DRAFT REPORT

Dam Safety Assessment of CCW Impoundments

Chesapeake Energy Center

United States Environmental Protection Agency
Washington, DC

June 17, 2010

O'BRIEN & GERE
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Dam Safety Assessment of CCW Impoundments

Chesapeake Energy Center

Prepared for:
US Environmental Protection Agency
Washington, DC

ROBERT R. BOWERS, P.E. – VICE PRESIDENT
O'BRIEN & GERE ENGINEERS, INC.

CRAIG F. BENSON, P.E. – PROJECT MANAGER
O'BRIEN & GERE ENGINEERS, INC.

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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 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 O'Brien & Gere's Order EP10W001240 to Contract BPA# EP10W000673 with the EPA, 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 the documented CCW management units at the subject facility. 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 down gradient 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 the Bottom Ash and Sedimentation Pond at the Chesapeake Energy Center in Chesapeake, Virginia. The above impoundment is owned and operated by the Virginia Electric & Power Company ("Dominion Virginia Power", Dominion Power). In the course of this assessment, O'Brien & Gere obtained information through interviews with representatives of Dominion Power.

2. PROJECT/FACILITY DESCRIPTION

2.1. GENERAL

The Chesapeake Energy Center is located at 2701 Vepco Street in Chesapeake, Virginia. A Site Location Map is included as Figure 1. The generating station was commissioned in 1953 and includes a power generating facility with an approximate capacity of 638 megawatts (MW) gross generation capacity from its four coal-fired electric generating units, as well as approximately 122 MW from its eight natural gas fired electric generating units. Coal combustion waste that is produced during power generation is managed on-site with a CCW impoundment.

The facility utilizes two structures for CCW management known as the Bottom Ash and Sedimentation Pond and the Dredged Materials Pond. The impoundments are located on the southernmost end of the site. The Bottom Ash and Sedimentation Pond impoundment was originally designed as two separate ponds; the Bottom Ash Pond and the Sedimentation Pond, separated by a dividing dike. The dividing dike was not constructed and the combined structure was named the Bottom Ash and Sedimentation Pond. The Dredged Materials Pond was the original CCW impoundment for the Chesapeake Energy Center; it was converted to a dry landfill when the Bottom Ash and Sedimentation Pond was constructed. This safety assessment report summarizes O'Brien & Gere's May 2010 inspection of the Bottom Ash and Sedimentation Pond at the Chesapeake Energy Center facility.

2.2. MANAGEMENT UNIT DESCRIPTION

The CCW impoundment inspected during this safety assessment is identified on Figure 2 – Facility Layout Plan.

2.2.1. Bottom Ash and Sedimentation Pond

The Bottom Ash and Sedimentation Pond forms the southern portion of the Chesapeake Energy Center site. It is bounded by water on three of its four sides: by the Center's Cooling Water Discharge Channel to the west; by the Deep Creek to the south; and by the Southern Branch of the Elizabeth River to the east. A dry landfill, the Dredged Materials Pond, forms the impoundment's northern boundary. The impoundment was constructed in 1984 and has not been expanded since. Bottom ash is sluiced to the impoundment using water pumped from the Southern Branch of the Elizabeth River. In addition, the pond also receives stormwater runoff and leachate from the Dredged Materials Pond, Oil Water Waste decant and wastewater treated in a septic tank and pre-chlorinated. Water that is routed through the pond is discharged into the Deep Creek through an outlet structure located approximately 400 feet east of the impoundment's western embankment.

2.2.2. Other Impoundments

The Facility Layout Map shows the location of the various impoundments or storage facilities on the site which are as follows:

- Dredged Materials Pond - Dewatered CCW in the bottom ash pond is excavated into dump trucks and hauled to the Dredged Materials Pond for dry storage. The Dredged Materials pond was provided with a synthetic liner and stormwater runoff and leachate both diverted to the Bottom Ash Pond.
- Oily Waste Pond - Located just north of the Bottom Ash and Sedimentation Pond on the western side of the site, is a small pond identified as the Oily Waste Pond. It receives wastewater from the Chesapeake Energy Center but does not receive any CCW. It decants into the Bottom Ash and Sedimentation Pond.

2.3. HAZARD POTENTIAL CLASSIFICATION

The definitions for the four hazard potentials (Less than Low, Low, Significant and High) to be used in this assessment are included in the EPA CCW checklists found in Appendix A. Based on the checklist definitions and as a result of this assessment, the hazard potential rating recommended for the Bottom Ash and Sedimentation Pond is **SIGNIFICANT.** A failure of the Bottom Ash and Sedimentation Pond embankments could cause environmental damage if the CCW and the sluice water were released into the surrounding rivers that ultimately flow into the Chesapeake Bay but loss of life does not appear to be probable.

The Bottom Ash and Sedimentation Pond is currently not regulated as a dam by the Virginia Department of Conservation and Recreation (VDCR). Therefore, it does not have a hazard classification assigned by the Commonwealth.

2.4. IMPOUNDING STRUCTURE DETAILS

The following sections summarize the structural components and basic operations of the Bottom Ash and Sedimentation Pond. The location of the impoundment on the Chesapeake Energy Center site is shown on Figure 2. A smaller scale plan of the pond and photo location identifiers is provided as Figure 3. Photos taken during the visual inspection are presented in Appendix B.

2.4.1. Embankment Configuration

The Bottom Ash and Sedimentation Pond is a combined incised/diked earthen embankment structure with a total surface area of approximately 9.7 acres, according to information provided by Dominion in the EPA Request for Information. The crest is approximately at elevation (EL) 20 feet above mean sea level. The inboard and outboard dike slopes were designed at an inclination of 2H:1V. According to contract drawings provided by Dominion, the bottom of the pond was designed with a liner, but the type, thickness and other design details for the liner are not shown on the drawings and the actual presence of the liner was not verified. As stated above, the impoundment is surrounded by water on three of its four sides. The maximum height of the embankments is approximately 17 feet.

