October 17, 2018

Big Rivers Electric Corporation
Sebree Generating Station
9000 Highway 2096
Robards, Kentucky 42452

Engineer’s Certification of Placement Above the Uppermost Aquifer
Existing Green CCR Surface Impoundment
EPA Final CCR Rule
Sebree Station
Robards, Kentucky

1.0 PURPOSE
The purpose of this document is to certify that the Placement above Sebree “Green” Existing CCR Surface Impoundment is in compliance with the Placement above the Uppermost Aquifer requirement of the Final CCR Rule at 40 CFR §257.60. Presented below is the project background, summary of findings, limitations and certification.

2.0 BACKGROUND
In accordance with 40 CFR §257.60, the owner/operator of an existing CCR Surface Impoundment must demonstrate that the base of the unit is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table). In accordance with 40 CFR §257.60(c)(1), the demonstration must be made by October 17, 2018. If such demonstration cannot be made, the unit is subject to the closure or retrofit requirements of 40 CFR §257.101

3.0 SUMMARY OF FINDINGS
Available data regarding site groundwater, site geology, and physical limits of the unit for the Green Surface Impoundment do not evidence a 5-foot separation between the base of the impoundment and the uppermost limit of the uppermost aquifer and they do not support a lack of hydraulic connectivity between the unit and the aquifer as specified in 40 CFR §257.60(a). Therefore the unit does not meet the Placement above the Uppermost Aquifer requirement of 40 CFR §257.60(a).
4.0 CERTIFICATION

I, Michael Brian Cole, being a Registered Professional Engineer in good standing in the State of Kentucky, do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, available data do not support a demonstration of Placement above the Uppermost Aquifer that meets the requirements of 40 CFR § 257.60(a).

M. Brian Cole
Printed Name

October 17, 2018
Date

ADDRESS: AECOM
500 W Jefferson St Suite 1600
Louisville, KY 40202

TELEPHONE: (502)-569-2301

ATTACHMENTS: Placement above the Uppermost Aquifer Demonstration for Coal Combustion Residuals
Existing Green CCR Surface Impoundment

Disposal of Coal Combustion Residuals (CCR) from Electric Utilities Final Rule

Placement above the Uppermost Aquifer Demonstration for Coal Combustion Residuals (CCR)

October 17, 2018

Prepared by

AECOM

Project Number: 60570534
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ATTACHMENTS

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1.0 INTRODUCTION

1.1 Objective

The purpose of this demonstration is to document compliance with 40 Code of Federal Regulations (CFR) §257.60 of the Environmental Protection Agency Final Coal Combustion Residual Rule (EPA Final CCR Rule) regarding the Placement above the Uppermost Aquifer Demonstration requirement for the existing “Green” Surface Impoundment at the Big Rivers Electric Corporation (BREC) Sebree Station in Sebree, Kentucky.

1.2 Rule Requirements

As required by 40 CFR §257.60(a) of the EPA Final CCR Rule, any existing CCR Surface Impoundments must be constructed with a base that is located no less than 1.52 meters (5 feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevation. The “uppermost aquifer” is defined by 40 CFR §257.40 as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility’s property boundary. This definition includes a shallow, deep, perched, confined or unconfined aquifer, provided it yields usable water.

The demonstration is due by October 17, 2018 in accordance with 40 CFR §257.60(c)(1). Those Surface Impoundments that cannot demonstrate compliance with the requirement of 40 CFR §257.60(a) are required by 40 CFR §257.60(c)(4) to cease placement of CCR in the unit within 6 months (April 2019).

1.3 Methodology/Background

The demonstration method involves the use of existing documentation of pertinent geologic and hydrogeologic information to develop a conceptual site model (CSM) for the uppermost aquifer inclusive of the definition of its uppermost limit, normal fluctuations in groundwater elevation, and the potential for the aquifer’s hydraulic interconnection with overlying strata and the planned landfill limits. Existing documentation includes state and/or federal geologic maps and water resources publications, the logs of borings drilled on site for geotechnical purposes, the logs of monitoring wells installed on site and in surrounding areas, and design drawings for the unit.

1.4 Site Background

Big Rivers Electric Corporation (BREC) owns and operates the “Sebree” Station in Sebree, Kentucky. The Sebree Station is located in Webster County, approximately 3.2 miles northeast of the town of Sebree, Kentucky situated immediately east of the Pennyrile Parkway approximately 1.5 miles north of the intersection of the Pennyrile Parkway and Kentucky Route 56 (see Figure 1). Sebree Station is composed of 2 Green generating units, one Reid generating unit, and 2 HMP&L generating units. The Green Surface Impoundment is located directly south of the Sebree Station, situated north of the Green CCR Landfill. The current Green Surface Impoundment footprint is approximately 16 acres (Figure 2).
Figure 1: BREC Sebree Site Location

Figure 2: BREC Green Surface Impoundment Site Location
1.5 Site History

The Green Surface Impoundment is a combined incised/dike earthen embankment structure. It is diked on the west, south and east sides, while the north side is incised. The south dike has the greatest height reaching approximately 20 feet. The original ground surface within the Surface Impoundment footprint was irregular and the predominant features were small stream valleys draining eastward to Green River. Most of the central portion of the south dike was constructed on a subdued ridge. The toe of the outboard slope intersected a lower drainage area. Underlying preconstruction soils consisted of Loring-Grenada, Loring-Zanesville-Wellston (Henderson County) and Loring-Wellston-Zanesville (Webster County) soil associations that are generally characterized as well drained to moderately well-drained soils on nearly level to sloping uplands.

The CCR unit has been in place for 40 plus years and is used for the placement of CCR material; currently slurried bottom ash. The immediate watershed that drains to the CCR unit, and in which the CCR unit is considered to be located, is unnamed and 54.13 acres in size. The unnamed watershed discharges from the CCR impoundment outflow structure and is routed to the Green River.

The west dike is generally less than 5-feet in height and the south dike reaches a maximum height of 19.5 feet. The east dike reaches a maximum height of approximately 8 feet and is buttressed with a secondary parallel embankment that serves as a 40-foot wide roadway. The Burns and Roe, Inc., Engineering and Consultants June 30, 1978, site grading plans show the original construction layout and ground contours for the impoundment site. Bottom ash has been placed above the normal pool along the inboard side, essentially creating reclaimed land.

The impoundment discharge consists of two corrugated steel pipes, each 30 inches in diameter. The pipe intakes are through a common concrete headwall collection structure with a variable height steel debris deflector on each pipe intake.

2.0 Geology

The site lies in the Western Kentucky Coalfields, a gently rolling upland. In the vicinity of the site, maximum topographic relief is on the order of 80 feet. Surface drainage is to the south to Groves Creek, a primary tributary to the Green River, and to the east to the Green River.

Published geologic mapping (Murphy, 2007) shows the site to be immediately underlain by unconsolidated loess representing the Pleistocene and Holocene geologic epoch and unconsolidated alluvium representing the Pleistocene and Holocene epochs. The loess reportedly consists of sandy and clayey silt. The alluvium reportedly consists of silt and clay with lesser amounts of sand and gravel.
The unconsolidated materials are shown to be underlain by the base of the Shelburn Formation (formerly identified as the Lisman Formation (Fairer, 1973)) and the Carbondale Formation, both of which represent the Pennsylvanian Geologic Period. The West Franklin Member consists of one to three layers of limestone interbedded by calcareous clay shale, and comprises the top of the Shelburn Formation. The Providence Limestone Member, consisting of limestone and interbedded shale, comprises the base of the Shelburn Formation. The Providence Limestone Member is reportedly absent in much of the area due to erosional channeling. Due to its discontinuous character and the presence of interbedded shale, hydrologically significant karst features are not present in the Providence Limestone Member. The underlying Carbondale Formation consists of cyclic sequences of sandstones, shales, siltstones and coals. The Carbondale sediments were deposited in a fluvial-deltaic system. As a result of this depositional environment, the lithologic units of the Carbondale tend to be lenticular bodies rather than continuous sheet-like strata. Gradational and abrupt horizontal changes in lithology are often encountered.

The structure contours illustrated on the geologic map (Murphy, 2007) are based on the altitude of the No. 9 coal seam, and show the site to lie on the flank of a gentle anticline. Stratigraphic dip is shown to be on the order of 35 feet per mile to the southeast. No faults or other significant structural features are depicted on the geologic map.

### 3.0 Hydrogeology

The stratigraphic interval considered as the most prominent water transmitting zone within and adjacent to the Sebree Generating Station is material identified as the Upper Sandstone Member (Sebree sandstone) of the Carbondale Formation. The United States Geologic Survey (USGS) Geologic Map of the Robards Quadrangle describes the Sebree sandstone sequence as "Siltstone, sandstone, shale and coal: Siltstone, light- to medium-gray, micaceous, thin-bedded, and locally calcareous. Sandstone, light- to medium-gray, grayish- and yellowish-brown, fine- to medium-grained slightly micaceous, thin-bedded to massive; locally fills channels."

For purposes of compliance with the CCR Rule groundwater monitoring requirements; this sequence, and in particular the member sandstone intervals, is considered to be the uppermost aquifer underlying the Green CCR Surface Impoundment.

