

**COAL COMBUSTION RESIDUALS (CCR)
ANNUAL SURFACE IMPOUNDMENT REPORT
MAY 2017 INSPECTION**

BUCK STEAM STATION
1555 Dukeville Road
Salisbury, North Carolina

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Amec Foster Wheeler Project No.: 7810-17-0844



**COAL COMBUSTION RESIDUALS (CCR)
ANNUAL SURFACE IMPOUNDMENT REPORT
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BUCK STEAM STATION

Main Dam (State ID ROWAN-047)
Additional Primary Dam (State ID ROWAN-068)
Basin 1 to Basin 2 Dam (State ID ROWAN-069)
Basin 2 to Basin 3 Dam (State ID ROWAN-070)
Divider Dam (State ID ROWAN-071)

Duke Energy Carolinas LLC
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Salisbury, Rowan County, North Carolina

Inspection Date: 05/22/2017
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Summary

Amec Foster Wheeler has been retained to conduct the 2017 Annual Inspection for the coal combustion residuals (CCR) surface impoundments at Buck Steam Station. *This annual dam/CCR Surface Impoundment Inspection Report meets the requirements of 40 C.F.R. § 257.83 (b) (1) and (2) and the requirements of the North Carolina Coal Ash Management Act (Session Law 2014-122) Part V, Section 10 (amending G.S. 143-215.32 (inspection of dams)).* This annual inspection focused primarily on (i) the structural stability of the CCR surface impoundment; (ii) the integrity of any hydraulic structures passing underneath the CCR surface impoundment or through the dike of the unit; and (iii) verifying that the construction, design, operation, and maintenance of the CCR surface impoundment is in accordance with recognized and generally accepted good engineering standards.

The purpose of this inspection and report is to provide an engineering opinion as to whether the impoundment is structurally sound and that the design, operation, and maintenance of the impoundment are in accordance with generally accepted engineering standards.

In summary, no conditions were observed during this field inspection nor identified by existing engineering analyses that represent an unsafe structural stability concern requiring immediate attention. Amec Foster Wheeler concludes that the construction, design, operation, and maintenance of the CCR surface impoundment have been sufficiently consistent with recognized and generally accepted engineering standards for protection of public safety.

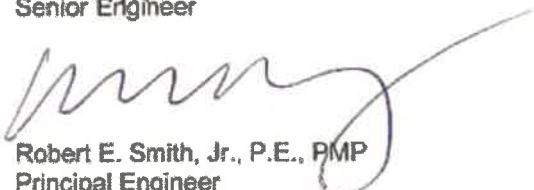


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Table of Contents	Page
1. Design / Geometry of the Impounding Structure.....	4
a. Main Dam (State ID ROWAN-047):.....	4
b. Divider Dam (State ID ROWAN-071):	4
c. Additional Primary Dam (State ID ROWAN-068):	4
d. Basin 1 to Basin 2 Dam (State ID ROWAN-069)	4
e. Basin 2 to Basin 3 Dam (State ID ROWAN-070):	5
2. Existing Instrumentation and Maximum Readings	5
3. Approximate Depth & Elevation of the Impounded Water and CCR	8
a. Basin 1 (Additional Primary Pond):	8
b. Basin 2 (Primary Pond):	8
c. Basin 3 (Secondary Pond):	8
4. Storage Capacity of Impounding Structure at the Time of the Inspection	8
a. Basin 1:.....	8
b. Basin 2:.....	8
c. Basin 3:.....	8
5. Approximate Volume of the Impounded Water and CCR at the Time of the Inspection	8
a. Basin 1:.....	9
b. Basin 2:.....	9
c. Basin 3:.....	9
6. Existing Conditions That Are Disrupting or Have Potential to Disrupt the Operation and Safety of the CCR Unit and Appurtenant Structures.....	9
a. Main Dam (ROWAN-047):.....	9
b. Additional Primary Dam (ROWAN-068):	10
c. Basin 1 to Basin 2 Dam (ROWAN-069):	11
d. Basin 2 to Basin 3 Dam (ROWAN-070):	11
e. Divider Dam (ROWAN-071):	12
7. Maintenance	13

1. Design / Geometry of the Impounding Structure

Based on the data reviewed and the visual inspection, no modifications to the geometry of impounding structures have been made since the 2016 annual inspection. The following geometry data was based on information provided by Duke Energy.

a. Main Dam (State ID ROWAN-047):