The Bottom Ash and Sedimentation Pond was designed as two separate ponds, but was ultimately constructed in 1984 as a single impoundment. In late 2001 to early 2002, two berms were constructed of reclaimed bottom ash in the eastern part of the pond to facilitate settling of solids in that area of the pond. Corrugated plastic pipes were installed in the ash berms to allow for the flow of water through the system.

In addition to the impoundment described above, there is one pond located to the northwest of the CCW impoundment known as the Oily Waste Pond. This pond's primarily function is to collect and treat wastewater from Units 1 to 4 and allow non-CCW waste to settle out before the wastewater enters the Bottom Ash and Sedimentation Pond. This pond was not assessed as part of this CCW impoundment assessment since its purpose is not to store CCW.

2.4.2. Type of Materials Impounded

CCW consists of bottom ash and fly ash. Bottom ash generated at the Chesapeake Energy Center is hydraulically sluiced to the Bottom Ash and Sedimentation Pond. The fly ash generated at the Chesapeake Energy Center is collected using electrostatic precipitators, handled dry, and disposed off-site. Therefore, the influent into the Bottom Ash and Sedimentation Pond includes sluice water with solids consisting of primarily bottom ash with lesser quantities of miscellaneous fines composed of coal fines and fly ash. The impoundment also receives stormwater runoff and leachate from the dry landfill located to its north, as well as pumped runoff and wastewater from other areas of the Chesapeake Energy Center.

2.4.3. Outlet Works

The Bottom Ash and Sedimentation Pond is an incised/diked impoundment that has been designed to receive sluice flows, direct precipitation and a minor amount of additional stormwater runoff. The primary outlet structure, located on the southern embankment approximately 400 feet east of the western embankment, consists of a wooden structure equipped with stop logs to govern the water level in the pond. A metal baffle serves to exclude floating debris from the discharge. The effluent discharges into a 20-inch HDPE pipe that extends through the southern embankment into the Deep Creek. The discharge is permitted under VDEQ permit # VA-0004081.

3. RECORDS REVIEW

A review of the available records related to design, construction, operation and inspection of the Chesapeake Energy Center CCW impoundment was performed as part of this assessment. The documents provided by Dominion Power are listed below:

Table 3.1 *Summary of Documents Reviewed*

Document	Dates	By	Description
Drawing G-1043-A	1974	Unknown	Outfall Details at Fly Ash Pond
Report: Soil and Foundation Engineering Study, Ash Pond Dike – VEPCO Power Station	1980	Schnabel Engineering Associates, P.C.	Report on the results of a subsurface investigation program and slope stability analyses performed on the (then) existing Fly Ash Pond
Report: Feasibility Study, Reclamation of Existing Fly Ash Pond	1984	gai consultants, inc.	Feasibility study for the conversion of the Energy Center's existing fly ash pond into a dry landfill and construction of new sluiced bottom ash pond south the fly ash pond
VEPCO Drawing No. 73519-C-100 through 103	1984	unknown	Topographic Survey of the Bottom Ash and Sedimentation Pond area
VEPCO Drawing No. 73519-C-10 through 22	1984	gai consultants, inc.	Contract Drawings – Dry Disposal Area Construction Plans. Reclamation of Existing Ash Pond
VEPCO Drawing No. 73519-C-30 through 34	1984	gai consultants, inc.	Contract Drawings – Dry Disposal Area Operation Plans. Reclamation of Existing Ash Pond
VEPCO Drawing No. 73519-C-76 Sheet 7 of 10	1985	gai consultants, inc.	Design Drawing - East Sedimentation Canal, Sections & Details
VEPCO Drawing No. 73519-C-100 through 102	1985	George W. Midgette, Jr. Land Surveyor	Topographic Survey of the Entrance Road, North Pond and South Pond areas
Annual Inspection Report for Virginia Regulated Impounding Structure	2009	John A. Cima, P.E. (Dominion Power – F&HE)	Completed standard visual inspection report for dams in the Commonwealth of Virginia
Response to EPA RFI	2009	Dominion Power	Utility's response to EPA questionnaire regarding CCW impoundments
Report: Geotechnical Engineering Study, Chesapeake Energy Center. Stability Evaluation of the Bottom Ash and Sedimentation Pond Dikes	2010	Schnabel Engineering, LLC	Report on the results of a subsurface investigation and slope stability analyses of the eastern, southern and western embankments (dikes) of the Bottom Ash and Sedimentation Pond
Ash Pond Influent Pump Rates	2010	Dominion Power	Summary of maximum pumping rates into the Bottom Ash and Sedimentation Pond
Chesapeake Energy Center. Bottom Ash and Sedimentation Pond Dikes Stability Status (Dominion Power – F&HE)	2010	Dominion Power	Summary of Schnabel's 2009 report and Dominion's plan to address deficiencies

3.1. ENGINEERING DOCUMENTS

Review of the design drawings and the engineering reports revealed information on the design details for the Bottom Ash and Sedimentation Pond which is summarized below:

- The Bottom Ash and Sedimentation Pond was originally constructed in 1984 in an area south of the (then) existing Fly Ash Pond.
- The Fly Ash Pond was converted from receiving sluiced CCW to a dry landfill when the Bottom Ash and

Sedimentation Pond was constructed

- Originally, two impoundments were to be constructed: the Bottom Ash Pond and the Sedimentation Pond. The dividing dike between the two proposed structures was not constructed, resulting in a single impoundment.
- The Bottom Ash and Sedimentation Pond is a combined incised/diked structure. The depth of constructed fill varies from 0 to 17 feet.
- The length of the crest of the dam is as follows:

Embankment	Approximate Length (ft)
East	340
South	730
South-West	810
West	730
Total Length (approx)	2,610

- Natural soils form the lower portion of the western and southern embankments while the eastern embankment appears to be constructed of fill for its full height.
- The embankments do not appear to have been keyed into the underlying foundation.
- The embankments are constructed of generally loose to medium dense and medium stiff to stiff sand with varying amounts of clay and/or silt.
- The southern embankment generally met industry accepted stability criteria for the load cases and failure modes modeled while the eastern and western embankments do not meet stability criteria for recommended load cases and failure modes.
- The minimum Factors of Safety (FOS) for slope stability under Normal Pool with Steady State Seepage Conditions[1] were calculated as follows:

  a) Southern Embankment: Shallow Failure= 1.4 to 1.8
     Deep-Seated Failure = 1.5 to 2.0
  b) Eastern Embankment: Shallow Failure= 0.9 to 1.0
     Deep-Seated Failure = 1.1
  c) Western Embankment: Shallow Failure= 1.0
     Deep-Seated Failure = 1.2

