



COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

VALLEY REGIONAL OFFICE

P.O. Box 3000, Harrisonburg, Virginia 22801

(540) 574-7800 Fax (540) 574-7878

located at 4411 Early Road, Harrisonburg, VA

www.deq.virginia.gov

Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

Amy Thatcher Owens
Regional Director

November 7, 2016

By Email (cathy.c.taylor@dom.com)

Ms. Cathy C. Taylor
Director, Electric Environmental Services
Dominion Resources Services, Inc.
5000 Dominion Boulevard
Glen Allen, Virginia 23060

Re: Concept Engineering Report – West Treatment Pond
Virginia Pollutant Discharge Elimination System (VPDES) Permit No. VA0004138
Dominion – Bremo Power Station

Dear Mr. Taylor:

The Concept Engineering Report (CER) received under cover letter dated November 3, 2016, for the above referenced project is approved. This action is in accordance with a memorandum dated November 7, 2016, a copy of which is enclosed for your information. As stipulated in Part I.G.5 of the facility's VPDES permit, noncompliance with the CER shall be deemed a violation of the permit.

The Department of Environmental Quality approval does not relieve you of your responsibility to:

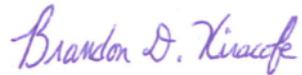
1. Construct the treatment system in accordance with the approved CER;
2. Operate the treatment system in a manner to consistently meet the facility's performance requirements;
3. Correct design and/or operation deficiencies; or
4. Comply with all other applicable laws and regulations.

Part I.G.5 of VPDES Permit No. VA0004138 requires that no later than 14 days following completion of construction of any project for which a CER has been approved, written notification shall be submitted to the DEQ-Valley Regional Office certifying, that based on an inspection of the project, construction was completed in accordance with the approved CER.

Nothing in this CER approval preempts, modifies, or otherwise alters any effluent limitations or monitoring requirements in VPDES Permit No. VA0004138.

If you have any questions, please contact Bev Carver of our office at beverley.carver@deq.virginia.gov or (540) 574-7805.

Sincerely,



Brandon D. Kiracofe
Regional Water Permits & Compliance Manager

Enc.: Concept Engineering Report Memo

cc: Paula Hamel (paula.a.hamel@dom.com)
Jason Williams (jason.e.williams@dom.com)
Ken Roller (kenneth.roller@dom.com)
Taylor L. Engen (taylor.l.engen@dom.com)
Correspondence File

MEMORANDUM
DEPARTMENT OF ENVIRONMENTAL QUALITY
VALLEY REGIONAL OFFICE

4411 Early Rd., P.O. Box 3000

Harrisonburg, VA 22801

SUBJECT: Concept Engineering Report
West Treatment Pond
Dominion – Bremo Power Station, VPDES Permit No. VA0004138

TO: Brandon D. Kiracofe, Regional Water Permits & Compliance Manager

FROM: Bev Carver

DATE: November 7, 2016

COPIES: Correspondence File

Project Name: Concept Engineering Report – West Treatment Pond

Project Owner: Virginia Electric and Power Company

Project Scope: Following removal of Coal Combustion Residuals from the West Ash Pond in accordance with the Virginia Solid Waste Management Regulations, the re-purposed eastern portion of the former West Ash Pond will be lined with a geomembrane liner system and placed back in service as the West Treatment Pond with a discharge via Outfall 002.

Staff Comments: The staff has no objections to the facilities as proposed in Dominion’s submittal dated November 3, 2016.

STAFF RECOMMENDATIONS:

The staff recommends that the Concept Engineering Report be approved.



Overnight Mail
Return Receipt Requested

November 3, 2016

Ms. Beverly Carver
Senior Water Permit Writer
Virginia Department of Environmental Quality
Valley Regional Office
4411 Early Road, Harrisonburg, VA 22801

RE: Dominion Brema Power Station VPDES Permit No. VA0004138:
Revised Concept Engineering Report for the West Treatment Pond

Dear: Ms. Carver:

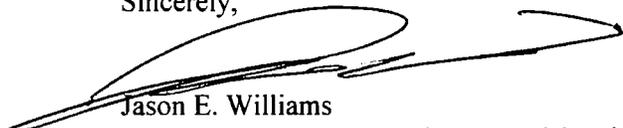
Enclosed is a revised Concept Engineering Report (CER) for the proposed West Treatment Pond at Dominion's Brema Power Station. The CER submitted by cover letter dated August 29, 2016 has been updated as follows:

1. Updated the revision month and revision number
2. Added Appendix A (XR-5 Geomembrane Specification)
3. Section 2.1 - changed "sources are expected to be routed" to "sources may be routed"
4. Section 2.1.7 - changed "Stormwater Treatment Pond" to "Stormwater Management Pond"
5. Section 3.0 - specified the CCR being removed as "from the West Ash Pond, in accordance with the Virginia Solid Waste Management Regulations (VSWMR)"
6. Section 3.0 - removed the last two sentences of the first paragraph starting with "Construction of the West Treatment Pond will involve..."
7. Revised Drawing 2 to correctly label outfalls 004 and 003 and changed the drawing title from "Existing Site Map" to "Existing Outfall Location Map"
8. Revised Drawing 5 to label outfall 009 in the West Treatment Pond Plan

Please contact Ken Roller of my staff at (804) 273-3494 or by email at kenneth.roller@dom.com should you have any questions or require additional information about this transmittal.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sincerely,



Jason E. Williams
Manager, Generation Environmental Services

ec: Brandon Kiracofe: brandon.kiracofe@deq.virginia.gov
Beverly Carver: beverley.carver@deq.virginia.gov



**Concept Engineering Report:
West Treatment Pond**

**CONCEPT ENGINEERING
REPORT:
WEST TREATMENT POND**

Bremo Power Station



Dominion

Submitted To: Virginia Electric and Power Company
1038 Bremo Road
Bremo Bluff, VA 23022

