REPORT

Dam Safety Assessment of CCW Impoundments

Possum Point Power Station

United States Environmental Protection Agency
Washington, DC

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Prepared for:
US Environmental Protection Agency
Washington, DC

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1. INTRODUCTION

1.1. GENERAL

In response to the coal combustion waste (CCW) impoundment failure at the TVA/Kingston coal-fired electric generating station in December of 2008, the U.S. Environmental Protection Agency (USEPA) has initiated a nationwide program of structural integrity and safety assessments of coal combustion waste impoundments or "management units". A CCW management unit is defined as a surface impoundment or similar diked or bermed management unit or management units designated as landfills that receive liquid-borne material and are used for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. Management units also include inactive impoundments that have not been formally closed in compliance with applicable federal or state closure/reclamation regulations. This project is being conducted in accordance with the terms of our Order EP10W001240 to Contract BPA# EP10W000673, dated April 8, 2010.

1.2. PROJECT PURPOSE AND SCOPE

The purpose of this work is to provide Dam Safety Assessment of CCW management units, including the following:

- Identify conditions that may adversely affect the structural stability and functionality of a management unit and its appurtenant structures
- Note the extent of deterioration, status of maintenance, and/or need for immediate repair
- Evaluate conformity with current design and construction practices
- Determine the hazard potential classification for units not currently classified by the management unit owner or by state or federal agencies

O'Brien & Gere's scope of services for this project includes performing a site specific dam safety assessment of all CCW management units at the subject facility. Specifically, the scope includes the following tasks:

- Perform a review of pertinent records (prior inspections, engineering reports, drawings, etc.) made available at the time of the site visit to review previously documented conditions and safety issues and gain an understanding of the original design and modifications of the facility.
- Perform a site visit and visual inspection of each CCW management unit and complete the visual inspection checklist to document conditions observed.
- Perform an evaluation of the adequacy of the outlet works, structural stability, quality and adequacy of the management unit's inspection, maintenance, and operations procedures.
- Identify critical infrastructure within 5 miles downstream of management units.
- Evaluate the risks and effects of potential overtopping and evaluate effects of flood loading on the management units.
- Immediate notification of conditions requiring emergency or urgent corrective action.
- Identify environmental permits issued for the management units.
- Identify leaks, spills, or releases of any kind from the management units within the last 5 years.
- Prepare a report summarizing the findings of the assessment, conclusions regarding the safety and structural integrity, recommendations for maintenance and corrective action, and other action items as appropriate.

This report addresses the above issues for Ash Ponds D and E at the Possum Point Power Station near Dumfries, Virginia. The above impoundments are owned and operated by Dominion Virginia Power (Virginia Electric & Power Company), a subsidiary of Dominion Resources, Inc. In the course of this assessment, we obtained information directly from and through interviews with representatives of Dominion Virginia Power (DVP).

2. PROJECT/FACILITY DESCRIPTION

2.1. GENERAL

The Dominion Possum Point Power Station is located in Possum Point, Virginia, approximately 3.5 miles east of Dumfries and 30 miles south of Washington, D.C. Possum Point Power Station is a 650-acre site that overlooks the Potomac River and the Quantico Creek. A Site Location Map is included as Figure 1 and a Site Layout as Figure 2.

The facility has four generating units with a combined generating capacity of approximately 1,200 MW. Units 3 & 4 are fired using natural gas and Unit 5 is an oil-fired unit. Unit 6 is fired by both natural gas and oil. Natural gas is provided via pipeline from Northern Virginia and oil is brought in by boat on the Potomac River. Dominion Virginia Power (DVP) stopped using coal for energy production at this facility in July of 2003.

The facility uses several impoundments for the treatment of bilge water from the barges, storm water from the site, and blowdown water from the cooling units. Prior to 2003, ash was slurried to Ash Pond E for CCW management. Because Ash Pond E was nearly full (roughly 2/3), Dominion Power constructed Ash Pond D in 1989 to provide additional CCW storage. It is our understanding that a minimum amount of CCW was hydraulically transported from Ash Pond E to Ash Pond D.

Three additional impoundments known as the Oil Waste Treatment Basin and the Metals Cleaning Waste Treatment Facility (two separate impoundments) are located in the vicinity of Ash Ponds D and E. These facilities are used to precipitate metals and collect oils from ballast and water from floor drains, blowdown from Unit 5 and Unit 6, and site stormwater.

Water that is collected on the generating site is pumped through approximately 6,500 feet of glass-lined steel pipe from the Oil Treatment Basin to the Metals Cleaning Waste Treatment Facility, where it drains by gravity to Ash Pond E. The primary spillway for Ash Pond D also discharges to Ash Pond E.

DVP maintains a single VPDES permit for discharge from Ash Pond E to Quantico Creek. Discharges at this location are monitored on a monthly and annual basis and reported to the Virginia Department of the Environment as permitted discharges from the CCW basins. This assessment report summarizes the April 2010 inspection of the CCW management units at the Possum Point Power Station.

2.2. MANAGEMENT UNIT DESCRIPTION

As noted, CCW consists of bottom ash and fly ash as a byproduct of coal combustion. Because DVP no longer uses coal to generate electricity, they are managing CCW generated previously in both Ash Pond E and Ash Pond D. It is estimated that approximately 2/3 of Ash Pond E consists of sluiced CCW, whereas Ash Pond D contains only a small fraction of the design capacity.

Although CCW is not currently generated by DVP at this site, Ash Ponds D and E continue to collect stormwater from the area immediately surrounding the impoundments and Ash Pond E continues to receive disposed water collected at the generator site. Depending upon water levels in Ash Pond E, river water is also pumped to Ash Pond E in order to keep stored CCW saturated. Ash Pond D is also used as a disposal site for the dried filtered material from the river water clarification process and, occasionally, the U.S. Army Corps of Engineers disposes of dredged river materials at this site. At this time, neither of these disposal volumes are substantial in terms of the storage capacity of the impoundments. Because the dam is not being used as it was intended, there is substantial reserve capacity

Ash Ponds D and E are regulated by the Virginia Department of Conservation and Recreation and, therefore, have been assigned Inventory Numbers (see inspection checklist). A one-line diagram illustrating the flow patterns to Ash Ponds D and E was provided by DVP.

2.2.1. Ash Pond D

Ash Pond D is located to the east of Ash Pond E and was constructed across a valley in 1988 by DVP. Information provided by DVP includes a 1988 design analysis of the dam and contract drawings. Some of the data from this report has been included in Appendix B. The earth embankment section of the dam is approximately 1,700 feet long with a maximum height of approximately 110 feet (Crest Elev. 150, Toe Elev. 40). The downstream toe of the dam is approximately 900 feet from Quantico Creek.

The principal spillway is a reinforced concrete riser structure located at the upstream toe of the embankment near the right abutment. The structure was designed with multiple 8-inch discharge openings to allow the plant operators to vary the flow from the dam as the impoundment is filled.

Water discharges from the principal spillway through a 30-inch reinforced concrete pipe to a stilling basin downstream of the dam. The outflow then travels through a concrete-lined channel into Ash Pond E. At the time of the inspection, the pool elevation was approximately 10 feet below the lowest discharge opening, or about Elevation 106.

There is a natural emergency spillway for Ash Pond D which would discharge through a low area in the surrounding topography to a valley to the north of the impoundment when the water level reaches approximate Elev. 144. The emergency spillway is sized to pass the PMF of 2,500 cfs with a freeboard of 2 feet. Although the trees and vegetation in the emergency spillway area are not maintained, the pool elevation is well below the principal spillway crest and flow through the emergency spillway is not likely under the current operating conditions.

2.2.2. Ash Pond E

Ash Pond E was designed as a cross-valley impoundment in 1968 by Stone & Webster Engineering Corporation. Reports maintained by DVP include slope stability analyses performed for the earth embankment section of this dam in 1990. The dam consists primarily of an earth embankment section that is approximately 2,500 feet long with a maximum height of approximately 40 feet and a reinforced concrete drop-inlet spillway. The downstream toe of the dam is located approximately 200 feet from Quantico Creek.

In 1988, a year prior to the completion of Ash Pond D, the height of the dam was raised by about three feet to increase storage capacity. The current crest elevation of the dam appears to vary between Elevation 40 and 42. Within the past year, geotextile and riprap were placed on the upstream slope of the embankment to alleviate historical erosion. This work resulted in some crest disturbance and the crest was repaired by placing geotextile, a 3”-6” layer of dense graded aggregate, and a layer of #57 stone to provide a better driving surface for maintenance vehicles.

The principal spillway is a free-standing concrete discharge tower located at the upstream toe of the embankment. Operators control the overflow elevation by installing or removing stop logs at the spillway entrance, and hence the depth of the water in the reservoir varies based upon operational requirements. If additional storage capacity is necessary to accommodate expected pumping operations, the operators will lower the reservoir by removing stop logs. Conversely, operators may add stop logs to raise the water surface elevation and to keep the stored CCW saturated. The maximum operating pool (with all stop logs installed) is approximately El. 38 feet.

Water is discharged from the base of the principal spillway through a 72-inch corrugated metal pipe. A stilling basin and discharge weir located at the downstream end of the 72-inch pipe dissipate the energy of this outflow prior to discharging into a marshy area, where it then flows under Possum Point Road and into Quantico Creek. In 1977, seepage along the original 72-inch concrete pipe caused internal erosion of embankment material, resulting in major damage to the embankment. The concrete pipe was replaced with the current 72-inch corrugated metal pipe, and anti-seep collars were installed in accordance with the standard practice of that time.

2.2.3. Other Impoundments

A Site Layout is provided as Figure 2 and illustrates three additional impoundments on the site. None of these impoundments store CCW, but a brief description of each follows:

1) Outfall 503/502 – Oil Treatment Basin – The process flow diagram indicates that boiler blowdown water, low head water from Generator 5 oil fuel storage tanks, and stormwater is either pumped or drains by gravity to this basin. When the basin is considered at capacity, this water is pumped to Ash Pond E through a discharge structure. The influent for the pump is located at the bottom of the reservoir so that floating oil can be recovered on the surface using a surface skimmer. DVP personnel indicated that operational practices now limit the amount of oil collected in the basin.

2) Outfall 501- Metals Cleaning Waste Treatment Facility - This facility consists of two basins: Pond A and Pond B. As noted in the process flow diagram, water sent to these basins includes blowdown water from boilers, preheaters, precipitators, floor drains, and the piping system, and storm water. The two-unit Metals Cleaning Treatment Facility begins in Pond B and flows by gravity to Pond A. The water is treated with lime to precipitate metals. Both ponds are provided with 60-mil HDPE liners which were installed in the 1990's.

