REPORT

Dam Safety Assessment of CCW Impoundments

Bremo Power Station

United States Environmental Protection Agency
Washington, DC

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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.

The U. S. EPA has authorized O'Brien & Gere to provide site specific impoundment assessments at selected facilities. This project is being conducted in accordance with the terms of BPA # EP10W000673, Order No. EP10W001240, 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 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 all environmental permits issued for the management units
- Identify all 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 West Ash Pond and the North Ash Pond management units at the Bremo Power Station in Bremo Bluff, Virginia. The Bremo Power Station Ash Pond impoundments are owned by Dominion Virginia Power (Virginia Electric & Power Company), a subsidiary of Dominion Resources, Inc., and operated through their operating segment, Dominion Generation. In the course of this assessment, we obtained information from representatives of Dominion Generation and Dominion Resources Services, Inc..

2. PROJECT/FACILITY DESCRIPTION

Dominion Virginia Power's Bremo Power Station is their oldest coal-fired power station in Virginia, generating more than 240 megawatts. The facility is located in Bremo Bluff, on the James River in Fluvanna County, Virginia as shown in Figure 1 – Site Location Map. Originally commissioned in 1931, the station utilizes two coal-fired generating units, Units 3 and Unit 4 that went into service in 1950 and 1958, respectively. Unit 3 has a capacity of 80 megawatts; Unit 4 has a capacity of 170 megawatts.

The facility utilizes two impoundments known as the West Ash Pond and the North Ash Pond for storage and disposal of water-borne CCW. The West Ash Pond is the primary disposal impoundment for the sluiced CCW discharge. Accumulated ash is periodically dredged and pumped to the North Ash Pond for final storage. This dam safety assessment report summarizes the April 2010 inspection of these impoundments at the Bremo Power Station.

2.1. MANAGEMENT UNIT IDENTIFICATION

The locations of the two CCW impoundments inspected during this dam safety assessment are identified on Figure 2.

2.1.1. West Ash Pond

The West Ash Pond is located on the northwest side of the power plant. The CCW impoundment has two sub-impoundments separated by a common dike; the West Ash Pond to the east and the Metals Pond to the west. The ash pond area is bounded by the Chesapeake and Ohio Railroad embankment and the James River to the south, Holman Creek to the east, Bremo Road (Route 656) to the north and a wooded area to the west. The West Ash Pond is not currently regulated as a dam by the Virginia dam safety agency. The West Ash Pond was reportedly constructed in 1978 and 1979; no information is available for the expansion of this CCW impoundment through construction of the Metals Pond. CCW materials contained in the West Ash Pond include fly ash, bottom ash, boiler slag, coal mill rejects (pyrites), boiler blowdown, and water/ coal fines/coal pile runoff from the Storm Water Pump Station. CCW is sluiced to the West Ash Pond at multiple discharge points on the west side of the pond. The Metals Pond is reportedly dedicated to the treatment of wastewaters generated during the chemical cleaning of station boilers and associated equipment. CCW piping is valved such that it could be discharged to the Metals Pond although no CCW materials were observed in the Metals Pond. Water flows across the pond to the concrete decanting structure located on the eastern side of the pond, and ultimately into the outfall for discharge into the James River. The discharge is permitted under VPDES number 0004138 as Outfall 002.

2.1.2. North Ash Pond

The North Ash Pond is located to the east of the power station. The North Ash Pond was commissioned in 1983 and stores CCW and other materials. The CCW stored in the West Ash Pond is periodically dredged and hydraulically transferred for final storage in the North Ash Pond. Dredge spoils are discharged on the north side of the impoundment through temporary piping. Water flows across the pond to the concrete decanting structure located on the southern side of the pond. Water from the decanting structure discharges into an outfall pipe which discharges into a stilling basin/ overflow structure before discharging to a weir box and into the second outfall for discharge into the James River. The discharge is permitted under VPDES number 0004138 as Outfall 004. The North Ash Pond is regulated by the Virginia Department of Conservation & Recreation (DCR) – Division of Dam Safety in accordance with the Virginia Impounding Structures Regulations. The dam has a DCR inventory number of 06520.

2.2. HAZARD POTENTIAL CLASSIFICATION

The Commonwealth of Virginia classifies dams or impounding structures in accordance the Virginia Dam Safety Act, Article 2, Chapter 6, Title 10.1 (10.1-604 et seq) of the Code of Virginia and Dam Safety Impounding Structures Regulations (Dam Safety Regulations), established and published by the Virginia Soil and Water Conservation Board (VSWCB). The regulations are administrated by the Virginia Department of Conservation & Recreation (DCR) - Division of Dam Safety. The Impounding Structure Regulations define a dam as any impounding structure that is 25 feet in height, measured from the outboard toe to the crest of the dam, and has a minimum impounding capacity of 15 acre-feet or more at the top of the structure; and, any impounding structure that has a height of six feet or greater and has an impounding capacity of 50 acre-feet or greater.

Dams or impounding structures regulated by the Commonwealth of Virginia are rated according to dam hazard potential classifications as established by the Impounding Structure Regulations. Three hazard potential classifications are defined below:

- *High* - dams that upon failure would cause probable loss of life or serious economic damage
- *Significant* - dams that upon failure might cause loss of life or appreciable economic damage
- *Low* - dams that upon failure would lead to no expected loss of life or significant economic damage. Special criteria: This classification includes dams that upon failure would cause damage only to property of the dam owner.

The Chesapeake & Ohio Railroad along the James River appears to be the only critical infrastructure downstream of either the West or North Ash Ponds, other than Bremo Generation facilities until the Town of Columbia, which is approximately 9 to 10 miles downstream. Failure of either pond could result in the lease of CCW to the James River.

2.2.1. West Ash Pond

The West Ash Pond is not currently officially regulated by DCR, and no state hazard potential classification has been assigned to this unit at this time. 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 checklist found in Appendix A. Based on the checklist definitions and as a result of this assessment, the hazard potential classification recommended for the West Ash Pond is **SIGNIFICANT.** This classification is recommended due to the potential economic loss since the Bremo Power Station would cease operations and potential environmental impacts to the James River in the event of a dam breach. Loss of human life is not likely.

2.2.2. North Ash Pond

The North Ash Pond is currently classified as a regulated impoundment by the DCR and DCR has assigned the North Ash Pond a *Significant* hazard potential classification due to the potential for economic damage to the railroad along the James River downstream of the dam. Dominion applied for re-certification of the North Ash Pond as a *Low* hazard potential classification, based on breach inundation mapping completed in February 2009; however, DCR has recently determined since the site assessment that it will remain classified as a *Significant* hazard dam based on information provided by Dominion.

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 checklist found in Appendix A. Based on the checklist definitions and as a result of this assessment, the hazard potential classification recommended for the North Ash Pond is **SIGNIFICANT.** This classification is recommended due to the potential temporary economic loss and disruption of Chesapeake & Ohio Railroad operations and potential environmental impacts to the James River in the event of a dam breach. Loss of human life is not likely.

2.3. IMPOUNDING STRUCTURE DETAILS

The following sections summarize the structural components and basic operations of the West Ash Pond and the North Ash Pond. The location of these impoundments at the facility is shown on Figure 2. A site plan of the West Ash Pond and the North Ash Pond and their relevant features are provided as Figure 3 and Figure 4, respectively, with photograph locations/ directions noted. It should be noted that the site plans shown in Figures 2, 3 and 4 are adapted from the available aerial imagery as noted and may not depict all current features or conditions. Additionally, photos taken during the visual inspection are incorporated in a Photographic Log provided as Appendices B and C for the West Ash Pond and North Ash Pond, respectively.

2.3.1. Embankment Configuration

West Ash Pond

The West Ash Pond is a diked earthen embankment structure that impounds an area of approximately 17 acres and has a capacity of approximately 290 acre-feet. It was reported in January 2009 that the estimated solids volume was 252 acre-feet. No information is available regarding the capacity, design or construction of the Metals Pond portion of the impoundment, which is also a diked earthen embankment structure. Available drawings for the West Ash Pond are limited to the 1976 Preliminary drawings (3 sheets) entitled "Layout – Waste Treatment & Settling Pond" prepared by Virginia Power & Electric Company and R.L. Downing Surveyor, Inc.. The crest is at approximately elevation (EL) 112.0 (This elevation appears to be a plant datum; other facilities adjacent to the river have a VEPCO plant datum of 100.0 equal to USGS El. 222.44 MSL). The east dike is the highest at approximately 20 feet above the outboard toe of slope. The drawings indicate the west dike to have outboard slopes of 2 horizontal to 1 vertical (2H:1V). Crest widths appear to be between 12 to 14 feet. Preliminary drawings show a 12 inch high drainage blanket extending 16 feet into the embankment from the toe of the slope. Drainage ditches were constructed at or beyond the outboard toe of the slope on the southern, western, and northern embankments and drain to Holman Creek. Available geotechnical data indicates the embankment fill materials to consist of lean clay, fat clay, and elastic silt, generally stiff to very stiff. The subsurface materials below the embankment consist of lean clay, fat clay, silty clay and elastic silt, generally soft to very stiff.

North Ash Pond

The North Ash Pond is a cross-valley zoned earthfill dam embankment structure. The structure impounds an area of approximately 96 acres and has a capacity of approximately 4,300 acre-feet. It was reported that in January 2009 that the estimated solids volume was 2,169 acre-feet. The crest of dam is at EL 212.0, and the pond bottom as designed was at EL 116 feet above mean sea level. Materials for Zone I (embankment), Zone II (the core) and Zone III (the cutoff trench) were obtained from borrow areas within the proposed pool area of the dam. The North Ash Pond was not designed with a liner. The dam has a maximum height of approximately 96 feet. Based on the design drawings prepared by J. K. Timmons & Associates, Inc., dated May 21, 1982 (Phase I) and November 1, 1982 (Phase II), the dam was completed in two phases to best utilize available construction time. Based on the Schnabel Engineering Associates Engineering Design Summary Report dated September 1, 1982, Phase I consisted of excavation of ash within the dam area and construction of the principal spillway drainage blanket, the principal spillway (outfall pipe) and the dam foundation to EL 120.0. Phase II consisted of construction of the embankment, outlet works, and completion of the cutoff trench, riser, drainage blanket and principal spillway extension (outfall pipe extension).

The inboard slopes were designed at 2.5H:1V and the outboard slopes were designed at 2.5H:1V. The inboard slope has 10 foot wave berms at EL 140, EL 170 and EL 206.0, the design maximum impoundment water surface elevation. The outboard slope has a toe berm, 40 feet wide, at EL 150. . Drawings show a 24 inch high drainage blanket extending 140 feet into the embankment from 10 feet inside the toe of the slope. Toe drains consisting of 6-inch diameter slotted pipe were installed along the perimeter of the drainage blanket and discharge through two headwalls into the diversion ditch. This diversion ditch conveys toe drainage and storm water runoff from the toe of the dam back to the secondary coal pile run-off pond and to the storm water treatment pond at the power station.

