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REPORT

Dam Safety Assessment of CCW Impoundments

Sunbury Generation LP

United States Environmental Protection Agency
Washington, DC

December 7, 2010

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REPORT

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Dam Safety Assessment of CCW Impoundments

Sunbury Generation LP

Prepared for:
US Environmental Protection Agency
Washington, DC

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1. INTRODUCTION

1.1. GENERAL

In response to the coal combustion waste (CCW) impoundment failure at the TVA/Kingston coal-fired electric generating station in December of 2008, the U. S. Environmental Protection Agency (US EPA) 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 US EPA has authorized O'Brien & Gere to provide actual 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 Assessments 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 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 Residual Waste Ash Basin No. 1 at the Sunbury Generation LP Electric Generating Station in Monroe Township, Snyder County, Pennsylvania. The impoundment is owned and operated by Sunbury Generation LP. In the course of this assessment, we obtained information from representatives of Sunbury Generation LP and I & I Engineering, Inc.

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2. PROJECT/FACILITY DESCRIPTION

Sunbury Generation LP's coal fired electric generating station is located in Shamokin Dam Borough and Monroe Township, Snyder County, Pennsylvania. Residual Waste Ash Basin No. 1 is located entirely in Monroe Township. A site location map is provided as Figure 1. Residual Waste Ash Basin No.1 serves as a captive CCW disposal facility for Sunbury Generation LP. The bottom ash produced from Sunbury Generation LP is carried in above-ground pipelines to the Basin's processing pad where the bottom ash is settled for recovery. The majority of the bottom ash is sold for beneficial use and water carries the remaining fine materials to two open water cells of the basin. The water initially enters the settling cell portion of the Basin for the removal of fine solids not captured on the bottom ash processing pad. The clarified water then flows from the settling cell to the settling pond and out of the Basin through a concrete discharge structure to the NPDES outfall into Rolling Green Run.

2.1. MANAGEMENT UNIT IDENTIFICATION

Residual Ash Basin No. 1 is regulated by the Pennsylvania Department of Environmental Protection (PADEP), Division of Waste Management. The Facility ID No. is 301306. The Basin is not currently regulated or identified by the PADEP Division of Dam Safety or listed on the National Inventory of Dams. The Basin is bordered on the west by railroad tracks, Rolling Green Run to the South, the abandoned Pennsylvania Canal and Susquehanna River to the East, and a site access road to the north.

Residual Ash Basin No.1 was built in 1949, with a vertical expansion in 1959. From 1949 to 1955 both bottom ash and fly ash were disposed of in the Basin. In 1955, Pennsylvania Power and Light, the facility's former owner, started disposing of the fly ash at an offsite location, and the Basin no longer receives fly ash. Sunbury Generation LP has a closure plan approved by PADEP, Division of Waste Management, however, there is no firm schedule in place for closure.

2.2. HAZARD POTENTIAL CLASSIFICATION

The Hazard Potential Classification is assigned based on the definitions (Less than Low, Low, Significant, and High) described in the EPA CCW checklist found in Appendix A. The Hazard Potential is based on the predicted impact, not the probability of failure. The spillway capacity and likelihood of overtopping are not taken into consideration. Based on the checklist definitions, the visual inspection, and document review, the hazard potential rating recommended for the Residual Waste Ash Basin No.1 is **HIGH.** The EPA inspection form describes a "High Hazard Potential" dam as one whose failure or mis-operation will probably cause loss of human life. There is a community of cottages located between Rolling Green Run and the Susquehanna River, approximately 150 feet southwest of the Basin. The first floor elevation of the closest cottage is approximately 434 feet, approximately 13 feet below the top of the dam. If the Basin were to fail in the southwest corner, the close proximity and difference in elevation between the top of the dam and the cottages indicate that the cottages would be inundated, causing significant property damage and possible loss of life. A dam breach analysis that examines the extent of inundation of the cottage community under a range of design flood events up to the Probable Maximum Flood and non-flood events (Sunny Day failure) would provide a more complete assessment of the potential for loss of life.

If the Residual Waste Ash Basin No.1 were to fail on any point along its embankment, it would drain its contents into the Susquehanna River via the remnant of channel of the Pennsylvania Canal or Rolling Green Run. Based on a review of available aerial photographs, there is no critical infrastructure within 5 miles downstream that would be impacted by a failure of the Basin. The nearest drinking water intake facility is the Dauphin Municipal Water Authority, located approximately 22 miles downstream.

The PADEP, Division of Dam Safety does not currently regulate the Basin, and has not assigned a hazard classification. However, representatives from the Division of Dam Safety attended the inspection conducted on

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May 10, 2010 to discuss regulation of the Basin in the future. Pennsylvania classifies dams according to size and hazard potential in accordance with the Pennsylvania Code, Title 25, Chapter 105 Rules and Regulations.

2.3. IMPOUNDING STRUCTURE DETAILS

The following sections summarize the structural components and basic operations of Residual Waste Ash Basin No. 1. A Site layout is shown in Figure 2. Additionally, photos taken during the visual inspection are incorporated in a Photographic Log provided as Appendix B.

2.3.1. Embankment Configuration

The impoundment is 62 acres (dikes included) and is holding accumulated bottom ash and fly ash. Currently 16 acres are ponded including a settling cell and a remaining open water area. The Basin is a diked earthen embankment with no liner. The dike is 2 ft above grade on the north side and protrudes approximately 20 feet above grade on the south side. The crest of the embankment is at elevation 447.5 MSL and the original pool bottom was at 429.5 MSL at the north end and 425.5 MSL at the south end. The depth of the basin ranges from 18 to 22 ft. The inboard slopes are 2H:1V, the outboard slopes are 2.5H:1V, both slopes are well vegetated.

2.3.2. Type of Materials Impounded

Since 1955, influent into the Residual Ash Basin No.1 has included water with solids consisting of primarily bottom ash and lesser quantities of coal rejects, dewatered wastewater treatment plant sludge, river silt from water intake tunnel cleanings, and construction/demolition waste generated at the generating station.

2.3.3. Outlet Works

Residual Ash Basin No.1 is a diked impoundment that has been designed to receive sluice flows and direct precipitation. The ash pond outlet structure, located on the western end of the Basin, consists of a concrete intake tower with a 5 foot long rectangular weir formed over removable concrete stop logs. The stoplogs are used to adjust the elevation of the weir which is normally at elevation 442.5. The outlet structure discharges through a pipe into a concrete box culvert on the outboard slope of the embankment into Rolling Green Run. This is a permitted NPDES outfall (NPDES Permit #PA0008451) and is equipped for flow monitoring.