2.3. HAZARD POTENTIAL CLASSIFICATION

The State of Virginia regulates dams under the Virginia Department of Conservation and Recreation (VDCR). Virginia impounding structure regulations classify dam hazard on the basis of potential loss of life or property damage. VDCR offers three separate classifications as follows:

High - dam failure would cause probable loss of life or serious economic damage
Significant - dam failure may cause loss of life or appreciable economic damage
Low - dam failure would result in no expected loss of life and would cause no more than minimal economic damage.

All dams in Virginia are subject to the Dam Safety Act if they meet the following threshold size criteria:

- 25 feet or greater in height and an impoundment capacity of 15 acre-feet or greater ;
- 6 feet or greater in height and an impoundment capacity of 50 acre-feet or greater.

Since the Ash Pond D and E dams exceed the height and storage requirements, they are both regulated under the VDCR Dam Safety Act.

The definitions of the four hazard potential categories (Less than Low, Low, Significant and High) to be used in this assessment are included in the USEPA CCW checklist presented in Appendix A.

Based upon the checklist definitions and the results of this assessment, the recommended hazard potential ratings for the two impoundments are as follows:

Ash Pond D – SIGNIFICANT HAZARD: This classification is suggested because loss of life is not probable, but economic loss and environmental damage is likely due to the proximity to Quantico Creek and Possum Point Road.

Ash Pond E – SIGNIFICANT HAZARD: Similar reasons as for Ash Pond D.

2.4. IMPOUNDING STRUCTURE DETAILS

The following sections summarize the structural components and basic operations of Ash Ponds D and E. The locations of these impoundments are shown in Figure 1. A Site Layout and Photo Location Maps are provided as Figures 2, 3 and 4. Additionally, photos taken during the visual inspection are incorporated in a Photographic Log provided as Appendices B and C for Ash Ponds D and E, respectively.

2.4.1. Embankment Configuration

Ash Pond D

Ash Pond D is impounded by a cross-valley embankment and has a surface area of approximately 58 acres at the design normal pool elevation. The embankment is approximately 1,600 feet long with a maximum height of about 110 feet. The upstream embankment slope was designed with an inclination of 2.5H:1V and the downstream slope was designed at an inclination of 2.7H:1V with several horizontal benches constructed into the slope at various elevations. The impoundment was reportedly designed with a 2-foot thick clay liner on the bottom of the pond and with a slurry wall along the lower portion of the upstream slope.

Due to operational changes at the plant, CCW is no longer sluiced to Ash Pond D. Therefore, only stormwater is collected in the pond and a small amount (approximately 30 cubic yards/week) of sediment is disposed of in the impoundment area.

Ash Pond E

Ash Pond E is a combination diked and cross-valley embankment structure with a total surface area of approximately 34 acres, based on plan view measurement of the pond. DVP has also estimated that approximately 2/3 of the impoundment storage capacity is filled with CCW. The remaining capacity is used for storage of stormwater, and disposed water from various generating site processes.

The 2,500-foot long embankment for Ash Pond E varies in height, with a maximum height of about 40 feet. Although the noted crest elevation is at Elev. 40 in the cross-section provided by DVP, additional fill has been added to the dam resulting in a maximum crest elevation of about Elev. 42. The upstream slope was designed at 1.5H:1V and the downstream slope was designed at an inclination of 2H:1V. According to the design documents, the upper layer of marshy foundation soils was to be excavated and replaced with a layer of sand fill, however, as-built drawings are not available and at least one other embankment section does not show the sand fill.

The principal spillway for Ash Pond E is a concrete riser structure with a 72-inch corrugated metal discharge pipe. Flow from the spillway pipe enters a concrete stilling basin before discharging to the Quantico Creek.

2.4.2. Type of Materials Impounded

Ash Pond D

Because CCW is no longer being generated at the Possum Point Power Station, Ash Pond D has not received any CCW material in recent years. Plant personnel use the impoundment area for the disposal of sediment cake from the filtration of river water at the plant, however, this quantity is estimated at no more than 30 cubic yards per week. DVP personnel also noted that the Corps of Engineers has used the impoundment area to dispose of material from river dredging operations. This activity does not occur regularly and records are not available to determine the quantity of river dredged material disposed of in the impoundment area.

Ash Pond E

Currently, influent to Ash Pond E includes water with solids consisting primarily of bottom ash, lesser quantities of miscellaneous fines and waste oil metals from blowdown activities. During the site visit, there were also large areas of cenospheres floating on the water surface (See Appendix C - Photo 10). As for Ash Pond D, CCW is no longer being sluiced to Ash Pond E.

2.4.3. Outlet Works

Ash Pond D

The primary outlet from Ash Pond D is a concrete riser structure located at the upstream toe of the dam near the right abutment and the southwest corner of the impoundment. Water discharging through the tower flows through a 320-foot long, 30-inch diameter reinforced concrete pipe to a stilling basin and then through a 580-foot long concrete-lined channel to Ash Pond E. Although the impoundment was designed to allow for the operation of 8-inch weir openings at various levels as the impoundment was filled, the current water surface elevation is approximately 10 feet below the lowest overflow opening of Elev. 116 feet.

Ash Pond E

Ash Pond E has been designed to receive sluice flows from plant generation activities and direct precipitation with minimal stormwater runoff. The primary outlet structure, located near the northwestern corner of the impoundment, is a concrete riser structure consisting of a weir equipped with stop logs to govern the water level in the pond (See Appendix C - Photo 8). A floating boom serves to exclude floating debris from the discharge. The weir overflow drops to the base of the structure and discharges through a 72-inch corrugated metal pipe that extends through the embankment to a stilling basin at the toe of the dam. Water from this stilling basin empties into a marsh-like area prior to flowing below Possum Point Road and into Quantico Creek (Appendix C - Photo 7). The discharge at this location is permitted under a Virginia Pollution Discharge Elimination System, VPDES Permit No. VA0002071.

3. RECORDS REVIEWED

3.1 RECORDS REVIEWED

A review of the available records related to design, construction, operation and inspection of the Possum Point Power Station CCW impoundments was performed as part of this assessment. The documents provided by Dominion Virginia Power (DVP) include:

Table 3.1: Summary of Documents Reviewed

Document	Dates	By	Description
Design Drawings – Ash Pond E	1977	Torrence Dreeling Farthing & Buford Inc.	Details of replacement for 72-inch primary spillway
Possum Point Power Station Ash Pond 'D' Dam DCR Inventory 15320 Final Design Report Submitted to State	1986	DVP	Report includes geotechnical investigation, embankment analysis and design, hydrology and hydraulics including PMP study and flood routing.
Design Drawings – Ash Pond D	1986	DVP	Design drawings of the structure, slopes, outlet structure.
Details of Metal Treatment Pond	1990	Engineering Design & Geosciences Group, Inc.	Details of Boring for metals treatment impoundments
Possum Point Power Station Ash Pond 'E' Dam DCR Inventory #15321 Drainage and Stability Calculations	1990	DVP	Report includes geotechnical investigation, embankment analysis and design, hydrology and hydraulics including PMP study and flood routing. Also includes boring details and slope stability analysis using those borings.
One Line Diagram Water Flow March 2006 Possum Point Power Station	2006	DVP	Illustrates location of internal outfalls and pumping to Ash Pond E and Ash Pond D from metals treatment facility and Oil Waste Treatment Basin
DCR Annual Inspection Report, Ash Pond 'D' Dam Inventory Number 15320	2009	DVP	Inspection form prepared by DVP
DCR Annual Inspection Report, Ash Pond 'E' Dam Inventory Number 15321	2009	DVP	Inspection form prepared by DVP

3.2. ENGINEERING DOCUMENTS

Review of the design drawings revealed information on the design details for Ash Ponds D and E as follows:

Ash Pond D

- Ash Pond D was designed in 1986 to provide additional storage for CCW.
- The project design flood was the Probable Maximum Flood (PMF).
- Soil borings for the design of the dam were included with the data from DVP. The design upstream slope is 2.5H:1V, and the design downstream slope is 2.7H:1V.

- A slurry wall along the upstream toe and a clay liner on the upstream face of the embankment were reportedly installed at the end of the original construction to satisfy DEQ concerns. Photos of the construction of the slurry wall were provided during the site visit. Other documents related to these features are in DVP's files but were not reviewed.

- The minimum factors of safety for slope stability were calculated as follows:

  a) Upstream slope during construction= 1.33
  b) Upstream slope – steady state seepage (effective stress) = 1.56
  c) Downstream slope – steady state seepage (effective stress) = 1.62

- The 2009 inspection report of the dam provided the following recommendations:

  a) Trap/eradicate groundhogs and fill holes.
  b) Seed regraded area on upstream slope.
  c) Maintain toe-drain outlet on south side of Possum Point Road, remove beavers/beaver dams as required.
  d) Consider cleaning sediment from pipe under Possum Point Road.

Ash Pond E

- The pond was originally constructed in 1968.

- In 1985, borings were completed and a stability analysis was performed, which indicated that the dam could not be raised by 15 feet, but 3-5 feet of dam raising was feasible while maintaining an adequate factor of safety.

- A safety analysis was performed in 1990 for stability and flood routing. The analysis indicated a factor of safety of 1.3 to 1.4 in the highest embankment sections. A conservatively high phreatic surface was assumed in this analysis.

- The design upstream slope is 1.5H:1V, the downstream slope is 2.0H:1V.

- The minimum factors of safety were calculated as follows (assumed high phreatic surface):

  a) The upstream slope factor of safety was estimated at greater than 1.5
  b) Downstream slope with steady state seepage at highest sections = 1.3 to 1.4

- The 1990 analysis indicated that the principal spillway would be capable of passing the 100-year storm without overtopping, including flows from Ash Pond D.

- Data presented in the 1990 analysis indicated that Ash Pond D has a surface area of approximately 17.5 acres and Ash Pond E has a surface area of 25.5 acres. (note: Figure 1 does not seem to confirm these estimates in that Ash Pond D appears to be almost twice the size of Ash Pond E).

- A visual inspection performed by DVP for the 1990 analysis revealed no signs of cracking, excessive settlement or slope instability. However, the following items were recommended in the report:

  a) A small seep was identified and periodic inspection recommended.
  b) Animal burrows in the slope of the embankment should be filled.
  c) Beavers should be removed from the area downstream of the dam.

d) A staff gauge should be installed to easily determine the pond level.