The emergency spillway, located to the north of the dam, is a 200 foot long depressed embankment/roadway area at EL 209.5. This spillway discharges to the west and then south through a wooded area. In the event of pond overflow through the emergency spillway, flows from this spillway appear to be captured by the diversion ditch to the west of the dam. We understand from operator interviews at the site that the emergency spillway has never discharged flow since the North Ash Pond dam was commissioned.

Piezometers and observation wells were installed in the dam embankment as part of the original construction and records indicate that they have been periodically monitored since 1989.

2.3.2. Type of Materials Impounded

West Ash Pond

CCW materials contained in the West Ash Pond include fly ash, bottom ash, boiler slag, coal mill rejects (pyrites), boiler blowdown, and water/ coal fines/coal pile runoff from the Storm Water Pump Station. CCW is sluiced to the West Ash Pond at multiple discharge points on the west side of the pond. The Metals Pond is reportedly dedicated to the treatment of wastewaters generated during the chemical cleaning of station boilers and associated equipment. CCW piping is valved such that it could be discharged to the Metals Pond although no CCW materials were observed in the Metals Pond.

North Ash Pond

The North Ash Pond stores CCW and other materials consisting of fly ash, bottom ash, boiler slag, coal mill rejects, coal fines from general dredge spoil materials from the West Ash Pond and sand/silt/sediment from dredging the James River within and adjacent to the cooling water intake structures. The CCW stored in the West Ash Pond was periodically dredged and hydraulically transferred for final storage in the North Ash Pond. Dredge spoils are discharged on the north side of the impoundment through temporary piping.

2.3.3. Outlet Works

West Ash Pond

The West Ash Pond outlet structure, located at the eastern perimeter of the impoundment, consists of a concrete box decant tower equipped with concrete stop logs to govern the water level in the pond (See Appendix B - Photo B1). The top of the tower operating floor is EL 112; the concrete box invert is EL 85.5. The tower is accessed via a steel bridge with concrete decking. Stop logs can be inserted or removed with a permanently installed block-and tackle system. A floating baffle serves to exclude floating debris and cenospheres from the discharge. The effluent discharges into a 36-inch concrete pipe that extends below grade toward the south under the Chesapeake & Ohio Railroad to Outfall 002 to the James River. The discharge is permitted under VPDES number 0004138 as Outfall 002.

North Ash Pond

The North Ash Pond outlet structure, located on the inboard slope of the impoundment, consists of a cast-in-place concrete decant tower equipped with concrete stop planks to govern the water level in the pond (See Appendix C - Photo C3). The top of the tower operating floor is EL 214.14; the tower invert is EL 114.0. The tower is accessed via a steel bridge with aluminum grating. Stop planks can be inserted or removed with a permanently installed electric hoist system to create discharge elevations between EL 170.00 and EL 214.00. A low level outlet (3 feet wide by 4 feet high) is closed with stop planks that can be removed with the electric hoist. The cable hanger for removal of these stop planks is at EL 155.00 and is intended to be accessed via boat when impoundment levels are approximately EL 155. A floating baffle serves to exclude floating debris and cenospheres from the discharge. The decant discharges into a 24-inch reinforced concrete pipe (principal spillway) that extends through the dam embankment emerging beyond the outboard toe. The outfall pipe changes to steel pipe, crossing the diversion ditch on pile supports to a stilling basin approximately 450 feet south of the toe. At the stilling basin, the discharge impacts an energy dissipating plate downwards into a grouted rip-rap lined stilling basin. At the center of the stilling basin is a 10 foot by 10 foot overflow with wooden baffles. Decant passing over the baffles drops into a 48 inch concrete outlet pipe to a cast-in-place weir box monitoring station. Discharge from monitoring station passes over a V-notch weir into a 48 inch concrete outfall pipe toward the south under the Chesapeake & Ohio Railroad to Outfall 004 to the James River. The discharge is permitted under VPDES number 0004138 as Outfall 004.

3. RECORDS REVIEW

A review of the available records related to design, construction, operation and inspection of the West and North Ash Ponds was performed as part of this assessment. Documents provided by representatives of Dominion Virginia Power are listed below:

Table 3.1 *Summary of West Ash Pond Documents Reviewed*

Document	Dates	By	Description
Preliminary Drawings Layout- Waste Treatment & Settling Pond	Survey 1976	Virginia Electric & Power Co./RL Downing Surveyor, Inc.	Embankment Plans and Sections
Annual Inspection Report	January 2009	Dominion	Prepared for Dominion use only as unregulated structure
Geotechnical Engineering Study, Stability Evaluation of the West Ash Pond	2009	Schnabel Engineering, LLC	Report on subsurface conditions and stability of dikes at 4 locations

Table 3.2 *Summary of North Ash Pond Documents Reviewed*

Document	Dates	By	Description
Design Drawings – Phase I	May 1982	J.K. Timmons & Associates, Inc.	Dam construction drawings/ plans for Drainage Blanket, Dam Foundation and Principal Spillway (outlet pipe)
Engineering Design Summary Report	September 1982	Schnabel Engineering Associates, P.C.	Geotechnical, and Hydrologic-Hydraulic Design of North Ash Pond Dam, NPDES Design Requirements
Design Drawings – Phase II	November 1982	J.K. Timmons & Associates, Inc.	Dam construction drawings/ plans for Dam Embankment, Outlet Works, Drainage Blanket and Principal Spillway Extension (outlet pipe)
"As-Built" Topography – Ash Disposal Site	October 1983	Photo Science, Inc.	
Operating Plan and Schedule Maintenance Plan and Schedule Inspection Schedule Emergency Action Plan Schedule	February 2009	Dominion	Required by Virginia DCR – Division of Dam Safety as part of the Operation and Maintenance Certificate Application
Operation and Maintenance Certificate Application for Virginia Regulated Impounding Structures (Renewal)	February 2009	Dominion	Required by Virginia DCR – Division of Dam Safety to operate a regulated dam
Emergency Preparedness Plan for Low Hazard Virginia Regulated Impounding Structures	February 2009	Dominion	Procedures for detection, evaluation and classification of emergency situations relevant to impoundment and appropriate actions
Downstream Hazard Analysis in Support of O&M Certificate Renewal	December 2008	Golder Associates	Inundation levels expected downstream for various breach and non-breach events.
Piezometer / Observation Well Data	1989 to 2009	Dominion	Figures showing estimated phreatic surface from piezometer readings
Geotechnical Report—Seismic Stability of Upper Ash Pond Dam	July 26, 2010	Schnabel Engineering, LLC	Seismic stability analysis of the downstream embankment slope

3.1. Engineering Documents

Review of the design drawings and geotechnical investigation reports revealed information on the impoundment design, construction, and construction chronology, which are summarized below.

West Ash Pond

- No design drawings or information regarding the design and construction of the West Ash Pond or the expansion of this CCW impoundment through construction of the Metals Pond was available. The construction of the impoundment generally matches the layout drawings by Virginia Electric & Power Co./RL Downing Surveyor, Inc. from 1976. (Elevations appear to be based on a plant datum; other facilities adjacent to the river have a VEPCO plant datum of 100.0 equal to USGS El. 222.44 MSL).
- The Geotechnical Engineering Study for the Stability Evaluation of the West Ash Pond by Schnabel reported the construction chronology for this facility, possibly provided by Dominion personnel. The geologic stratigraphy at this site consists of embankment fill underlain by recent alluvial deposits of the James River underlain by residual soils derived from weathering of the underlying schist rock. Geotechnical data indicates the embankment fill materials to consist of lean clay, fat clay, and elastic silt, generally stiff to very stiff. The subsurface materials below the embankment consist of lean clay, fat clay, silty clay and elastic silt, generally soft to very stiff. The Schnabel engineering analyses evaluated four sections through the existing embankment and foundation materials. The sections were located on the four perimeter dikes; the stability of the interior dike between the West Ash Pond and the Metals Pond was not evaluated. These analyses included modeling of phreatic surfaces and seismic acceleration. The results of the analyses indicate that factors of safety for the eastern, northern, western and southern embankments exceed USACE recommended minimum factors of safety for embankment slope stability for load cases at normal pool and steady state seepage and varying stress conditions and seismic loading.
- No indication or mention of ash, coal slimes, or other CCW by-products within the dikes or dike foundations was noted in our review of the engineering records listed above.
- No indication of former spills or releases of impounded materials from the West Ash Pond was noted in the records reviewed.
- Review of FEMA Flood Insurance Rate Map No. 51065C0260C for Fluvanna County indicates the 100-year flood is approximately El. 231 above MSL at the West Ash Pond. The West Ash Pond, which has a crest elevation of approximately El. 234, assuming correction for plant datum, would be subject to flood conditions and flood loadings. Overtopping does not appear to occur based on the correction from plant datum.

North Ash Pond

The North Ash Pond is an engineered cross-valley zoned earthfill dam embankment structure with complete engineering drawings supported by an Engineering Design Summary Report outlining the geotechnical and hydrologic design supported by analyses. Schnabel Engineering Associates provided the geotechnical design and specifications; J.K. Timmons and Associates provided the hydrologic-hydraulic design and the contract drawings. Specifications supporting the contract documents were not available. Note that a different datum was used for the design of this embankment structure; all elevations on the drawings need to be adjusted by +128 feet. The following information was obtained from these documents.

- The North Ash Pond is a cross-valley zoned earthfill dam embankment structure that has a storage capacity of 316 acre-feet at EL 206.

- The hydrologic-hydraulic design of the dam was based on the Probable Maximum Flood (PMF). The dam was designed to store the entire PMF with an increase in water level of only 3.5 feet above normal pool, allowing a 2.5 foot freeboard prior to overtopping. The contributory drainage to the impoundment is 103 acres.
- The emergency spillway was designed only to be used if the outlet structure fails or a large storm occurs prior to decanting excess make-up water following the final ash discharge into the pond.
- The emergency spillway is 200 foot long depressed embankment/roadway area at EL 209.5. This spillway discharges to the west and then south through a wooded area. Flows from this spillway appear to be captured by the diversion ditch to the west of the dam.
- Five piezometers or observation wells were installed in the dam embankment as part of the original construction and records indicate that they have been periodically monitored since 1989. The piezometers and wells are installed in the upstream slope on the wave berm at EL 206.0, the dam crest, and on the toe berm. The figures showing the phreatic surface through the embankment show that the drainage blanket is functioning as intended.
- The downstream hazard analysis prepared by Golder Associates evaluated four scenarios: "sunny day" breach; a structure breach during the Spillway Design Flood (SDF); a baseline outflow model of the SDF with no structure breach; and a structure breach during the Probable Maximum Flood (PMF). The downstream flood models for three failure scenarios yielded very similar high water elevations at the railroad embankment, ranging from 1.3 to 1.8 feet, since the embankment acts as a very long overflow weir. The duration of this flow over the embankment is predicted to range between 40 and 65 minutes. The non-breach scenario did not impact the railroad embankment since the emergency spillway discharges to the storm water pond at the power station. The hazard classification of LOW as defined in the Virginia Impounding Structure Regulations was recommended; however, DCR has recently determined since the site assessment that the dam will remain classified as a SIGNIFICANT hazard dam based on information supplied by Dominion since the site assessment. No indication or mention of ash, coal slimes, or other CCW by-products within the dikes or dike foundations was noted in our review of the engineering records listed above.
- No indication of former spills or releases of impounded materials from the Ash Pond was noted in the records reviewed.
- Review of FEMA Flood Insurance Rate Map No. 51065C0260C for Fluvanna County indicates the 100-year flood has an elevation of approximately El. 229 above MSL at the North Ash Pond. The toe of the Pond is at approximately El. 228; therefore, overtopping will not occur and no impacts of flood loading on the Pond embankment are anticipated from the 100-year flood.