The sandstone units in the upper Carbondale Formation reportedly can provide well yields of 500 gallons per day (gpd) or greater with some reported yields on the order of 30 gallons per minute [gpm] (Maxwell and Devaul, 1962). The Providence Limestone Member of the Shelburn Formation is reported to yield little to no water to wells. The lower Carbondale Formation, above and below the No. 9 coal seam, consists primarily of shales that reportedly yield little to no water to wells. Previous site-specific investigations, by others, have noted the presence of perched zones of saturation in the overlying unconsolidated materials.
3.1 Groundwater Monitoring System

Three temporary piezometers (P-10, P-11 and P-12) were installed adjacent to, and respectively; northwest, southwest and northeast of the Green CCR impoundment to determine the general direction of groundwater movement. Measured static water levels, from the highest to lowest elevation were observed in P-10 (highest), P-11 and P-12 (lowest) resulting in a calculated hydraulic gradient or apparent direction of groundwater movement is generally from northwest to southeast. This groundwater gradient characterization and the ability to locate monitoring wells specific to the CCR unit justify the placement of the minimum of one upgradient and three downgradient monitoring wells. The upgradient monitoring well (M-11) was installed adjacent to, and northwest of the impoundment. The downgradient monitoring wells (M-12, M-13 and M-14) were installed adjacent to, and respectively; south-southeast, southeast and east-northeast of the impoundment. All monitoring wells are completed in the stratigraphic interval described above. Approximate locations of the groundwater monitoring wells are shown on the Groundwater Monitoring Well Location Aerial Photo (Attachment B). Boring logs and well construction diagrams are presented as Attachment C.

3.2 Groundwater Flow

Water level data were collected from the unit during the nine baseline CCR monitoring events from March 2016 through October 2017 as summarized on Table 1 of Attachment A.

These data and the piezometric surface map presented below (Figure 3) represent general conditions at the Surface Impoundment and support the following analysis.

Overall groundwater flow beneath the footprint of the Green Surface Impoundment is to the east/southeast towards the Green River located east of the impoundment. The hydraulic gradients calculated from seasonal high, mid-point, and low events during the baseline period ranged from 0.0159 to 0.0283 towards the east/southeast as presented in Table 2 of Attachment A.
Figure 3: Green Surface Impoundment - Piezometric Surface Map
4.0 **UPPERMOST AQUIFER**

The “uppermost aquifer” is defined by 40 CFR §257.40 as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility’s property boundary. This definition includes a shallow, deep, perched, confined or unconfined aquifer, provided it yields usable water.

4.1 **Aquifer Characteristics**

Site-specific data pertaining to the aquifer characteristics beneath the Green Surface Impoundment were obtained prior to initiation of this CCR Program.

Available information pertaining to the sandstone units in the upper Carbondale Formation, identified as the uppermost aquifer beneath the Surface Impoundment, generally provide well yields of 500 gpd or greater with some reported yields on the order of 30 gpm (Maxwell and Devaul, 1962). The Providence Limestone Member of the Shelburn Formation is reported to yield little to no water to wells. The lower Carbondale Formation, above and below the No. 9 coal seam, consists primarily of shales that reportedly yield little to no water to wells. Previous site-specific investigations, by others, have noted the presence of perched zones of saturation in the overlying unconsolidated materials.

4.2 **Placement Above the Uppermost Aquifer**

Based on the available boring logs from the monitoring well system, the top of the upper Carbondale Formation (uppermost aquifer) is at an approximately elevation of 363 feet to the northwest (at MW-11), at 348 feet to the northeast (at MW-14), at 351 feet to the east (at MW-13), and not encountered to the southwest (at MW-12) of the Surface Impoundment. Illustrated well boring cross-sections are presented as Attachment B. Based on the interpreted top of the upper Carbondale Formation (uppermost aquifer), the base of the Surface Impoundment (360 feet) rests on or intercepts the uppermost aquifer within the northern most reaches of the Surface Impoundment and does not meet the 5-foot separation of the uppermost aquifer.

Groundwater data provided by BREC via baseline data collection from monitoring wells between March 2016 and October 2017 were used to interpret the elevations of the uppermost aquifer within the area of the Surface Impoundment. Seasonal measurements (April, June, August, October 2016, and January 2017) are presented within the Groundwater Elevation Summary located as Attachment B. Based on the cross sections presented in Attachment B, the potentiometric surface is approximately 5 feet (at MW-12) and 32 feet (at MW-11) above the lowest base of the Surface Impoundment (360 feet) and hydraulic connectivity cannot be disproven.
5.0 CONCLUSIONS

Available data regarding site groundwater, site geology, and physical limits of the unit for the Green Surface Impoundment do not evidence a 5-foot separation between the base of the impoundment and the uppermost limit of the uppermost aquifer and they do not support a lack of hydraulic connectivity between the unit and the aquifer as specified in 40 CFR §257.60(a). Therefore the unit does not meet the Placement above the Uppermost Aquifer requirement of 40 CFR §257.60(a).

6.0 REFERENCES


Geotechnical and other information provided by Associated Engineers, Inc.

Engineering design drawings and other information provided by Big Rivers Electric Corporation.


United States Geological Survey U.S. Geological Survey (USGS) 7.5 minute Robards and Delaware topographic quadrangle maps
Attachments
Attachment A

Tables 1 and 2
<table>
<thead>
<tr>
<th>Date Measured</th>
<th>MW-11 Upgradient/Background</th>
<th>MW-12 Downgradient</th>
<th>MW-13 Downgradient</th>
<th>MW-14 Downgradient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Depth to Water (ft) (feet)</td>
<td>Depth to Water (ft) (feet)</td>
<td>Depth to Water (ft) (feet)</td>
<td>Depth to Water (ft) (feet)</td>
</tr>
<tr>
<td>4/1/2016</td>
<td>8.20 393.12</td>
<td>32.51 363.03</td>
<td>18.86 375.74</td>
<td>22.13 368.58</td>
</tr>
<tr>
<td>6/2/2016</td>
<td>8.32 393.00</td>
<td>29.62 365.92</td>
<td>18.83 375.77</td>
<td>23.01 367.7</td>
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<tr>
<td>8/16/2016</td>
<td>8.45 392.87</td>
<td>27.79 367.75</td>
<td>20.60 374</td>
<td>25.55 365.16</td>
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<tr>
<td>10/25/2016</td>
<td>9.06 392.26</td>
<td>29.57 365.97</td>
<td>20.30 374.3</td>
<td>26.52 364.19</td>
</tr>
<tr>
<td>1/26/2017</td>
<td>9.65 391.67</td>
<td>27.96 367.58</td>
<td>18.54 376.06</td>
<td>19.35 371.36</td>
</tr>
<tr>
<td>1/27/2017</td>
<td>10.12 391.20</td>
<td>26.93 368.61</td>
<td>19.23 375.37</td>
<td>24.01 366.7</td>
</tr>
<tr>
<td>8/11/2017</td>
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<td>27.51 368.03</td>
<td>20.73 373.87</td>
<td>26.53 364.18</td>
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<tr>
<td>9/20/2017</td>
<td>9.97 391.35</td>
<td>32.20 363.34</td>
<td>20.68 373.92</td>
<td>26.03 364.68</td>
</tr>
</tbody>
</table>

*Reference elevation of monitoring wells surveyed by Associated Engineers, Inc., Madisonville, Kentucky, January 2015
Survey coordinates were based on the Kentucky State Plane, Kentucky Southern Zone, NAD27 datum
TOIC = Top of internal casing
GW = Groundwater; GS = Ground Surface; NM = Not measured
<table>
<thead>
<tr>
<th>Well ID / GW Elevation (ft, NAD27)</th>
<th>Change in Head (feet)</th>
<th>Horizontal Distance* (feet)</th>
<th>Hydraulic Gradient</th>
</tr>
</thead>
<tbody>
<tr>
<td>MW-11</td>
<td>MW-12</td>
<td>Apr 2016</td>
<td>Oct 2016</td>
</tr>
<tr>
<td>393.12</td>
<td>363.03</td>
<td>30.09</td>
<td>1358</td>
</tr>
<tr>
<td>392.26</td>
<td>365.97</td>
<td>26.29</td>
<td>1358</td>
</tr>
<tr>
<td>391.20</td>
<td>368.61</td>
<td>22.59</td>
<td>1358</td>
</tr>
<tr>
<td>MW-11</td>
<td>MW-13</td>
<td>Apr 2016</td>
<td>Oct 2016</td>
</tr>
<tr>
<td>393.12</td>
<td>375.74</td>
<td>17.38</td>
<td>996</td>
</tr>
<tr>
<td>392.26</td>
<td>374.30</td>
<td>17.96</td>
<td>996</td>
</tr>
<tr>
<td>391.20</td>
<td>375.37</td>
<td>15.83</td>
<td>996</td>
</tr>
<tr>
<td>MW-11</td>
<td>MW-14</td>
<td>Apr 2016</td>
<td>Oct 2016</td>
</tr>
<tr>
<td>393.12</td>
<td>368.58</td>
<td>24.54</td>
<td>956</td>
</tr>
<tr>
<td>392.26</td>
<td>365.16</td>
<td>27.10</td>
<td>956</td>
</tr>
<tr>
<td>391.20</td>
<td>366.7</td>
<td>24.50</td>
<td>956</td>
</tr>
</tbody>
</table>

*Reference elevation of monitoring wells surveyed by Associated Engineers, Inc., Madisonville, Kentucky, January 2015

Survey coordinates were based on the Kentucky State Plane, Kentucky Southern Zone, NAD27 datum

*Horizontal distance between monitoring wells, parallel to the direction of groundwater flow (as determined by measurements utilizing Kentucky GIS)
Attachment B