- The 2009 inspection report of the dam provided the following recommendations:

a) Work toward clearing vegetation 25 feet beyond downstream toe of embankment
b) Trap/eradicate groundhogs and fill holes
c) Re-establish eroded areas of upstream slope at waterline. Consider using rip-rap underlain by filter fabric.
d) Continue regular mowing of downstream slope

3.2.1. Stormwater Inflows

Based on the original design report, Ash Pond D has a drainage area of approximately 128.5 Acres. Although the dam is only classified as Significant Hazard, which would correspond to a Spillway Design Flood of the ½ PMF, the Ash Pond D emergency spillway was designed for the full PMF. Based on the design analyses, the spillway system (principal and emergency) is capable of passing the PMF without overtopping of the embankment (see table below). In addition, the currently low level of the pond provides more storage capacity than envisioned in the design, which further reduces the potential for overtopping during a major storm event.

As noted above, water discharging from Ash Pond D through the outlet structure would flow to Ash Pond E. However, the current level of the Ash Pond D reservoir is well below the lowest inflow port that would allow discharge from the pond. Therefore, under current operating conditions, the contributing drainage area to Ash Pond E is just the direct runoff area of approximately 117.5 Acres. At the time of the original design (1968), the 100-year/24-hour storm was considered to be the industry design standard, and this storm was used for the analysis and design of the spillway. The current VDCR Spillway Design Flood criterion for Significant Hazard dams is the ½ PMF, with a potential reduction to a minimum of the 100-year flood by means of an incremental damage analysis.

The total watershed areas and flood routing calculations noted in reports provided by DVP are summarized as follows[1]:

``Drainage Area	Acres (approximate)	Peak Flow Expected	Spillway Capacity
Ash Pond D Watershed	128.5	2,250 CFS (PMF)	2,970 CFS (Emergency Spillway – Crest El. 144')
Ash Pond E Watershed	117.5	TBD[1]	60 CFS (Principal Spillway - 72-inch discharge pipe)
	[1.]Due to the new "Significant Hazard" classification, this work has not be completed.		

[1] Possum Point Power Station – Ash Pond 'E' Dam, DCR Inventory #15321, DCR Inventory Report, Drainage and Stability Calculations, March 1990

3.2.2. Stability Analyses

DVP performed stability analyses for the Ash Pond D design in 1986 and for Ash Pond E in 1990. A summary of the calculations performed follows:

Ash Pond D

DVP provided the complete design report for Ash Pond D, including borings, slope stability analyses and hydraulic studies. Based upon the data provided in the report, the minimum factor of safety for slope stability for the end-of-construction case is 1.33. Factors of safety for the steady state seepage condition are greater than 1.5. As noted above, the water surface elevation is currently estimated at 106 feet, which is well below the design elevation of 145. As such, the assumption can be made that the safety factors presented in the design report are much lower than those that would result from the current conditions.

Ash Pond E

Although the cross-sectional figure of the dam indicates a top-of-dam elevation of 40 feet, the report noted that 3-5 feet of additional fill could be added to the crest of the dam to provide additional capacity for CCW. DVP has stated that the top of dam elevation was raised in recent years and the crest appears to be between Elev. 40 and 42. However, since a survey has not been performed since the raising, the actual crest elevation is unknown. Based on the gauge at the outlet structure, the water surface elevation at the time of the inspection was about Elev. 38.5. There appeared to be about 2 to 3 feet of freeboard at this time, which would indicate an embankment crest elevation between Elev. 40.5 and 41.5.

The report indicates a safety factor of greater than 1.5 for the upstream slope and 1.3 to 1.4 for the downstream slope. However, as noted, the current crest elevation was not used, nor was the water surface elevation observed during our site visit (about El. 38.5). Computer generated runs using the Simplified Bishop Method were included in the stability analysis data provided by DVP.

3.2.3. Instrumentation

As part of the design and construction, five (5) piezometers were installed in the Ash Pond D embankment for monitoring the phreatic surface. In addition, monitoring wells were installed near the base of the Ash Pond D embankment to monitor ground water quality. The piezometers have been monitored since 1989, generally on a quarterly basis, and the data obtained for the period of 1989 to 2009 was provided by DVP. The piezometer readings indicate that the phreatic surface has remained fairly low within the embankment and ties into the toe drain. Ash Pond E does not have any dam safety instrumentation, although borings were completed as part of the 1990 stability analysis.

3.3. PREVIOUS INSPECTIONS

Per the requirements of the VDCR, annual inspections are performed at both Ash Pond D and Ash Pond E. Copies of these 2009 reports were provided by DVP for this assessment. In addition, DVP staff conducts monthly inspections of both Ash Pond D and Ash Pond E and water samples are collected from Ash Pond E for VPDES permitting. Annual maintenance of the dam is also performed to clear undesirable vegetation (trees, large plants) and to remove unwanted rodents. Comments from those inspection reports are noted in Section 3.1 above.

3.4. OPERATOR INTERVIEWS

Numerous plant and corporate personnel took part in the assessment proceedings. The following is a list of participants for the inspection of Ash Ponds D and E:

Table 3.2: List of Participants

Name	Affiliation	Title
John Cima, PE	DVP	Corporate Dam Safety Engineer
Jeff Marcell	DVP	Environmental Supervisor Possum Point Power Station
Glen Johnson	DVP	Corporate Environmental Compliance
Jesse Miller	USEPA	Chemical Engineer
Amanda Geldard	USEPA	Environmental Protection Specialist
Craig Benson, PE	O'Brien & Gere	Project Manager
Robert Bowers, PE	O'Brien & Gere	Vice President

DVP facility personnel provided good background information for the facility and the impoundments. Mr. John Cima was also the engineer of record for the design of Ash Pond D and had provided site inspection services for both ash ponds for over 25 years.

4. VISUAL INSPECTION

The following sections summarize the inspections of Ash Pond D and Ash Pond E, which occurred on April 28 and 29, 2010, respectively. At the time of the inspections, O'Brien & Gere completed an EPA inspection checklist for each ash pond, which was submitted electronically to EPA on May 5, 2010. Copies of the completed inspection checklists are included as Appendix A.

4.1. GENERAL

The weather on the dates of the inspections was clear and approximately 60 - 75 degrees. The visual inspections consisted of thorough site walks along the crest and downstream portions of both ash ponds. O'Brien & Gere team members made observations and took photographs along the crest, downstream slope and toe, and along accessible portions of the upstream slopes. The team also inspected the outlet structures. As previously noted, CCW material is no longer sluiced into the ponds; instead, water from general operational processes is discharged to Ash Pond E. Inflow to the ponds was not occurring during the inspections.

Photos of relevant features and conditions observed during the inspections were taken by O'Brien & Gere and are provided in Appendices B and C for Ash Ponds D and E, respectively. A Site Plan of each pond is presented as Figures 3 and 4, which also provide photograph locations and directions.

4.2. SUMMARY OF FINDINGS

Ash Pond D

It should be noted that the inspection team was not allowed to view the upstream slope and crest of the dam from the outlet tower to the left abutment (looking downstream) because of a nesting eagle in the area. While this limited our ability to inspect the exposed portion of the upstream slope, we could view the majority of the upstream slope from a distance. The following observations were made during the visual inspection:

- Dry river dredging material and sediment cake from water filtration operations were stockpiled at the north end of the impoundment (Appendix B – Photo 1).

- The natural emergency spillway along the northwestern portion of the impoundment has substantial tree growth. However, because the reservoir level is well below the lowest inflow port by about 10 feet, there should be substantial storage capacity to preclude the need for the emergency spillway.

- The upstream slope of the embankment is covered with well-tended grass, which is mowed 2-3 times per year (Appendix B – Photo 2 and 3).

- As noted in the review of the documents, Dominion Virginia Power (DVP) personnel reported that a 24-inch thick clay liner had been installed on the upstream slope of the dam. Apparently, a large amount of rain fell last year and caused minor sloughing of the slope. Ongoing repairs have included regrading and hydroseeding of the slope. At the time of the site visit, the grass had not been reestablished on the slope. This area can be seen on the left side of Photo 3 (Appendix B).

- The water surface elevation is approximately 10 feet below the lowest inflow port in the outlet tower (Appendix B – Photo 3). As such, no water is currently flowing through the outlet pipe or discharging downstream to Ash Pond E.

- In the vicinity of the right abutment, there is a saturated area along the downstream slope of the embankment that appears to be below the pond water level. DVP operators stated that this area is wet throughout the year, which results in difficulty in mowing because the tractors get stuck. DVP also noted that this area was wet prior to the construction of the dam and it appears to be a perched groundwater condition at the interface between the embankment and natural ground. The area of saturation is shown by the taller grasses in Appendix B – Photo 4 and Photo 7.

- The downstream slope of the dam is well maintained, although there are some minor erosion gullies visible. (Appendix B – Photo 5). There are also several locations where sloughing occurred after construction. These areas have been repaired by filling with large riprap. A close examination of these areas showed no visible signs of continued movement.

- A toe drain system was designed and installed along the base of the embankment. The toe drain flow could not be measured since the outlet is below ground and not accessible, but the DVP operators indicated that the flow volume appears to be fairly consistent judging from the sound. It appeared that the toe drain pipe had about 2 inches of water flowing from the outlet. The location of the toe-drain manhole is near the fire hydrant in Photo 6 (Appendix B). This flow is visually observed by DVP during the annual inspections by looking into the receiving manhole.

- The toe drain discharges into an abandoned 72-inch pipe located beneath Possum Point Road. The outlet end of the pipe is partially buried by eroded soil from stormwater runoff from the road, as illustrated in Photo 8 (Appendix B).

- The concrete drainage channel leading from the outlet structure to Ash Pond E has several locations that have been undermined by runoff and/or settlement. Although not a significant dam safety issue, the voids could provide refuge for rodents and continuing erosion problems and should be backfilled (Appendix B – Photo 9).

As shown in the photographs, the pond level is well below the design normal pool elevations. Based on our site visit and conversations with plant personnel, no uncontrolled releases have occurred from Ash Pond D. Some patchwork repairs have been undertaken to restore the sloughed sections of both the upstream and downstream slopes of the embankment. However, the dam appears to have performed generally as designed since its original construction.