3.1.1. Stormwater Inflows

West Ash Pond

Direct stormwater inflows to the West Ash Pond are minimal. The impounding structure is comprised of diked embankments which direct stormwater away from the impoundment and limit runoff to that precipitation which falls directly on the water surface and crest of the embankments. Stormwater collected from other areas of the power station are pumped to the West Ash Pond by the Storm Water Pump Station.

North Ash Pond

Stormwater that falls within the 103 acre drainage area drains to the dam pool and discharges through the outlet structure.

3.1.2. Stability Analyses

West Ash Pond

The Geotechnical Engineering Study for the Stability Evaluation of the West Ash Pond by Schnabel was completed in 2009. The geologic stratigraphy at this site consists of embankment fill underlain by recent alluvial deposits of the James River underlain by residual soils derived from weathering of the underlying schist rock. Geotechnical data indicates the embankment fill materials to consist of lean clay, fat clay, and elastic silt, generally stiff to very stiff. The subsurface materials below the embankment consist of lean clay, fat clay, silty clay and elastic silt, generally soft to very stiff. The Schnabel engineering analyses evaluated four sections through the existing embankment and foundation materials. The sections were located on the four perimeter dikes; the stability of the interior dike between the West Ash Pond and the Metals Pond was not evaluated. These analyses included modeling of phreatic surfaces and seismic acceleration. The results of the analyses indicate that factors of safety for the eastern, northern, western and southern embankments exceed USACE recommended minimum factors of safety for embankment slope stability for load cases at normal pool and steady state seepage and varying stress conditions and seismic loading.

North Ash Pond

Slope stability analyses of the dam embankment were performed by Schnabel during design in 1982 and summarized in the Engineering Design Summary Report. Various conditions encountered during construction, partial drawdown and steady state conditions dictated that the upstream and downstream slopes should be designed no steeper than 2.5H:1V and that a 40 foot toe berm would be required for the downstream embankment. Based on the design report, calculated factors of safety for all load cases met or exceeded USACE guidelines for the final design slope configurations. Based on the piezometer data recorded since construction of the dam, the phreatic surface has been maintained below the levels predicted by the design seepage analysis and incorporated into the design slope stability analysis for the steady state seepage load case. The stability analysis methods appear to have been performed in general accordance with USACE Slope Stability Analysis Engineer Manual EM 1110-2-1902. Seismic stability was not checked during the original dam design development.

Dominion Virginia Power retained Schnabel Engineering to evaluate the slope stability of the North Ash Pond dam during a seismic event since the site assessment. The results of the seismic analysis are presented in Schnabel's Geotechnical Report—Seismic Stability of Upper Ash Pond Dam, dated July 26, 2010. Schnabel evaluated the seismic stability using common methods and criteria that were standard to the industry in 1982 at the time of design and construction. In addition, they completed the seismic analysis using current methods and updated seismic coefficients. The section analyzed for seismic stability was the same section analyzed for the other load cases during the 1980's design phase, with some minor adjustment of soil profile based on construction observations. Soil strength parameters used in the analyses were estimated from existing laboratory test data. Undrained shear strength of compacted clays forming the embankment were estimated from "pocket penetrometer" values obtained on samples collected from the West Ash Pond dikes during a recent geotechnical investigation (2009), assuming that the compacted clays in the North Ash Pond would have similar strength properties. The phreatic surface was estimated using SEEP/W and available permeability data from the original design. The results of both methods indicated computed factors of safety greater than 1.0, the recommended minimum for the seismic load case

3.1.3. Modifications from Original Construction

West Ash Pond

No design drawings or information regarding the design and construction of the West Ash Pond or the expansion of this CCW impoundment through construction of the Metals Pond were available. The construction of the West Ash Pond impoundment generally matches the layout drawings by Virginia Electric & Power Co./RL Downing Surveyor, Inc. from 1976. The Metals Pond does not appear on the drawings but it is inconclusive as to when the Metals Pond expansion was constructed.

North Ash Pond

Based on the inspection, operator interviews, and review of engineering records, it does not appear that the dam has been modified since it was constructed.

3.1.4. Instrumentation

The only instrumentation currently in use is at the North Ash Pond in the form of the observation wells and piezometers installed during construction, which are periodically monitored. Review of the recorded water levels within these wells and piezometers indicated that the phreatic surface within the embankment due to seepage of impounded water is generally consistent and indicates that the drainage blanket is functioning as designed. There is a V-notch weir in the outfall system from the impoundment and is used for monitoring of decant water flows.

3.2. PREVIOUS INSPECTIONS

A Dominion professional engineer has been performing regular formal dam safety inspections of the North Ash Pond as a regulated impoundment.. A summary of deficiencies cited in the recent state inspection reports is provided below:

Date of State Inspection	Findings (deficiencies)
September 2004	Emergency Spillway -tree growth downstream; minor erosion downstream slope left abutment; cracks in stilling basin grouted rip-rap; corrosion on tower bridge handrail
November 2005	Corrosion on tower bridge handrail and grating supports; OW W-1 not functional-level probe could not be extended; water backing up from diversion ditch into west toe drain pipes; toe drain outlet channels overgrown with vegetation; considerable amount of silt/sediment in stilling basin
October 2006	Emergency Spillway-tree growth downstream; minor erosion downstream slope from mower; cracks in stilling basin grouted rip-rap; vegetation in stilling basin; wells/piezometers fixed; water backing up from diversion ditch into toe drain pipes due to beaver dam; standing water on toe berm;
October 2007	Erosion gullies in upstream slope; some tree/brush growth at abutment contacts/ groin ditches; minor erosion downstream slope from mower; cracks in stilling basin grouted rip-rap; standing water on toe berm;
October 2008	Minor erosion downstream slope from mower; encroachment of trees in groin ditches on downstream slope; vegetation in stilling basin;
October 2009	Minor erosion downstream slope from mower; encroachment tree growth in groin ditches being reduced with mowing; standing water on toe berm; OW W-3 needs repair; drainage ditch improvements addressed inundation of toe drains

In January 2009, a Dominion professional engineer performed a dam safety inspection of the West Ash Pond, which is a non-regulated impoundment. Findings (deficiencies) noted included standing water in drainage ditches along north and west embankments at toe of slope; a rodent burrow in northwest corner near toe.

Based on our review of the Dominion inspection reports, none of the reports identified any serious dam safety issues. If previous deficiencies are not mentioned in subsequent inspection reports, then it is inferred that the prior deficiency had been resolved.

3.3. OPERATOR INTERVIEWS

Numerous plant and corporate personnel took part in the inspection proceedings. The following is a list of participants from the inspection of the Bremo Power Station Ash Ponds:

Table 4 *List of Participants*

Name	Affiliation	Title
Jean Tribull	Dominion Generation - Bremo	Environmental Compliance Coordinator
Mindy Wayland	Dominion Generation - Bremo	Environmental Compliance
Greg Searcy	Dominion Generation – Bremo – Operations	Manager F&H O&M
John Matthews	Dominion Generation - Bremo	Supervisor, F&H Technical Support
John Cima, PE	Dominion Resources Services, Inc.	Consulting Engineer, Geotechnical
Mike Isper	Dominion Resources Services, Inc.	Environmental Specialist III
Dreher Whetstone, PE	O'Brien & Gere	Technical Associate
Dana Pizarro, PE	O'Brien & Gere	Vice President

Facility personnel provided a good working knowledge of the West and North Ash Ponds and general plant operations and provided requested historical documentation. Some personnel also accompanied O'Brien & Gere throughout the visual inspections to answer questions and provide additional information as needed in the field. Additional information not available at the meeting was provided on May 18, 2010 by Dominion representatives.

4. VISUAL INSPECTION

4.1. WEST ASH POND

The following sections summarize the inspection of the West Ash Pond which occurred on April 29, 2010. At the time of the inspection, O'Brien & Gere completed an EPA inspection checklist which was submitted electronically to EPA May 11, 2010. A copy of the completed inspection checklist is included in Appendix A.

4.1.1. General

The weather on the dates of the inspection was clear and approximately 55 degrees. The visual inspection consisted of a thorough site walk by the group along the embankment crests and toe of the outboard slope of the West Ash Pond and the Metals Pond. The inboard slopes of the West Ash Pond embankments could not be observed since at normal pool; the inboard slope of the Metals Pond was observed by the group since the water level was relatively low. O'Brien & Gere team members made observations at the toe and crest of the embankments at specific locations on the embankment slopes. We also observed inlet/outlet structures and current operation.

Photos of relevant features and conditions observed during the inspection were taken by O'Brien & Gere and are provided in Appendix B. An aerial photograph of the Ash Pond is presented as Figure 3, which provides photograph locations and directions. This aerial photograph obtained from the Commonwealth of Virginia was taken in 2002.

4.1.2. Summary of Findings

During the visual site inspection of the West Ash Pond, representative features were observed. The following observations were made during the inspection:

- Sluiced CCW by-product discharge is conveyed on aboveground piping that is routed up the downstream slope of the embankment in the southeast corner of the West Ash Pond and along the embankment crest to the dividing dike between the West Ash Pond and the Metals Pond (Photos B2, B3, B4, B5 and B12). The CCW discharge is discharged via multiple valved discharge points into the west side of the West Ash Pond (Photo B4). The CCW piping could be valved to discharge to the Metals Pond (Photo B3) although no CCW materials were observed in the Metals Pond (Photos B5, B6).
- The CCW in the West Ash Pond has accumulated above the normal pool level over less than 5 percent of the pond area (Photo B9). This pond is periodically dredged and hydraulically transferred to the North Ash Pond. Significant vegetation exists in the Metals Pond, limiting inspection of the lower sections of the inboard slopes.
- Two hydraulic interconnections exist between the West Ash Pond and the Metals Pond. The first is a corrugated metal pipe through the dividing dike (Photo B8). No water was observed flowing into the Metals Pond. The pipe on the West Ash Pond side of the dike could not be located. The second interconnection is the Metal Pond pump (acid waste pump) system, which can pump from the Metal Pond into the West Ash Pond. This system was not operating during the inspection. It appears that operation is activated at the local control panel and used intermittently after receipt of wastewaters from chemical cleaning of station boilers and associated equipment.
- The crest and gravel crest road appeared to be in good condition with no cracks or settlement; the exposed portions of the inboard slope on the south and west embankments of the West Ash Pond exhibit minor wave erosion. Significant vegetation exists on the inboard slope in the southeast corner of the West Ash Pond.