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3. RECORDS REVIEW

3.1. ENGINEERING DOCUMENTS

A review of the available records related to design, construction, operation, and inspection of Residual Waste Ash Basin No. 1 was performed as part of this assessment. The documents provided by Sunbury Generation L.P. are listed below:

Table 3.1 *Summary of Residual Waste Ash Basin No. 1 Documents Reviewed*

Document	Date	By	Description
Residual Waste Permit Renewal Application	October 2007	Sunbury Generation LP	Technical Appendices
Residual Waste Permit Renewal Application	October 2007	Sunbury Generation LP	Technical Appendices
Exhibit G1			General Project Description
Form F			Soils Information
Exhibit 24R			Impoundment Plan
Exhibit 1R			Design Concept and Operating Plan
Water Quality Report	April 27, 2010	I & I Engineering, Inc.	Cover Letter and Sampling Information
Design Drawings	November 2007	I & I Engineering, Inc.	Contract Documents for Closure
3R-3			Cross Sections
3R-4			Dike and Outlet Structure Details

A review of the Permit Renewal Application, Water Quality Reports, and Design Drawings revealed the following information:

- The Basin is approximately 2,400 feet long by 1,050 feet wide.
- There is no liner in the Basin.
- Bottom ash is collected in the boiler bottoms and sluiced in above-ground pipelines to the Basin's processing pad, where the bottom ash is settled for recovery. The majority of the bottom ash is sold for beneficial use. Water carries the remaining fine materials to two open water cells of the basin.
- When the dam was originally constructed, approximately 55 acres were ponded. Currently 16 of the original 55 acres (approximately 30%) are ponded.
- Inspections of the dike are made quarterly by qualified personnel and after heavy rainfall events.
- Numerous trees and woody vegetation on the east outboard embankment slope along the river have been left in place to protect against river erosion during floods.
- The original dikes were built from soils from the site and varied in elevation from 442 feet to 444 feet.
- The dikes were raised in 1959 to a uniform elevation of 447.5 feet with soils from a nearby source (location unknown).
- Wind and water erosion are not expected to cause a problem because currently only 16 acres are ponded and minimal waves are produced.
- No known spills or releases have occurred since the facility was acquired by Sunbury Generation LP in June 2006.

3.1.1 Stormwater Inflows

Residual Waste Ash Basin No. 1 is comprised of diked embankments on four sides which direct storm water away from the impoundment and limit runoff to precipitation that falls within the diked area. The Permit Renewal Application describes the Basin's drainage area as the Basin itself (approximately 62 acres). The Basin captures direct precipitation from its drainage area which drains to the settling cell and settling pond, then exits the Basin through the outlet structure.

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The Permit Renewal Application contained a hydrologic/hydraulic analysis to evaluate the Basin's performance during the 24-hour 25-year storm (the regulatory flood event for residual waste regulation). The minimum freeboard required by the permit is 2 feet.

The information contained in the permit application is summarized as follows:

- The outlet has a 5-foot long rectangular weir formed by stoplogs positioned normally at elevation 442.5 feet. The average depth over the weir is 0.5 feet corresponding to 5.4 cfs.
- To check the freeboard, the Basin was assumed to be 25% of the existing pond, the starting water surface elevation was 443.0 feet MSL (0.5 feet above the weir).
- The maximum inflow to the Basin during the 25-year storm was computed as approximately 115 cfs
- The routing calculations show the Basin's water level would rise 0.66 feet to 443.66 feet, the depth over the weir would be 1.16 feet and the peak discharge would be 20 cfs during the 24 hour 25-year storm.
- The minimum freeboard according to the analysis contained in the Permit Renewal Application is 3.84 feet, which meets the residual waste regulation requirements.

The regulatory flood event for dam safety regulations is of a significantly greater magnitude. It can range from the 100-year storm (5-8 inches) to the Probable Maximum Flood (PMF) (25-40 inches) depending on the size and hazard classification.

The current ponded area of the Basin is approximately 16 acres and there is normally 4.5 feet of freeboard (447.5-443) which corresponds to approximately 72 acre-feet of available storage. If this 72 acre-feet was evenly distributed over the 62 acre drainage area it would allow for 1.16 feet (14 inches) of rain to fall before the embankments were overtopped, assuming that the spillway was clogged and no precipitation was absorbed or stored in the soil.

The 100-year storm is approximately 6.1 inches (NRCS) and the basin would be able to absorb the entire volume of runoff without overtopping. However, based on a range of 25-40 inches, overtopping is a possibility during the PMF. A more detailed hydrologic/hydraulic analysis of the Basin would be necessary to determine its performance under the PMF.

3.1.2 Stability Analysis

A slope stability analysis of the basin embankment was conducted in February of 1997 in support of the Residual Waste Permit Application. Static (normal pool with steady state seepage) and dynamic (earthquake) loading cases were examined. The slope stability analysis was based on current or as-built conditions (boring logs and water surface elevations). The inboard water surface elevation used in the analysis was 443 feet and the outboard embankment water surface elevation was 428 feet.

In order to determine the soil properties of the embankment, two test borings were drilled through the embankment, by bst (boring, soils, & testing co.) on December 5, 1996. The borings were located on the east dike and the Basin's southwest corner. The boring logs document the presence of both fly ash and bottom ash layers in the embankment, which appears consistent with the embankment cross sections presented in permit application drawings documenting the raising of the dikes in 1959 (see Section 3.1.3).

The soil information extracted from the boring logs was used to model a typical embankment cross section for use in the stability analysis as presented below:

Table 3.2 *Summary of Soils Information Used in the Stability Analysis*

Elevation Range	Description	Consistency-Relative Density	Y Unit Weight (lbs/ft^3)	c' Cohesion (lbs/ft^2)	Ø Angle of internal Friction
440-447.5	Sandy Silt	Stiff	120	300	34
436-440	Fly Ash and Fly Ash with Cinders	Medium Dense to Loose	105	100	32
425-436	Silty Sand w/Gravel	Medium Dense	120	200	35
420-425	Silty Clay, Firm	Firm	115	1200	10
414-420	Silty Clay with Shale Fragments	Soft	110	600	0
<420	Rock				

The slope stability analysis was performed with STABL4 software based on the Simplified Janbu Method of Slices. The resulting factor of safety for the static loading case was 1.83; the factor of safety for the dynamic loading case was 1.26.