	Main Dam
Dam Length, ft	Approx. 2,384
Maximum Dam Height, ft	Approx. 70
Crest Elevation, ft	Approx. 680 on Secondary Pond Side Approx. 690 on the Primary Pond Side
Normal Pond (Basin 3) Elevation, ft	Approx. 674.0
Crest Width, ft	Approx. 15
Pond Area: Primary Pond, acres	Approx. 46

b. Divider Dam (State ID ROWAN-071):

	Divider Dam
Dam Length, ft	Approx. 1400
Maximum Dam Height, ft	Approx. 10
Crest Elevation, ft	Approx. 690
Normal Pond (Basin 3) Elevation, ft	Approx. 674.0
Crest Width, ft	Approx. 15
Pond Area: Primary Pond, acres	Approx. 46
Secondary Pond, acres	Approx. 16.5

c. Additional Primary Dam (State ID ROWAN-068):

	Additional Primary Dam
Dam Length, ft	Approx. 2000
Maximum Dam Height, ft	Approx. 72
Crest Elevation, ft	Approx. 710
Normal Pond (Basin 1) Elevation, ft	Approx. 703.8
Crest Width, ft	Approx. 20
Pond Area: Additional Primary Pond, acres	Approx. 57

d. Basin 1 to Basin 2 Dam (State ID ROWAN-069)

	Basin 1 to Basin 2 Dam
Dam Length, ft	Approx. 280
Maximum Dam Height, ft	Approx. 25
Crest Elevation, ft	Approx. 710
Maintained Pond (Basin 1) Elevation, ft	Approx. 703.8
Crest Width, ft	Approx. 15
Pond Area: Primary Pond, acres	Approx. 46
Additional Primary Pond, acres	Approx. 57

e. Basin 2 to Basin 3 Dam (State ID ROWAN-070):

	Basin 2 to Basin 3 Dam
Dam Length, ft	Approx. 130
Maximum Dam Height, ft	Approx. 20
Crest Elevation, ft	Approx. 690
Maintained Pond (Basin 2) Elevation, ft	Approx. 682.2
Crest Width, ft	Approx. 10
Pond Area: Primary Pond, acres	Approx. 46
Secondary Pond, acres	Approx. 16.5

2. Existing Instrumentation and Maximum Readings

Monitoring equipment/devices/procedures used at Buck Steam Station include piezometers, basin water level measurements, discharge flow readings and survey monument readings.

Presently, 18 piezometers and six observation wells are located on the various dams and dikes. Duke Energy personnel at the station record monthly water level readings within the piezometers and observation wells and report the readings to Duke Energy CCP Engineering. The data collected is analyzed by Duke Energy CCP Engineering for any changes or anomalies. Tabulated in Table 1 below are the maximum recorded elevations since the 2016 annual inspection.

Table 1: Buck Steam Station Piezometer and Observation Well Data

<i>Location</i>	<i>Latitude/Longitude Coordinates</i>	<i>Piezometers & Observation Wells</i>	<i>Maximum Recorded Elevation Reading, ft.</i>
Main Dam, Station 5+40	35°42'41.47"N 80°21'52.25"W	P1/P1A	663.50
Main Dam, Station 5+40	35°42'42.38"N 80°21'51.75"W	P2/P2A	652.00
Main Dam, Station 5+40	35°42'43.20"N 80°21'51.32"W	P3	633.31
Basin 2 to Basin 3 Dam	35°42'27.37"N 80°21'51.44"W	P4	681.03
Basin 2 to Basin 3 Dam	35°42'27.62"N 80°21'51.39"W	P5	677.51
Secondary Cell Divider Dike	35°42'32.21"N 80°21'51.84"W	P6	680.69
Secondary Cell Divider Dike	35°42'37.01"N 80°21'51.58"W	P7	681.00
Main Dam, Station 7+50	35°42'40.83"N 80°21'49.75"W	P8	667.83
Main Dam, Station 7+50	35°42'41.27"N 80°21'49.50"W	P9	643.67
Additional Primary Dam, Station 69+50	35°42'19.62"N 80°22'28.23"W	P10	678.52

