the Bottom Ash Pond, but do not pass completely through the berms.

The following pipes are laid in concrete lined pipe trenches up the exterior slopes, then along and across the top of the berms to the interior of the Bottom Ash Pond. Once within the interior of the Bottom Ash Pond, the pipes are either re-buried or lay above grade. All pipes through the berms, with the exception of the Bottom Ash Pond’s active discharge pipe and inoperable overflow structure, are located above the normal water level of the Bottom Ash Pond (approximate elevation 318.5 feet).

- Bottom Ash Transport Water Inlet: estimated 8 to 10-inch iron pipe (the end of the pipe was physically inaccessible for direct measurement);
- Plant Operations Wastewater Inlet: 12-inch iron pipe;
- Pipe Trench Sump Discharge Pipe: 4-inch PVC pipe;
- Former Transport Water Inlets: Dual, 3-inch iron pipes;

The Bottom Ash Pond was constructed with twin, 2,140-foot long culverts passing beneath the compacted clay liner to convey stormwater in an existing waterway from the eastern side of the Bottom Ash Pond to the western side. The stormwater culverts were located in the same location and along the same trajectory as the original Compress Road, which was vacated and removed during the construction of the Bottom Ash Pond. The purpose of the twin stormwater culverts is to maintain the gravity flow of off-site stormwater (originating on the east side of the Bottom Ash Pond) to the west side of the Bottom Ash Pond, eventually discharging into Ditch #4 which runs just outside of the west fence of the power plant facility. The stormwater culverts were constructed as continuously reinforced concrete box culverts with inside dimensions of 5 feet tall by 8 feet wide for approximately 2,090 feet (measured from the east inlet toward the west discharge. The westernmost 50 feet (+/-) of the stormwater culverts are constructed of oval corrugated metal arch-pipe with approximate inside dimensions of 4 feet tall by 6.5 feet wide. The inlet and discharge elevations are recorded as 301.9 feet and 297.7 feet, respectively.

3.6.2 Structural Integrity of Identified Hydraulic Structures

Visual observation of each hydraulic structure passing through or beneath the berms of the Bottom Ash Pond was completed on September 16, 2021, where visible. The observations considered operating status (active or inactive), structural integrity, significant deterioration and deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively impact the operation of the hydraulic structure. The results of the visual inspection are described below.

- Overflow Structure: The concrete headwall of the overflow structure was in good condition with no visual signs of deterioration. The iron shear gate and inlet of the 30-inch corrugated metal pipe appeared to be in good condition with no visual signs of deterioration. The discharge of the 30-inch corrugated metal pipe was not identified due to buried by excessive CCR accumulation at the discharge end in the inactive the Fly Ash Pond. The excessive CCR accumulation negates the functionality of the overflow structure. The inoperable overflow structure is not determined to be a deficiency because the active discharge structure adequately manages flow during and following the peak discharge from the design flood event (the 1,000-year flood). The overflow structure also sits at an elevation generally above the normal operating pool of the Bottom Ash Pond.
- Active Discharge Structure: The concrete discharge structure that includes the 10-inch carbon fiber discharge pipe appeared in good condition with no visual signs of deterioration. The inlet of the 10-inch discharge pipe was beneath the water surface and therefore, not directly observed. The control valve serving the discharge was observed to be in good condition and was reported to have been recently operated per plant personnel. The discharge of the 10-inch carbon fiber pipe was previously moderately deteriorated, but was not observed during the most recent site visit. The past deterioration did not compromise the operation of the discharge pipe, which is to allow effluent to flow into the process pond in a controlled manner.
- Makeup Water Inlet: The 8-inch iron pipe passing through the northern berm of the Bottom Ash Pond from the Fly Ash Pond appeared in good condition with no visual signs of deterioration. The inlet and discharge ends of the pipe showed no signs of deterioration and the inlet valves were observed and reported to be in operating condition. The

discharge end of the pipe is well above normal operating levels. The pipe is reported to be inactive.