The assumptions made regarding the phreatic surface in the embankment appear reasonable based on the boring logs. The assumption of a four-foot thick horizontal layer of fly ash passing completely through the embankment in the modeled typical section is, however, inconsistent with the reported history of the dike construction and the cross sections of the raised dikes presented in the permit application (see Section 3.1.3). Additionally, no documentation is provided of the source of the cohesion and internal friction angle values used for the fly ash layer.

No analysis was presented of a maximum surcharge (flood) pool loading condition.

3.1.3. Modifications from Original Construction

The original dikes of Residual Waste Ash Basin No. 1 were reportedly constructed in 1949 of site soils and varied in crest elevation from 442 feet to 444 feet. In 1959, the basin dikes were expanded vertically to a uniform elevation of 447.5 feet with soils from a nearby borrow source (location unknown). A drawing supplied with the Residual Waste Management permit renewal application shows cross sections from the design drawings for the raised level. The cross sections show that the raised portions of the embankment were constructed with earth fill spanning the top of the existing dike crest and over existing ash on the inboard slope of the dike. In most locations, the existing ash level in the basin was below the original dike crest level at the time of the raising. The cross sections show that bottom ash was used as fill on the inboard dike slopes to raise a level surface 6 inches below the original earth crest elevation to serve in combination with the original dike crest in forming a foundation for the earth fill vertical expansion. On the north and west side of the Basin, a dike was raised where the Basin had previously met existing grades. The cross sections show existing ash beneath portions of the new, raised dikes in these areas as well.

The investigation borings performed through the Basin dikes in 1996 confirmed that the raised dikes were built upon ash layers.

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3.1.4. Instrumentation

There is no instrumentation currently in place specifically intended to monitor embankment stability parameters. There are five monitoring wells in the east dike of Basin for the purpose of monitoring ground water quality. Ground water elevations are recorded when these wells are sampled.

There is a weir and flow monitoring equipment at the NPDES outfall recording the cumulative discharge from Residual Waste Ash Basin No. 1 to Rolling Green Run.

3.2. PREVIOUS INSPECTIONS

Sunbury Generation LP staff conducts quarterly inspections of the Residual Waste Ash Basin No. 1 embankments. Additionally, the PADEP Waste Management Program conducts periodic inspections of entire Basin. The PADEP Division of Dam Safety inspected the Basin for the first time on May 10, 2010.

3.3. OPERATOR INTERVIEWS

Numerous plant and corporate personnel took part in the inspection proceedings, along with representatives of the PADEP and the Snyder County Emergency Management Agency. The following is a list of participants from the inspection of the Sunbury Generation LP Residual Waste Ash Basin No. 1:

Table 4 *List of Participants*

Name	Affiliation	Title
Jeff Specht	Sunbury Generation LP	Plant Manager/CFO
Ed Griegel	Sunbury Generation LP	Vice President Operations
Mark Crawford	Sunbury Generation LP	Environmental Health and Safety Manager
Kevin Aucher	Sunbury Generation LP	Yard Supervisor
Michael J. Bodnar, PG	I & I Engineering, Inc.	Consultant
Kirk A. Kreider, PE	Pennsylvania Department of Environmental Protection – Division of Dam Safety.	Chief, Susquehanna Watershed Section
Heath Maines	Pennsylvania Department of Environmental Protection – Division of Dam Safety	
Clark Smith	Pennsylvania Department of Environmental Protection – Waste Management Program	Solid Waste Specialist
George Grose	Pennsylvania Department of Environmental Protection – Watershed Management Program	
Derrick Shambach	Snyder County Emergency Management Agency	
Erin Burke	O'Brien & Gere	Design Engineer
Gary Emmanuel, PE	O'Brien & Gere	Project Manager

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Facility personnel provided a good working knowledge of Residual Waste Ash Basin No. 1 and general plant operations and provided requested historical documentation and also accompanied O'Brien & Gere throughout the visual inspections to answer questions and provide additional information as needed in the field. In addition to the facility personnel, Sunbury Generation LP's engineering consultant was present to provide additional information in regards to the closure plan and Residual Waste Management permit requirements.

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4. VISUAL INSPECTION

The following sections summarize the inspection of Residual Waste Ash Basin No.1, which occurred on May 10, 2010. At the time of the inspection, O'Brien & Gere completed an EPA inspection checklist for the facility, which was submitted electronically to EPA on May 17, 2010. A copy of the completed inspection checklist is included as Appendix A.

4.1. GENERAL

The weather on the dates of the inspection was clear and approximately 60 degrees. The visual inspection consisted of a thorough site walk. O'Brien & Gere team members observed the processing pad, concrete sluiceway, settling cell, settling pond, inboard slopes, outboard slopes, outlet structure, and the downstream area including the cottage community. The site layout of Residual Waste Ash Basin No.1 is shown in Figure 2.

Photos of relevant features and conditions observed during the inspection were taken by O'Brien & Gere and are provided in Appendix B. Photograph locations are provided in Figure 3.

4.2. SUMMARY OF FINDINGS

The following observations were made during the inspection:

- Bottom ash is brought to the settling cell and settling pond via a concrete sluiceway.
- The Basin was observed to be 70% full of bottom ash and fly ash. The full (closed) section has formed a solid working surface now used for bottom ash recovery and storage for beneficial use, stockpile of soil for basin closure, and storage of operating equipment and supplies for the electrical generation station.
- Rolling Green Run flows adjacent to the south and east embankments.
- There is no major settlement on the crest, although some rutting from vehicle traffic is present.
- Portions of the filled interior area of the basin have been vegetated, including trees on the ash fill along the east embankment adjacent to open water at the south end of the basin.
- A summary of the conditions of the embankments is presented below:

  East Embankment -The east embankment is separated from the Susquehanna River by remnants of the former Pennsylvania Canal, including the canal and its river-side berm and Rolling Green Run. The entire outboard slope is heavily overgrown with trees and woody vegetation that made it impossible to closely examine this slope of the embankment. The inboard slope of the embankment is built up with fill along its entire length and vegetated with trees or grasses. The Residual Waste Permit Application states that trees were left in place on the east embankment to prevent erosion of the embankment from Susquehanna River flooding.

  South Embankment – The embankment slopes were clear of trees, but there is tree growth immediately at the toe of the outboard slope. The slopes have been cleared in the past, but some new woody vegetation is present. There does not appear to be any major scarps, slides or cracking on the embankment, although the brush vegetation made a close inspection difficult.