- The outboard slopes of the embankments have 6 to 12 inches of vegetation but could be inspected by walking the slopes. No cracks, sloughing, bulging or major erosion was observed on these slopes. One animal burrow was noted on the outboard slope of the northwest corner of the Metals Pond.
- Standing water was observed in the perimeter drainage ditch on the west and north sides at the toe of the embankments. This water could be toe drain discharge or stormwater or both.
- No seepage or wet areas were observed on any of the outboard slopes or at the outboard toe on the east and south sides of the impoundment.
- A pressurized discharge pipe from the Storm Water Pump System is embedded in the eastern embankment of the West Ash Pond and was discharging water into the pond above the water surface (Photo B11). No seepage or wet areas were observed on any of the outboard slopes or at or beyond the outboard toe in the vicinity of this pipe.
- The outlet structure appeared to be in good condition and functioning normally. The cenosphere boom/ baffle system was in place and functioning. Decant water appeared clear.

4.2. NORTH ASH POND

The following sections summarize the inspection of the North Ash Pond which occurred on April 29, 2010. At the time of the inspection, O'Brien & Gere completed an EPA inspection checklist which was submitted electronically to EPA May 7, 2010. A copy of the completed inspection checklist is included in Appendix A.

4.2.1. General

The weather on the dates of the inspection was clear and approximately 55 degrees. The visual inspection consisted of a thorough site walk by the group of the wave berm on the upstream slope of the dam, the crest/roadway of the dam, and the downstream embankment, toe berm, and toe. Some members of the group also did a site walk of the emergency spillway, split into two groups, one covering the crest and one covering the downstream slope. The entire group also observed the stilling basin/overflow/weir box. O'Brien & Gere team members made observations of these areas and locations. We also observed the decant tower structure, monitoring instrumentation, and current operation.

Photos of relevant features and conditions observed during the inspection were taken by O'Brien & Gere and are provided in Appendix C. An aerial photograph of the North Ash Pond is presented as Figure 4, which provides photograph locations and directions. This aerial photograph is believed to have been taken in 2002.

4.2.2. Summary of Findings

During the visual site inspection of the North Ash Pond, representative features were observed. The following observations were made during the inspection:

- The North Ash Pond stores CCW and other materials consisting of fly ash, bottom ash, boiler slag, coal mill rejects, coal fines from general dredge spoil materials from the West Ash Pond and sand/silt/sediment from dredging the James River within and adjacent to the cooling water intake structures. The CCW stored in the West Ash Pond is periodically dredged and hydraulically transferred for final storage in the North Ash Pond. Dredge spoils are discharged on the north side of the impoundment through temporary piping. No temporary piping was observed at the time of the inspection. As can be seen in Figure 4, the CCW has accumulated above the normal pool level over an estimated 50 percent of the pond area and is generally representative of conditions observed during the walkover. Water in the pond is isolated to primarily the southern half of the pond.

- The crest and gravel crest road appeared to be in good condition with no cracks or settlement (Photos C4, C12, C13 and C14); the exposed portions of the inboard slope exhibit minor wave erosion on the wave berm at the water interface. Some minor erosion/superficial sloughing has occurred on the wave berm and the upstream slope to the crest along the dam (Photo C2).
- The upstream and downstream slopes of the dam embankments have 6 to 12 inches of vegetation but could be inspected by walking the slopes. No cracks, sloughing, bulging or major erosion was observed on these slopes (Photos C5 to C7, C11).
- Standing water was not observed on the toe berm but the ground was soft (Photo C7). The top of the toe berm was moist at the surface due slow drainage of stormwater.
- No seepage was observed on downstream slopes of the dam embankments.
- Flow from three of the four toe drain pipes was observed and was visually estimated to be less than 2 gallons per minute. Flow from the toe drains was observed to be clear (Photos C8, C10). Water was flowing freely to the diversion ditch.
- Significant vegetation and trees were observed immediately downstream of the emergency spillway crest.
- The outlet structure appeared to be in good condition and functioning normally. The cenosphere boom/ baffle system was in place (Photo C3). Decant water appeared clear.
- The stilling basin/overflow/weir box structure appeared to be in good condition and functioning normally. Associated trash racks, weirs, the grouted-riprap channel and concrete flume all appeared in good condition (Photos C16 and C17).

5. CONCLUSIONS

5.1. WEST ASH POND

Based on the ratings defined in the RFP (Satisfactory, Fair, Poor and Unsatisfactory), the information reviewed and the visual inspection, the overall condition of the West Ash Pond dam is considered to be **FAIR**. Acceptable performance is expected under applicable static, hydrologic, and seismic conditions. The primary reason for this condition rating is that minor deficiencies exist in the form of standing water in the drainage ditches on the north and west sides of the impoundment at the embankment toes and a pressurized discharge pipeline is embedded in the eastern embankment of the pond that presents potential for embankment internal erosion if the pipe were to develop a leak.

The regular operating procedures of the facility do not appear to be impacting the structural integrity of the impounding embankments.

The plant engineering staff maintain all available design documents and inspection reports in a well organized manner. Regular operations and maintenance procedures being practiced at the West Ash Pond are adequate, although we recommend additional maintenance actions be implemented to correct some of the conditions observed.

5.2. NORTH ASH POND

Based on the ratings defined in the RFP (Satisfactory, Fair, Poor and Unsatisfactory), the information reviewed and the visual inspection, the overall condition of the North Ash Pond dam is considered to be **FAIR**. Acceptable performance is expected under applicable static, seismic, and hydrologic conditions. The primary reason for this condition rating is that a minor deficiency exists in the form of trees, brush, and other obstructions downstream of the emergency spillway crest in the emergency spillway.

The regular operating procedures of the facility do not appear to be impacting the structural integrity of the impounding embankments.

The plant engineering staff maintain all available design documents and inspection reports in a well organized manner. Installed piezometers and observation well are periodically monitored. Regular operations and maintenance procedures being practiced at the North Ash Pond are adequate, although we recommend additional maintenance actions be implemented to correct some of the conditions observed.

6. RECOMMENDATIONS

Based on the findings of our visual inspection and review of the available historical documents for the West and North Ash Ponds, O'Brien & Gere recommendations are grouped into the following categories, based on the urgency and nature of the issue to be addressed.

6.1. URGENT ACTION ITEMS

None of the recommendations are considered to be urgent, since the issues noted above do not appear to threaten the structural integrity of either the West Ash Pond or North Ash Pond in the near term.

6.2. LONG TERM IMPROVEMENT

West Ash Pond

All of the deficient conditions observed during the inspection are considered to be maintenance items that do not require immediate attention, but should be implemented in the near future as part of a regular maintenance plan. The recommended maintenance actions are provided below:

- Inboard slopes –Inspect and repair erosion that is present on exposed portions of all inboard slopes from wave action on a regular basis. Remove or control vegetation at least twice annually.

- Outboard slopes –Mow vegetation at least twice annually. Perform follow-up inspection of outboard slopes after vegetation is mowed to check for adverse conditions such as sloughs, erosion, and seepage. Trap burrowing rodents and fill animal burrows.

- Drainage Ditches – Eliminate standing water by regrading perimeter ditches to drain water away from the toe of the embankments. Perform follow-up inspection of drainage ditches after vegetation is mowed/removed in drainage ditches to check for adverse conditions such as seepage.

- Storm Water Discharge Piping – Replace below-grade piping in eastern embankment with above-grade piping on supports; abandon existing pipe in place by filling with concrete or flowable fill.

North Ash Pond

All of the deficient conditions observed during the inspection are considered to be maintenance items that do not require immediate attention, but should be implemented in the near future as part of a regular maintenance plan. The recommended maintenance actions are provided below:

- Inboard slopes –Inspect and repair erosion that is present on exposed portions of all inboard slopes from wave action on a regular basis. Repair areas with minor sloughing. Remove or control vegetation at least twice annually.

- Outboard slopes –Mow vegetation at least twice annually. Perform follow-up inspection of outboard slopes after vegetation is mowed to check for adverse conditions such as sloughs, erosion, and seepage. Eliminate encroachment of trees into groin drains at the abutments. Trap burrowing rodents and fill animal burrows. Monitor toe berm for presence of standing water and regrade if condition is not abated.

- Emergency Spillway – Inspect annually at crest and downstream for a distance of 100 feet for presence of trees, brush, debris, or other obstructions that could restrict flows. Any such obstructions should be removed.

- Drains/ Drainage Ditches – Clear vegetation at least twice annually from headwall areas and downstream swales to diversion ditch. Perform follow-up inspection to check for adverse conditions such as water backing up into toe drains.

- Stilling Basin/Overflow – Remove vegetation and sediments from basin as required. Repair grouted-in-place riprap as required.

6.3. MONITORING AND FUTURE INSPECTION

O'Brien & Gere recommends continued annual inspections by Dominion's engineer with experience in performance of dam safety inspections. An O&M Plan for the North Ash Pond was developed in 2009 which established a firm schedule for operations, maintenance, and inspection activities. A similar O&M Plan should be developed for the West Ash Pond. Long term improvements noted above should be incorporated into plans as appropriate.

The monitoring of the observation wells or piezometers at the North Ash Pond should continue on a periodic basis so that phreatic surfaces in the embankments can be monitored during future inspections. Annual inspections should include recording water levels in wells/piezometers and corresponding ash pond water levels. In addition, estimated flow rate and turbidity of drainage from toe drains should be documented during the annual inspections.

The crest elevation of the West Ash Pond should be surveyed to assess whether the integrity of this Pond could be affected if overtopped by the 100 year flood.

6.4. TIME FRAME FOR COMPLETION OF REPAIRS/IMPROVEMENTS

Removal of trees and mowing of vegetation on the slopes should be completed this fall and a follow-up inspection of these slopes should be performed shortly after completion of this task as Dominion has conducted in the past for the North Ash Pond. Removal of trees, brush and obstructions from the emergency spillway should be completed this fall. Continuing to perform this task during the fall months after the vegetation has gone dormant may help to simplify the work. This effort should be extended to the West Ash Pond.

After the mowing is completed, the follow-up inspection should also focus on identification of any animal burrows, which should be filled as soon as practical.

Mowing should be repeated in late spring/early summer to control vegetation.