- Bottom Ash Transport Water Inlet: The bottom ash transport pipe was estimated at 8 to 10-inches in diameter. An exact determination was not possible because the inlet discharge end of the pipe is inaccessible. A portion of the bottom ash transport water pipe is located below grade within the northwest portion of the berm after rising from within the concrete lined pipe trench. The discharge end of the pipe was 2-feet or more above the current water level in the Bottom Ash Pond and was not discharging at the time of observation. The transport pipe appeared to be in good condition within the concrete lined pipe trench and at its discharge location in the Bottom Ash Pond. The concrete lined pipe trench did not appear to show any signs of significant deterioration.
- Plant Operations Wastewater Inlet: The plant operations wastewater 12-inch iron inlet pipe was observed to be in good condition within the concrete lined pipe trench. The plant operations wastewater inlet pipe is located below grade within the northwest portion of the berm after rising from within the concrete lined pipe trench. The discharge end of the pipe was showed signs of slight deterioration due to corrosion. The deterioration of the discharge end of the pipe does not compromise the operation of the inlet pipe.
- Pipe Trench Sump Discharge Pipe: The pipe trench sump discharge pipe (a 4-inch PVC pipe that runs along the top of the Bottom Ash Pond berm) was observed to be in good condition with no signs of deterioration. The PVC pipe is not located below grade at any point along its path within the boundary of the CCR Surface Impoundment.
- Dual Inactive Transport Water Inlets: The two inactive transport water inlet (3-inch) iron pipes are not located below grade at any point along their path, and therefore, were not evaluated as part of this periodic structural stability assessment.

A visual inspection of the dual stormwater culverts located beneath the compacted clay liner of the Bottom Ash Pond was conducted in person (for the first 100 to 200 feet) and via remote video operations for the entire length of the pipes. Each stormwater culvert was inspected independently. A complete inspection of both stormwater culverts was accomplished. Sediments were observed in the western ends of both stormwater culverts. Approximately 350 feet of sediment was observed in the northern culvert and approximately 500 feet of sediment was observed in the southern culvert. The southern culvert was also found to have two tires present in the last 100 +/- feet of the western end of the southern culvert. The observed condition of both sections of the stormwater culverts were observed to be consistent with the prior video inspection in 2016. The most recent observations are discussed below.

The continuously reinforced concrete box culvert sections of the stormwater culverts were observed to overall be in good condition. All surfaces of the concrete sections of the stormwater culverts were visible from the inlet and outlet of each culvert except where the bottom of the continuously reinforced concrete box culverts was obscured by sediment deposits. Maximum estimated thickness of sediments were 6-inches or less in depth. Recurring normal concrete shrinkage cracking in the top of both stormwater culverts was observed at regular intervals. No apparent separation or displacement of the concrete was observed. Minor seepage and calcification were observed at each crack. Cracking along the exterior vertical walls of the concrete box culvert was observed. Where cracking was present in the vertical walls, seepage and calcification were present, but heavy flows were not observed. No deterioration was observed along the bottom of the concrete sections of the stormwater culverts where it was visible and not obscured by sediments.

Debris was identified in the concrete sections of the stormwater culvert in the form of random individual stones (possibly from the riprap at the east inlet) and two tires in the south culvert that are presumed to have floated into the culvert during heavy precipitation events. The observed minor shrinkage cracking of the concrete sections of the stormwater culvert do not negatively affect the structural integrity nor the operation of the hydraulic structures. The sediment within the concrete section of the stormwater culverts slight reduces the hydraulic capacity and flow velocity within the stormwater culverts. However, the percentage of the total cross sectional area of the stormwater culverts is less than 10% for the reinforced concrete box culvert sections. The flat topography surrounding the Bottom Ash Pond is not anticipated to result in inundation of the Bottom Ash Pond due to the slightly reduced hydraulic capacity of the structure. Based on the past 6 years of observations, the sediment appears to flush out of the culverts during heavy precipitation events. Therefore, the sediment in the stormwater culverts is not considered a deficiency.

One factor in the sedimentation of the stormwater culverts in 2016 was that the bottom elevation of the grassed lined channel downstream of the discharge of the stormwater culverts was observed to be higher than the invert discharge elevation of the stormwater culverts. The elevation of the grass-lined channel reduces the velocity of water discharging from the stormwater culverts, resulting in sedimentation within the culverts. The elevation of the bottom of the grass-lined channel negatively affects the operation of the stormwater culverts by reducing the discharge velocity of stormwater from the stormwater culverts. Therefore, the elevation of the bottom of the grass-lined channel was previously identified as a deficiency and we recommended that the earthen discharge channel immediately downstream of twin culverts be dug out to create a sediment trap and to allow water to freely flow out of the discharge ends of the culverts. The plant implemented the past recommendation and the sediment trap appeared to allow the culverts to ‘self-clean’ sediments from the discharge end of the culverts during heavy precipitation events. During the recent site visit (2021) the sediment trap was again becoming full of sediment and debris (including tires). Therefore, we recommend that accumulated sediment be removed from the last 100 to 200 feet of the earthen discharge channel to allow sediments to hydraulically flush out of the western ends of the twin culverts.