Ash Pond E

The following observations were made during the inspection:

- Water collected at the plant from various operations is pumped to Ash Pond E near the southeast end of the pond (Appendix C – Photo 1). A weir has been constructed at this location to route the water through a channel that has been constructed in the CCW marshy area.

- The CCW has filled approximately 2/3 of the impoundment capacity, based upon estimates provided by DVP.

- The downstream slope is generally covered with well-maintained grass, although small trees and shrubbery are growing along the southern portion and the southwestern corner of the impoundment slope (Appendix C – Photo 2, Photo 6 and Photo 7).

- A drainage ditch runs along the southern section of the outboard toe and is steeply sloped in some locations (Appendix C – Photo 3). Toward the eastern end of the pond, this ditch is very shallow (about 6-inches deep), but it becomes 3-4 feet deep as it approaches the western end of the pond. While the ditch did not appear to be actively eroding, it did have flowing water in the bottom. The water appeared to be clear.

- Immediately beyond the toe of the downstream slope is a marshy area that extends from the southeastern corner to the approximate location of the outlet structure for the dam (Appendix C – Photo 5).

- There are trees of various size (3" dia. – 20" dia.) immediately downstream of the toe of the slope (Appendix C – Photos 3, 6, 7, and 11).

- A crushed-stone access road was constructed over the length of the crest in the area of the dam that still impounds water (not filled in with CCW). Within the past year, a layer of geotextile and riprap were placed on the upstream slope of the embankment to alleviate historical erosion. This work resulted in some crest disturbance and the crest was repaired by placing geotextile, a 3"-6" layer of dense graded aggregate, and a layer of #57 stone to provide a driving surface for maintenance vehicles (Appendix C – Photos 4, 6, 9, and 10).

- The road appears to be in good condition; however, there is visible variation in the crest elevation, which could be an indication of differential settlement along the crest of the dam (Appendix C – Photo 4). The actual crest elevation could not be established from the site visit or the records, but it appears to vary by as much as 2 feet. The elevation difference can be seen if Photo 10 and Photo 4 are compared. Survey elevations were not obtained during the site inspection, but at the southwestern corner of the impoundment, the apparent difference between the water surface elevation and the crest of the dam was less than three feet.

- The outlet structure appeared to be in good condition and functioning normally (Appendix C – Photo 7 and Photo 8). However, the operators adjust the pond elevation by inserting or removing stop logs at the spillway drop inlet and it could not be determined if there is adequate freeboard between the maximum pool elevation and the low point on the crest of the embankment.

- Between the outlet structure and the northwestern end of the embankment, there appears to be some seepage along the toe that extends partially up the downstream slope of the dam. DVP noted that this area is monitored, as it is often wet and difficult to mow (Appendix C – Photo 11). It is estimated that the saturated soil extends approximately 1/3 of the height of the embankment at this location.

- Floating cenospheres are visible in the foreground of Photo 4 and Photo 10 (Appendix C).

As noted in the Stability Analysis Report from 1990, fairly heavy seepage developed along the original concrete discharge pipe in 1977. This pipe was replaced with a 72-inch corrugated metal pipe and concrete anti-seep collars. Based on conversations with plant personnel, no other uncontrolled releases have occurred from Ash Pond E since these repairs were completed. Although rock fill and crushed stone have been placed on the surface of the dam and some differential settlement may have occurred, the embankment appears to have performed as designed over the years.

5. CONCLUSIONS

Based on the EPA ratings defined in the RFP (Satisfactory, Fair, Poor and Unsatisfactory), the information reviewed and the visual inspections, the overall condition of the dams is as follows:

Ash Pond D

The Ash Pond D dam is considered to be in **SATISFACTORY** condition**.** Due to operational changes, the existing pool elevation is well below the lowest discharge port in the outlet tower. Because the dam is not currently subjected to the original design loading conditions, both the structural and hydraulic capacity should have additional factors of safety beyond those designed. In addition, no significant dam safety deficiencies were identified during the review of the existing records or the site inspection. Several minor maintenance items should be performed as described in Section 6 below.

Ash Pond E

The Ash Pond E dam is considered to be in **FAIR** condition**.** While acceptable performance is expected under all required loading conditions, several minor deficiencies were noted during the inspection and some additional information needs to be gathered and previous analyses updated to demonstrate that the dam will continue to meet current safety criteria. The noted deficiencies are as follows:

- The area immediately downstream of the dam is saturated for most of the length of the embankment. This area was historically swampy and it appears that the saturated conditions are a result of poor drainage; however, the records indicate that a sand layer was placed beneath the embankment during the original construction, which raises the possibility that underseepage could be contributing to the downstream saturation.

- Some saturation of the lower downstream slope of the embankment was observed in a small area between the outlet structure and the north end of the embankment. This area of saturation appears to be the result of minor seepage (no visible flowing water) through the embankment.

- The crest elevation of the embankment appears to vary considerably along its length, which could be a result of differential settlement. In particular, observation of the freeboard indicates that the southwestern portion of the embankment may be significantly lower than other sections.

- The most recent stability analysis for the embankment was performed in 1990. Since that time, additional rock fill and crushed stone were placed to fill in some erosion (as noted in the 2009 inspection report) and improve the driving surface. Although the analysis was based on a normal pool level (El. 35) and crest elevation of 40 ft., neither of these elevations appear to be representative of current operating conditions or the added fill placed on the dam circa 1988 to provide additional storage. The stability analysis also assumed a conservative phreatic surface which does not reflect the phreatic levels observed when the boring program was undertaken. Finally, seismic loading was not considered in the stability analysis provided for review and the pond level used for the maximum pool loading condition does not appear to be consistent with current standards.

- At the time of our site visit, several stop logs had been removed from the spillway crest, yet it still appeared that the water surface elevation was within three feet of the top of the dam (possibly less along the southwestern portion of the embankment). The water surface elevation shown in the structural stability analysis provided a freeboard of five feet during normal conditions.

- Current VDCR criterion establishes the ½ PMF as the base Spillway Design Flood for "Significant Hazard" dams. However, the 100-year flood was used as the basis for the original design and the most recent hydraulic analysis of the spillway. This analysis indicated that the peak outflow during the 100-year flood would be approximately 58 cfs vs. an estimated outlet pipe capacity of 60 cfs, but it also included rainfall runoff from Ash Pond D, which would not represent current operating conditions.

6. RECOMMENDATIONS

Based on the findings of our visual inspection and review of the available records for Ash Ponds D and E, O'Brien & Gere recommends that additional studies be performed for Ash Pond E to demonstrate reliable performance and that minor upgrades and additional maintenance of the embankments be performed for both ponds to correct the drainage and other miscellaneous deficiencies cited above. The recommended measures are outlined as follows:

6.1. IMMEDIATE ACTION ITEMS

Ash Pond E

As noted, the hydraulic and stability analyses do not accurately reflect the current reservoir levels and operations or the configuration of and the phreatic levels within the embankment. The following additional investigations and analyses are recommended:

- A new survey should be performed to establish the embankment crest profile and the most critical cross sections of the dam. This survey should include bathymetric information to verify the configuration of the upstream slope, due to the rather steep slope of 1.5H:1V indicated in the records.

- New borings and piezometers should be installed to investigate the composition/condition of the foundation sand layer and to identify the current phreatic surface in the embankment, particularly in the vicinity of the saturated slope area along the western section of the embankment and at the critical cross-section(s).

- An updated hydraulic analysis should be performed using the current reservoir operating levels and conditions (no inflow from Ash Pond D) and the ½-PMF as required for "Significant Hazard" dams in Virginia. As an alternative or in addition, an incremental damage analysis could be performed to investigate the potential for reducing the Spillway Design Flood (possibly as low as the 100-year flood) as allowed by the new VDCR dam safety regulations.

- Based on the surveyed crest elevations and cross-sections of the dam, measured phreatic water levels in the piezometers, and current normal and maximum operating pools, an updated slope stability analysis should be performed for the embankment. This analysis should include all applicable loading conditions, including normal pool with earthquake.

6.2. LONG TERM IMPROVEMENTS

The deficient conditions observed during the inspection do not require immediate attention, but should be corrected in the near future as part of a regular maintenance plan. The recommended maintenance/improvement actions are presented below:

Ash Pond D

- The sloughed section on the upstream slope of the dam should be stabilized with grass cover. It is our understanding that Dominion Virginia Power (DVP) has already been making efforts to establish a vegetative cover in this area.

- The wet area located downstream of the dam should be monitored to confirm that seepage from the impoundment is not occurring along the embankment/natural ground interface in this location. It may be advisable to install a series of piezometers through this area to monitor this condition.

- Piezometers and monitoring wells should be measured once a year in order to provide historical performance data for the impoundment.

- Maintenance of the upstream and downstream slopes of the dam should continue, including mowing, deleterious vegetation removal, and rodent removal. As noted in the field, it is advisable to mow using alternate routes to prevent rutting of the slopes and benches of the dam. Existing ruts should be filled or regraded to prevent ponding of water in these locations.

- Measures should be taken to prevent the toe drain outlet pipe from becoming buried by erosion of the stream channel. It would also be advisable to install a V-notched weir to monitor the toe drain flow volume.

Ash Pond E

- Maintenance of the upstream and downstream slopes of the dam should continue, including vegetation control and rodent removal. As noted in the field, it is advisable to mow using alternate routes to prevent rutting on the slopes of the dam.

- Trees that are encroaching on the downstream toe of the slope should be removed to a distance of 10 – 20 feet from the toe of the dam to allow unobstructed inspection for potential seepage and stability issues, and to minimize potential damage to the embankment from uprooted trees.

- The drainage ditch along the southwestern section of the embankment has resulted in a 3 to 4-foot deep cut below the toe of the dam (See Photo 3, Appendix C). This ditch should be cleared of trees and regraded to provide a slope more consistent with the embankment itself (2H:1V).

- The crest elevation of the southwestern portion of the embankment should be raised to a uniform design elevation and installation of surveying monuments should be considered to monitor any future settlement in this area. Conversely, high sections of the crest could be cut to a lower uniform elevation, if the updated stability analyses indicate that this is more appropriate. However, modification of the operating procedures may be necessary to assure that adequate freeboard is maintained if the embankment crest is lowered.

- The area immediately downstream of the saturated section of the western embankment should be regraded to promote drainage away from the toe of the slope. This area should be monitored during future inspections for any increase in the amount or extent of seepage.