6.5. CERTIFICATION STATEMENT

I acknowledge that the West Ash Pond management unit referenced herein was personally inspected by me on April 29, 2010 and was found to be in the following condition:

SATISFACTORY
FAIR
POOR
UNSATISFACTORY

I acknowledge that the North Ash Pond management unit referenced herein was personally inspected by me on April 29, 2010 and was found to be in the following condition:

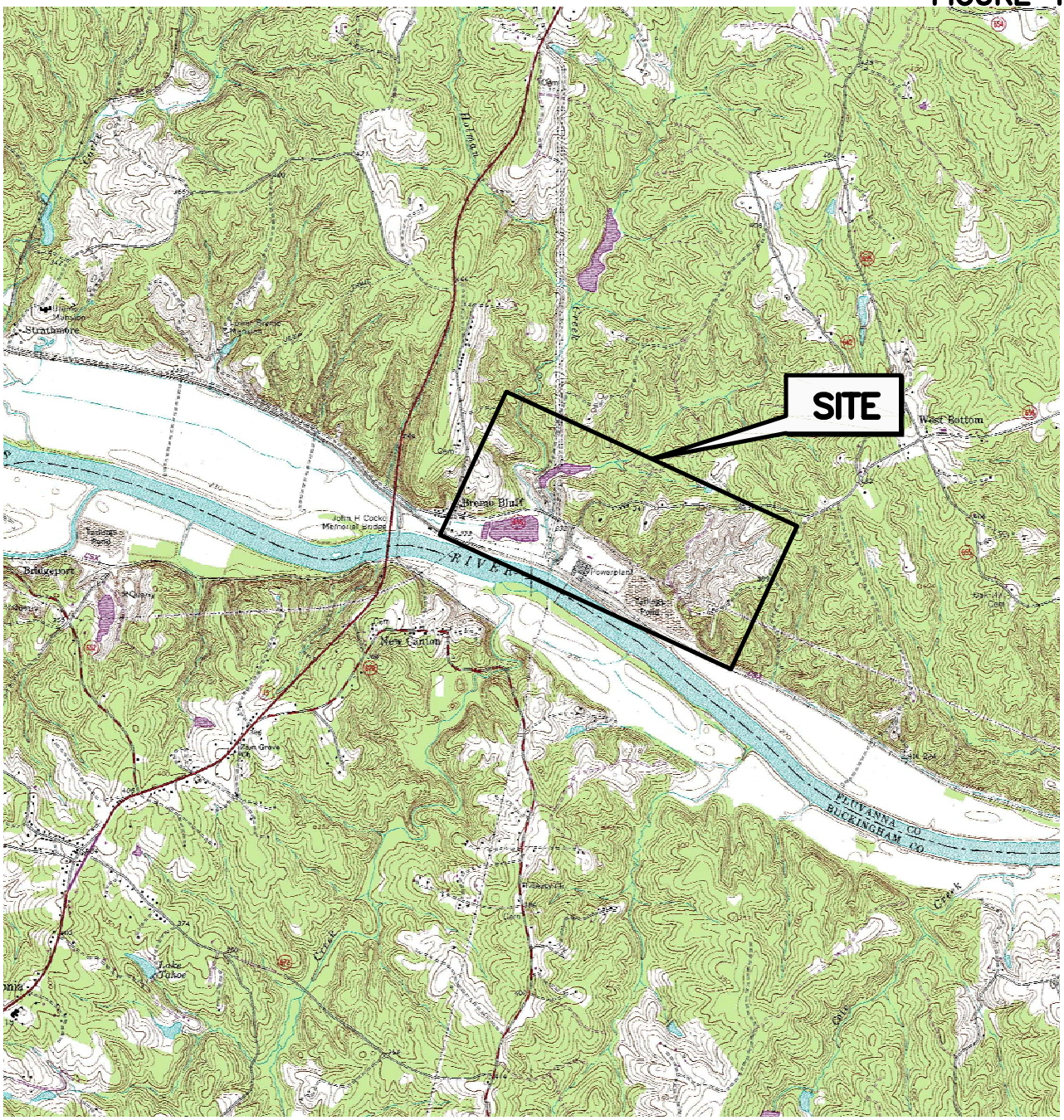
SATISFACTORY
FAIR
POOR
UNSATISFACTORY

Signature: _____ Date: September 29, 2010

Dana R. Pizarro, P.E.
Virginia PE #037259

FIGURES

FIGURE 1



ADAPTED FROM: ARVONIA QUADRANGLE, VIRGINIA U.S.G.S. 7.5 MIN. QUAD 1999

QUADRANGLE LOCATION

US EPA
DAM SAFETY ASSESSMENT OF CCW IMPOUNDMENTS

BREMO POWER STATION
BREMO BLUFF, VIRGINIA

SITE LOCATION MAP

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

SCALE: 1:24000

46122-BREMO-F01
JUNE 2010

O'BRIEN & GERE

2010 © O'Brien & Gere Engineers, Inc.

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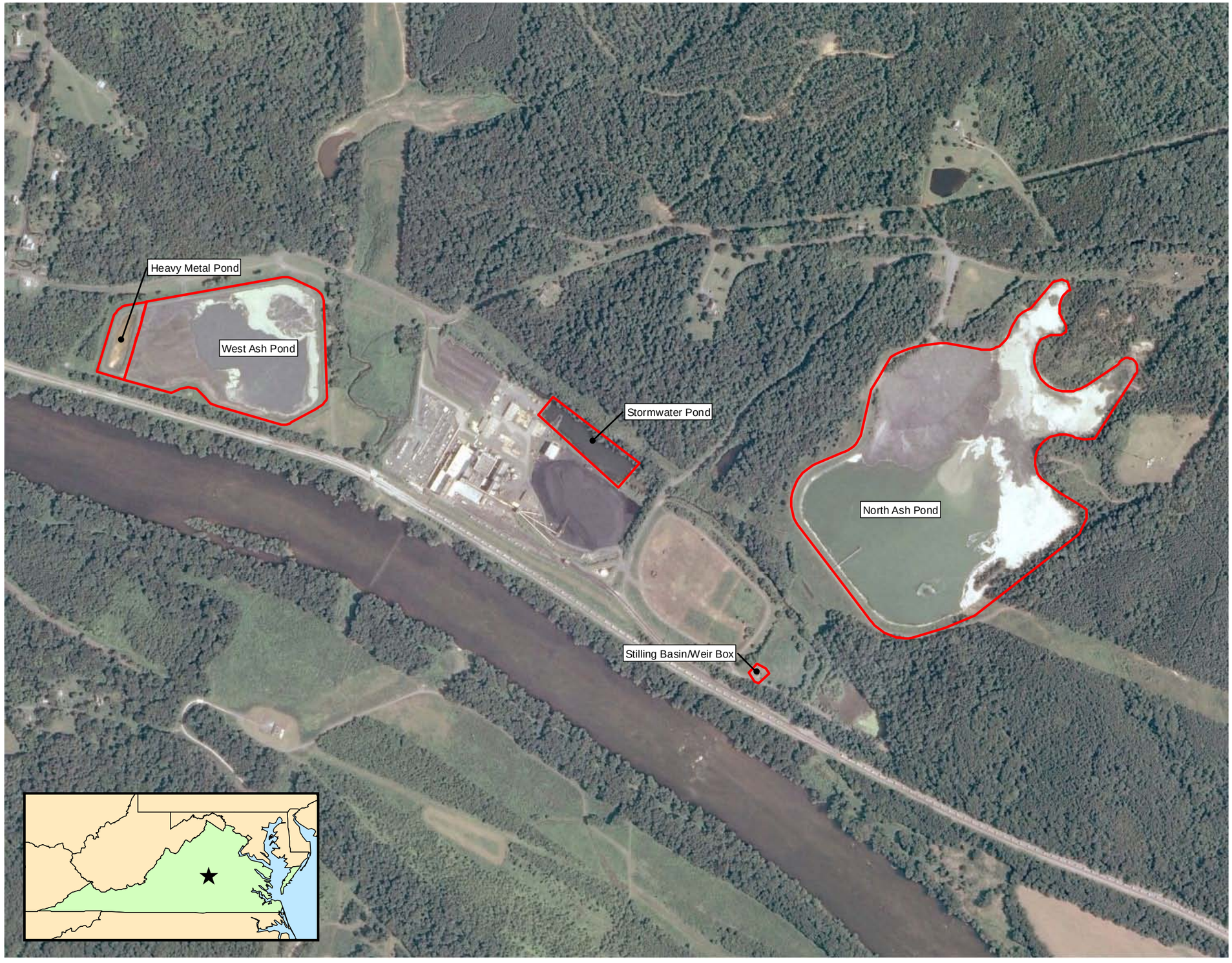
DRAFT FIGURE 2



N

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

BREMO POWER STATION
BREMO BLUFF, VIRGINIA

SITE LAYOUT

0 300 600 1,200
Feet

JUNE 2010
13498/46122

O'BRIEN & GERE

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NAME: KaufmaDR

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DRAFT FIGURE 3

N

LEGEND

B1 Photograph Direction/Location

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

BREMO POWER STATION
BREMO BLUFF, VIRGINIA

PHOTO LOCATIONS
WEST ASH POND

0 100 200 400
Feet

JUNE 2010
13498/46122

O'BRIEN & GERE

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NAME: KaufmaDR
DATE: 6/11/2010 3:47:19 PM

DRAFT FIGURE 4

N

LEGEND

C6 Photograph Direction/Location

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

BREMO POWER STATION
BREMO BLUFF, VIRGINIA

PHOTO LOCATIONS NORTH ASH POND

0 150 300 600
Feet

JUNE 2010
13498/46122

O'BRIEN & GERE

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NAME: KaufmaDR
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APPENDIX A

Visual Inspection Checklist

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Dominion - Bremo Bluff Station	Date:	4/29/2010
Unit Name:	North Ash Pond	Operator's Name:	Dominion
Unit I.D.:		Hazard Potential Classification:	High (Significant) Low
Inspector's Name:	D. Whetstone ,PE; Dana Pizarro, 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?	Annually		18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)?	206.0		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	209.5		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	212.0		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

1. Annual by engineer; submitted to VDCR.
2. Emergency spillway elevation = 209.5; decant elevation varies
6. Piezometers (5) (upstream slope, crest, and downstream slope)
9. Some small trees in left groin; rip rap groin
21. Very low flow (est. <2 gpm) from 3 of 4 toe drains. A few small wet areas near right groin at top of downstream toe berm.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # VA0004138 INSPECTOR D. Whetstone/D. Pizarro
Date 4/29/2010

Impoundment Name North Ash Pond
Impoundment Company Dominion – Bremo Bluff Station
EPA Region 3
State Agency (Field Office) Address VA Dept. of Environmental Quality
Glenn Allen, PA
Name of Impoundment _____(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update _____

	Yes	No
Is impoundment currently under construction?		X
Is water or ccw currently being pumped into the impoundment?	X*	

* - During dredging of W. Ash Pond

IMPOUNDMENT FUNCTION: Storage fly ash and bottom ash. No beneficial re-use

Nearest Downstream Town : Name Columbia
Distance from the impoundment 9 miles
Impoundment Location:
Longitude 37 Degrees 42 Minutes 29 Seconds
Latitude 78 Degrees 16 Minutes 42 Seconds
State VA County Fluvanna

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

If So Which State Agency? VA Deptment of Conservation and Recreation
VADCR – Dam Safety Section

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.