  West Embankment - There are no large trees, but some new woody vegetation is present on the embankment. The vegetation made a close inspection difficult, but it appears some minor cracking and scarps are present on the lower portions of both the inboards and outboard slopes.

  North Embankment -The interior of the Basin is filled to the embankment crest. No major scarps, slides or cracking on the embankment crest or outboard slopes, which average approximately two feet above existing grades to the north. Vehicle access to the Basin's interior is via an unpaved roadway over the embankment.

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5. CONCLUSIONS

Based on the ratings defined in the project Scope of Work (Satisfactory, Fair, Poor, and Unsatisfactory), the information reviewed and the visual inspection, the overall condition of the Residual Waste Ash Basin No. 1 is considered to be **POOR**. The Basin appears in fair condition and acceptable performance is expected under static and seismic loading conditions; however, there is insufficient information to draw a conclusion about the Basin's performance in a flood event. Additionally, some deficiencies exist that require repair and/or additional studies or investigations. The deficiencies include the following:

- There is significant undesirable and uncontrolled trees and woody vegetation growth on the east embankment slopes, new woody vegetation emerging on the south and west embankment slopes, and trees located immediately at the toe of the south embankment outboard slope.
- There is some rutting from vehicle traffic along the crest of the embankments.

The permit application submitted to the PADEP, Division of Waste Management had a detailed stability analysis which indicates acceptable factors of safety for static and dynamic loading conditions. The conditions observed and data provided indicate that the assumptions used in the analysis are based on current as-built conditions and are valid and/or conservative. A visual inspection identified maintenance concerns, but no major structural deficiencies. Based on these criteria, the Basin is expected to perform acceptably under these loading conditions.

The stability analysis did not examine the loading conditions in a regulatory flood, conventionally required in dam safety evaluations. A hydrologic and hydraulic analysis conducted as part of the Residual Waste permit application and concluded that the Basin could pass the 24 hour 25-year storm with acceptable freeboard. A review of these analyses showed them to be based on valid assumptions. The regulatory flood for a dam of the size of the Basin would, however, be in the range from the 100-year storm to the Probable Maximum Flood (PMF).

The 100-year, 24-hour storm is approximately 6.1 inches and the basin would be able to absorb the entire volume of runoff without overtopping. However, based on a range of 25-40 inches, overtopping is a possibility during the PMF. A more detailed hydrologic/hydraulic analysis of the Basin would be necessary to determine an appropriate regulatory flood; to document capacity of the spillway/outlet to prevent overtopping in that flood event; and to establish loading conditions for a maximum surcharge pool stability analysis.

Based on these findings, we are of the opinion that the operations and maintenance procedures being practiced at the Residual Waste Ash Basin No. 1 are adequate, in relationship to Solid Waste Management, but not Dam Safety regulations.

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6. RECOMMENDATIONS

Based on the findings of our visual inspection and review of the available records for the Residual Waste Ash Basin No. 1, O'Brien & Gere recommends Sunbury Generation LP work with the PADEP, Division of Dam Safety to develop a plan for dealing with the trees and woody vegetation growth from the embankments. The trees on the east embankment provide stability and protection from Susquehanna River flood waters. These benefits will have to be weighed against the documented threats to dam safety associated with the growth of trees on dams embankments. There is, however, water impounded against the south embankment and that embankment should be maintained consistent with conventional dam safety practices, including the removal of woody vegetation. O'Brien & Gere also recommends Sunbury Generation LP work with the PADEP, Division of Dam Safety to bring the Basin into compliance with current state regulations.

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 the dam in the near term.

6.2. LONG TERM IMPROVEMENT

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

- Under the guidance of the PADEP, Division of Dam Safety, remove selected trees and woody vegetation from the embankments. Conduct a dam breach analysis to determine the extent of inundation to the cottage community located near the southeast embankment. The results of the breach analysis can be used to establish/confirm the hazard classification.
- A formal spillway capacity analysis should be conducted based on the regulatory flood event.
- Updated slope stability analyses should be performed to include evaluation of the maximum surcharge pool loading condition.
- Plan for a regular (annual) inspection by a PE with dam safety experience, including an inspection following removal of the trees from the embankment slopes.
- Work with the PADEP, Division of Dam Safety to bring the Basin into compliance with current state dam safety regulations including preparation of an Emergency Action Plan and Operations and Maintenance Plan, as required.

6.3. MONITORING AND FUTURE INSPECTION

O'Brien & Gere recommends that Sunbury Generation LP continue the schedule of quarterly inspections while it works with PADEP, Division of Dam Safety to develop an Operations and Monitoring Plan. Consideration should also be given to independent inspections by licensed dam safety engineers on at least a biennial basis.

6.4. TIME FRAME FOR COMPLETION OF REPAIRS/IMPROVEMENTS

We recommend that Sunbury Generation LP contact the PADEP, Division of Dam Safety and develop a plan to remove the vegetation, perform the necessary engineering evaluations, conduct a spillway evaluation and slope stability analyses and complete other acquired documentation for compliance with Pennsylvania Dam Regulations by the end of 2010. The completion date for the repairs and engineering documents should be determined by the PADEP, Division of Dam Safety.

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6.5. CERTIFICATION STATEMENT

I acknowledge that the Residual Waste Ash Basin No. 1 CCW Management unit referenced herein was personally inspected by me on May 10, 2010 and was found to be in the following condition:

~~SATISFACTORY~~

~~FAIR~~

POOR

~~UNSATISFACTORY~~

Signature: _____ Date: December 7, 2010

Gary Emmanuel, PE
PA PE # 030497-E

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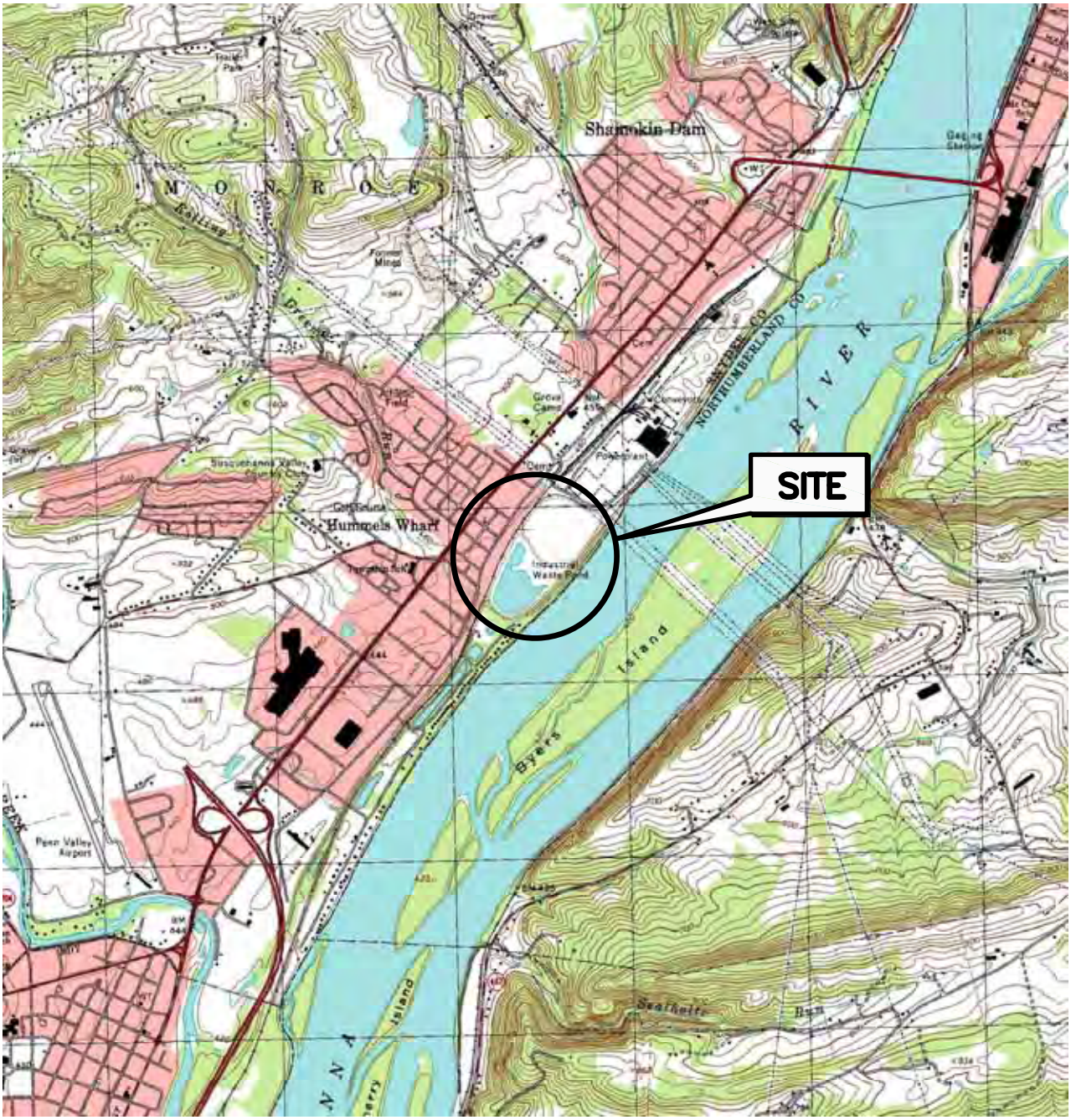
FIGURE 1



ADAPTED FROM: SUNBURY QUADRANGLE, PENNSYLVANIA U.S.G.S. 7.5 MIN. QUAD 1999

QUADRANGLE LOCATION

US EPA
DAM SAFETY ASSESSMENT OF CCW IMPOUNDMENTS

SUNBURY GENERATION, LP
SHAMOKIN DAM, PENNSYLVANIA

SITE LOCATION MAP

3000 0 3000

1"=3000'

46122-SUNBURY-F01

DECEMBER 2010

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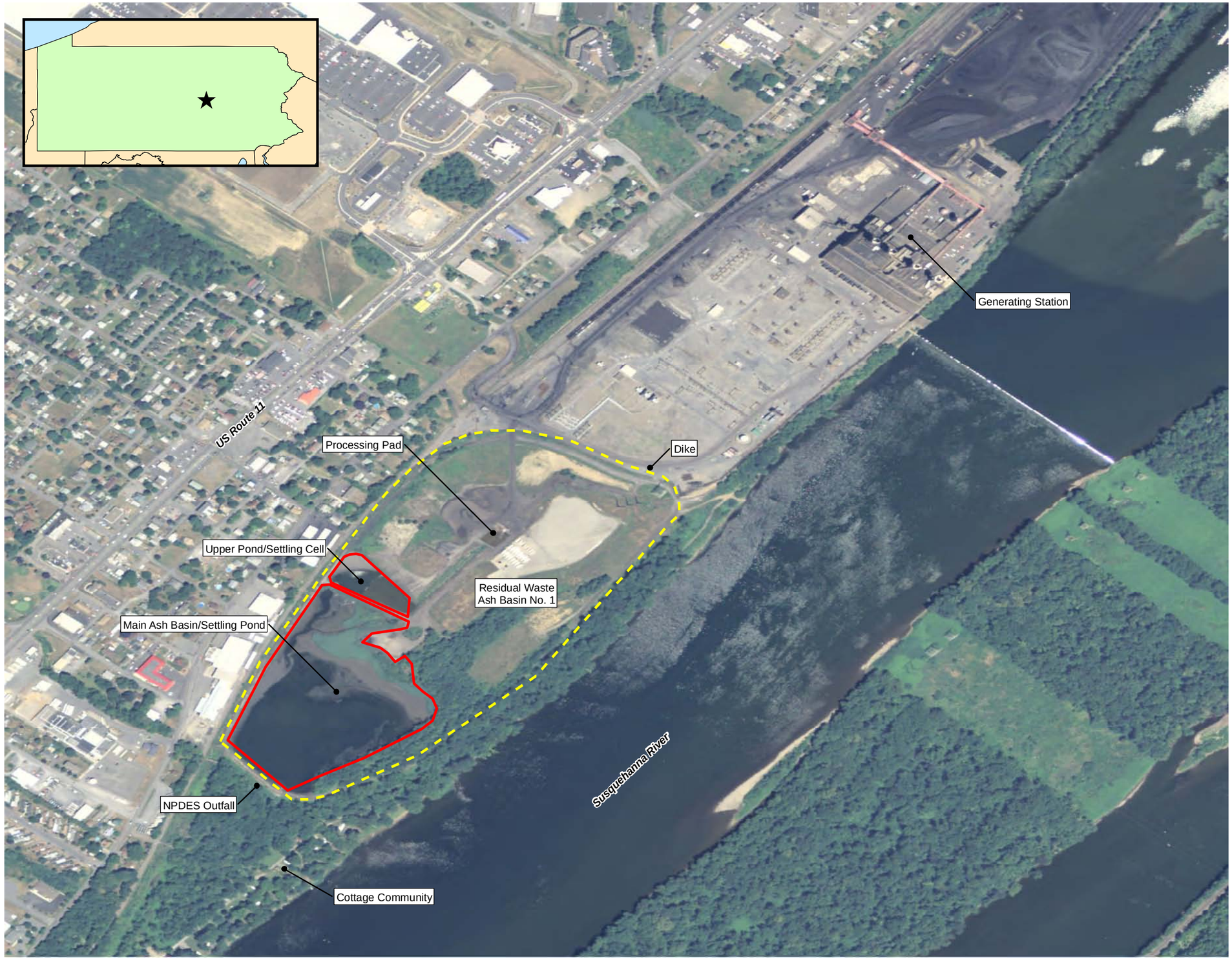
FIGURE 2



NOTE
Aerial imagery provided by National Agriculture Imagery Program (USDA), 2010.