6.3. MONITORING AND FUTURE INSPECTION

DVP should continue to have Ash Pond E inspected on a quarterly basis by Station personnel and annually by a registered engineer. While Ash Pond D is not as critical, it should also be monitored at the same frequency.

6.4. TIME FRAME FOR COMPLETION OF REPAIRS/IMPROVEMENTS

It is O'Brien & Gere's recommendation that DVP initiate the hydraulic and stability analyses for Ash Pond E within the next 6 months. The results of these analyses should be provided to VDCR for their records. If the analyses indicate that remedial action is necessary, these improvements should be undertaken within 12 months.

6.5. CERTIFICATION STATEMENT

I acknowledge that the Ash Pond D and Ash Pond E CCW management units referenced herein were personally inspected by me on April 28 and 29, 2010, and were found to be in the following condition:

Ash Pond D

SATISFACTORY
~~FAIR~~
~~POOR~~
~~UNSATISFACTORY~~

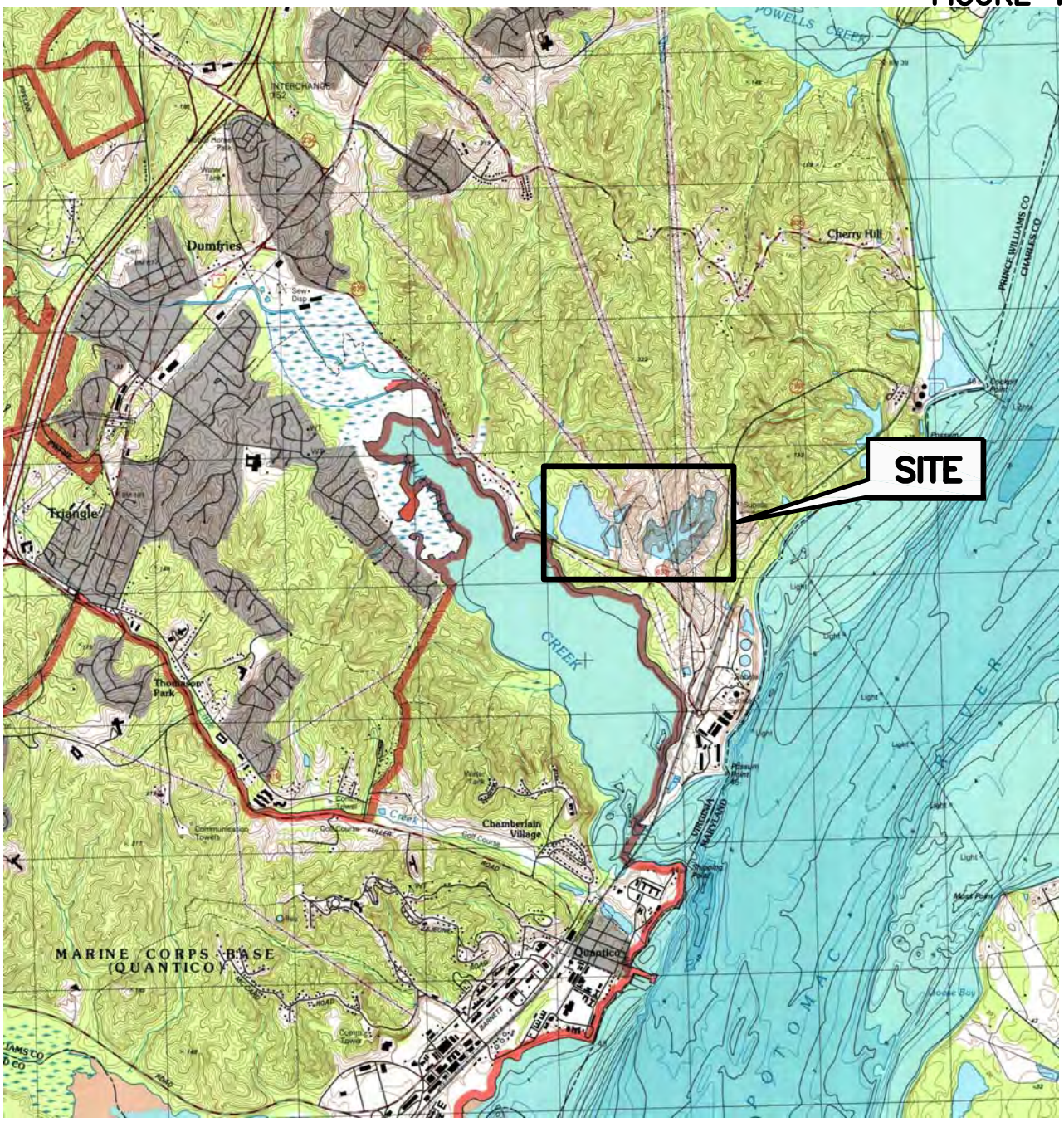
Ash Pond E

~~SATISFACTORY~~
FAIR
~~POOR~~
~~UNSATISFACTORY~~

Signature: _____ Date: September 10, 2010

Craig A. Benson, PE
VA PE # 0402 035374

FIGURE 1



ADAPTED FROM: QUANTICO QUADRANGLE, VIRGINIA U.S.G.S. 7.5 MIN. QUAD 1994

VIRGINIA

QUADRANGLE LOCATION

US EPA
DAM SAFETY ASSESSMENT OF CCW IMPOUNDMENTS

POSSUM POINT SUBSTATION
DUMFRIES, VIRGINIA

SITE LOCATION MAP

1"=4000' 4000 0 4000

46122-POSSUM_POINT-F01
JUNE 2010

O'BRIEN & GERE

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I:\US-EPA.13498\46122.ASSESS-OF-DAM-S\DOCS\DWG\SHEETS\46122-POSSUM_POINT-F01.DWG, 06/09/2010 9:51AM

FIGURE 2

NOTE
Aerial imagery provided by National Agriculture Imagery Program (USDA), 2009.

POSSUM POINT POWER STN.
POSSUM POINT, VIRGINIA

SITE LAYOUT

0 600 1,200 2,400
Feet

SEPTEMBER 2010
13498/46122

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DATE: 9/9/2010 9:27:48 AM

FIGURE 3

N

LEGEND

1 Photograph Direction/Location

NOTE
Aerial imagery provided by National Agriculture Imagery Program (USDA), 2009.

POSSUM POINT POWER STN.
POSSUM POINT, VIRGINIA

PHOTO LOCATIONS
ASH POND D

0 150 300 600
Feet

SEPTEMBER 2010
13498/46122

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FIGURE 4

N

LEGEND

1 Photograph Direction/Location

NOTE
Aerial imagery provided by National Agriculture Imagery Program (USDA), 2009.

POSSUM POINT POWER STN.
POSSUM POINT, VIRGINIA

PHOTO LOCATIONS
ASH POND E

0 150 300 600
Feet

SEPTEMBER 2010
13498/46122

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APPENDIX A

Visual Inspection Checklist

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit #: VA0002071 INSPECTOR Bowers/Benson
Date: April 28, 2010

Impoundment Name: Possum Point Ash Pond 'D'
Impoundment Company: Dominion Power
EPA Region: Region 3
State Agency (Field Office) Address: DCR Dam Safety – Region 1; 98 Alexandria Pike, Suite 33, Warrenton, VA 20186
Phone 540-351-1587

Name of Impoundment: Possum Point Ash Pond 'D'

Permit number:
Virginia Department of Conservation & Recreation (DCR) Inventory Number: 15320
VPDES Permit No. VA0002071 (Dam discharges to downstream Dam 'E' discharge point)

Annual Sampling Requirements:

- **Annual -** Water Quality Analysis for metals, pesticides, base neutral extractables, Volatiles, Acid Extractables, radionuclides, and miscellaneous items.
- **Monthly Permit Requirements:**
  Flow – Not Logged / Estimated
  PH: Min 6.0 / Max 9.0 /Grab Sample / Monthly
  Heat: Rej** Max 5.58 BTU/H
  CL2: avg 0.022 mg/l - Max 0.03 mg/l
  704 TUc NOAEC – Acute 48 Hr Stat Ceriodaphnia Dubia – Max= NL TU-A
  721 TUc Chronic 7 Day Statre Pimephales Promela: Max NL TU-C

New: 1989 Update None

Is impoundment currently under construction? _____ NO
Is water or ccw currently being pumped _____ NO
into the impoundment?

IMPOUNDMENT FUNCTION:
The pond is no longer functioning for treatment purposes or storage of coal combustion waste (CCW) because the power generators either use fuel oil or natural gas. Although some CCW's have been stored in the facility, the impoundment is now used to dispose of sediment cake from the dewatering operations of the clarification process from their river intake. This results in approximately 30-cubic yards per week. The Corps Of Engineers has also used the impoundment to dump river dredging material which is unloaded from barges and hauled to the impoundment area in dump trucks.

Because only storm water now drains into the pond and the watershed is relatively small, the pool elevation is reportedly dropping. It is currently estimated to be approximately 10-feet below the lowest decant elevation of 116 feet.

Nearest Downstream Town Name:
The impoundment discharges downstream into Quantico Creek - An immediate tributary to the Potomac River. Quantico is the nearest town across Quantico Creek.