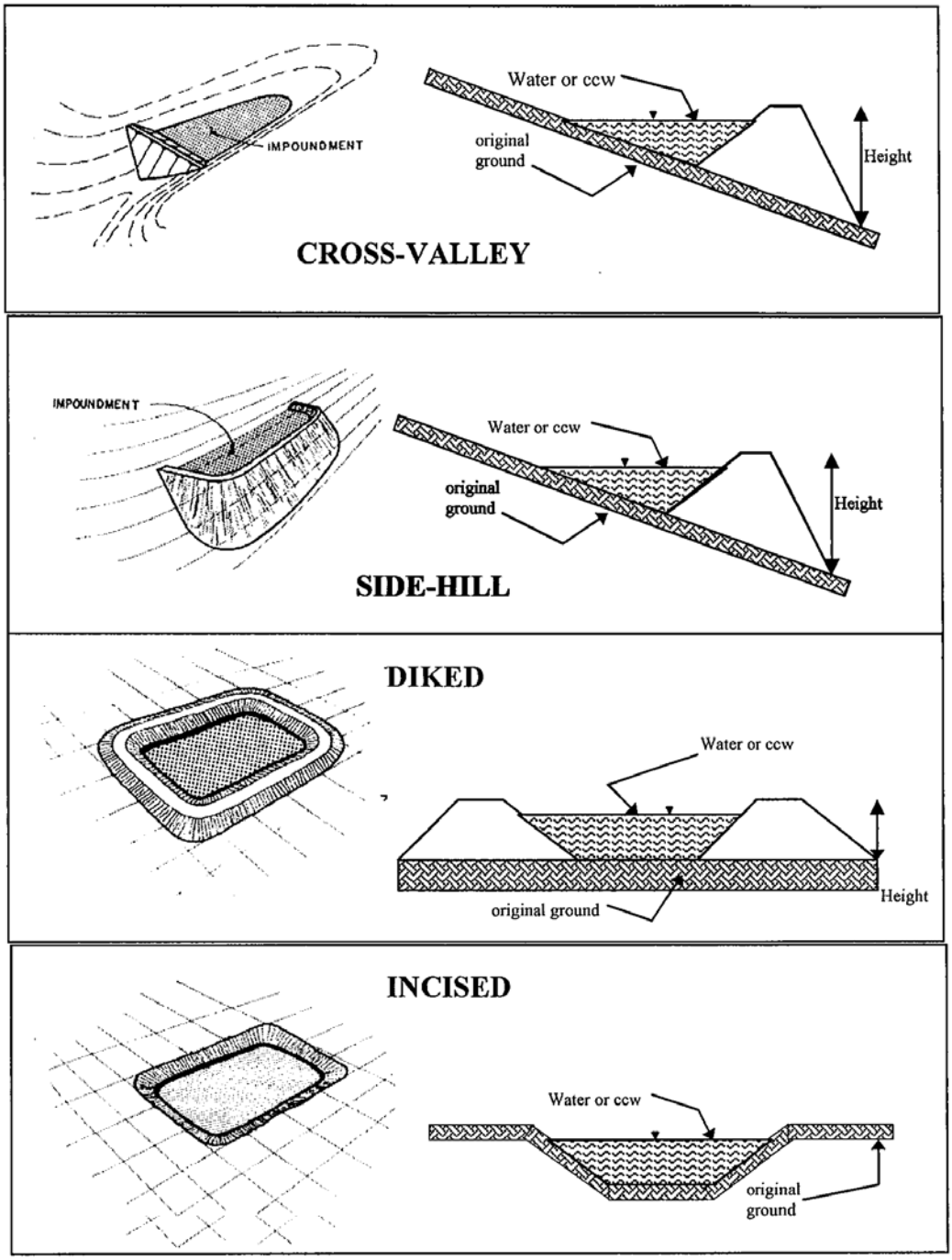
_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

VA State DCR Hazard Potential Classification is Significant.

Potential for off-site environmental damage to James River if failure occurs. Potential for disruption of railroad.

CONFIGURATION:



_X___ Cross-Valley
_____ Side-Hill
_____ Diked
_____ Incised (form completion optional) _____Combination Incised/Diked

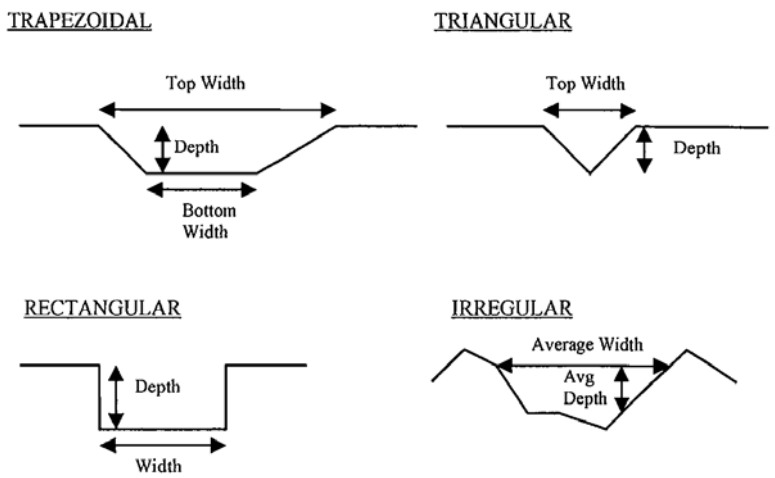
Embankment Height ___102___ feet Embankment Material Primarily silt and clay
Residual soils

Pool Area __62_____ acres Liner None

Current Freeboard > 5 feet Liner Permeability --

TYPE OF OUTLET (Mark all that apply)

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

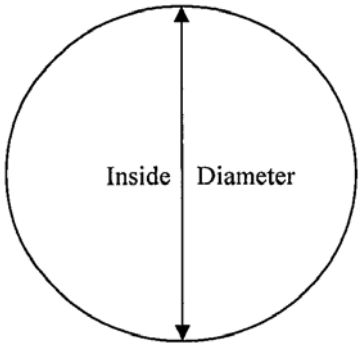


_____ depth
_____ bottom (or average) width
_____ top width

_X___ **Outlet**

_24__ inside diameter

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



Is water flowing through the outlet? YES _____ NO _X____

_____ **No Outlet**

_X___ **Other Type of Outlet** (specify) 4-29-10 pool at 9' – 6" below top of riser tower. Top of stoplog at 8'-9" below top of riser. Decanting tower with stop logs

The Impoundment was Designed By JK Timmons & Schnabel

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 able 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 : _____

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name: Dominion Bremo Station	Date: 4/29/2010
Unit Name: West Ash Pond	Operator's Name: Dominion
Unit I.D.:	Hazard Potential Classification: High (Significant) Low
Inspector's Name: D. Whetstone, P.E./Dana Pizarro, P.E.	

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?	Annually		18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)?	110'		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	110'		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	112 ft		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? (toe drain)		✓
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

6. No instrumentation.
3. Concrete stop logs; all stop logs in-place would bring water level up about 1' from current.
10. Ground surficial roadway
12. Cemosphere booms and baffle at weir.
21. Perimeter ditch has standing water on west and north sides; could be toe drains discharge; but probably stormwater and poor drainage in ditch.
23. See 21.
8. No documentation to substantiate this.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # VA0004138 INSPECTOR D. Whetstone/D. Pizarro
Date 4/29/2010

Impoundment Name West Ash Pond
Impoundment Company Dominion – Bremo Bluff Station
EPA Region 3
State Agency (Field Office) Address VA Dept. of Environmental Quality
Glenn Allen, PA
Name of Impoundment _____(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update _____

	Yes	No
Is impoundment currently under construction?		X
Is water or ccw currently being pumped into the impoundment?	X	

IMPOUNDMENT FUNCTION: Storage fly ash and bottom ash.

Nearest Downstream Town : Name Columbia
Distance from the impoundment 9 miles
Impoundment
Location: Longitude 37 Degrees 42 Minutes 40 Seconds
Latitude 78 Degrees 17 Minutes 32 Seconds
State VA County Fluvanna

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

If So Which State Agency? VA Deptment of Conservation and Recreation
VADCR – Dam Safety Section

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.

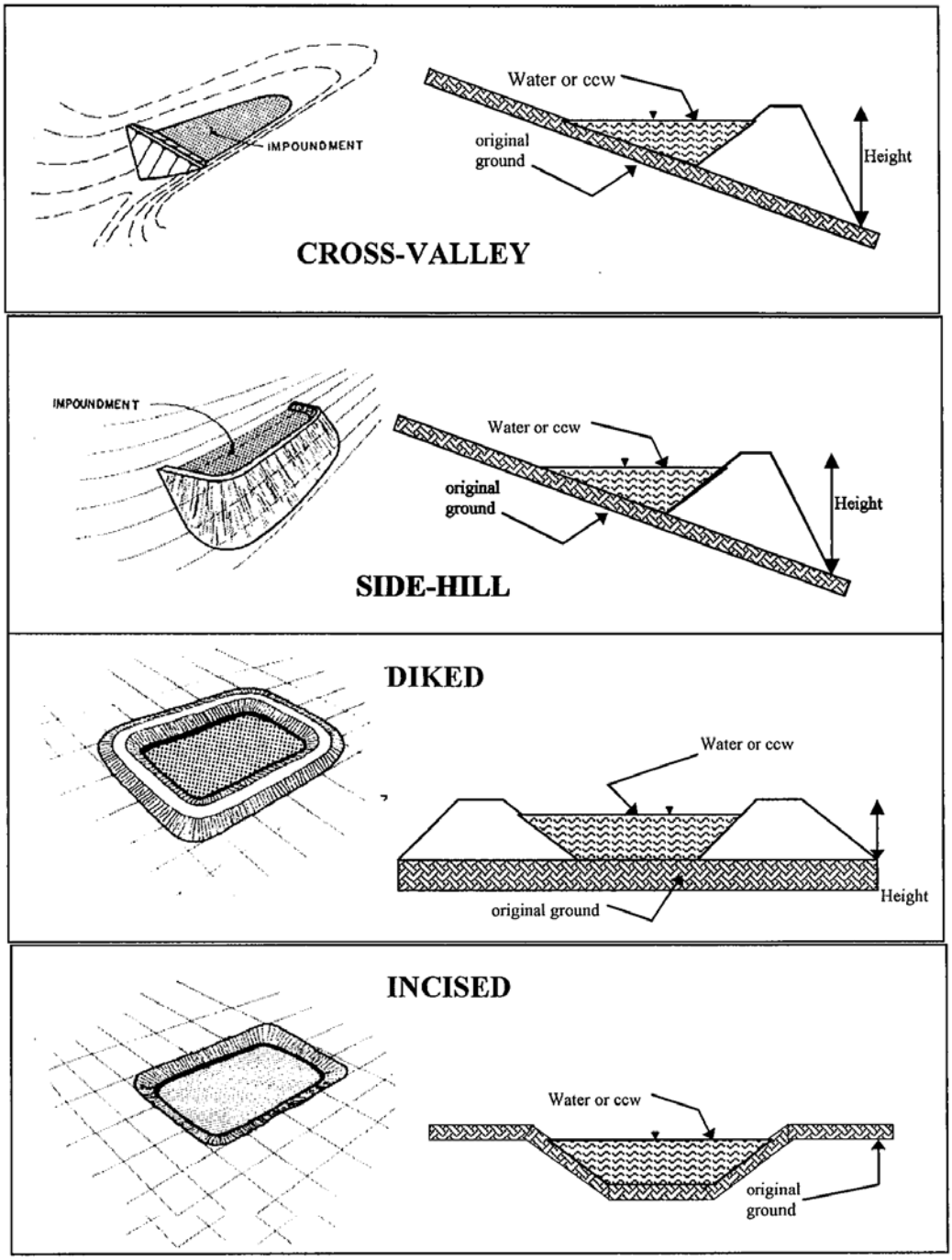
_X___ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.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

Environmental damage to James River. Failure would cause shut down of power plant.