Submitted By: Golder Associates Inc.
2108 W. Laburnum Avenue
Suite 200
Richmond, VA 23227



**June 2016
Revised October 2016 (Rev. 2)**

1520-347.600

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- Appendix A – XR-5 Geomembrane Specification

1.0 INTRODUCTION

This Concept Engineering Report (CER) has been prepared for the proposed West Treatment Pond at Dominion's Bremo Power Station (Station), located in Fluvanna County, Virginia. The Station converted from a coal-fired power plant to a natural gas-fired power plant in 2014. Coal Combustion Residuals (CCR) from historical coal-fired operations are stored in three impoundments on-site (North Ash Pond, West Ash Pond, and East Ash Pond). Process water from these ponds and other Station activities has historically been discharged with contact stormwater to the James River pursuant to the authorization, limits, and conditions of a Virginia Department of Environmental Quality (DEQ) Virginia Pollutant Discharge Elimination System (VPDES) Permit (Permit No. VA0004138).

Dominion is preparing to close these three CCR surface impoundments in response to the U.S. Environmental Protection Agency's (EPA's) publication of the Federal Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule (40 CFR 257). During closure activities of these three CCR impoundments, Dominion will also close the Metals Cleaning Waste Treatment Basin (Metals Pond) by dewatering and removing accumulated solids. Dominion has prepared this CER to provide a description of the proposed West Treatment Pond, which is expected to be brought on-line following DEQ approval of this CER.

1.1 Site Description

The Bremo Power Station is owned and operated by Virginia Electric and Power Company (Dominion) in Fluvanna County, Virginia, at 1038 Bremo Road, just east of Route 15 (James Madison Highway) and north of the James River. The location of the Station is illustrated on the inset United States Geological Survey (USGS) topographic map on Drawing 1. An existing site map is presented on an aerial photograph as Drawing 2. The Station property consists of wooded, open, and developed land just north of the James River. The Station's northern, eastern, and western boundaries are bordered by primarily undeveloped parcels, and the Station is bordered to the south by a CSX rail line and the James River. Land use surrounding the Station is classified as "A-1 Agricultural," and consists of undeveloped wooded and agricultural properties within a rural residential setting.

2.0 WASTEWATER SOURCES

The existing outfalls and wastewater sources are shown on the existing site map on Drawing 2. Drawing 3 depicts the proposed outfall locations and wastewater sources after the closure activities for the West (western portion), North, and East Ash Ponds, and the Metals Pond are complete. Drawing 4 is a Process Flow Diagram showing the final wastewater sources after the closure activities are complete. These wastewater sources are described below.

2.1 During Closure

The following wastewater sources may be routed to the West Treatment Pond during the closure activities for the CCR impoundments and Metals Pond.

2.1.1 Metals Pond Pumped Decant Water

Metals Pond Pumped Decant Water is surface water that has accumulated in the Metals Pond and needs to be removed as an initial step to facilitate closure. In the past, this water was periodically pumped to the West Ash Pond via internal outfall 202 for ultimate discharge to the James River via outfall 002.

Decanting shall be accomplished by pumping the decant water to the centralized source water treatment system (CSWTS) for treatment prior to discharge via internal outfall 504. Alternatively, the Metals Pond Pumped Decant Water may be transported off-site for treatment and/or disposal at a permitted facility.

2.1.2 Metals Pond Contact Stormwater

Metals Pond Contact Stormwater is stormwater that, following removal of the decant water, has contacted the accumulated material in the Metals Pond during closure of the Metals Pond. Metals Pond Contact Stormwater will need to be removed from the Metals Pond to facilitate closure. The Metals Pond Contact Stormwater will be routed to the CSWTS for treatment prior to discharge via internal outfall 504. Alternatively, the Metals Pond Contact Stormwater may be transported off-site for treatment and/or disposal at a permitted facility.

2.1.3 Metals Pond Material Dewatering Water

Metals Pond Material Dewatering Water is the water that will be produced from dewatering the accumulated material in the Metals Pond to allow for its removal and off-site disposal. This waste stream will be directed to the CSWTS for treatment prior to discharge through internal outfall 504, or may be transported off-site for disposal at a permitted facility.

2.1.4 Ash Pond Decant Water

Ash Pond Decant Water includes surface waters that result from the commingling of a number of wastewater types, historically including but not necessarily limited to the following: ash pond contact stormwater, low-volume Station wastewater, sewage treatment plant discharges, ash dewatering water, and waters that are used to convey CCR to an impoundment through sluicing or dredging. As an initial step in the process leading to closure of the ash impoundments, it will be necessary to remove the Ash Pond Decant Water to dewater the CCR sufficiently to allow for preparation of a stable surface on which to construct the closure cap, or to initiate CCR removal. Ash Pond Decant Water will be routed to the CSWTS for treatment and discharge through internal outfall 504, or transported off-site for disposal at a permitted facility.

2.1.5 Ash Pond Contact Stormwater

Ash Pond Contact Stormwater is stormwater that has contacted the CCR in the North, East, and West Ash Ponds, and is considered process wastewater. This waste stream will be directed to the CSWTS for treatment prior to discharge through internal outfall 504, or transported off-site for disposal at a permitted facility.

2.1.6 Ash Pond Ash Dewatering Water

Ash Pond Ash Dewatering Water is considered to be the pore water within the CCR mass in the West, North, and East Ash Ponds. This wastewater refers to the water that is produced from dewatering the CCR to stabilize the CCR and allow for its removal by mechanical dredging or excavation, or to support a closure cap system. Ash Pond Ash Dewatering Water is generated from the CCR dewatering process through mechanical means (e.g., vacuum wells, sump pumps, or other *in situ* withdrawal methods) and from cutting drainage ditches and/or rim ditches into the CCR mass. Ash Pond Ash Dewatering Water will be directed to the CSWTS for treatment prior to discharge through internal outfall 504, or transported off-site for disposal at a permitted facility.