<i>Location</i>	<i>Latitude/Longitude Coordinates</i>	<i>Piezometers & Observation Wells</i>	<i>Maximum Recorded Elevation Reading, ft.</i>
Additional Primary Dam, Station 69+50	35°42'19.65"N 80°22'28.68"W	P11	669.52
Additional Primary Dam, Station 71+00	35°42'21.29"N 80°22'28.31"W	P13	679.33
Additional Primary Dam, Station 71+00	35°42'21.32"N 80°22'28.85"W	P14	656.51
Additional Primary Dam, Station 71+00	35°42'21.35"N 80°22'29.64"W	P15	651.44
Additional Primary Dam, Station 71+00	35°42'21.38"N 80°22'30.56"W	P16	650.60
Additional Primary Dam, Station 73+00	35°42'22.75"N 80°22'27.76"W	P17	681.33
Additional Primary Dam, Station 73+00	35°42'23.11"N 80°22'28.19"W	P18	668.92
Additional Primary Dam, Station 73+00	35°42'23.57"N 80°22'28.78"W	P19	658.63
Main Dam, Station 5+40	35°42'41.41"N 80°21'52.15"W	OW1	673.67
Main Dam, Station 5+40	35°42'42.26"N 80°21'51.64"W	OW2	660.06
Main Dam, Station 5+40	35°42'43.16"N 80°21'51.14"W	OW3	633.83
Main Dam, Station 7+50	35°42'40.89"N 80°21'49.81"W	OW8	667.07
Main Dam, Station 7+50	35°42'41.33"N 80°21'49.55"W	OW9	659.72
Additional Primary Dam, Station 69+50	35°42'19.69"N 80°22'29.61"W	OW10	660.49

Basin water surface measurements are recorded weekly during the weekly inspections by Duke Energy personnel. Measurements for Basin 1 and Basin 2 are performed by measuring down from the top of the concrete discharge tower to the water surface. Basin 3 has an automated instrumentation system that provides the basins level. However, if this system is not working properly, then the readings are measured in the same manner as Basin 1 and Basin 2. These basin level readings are recorded with the piezometer and observation well records. Table 2 represents the maximum recorded elevations since the 2016 annual inspection.

Table 2: Buck Steam Station Basin Water Surface Elevations

<i>Location</i>	<i>Latitude/Longitude Coordinates</i>	<i>Water Surface Measurements</i>	<i>Maximum Recorded Reading, ft.</i>
Measurements made at the Basin 1 Discharge Tower	35°42'8.83"N 80°22'5.62"W	Additional Primary Pond Elevation	702.07
Measurements made at the Basin 2 Discharge Tower	35°42'27.14"N 80°21'52.15"W	Basin 2 Pond Elevation	682.83
Measurements Made at the Basin 3 Discharge Tower	35°42'38.59"N 80°21'48.11"W	Basin 3 Pond Elevation	673.33

The discharge measurements from Basin 3 to the Yadkin River are made monthly by Duke Energy personnel by measuring water depths in the V-notch weir located at the toe of the Main Dam (ROWAN-047). Table 3 presents the maximum recorded reading since the 2016 annual inspection.

Table 3: Buck Steam Station Discharge Outflow Rate

<i>Location</i>	<i>Latitude/Longitude Coordinates</i>	<i>V-notch Weir at Toe of Main Dam</i>	<i>Maximum Recorded Reading</i>
Discharge Outfall (Basin 3)	35°42'43.47"N 80°21'50.22"W	Secondary Basin (Basin 3) Discharge	1.6 MGD

Nine survey monuments are located on the Additional Primary Dam (ROWAN-068). These monuments were first monitored on May 24, 1984 and have generally been measured annually. The monuments were last surveyed on October 5, 2016 by Lake Norman Surveying and Mapping.

Table 4: Buck Steam Station Survey Monument Measurements

<i>Location (ROWAN-068)</i>	<i>Survey Monuments</i>	<i>Settlement from May 24, 1984 to November 12, 2015</i>	<i>Settlement from November 12, 2015 to October 5, 2016</i>
Additional Primary Dam, Crest	Monument # 5	0.073 ft	0.010 ft down
Additional Primary Dam, Crest	Monument # 6	0.158 ft	0.005 ft down
Additional Primary Dam, 690 Berm	Monument # 7	0.048 ft	0.003 ft up
Additional Primary Dam, Crest	Monument # 8	0.228 ft	0.005 ft up
Additional Primary Dam, 690 Berm	Monument # 9	0.088 ft	0.008 ft up
Additional Primary Dam, 670 Berm	Monument #10	0.078 ft	0.018 ft up
Additional Primary Dam, Crest	Monument #11	0.203 ft	0.008 ft up
Additional Primary Dam, 690 Berm	Monument #12	0.060 ft	0.015 ft up
Additional Primary Dam, Crest	Monument #13	0.228ft	0.003 ft up

3. Approximate Depth & Elevation of the Impounded Water and CCR

The coal-fired units at the Buck Steam Station were retired in 2013 and thus no ash has been added to the ash basins since then. The data presented is based on the information provided by Duke Energy.