Groundwater Elevation Summary
Attachment C

Boring Logs and Well Construction Diagrams
| 4. Owner name | Big Rivers Electric Corporation |
| 5. Owner address | 201 Third Street |
| 6. City | Henderson |
| 7. State | KY |
| 8. Zip | 42420 |
| 11. City | Robards |
| 12. State | KY |
| 13. Zip | 42452 |
| 15. Facility type | CERCLA, ROA, Solid Waste, Drinking Water, Mining |
| 19. County | Webster |
| 20. Physiographic Region | Blue Grass, Eastern Kentucky Upland |
| 21. Surface elevation (ft) | 398.36 |
| 30. Drilling method | Auger – HS, Auger – SS, Auger – bucket, Auger – hand, Cable tool, Rotary – air, Rotary – mud, Core, Driven casing, Sonic, Excavator, Combination – HS auger and air rotary, Combination – other (specify) |
| 31. Well status | Active, Inactive, Unsuitable for intended use |
| 32. Wellhead | Flush, Well cap, Locking, Sanitary seal |
| 33. Well development method | Surging, Jetting, Pumping, Backwashing, Bailing, Compressed air, Combination of methods (specify) |
| 46. Well completion: Casing and screens | Depth (ft) | 0.0 | 22.3 | 43.5 |
| 48. Lithologic log | Description | See attachment |

### Lithologic Log

<table>
<thead>
<tr>
<th>From depth (ft)</th>
<th>To depth (ft)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>22.3</td>
<td>Concrete</td>
</tr>
<tr>
<td>22.3</td>
<td>43.5</td>
<td>Cements, gravel</td>
</tr>
<tr>
<td>43.5</td>
<td>48.5</td>
<td>Bentonite pellets</td>
</tr>
</tbody>
</table>

### Sketch Map

- Auger – HS, Auger – SS, Auger – bucket, Auger – hand, Cable tool, Rotary – air, Rotary – mud, Core, Driven casing, Sonic, Excavator, Combination – HS auger and air rotary, Combination – other (specify)

### Surface Water Wells

#### Well Water Quality

- Total depth: 49.9 ft
- Depth to bedrock: 21.3 ft
- Static water level: 5.24 ft
- Casing height above surface (in): 36 in

#### WELL WATERS ONLY

- 34. Estimated well yield: gpm
- 35. Wells service: gpd
- 36. Disinfectant amount: Type
  - 37. Type: Bleach, Hypochlorite

### Coliform Test

- 42. Coliform test type: fecal, fecal and total
- 43. Coliform test results: 0 or <1.0 NTU, Confluent per 100 mL

### Additional Information

- 44. Date sampled: Month Day Year
- 45. Date analyzed: Month Day Year

---

**Lat/Long Information**

- Latitude: 37.642616
- Longitude: -87.503252

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**Notes**

- The work described above was done under my supervision, and this report is true and correct to the best of my knowledge.
- The driller is not responsible for natural groundwater quality or quantity encountered while drilling or completing this well.
### Lithologic Log MW-11

<table>
<thead>
<tr>
<th>From depth (ft)</th>
<th>To depth (ft)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
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<td>0.3</td>
<td>Ash</td>
</tr>
<tr>
<td>0.3</td>
<td>2.0</td>
<td>Silty clay light brown</td>
</tr>
<tr>
<td>2.0</td>
<td>3.1</td>
<td>Silty clay brown</td>
</tr>
<tr>
<td>3.1</td>
<td>4.0</td>
<td>Silty clay light gray</td>
</tr>
<tr>
<td>4.0</td>
<td>6.7</td>
<td>Silty clay gray moist</td>
</tr>
<tr>
<td>6.7</td>
<td>15.0</td>
<td>Silty clay yellowish brown moist</td>
</tr>
<tr>
<td>15.0</td>
<td>21.3</td>
<td>Silty clay w/weathered shale light gray</td>
</tr>
<tr>
<td>21.3</td>
<td>22.3</td>
<td>Sandy shale light gray soft</td>
</tr>
<tr>
<td></td>
<td>22.3</td>
<td>Auger refusal</td>
</tr>
<tr>
<td>22.3</td>
<td>33.0</td>
<td>Sandy shale gray</td>
</tr>
<tr>
<td>33.0</td>
<td>35.9</td>
<td>Claystone</td>
</tr>
<tr>
<td>35.9</td>
<td>40.4</td>
<td>Sandstone gray</td>
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<tr>
<td>40.4</td>
<td>41.5</td>
<td>Claystone</td>
</tr>
<tr>
<td>41.5</td>
<td>44.3</td>
<td>Sandstone gray water</td>
</tr>
<tr>
<td>44.3</td>
<td>45.1</td>
<td>Shale gray</td>
</tr>
<tr>
<td>45.1</td>
<td>49.9</td>
<td>Sandstone with carbonaceous strks gray water</td>
</tr>
<tr>
<td>49.9</td>
<td></td>
<td>TD</td>
</tr>
</tbody>
</table>
MONITORING WELL 8006-3938
(MW-11)

CONSTRUCTION INCLUDES 4 BUMPER GUARDS INSTALLED
IN ACCORDANCE WITH 401 KAR 6:550 SECTION B

0.0' (ELEV. 398.5')

0.0'

2.0'

10 1/2''

22.3'

Hole Dia.

2'' I.D.
PVC
RISER

43.5'

0.010
SLOT
PVC
SCREEN

48.5'

6 1/2''

39.5'

BENTONITE PELLETS

41.5'

49.9'

8'' ID STEEL PROTECTIVE CASING WITH
LOCKING CAP AND WEEP HOLES

CONCRETE PAD MIN. 6'' THICKNESS AND 3'' DIAMETER

NEAT CEMENT
CROUT

SILICA SAND
FILTER PACK

Plug

BIG RIVERS ELECTRIC CORPORATION

Well Construction Diagram

Jdo Number 15-01405
Date 12/24/15
Scale No Scale
Drawn By. D. Dunbar

2740 North Main St. - Madisonville, KY 42431
Phone (270) 821-7733 Fax (270) 821-7789
www.associateingeniess.com
4. Owner name: Big Rivers Electric Corporation
5. Owner address: 201 Third Street
6. City: Henderson
7. State: KY
8. Zip: 42420
9. Site name: Sbree Station
10. Site address: 9000 Highway 2096
11. City: Robards
12. State: KY
13. Zip: 42452
14. Agency Interest (AI) Number: 4196
15. Facility type & ID Number: CERCLA, Solid Waste, Drinking Water, RCRA, UST, Mining, CCR Rule
16. Owner phone: 270 - 844 - 6031
17. Site phone: 270 - 521 - 7927
18. USGS topic map: Robards
19. County: Webster
20. Physiographic Region: Blue Grass, Ohio River Alluvium, E. Coal Field, W. Coal Field, Miss. Plateau, Jackson Purchase
21. Surface elevation (ft): 392
22. Elevation determined by: GPS, Survey, Prior report
23. Install start date: 01 05 16
24. Install end date: 01 14 16
25. Total depth: 72.0
26. Depth to bedrock: 55.0
27. Static water level: 29.32
28. Casing height above surface (in): 38.28
29. Use well water: gpm, gph
30. Disinfectant amount: mg/L
31. Well status: Active, Inactive, Unsuitable for intended use
32. Wellhead: Flush, Well cap, Sanitary seal
33. Well development method: Surging, Jetting, Pumping, Backwashing, Boring, Compressed air, Combination of methods (specify)
34. Water Wells only: air-lift pump and water flush
35. Well service: of people served
36. Well fluid: Water or wastewater
37. Type: Bleach, Hypochlorite
38. Pitting adapter installed: Yes, No
39. Pump installed: Submersible, Jet, Boiler or bucket, Turbine, Hand, No pump
42. Coliform test type: fecal, fecal and total
43. Coliform test results: 0 or <1.0, NTAC, Confluent of # colonies per 100 mL
44. Date sampled: Month Day Year
45. Date analyzed: Month Day Year
46. Well completion: Casing and screens
47. Annulus fill and seal
48. Lithologic log (if more space is needed, continue on separate page)
49. Sketch map
50. Comments:
51. Affirmation: The work described above was done under my supervision, and this report is true and correct to the best of my knowledge.

**UNIFORM KENTUCKY WELL CONSTRUCTION RECORD**

Use this form only to report installation of monitoring or water wells. Original copy must be submitted to Division of Water within 60 days of completion. See instructions on reverse of form. Record must be typed or neatly printed or it will be returned to the driller as unacceptable.

One copy to Division of Water, one copy to owner, one copy to driller's files.