2.1.7 Stormwater Management Pond Discharge

Discharge from the Stormwater Management Pond is a potential wastewater source for the West Treatment Pond during the closure activities for the North, East, and West Ash Ponds and the Metals Pond. Flow from the Stormwater Management Pond is currently being discharged directly to outfall 002 following filtration. Once the West Treatment Pond is constructed, the Stormwater Management Pond will be directed to the West Treatment Pond for solids removal via settling prior to discharge through outfall 002. The Station will also have the ability to transfer water from the West Treatment Pond back to the Stormwater Management Pond, as needed, for use as process make-up water and to facilitate maintenance of the West Treatment Pond.

2.2 Final Conditions

The post-closure wastewater sources to the West Treatment Pond are shown on Drawing 4. After closure of the CCR impoundments and Metals Pond, the discharge from the Stormwater Management Pond will continue to be directed to the West Treatment Pond for treatment via settling. Some Station process waters, and low-volume waste and auxiliary process water may also be intermittently directed to the West Treatment Pond. The Operations and Maintenance (O&M) Manual will be updated to identify the sampling location and procedures for outfall 002, including procedures to be used to estimate flow, based on the final configuration of the West Treatment Pond.

3.0 WEST TREATMENT POND CONSTRUCTION

Following removal of the CCR from the West Ash Pond, in accordance with the Virginia Solid Waste Management Regulations (VSWMR), the re-purposed eastern portion of the former West Ash Pond will be

lined with a 40-mil Ethylene Interpolymer Alloy (EIA) geomembrane liner system (XR-5) (see Attachment A - XR-5 Geomembrane Specification) and placed back in service as the West Treatment Pond with a discharge via outfall 002 (see Drawing 5 - West Treatment Pond Modification Plan).

A new earthen fill embankment will be constructed across the pond to form the new western embankment of the West Treatment Pond to a crest elevation of 234.0 feet above mean sea level (ft amsl). Additional soil fill will be placed on the interior slopes of the existing embankments to flatten the slopes from 2H:1V to 3H:1V and to add an 8-foot-wide safety bench at elevation 228.0 ft amsl. Once the West Treatment Pond embankments are complete, the remainder of the former West Ash Pond and Metals Pond embankments will be removed, and the remainder of the former pond area to the west of the new West Treatment Pond will be graded to drain and seeded.

The existing concrete intake tower will be modified slightly to eliminate the removable stop logs and install a permanent discharge weir crest at elevation 230.0 ft amsl. The outlet weir will have a crest length of 5.5 feet. The existing 42-inch diameter corrugated metal pipe outlet at the base of the tower will remain and continue to the James River through a series of junction boxes, manholes, and pipes via outfall 002. As part of the pond closure project, it is planned to slip-line this pipe to increase its longevity. The O&M Manual will be updated to identify the sampling location and procedures for outfall 002, including procedures to be used to estimate flow, based on the final configuration of the West Treatment Pond.

The XR-5 liner will be underlain by an 8-ounce non-woven cushion geotextile installed over a prepared and inspected subgrade in accordance with the project specifications. Penetrations into the pond liner for the 10-inch diameter stormwater discharge pipe and the 8-inch diameter process water pipe from the station will be secured and booted to provide a watertight seal. The liner will also be connected to the concrete outlet tower near the base of the tower using a batten strip connection for water tightness. Construction Quality Assurance (CQA) oversight during construction will be carried out by third-party inspectors in accordance with the approved CQA Plan. Documentation of the installation, including liner and geotextile deployment, nondestructive and destructive seam testing, repairs, and surveyed record drawings, will be prepared and certified by a licensed professional engineer.