a. Basin 1 (Additional Primary Pond):

Elevation of Water: 702.04 ft (on May 22, 2017)
Minimum Depth of Water: 0 ft (ash at the surface over the majority of the basin)
Maximum Depth of Water: Less than 1 ft in the immediate area of the discharge tower.
Present Depth of Water: Less than 1 ft in the immediate area of the discharge tower.

b. Basin 2 (Primary Pond):

Elevation of Water: 681.52 ft (on May 22, 2017)
Minimum Depth of Water: 0 ft (ash at the surface over the majority of the basin)
Maximum Depth of Water: 19 ft
Present Depth of Water: varies (0-19 ft)

c. Basin 3 (Secondary Pond):

Elevation of Water: 673.22 ft (on May 22, 2017)
Minimum Depth of Water: 0 ft to ash at the discharge from the Primary Basin.
Maximum Depth of Water: 16.3 ft
Present Depth of Water: varies (0-16.3 ft)

4. Storage Capacity of Impounding Structure at the Time of the Inspection

The basin capacities presented below are based on the information dated April 27, 2016 and provided by Duke Energy and remained unchanged at the time of the 2017 annual inspection.

a. Basin 1:

Storage Capacity: approx. 1,755 acre-feet
Remaining Capacity: 288 acre-feet (Ash sluicing ceased in October 2012)

b. Basin 2:

Storage Capacity: approx. 1,177 acre-feet
Remaining Capacity: 170 acre-feet (Ash sluicing ceased in October 2012)

c. Basin 3:

Storage Capacity: approx. 262 acre-feet
Remaining Capacity: 123 acre-feet (Basin 3 has served as a polishing pond since the construction of the Divider Dam)

5. Approximate Volume of the Impounded Water and CCR at the Time of the Inspection

The following water and ash volume estimates are based on data provided by Duke Energy. Note that ash volumes are converted from tons to acre-feet using a unit weight of ash of 1.2 tons/cubic yard.

a. Basin 1:

Approximate Water Volume: 6.1 acre-feet (2,000,000 gals)
Approximate CCR Volume: 1,467 acre-feet (2,840,000 tons)

b. Basin 2:

Approximate Water Volume: 169 acre-feet (55,000,000 gals)
Approximate CCR Volume: 1,007 acre-feet (1,950,000 tons)

c. Basin 3:

Approximate Water Volume: 98 acre-feet (32,000,000 gals)
Approximate CCR Volume: 139 acre-feet (270,000 tons)

6. Existing Conditions That Are Disrupting or Have Potential to Disrupt the Operation and Safety of the CCR Unit and Appurtenant Structures

Jianhua Li and Tex Widmer of Amec Foster Wheeler inspected the Main Dam (State ID ROWAN-047), Additional Primary Dam (State ID ROWAN-068), Basin 1 to Basin 2 Dam (State ID ROWAN-069), Basin 2 to Basin 3 Dam (State ID ROWAN-070) and Divider Dam (State ID ROWAN-071) on May 22, 2017. To supplement the visual observations of the Basin 1 to Basin 2 Dam (ROWAN-069), Basin 2 to Basin 3 Dam (ROWAN-070), and Main Dam (ROWAN-047) risers and discharge pipes, we reviewed the "CCP Annual Pipe and Riser Inspection Assessment" for Buck Steam Station prepared by Duke Energy on March 22, 2017. The assessment report summarizes the closed circuit television (CCTV) video inspections conducted on the discharge structures in the CCR units between January and February 2017. No actual structural weakness of the CCR units was identified and the discharge from the Basin 3 Outfall (Main Dam) showed no discoloration during the 2017 field inspection. Several issues were noted that require ongoing observations and maintenance to prevent them from becoming more serious issues with regards to the stability and function of the impoundments.

a. Main Dam (ROWAN-047):

In general, the Main Dam visually appeared to be in good condition at the time of the 2017 annual field inspection. No structural weaknesses were identified. The observations made during the inspection of the dam are discussed below:

Downstream Slope

- An area of seepage adjacent to the discharge pipe outlet behind the previous location of a maintenance/utility building (BUC-1) was observed during the 2017 annual inspection. The slope was damp, while the lower area near the culvert was wet. The area around AOW S-13 will continue to be observed during weekly inspections performed by Duke Energy.
- An area of seepage was observed at the toe of the dam near P3 & OW3 during the 2017 annual inspection. The area was damp, with standing water observed in the channel at the time of inspection and will continue to be observed during weekly inspections performed by Duke Energy.
- Wetness was observed in an area north of the roadway culvert inlet, near MW-3 during the 2017 annual inspection. It was noted that approximately 0.63 inches of rainfall occurred the same day prior to the start of the inspection. The area will continue to be observed during weekly inspections performed by Duke Energy.