- The minimum factors of safety for slope stability under Normal Pool with Steady State Seepage and Seismic Loading Conditions[2] were calculated as follows:

  a) Eastern Embankment: Shallow Failure= 0.9
     Deep-Seated Failure = 1.1
  b) Western Embankment: Shallow Failure= 0.9
     Deep-Seated Failure = 1.1

1. Minimum FOS = 1.5 per USACE EM 1110-2-1902
2. Minimum FOS = 1.1 per USACE EM 1110-2-1902

- The eastern and western embankments have experienced localized erosion and/or shallow slope failures. According to available documentation, Dominion Power will investigate alternatives to repair the failures.
- Woody vegetation had been allowed to grow on the embankments but has been cleared and maintained by Dominion Power since early 2009.
- In their May 2010 summary of the February 2010 Schnabel report, Dominion Power – F&HE presented a "Recommended Action Plan" for evaluation, design and construction of improvements to the Bottom Ash and Sedimentation Pond. The recommend short and long term actions presented in the Plan consists of the

following (**F&HE recommended timing in parentheses)**:

- Perform topographic surveys of the southern, eastern and western embankments (**as soon as possible**).
- Develop basic plan and details to repair the eastern embankment toe erosion/failure and hire civil contractor to make the recommended repairs (**develop plan concurrent with survey, timing of repairs subject to permitting requirements**).
- Perform conceptual study and develop conceptual plan, details and cost estimate for (a) improving the eastern embankment's long-term stability using sheet pile wall at toe; and (b) placing riprap buttress along discharge canal to restore eroded areas below the western embankment. Bathymetric survey recommended by Schnabel was performed several years ago and may be able to be utilized in the conceptual study (**next three months**).
- Develop and implement schedule to affect long term stability improvements to the eastern and western embankments based on study results (**by year-end 2010, subject to permitting**).
- Continue to observe and monitor the condition of the eastern and western embankment slopes as recommended by Schnabel until short and long term repairs are made (**ongoing**).

3.1.1. Stormwater Inflows

Stormwater inflows to the Bottom Ash and Sedimentation Pond consists of direct precipitation on the pond and runoff conveyed to the pond from an unknown portion of the Chesapeake Energy Center site. Some runoff from the dry ash storage facility (former Fly Ash Pond) located immediately to the north of the impoundment is directed to the Pond, as is runoff from other areas of the Chesapeake Energy Center.

The Feasibility Study of 1984 included mention of providing storage for the 10-year 24-hour storm, one days worth of bottom ash sluice water, inflow from the waste pond, sewage inflow, inflow from the oily waste pond, two feet of sediment and two feet of freeboard. However, it is not clear if the decant structure currently in place was that noted in the 1984 design. The additional study performed in 2010 by Schnabel Engineering LLC (Schnabel) did not include a flood routing analysis. Therefore, the impoundment's storm water storage and discharge capacities are not currently known. The 10-year, 24-hour storm may be pertinent to the design and operation of certain waste management facilities, but it is not a design event conventionally used for dam safety design and assessment.

The scope of this CCW impoundment assessment includes an evaluation of the ability of the management unit to safely pass an appropriate design flood up to the Probable Maximum Flood (PMF). Generally, Spillway Design Floods (SDF) are assigned based on the hazard classification of the structure' The dam safety statutes or regulations provided by the State or Commonwealth in which an impoundment is located may be considered for guidance in selecting the appropriate SDF for a CCW management unit.

The Virginia Dam Safety Act classifies 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.

Failure of the Bottom Ash and Sedimentation Basin is not expected to result in loss of life nor cause appreciable economic damage to other entities besides Dominion Power. Therefore, the impoundment appears to fall within the **Low** Hazard category of VDCR requirements. Dominion Power officials noted that the facility is not currently regulated by VDCR.

As a potentially **Low** Hazard Dam in the Commonwealth of Virginia, the facility should be able to safely pass the 100-year flood, or an incremental analysis could be performed to demonstrate that the appropriate Spillway Design Flood (SDF) has a greater return period than the 100-year event (with a minimum return period of 50-years). Since hydrologic and hydraulic analyses have not been performed for the Bottom Ash and Sedimentation Basin, its capacity to safely pass the 100-year flood is unknown. Based on the freeboard available in the western portion of impoundment (greater than 4 feet), it appears that the CCW impoundment may be able safely pass the 100-year flood, however, since less freeboard is maintained in the eastern portion of the impoundment after the basin was sub-divided by the reclaimed coal ash berms is much less, and the site runoff is directed into the eastern portion, the facility's capacity to safely pass the apparent SDF cannot be assessed based on visual observations and thus should be analyzed using appropriate engineering methods.

3.1.2. Stability Analyses

As stated above, Schnabel performed a subsurface investigation and stability analyses for the Bottom Ash and Sedimentation Basin's western, southern, and eastern embankments. The southern embankment generally met the slope stability criteria presented in USACE EM 1110-2-1902 and ER 1110-2-1806, the accepted standard in the industry. The eastern and western embankments do not meet stability criteria for potential shallow or deep-seated failures. Stability analyses using the SDF loading conditions were not performed for any of the embankments.

3.1.3. Instrumentation

Older well stand-ups were observed on the Bottom Ash and Sedimentation Basin embankments, but no records of any readings taken from wells or piezometers that may be installed are known to exist. Temporary wells were installed during Schnabel's subsurface investigation but they were abandoned (filled) at the end of the program. Water surface elevation readings taken during their investigation were provided on the boring logs.