The final approximately 50 feet (2,090 to 2,140 feet) of each stormwater culvert was constructed with corrugated metal pipe. The northern stormwater culvert remains in good condition with minimal deterioration. The southern stormwater culvert remains in good condition except for two locations previously noted where seams near the top of the corrugated metal pipe have separated. The bituminous lining of both the corrugated metal culverts has deteriorated and the long-term potential is that the metal culverts may deteriorate over time. The separated seams of the southern stormwater culvert are identified as a deficiency. However, it is noted that the approximately 50 feet of corrugated pipe is located outside of the footprint of the actual Bottom Ash Pond. So long-term deterioration of the metal culvert is not expected to cause a release from the Bottom Ash Pond. But the long-term deterioration of the southern metal culvert pipe section could result in a significant reduction in the hydraulic capacity of the southern culvert, resulting in potential inundation of the culverts.

Consistent with recognized and generally accepted good engineering practices, it is recommended corrective measures be taken to address the deficiencies identified in the hydraulic structures passing through or beneath the berms of the Bottom Ash Pond. The identified deficiencies and recommended corrective measures are as follows:

- Repair the separated seams of the corrugated metal pipe section in the southern stormwater culvert.

Previous corrective measures taken following the 2016 Structural Stability Assessment to lower the grade of the grass lined channel at the discharge end of the twin culverts was successful in allowing the culverts to self-clean during heavy precipitation events. Therefore, it is again recommended that the first 100 feet (minimum) of the grass lined channel be excavated to a depth of two (2) feet or more below the discharge elevation of the stormwater culverts to allow complete discharge of the stormwater culverts following a rainfall event. The excavation of the channel will also provide a sediment trap for the deposition of sediments in the stormwater flow. In addition, it is recommended to remove the debris (primarily tires) from within the south stormwater culvert if the twin culverts do not ‘self-clean’.

3.7 Downstream Inundation and Sudden Drawdown

As stated above, §257.73(d)(1)(vii) requires the structural integrity of the CCR unit must be maintained during low pool of the adjacent water body or sudden drawdown of the adjacent water body. The exterior slopes of the Bottom Ash Pond berms are not subject to inundation by an adjacent water body. Therefore, the structural integrity of the Bottom Ash Pond was not assessed for low pool or sudden drawdown of an adjacent water body.

3.8 Miscellaneous Assessed Site Features

Various site features which are present in or near the Bottom Ash Pond were assessed in 2016 for their impact on the structural stability of the Bottom Ash Pond. Various identified site features are as follows:

- Three electrical manholes were identified along the northern berm of the Bottom Ash Pond. The manholes are reported by SBMU personnel to support the original power supply that powered the original scrubber sludge pump station located in the northeast corner of the Bottom Ash Pond. The electrical manholes and the associated electrical conduit run parallel to the centerline of the berm, do not pass through the berm and therefore are not found to be detrimental to the structural integrity of the Bottom Ash Pond Berms.
- Three 10-inch iron pipes were identified along the interior of the eastern berm of the Bottom Ash Pond. The iron pipes do not penetrate the berms of Bottom Ash Pond. SPS personnel identified the pipes as former aeration lines. The pipes observed were laid on the bottom of the Bottom Ash Pond, as reported by SPS personnel. The aeration lines were connected with a header pipe that ran along the inside of the northern half of the east berm. The aeration system was operated during the early years of operation to treat odors, but have not been used in recent years and are not anticipated to be used in the future.
- A pit was observed in the deposited CCR materials in the southwest portion of the Bottom Ash Pond. The pit was 50 to 80 feet in horizontal dimension, approximately 10+/- feet deep and at least 20 feet inward of the Bottom Ash Pond berms. The pit was identified by SPS personnel as an excavation used to obtain a quantity of CCR materials for off-site testing for potential beneficial use. The pit was not backfilled and had vegetation growing around the perimeter.