1. Kentucky Well ID (AKGWA) Number: 8006 - 3939
2. Owner well ID: MW-12
3. Attachments Required
   1. Site plan or sketch map
   2. Well location
   3. On topographic map, OR Obtained by GPS until
   Conditionally Required
   4. Well diagram (monitoring well)
   5. Coliform analysis (if applicable)
   6. Signed Variance (if applicable)
   7. Other laboratory analysis report
4. Install start date: 01 05 16
5. Install end date: 01 14 16
6. Total depth: 72.0
7. Depth to bedrock: 55.0
8. Static water level: 29.32
9. Casing height above surface (in): 38.28
10. Use well water: gpm, gph
11. Disinfectant amount: mg/L
12. Well status: Active, Inactive, Unsuitable for intended use
13. Wellhead: Flush, Well cap, Sanitary seal
14. Well development method: Surging, Jetting, Pumping, Backwashing, Boring, Compressed air, Combination of methods (specify)
15. Water Wells only: air-lift pump and water flush
16. Well service: of people served
17. Well fluid: Water or wastewater
18. Type: Bleach, Hypochlorite
19. Pitting adapter installed: Yes, No
20. Pump installed: Submersible, Jet, Boiler or bucket, Turbine, Hand, No pump
22. Coliform test type: fecal, fecal and total
23. Coliform test results: 0 or <1.0, NTAC, Confluent of # colonies per 100 mL
24. Date sampled: Month Day Year
25. Date analyzed: Month Day Year

**Latitude:** 37.639148
**Longitude:** -87.501824

Lat/Long Method: INT, GPS, SUR, REP
Date Received: 5/21/16

rev 02/29/2012
### Lithologic Log MW-12

<table>
<thead>
<tr>
<th>From depth (ft)</th>
<th>To depth (ft)</th>
<th>Description</th>
</tr>
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<tr>
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<td>4.0</td>
<td>Silty clay brown fill</td>
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<td>13.6</td>
<td>Clay gray wet</td>
</tr>
<tr>
<td>13.6</td>
<td>21.2</td>
<td>Silty clay yellowish brown very moist</td>
</tr>
<tr>
<td>21.2</td>
<td>23.0</td>
<td>Silty clay yellowish brown very moist</td>
</tr>
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<td>23.0</td>
<td>31.5</td>
<td>Silty clay yellowish brown very moist</td>
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<tr>
<td>31.5</td>
<td>37.0</td>
<td>Silty clay brown, moist</td>
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<td>37.0</td>
<td>40.5</td>
<td>Silty clay yellowish brown moist</td>
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<tr>
<td>40.5</td>
<td>52.0</td>
<td>Silty clay brown moist</td>
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<tr>
<td>52.0</td>
<td>55.0</td>
<td>Silty clay brown very moist</td>
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<tr>
<td>55.0</td>
<td>56.5</td>
<td>Shale gray soft</td>
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<tr>
<td>56.5</td>
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<td>72.0</td>
<td>Shale gray</td>
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<tr>
<td>72.0</td>
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<td>TD</td>
</tr>
</tbody>
</table>
**UNIFORM KENTUCKY WELL CONSTRUCTION RECORD**

*Use this form only to report installation of monitoring or water wells.*

Original copy must be submitted to Division of Water within 60 days of completion.

See instructions on reverse of form.

Record must be typed or neatly printed or it will be returned to the driller as unacceptable.

One copy to Division of Water, one copy to owner, one copy to driller's files.

4. **Owner name**
   Big Rivers Electric Corporation

5. **Owner address**
   201 Third Street

7. **State**
   KY

8. **Zip**
   42420

12. **State**
    KY

13. **Zip**
    42452

15. **Facility type**
    CERCLA & RCRA

16. **Owner phone**
    270-844-6031

17. **Site phone**
    270-521-7927

18. **USGS toponym**
    Robards

19. **County**
    Webster

20. **Physiographic Region**
    Blue Grass

21. **Surface elevation (ft)**
    391.6

22. **Elevation determined by**
    Survey

29. **Well use**
   □ Agriculture
   □ Geothermal

   □ Commercial
   □ Heat pump

   □ Domestic
   □ HVAC

   □ Industrial
   □ Injection

   □ Monitoring
   □ Drinking well

   □ Public
   □ Unused

30. **Drilling method**
    □ Auger – HS
    □ Jet wash

    □ Auger – SS
    □ Puhsp/enerate

    □ Auger – bucket
    □ Rotary – air

    □ Auger – hand
    □ Rotary – mud

    □ Cable tool
    □ Rotary – reverse

    □ Core
    □ Sand point

    □ Driven casing
    □ Sonic

31. **Well status**
    □ Active
    □ Inactive

    □ Unsuitable for intended use

32. **Wellhead**
    □ Flush
    □ Well cap

    □ Locking
    □ Sanitary seal

33. **Well development methods**
    □ Surging
    □ Jetting

    □ Pumping
    □ Backwashing

    □ Bailing
    □ Compressed air

    □ Combination of methods (specify)

34. **Well length**
    Air-lift pump and water flush

46. **Well completion: Casing and screens**

<table>
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<tr>
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<th>To depth (ft)</th>
<th>Screen diameter (inches)</th>
<th>Casing</th>
<th>From depth (ft)</th>
<th>To depth (ft)</th>
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<tr>
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<td>10.5</td>
<td>2.0</td>
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<td>20.5</td>
<td>Concrete</td>
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<td>22.0</td>
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<td>Cement grout</td>
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<td>60.0</td>
<td>6.5</td>
<td>2.0</td>
<td>2.0</td>
<td>60.0</td>
<td>Bentonite pellets</td>
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<td>6.5</td>
<td>2.0</td>
<td>2.0</td>
<td>62.5</td>
<td>Silica sand</td>
</tr>
</tbody>
</table>

48. **Lithology log**

49. **Sketch map**

50. **Comments**

51. **Affirmation:** The work described above was done under my supervision, and this report is true and correct to the best of my knowledge.

**Signature of certified driller**
0219-0364-00
**Drilling company**
Associated Engineers, Inc.

**Date signed**
5/25/16

---

**Latitude**
37.640856

**Longitude**
-87.500722

**Lat/Long Method**
INT GPS SUR REP

**Date received**
5/27/16

---

rev 02/29/2012
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<tr>
<td>10.6</td>
<td>12.8</td>
<td>Silty clay light gray</td>
</tr>
<tr>
<td>12.8</td>
<td>23.5</td>
<td>Silty clay yellowish brown wet</td>
</tr>
<tr>
<td>23.5</td>
<td>34.2</td>
<td>Silty clay brown very moist</td>
</tr>
<tr>
<td>34.2</td>
<td>39.5</td>
<td>Silty clay yellowish brown very moist</td>
</tr>
<tr>
<td>39.5</td>
<td>40.5</td>
<td>Sandstone yellowish brown soft weathered</td>
</tr>
<tr>
<td></td>
<td>40.5</td>
<td>Auger refusal</td>
</tr>
<tr>
<td>40.5</td>
<td>50.4</td>
<td>Sandstone yellowish brown soft weathered</td>
</tr>
<tr>
<td>50.4</td>
<td>51.1</td>
<td>Shale gray</td>
</tr>
<tr>
<td>51.1</td>
<td>51.5</td>
<td>Sandy shale gray</td>
</tr>
<tr>
<td>51.5</td>
<td>TD</td>
<td></td>
</tr>
</tbody>
</table>
UNIFORM KENTUCKY WELL CONSTRUCTION RECORD

Use this form only to report installation of monitoring or water wells. Original copy must be submitted to Division of Water within 60 days of completion. See instructions on reverse of form. Record must be typed or neatly printed or it will be returned to the driller as unacceptable.

One copy to Division of Water, one copy to owner, one copy to driller's files.

4. Owner name Big Rivers Electric Corporation
5. Owner address 201 Third Street
6. City Henderson
7. State KY
8. Zip 42420
9. Site number 4196
10. Site name Sebree Station
11. Site address 9000 Highway 2096
12. City Robards
13. State KY
14. Agency interest CERCLA
15. Facility type RCRA
16. ID Number UST
17. ID Number Mining
18. USGS topo map Robards
19. County Webster
20. Physiographic region Blue Grass
21. Region Ohio River Alluvium
22. Elevation determined by GPS
23. Survey Prior report
24. Prior well log

25. Well use Agriculture
26. Well drillers Auger - HS
27. Industrial Heating
28. Domestic HVAC
29. Injection Injection
30. Monitoring / Remedied
31. Public
32. Well status Active
33. Inactive
34. Unsuitable for intended use
35. Wellhead
36. Flush
37. Well cap
38. Locking
39. Sanitary seal
40. Elevator development
41. Shrugging
42. Jetting
43. Pumping
44. Backwashing
45. Bailing
46. Compressed air
47. Combination of methods (specify)

48. Lithologic log
49. Sketch map

50. Comments

51. Certification: The work described above was done under my supervision, and this report is true and correct to the best of my knowledge.

Signature of certifier: Date signed: 5/25/11

Drilling company: Associated Engineers, Inc.

Latitude: 37.642198
Longitude: -87.50009

Lat/Long Method: INT GPS SUR REP

Date Received: 2/27/11

rev 02/29/2012
### 48. Lithologic Log MW-14

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<td>Ash black</td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td>3.8</td>
<td>Silty clay yellowish brown</td>
<td></td>
</tr>
<tr>
<td>3.8</td>
<td>11.2</td>
<td>Silty clay brown</td>
<td></td>
</tr>
<tr>
<td>11.2</td>
<td>16.9</td>
<td>Silty clay yellowish brown w/sandstone fragments</td>
<td></td>
</tr>
<tr>
<td>16.9</td>
<td>21.9</td>
<td>Sandstone yellowish brown soft weathered</td>
<td></td>
</tr>
<tr>
<td>21.9</td>
<td>24.7</td>
<td>Shale gray soft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24.7</td>
<td>Auger refusal</td>
<td></td>
</tr>
<tr>
<td>24.7</td>
<td>26.5</td>
<td>Shale gray soft</td>
<td></td>
</tr>
<tr>
<td>26.5</td>
<td>39.8</td>
<td>Sandy shale gray</td>
<td></td>
</tr>
<tr>
<td>39.8</td>
<td>48.3</td>
<td>Sandstone gray, water</td>
<td></td>
</tr>
<tr>
<td>48.3</td>
<td>49.1</td>
<td>Shale and interbedded sandstone gray</td>
<td></td>
</tr>
<tr>
<td>49.1</td>
<td>49.3</td>
<td>Sandstone gray</td>
<td></td>
</tr>
<tr>
<td>49.3</td>
<td>49.6</td>
<td>Shale gray</td>
<td></td>
</tr>
<tr>
<td></td>
<td>49.6</td>
<td>TD</td>
<td></td>
</tr>
</tbody>
</table>
MONITORING WELL 8006-3941
(MW-14)

CONSTRUCTION INCLUDES 4 GRAMPER GUARDS INSTALLED IN ACCORDANCE WITH 491 KAR 6500 SECTION B
CONCRETE PAD MIN. 6" THICKNESS AND 3" DIAMETER

0.0' (ELEV. 387.7')

8" ID STEEL PROTECTIVE CASING WITH LOCKING CAP AND WEEP HOLES

0.0'

CONCRETE

2.0'

24.7'

10 1/2" Hole Diam.