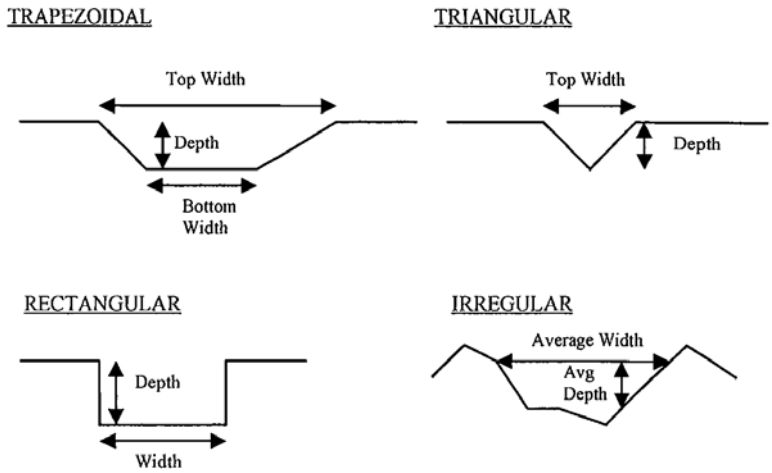
CONFIGURATION:



_____ Cross-Valley
_____ Side-Hill
_X___ Diked
_____ Incised (form completion optional) _____Combination Incised/Diked
Embankment Height ___17___ feet Embankment ____Residual soils_____
Pool Area __17_____ acres Liner _None_____
Current Freeboard _1-2_____ feet Liner Permeability _____--_____

TYPE OF OUTLET (Mark all that apply)

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

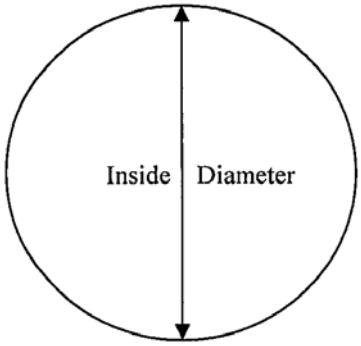


_____ depth
_____ bottom (or average) width
_____ top width

_X___ **Outlet**

_36__ inside diameter

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



Is water flowing through the outlet? YES ___X____ NO _____

_____ **No Outlet**

_X___ **Other Type of Outlet** (specify) Decanting tower with stop logs

The Impoundment was Designed By VA Electric and Power

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 able 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 : _____

APPENDIX B

Photographs-West Ash Pond

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – West Ash Pond	Location: Bremo Bluff, Virginia

Orientation: West

Description: Outlet Structure

Date: 4/29/10

Photo Number: B1

Photographer: DRP

Orientation: West

Description: Southern Embankment

Note: CCW discharge pipe on crest

Date: 4/29/10

Photo Number: B2

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – West Ash Pond	Location: Bremo Bluff, Virginia

Orientation: West

Description: Southern Embankment

Note: CCW discharge split to Metals or West Ash Pond

Date: 4/29/10

Photo Number: B3

Photographer: DRP

Orientation: North

Description: Dividing Dike Between West Ash Pond & Metals Pond

Note: CCW discharges

Date: 4/29/10

Photo Number: B4

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – West Ash Pond	Location: Bremo Bluff, Virginia

Orientation: North

Description: Dividing Dike Between West Ash & Metals Pond

Date: 4/29/10

Photo Number: B5

Photographer: DRP

Orientation: North

Description: Metals Pond

Date: 4/29/10

Photo Number: B6

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – West Ash Pond	Location: Bremo Bluff, Virginia

Orientation: South

Description: Pumping System from Metals Pond into West Ash Pond

Date: 4/29/10

Photo Number: B7

Photographer: DRP

Orientation: West

Description: Overflow Pipe from West Ash Pond into Metals Pond

Date: 4/29/10

Photo Number: B8

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – West Ash Pond	Location: Bremo Bluff, Virginia

Orientation: East

Description: Northern Embankment

Date: 4/29/10

Photo Number: B9

Photographer: DRP

Orientation: South

Description: Eastern Embankment

Date: 4/29/10

Photo Number: B10

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – West Ash Pond	Location: Bremo Bluff, Virginia

Orientation: West

Description: Discharge from Storm Water Detention Pond into West Ash Pond, Eastern Embankment

Date: 4/29/10

Photo Number: B11

Photographer: DRP

Orientation: West

Description: Southern Embankment

Note: CCW discharge pipes to West Ash Pond

Date: 4/29/10

Photo Number: B12

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – West Ash Pond	Location: Bremo Bluff, Virginia

Orientation: West

Description: Southern Embankment

Note: Drainage swale at toe of slope

Date: 4/29/10

Photo Number: B13

Photographer: DRP

Orientation: South

Description: Western Embankment of Metals Pond

Note: Standing water at toe of slope

Date: 4/29/10

Photo Number: B14

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – West Ash Pond	Location: Bremo Bluff, Virginia

Orientation: East

Description: Northern Embankment of West Ash Pond

Note: Access Road to embankment in background

Date: 4/29/10

Photo Number: B15

Photographer: DRP

Orientation: East

Description: Northern Embankment of West Ash Pond

Note: Standing water at toe of slope

Date: 4/29/10

Photo Number: B16

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix B)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – West Ash Pond	Location: Bremo Bluff, Virginia

Orientation: East

Description: Eastern Embankment of West Ash Pond

Date: 4/29/10

Photo Number: B17

Photographer: DRP

Orientation: East

Description: Storm Water Pump Station that discharges to West Ash Pond; Storm Water Pond in Foreground

Date: 4/29/10

Photo Number: B18

Photographer: DRP

APPENDIX C

Photographs-North Ash Pond

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – North Ash Pond	Location: Bremo Bluff, Virginia

Orientation: Southeast

Description: North Ash Pond Dam Crest

Date: 4/29/10

Photo Number: C1

Photographer: DRP

Orientation: Southeast

Description: North Ash Pond Dam Crest

Note: Minor Erosion/Superficial Sloughing

Date: 4/29/10

Photo Number: C2

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – North Ash Pond	Location: Bremo Bluff, Virginia

Orientation: North

Description: Outlet Structure

Date: 4/29/10

Photo Number: C3

Photographer: DRP

Orientation: Northwest

Description: North Ash Pond Dam Crest

Note: Piezometer and Observation Wells on Upstream Slope

Date: 4/29/10

Photo Number: C4

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – North Ash Pond	Location: Bremo Bluff, Virginia

Orientation: North

Description: Downstream slope of North Ash Pond Dam

Date: 4/29/10

Photo Number: C5

Photographer: DRP

Orientation: West

Description: Downstream toe of North Ash Pond Dam

Note: Diversion Ditch at Toe

Date: 4/29/10

Photo Number: C6

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – North Ash Pond	Location: Bremo Bluff, Virginia

Orientation: North

Description: Downstream Toe of North Ash Pond Dam

Note: Piezometer on Toe Berm

Date: 4/29/10

Photo Number: C7

Photographer: DRP

Orientation: Northeast

Description: Toe Drain East Headwall

Date: 4/29/10

Photo Number: C8

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG (Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – North Ash Pond	Location: Bremo Bluff, Virginia

Orientation: Northwest

Description: Steel Spillway Pipe over Diversion Ditch

Date: 4/29/10

Photo Number: C9

Photographer: DRP

Orientation: Northeast

Description: Toe Drain West Headwall

Date: 4/29/10

Photo Number: C10

Photographer: DRP

PHOTOGRAPHIC LOG (Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – North Ash Pond	Location: Bremo Bluff, Virginia

Orientation: Southeast

Description: Downstream Slope of Damn

Date: 4/29/10

Photo Number: C11

Photographer: DRP

Orientation: Southwest

Description: North Ash Pond Dam / Side Hill Embankment Crest

Date: 4/29/10

Photo Number: C12

Photographer: DRP

PHOTOGRAPHIC LOG (Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – North Ash Pond	Location: Bremo Bluff, Virginia

Orientation: Southwest

Description: North Ash Pond shallow embankment near emergency spillway

Date: 4/29/10

Photo Number: C13

Photographer: DRP

Orientation: Northeast

Description: North Ash Pond Dam Crest and Emergency Spillway

Note: Significant trees and brush downstream of crest

Date: 4/29/10

Photo Number: C14

Photographer: DRP

PHOTOGRAPHIC LOG (Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – North Ash Pond	Location: Bremo Bluff, Virginia

Orientation: North

Description: North Ash Pond Dam

Date: 4/29/10

Photo Number: C15

Photographer: DRP

Orientation: East

Description: Stilling Basin / Overflow

Date: 4/29/10

Photo Number: C16

Photographer: DRP

O'BRIEN & GERE

PHOTOGRAPHIC LOG(Appendix C)

Client: US EPA	Project Number: 46122
Site Name: Bremo Power Station – North Ash Pond	Location: Bremo Bluff, Virginia