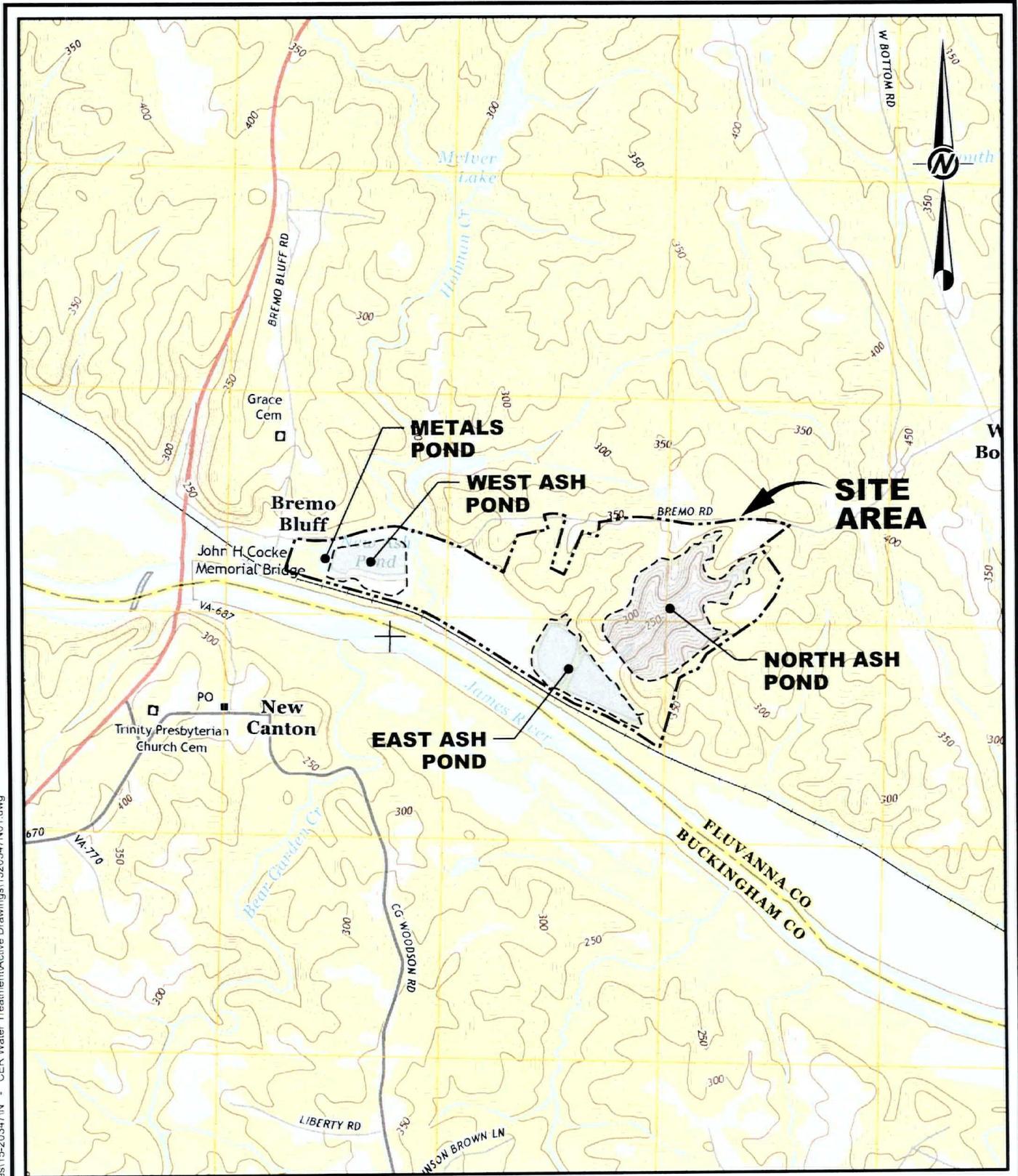
3.1 West Treatment Pond Capacity

Once constructed, the normal pool volume of the West Treatment Pond will be approximately 19,875,000 gallons as measured at the spillway crest (elevation 230.0 ft amsl). At normal pool, the pond has a freeboard of 4 feet. The pond does not have a contributing drainage area other than the pond area itself, approximately 5.9 acres, so stormwater inflows from large storm events are limited to what falls within the pond. The modeled high water level for the 24-hour, 100-year storm event is elevation 231.0 ft amsl.

3.2 Dam Safety

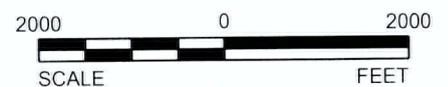
Due to the capacity of the West Treatment Pond being greater than 50 acre-feet (16,300,000 gallons), the West Treatment Pond is regulated under the Virginia Department of Conservation and Recreation (DCR) Dam Safety Program. The West Treatment Pond is anticipated to receive a Hazard Potential Classification of "Low" once construction is complete. Requirements under the DCR certificate include annual inspections, inspection by a licensed professional engineer every 6 years, maintenance of an emergency preparedness plan, and development of breach inundation maps.