These features were observed on September 16, 2021 and were found to be in the same conditions as found 5 years prior. No deficiencies or recommendations are noted for these features.

4.0 RECOMMENDED CORRECTIVE MEASURES SUMMARY

As stated above, §257.73(d)(2) pertaining to CCR surface impoundments states each periodic assessment must identify any structural stability deficiencies associated with the CCR surface impoundment and recommend corrective measures. The one deficiency identified and the recommended corrective measure is summarized below:

- The southern stormwater culvert appears to be in good condition except for two locations where seams near the top of the corrugated metal pipe have been damaged and separated. The bituminous lining of both the corrugated metal culverts is cracking and deteriorating and could no longer function properly. Therefore, the separated seams of the southern stormwater culvert are identified as a CCR rule deficiency.

  Gredell Engineering recommends repair of the separated seams of the southern corrugated metal pipe section in the southern stormwater culvert to prevent long-term deterioration of the metal pipe sections.

No other deficiencies were identified in the 2021 Periodic Structural Stability Assessment process.

5.0 MISCELLANEOUS REQUIREMENTS

Section 257.73(g) states that SBMU must comply with:

- The recordkeeping requirements specified in 257.105(f);
- The notification requirements specified in 257.106(f); and,
- The Internet requirements specified in 257.107(f).

6.0 REFERENCES

Geotechnology Inc., 2011. "Global Stability Evaluation Fly Ash and Bottom Ash Ponds Sikeston Power Station Sikeston, Missouri."

Gredell Engineering Resources, Inc., 2016a, "Sikeston Board of Municipal Utilities Sikeston Power Station Bottom Ash Pond Hazard Potential Classification Assessment."

Gredell Engineering Resources, Inc., 2016b, "Sikeston Board of Municipal Utilities Sikeston Power Station Bottom Ash Pond Inflow Design Flood Control System Plan."

Gredell Engineering Resources, Inc., 2016c, "Sikeston Board of Municipal Utilities Sikeston Power Station Bottom Ash Pond History of Construction."

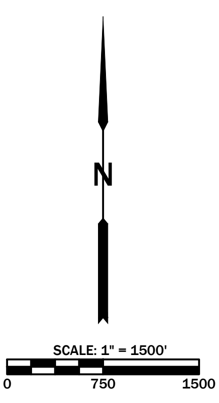
Gredell Engineering Resources, Inc., 2021a, "Sikeston Board of Municipal Utilities Sikeston Power Station Bottom Ash Pond Hazard Potential Classification Assessment."

Gredell Engineering Resources, Inc., 2021b, "Sikeston Board of Municipal Utilities Sikeston Power Station Bottom Ash Pond Inflow Design Flood Control System Plan "

Sikeston Board of Municipal Utilities, 2018, "Sikeston Power Station Missouri State Operating Permit, MO-0095575."

APPENDIX A

Figures



NOTES:

1. PROPERTY LINE TAKEN FROM THE SCOTT COUNTY ASSESSOR'S WEBSITE (SCOTTGIS.COUNTYPORTAL.NET) 6-8-15
2. IMAGE PROVIDED BY BING MAPS 2020 IMAGE