Orientation: West

Description: Weir Box Interior

Date: 4/29/10

Photo Number: C17

Photographer: DRP

APPENDIX D

North Ash Pond – Estimated Phreatic Surface From Piezometer Readings

BREMO NORTH ASH POND DAM
BREMO POWER STATION
FLUVANNA COUNTY, VIRGINIA

ESTIMATED PHREATICE SURFACE
FROM PIEZOMETER READINGS
August 1989 – October 2009

FOSSIL & HYDRO ENGINEERING
GLEN ALLEN, VIRGINIA

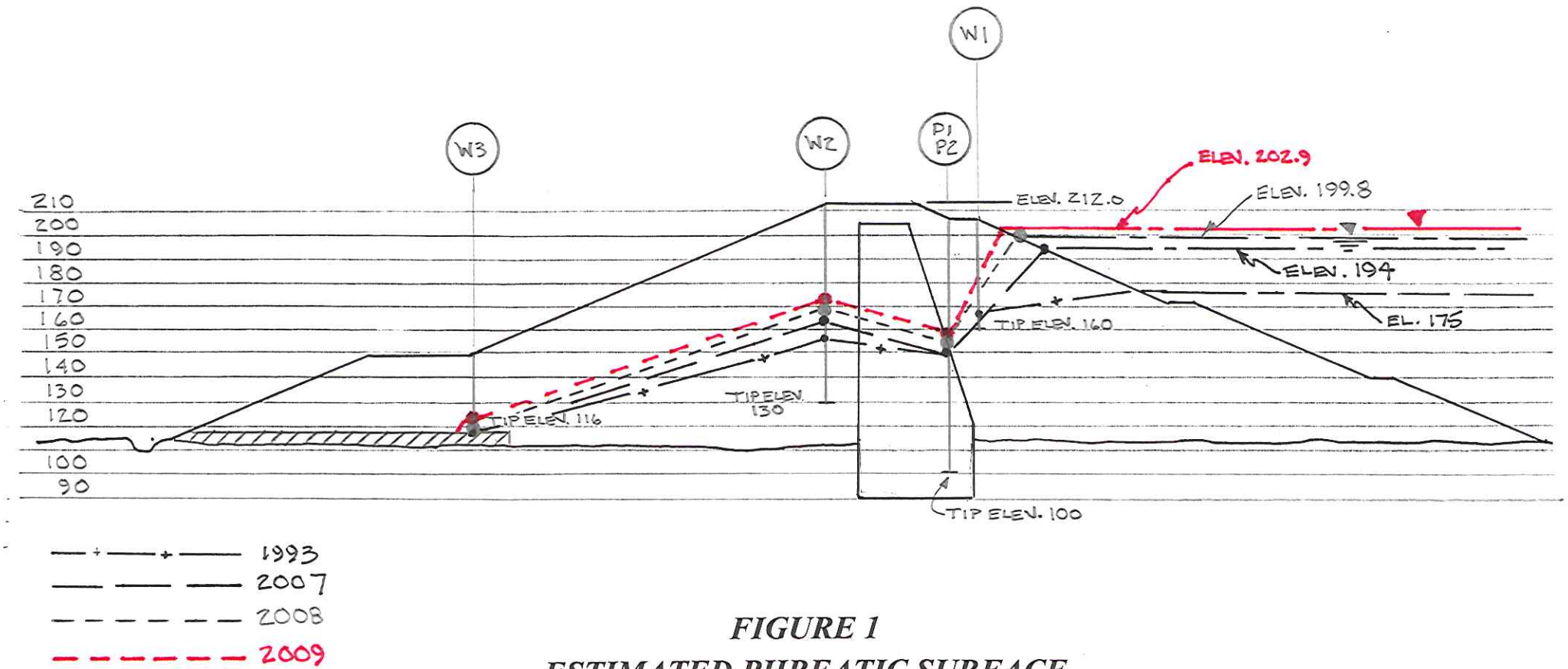


FIGURE 1
ESTIMATED PHREATIC SURFACE
FROM PIEZOMETER READINGS
OCTOBER 28, 2009

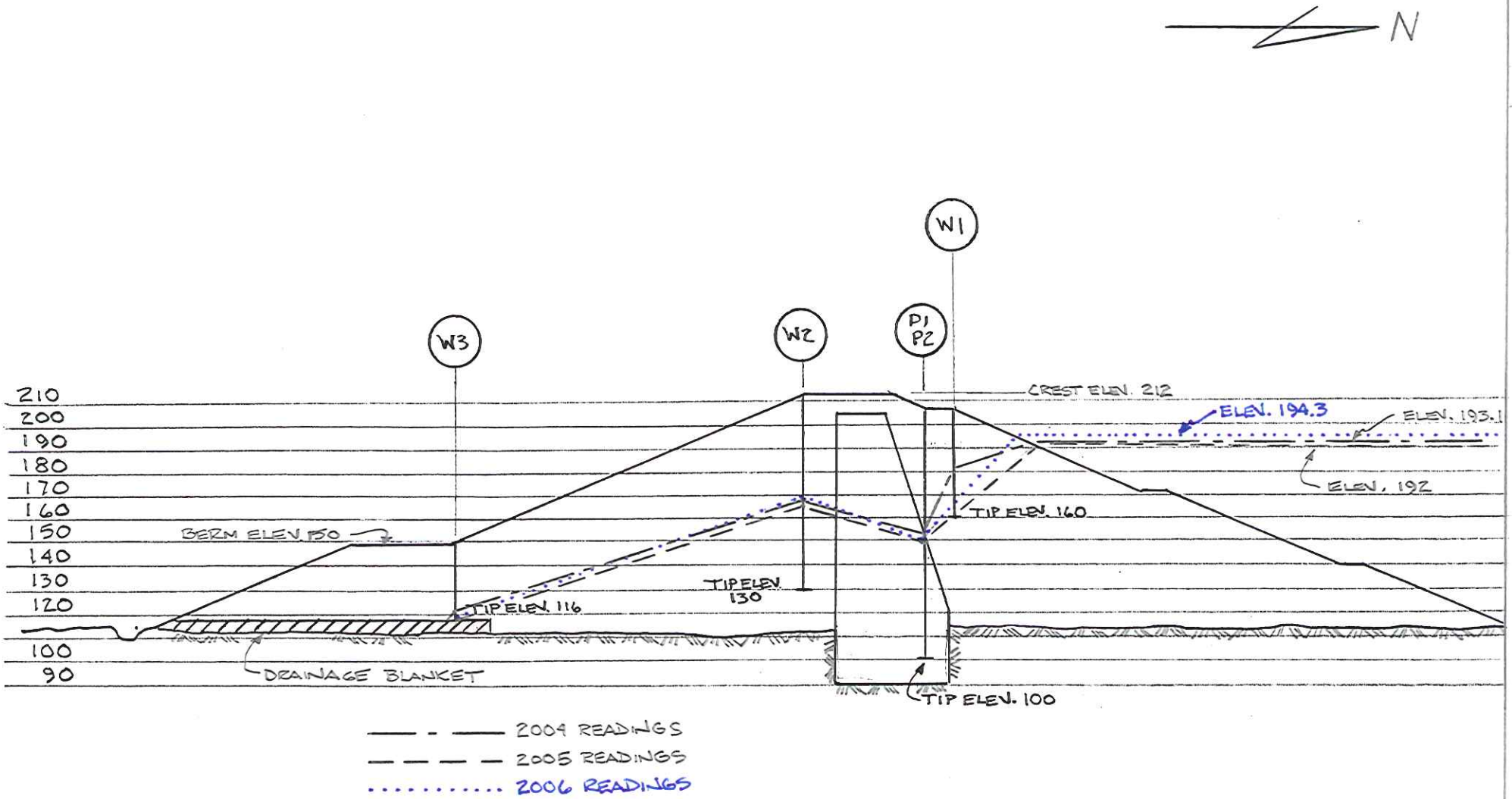
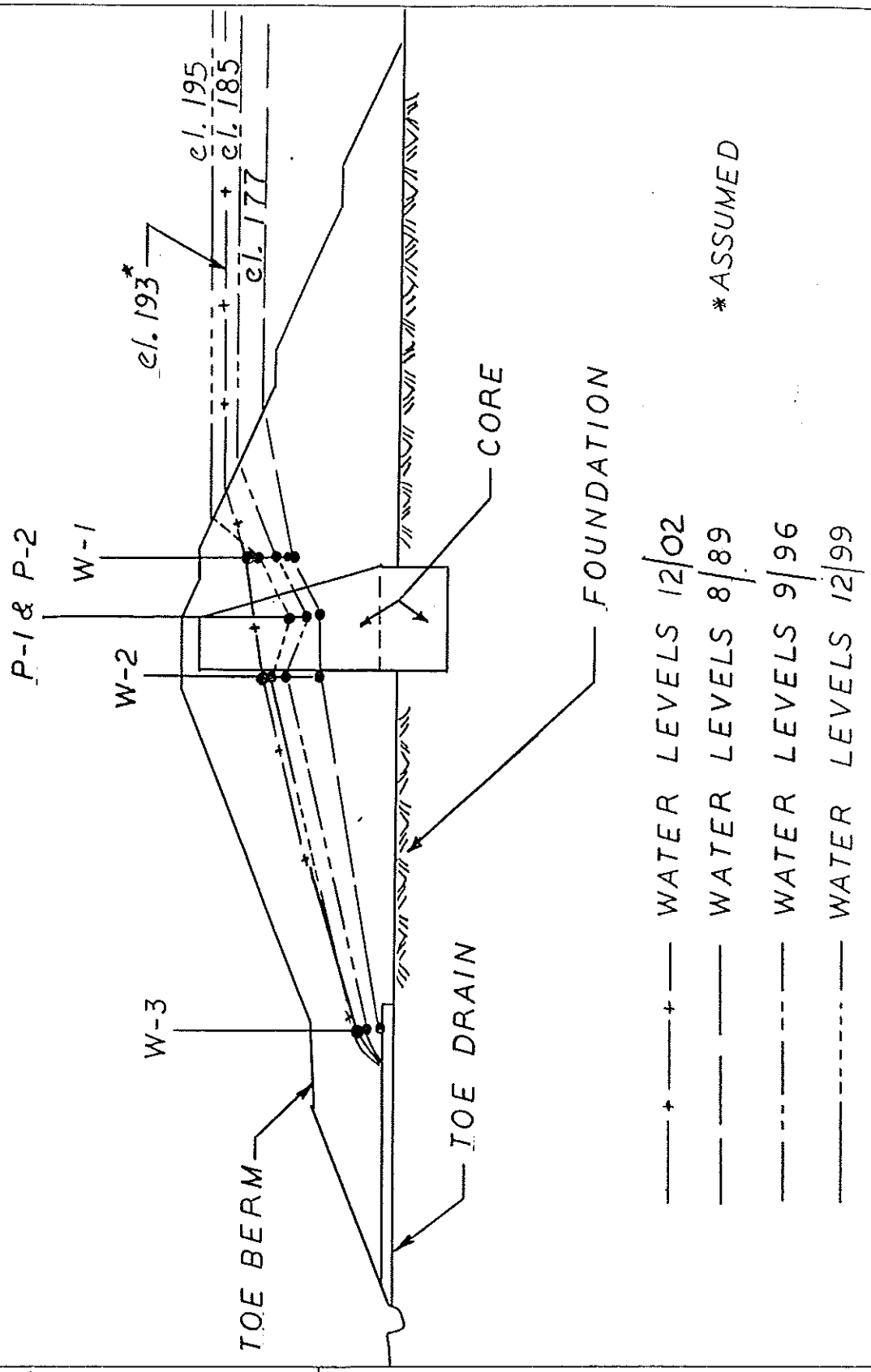


FIGURE 2

ESTIMATED PHREATIC SURFACE
FROM PIEZOMETER READINGS



REV	DATE	DESCRIPTION	BY	CHKD	ENGR	APPD

REV	DATE	DESCRIPTION	BY	CHKD	ENGR	APPD

VIRGINIA POWER
NORTH CAROLINA POWER

FOSSIL AND HYDRO ENGINEERING
RICHMOND, VIRGINIA

DRWN	JAC
CHKD	—
ENGR	JAC
APPD	—
DATE	1/03

ESTIMATED PHREATIC SURFACE BASED ON OBSERVATION WELL & PIEZOMETER DATA

CADD NO. —

DRAWING NO. **FIGURE 1**

SH 1 OF 1

REV 0