DRAWINGS



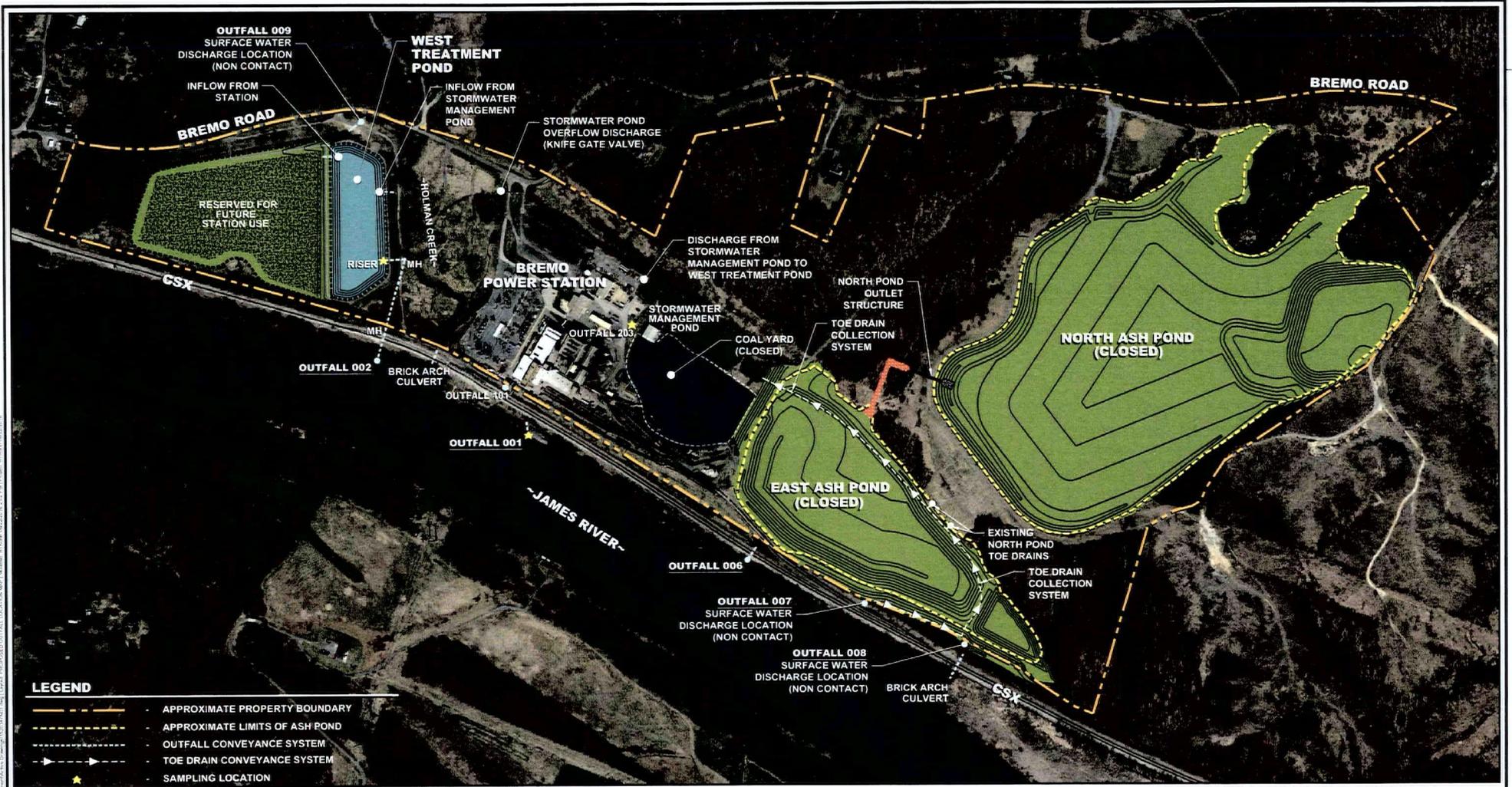
REFERENCE

BASE MAP CONSISTS OF 7.5-MINUTE USGS TOPOGRAPHIC QUADRANGLE NAMED ARVONIA VIRGINIA DATED 2013.



G:\Plan Production Data Files\Drawing Data Files\15-20347N - CER Water Treatment\Active Drawings\1520347N01.dwg

 <p>Golder Associates Richmond, Virginia</p>	DATE	12/1 /15	TITLE	<h2>SITE LOCATION MAP</h2>
	DESIGN	JRD		
PROJECT No.	15-20347	CADD	BPG	<h3>DOMINION - BREMO POWER STATION</h3>
SCALE	AS SHOWN	CHECK	DPM	
REV	0	REVIEW	JRD	



LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- APPROXIMATE LIMITS OF ASH POND
- OUTFALL CONVEYANCE SYSTEM
- TOE DRAIN CONVEYANCE SYSTEM
- SAMPLING LOCATION

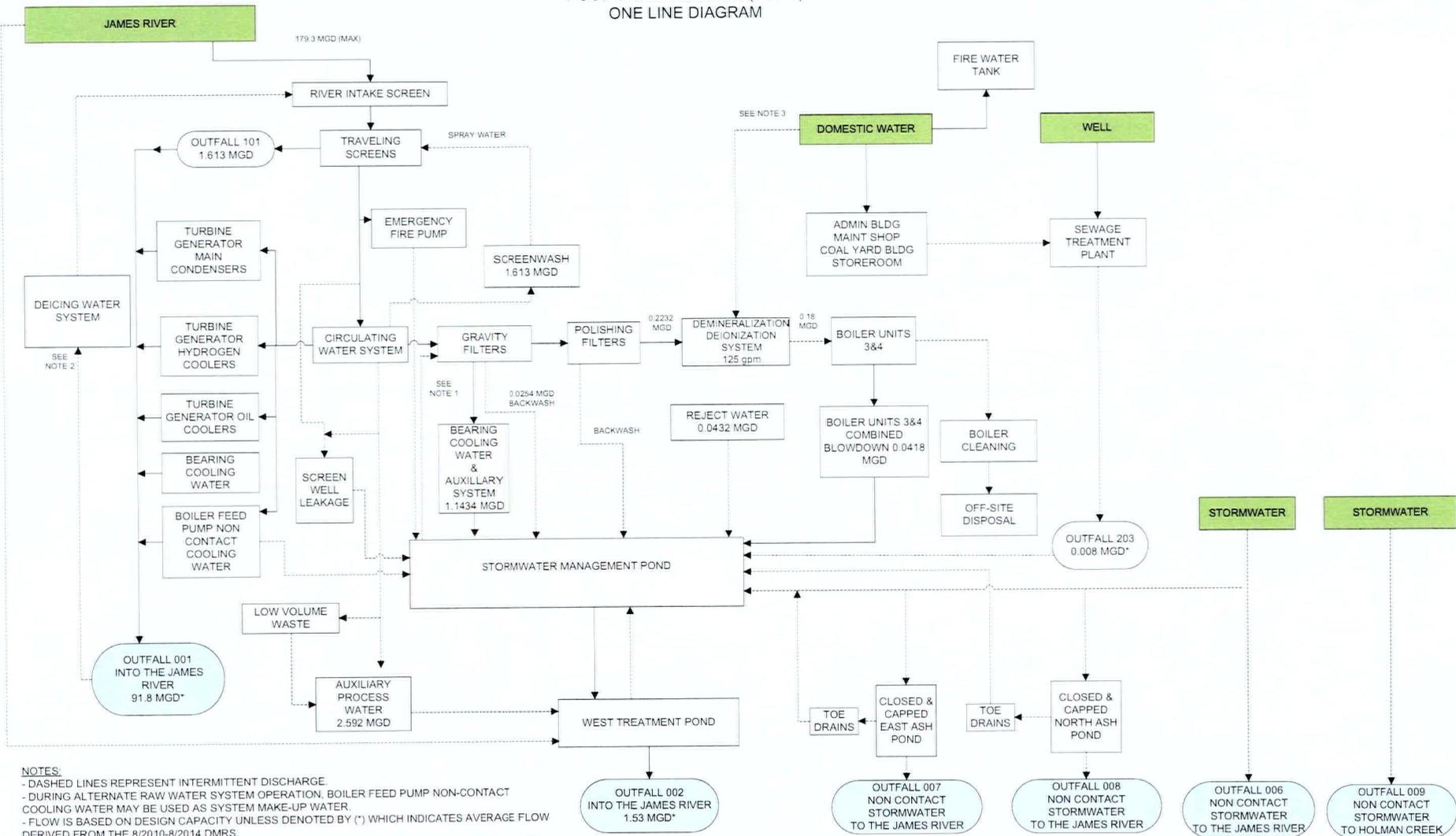
SAMPLING LOCATIONS	
OUTFALL	DESCRIPTION
001	END OF PIPE
002	WIER OF RISER
203	STP WIER