SUNBURY GENERATION, LP
MONROE TOWNSHIP, PA

SITE LAYOUT

0 300 600 1,200
Feet

DECEMBER 2010
13498/46122

O'BRIEN & GERE

NAME: KaufmaDR

DATE: 11/29/2010 8:22:50 AM

This document was developed in color. Reproduction in B/W may not represent the data as intended.

US EPA ARCHIVE DOCUMENT

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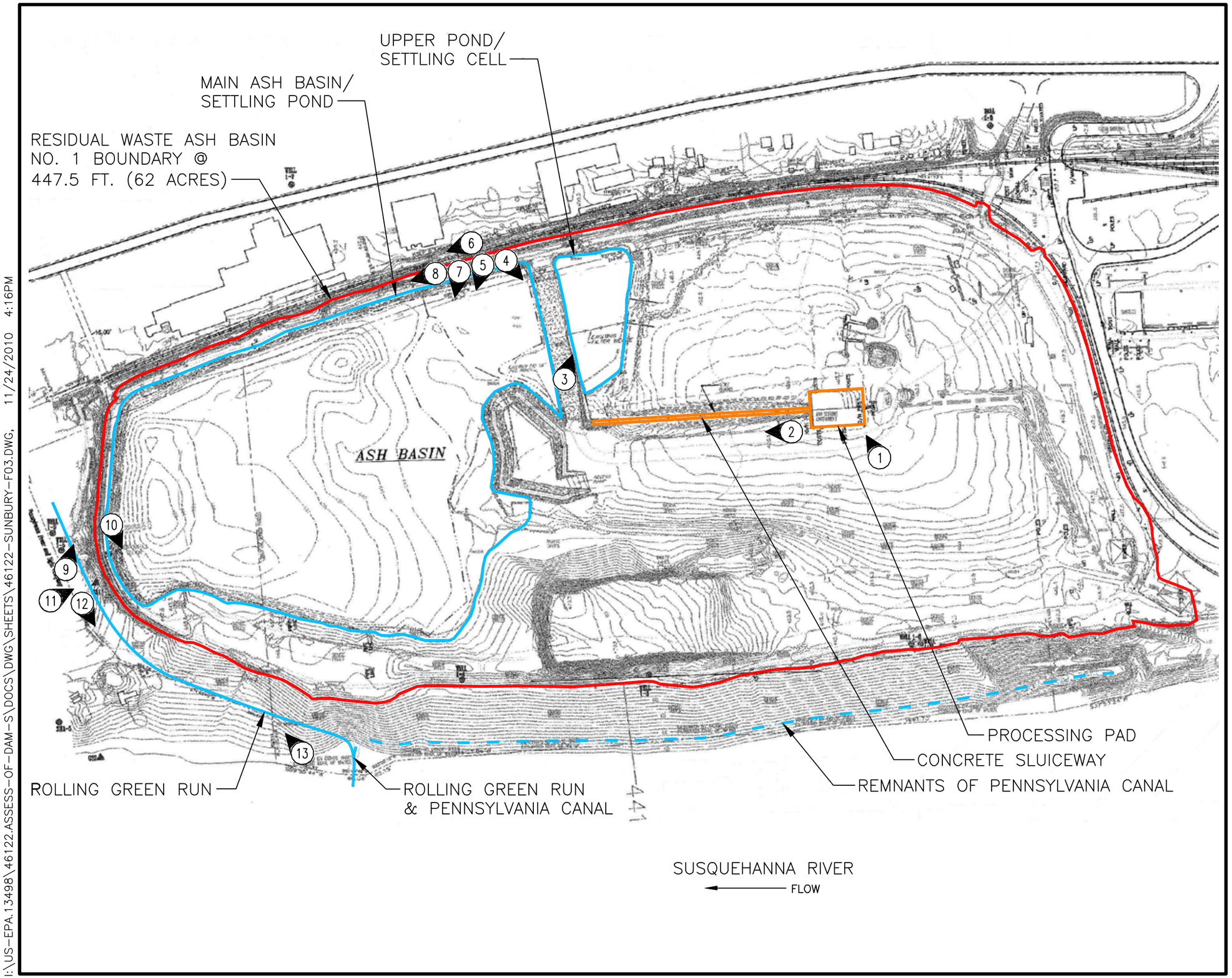
FIGURE 3



LEGEND:

1 PHOTOGRAPH NUMBERS, LOCATION AND DIRECTION OF VIEW

US EPA
DAM SAFETY ASSESSMENT
OF CCW IMPOUNDMENTS

SUNBURY GENERATION LP
SHAMOKIN DAM,
PENNSYLVANIA

PHOTOGRAPH LOCATIONS

1"=240' 240 0 240

46122-SUNBURY-F03
DECEMBER 2010

O'BRIEN & GERE

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APPENDIX A

Visual Inspection Checklist

US EPA ARCHIVE DOCUMENT

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Sunbury Generation, LP	Date:	May 10, 2010
Unit Name:	Residual Waste Ash Basin No.1	Operator's Name:	Sunbury Generation, LP
Unit I.D.:	N/A	Hazard Potential Classification:	High ✓ Significant Low
Inspector's Name:	Gary Emmanuel, 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?	N/A		18. Sloughing or bulging on slopes?	✓	
2. Pool elevation (operator records)?	441.0		19. Major erosion or slope deterioration?		
3. Decant inlet elevation (operator records)?	441.0		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	441.0		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	447.0		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

See Attached Comment Sheet

US EPA ARCHIVE DOCUMENT

Comment Sheet

Residual Waste Ash Basin No.1

2-4. Elevation estimated based on visual inspection. Actual elevation is not measured or recorded by the facility. The highest elevation would be 445 feet, based on 2 feet of permit required freeboard. Decant elevation is managed with stop logs.