NEAT CEMENT
GROUT

37.8'

BENTONITE PELLETS
39.8'

41.8'

0.010
SLOT
PVC
SCREEN

46.8'

6 1/2"

PLUG

SILICA SAND FILTER PACK

49.6'

2"I.D.
PVC
RISER

BIG RIVERS ELECTRIC CORPORATION
Well Construction Diagram

ASSOCIATED ENGINEERS, INC.

2746 North Main St. - Madisonville, KY 42431
Phone: (270) 821-7752 - Fax: (270) 821-7759
www.associatedengineers.com
October 17, 2018

Big Rivers Electric Corporation
Sebree Generating Station
9000 Highway 2096
Robards, Kentucky 42452

Engineer’s Certification of Placement Above the Uppermost Aquifer Demonstration
Existing Reid/HMPL CCR Surface Impoundment
EPA Final CCR Rule
Sebree Station
Robards, Kentucky

1.0  PURPOSE

The purpose of this document is to certify that the Placement above Sebree “Reid/HMPL” Existing CCR Surface Impoundment is in compliance with the Placement above the Uppermost Aquifer requirement of the Final CCR Rule at 40 CFR §257.60. Presented below is the project background, summary of findings, limitations and certification.

2.0  BACKGROUND

In accordance with 40 CFR §257.60, the owner/operator of an existing CCR Surface Impoundment must demonstrate that the base of the unit is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table). In accordance with 40 CFR §257.60(c)(1), the demonstration must be made by October 17, 2018. If such demonstration cannot be made, the unit is subject to the closure or retrofit requirements of 40 CFR §257.101.

3.0  SUMMARY OF FINDINGS

Available data regarding site groundwater, site geology, and physical limits of the unit for the Reid/HMPL Surface Impoundment do not evidence a 5-foot separation between the base of the impoundment and the upper most limit of the uppermost aquifer and they do not support a lack of hydraulic connectivity between the unit and the aquifer as specified in 40 CFR §257.60(a). Therefore the unit does not meet the Placement above the Uppermost Aquifer requirement of 40 CFR §257.60(a).
4.0 CERTIFICATION

I, Michael Brian Cole, being a Registered Professional Engineer in good standing in the State of Kentucky, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above-referenced CCR Unit, that the available data do not support a demonstration of Placement above the Uppermost Aquifer that meets the requirements of 40 CFR § 257.60(a).

M. Brian Cole  
Printed Name

October 17, 2018  
Date

ADDRESS: AECOM  
500 W Jefferson St Suite 1600  
Louisville, KY 40202  

TELEPHONE: (502)-569-2301

ATTACHMENTS: Placement above the Uppermost Aquifer Demonstration for Coal Combustion Residuals
Existing “Reid/HMPL” CCR Surface Impoundment

Disposal of Coal Combustion Residuals (CCR) from Electric Utilities Final Rule

Placement above the Uppermost Aquifer Demonstration for Coal Combustion Residuals (CCR)

October 17, 2018

Prepared by

AECOM

Project Number: 60571713
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FIGURES

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Figure 2. Surface Impoundment Site Location
Figure 3. Surface Impoundment – Groundwater Contour Map – September 2017

ATTACHMENTS

Attachment A. Tables 1 and 2
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Attachment C. Boring Logs and Well Construction Diagrams
1.0 INTRODUCTION

1.1 Objective

The purpose of this demonstration is to document compliance with 40 Code of Federal Regulations (CFR §257.60 of the Environmental Protection Agency Final Coal Combustion Residual Rule (EPA Final CCR Rule) regarding the Placement above the Uppermost Aquifer Demonstration requirement for the existing “Reid/HMPL” Surface Impoundment at the Big Rivers Electric Corporation (BREC) Sebree Station in Sebree, Kentucky.

1.2 Rule Requirements

As required by 40 CFR §257.60(a) of the EPA Final CCR Rule, existing CCR Surface Impoundments must be constructed with a base that is located no less than 1.52 meters (5 feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevation. The “uppermost aquifer” is defined by 40 CFR §257.40 as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility’s property boundary. This definition includes a shallow, deep, perched, confined or unconfined aquifer, provided it yields usable water.

The demonstration is due by October 17, 2018 in accordance with 40 CFR §257.60(c)(1). Those Surface Impoundments that cannot demonstrate compliance with the requirement of 40 CFR §257.60(a) are required by 40 CFR §257.60(c)(4) to cease placement of CCR in the unit within 6 months (April 2019).

1.3 Methodology/Background

The demonstration method involves the use of existing documentation of pertinent geologic and hydrogeologic information to develop a conceptual site model (CSM) for the uppermost aquifer inclusive of the definition of its uppermost limit, normal fluctuations in groundwater elevation, and the potential for the aquifer’s hydraulic interconnection with overlying strata and the planned landfill limits. Existing documentation includes state and/or federal geologic maps and water resources publications, the logs of borings drilled on site for geotechnical purposes, the logs of monitoring wells installed on site and in surrounding areas, and design drawings for the unit.

1.4 Site Background

Big Rivers Electric Corporation (BREC) owns and operates the “Sebree” Station in Sebree, Kentucky. The Sebree Station is located in Webster County, approximately 3.2 miles northeast of the town of Sebree, Kentucky situated immediately east of the Pennyrile Parkway approximately 1.5 miles north of the intersection of the Pennyrile Parkway and Kentucky Route 56 (see Figure 1). Sebree Station is composed of 2 Green generating units, one Reid generating unit, and 2 HMP&L generating units. The Green Surface Impoundment is located directly south of the Sebree Station, situated north of the Green CCR Landfill. The current Green Surface Impoundment footprint is approximately 16 acres (Figure 2).
Figure 1: BREC Sebree Site Location

Figure 2: BREC Reid/HMPL Surface Impoundment Site Location
1.5 Site History

The Reid/HMPL Surface Impoundment is a combined incised/dike earthen embankment structure. It is diked on the west, south and east sides, while the north side is incised. The west dike has the greatest height reaching approximately 42 feet. The original terrain on which the Surface Impoundment was constructed generally sloped toward the west. Although the Green River is located less than 0.5 miles from the site, the structure does not extend significantly into the floodplain. Underlying preconstruction soils consisted of Loring-Grenada, Loring-Zanesville-Wellston (Henderson County) and Loring-Wellston-Zanesville (Webster County) soil associations are generally characterized as well drained to moderately well drained soils on nearly level to sloping uplands.

The CCR unit has been in place for 40 plus years and is used for the placement of CCR material; currently slurried bottom ash. The immediate watershed that drains to the CCR unit, and in which the CCR unit is considered to be located, is unnamed and 25.45 acres in size. The unnamed watershed discharges from the CCR impoundment outflow structure and is routed to the Green River.

The embankment reaches its greatest relief of approximately 42 feet on the west side. The Burns & McDonnell Engineering Co., October 8, 1971 design drawings show the inboard slope and central core portion of the dike to be constructed of compacted soil fill and the outboard slope to be consisted of sand fill. A sand blanket drain was designed for the outboard third of the base of the dike for the majority of the length and the plans show a crushed limestone drainage layer with a minimum thickness of 18 inches topped with a minimum 6-inches thick sand layer that extends across the entire width of the dike cross section in the southwest corner. The plans also show a cut-off trench in the original ground below dike crest and extending for the entire length of the dike.

The impoundment discharge consists of a rectangular concrete drop structure with a variable height steel debris skimmer. The pool elevation can be controlled by adding or removing stop logs. The discharge structure connects to a 24-inch diameter smooth walled metal pipe underground conveyance.

2.0 GEOLOGY

The site lies in the Western Kentucky Coalfields, a gently rolling upland. In the vicinity of the site, maximum topographic relief is on the order of 80 feet. Surface drainage is to the south to Groves Creek, a primary tributary to the Green River, and to the east to the Green River.

Published geologic mapping (Murphy, 2007) shows the site to be immediately underlain by unconsolidated loess representing the Pleistocene and Holocene geologic epoch and unconsolidated alluvium representing the Pleistocene and Holocene epochs. The loess reportedly consists of sandy and clayey silt. The alluvium reportedly consists of silt and clay with lesser amounts of sand and gravel.

The unconsolidated materials are shown to be underlain by the base of the Shelburn Formation (formerly identified as the Lisman Formation (Fairer, 1973) and the Carbondale Formation, both of which represent the Pennsylvanian Geologic Period. The West Franklin Member consists of
one to three layers of limestone interbedded by calcareous clay shale, and comprises the top of the Shelburn Formation. The Providence Limestone Member, consisting of limestone and interbedded shale, comprises the base of the Shelburn Formation. The Providence Limestone Member is reportedly absent in much of the area due to erosional channeling. Due to its discontinuous character and the presence of interbedded shale, hydrologically significant karst features are not present in the Providence Limestone Member. The underlying Carbondale Formation consists of cyclic sequences of sandstones, shales, siltstones and coals. The Carbondale sediments were deposited in a fluvial-deltaic system. As a result of this depositional environment, the lithologic units of the Carbondale tend to be lenticular bodies rather than continuous sheet-like strata. Gradational and abrupt horizontal changes in lithology are often encountered.