- Ruts and bare areas created during the installation of monitoring wells were observed during the 2017 inspection. According to Duke personnel, these areas have been seeded but not germinated. These areas are managed under the facility preventive maintenance program and continue to be observed by Duke Energy.

Crest

- The crest of the Main Dam appeared to be generally level and well maintained. Some localized minor potholes were observed at the time of the 2017 annual inspection.

Outlet Structures

- Principal Spillway – The original 36-inch corrugated metal pipe (CMP) principal spillway was abandoned and a new concrete overflow box spillway had been constructed per Duke Energy WO No. 7298831 at the time of the 2017 annual inspection. The new spillway discharges water from Basin 3 to the Yadkin River through a 36 inch diameter ductile iron pipe (DIP) with three alignment changes and approximately 274 feet in total length. During the 2017 annual inspection, the concrete spillway outlet had separated at its final downstream joint (Issue BUC-118 and BUC-119). Additionally, a crack was observed near the middle of the concrete spillway outlet channel. Both conditions will continue to be observed during weekly inspections performed by Duke Energy. The DIP was inspected during the 2017 Pipe Inspection and found to be in excellent condition.
- Riser Structure – Per Duke Energy WO No. 7298831, this structure has been abandoned as a part of the previous principal spillway in 2016.

CMP Storm Water Culvert – At the time of the 2017 inspection, a steady trickle of flow was observed at the point of discharge during the 2017 annual inspection.

RCP Storm Water Culvert – Flow was observed entering and exiting the RCP beginning near the downstream toe during the 2017 annual inspection. Flow was reported by Duke Energy to be approximately the same as during previous inspections.

b. Additional Primary Dam (ROWAN-068):

In general, the Additional Primary Dam visually appeared to be in good condition at the time of the 2017 annual field inspection. The observations made during the inspection of the dam are discussed below:

Downstream Slope

- Standing water in isolated locations on the lower and upper bench was observed at the time of the 2017 annual inspection (BUC-109). It was noted that approximately 0.63 inches of rainfall occurred the same day prior to the start of the inspection. These areas are managed under the facility preventive maintenance program and continue to be monitored.
- Seepage was observed in the riprap along the toe during the 2017 annual inspection. The zone will continue to be observed during weekly inspections.
- During the 2017 annual inspection seepage was observed in an area on the west side downstream toe in addition to localized standing water, spanning approximately 20 feet southwest of the inlet to the culvert. The zone will continue to be observed during weekly inspections.
- Water was observed to be flowing in terracotta pipe # 1, and standing still in terracotta pipe #2 (BUC-3). Duke Energy indicated that the flow observed during the 2017 annual inspection was

approximately the same rate as observed during the weekly inspections.

Crest

- The crest of the Additional Primary Dam appeared to be generally level and well maintained. Minor potholes with standing water were observed at the time of the 2017 annual inspection.

Outlet Structures

- CMP Storm Water Culvert – Culvert was observed to be in good condition during the 2017 annual inspection.

c. Basin 1 to Basin 2 Dam (ROWAN-069):

In general, the Basin 1 to Basin 2 Dam visually appeared to be in good condition at the time of the 2017 annual field inspection. No structural weaknesses were identified. The observations made during the inspection of the dam are discussed below:

Outlet Structures

- Abutment Contacts – No issues were observed during the 2017 annual inspection.
- Principal Spillway – The principal spillway consists of a discharge riser tower with a 36" RCP barrel pipe. During the 2017 annual inspection concrete was observed to be spalling inside the discharge riser. The riser was inspected during the 2017 Pipe Inspection. The stop logs appeared to be in good condition with only minor leakage observed during the video inspection. The horizontal beams appeared to be in good condition with no evidence of structural deterioration. No appearances of potential structural weakness were identified.
- Discharge Pipe – The discharge pipe is a 36-inch CMP approximately 183 feet in length. This pipe was inspected during the 2017 annual pipe inspection. The pipe was previously repaired (WO No. 6512772) using a packer to seal selected joints to prevent infiltration. There was an observed stain at a joint at 28.7, 52.3 and 76.8 feet. The stain appeared to be on the concrete prior to the repairs and there was no evidence of active leakage. A longitudinal crack was observed at 51.1 feet (PACP Grade: 3 out of 5) and a multiple fracture condition was observed at 112.5 feet (PACP Grade: 4 out of 5). Based on the 2017 annual CCTV inspection assessment, Duke Energy considers this pipe to be in good condition, with a low risk of failure. We concur with Duke's assessment but recommend that these conditions continue to be monitored annually.