3.2. PREVIOUS INSPECTIONS

The Bottom Ash and Sedimentation Pond is not regulated by VDCR; therefore, no regular inspections by state personnel are performed. Mr. John A. Cima, P.E., Dominion's geotechnical engineer performed a visual inspection on January 21, 2009 and in April 2010. Schnabel Engineering, LLC performed a visual inspection in August 2009. Dominion personnel perform daily informal inspections of the pond during their security detail.

3.3. OPERATOR INTERVIEWS

Numerous plant and corporate personnel took part in the inspection proceedings. The following is a list of participants for the inspection of the Bottom Ash and Sedimentation Pond:

Table 3.2 *List of Participants*

Name	Affiliation	Title
John Cima, PE	Dominion Power	Corporate Dam Safety Engineer
Dave Snoody	Dominion Power	Director, F&H Station III
Paul Dichson	Dominion Power	
Glen Johnson	Dominion Power	Corporate Environmental Compliance
Craig Dufficy	USEPA	Environmental Engineer
Lisa Silvia	VDEQ	
Keith Primm	VDEQ	
Craig Benson, PE	O'Brien & Gere	Project Manager
Johan Anestad, PE	O'Brien & Gere	Technical Associate

Facility personnel provided good background information, general plant operation and requested historical documentation for the Bottom Ash and Sedimentation Pond.

4. VISUAL INSPECTION

The following section summarizes the inspection of the Bottom Ash and Sedimentation Pond which occurred on May 11, 2010. Following the inspection, O'Brien & Gere completed the EPA inspection checklists that briefly summarize the results of the inspection. The checklists were submitted electronically to the EPA on May 21, 2010. Copies of the completed inspection checklists are included as Appendix A.

4.1. GENERAL

The weather on the day of the inspection was mostly cloudy and approximately 60 - 70 degrees. The visual inspection consisted of a thorough site walk along the crest and perimeter of the pond. O'Brien & Gere team members made observations along the toe, outboard slope, and crest of the embankments, and along exposed portions of the inboard slopes. The team also inspected the inlet/outlet structures.

Photos of relevant features and conditions observed during the inspection were taken by O'Brien & Gere and are provided in Appendix B. A Site Plan of the Bottom Ash and Sedimentation Pond is presented as Figure 3, which also provides photograph locations and directions.

4.2. SUMMARY OF FINDINGS

The following observations were made during the inspection:

- Sluiced CCW by-product discharge enters the pond in the northeastern corner (Photo 13) and sluice water exits the pond through a wooden structure and 20-inch HDPE pipe on the western third of the southern embankment (Photos 10 - 12).
- The 20-inch HDPE appears to have been installed within an older corrugated metal pipe (Photo 12). It is not clear when the older corrugated pipe was installed but it is shown in the 1984 site survey .
- The outlet structure appeared to be in good condition, discharge from the structure could not be observed because the pipe ends below the water surface in the Deep Creek.
- The outboard slope is generally covered with sparsely growing grasses, though some reedy grasses are growing along the toe of the southern and eastern embankments.
- Woody vegetation has generally been cleared from the limits of the Bottom Ash and Sedimentation Pond embankments, though some remains along the toe of the eastern embankment (Photo 9).
- The western embankment has experienced localized erosion and/or shallow slope failures in the native soils that form the embankments foundation. Some animal burrows were also observed on the western embankment (Photo 3).
- The eastern embankment has experienced localized erosion and/or shallow slope failures (Photo 8).
- The outboard slope of the embankment appears to have been constructed steeper than 2H:1V (Photo 7).
- The inboard slope is covered with well maintained grasses (Photo 11).
- Berms have been constructed of reclaimed bottom ash within the impoundment to aid the settling of CCW solids in the eastern portion of the pond. Corrugated plastic pipes installed within the berms allow water to decant to the west and eventually enter the outlet structure (Photo 16). One of the ash berms has been breached (Photo 15).
- A crushed-stone access road was constructed over the length of the crest. The road appears to be in good condition with no rutting, erosion or standing water observed.

Based on conversations with plant personnel, no releases have occurred from the Bottom Ash and Sedimentation Pond impoundment. No patchwork repair on the embankment appears to have been performed.

5. CONCLUSIONS

Based on the ratings defined in the Scope of Work (Satisfactory, Fair, Poor and Unsatisfactory), the information reviewed and the visual inspection, the overall condition of the Bottom Ash and Sedimentation Pond is considered to be **POOR**. Based on the stability analyses performed by Schnabel, acceptable performance is not expected under recommended loading conditions. Additionally, the impoundment has experienced localized erosion/slope failure on its eastern and western embankments.

The owner has removed most deleterious vegetation from the embankments and is well aware of the deficiencies outlined above. Dominion Power has developed a memorandum with an outline of steps to take to rectify the deficient conditions. The proposed schedule of investigations, analyses and repairs presented in the memorandum appears to address the deficiencies in an appropriate timeframe.

6. RECOMMENDATIONS

Based on the findings of the visual inspection and review of the available records for the Bottom Ash and Sedimentation Pond, O'Brien & Gere recommends that the F&HE recommended action plan is implemented and that the studies and repairs are performed in a timely manner.

6.1. URGENT ACTION ITEMS

The recommendations in the Dominion Power - F&HE memorandum are considered to be urgent, i.e. require *immediate* attention to ensure the structural integrity of the impoundment in the near term. These items, noted in Section 3.1 of this report, should be completed in accordance with the timeframe presented. Dominion Power should provide updates to the EPA on the status/completion of this work as well as basis of design documentation for the rehabilitation alternative and revised stability analyses.

6.2. LONG TERM IMPROVEMENT

The deficient conditions observed during the inspection may not require immediate attention, but additional investigations/analyses and corrective actions should be implemented in the near future. The following items need to either continue to be undertaken or completed:

- Continue to observe and monitor the condition of the eastern and western embankment slopes as recommended by Schnabel until short and long term repairs are made.
- Annual inspections and six year reporting per the VDCR requirements for regulated structures.