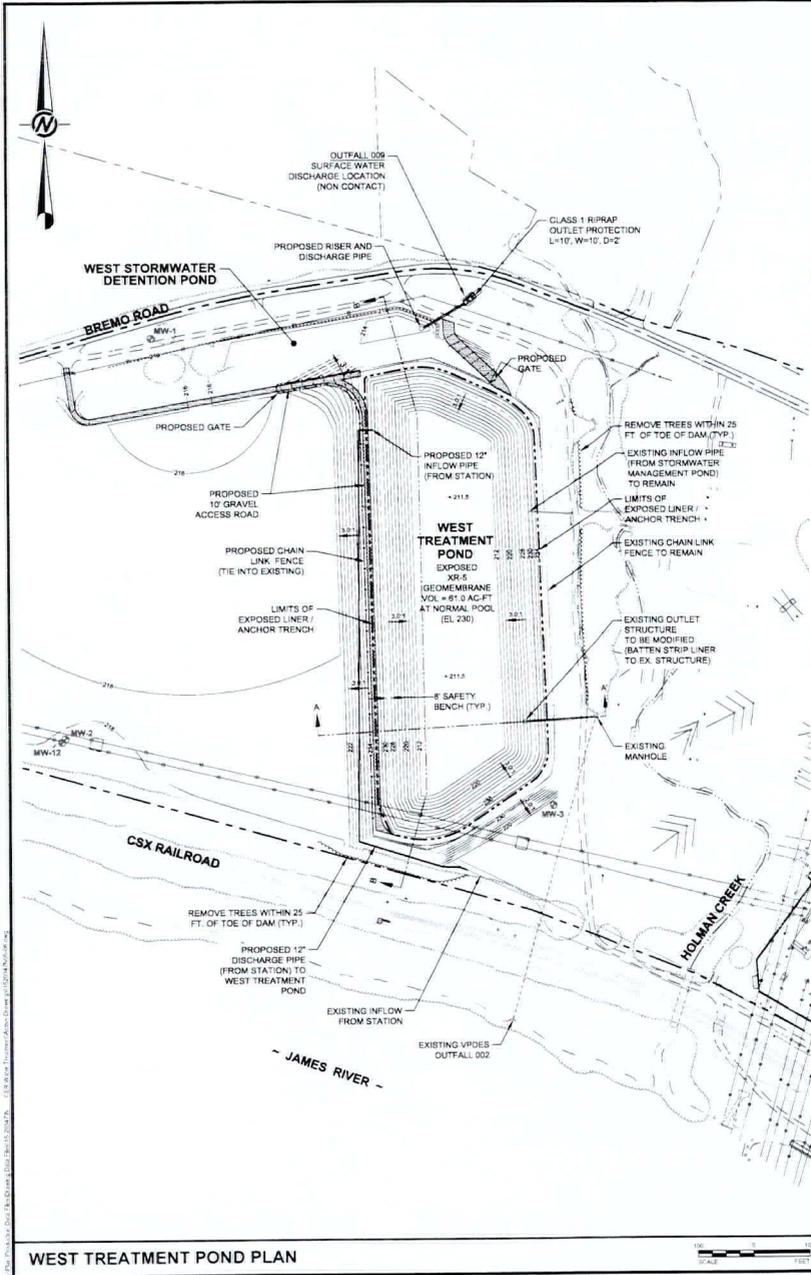
1962/16 REV. DATE	PER DES COMMENTS REVISION DESCRIPTION	JRD DES	ATN CDD	ATN CHK	JRD REV
PROJECT: DOMINION BREMO POWER STATION CCR IMPOUNDMENT CLOSURE WEST TREATMENT POND CER					
PROPOSED OUTFALL LOCATION MAP					
PROJECT No: 15-20347		FILE No: 150347N03			
DESIGN: JRD CADD: ATN CHECK: ATN REVIEW: JRD	06/27/15 06/27/15 06/30/15 06/30/15	SCALE: AS SHOWN	DRAWING 3		



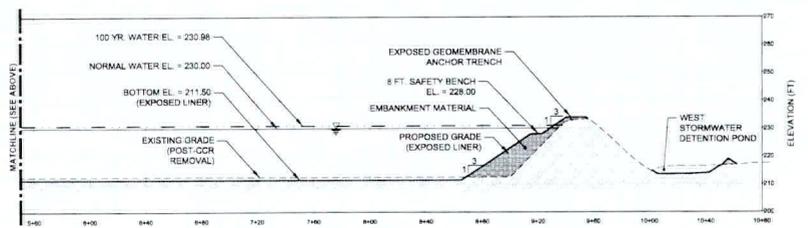
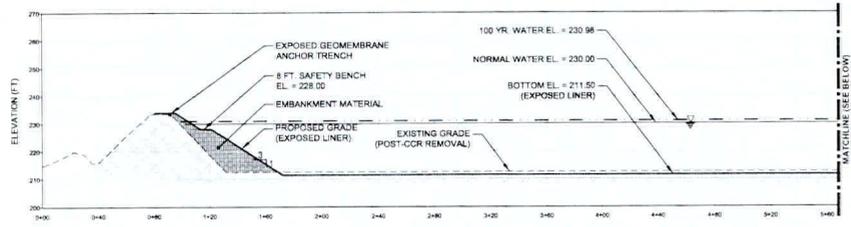
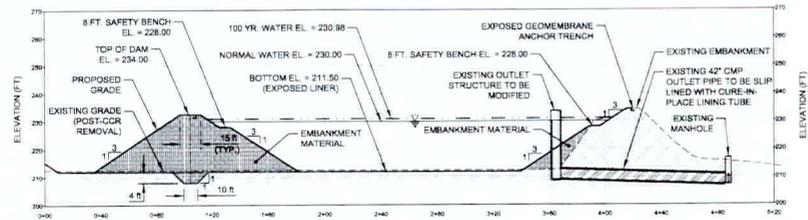
BREMO POWER STATION
STATION WATER FLOW
POST CONSTRUCTION (FINAL)
ONE LINE DIAGRAM