d. Basin 2 to Basin 3 Dam (ROWAN-070):

In general, the Basin 2 to Basin 3 Dam visually appeared to be in good condition at the time of the 2017 annual field inspection. The observations made during the inspection of the dam are discussed below:

Downstream Slope

- Following the 2016 inspection, the installation of a HDPE pipe for the Basin 1 and Basin 2 Bulk Dewatering Pumping System on the downstream slope was completed. The system will not operate until the revised NPDES permit is issued. Continued monitoring of the pipe takes place during Duke Energy's weekly dam inspections. (WO No. 6988924-10)

- Evidence of some localized rip-rap discoloration and soil sedimentation was noted in the rip-rap near the bottom of the downstream slope.

Crest

- The crest of the Secondary Dam appeared to be generally level and well maintained.

Outlet Structures

- **Riser Structure** – The vertical riser structure is an approximately 10-foot by 10-foot reinforced concrete box with stop logs on two sides. The vertical riser structure extends approximately 16 feet from top to bottom. The stop logs appeared to be in good condition with only minor leakage observed during the video inspection. The horizontal beams appeared to be in good condition with no evidence of structural deterioration. Surface spalling was observed at 2.9, 6.2, and 10.8 feet. An infiltration stain was also observed at 12.7 feet. No appearances of potential structural weakness were identified. Since the 2016 inspection the high level bridge to the riser structure has been repaired per BUC-6; however, the lower level bridge was found to be in general poor condition and taped off to prevent access.
- **Discharge Pipe** – The discharge pipe is a 42-inch reinforced concrete pipe approximately 76 feet in length. This pipe was previously repaired (WO No. 6512772) using a packer to seal selected joints to prevent infiltration. The previous pipe inspection report, prepared by Amec Foster Wheeler on September 22, 2016, indicated an active leak at joint approximately 27.6 feet from the riser. This leak was not observed during the 2017 pipe inspection. Sediments were observed in the joint in question, which may have prevented its detection. This leak is currently being repaired under Duke Energy WO No. 20398688. An infiltration stain was observed at 53.2 feet from the outlet. Overall, the pipe appeared to be in good condition and could be considered a low risk. No evidence of cracking or structural deterioration of the concrete was observed. No appearances of potential structural weakness were identified.

e. Divider Dam (ROWAN-071):

In general, the Divider Dam visually appeared to be in good condition at the time of the 2017 annual field inspection. The observations made during the inspection of the dam are discussed below:

Downstream Slope

- Some bare areas with sparse grass were observed in small areas of the downstream slope. These areas are managed under the facility preventive maintenance program and will continue to be observed during the weekly inspections.
- Wetness and shallow ponded water were observed at the time of the 2017 inspection on both the left and right sides but this is due to rainfall and lack of positive drainage in some areas of the bench. This area is managed under the facility preventive maintenance program and will continue to be observed during the weekly inspections performed by Duke Energy.
- Wetness and seep flow observed in previous weekly inspections near the water's edge on the downstream slope of the dam was not observed at the time of the 2017 annual dam inspection. Duke Energy indicated that following removal of vegetation at the water's edge, it appears that the observed seep flow was storm water flow collecting within the riprap. The conditions described above have been observed during previous inspections and continue to be monitored.

- New riprap was placed at the right end of the toe for approximately 30 to 40 feet in 2017 (WO No. 10317190). Additionally, a low spot of sparse riprap reported in the 2016 inspection report was filled with new riprap (WO No. 10317190).

7. Maintenance

Duke Energy has developed an Operations and Maintenance (O&M) Manual to instruct operation and engineering personnel the proper procedures for operating and maintaining the Ash Basin System. The Station Owners and Station Environmental Coordinators operate and maintain the impoundment facility in a safe and regulatory-compliant manner such as meeting State and Federal laws along with company guidelines without interruption to the station's generation of electricity. The O&M manual provides the necessary information in a concise and comprehensive manner and assists those responsible for operating and maintaining the ash impoundment facility and associated support features.

Observations during this 2017 inspection indicate that Duke is adequately maintaining the facility.