The impoundment appears to fall within the Low Hazard category of VDCR requirements (its storage is greater than 50 acre-feet). It is O'Brien & Gere's recommendation that flood routing analyses be performed. As a Low Hazard Dam, the facility should be able to safely pass the 100-year flood or an incremental analysis could be performed to demonstrate that the appropriate Spillway Design Flood (SDF) has a greater return period than the 100-year event (with a minimum return period of 50-years). Addition stability analyses, using SDF loading conditions, should also be performed.

6.3. MONITORING AND FUTURE INSPECTION

Dominion Power should continue to inspect the Bottom Ash and Sedimentation Pond on a daily basis. A schedule for more formal inspections to be performed after the improvements to the structure are constructed should be developed. The facility also appears to exceed the minimum requirements for dams in Virginia. Therefore, it is O'Brien & Gere's recommendation that the structure be inspected in accordance with VDCR requirements.

6.4. TIME FRAME FOR COMPLETION OF REPAIRS/IMPROVEMENTS

It is O'Brien & Gere's recommendation that Dominion Power follow the timeframe for investigations, analyses and implementation of improvements presented in the Dominion Power – F&HE document. It is further suggested herin that Dominion Power begin the permitting process immediately upon determination of the rehabilitation method selected.

6.5. CERTIFICATION STATEMENT

I acknowledge that the Bottom Ash and Sedimentation Pond CCW management unit referenced herein was personally inspected by me on May 11, 2010 and was found to be in the following condition:

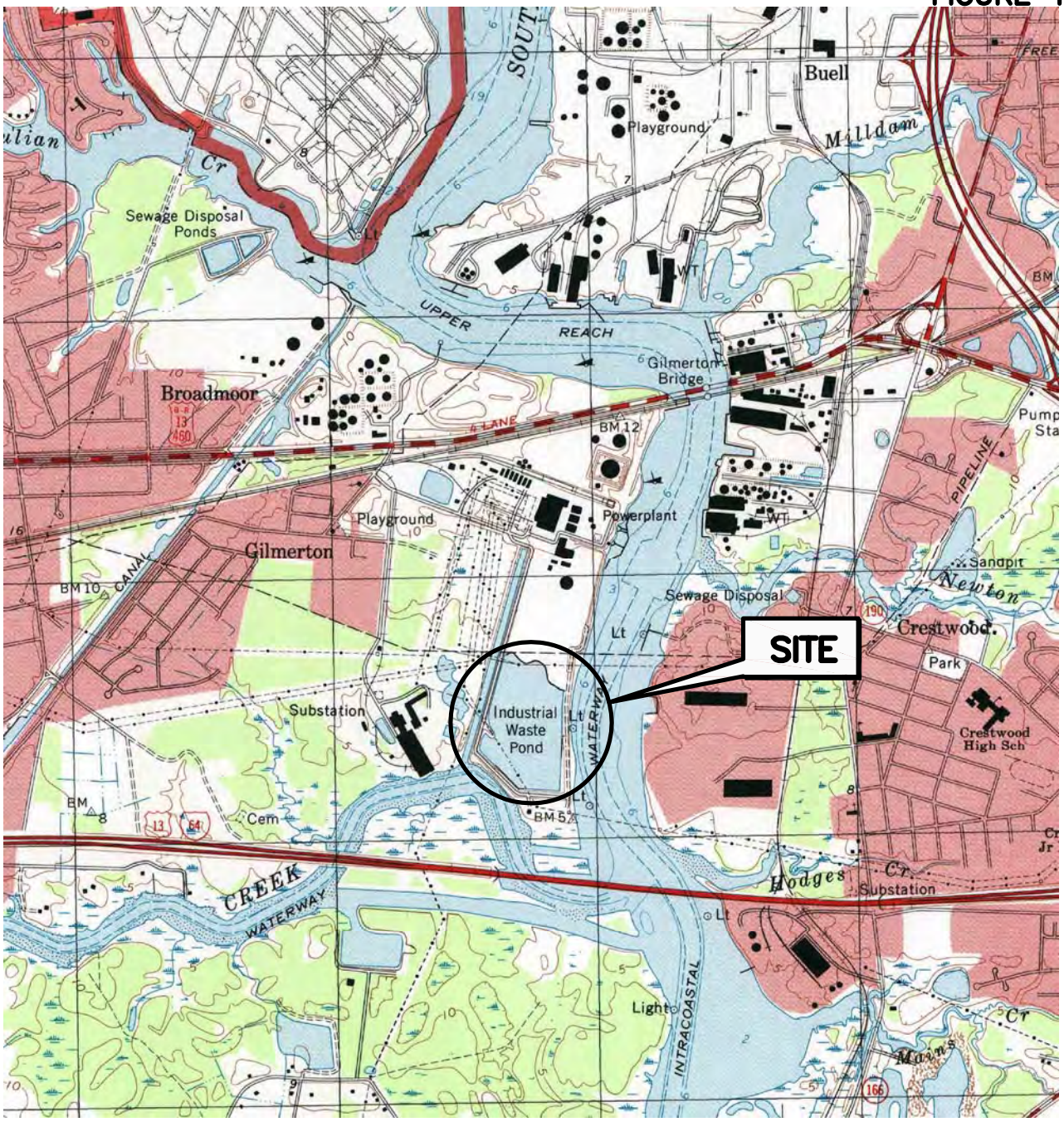
~~SATISFACTORY~~
~~FAIR~~
POOR
~~UNSATISFACTORY~~