Distance from the impoundment: Approximately 900 feet to Quantico Creek.
Impoundment Location:

Longitude: 38 Degrees 32 Minutes 56.5 Seconds
Latitude: 77 Degrees 17 Minutes 11.5 Seconds
State VA County Prince William

Does a state agency regulate this impoundment? YES _X____ NO _____

If So Which State Agency?___ DCR Dam Safety – Region 1; 98 Alexandria Pike,
Suite 33, Warrenton, VA 20186
Phone 540-351-1587

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

_____ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

_____ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

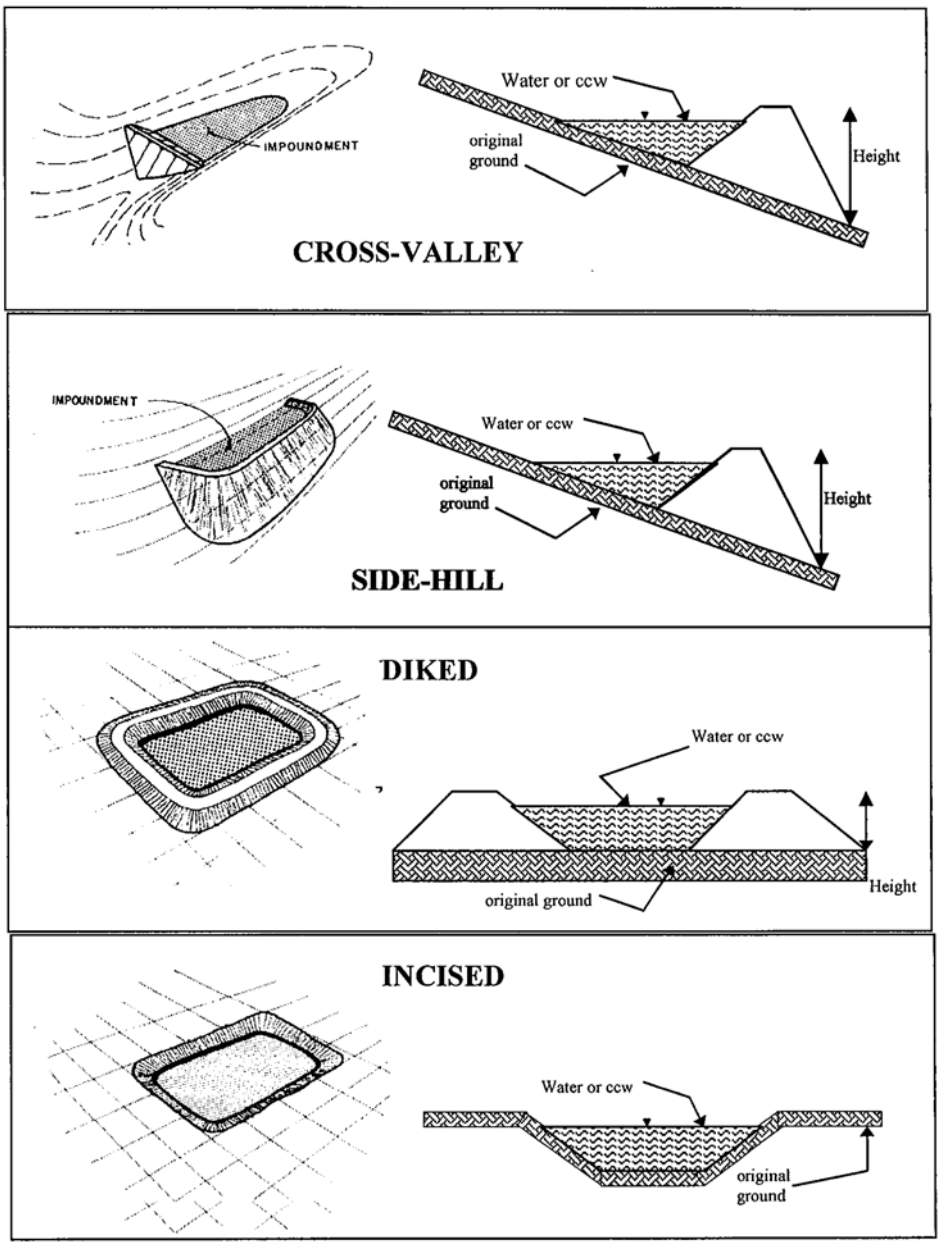
__X____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

There is a state highway (Possum Point Road – Rte. 633) downstream of the dam and the potential for economic loss on this facility. In addition, some CFC products were hydraulically dredged from Ash Pond E to Ash Pond D. If released to Quantico Creek, it could result in environmental damage.

CONFIGURATION:



_X__ Cross-Valley
_____ Side-Hill
_____ Diked
_____ Incised (form completion optional) ___ __ Combination Incised/Diked
Embankment Height 140 feet Embankment Material: earth fill
Pool Area: 11.4 acres (at EL 40 ft) Liner Clay blanket on upstream slope
Current Freeboard : 45 feet Liner Permeability 1×10^{-7} cm/sec

EPA Form XXXX-XXX, Jan 09

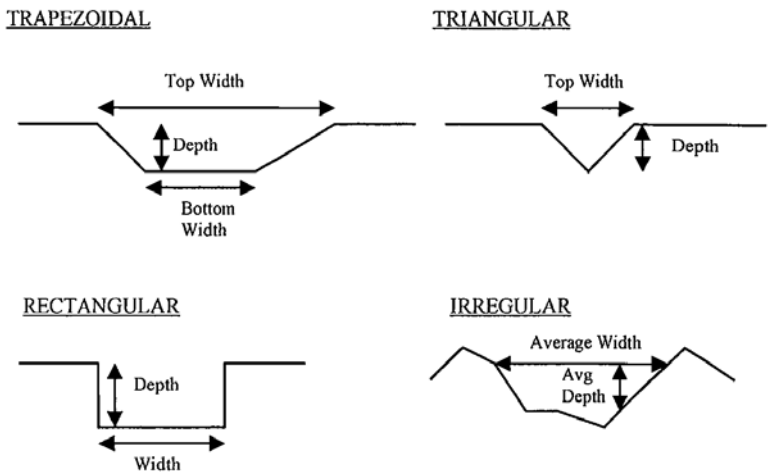
TYPE OF OUTLET (Mark all that apply)

The primary service outlet is a free standing, 66-foot tall, concrete tower with 14, 8-inch openings and a single 6' 3" opening at elevation 142.0 feet. The tower has an access bridge from the crest of the dam and three valve operators for the 8-inch wall valves. This arrangement of wall valves is intended to allow for the raising of valves as the quantity of ash in the impoundment increases. The tower is shown in Photo 1.

Crest of weir: 142.0
Top of dam: 150.0 (8 feet of freeboard)

_____ **Open Channel Spillway**
__ _ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

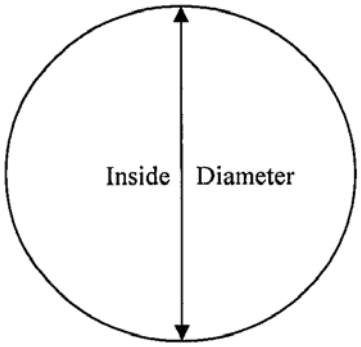
__ __ depth
__ __ bottom (or avg) width
__ __ top width



_____ **Outlet**

The outlet pipe is a 36" Diameter rubber gasketed reinforced concrete pipe. Photos taken during construction indicate the pipe was installed in a clay seam.

Material
_____ corrugated metal
_____ welded steel
___X_concrete
_____ plastic (hdpe, pvc, etc.)
_____ other (specify) _____



Is water flowing through the outlet? YES __X_____ NO _____

There is a minor amount of flow, just a trickle. Because the inlet is above the water surface, this flow may be from leakage in the pipe although it is difficult to tell. The water appears to be clear (no sediment).

_____ No Outlet

_____ Other Type of Outlet (specify) _____

The Impoundment was Designed By: Virginia Power Engineering And Construction, Richmond Virginia in 1986.

Has there ever been a failure at this site? YES _____ NO ____X_____

If So When? _____

If So Please Describe : _____

Has there ever been significant seepages at this site? YES _____ NO __X_____

If So When? _____

If So Please Describe:
While there is no significant seepage, there is controlled seepage occurring from the toe drain system. Significant sedimentation has occurred on the hillside adjacent to the stream channel downstream of the discharge conduit. While there is flow through the 72-inch conduit, only 2 – 3 feet remain in the top of this pipe because of sedimentation. This needs to be monitored on a regular basis to ensure that the outfall is not completely blocked, which would reduce the ability of the toe drain to discharge freely.

In addition, there is an area downstream of the dam on the right-hand side (South-west area) which has exhibited some type of surfacing or ponding of water. Dominion crews have had difficulty mowing this area because of muddy conditions. This area, at 70-80 feet above the downstream toe of the dam, is roughly 30-feet below the current pool elevation . However, Dominion employees have indicated that this area was wet prior to the construction of the dam and has exhibited no increase in seepage activity for the life of the dam (23 years). Topographic maps and cross sections of the dam (See Drawing 715932-C-124 and C-127) illustrate that this area was not modified during the construction of the dam, it was merely blended into the downstream face of the dam. Dominion believes that this seepage is a result of an artesian groundwater condition in the vicinity of the natural ground/embankment interface.

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES_ NO: X

If so, which method (e.g., piezometers, gw pumping,...)?

If so please describe :

Piezometers (PVC observation wells) have been installed at several locations along the downstream slope and at the toe of the slope. In addition, there are several surface monuments for monitoring crest elevations. Water levels in the piezometer are monitored annually. Crest elevations were monitored regularly until 1999, when monitoring was discontinued.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit #: VA0002071 INSPECTOR Bowers/Benson
Date: April 28, 2010

Impoundment Name: Possum Point Ash Pond 'E'
Impoundment Company: Dominion Power
EPA Region: Region 3
State Agency (Field Office) Address: DCR Dam Safety – Region 1; 98 Alexandria Pike, Suite 33, Warrenton, VA 20186
Phone 540-351-1587

Name of Impoundment: Possum Point Ash Pond 'E'

Permit number:
Virginia Department of Conservation & Recreation (DCR) Inventory Number: 15320
VPDES Permit No. VA0002071 (Dam discharges to downstream Dam 'E' discharge point)

Annual Sampling Requirements:

- **Annual -** Water Quality Analysis for metals, pesticides, base neutral extractables, Volatiles, Acid Extractables, radionuclides, and miscellaneous items.
- **Monthly Permit Requirements:**
  Flow – Not Logged / Estimated
  PH: Min 6.0 / Max 9.0 /Grab Sample / Monthly
  Heat: Rej** Max 5.58 BTU/H
  CL2: avg 0.022 mg/l - Max 0.03 mg/l
  704 TUc NOAEC – Acute 48 Hr Stat Ceriodaphnia Dubia – Max= NL TU-A
  721 TUc Chronic 7 Day Statre Pimephales Promela: Max NL TU-C

New: 1967 Update 1977

EPA Form XXXX-XXX, Jan 09

Is impoundment currently under construction? _____ NO
Is water or ccw currently being pumped _____ NO
into the impoundment?

IMPOUNDMENT FUNCTION:
The pond is approximately 2/3 full of CFC sediment. The pond also accepts storm water from the watershed in this area as well as blow-down from water chillers in the current oil and natural gas production of electricity.

Nearest Downstream Town Name:
The impoundment discharges downstream into Quantico Creek - An immediate tributary to the Potomac River. Quantico is the nearest town across Quantico Creek.