The structure contours illustrated on the geologic map (Murphy, 2007) are based on the altitude of the No. 9 coal seam, and show the site to lie on the flank of a gentle anticline. Stratigraphic dip is shown to be on the order of 35 feet per mile to the southeast. No faults or other significant structural features are depicted on the geologic map.

### 3.0 Hydrogeology

The stratigraphic interval considered as the most prominent water transmitting zone within and adjacent to the Sebree Generating Station is material identified as the Upper Sandstone Member (Sebree sandstone) of the Carbondale Formation. The United States Geologic Survey (USGS) Geologic Map of the Robards Quadrangle describes the Sebree sandstone sequence as "Siltstone, sandstone, shale and coal: Siltstone, light- to medium-gray, micaceous, thin-bedded, and locally calcareous. Sandstone, light- to medium-gray, grayish- and yellowish-brown, fine- to medium-grained slightly micaceous, thin-bedded to massive; locally fills channels."

For purposes of compliance with the CCR Rule groundwater monitoring requirements; this sequence, and in particular the member sandstone intervals, is considered to be the uppermost aquifer underlying the Reid/HMPL CCR Surface Impoundment.

The sandstone units in the upper Carbondale Formation reportedly can provide well yields of 500 gallons per day (gpd) or greater with some reported yields on the order of 30 gallons per minute [gpm] (Maxwell and Devaul, 1962). The Providence Limestone Member of the Shelburn Formation is reported to yield little to no water to wells. The lower Carbondale Formation, above and below the No. 9 coal seam, consists primarily of shales that reportedly yield little to no water to wells. Previous site-specific investigations, by others, have noted the presence of perched zones of saturation in the overlying unconsolidated materials.

### 3.1 Groundwater Monitoring System

Five temporary piezometers (P-13/P-13A, P-14 and P-15/P-15A) were installed adjacent to and respectively; northwest, southeast and southwest of the Reid/HMPL CCR impoundment to determine general direction of groundwater movement. Measured static water levels, from the highest to lowest elevation were observed in P-13/13A (highest), P-14 and P-15/P-15A (lowest) resulting in a calculated hydraulic gradient or apparent direction of groundwater movement is generally from east-northeast to west-southwest. This groundwater gradient characterization
and the ability to locate monitoring wells specific to the CCR unit justify the placement of the minimum of one upgradient and three down-gradient monitoring wells. The upgradient monitoring well (MW-7) was installed adjacent to, and east-northeast of the impoundment. The downgradient monitoring wells (MW-8, MW-9 and MW-10) were installed adjacent to, and respectively; west, southwest and south-southwest of the impoundment. All monitoring wells are completed in the stratigraphic interval described above. Approximate locations of the groundwater monitoring wells are shown on the Groundwater Monitoring Well Location Aerial Photo (Attachment B). Boring logs and well construction diagrams are presented as Attachment C.

3.2 Groundwater Flow

Water level data were collected from the unit during the nine baseline CCR monitoring events from March 2016 through October 2017 as summarized on Table 1 of Attachment A.

These data and the piezometric surface map presented below (Figure 3) represent general conditions at the Surface Impoundment and support the following analysis.

Overall groundwater flow beneath the footprint of the Reid/HMPL Surface Impoundment is to the southwest towards an unnamed tributary to Groves Creek located west/southwest of the impoundment. The hydraulic gradients calculated during the baseline period ranged from 0.0251 to 0.0258 towards the southwest as presented in Table 2 of Attachment A.
Figure 3: Reid/HMPL Surface Impoundment - Piezometric Surface Map
4.0 **UPPERMOST AQUIFER**

The “uppermost aquifer” is defined by 40 CFR §257.40 as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility’s property boundary. This definition includes a shallow, deep, perched, confined or unconfined aquifer, provided it yields usable water.

4.1 **Aquifer Characteristics**

Site-specific data pertaining to the aquifer characteristics beneath the Reid/HMPL Surface Impoundment were obtained prior to initiation of this CCR Program.

Available information pertaining to the sandstone units in the upper Carbondale Formation, identified as the uppermost aquifer beneath the Surface Impoundment, generally provide well yields of 500 gpd or greater with some reported yields on the order of 30 gpm (Maxwell and Devaul, 1962). The Providence Limestone Member of the Shelburn Formation is reported to yield little to no water to wells. The lower Carbondale Formation, above and below the No. 9 coal seam, consists primarily of shales that reportedly yield little to no water to wells. Previous site-specific investigations, by others, have noted the presence of perched zones of saturation in the overlying unconsolidated materials.

4.2 **Placement Above the Uppermost Aquifer**

Based on the available boring logs from the CCR Rule monitoring well system, the top of the upper Carbondale Formation (uppermost aquifer) is at an approximately elevation of 413.4 feet to the northeast (at MW-7), 384.2 feet to the south (at MW-10), 364.4 feet to the southwest (at MW-9), and 341.6 feet to the west (at MW-8) of the Surface Impoundment. Illustrated well boring cross-sections located adjacent to the Surface Impoundment are presented as Attachment B. Although it is not directly evidenced whether the base of the Surface Impoundment (389.2 feet in the western corner and approximately 400 feet in the northeast corner) intercepts or encroaches on the 5 foot separation from the top of the upper Carbondale Formation (uppermost aquifer) in the vicinity of monitoring well MW-7, hydraulic connectivity cannot be disproven based on available groundwater surface data discussed below.

Groundwater data provided by BREC via baseline data collection from monitoring wells between March 2016 and October 2017 were used to interpret the elevations of the uppermost aquifer within the area of the Surface Impoundment. Seasonal measurements (March, May, August, October 2016, and January 2017) are presented within the Groundwater Elevation Summary located as Attachment B. Based on the cross sections presented in Attachment B, the potentiometric surface is approximately 0.5 and 2 feet above the lowest base of the Surface Impoundment (389.2 feet at the west corner) and averaging approximately 28 feet above the Surface Impoundment base of approximately 400 feet at the northeast corner.
5.0 CONCLUSIONS

Available data regarding site groundwater, site geology, and physical limits of the unit for the Reid/HMPL Surface Impoundment do not evidence a 5-foot separation between the base of the impoundment and the uppermost limit of the uppermost aquifer and they do not support a lack of hydraulic connectivity between the unit and the aquifer as specified in 40 CFR §257.60(a). Therefore the unit does not meet the Placement above the Uppermost Aquifer requirement of 40 CFR §257.60(a).

6.0 REFERENCES


Geotechnical and other information provided by Associated Engineers, Inc.

Engineering design drawings and other information provided by Big Rivers Electric Corporation


United States Geological Survey U.S. Geological Survey (USGS) 7.5 minute Robards and Delaware topographic quadrangle maps
Attachments
Attachment A

Tables 1 and 2
# TABLE 1

**MONITORING WELL NETWORK GROUNDWATER ELEVATIONS - MARCH 2016 - OCTOBER 2017**  
REID/HMPL STATION SURFACE IMPOUNDMENT  
BIG RIVERS ELECTRIC CORPORATION  
SEBREE STATION  
WEBSTER COUNTY, KENTUCKY

<table>
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<tr>
<th>Date Measured</th>
<th>Depth to Water (ft)</th>
<th>GW Elevation (feet)</th>
<th>Depth to Water (ft)</th>
<th>GW Elevation (feet)</th>
<th>Depth to Water (ft)</th>
<th>GW Elevation (feet)</th>
<th>Depth to Water (ft)</th>
<th>GW Elevation (feet)</th>
</tr>
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<td>388.50</td>
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*Reference elevation of monitoring wells surveyed by Associated Engineers, Inc., Madisonville, Kentucky, January 2015  
Survey coordinates were based on the Kentucky State Plane, Kentucky Southern Zone, NAD27 datum  
TOIC = Top of internal casing  
GW = Groundwater; GS = Ground Surface; NM = Not measured
### TABLE 2

**HYDRAULIC GRADIENT**

**GROUNDWATER MONITORING SYSTEM**

**BIG RIVERS ELECTRIC CORPORATION - SEBREE STATION**

**REID/HMPL STATION SURFACE IMPOUNDMENT**

**WEBSTER COUNTY, KENTUCKY**

<table>
<thead>
<tr>
<th>Well ID / GW Elevation (ft, NAD27)</th>
<th>Change in Head (feet)</th>
<th>Horizontal Distance* (feet)</th>
<th>Hydraulic Gradient</th>
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<tr>
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<td>Aug 2016 428.68</td>
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<td>36.84</td>
<td>1466</td>
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<tr>
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<td>Jan 2017 428.84</td>
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<td>1466</td>
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<tr>
<td>May 2017 428.70</td>
<td>391.35</td>
<td>37.35</td>
<td>1466</td>
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<tr>
<td>Aug 2017 426.71</td>
<td>388.94</td>
<td>37.77</td>
<td>1466</td>
</tr>
<tr>
<td>Sept 2017 426.33</td>
<td>388.69</td>
<td>37.64</td>
<td>1466</td>
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<tr>
<td>Oct 2017 426.27</td>
<td>388.50</td>
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<td>1466</td>
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</table>

*Reference elevation of monitoring wells surveyed by Associated Engineers, Inc., Madisonville, Kentucky, January 2015*  

Survey coordinates were based on the Kentucky State Plane, Kentucky Southern Zone, NAD27 datum  

*Horizontal distance between monitoring wells, parallel to the direction of groundwater flow (as determined by measurements utilizing Kentucky GIS)*
Attachment B

Groundwater Elevation Summary
Attachment C

Boring Logs and Well Construction Diagrams
UNIFORM KENTUCKY WELL CONSTRUCTION RECORD

Use this form only to report installation of monitoring or water wells. Original copy must be submitted to Division of Water within 60 days of completion. See instructions on reverse of form. Record must be typed or neatly printed or it will be returned to the driller as unacceptable. One copy to Division of Water; one copy to owner; one copy to driller’s files.