Signature: _____ Date: _____

Craig A. Benson, PE
VA PE # 0402 035374

FIGURES

FIGURE 1



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

VIRGINIA

QUADRANGLE LOCATION

US EPA
DAM SAFETY ASSESSMENT
OF CCW IMPOUNDMENTS

CHESAPEAKE ENERGY CENTER
CHESAPEAKE, VIRGINIA

SITE LOCATION MAP

1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 5 0 1 KILOMETER

SCALE: 1:24000

46122-CHESAPEAKE-F01

JUNE 2010

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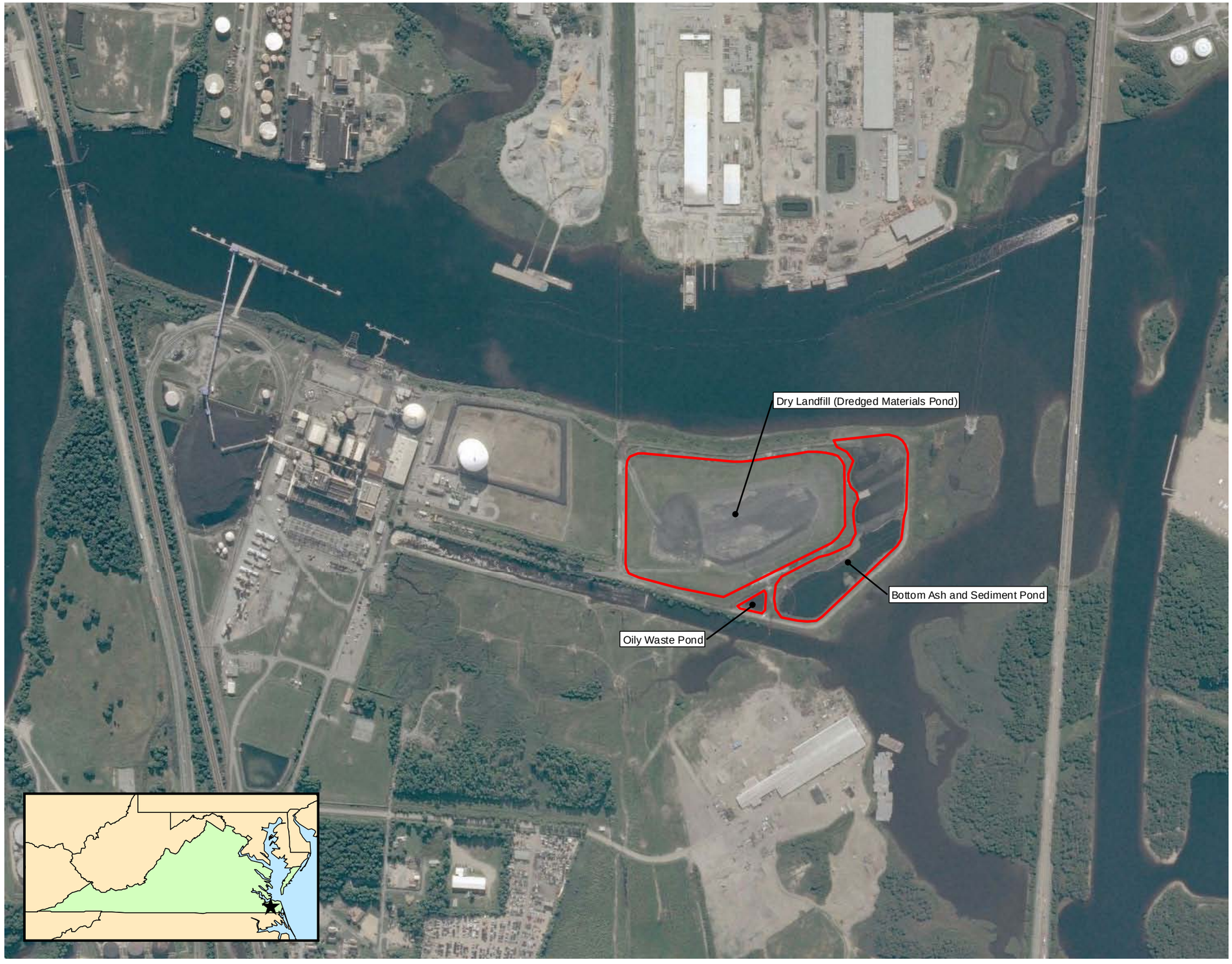
DATE: 6/11/2010 1:53:28 PM

DRAFT FIGURE 2



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

CHESAPEAKE
ENERGY CENTER
CHESAPEAKE, VIRGINIA

SITE LAYOUT

0 300 600 1,200
Feet

JUNE 2010
13498/46122

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DRAFT FIGURE 3

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LEGEND

1 Photograph Direction/Location

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

CHESAPEAKE
ENERGY CENTER
CHESAPEAKE, VIRGINIA

PHOTO LOCATIONS

0 100 200 400
Feet

JUNE 2010
13498/46122

O'BRIEN & GERE

APPENDIX A

Visual Inspection Checklist

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Chesapeake Energy	Date:	5/11/10
Unit Name:	Ash Pond	Operator's Name:	Dominion Power
Unit I.D.:		Hazard Potential Classification:	High / Significant ✓ / Low
Inspector's Name:	Craig Benson, PE; Johan Anestad, 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)?	16.0		19. Major erosion or slope deterioration?	✓	
3. Decant inlet elevation (operator records)?	8.0		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?			Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	20.0		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

2&3 - The interior of the Ash Pond has been divided into three smaller/ decant impoundments by building dividing dikes with reclaimed ash. Water surface elevations from in these impoundments range from about EL. 16 to to about EL. 8. at the overflow structure which discharges into Deep Creek (which flows into the Elizabeth River).

4,8,4,15,22 - Not applicable

20 - Discharge pipe underwater so we could not see quality of water or if there was external seepage around pipe

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit #: VA0004081 INSPECTOR Anestad /Benson
Date: May 10, 2010

Impoundment Name: Ash Pond
Impoundment Company: Dominion Power
EPA Region: Region 3
State Agency (Field Office) Address: Not Regulated

Name of Impoundment: Ash Pond

Permit number:
VPDES Permit No. VA0004081

Annual Sampling Requirements:
Flow, PH, TSS, CL2, Total P, Total Nitrogen, Dissolved Copper, Oil & Grease.

New: 1984 Update ___

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

IMPOUNDMENT FUNCTION:
Bottom ash is slurry pumped into the impoundment which is subdivided into three sections with reclaimed bottom ash. The slurry is continuously dewatered and CCW are then moved to a dry-disposal land fill adjacent to the slurry operations. Leachate and stormwater run-off from the land fill area also drain into this CCW pond.

Nearest Downstream Town Name:
The dam empties into the Elizabeth River. The Elizabeth River runs through Portsmouth and Norfolk prior to Flowing

Distance from the impoundment: Approximately 50 feet.