6. Impoundment discharge is continuously recorded at the outlet. Two monitoring wells are located on the east embankment and sampled quarterly for water quality.

9. The south and east embankments are heavily wooded. The largest tree is approximately 15 inches in diameter based on a visual inspection.

11. There is some minor rutting from vehicle traffic and ponding along the crest.

12. N/A

15. The west diversion ditch is overgrown in spots and free flow is also affected by sediment deposits associated with storm sewer discharge and embankment erosion.

17-22. The east and south embankment slopes are heavily vegetated with uncut trees and brush that prevented a detailed inspection of the slopes. No evidence of major cracks, scarps, sloughing, bulging, or erosion in the south and east slopes was observed from the limited view available. The slopes of the west embankment are very steep with resulting sloughing and erosion on the lower portions of the slope. No evidence of surface movements was observed in the valley bottom, though this area is likewise heavily vegetated.

23. Rolling Green Run flows adjacent to the south embankment. A diversion ditch flows along the west embankment, receiving discharges from numerous storm drainage systems on adjacent properties.

US EPA ARCHIVE DOCUMENT

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # PA0008451 INSPECTOR Gary Emmanuel, P.E.

Date: May 10, 2010

Impoundment Name: Residual Waste Ash Basin No.1
Impoundment Company: Sunbury Generation, LP
EPA Region: Region III: The Mid-Atlantic Region
State Agency (Field Office) Address: Pennsylvania Department of Environmental Protection
North Central Region
208 West Third Street, Suite 101
Williamsport, PA 17701

Name of Impoundment: Residual Waste Ash Basin No.1 (Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New _____ Update X

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

IMPOUNDMENT FUNCTION: To store bottom ash, dewatered sludge from the wastewater treatment facility, river silt from the water intake tunnel cleanings, captive clean construction demolition wastes, and stormwater.

Nearest Downstream Town : Name Hummels Wharf
Distance from the impoundment 0 miles

*Nearest drinking water intake is Dauphin Municipal Water Authority, 22 miles downstream.

US EPA ARCHIVE DOCUMENT

Impoundment
Location: Longitude -76 Degrees 50 Minutes 05 Seconds
Latitude 40 Degrees 49 Minutes 49 Seconds
State PA County Snyder

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

If So Which State Agency? Pennsylvania Department of Environmental Protection, Division of Waste Management

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.

_____ **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.

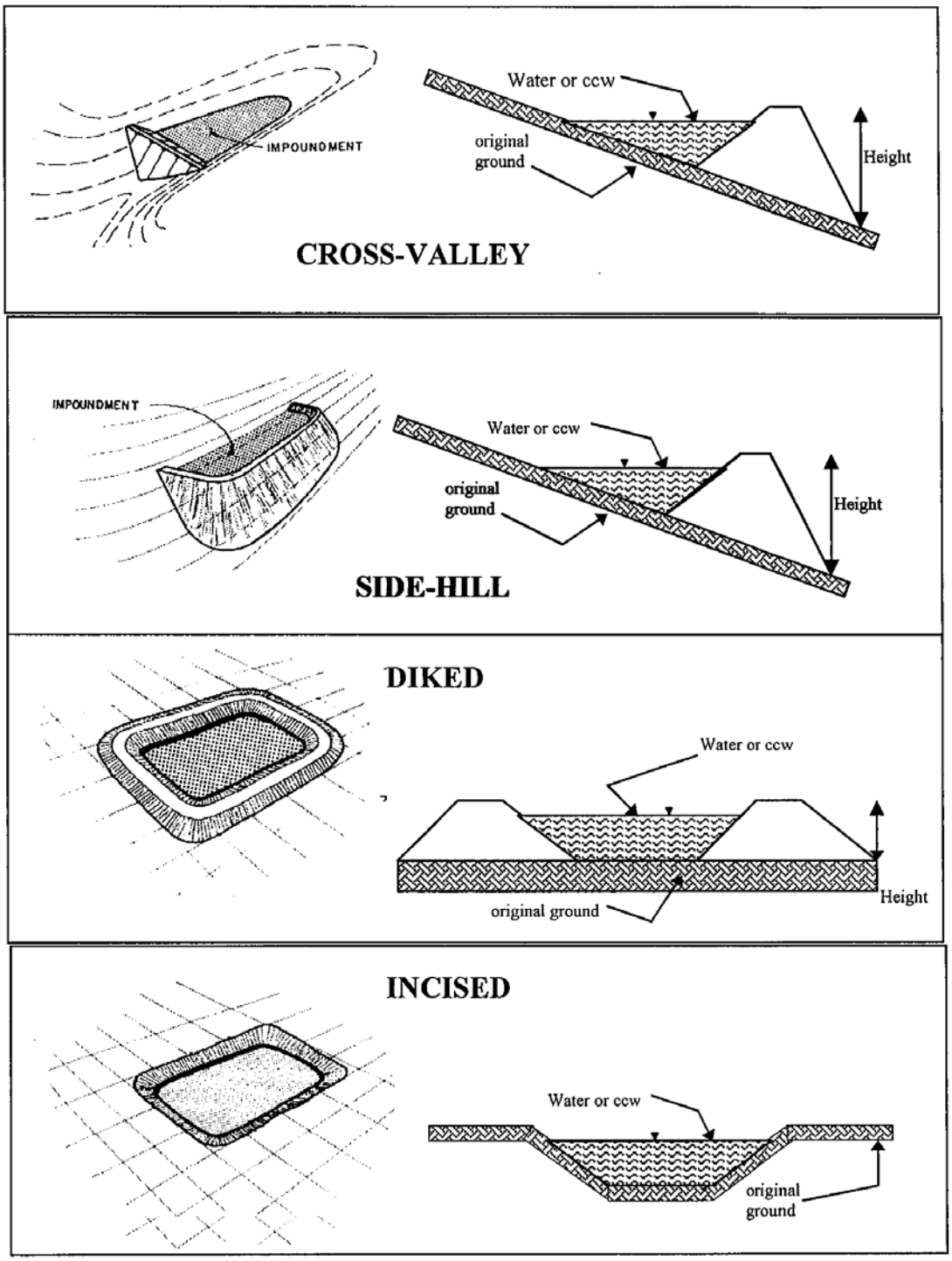
X **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

There is a community of cottages located along River Road, southeast of Residual Ash Basin No.1. If the impoundment were to fail, the cottages could be inundated causing loss of property and possible loss of life. The release of ash from the Basin would drain directly into Rolling Green Run and the Susquehanna River, causing significant environmental damage.