Distance from the impoundment: Approximately 150 feet to Quantico Creek

Impoundment Location:

Longitude: 38 Degrees 33 Minutes 09.9 Seconds
Latitude: 77 Degrees 17 Minutes 34.9 Seconds
State VA County Prince William

Does a state agency regulate this impoundment? YES _X____ NO _____

If So Which State Agency?___ DCR Dam Safety – Region 1; 98 Alexandria Pike,
Suite 33, Warrenton, VA 20186
Phone 540-351-1587

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

_____ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

_____ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

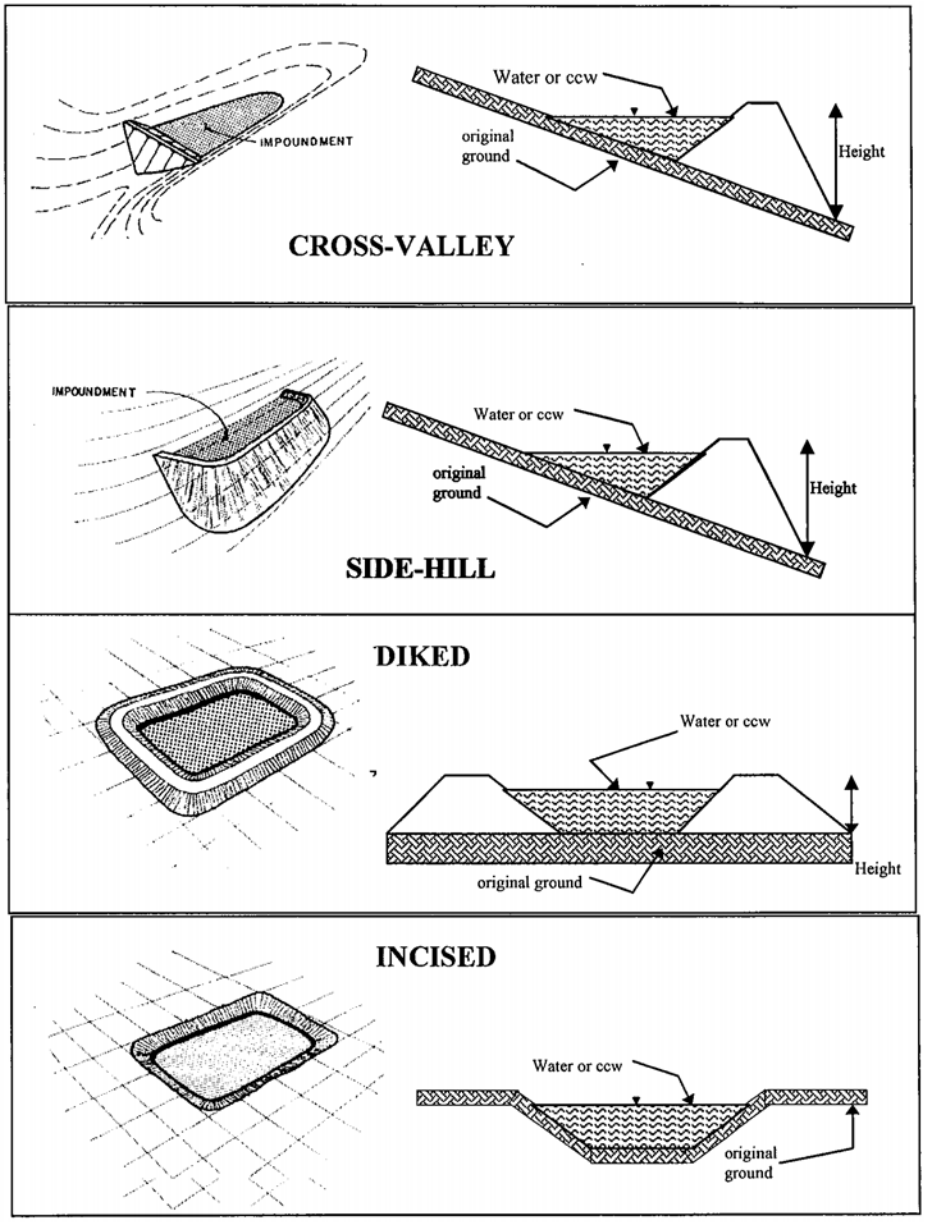
__X____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

There is a state highway (Possum Point Road – Rte. 633) downstream of the dam and the potential for economic loss on this facility. In addition, coal combustion waste (CCW) is currently stored in this reservoir. Dominion Power estimates that approximately 2/3 of the reservoir capacity is full of CCW. At normal pool elevation of 38 feet, this is equal to approximately 30 acre-feet of sediment. As such, if released to Quantico Creek, it could result in environmental damage.

CONFIGURATION:



__X__ Cross-Valley
_____ Side-Hill
_____ Diked
_____ Incised (form completion optional) _____ Combination Incised/Diked

Embankment Height 42-44 feet Embankment Material: earth fill
Pool Area: 5.5 acres (at 35 ft) Liner None
Current Freeboard : 2.7 feet__ Liner Permeability _____

EPA Form XXXX-XXX, Jan 09

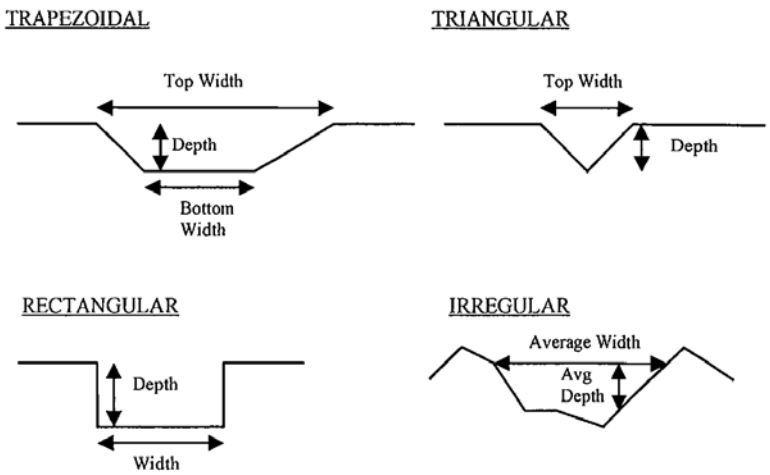
TYPE OF OUTLET (Mark all that apply)

The primary service outlet is a reinforced concrete decant tower located on the west side of the pond that is connected to a 72-inch corrugated metal discharge pipe located through the embankment.

Crest of weir – 35.0, but the overflow elevation has been increased by installation of wooden stop logs.
Top of dam – 40 – 42 feet (Although drawings indicate a crest elevation of 42 feet, there is settlement in several places, resulting in a variable crest elevation at the time of inspection)

_____ **Open Channel Spillway**
__ _ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

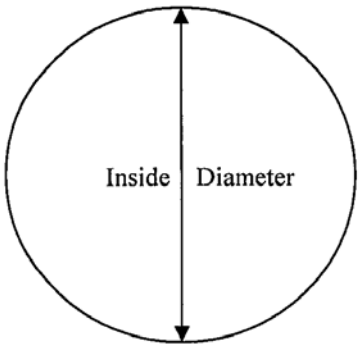
__ __ depth
__ __ bottom (or avg) width
__ __ top width



_____ **Outlet**

The outlet pipe is a 72-inch diameter corrugated metal discharge pipe.

Material
_72”___ corrugated metal
_____ welded steel
___ __ concrete
_____ plastic (hdpe, pvc, etc.)
_____ other (specify) _____



Is water flowing through the outlet? YES __X_____ NO _____
_____ No Outlet

_____ Other Type of Outlet (specify) _____

The Impoundment was Designed By: Stone and Webster Engineering Corporation in 1967

Has there ever been a failure at this site? YES __X_____ NO ____ _____

If So When? __1977_____

If So Please Describe :
Major repairs to the dam were required in 1977 when seepage along the original spillway pipe caused internal erosion (piping) and failure of the dam in the pipe area. The original pipe was a 72 inch diameter concrete pipe. This was replaced with the current 72-inch corrugated metal pipe with anti-seep collars. There have been no additional issues at this location of the dam since the repair work was completed.

Has there ever been significant seepages at this site? YES _____ NO __X_____

If So When? _____

If So Please Describe:
While there is no significant seepage, there are very wet conditions along the toe of the slope in several locations, and one location where the saturated zone extends up the slope. Because there is currently no piezometric data available , it is unclear if the phreatic zone is elevated in the dam or not.

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES_ NO: X

If so, which method (e.g., piezometers, gw pumping,...)?

If so please describe:

Monitoring wells have not been installed in the embankment, so the status of the phreatic zone cannot be monitored.

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Dominion Power - Possum Point	Date:	4/28/10
Unit Name:	Ash Pond "D"	Operator's Name:	Dominion Power
Unit I.D.:	VA DCR - 15320	Hazard Potential Classification:	High Significant ✓ Low
Inspector's Name:	Robert Bowers, PE; Craig Benson, PE		

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Annual		18. Sloughing or bulging on slopes?	✓	
2. Pool elevation (operator records)?	110.0		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	116.0		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	142.0		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	150.0		Is water exiting outlet, but not entering inlet?	✓	
6. If instrumentation is present, are readings recorded (operator records)?		✓	Is water exiting outlet flowing clear?	✓	
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?			From underdrain?	✓	
9. Trees growing on embankment? (If so, indicate largest diameter below)		✓	At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?	✓	
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place?	✓		From downstream foundation area?	✓	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?	✓		"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?		✓
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

8. N/A - Dam is not currently under construction.

18. Areas on the downstream slope that had sloughed in the past were filled with rock and appear stable. Sloughing on the upstream slope of the dam was repaired and reseeded last year. Grass growing in this area is not fully established but they are making efforts to do that.