4. Owner name: Big Rivers Electric Corporation
5. Owner address: 201 Third Street
6. City: Henderson
7. State: KY
8. Zip: 42420
10. Site address: 9000 Highway 2096
11. City: Robards
12. State: KY
13. Zip: 42425
14. Agency Interest (AI) Number: 4196
15. Facility type: CERCLA & RCRA
16. Owner phone: 270-844-6031
17. Site phone: 270-521-7927
18. USGS topographic map: Robards
19. County: Henderson
20. Physiographic region: Blue Grass
21. Surface elevation (ft): 441.8
22. Elevation determined by: Survey
23. Install start date: 12-4-15
24. Install end date: 1-6-15
25. Total depth: 734
26. Depth to bedrock: 241
27. Static stage: 12.30
29. Well use: Agriculture, Commercial, Domestic, Industrial, Monitoring/Remed (Wells only: Water only)
30. Drilling method: Air auger, Jet wash, Auger - HS, Auger - SS, Auger - bucket, Auger - hand, Rotary - air, Rotary - reverse, Cable tool, Core, Sand point, Drilled casing, Sonic, Excavation, Combined - HS auger and air rotary, Combined - other (specify), Sonic, Air-lift pump and water flush
31. Well status: Active, Inactive, Unsuitable for intended use
32. Wellhead flush, Wet cap, Lifting, Sanitary seal
33. Well development method: Sizing, Jetting, Pumping, Backwashing, Reaming, Compressed air, Combination of methods (specify)
34. Estimated well yield: gpm
35. Well service: # of people served
36. Disinfectant amount: qts
37. Type: Bleach
38. Pump installed: Submersible, Jet, Bassett or Tee, Turbine, Hand, No pump
39. Depth to intake (ft): 
40. Apparent quality and odor: Clear
41. Color: Clear or cloudy, CHlorine, Iron, Sulfur
42. Turbid
43. Colorimetric test results: 0 or <10, TNDC, Confluent, or # colonies per 100 mL
44. Date sampled: Month Day Year
45. Date analyzed: 
46. Well completion: Casing and screens
47. Annulus fill and seal
48. Lithologic log (if more space is needed, continue on separate page)
49. Sketch map
50. Comments

30.1 Drilling method
30.2 Screen method
30.3 Casing and screen
30.4 Materials used for casing and screen
30.5 Description of annulus fill and seal
30.6 Description of well completion

46. Lithologic log

47. Annulus fill and seal

49. Sketch map

50. Latitude: 37.649307
51.Longitude: -87.503061
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<td>12.9</td>
<td>15.5</td>
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<td></td>
<td>28.4</td>
<td>Auger refusal</td>
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<tr>
<td>28.4</td>
<td>33.8</td>
<td>Sandstone yellowish brown weathered</td>
</tr>
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<td>37.3</td>
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</tr>
<tr>
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<td>TD</td>
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</table>
MONITORING WELL 8006-3934
(MW-7)

CONSTRUCTION INCLUDES 4 BUMPER GUARDS INSTALLED IN ACCORDANCE WITH 401 KAR 6:350 SECTION 8

CONCRETE PAD MIN. 6" THICKNESS AND 3' DIAMETER

0.0' (ELEV. 438.3')

8" ID STEEL PROTECTIVE CASING WITH LOCKING CAP AND WEEP HOLES

0.0'

2.0'

10 1/2" Hole Diam.

28.4'

NEAT CEMENT GROUT

63.9'

BENTONITE PELLETS

65.9'

SILICA SAND FILTER PACK

73.4'

2" I.D.
PVC RISER

67.9'

0.010 SLOT
PVC SCREEN

72.9'

CENTRALIZERS INSTALLED AT 50' INTERVALS BEGINNING AT BOTTOM OF SCREEN

6 1/2"
**UNIFORM KENTUCKY WELL CONSTRUCTION RECORD**

Use this form only to report installation of monitoring or water wells. Original copy must be submitted to Division of Water within 60 days of completion. See instructions on reverse of form. Record must be typed or neatly printed or it will be returned to the driller as unacceptable.

One copy to Division of Water, one copy to owner, one copy to driller's files.

---

### Attach Well Identification Number (AKGWA) Label Here

**Water wells:** yellow label  
**Monitoring wells:** blue label

---

**4. Owner name**  Big Rivers Electric Corporation  
**5. Owner address**  201 Third Street  
**6. City**  Henderson  
**7. State**  KY  
**8. Zip**  42420  
**9. Site name**  Sebree Station  
**10. Site address**  9000 Highway 2096  
**11. City**  Robards  
**12. State**  KY  
**13. Zip**  42452  
**14. Agency **  Interest 4196  
**15. Facility type**  CERCLA & ROPA  
**16. Owner phone**  270-844-6031  
**17. Site phone**  270-521-7927  
**18. USGS topo map**  Robards  
**19. County**  Henderson  
**20. Physiographic Region**  Blue Grass  
**21. Surface elevation (ft)**  385  
**22. Elevation determined by**  GPS  
**23. Install start date**  12-10-15  
**24. Install end date**  07-06-16  
**25. Total depth**  54  
**26. Depth to bedrock**  44  
**27. Static water level**  -8.1  
**28. Casing height above surface (in)**  105  

---

**WATER WELLS ONLY**

**34. Estimated well yield**  40 gpm  
**35. Well service**  0 gpd  

---

**46. Well completion: Casing and screens**

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<th>ID</th>
<th>Casing type</th>
<th>Screen total size</th>
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<th>Description</th>
<th>From depth (feet)</th>
<th>To depth (feet)</th>
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<td>44.2</td>
<td>47.2</td>
<td>6.5</td>
<td>2.28</td>
<td>Sch 40 PVC</td>
<td>2.0</td>
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<td>47.2</td>
<td>52.2</td>
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<td>Sch 40 Screen</td>
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**47. Annulus fill and seal**

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<th>To depth (feet)</th>
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<td>1</td>
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<tr>
<td>Bentonite pellets</td>
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<td>54.2</td>
<td>1</td>
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<tr>
<td>Silica sand</td>
<td>43.2</td>
<td>54.2</td>
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</table>

**48. Lithologic log (if more space is needed, continue on separate page)**

---

**49. Sketch map**

**50. Comments**

1/4/14 40.033N followed by 10 1/2' drag bit advanced to 44.2'. 8" ID PVC casing set to 44.2'. 6 1/2' tricone bit advanced to 54.2'. Silica sand set 59.2'-54.2'. 2" casing and screen set. Sand placed 45.2'-52.2'. Bentonite pellets set 45.2'-49.2'. Pellets set from 45.2' to 49.2' as casing pulled to 41.2'. After 8 hour hydration time not able to pull 8" casing due to soil squeeze. Remaining annulus grouted with cement using tremie method. Pad installed after annulus cured. Production casing installed after annulus completion stabilized. (The 4/3/14 completion reports)

**51. Affirmation**

The work described above was done under my supervision, and this report is true and correct to the best of my knowledge.

**Signature**

**Date signed**  08/31/16

**Date received**  02/29/2012

---

Latitude 37.648863  
Longitude -87.508597
### 48. Lithologic Log MW-8

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<td>Silty clay gray moist</td>
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<td>Silty clay w/gravel gray wet</td>
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<td>Sandstone w/ shale strks gray</td>
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<td>Sandy shale and interbedded sandstone gray</td>
</tr>
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MONITORING WELL 8006-3935
(MW-8)

CONSTRUCTION INCLUDES 4 BUMPER GUARDS INSTALLED IN ACCORDANCE WITH 401 KAR 6:350 SECTION 8

CONCRETE PAD MIN. 6" THICKNESS AND 3' DIAMETER

0.0' (ELEV. 385.84')

8" ID PVC CASING

PLUG

LOCKING CAP

DUE TO ARTESIAN CONDITIONS, 2" ID INNER CASING EXTENDED 8.77' ABOVE SURFACE. OUTER PROTECTIVE CASING INSTALLED IN ACCORDANCE WITH APPROVED VARIANCE DATED 6/22/16

8" ID PVC CASING

0.0'

CONCRETE

2.0'

10 1/2" Hole Diam.

8" ID PVC CASING

2" I.D. PVC RISER

44.2'

43.2'

BENTONITE PELLETS

45.2'

SILICA SAND FILTER PACK

52.2'

54.2'

6 1/2'

0.010 SLOT PVC SCREEN

PLUG

BIG RIVERS ELECTRIC CORPORATION

Well Construction Diagram

Job Number: 15-0140F
Date: 12/28/15
Scale: No Scale

D. Dunbar
**UNIFORM KENTUCKY WELL CONSTRUCTION RECORD**

Use this form only to report installation of monitoring or water wells. Original copy must be submitted to Division of Water within 60 days of completion. See instructions on reverse of form.

Record must be typed or neatly printed or it will be returned to the driller as unacceptable.