Impoundment Location:

Longitude: 36 Degrees 45 Minutes 43.41 Seconds
Latitude: 76 Degrees 18 Minutes 13.5 Seconds
State VA, Chesapeake

Does a state agency regulate this impoundment? YES _ ____ NO __X____

If So Which State Agency?____

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.

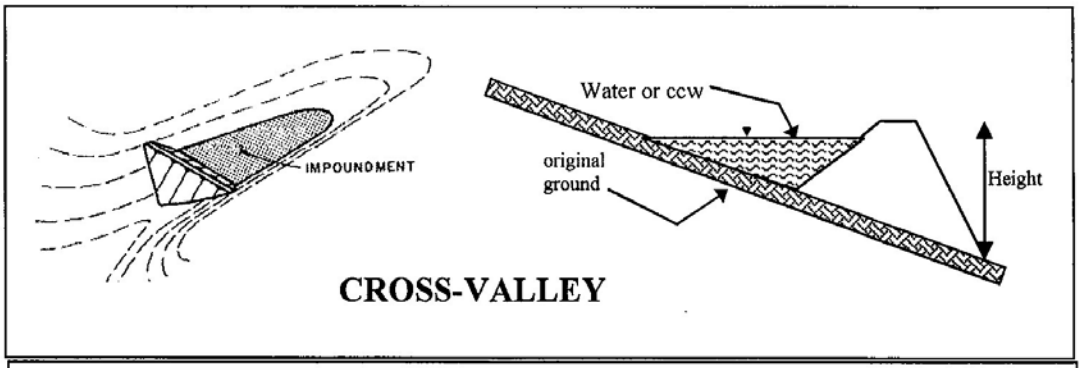
__X____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, **environmental damage**, disruption of lifeline facilities, or can impact other 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.

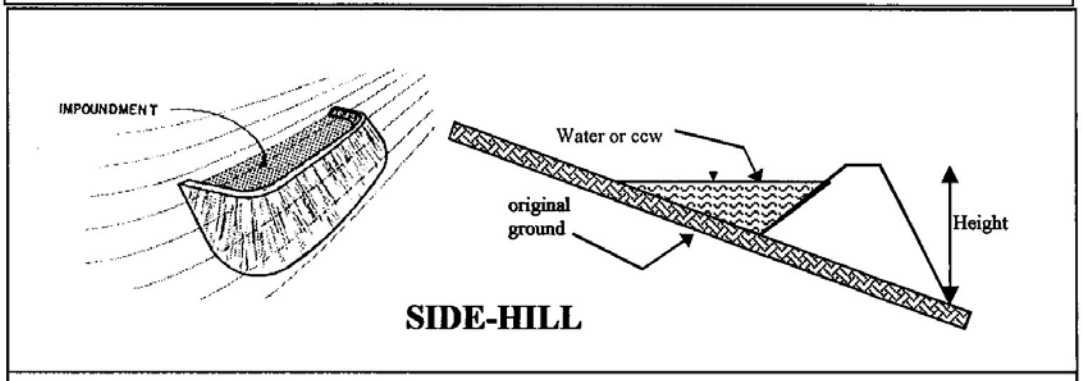
_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

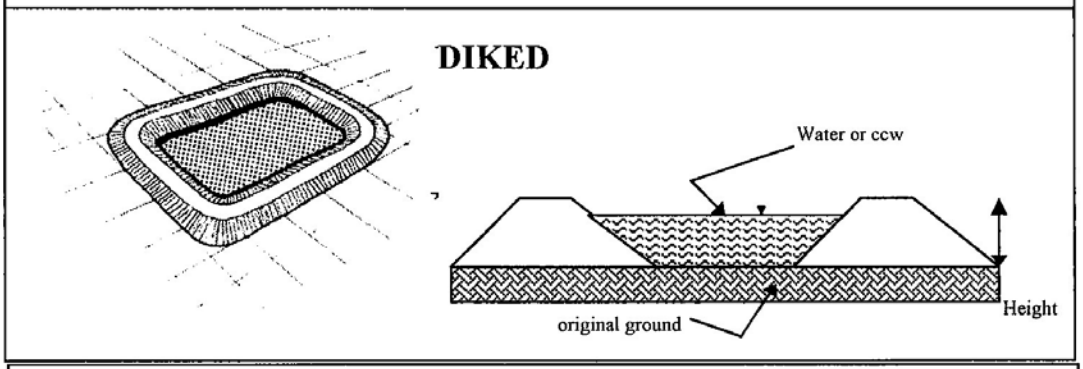
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

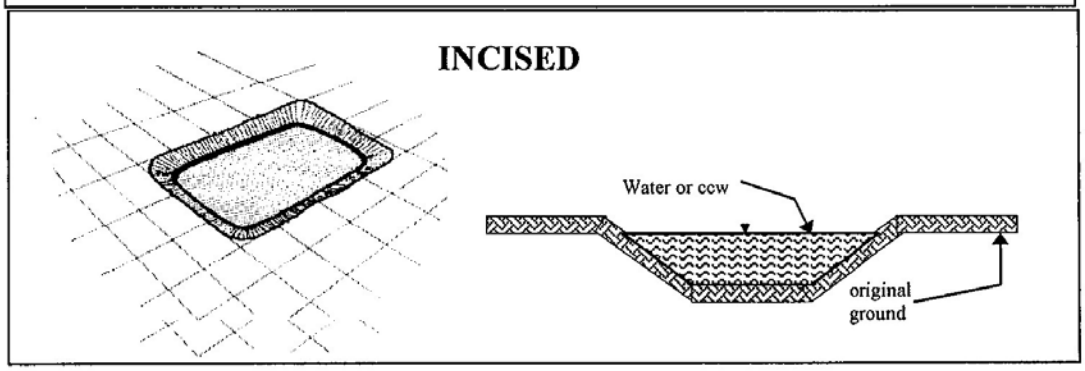
If the dam were to fail, the potential for environmental damage is significant as it is immediately adjacent to the Elizabeth River which flows to the Chesapeake Bay.