US EPA ARCHIVE DOCUMENT

CONFIGURATION:



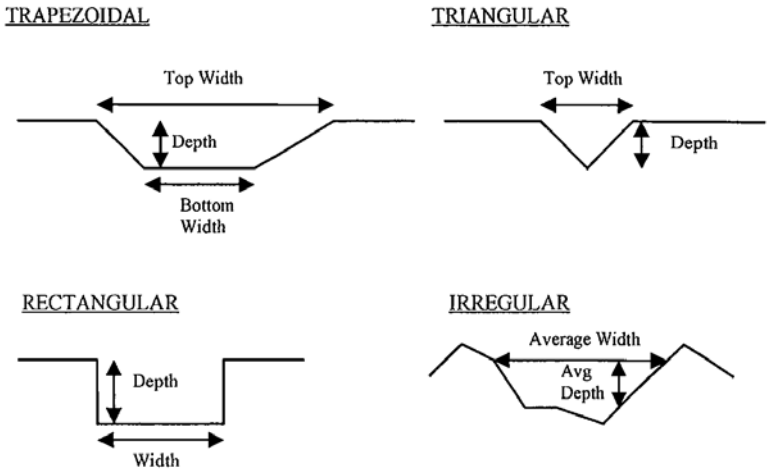
_____Cross-Valley
_____ Side-Hill
_X___ Diked
_____ Incised (form completion optional) _____ Combination Incised/Diked

Embankment Height 23 feet
Embankment Material Earth
Pool Area 62 Permit, 16 Current (acres)
Liner N/A
Current Freeboard 2 feet (by permit)
Liner Permeability N/A

US EPA ARCHIVE DOCUMENT

TYPE OF OUTLET (Mark all that apply)

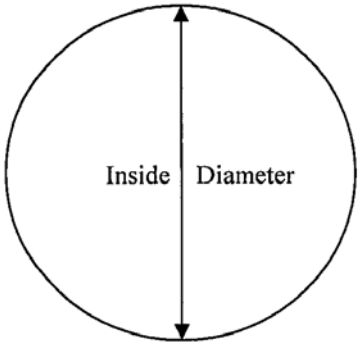
__X__ **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
__X___Rectangular
_____ Irregular



Varies depth
5' 2"__ bottom (or average) width
N/A___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**

_____ **Other Type of Outlet** (specify) _____

The Impoundment was Designed By: Pennsylvania Power and Light

Has there ever been a failure at this site? YES _____ NO__X_____
If So When? _____

If So Please Describe : _____

US EPA ARCHIVE DOCUMENT

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: _____
_____
_____

US EPA ARCHIVE DOCUMENT

APPENDIX B

Site Plan/Photographic Log

US EPA ARCHIVE DOCUMENT

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Residual Waste Ash Basin No. 1	Location: Sunbury Generation LP – Shamokin Dam, PA

Orientation:

Description: View of Processing Pad/Sluice Trough

Date: May 10, 2010

Photo Number: 1

Photographer: G. Emmanuel, P.E.

Orientation: West

Description: View of the Concrete Sluiceway from Processing Pad to Upper Settling Cell.

Date: May 10, 2010

Photo Number: 2

Photographer: G. Emmanuel, P.E.

US EPA ARCHIVE DOCUMENT

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Residual Waste Ash Basin No. 1	Location: Sunbury Generation LP – Shamokin Dam, PA

Orientation: Northeast

Description: View of Settling Cell. Turbidity Barrier splits Cell to concentrate solids settling.

Date: May 10, 2010

Photo Number: 3

Photographer: G. Emmanuel, P.E.

Orientation:

Description: Pipes connecting the Upper Settling Cell and main Settling Pond

Date: May 10, 2010

Photo Number: 4

Photographer: G. Emmanuel, P.E.

US EPA ARCHIVE DOCUMENT

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Residual Waste Ash Basin No. 1	Location: Sunbury Generation LP – Shamokin Dam, PA

Orientation: Southwest

Description: View of the Settling Pond

Date: May 10, 2010

Photo Number: 5

Photographer: G. Emmanuel, P.E.

Orientation:

Description: Outboard slope along west embankment

Date: May 10, 2010

Photo Number: 6

Photographer: G. Emmanuel, P.E.

US EPA ARCHIVE DOCUMENT

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Residual Waste Ash Basin No. 1	Location: Sunbury Generation LP – Shamokin Dam, PA

Orientation:

Description:
Inboard slope along west embankment

Date:
May 10, 2010

Photo Number:
7

Photographer:
G. Emmanuel, P.E.

US EPA ARCHIVE DOCUMENT

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Residual Waste Ash Basin No. 1	Location: Sunbury Generation LP – Shamokin Dam, PA

Orientation: West

Description: Crest of west embankment

Date: May 10, 2010

Photo Number: 8

Photographer: G. Emmanuel, P.E.

Orientation:

Description: Outboard slope along south embankment

Date: May 10, 2010

Photo Number: 9

Photographer: G. Emmanuel, P.E.

US EPA ARCHIVE DOCUMENT

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Residual Waste Ash Basin No. 1	Location: Sunbury Generation LP – Shamokin Dam, PA

Orientation:

Description: Settling Pond/Main Settling Pond Outlet Structure. Note trees on ash fill on the inboard side of the east embankment in background.

Date: May 10, 2010

Photo Number: 10

Photographer: G. Emmanuel, P.E.

Orientation:

Description: Weir for flow monitoring at NPDES outfall to Rolling Green Run.

Date: May 10, 2010

Photo Number: 11

Photographer: G. Emmanuel, P.E.

US EPA ARCHIVE DOCUMENT

O'BRIEN & GERE

PHOTOGRAPHIC LOG

Client: US EPA	Project Number: 46122
Site Name: Residual Waste Ash Basin No. 1	Location: Sunbury Generation LP – Shamokin Dam, PA

Orientation:

Description: Rolling Green Run channel downstream of NPDES outfall and along toe of south embankment slope.

Date: May 10, 2010

Photo Number: 12

Photographer: G. Emmanuel, P.E.

Orientation:

Description: Outboard slope of south embankment

Date: May 10, 2010

Photo Number: 13

Photographer: G. Emmanuel, P.E.

US EPA ARCHIVE DOCUMENT