- NOTES:**
- DASHED LINES REPRESENT INTERMITTENT DISCHARGE.
 - DURING ALTERNATE RAW WATER SYSTEM OPERATION, BOILER FEED PUMP NON-CONTACT COOLING WATER MAY BE USED AS SYSTEM MAKE-UP WATER.
 - FLOW IS BASED ON DESIGN CAPACITY UNLESS DENOTED BY (*) WHICH INDICATES AVERAGE FLOW DERIVED FROM THE 8/2010-8/2014 DMRS.
 - 1. ALTERNATE WATER SUPPLY WILL RECIRCULATE 2.8 MGD AND NORMALLY WILL NOT INTERFACE WITH RIVER.
 - 2. DEICING WATER IS USED ONLY DURING SEVERE COLD WEATHER.
 - 3. COUNTY WATER IS USED WHEN RIVER WATER IS TOO TURBID FOR USE AS MAKE-UP WATER.



EMBANKMENT MATERIAL NOTE
 THE EMBANKMENT SOILS ARE SPECIFIED TO BE LOW TO MODERATE PLASTICITY (SPLIP LESS THAN 30), GENERALLY FREE OF ORGANIC MATTER AND OTHER DILETERIOUS MATERIALS AND ROCK FRAGMENTS LARGER THAN 2 INCHES IN ANY DIMENSION. EMBANKMENT SOILS WILL BE COMPACTED IN LIFTS TO AT LEAST 95% OF STANDARD PROCTOR DRY DENSITY. SEE TECHNICAL SPECIFICATIONS FOR COMPLETE MATERIAL DESCRIPTION, INSTALLATION AND TESTING REQUIREMENTS



Golden Associates

NO.	DATE	BY	CHKD	APP'D	DESCRIPTION

**DOMINION
 BREMO POWER STATION
 CCS STORAGE TANKS
 WEST TREATMENT POND / CER
 FLUVANIA COUNTY, VIRGINIA**

**WEST TREATMENT POND
 MODIFICATION PLAN**

PROJECT No. 19-0347
 FILE No. 192034705-08
 REV. 0 SCALE AS SHOWN
 DESIGN JRD 02/05/15
 CADS ATN 02/05/15
 CHECK ATN 06/22/15
 REVIEW JRD 06/22/15

DRAWING 5

APPENDICES

APPENDIX A

XR-5 GEOMEMBRANE SPECIFICATION

SECTION 310519.16c

XR-5 GEOMEMBRANE

PART 1 – GENERAL

1.01 Work Included

- A. This Section includes the specifications and guidelines for the manufacture, installation, and testing of XR-5 geomembrane.

1.02 References

- A. Construction Quality Assurance Plan
- B. Latest version of the following standards:
 - 1. ASTM D 751 – Standard Test Methods for Coated Fabrics
 - 2. ASTM D 4833 – Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products
- C. Additional references may be required based on manufacturer warranty requirements.

1.03 Submittals

- A. Pre-Installation
 - 1. Manufacturer’s quality control results/certificates
 - 2. Manufacturer’s specification for geomembrane
 - 3. Field panel layout
 - 4. Resumes of geomembrane superintendent and installers
 - 5. List of personnel performing installation
- B. Installation
 - 1. Subgrade surface acceptance certification
 - 2. Quality control documentation recorded during installation
 - 3. Material and installation warranties from manufacturer and installer

1.04 Pre-Qualifications

- A. Manufacturer/Fabricator

1. Manufacturer shall have successfully produced a minimum of 2,000,000 ft² that conforms to the manufacturer's specifications.
2. Fabricator shall have successfully assembled a minimum of 2,000,000 ft² of XR-5 sheet specifically for the purpose of containment.

B. Installer

1. Installer shall be approved by OWNER and have at least of 5 years of continuous experience in installation of EPDM geomembrane, or experience totaling 2,000,000 ft² of installed XR-5 geomembrane for at least 10 completed facilities.
2. Installer shall be a member of the International Association of Geosynthetic Installers (IAGI).
3. Installation personnel shall be qualified by experience or applicable tests.

1.05 Quality Assurance Program

- A. Manufacturer, fabricator, and installer shall participate in and conform to the items and requirements of quality assurance program as outlined in this Specification and the Quality Assurance Plan.
- B. Quality assurance shall be conducted in a manner that complies with the manufacturer's warranty requirements. CONTRACTOR shall provide a demonstration that the proposed methods comply with the manufacturer's warranty program.
- C. Upon delivery, the XR-5 geomembrane shall be visually inspected for defects, such as pinholes, blisters, etc. Additionally, the geomembrane shall be visually inspected to ensure uniform color, thickness, and texture.

1.06 Delivery, Storage, and Handling

A. Packing and Shipping

1. Manufacturer shall identify each package or roll delivered to site with the following:
 - a. Manufacturer's name.
 - b. Product Identification.
 - c. Thickness.
 - d. Identification number.
 - e. Dimensions.
2. Protect geomembrane from excessive heat, cold, puncture, cutting, or other damaging or deleterious conditions during loading, transport, and unloading at site.