CONFIGURATION:









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

Embankment Height: 17 feet Embankment Material: Clay/earth fill
Pool Area: 9.7 acres Liner None
Current Freeboard : 4-12 feet Liner Permeability _____

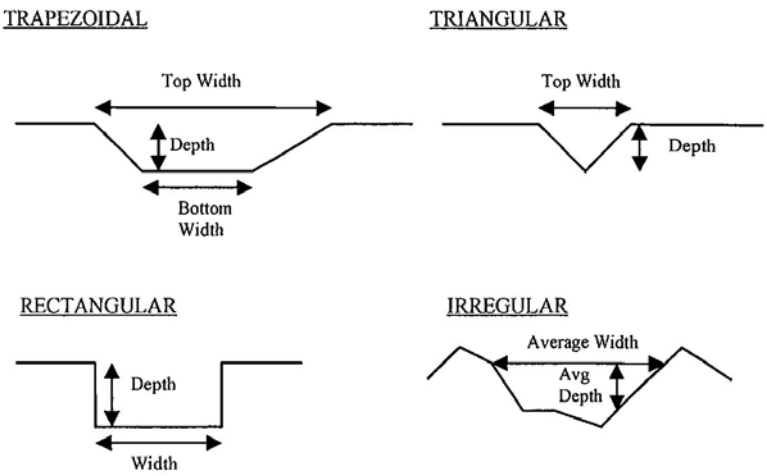
TYPE OF OUTLET (Mark all that apply)

The primary service outlet is a wooden structure decant tower located on the South West side of the reservoir. Water discharges through a 20-inch HDPE pipe which appears to be installed within the previous corrugated metal pipe for this facility. The pipe outfall is below the water level so it was not possible to inspect the water quality leaving the pipe.

Crest of weir: 12.0 feet
Top of dam: 20.0 feet

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

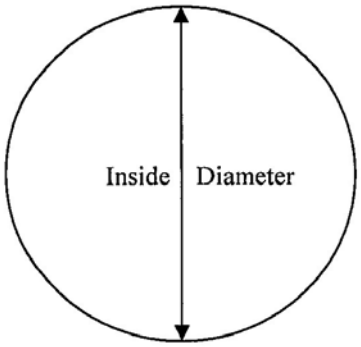
__ __ depth
__ __ bottom (or avg) width
__ __ top width



_____ **Outlet**

The outlet pipe is a 20-inch HDPE pipe.

Material
_____ corrugated metal
_____ welded steel
___ __ concrete
__X__ 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: GNI Consultants, 1984

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:

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 were installed during a subsurface investigation program performed in 2009. No readings have been taken subsequent to the piezometer installation.

APPENDIX B

Photographs

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Chesapeake Energy Center	Location: Chesapeake, Virginia

Orientation: South

Description: Outboard slope and toe of Western embankment

Date: May 11, 2010

Photo Number: 1

Photographer: NJA

Orientation: North

Description: Outboard slope and crest of Western embankment

Note vegetation remaining north of impoundment

Date: May 11, 2010

Photo Number: 2

Photographer: NJA

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Chesapeake Energy Center	Location: Chesapeake, Virginia

Orientation: East

Description: Erosion and/or localized shallow slope failure of western embankment.

Note animal burrow.

Date: May 11, 2010

Photo Number: 3

Photographer: NJA

Orientation: Northwest

Description: Outboard slope and crest of southern embankment

Date: May 11, 2010

Photo Number: 4

Photographer: NJA

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Chesapeake Energy Center	Location: Chesapeake, Virginia

Orientation: East

Description: Outboard slope and crest of southern embankment

Date: May 11, 2010

Photo Number: 5

Photographer: NJA

Orientation: North

Description: Minor erosion on outboard slope of southern embankment

Date: May 11, 2010

Photo Number: 6

Photographer: NJA

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Chesapeake Energy Center	Location: Chesapeake, Virginia

Orientation: West

Description: Outboard slope of southern embankment

Note slope of upper portion of embankment

Date: May 11, 2010

Photo Number: 7

Photographer: NJA

Orientation: Southwest

Description: Outboard slope and toe of eastern embankment

Note erosion or localized slope failure of toe

Date: May 11, 2010

Photo Number: 8

Photographer: NJA

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Chesapeake Energy Center	Location: Chesapeake, Virginia

Orientation: North

Description: Outboard slope and toe of eastern embankment

Note riprap erosion protection of toe

Date: May 11, 2010

Photo Number: 9

Photographer: NJA

Orientation: West

Description: Inboard slope of southern embankment and outlet structure

Date: May 11, 2010

Photo Number: 10

Photographer: NJA

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Chesapeake Energy Center	Location: Chesapeake, Virginia

Orientation: Down

Description: Debris baffle for outlet structure

Date: May 11, 2010

Photo Number: 11

Photographer: NJA

Orientation: West

Description: Discharge end of 20-inch HDPE outlet pipe through southern embankment into Deep Creek

Note submerged downstream end of pipe

Date: May 11, 2010

Photo Number: 12

Photographer: NJA

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Chesapeake Energy Center	Location: Chesapeake, Virginia

Orientation: Northeast

Description: Influent pipe

Date: May 11, 2010

Photo Number: 13

Photographer: NJA

Orientation: East

Description: Interior of Bottom Ash and Sedimentation Pond. Photo taken from western embankment

Date: May 11, 2010

Photo Number: 14

Photographer: NJA

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Chesapeake Energy Center	Location: Chesapeake, Virginia

Orientation: North

Description: Interior of Bottom Ash and Sedimentation Pond. Photo depicts CCW dividing dike that has been breached for reconstruction

Date: May 11, 2010

Photo Number: 15

Photographer: NJA

Orientation: Northeast

Description: Decant pipe from easternmost portion of the impoundment into western portion

Date: May 11, 2010

Photo Number: 16

Photographer: NJA

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Chesapeake Energy Center	Location: Chesapeake, Virginia

Orientation: North	
Description: Interior of Oily Waste Pond	
Date: May 11, 2010	
Photo Number: 17	
Photographer: NJA	
Orientation:	
Description:	
Date:	
Photo Number:	
Photographer:	