21. Seepage was observed discharging from the toe drain outlet pipe. Wet areas were observed on the constructed benches in the downstream slope (apparently due to runoff) and along the natural ground (hillside)/

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Dominion Power - Possum Point	Date:	4/28/10
Unit Name:	Ash Pond "E"	Operator's Name:	Dominion Power
Unit I.D.:	VA DCR - 15321	Hazard Potential Classification:	High Significant ✓ Low
Inspector's Name:	Robert Bowers, PE; Craig Benson, PE		

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Annual		18. Sloughing or bulging on slopes?	✓	
2. Pool elevation (operator records)?	36.5		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	35.0		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	35.0		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	40.0		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?		✓	Is water exiting outlet flowing clear?	✓	
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?			From underdrain?		✓
9. Trees growing on embankment? (If so, indicate largest diameter below)	✓		At isolated points on embankment slopes?	✓	
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?	✓		Over widespread areas?		✓
12. Are decant trashracks clear and in place?	✓		From downstream foundation area?	✓	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		✓	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

8. N/A - Dam is not currently under construction.

9. A number of trees are growing just beyond the toe of the slope.

11. There are areas of settlement on the crest of the dam, such that the freeboard has been reduced in some locations.

18. Undulations were seen in downstream slope, probably cause by remaining stumps from cut trees.

21. Seepage may be due to poor drainage below the dam and because of the construction technique used.

APPENDIX B

Photographs – Ash Pond D

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122.040.100
Site Name: Possum Point – Ash Pond D	Location: Dominion Power – Possum Point Virginia

Orientation: South-West

Description: Reservoir from north bank. Note dredged material in foreground of picture

Date: 4/28/10

Photo Number: 1

Photographer: Benson

Orientation: South-West

Description: Crest of dam looking upstream face.

Date: 4/28/10

Photo Number: 2

Photographer: Benson

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122.040.100
Site Name: Possum Point – Ash Pond D	Location: Dominion Power – Possum Point Virginia

Orientation: South - East

Description: Upstream slope of dam and decant tower. Note area of bare soil toward middle of the dam which has recently been repaired due to sloughing of soil on top of clay layer.

Date: 4/28/10

Photo Number: 3

Photographer: Benson

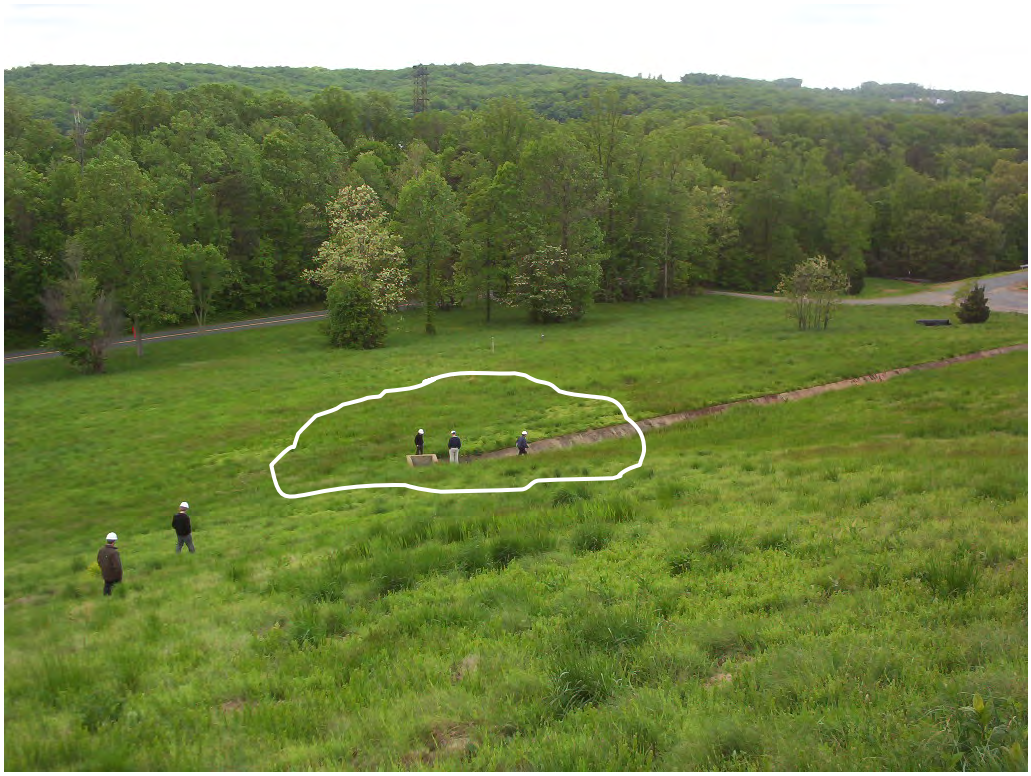
Orientation: North - West

Description: Downstream slope of dam and drainage outfall structure and concrete channel. Approximate area of wetness highlighted.

Date: 4/28/10

Photo Number: 4

Photographer: Benson



O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122.040.100
Site Name: Possum Point – Ash Pond D	Location: Dominion Power – Possum Point Virginia

Orientation: South- East

Description: Downstream slope of dam.

Date: 4/28/10

Photo Number: 5

Photographer: Benson

Orientation: North-West

Description: Downstream slope of dam. Toe-drainage structure near fire-hydrant in fore-ground

Date: 4/28/10

Photo Number: 6

Photographer: Benson

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122.040.100
Site Name: Possum Point – Ash Pond D	Location: Dominion Power – Possum Point Virginia

Orientation: North - East

Description: Downstream slope of dam. Approximate area of surface wetness highlighted. (See also Photo 4)

Date: 4/29/10

Photo Number: 7

Photographer: Benson

Orientation: South-East

Description: Toe-drain outlet pipe. Note, sediment in ditch only provide 2.25' opening in 6-foot pipe.

Date: 4/28/10

Photo Number: 8

Photographer: Benson

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122.040.100
Site Name: Possum Point – Ash Pond D	Location: Dominion Power – Possum Point Virginia

Orientation: South-West

Description: Erosion at downstream concrete lined channel from Ash Pond D to Ash Pond E

Date: 4/28/10

Photo Number: 9

Photographer: Benson

APPENDIX C

Photographs – Ash Pond E

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122.040.100
Site Name: Possum Point – Ash Pond E	Location: Dominion Power – Possum Point Virginia

Orientation: North West

Description: Photo of stilling basin as pipes enter Ash Pond E

Date: 4/29/10

Photo Number: 1

Photographer: Benson

Orientation: West

Description: Crest of dam looking West

Date: 4/29/10

Photo Number: 2

Photographer: Benson

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122.040.100
Site Name: Possum Point – Ash Pond E	Location: Dominion Power – Possum Point Virginia

Orientation: South - East

Description: Deep ditch at toe of slope

Date: 4/29/10

Photo Number: 3

Photographer: Benson

Orientation: North - West

Description: View along crest of dam/upstream side. Note cenospheres in foreground and accumulated CCW

Date: 4/29/10

Photo Number: 4

Photographer: Benson

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122.040.100
Site Name: Possum Point – Ash Pond E	Location: Dominion Power – Possum Point Virginia

Orientation: South West

Looking at marsh area downstream of dam and close proximity to Quantico Creek (bay).

Date: 4/29/10

Photo Number: 5

Photographer: Benson

Orientation: South-West

Description: Crest of dam looking at downstream slope. Notice trees encroaching on toe of dam.

Date: 4/29/10

Photo Number: 6

Photographer: Benson

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122.040.100
Site Name: Possum Point – Ash Pond E	Location: Dominion Power – Possum Point Virginia

Orientation: South - East

Description: Outfall Structure. Steps on left provide access from the crest of the dam. Monthly VPDES samples are collected at this location.

Date: 4/29/10

Photo Number: 7

Photographer: Benson

Orientation: South-East

Description: Decant structure. Note boom on surface to prevent floatables from entering discharge pipe.

Date: 4/29/10

Photo Number: 8

Photographer: Benson

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122.040.100
Site Name: Possum Point – Ash Pond E	Location: Dominion Power – Possum Point Virginia

Orientation: South East

Description: Crest of dam. Noted gravel driving surface and rip-rap on upstream face of dam.

Date: 4/29/10

Photo Number: 9

Photographer: Benson

Orientation: South-West

Description: Upstream face of dam.

Date: 4/29/10

Photo Number: 10

Photographer: Benson

O'BRIEN & GERE

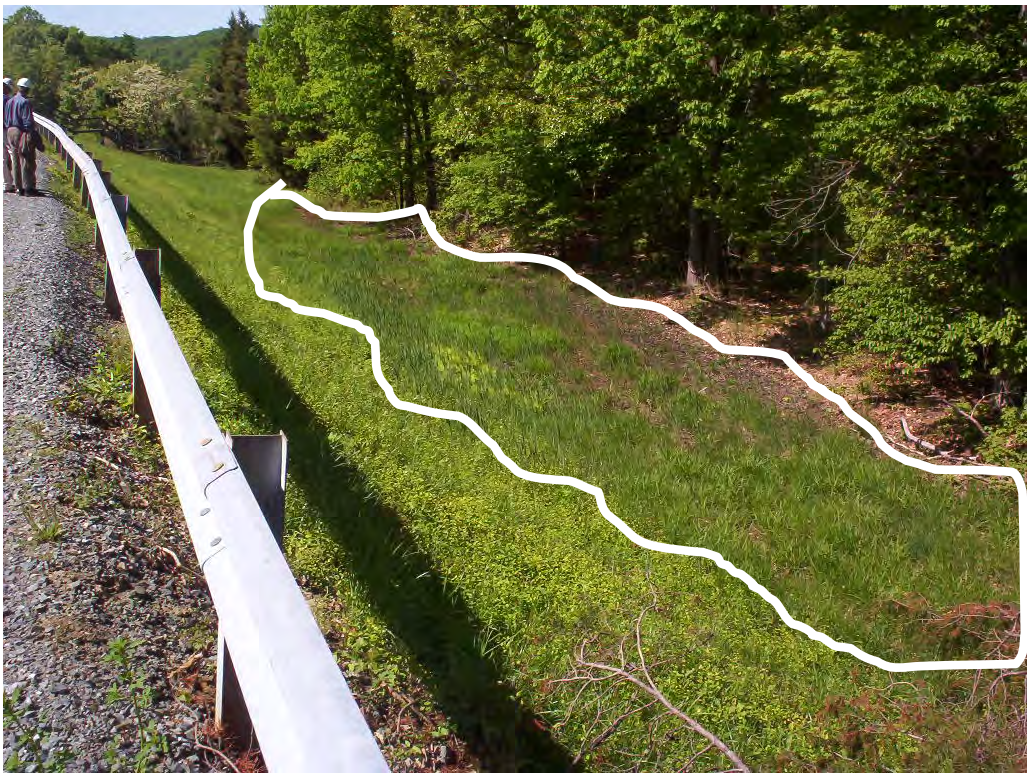
PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122.040.100
Site Name: Possum Point – Ash Pond E	Location: Dominion Power – Possum Point Virginia

Orientation: South - East

Description: Downstream slope of dam. Approximate area of wet slope outlined, potential seepage or poor drainage issues.

Date: 4/29/10

Photo Number: 11

Photographer: Benson