B. Acceptance at Site

1. Conduct surface observations of each roll for defects and damage. This examination shall be conducted without unrolling rolls unless defects or damages are found or suspected.
2. Defected or damaged rolls or portions of rolls will be rejected and shall be removed from the Project Site and replaced with new rolls.
3. Rolls or portions of rolls without proper identification or labeling will be rejected and shall be removed from the Project Site.

C. Storage and Protection

1. OWNER will provide on-site storage area for geomembrane rolls from time of delivery until deployment.
2. Installer shall protect geomembrane from dirt, water, and other sources of damage.
3. Preserve integrity and readability of geomembrane roll labels.
4. Rolls which do not have proper identification at delivery will not be accepted.

PART 2 – PRODUCTS

2.01 Materials

- A. The XR-5 geomembrane shall be Seaman's 8138 XR-5 geomembrane or approved alternate, and shall conform to the criteria below. Manufacturer quality control testing will be performed in accordance with manufacturer specifications, and quality assurance testing will be conducted in accordance with the criteria contained in section 3.03 of this specification.

Testing Properties	Testing Method	Units	Test Value	Frequency
Thickness	ASTM D751	mils	40 (36 min.)	per 36,000 ft ²
Weight	ASTM D751	oz/yd ²	38.0 ± 2.0	per 36,000 ft ²
Tear Strength (trap tear)	ASTM D4533	lb	40/55 ¹	per 36,000 ft ²
Yield Strength (Break), grab tensile	ASTM D751	lb	550/550 ²	per 36,000 ft ²
Puncture Resistance	ASTM D4833	lb	200 (min.)	per 36,000 ft ²

1. The first number represents the average of all five specimens in both warp and filling directions (10 tests), and the second number represents the average of the five highest peak loads (not including the initial peak loads) for the five test specimens (warp or filling direction).
2. The first number represents the average longitudinal break strength and the second number represents the average transverse break strength.

- B. Construction quality assurance (CQA) testing for the geomembrane material shall be performed for the same properties shown above, but at a frequency of one test per 200,000 ft² of installed geomembrane.

PART 3 – EXECUTION

3.01 Preparation

A. Subgrade

1. Subgrade Characteristics:

- a. The subgrade shall contain no sharp edges, loose material, oil/grease, or other materials which may damage the XR-5 geomembrane.
- b. All subgrade voids greater than 0.25 inches shall be properly filled with an acceptable fill material.
- c. The subgrade shall be free of sticks, particles greater than 0.5” in diameter, and other materials which may damage the geomembrane.
- d. The subgrade shall contain no more than 1% organic matter (visual inspection).
- e. The subgrade shall be free of standing water, mud, snow, or excessive moisture.

2. Liner subgrade shall be compacted as detailed in Section 310000 – Earthwork.

3. CONTRACTOR is responsible for preparing the liner subgrade, and shall maintain the subgrade through installation of the liner. Damage to the prepared subgrade shall be accomplished at CONTRACTOR’s expense.

4. Liner may not be placed on the subgrade prior to approval of the subgrade in accordance with the Quality Assurance Plan.

3.02 Installation

A. Geotextile material shall be placed directly on the subgrade to serve as a cushion for the geomembrane. The geotextile should be at least 8 oz/yd².

B. The geomembrane shall be placed in a relaxed condition free from tension; however, wrinkles shall be minimized. The geomembrane shall not be stretched.

C. Panel Layout

1. Anchor trench

- a. The anchor trench shall be dug along the perimeter of the proposed pond in accordance with the design drawings.
- b. The top-of-slope runout length to the anchor trench shall be at least 3 feet.

2. Adequate care shall be taken when unrolling and placing geomembrane to prevent damage from puncture, tearing, etc. Installer will repair damaged geomembrane at Installer's expense.

D. Seaming

1. Seaming shall be accomplished in accordance with manufacturer specifications.
2. Trial seams shall be tested for each welding machine prior to conducting seaming operations.
3. A minimum of 6 inches of overlap shall be maintained between adjacent liner sections.
4. Both the factory seams and field seams shall conform to the following criteria:

Testing Properties	Testing Method	Units	Test Value	Frequency
Adhesion (Heat-welded seam)	ASTM D751	lb/2in	40	per 500 ft
Bonded Seam Strength – Procedure A, grab method	ASTM D751	lb	550	per 500 ft

3.03 Quality Assurance

- A. Quality assurance shall be conducted in accordance with manufacturer's warranty requirements and the Quality Assurance Plan (CQA Plan). In cases where the CQA Plan or these specifications disagree with manufacturer's warranty requirements, the warranty requirements will take precedence.
- B. All field seams, patches, and other appurtenances shall be non-destructively tested using the air lance method (ASTM D4437).
- C. Destructive sampling shall be conducted for all field seams, at intervals not exceeding 500 feet. Destructive sampling shall be conducted as follows:
 1. A sample approximately 12 inches wide and 5-6 feet long shall be cut from the seam. The sample should be centered on the seam.
 2. Each sample shall be labeled with the identification, location, panel numbers, and seam number. The sample date, time, welding technician, and ambient temperature should also be recorded.
 3. Each sample will be cut into three sections of approximately 2 feet in length. One section will be sent to a third party laboratory for testing, one section will be presented to the owner for archiving, and one section will be retained by the installer.

4. The samples shall be tested in accordance with Procedure A (Grab Test Method) of ASTM D751. The 2-foot section will be cut into five equivalent specimens for testing.
5. Four of the five specimens must meet the minimum seam strength requirements for the seam to pass. The lowest strength must not be less than 80% of the required bonded seam strength shown in section 3.02 above.
6. Failed seams will be traced outward from the sample location (in both directions) until the samples meet the minimum strength requirements.

* * * * * END OF SECTION * * * * *