LEGEND

SBMU PROPERTY LINE (APPROXIMATE)	——PL——
SIKESTON RIDGE	—— —— ——

STRUCTURAL STABILITY ASSESSMENT
BOTTOM ASH POND
SIKESTON POWER STATION

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING LAND - AIR - WATER
1505 East High Street Telephone: (573) 659-9078
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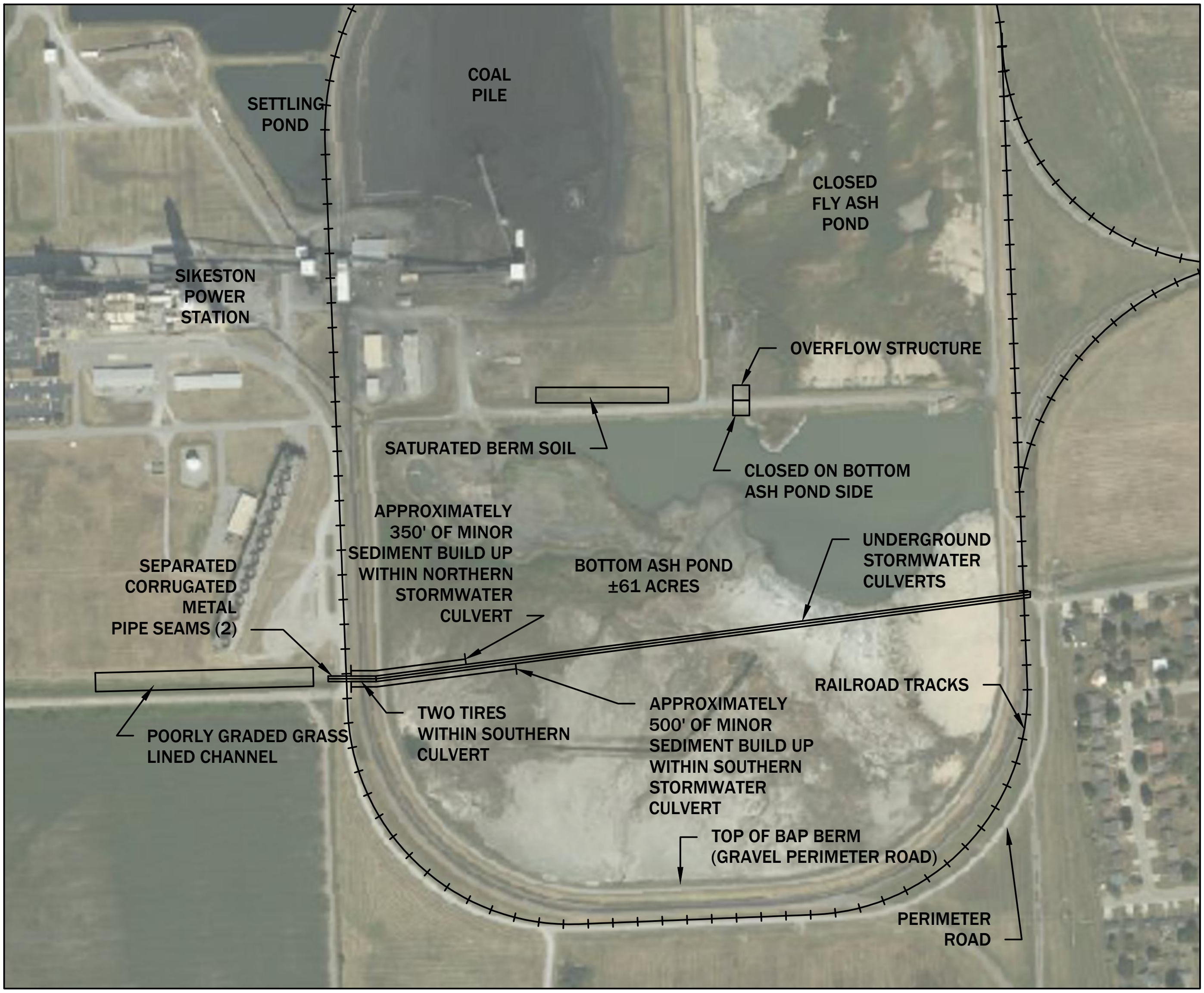
MO CORP. ENGINEERING LICENSE NO. E-2001001669-D

FIGURE 1 - AERIAL OVER VIEW

DATE	SCALE	PROJECT NAME	REVISION
10/2021	AS NOTED	SIKESTON	
DRAWN	APPROVED	FILE NAME	SHEET #
AMM	TRG	STRUC STAB ASSMNT	1 OF 2



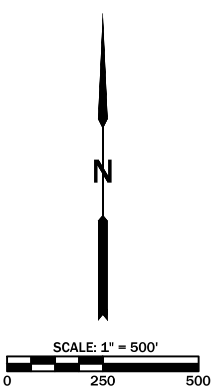


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FIGURE 2 - BOTTOM ASH POND FEATURES OF INTEREST

DATE	SCALE	PROJECT NAME	REVISION
10/2021	AS NOTED	SIKESTON	
DRAWN	**APPROVED**	**FILE NAME**	**SHEET #**
AMM	TRG	STRUC STAB ASSMNT	2 OF 2