**1. Kentucky Well ID (AKGWA) Number** 3006 - 39366

**2. Owner well ID** MW - 9

**3. Attachments Required**
   - Site plan or sketch map
   - Well location on topographic map, OR
     - Obtained by GPS unit

**Conditionally Required**
   - Well diagram (monitoring well)
   - Coliform analysis (if applicable)
   - Signed Variance (if applicable)

Optional
   - Other laboratory analysis report

**4. Owner name** Big Rivers Electric Corporation

**5. Owner address** 201 Third Street

**6. City** Henderson

**7. State** KY 8. Zip 42420

**9. Site name** Sebree Station

**10. Site address** 9000 Highway 2096

**11. City** Robards


**14. Agency**
   - Interest (All)
     - ID Number 4196
     - Number CCR Rule

**16. Owner phone** 270 - 844 - 6031

**17. Site phone** 270 - 521 - 7927

**18. USGS topo map** Robards

**19. County** Henderson

**20. Physiographic Region**
   - Blue Grass
   - Ohio River Alluvium
   - E. Coal Field
   - W. Coal Field
   - Miss. Plateau
   - Jackson Purchase

**21. Surface elevation (ft)** 392.5


**23. Install start date** 11 23 15

**24. Install end date** 11 25 15

**25. Total depth** 56.3

**26. Depth to bedrock** 28.2

**27. Static water level** 0.99

**28. Casing height above surface (in)** 30.60

**WATER WELLS ONLY**

**34. Estimated well yield**
   - gpm
   - gph
   - gpd

**35. Well service**

**36. Disinfectant amount**
   - Type
   - %

**37. Type**
   - Bleach
   - Hypochlorite

**38. Filtrate adapter installed**
   - Yes
   - No

**39. Pump installed**
   - Submersible
   - Jet
   - In-line
   - Bare
   - No pump

**40. Depth to intake (ft)**

**41. Apparent quality and odor**
   - Clear
   - Cloudy
   - Muddy
   - Sulfur

**42. Coliform test type**
   - Fecal
   - Fecal and total

**43. Coliform test results**
   - 0 or <10
   - TNTC
   - Confluent

**44. Date sampled**
   - Month
   - Day
   - Year

**45. Date analyzed**

**Signature of**

**Certified driller**

**Date signed** 5/26/12

**Drilling company** Associated Engineers, Inc.

**Certification number** 0219-0364-00

**Latitude** 37.647299

**Longitude** -87.507169

**Last/Long Method**

**Comments**

4 1/4” ID wax followed by 10 1/2” drag bit advanced to 26.5’. 8” ID PVC casing set to 28.5’. 6 1/2” tricone bit advanced to 56.3’. 43” 40 mesh screen set 45.5’-56.3’. 4” casing and screened set. Sand placed 33.0’-44.5’. Bentonite pellets set 26.5’-33.0’. 6” casing pulled after 9 hour hydration time. Hole grouted 2’-43.5’. Protective surface casing and pad installed after grout cured.

41/2” ID well hole followed by 10 1/2” drag bit advanced to 26.5’. 8” ID PVC casing set to 28.5’. 6 1/2” tricone bit advanced to 56.3’. 43” 40 mesh screen set 45.5’-56.3’. 4” casing and screened set. Sand placed 33.0’-44.5’. Bentonite pellets set 26.5’-33.0’. 6” casing pulled after 9 hour hydration time. Hole grouted 2’-43.5’. Protective surface casing and pad installed after grout cured.

**Graphical Representation**

**Formulas**

**Data**

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**Graphical Representation**

**Formulas**

**Data**

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<th>Priority Code</th>
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<td>From depth (ft)</td>
<td>To depth (ft)</td>
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<td>--------------</td>
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<td>1.5</td>
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<td>53.6</td>
<td>56.3</td>
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<td>56.3</td>
<td>TD</td>
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</table>
MONITORING WELL 8006-3936
(MW-9)

CONSTRUCTION INCLUDES 4 BUMPER GUARDS INSTALLED
IN ACCORDANCE WITH 401 KAR 6:550 SECTION 8

0.0’ (ELEV. 392.6’)

10 1/2” Hole Diam.

2” I.D.
PVC
RISER

28.5’

35.0’

0.010
SLOT
PVC
SCREEN

45.0’

CENTRALIZERS INSTALLED AT 50’ INTERVALS
BEGINNING AT BOTTOM OF SCREEN

6 1/2”

PLUG

NEAT CEMENT
GROUT

BENTONITE PELLETS
33.0’

SILICA SAND
FILTER PACK

56.3’

8” ID STEEL PROTECTIVE CASING WITH
LOCKING CAP AND WEEP HOLES

CONCRETE

2.0’

0.0’

BIG RIVERS ELECTRIC CORPORATION

Well Construction Diagram

Associated Engineers, Inc.

2740 North Main St. - Madisonville, KY 42431
Phone: (270) 821-7732 - Fax: (270) 821-7789
www.associatedengineers.com
### UNIFORM KENTUCKY WELL CONSTRUCTION RECORD

**Use this form only to report installation of monitoring or water wells.**

Original copy must be submitted to Division of Water within 60 days of completion.

See instructions on reverse of form.

Record must be typed or neatly printed or it will be returned to the driller as unacceptable.

One copy to Division of Water, one copy to owner, one copy to driller's files.

---

1. **Kentucky Well ID (AKGWA) Number:**
   8006 * 3937

2. **Owner well ID:**
   MW-1.0

3. **Attachments Required:**
   - Site plan or sketch map
   - Well location
   - On topographic map, OR
   - Obtained by GPS unit
   - Conditionally Required
   - Well diagram (monitoring well)
   - Coliform analysis (if applicable)
   - Signed Variance (if applicable)
   - Optional
   - Other laboratory analysis report

---

6. **Owner name:** Big Rivers Electric Corporation

5. **Owner address:**
   201 Third Street

7. **City:** Henderson

8. **State:** KY

9. **Zip:** 42420

10. **Site name or address:** Searce Station

11. **Site address:** 9000 Highway 2096

12. **City:** Robards

13. **State:** KY

14. **Agency:** CERCLA

15. **Facility type:** Solid Waste

16. **Agency Interests (All):**
   - CCR

17. **ID Number:** 419.98

18. **16. Owner phone:** 270 * 844 * 6031

21. **Well elevation (ft):** 419 + 98

22. **Elevation determined by:** Survey

---

29. **Well use:**
   - Agriculture
   - Geothermal
   - Commercial
   - HVAC
   - Industrial
   - Injection
   - Monitoring/Remed.
   - Mining
   - Public

31. **Well status:**
   - Active
   - Inactive
   - Unsuitable for intended use
   - Monitoring

32. **Well development method:**
   - Drilling
   - Jetting
   - Pumping
   - Drilling/cementing
   - Bailing
   - Air-lift pump and water flush

36. **Disinfectant amount:**
   - Type
   - Chlorine
   - Iron
   - Salt

---

46. **Well completion:**
   - Casing and screens

   **From depth:**
   - To depth (feet)
   - Screen diamet.
   - Casing diamet.
   - Casing type
   - Screen size
   - From depth (feet)
   - To depth (feet)
   - Material

---

48. **Lithologic log:**
   - (If more space is needed, continue on separate page)

51. **Affirmation:** The work described above was done under my supervision, and this report is true and correct to the best of my knowledge.

---

**Certification number:** 0218-0524-00

**Drilling company:** Associated Engineers, Inc.

---

**Latitude:** 37.646374

**Longitude:** -87.505864

**Lat/Long Method:** INT GPS SUR REP

---

**Signature of certified driller:**

**Date signed:** 4/22/10

**Date received:** 4/22/10

---

**rev 02/29/2012**
## Lithologic Log MW-10

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<th>Description</th>
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<td>0.3</td>
<td>12.9</td>
<td>Silty clay yellowish brown</td>
</tr>
<tr>
<td>12.9</td>
<td>14.0</td>
<td>Silty clay brown moist</td>
</tr>
<tr>
<td>14.0</td>
<td>17.5</td>
<td>Sandy clay brown wet</td>
</tr>
<tr>
<td>17.5</td>
<td>28.5</td>
<td>Sandy clay yellowish brown wet</td>
</tr>
<tr>
<td>28.5</td>
<td>29.4</td>
<td>Shale gray soft</td>
</tr>
<tr>
<td></td>
<td>29.4</td>
<td>Auger refusal</td>
</tr>
<tr>
<td>30.0</td>
<td>35.8</td>
<td>Shale gray soft</td>
</tr>
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<td>35.8</td>
<td>37.6</td>
<td>Sandstone gray</td>
</tr>
<tr>
<td>37.6</td>
<td>48.5</td>
<td>Shale and interbedded sandstone gray</td>
</tr>
<tr>
<td>48.5</td>
<td>52.3</td>
<td>Sandstone gray</td>
</tr>
<tr>
<td>52.3</td>
<td>54.5</td>
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<td>Shale and interbedded sandstone gray</td>
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MONITORING WELL 8006-3937
(MW-10)

CONSTRUCTION INCLUDES 4 BUMPER GUARDS INSTALLED IN ACCORDANCE WITH 401 KAR 6:350 SECTION 8

CONCRETE PAD MIN. 6" THICKNESS AND 3' DIAMETER

0.0' (ELEV. 419.6')

10 1/2" Hole Diam.

2" I.D.
PVC
RISER

29.4'

69.5'

0.010
SLOT
PVC
SCREEN

CENTRALIZERS INSTALLED AT 50' INTERVALS BEGINNING AT BOTTOM OF SCREEN

6 1/2"

PLUG

63.5'

BENTONITE PELLETS
67.5'

SILICA SAND
FILTER PACK

80.0'

8" ID STEEL PROTECTIVE CASING WITH LOCKING CAP AND WEEP HOLES

0.0'

CONCRETE

2.0'

NEAT CEMENT
GROUT

BIG RIVERS ELECTRIC CORPORATION

Well Construction Diagram

ASSOCIATED ENGINEERS, INC.

2740 North Main St. • Madisonville, KY 42431
Phone: (270) 821-7732 • Fax: (270) 821-7789
www.associatedengineers.com

Job Number: 15-0140F
Revisions:

Date: 12/28/15
Scale: No Scale
Drawn By: D. Dunbar