October 28, 2019

FACT SHEET
Virginia Water Protection Individual Permit No. 17-0702
Birchwood Power Facility Surface Water Withdrawal Project, King George County, Virginia

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The Department of Environmental Quality (DEQ) has reviewed the application for issuance of Virginia Water Protection (VWP) Individual Permit Number 17-0702 and has determined that the project qualifies for an individual permit. Based on the information provided in the application and in compliance with § 401 of the Clean Water Act as amended (33 USC 1341 et seq.) and the State Water Control Law (Code of Virginia §§ 62.1-44.2 through 62.1-34.28) and regulations (9VAC25-210). DEQ has determined that there is a reasonable assurance that the activity authorized by this permit will protect instream beneficial uses, will not violate applicable water quality standards, and will not cause or contribute to significant impairment of state waters or fish and wildlife resources, provided the permittee complies with all permit conditions. Surface water impacts have been avoided and minimized to the maximum extent practicable.

The following details the application review process and summarizes relevant information for developing the Part I - Special Conditions for permit issuance.

1. Contact Information:

Permittee Legal Name and Address:

Birchwood Power Partners, L.P.
10900 Birchwood Drive
King George County, VA 23321
Julie.caiafa@ge.com
540-775-6320

Property Owner Name and Address:
(same as permittee)

Agent Legal Name and Address:

(same as permittee)

2. JPA Processing Dates:

Received Application:	April 21, 2017
Joint Publication with VMRC of Received JPA:	N/A (see Section 12)
Application Complete:	August 25, 2017
Processing Deadline (120 days from Complete Application):	December 27, 2017
Letter(s) sent to Local Government(s):	May 20, 2017
Letters sent to Commissioner of Revenue:	N/A, see section 13
Letters sent to VDH, VDGIF, VDCR, VMRC:	May 9, 2017
1st Request for Additional Information Sent:	May 8, 2017
Letters sent to Riparian Land Owners:	N/A, see section 13
Response to 1st Request for Additional Information Received:	June 7, 2017
Permit Fee Deposited by Accounting:	May 31, 2017
2nd Request for Additional Information Sent:	February 7, 2018
Response to 2nd Request for Additional Information Received:	June 21, 2018
3rd Request for Additional Information Sent:	July 20, 2018
Response to 3rd Request for Additional Information Received:	July 26, 2018
Draft Permit Package Issued:	July 16, 2019
Copy of Public Notice sent to DEQ Central Office:	July 16, 2019
Copy of Public Notice sent to Admin. Board Planning:	July 25, 2019
Public Notice Published:	August 1, 2019
End of 30-Day Public Comment Period:	September 3, 2019
Received Verification of Publication:	August 8, 2019

3. Project Location:

The location of the existing Rappahannock River intake is on the north bank of the lower Rappahannock River in King George County, Virginia. The location of the power plant facility is approximately 8 miles east of Fredericksburg along VA Route 3, then approximately one mile north along State Route 665 and Birchwood Drive. The surface water intake is located approximately 1.7 miles southeast of the facility entrance, on the north bank of the Lower Rappahannock River directly across from Moss Neck.

City/County:	King George County
Waterbody:	Rappahannock River
Basin:	Rappahannock River
Subbasin:	Lower Rappahannock River
Section:	1
Class:	II
Special Standards:	a
HUC:	02080104
Latitude & Longitude (of intake):	38.24280 N, -77.29351W
U.S.G.S. Quadrangle:	Rappahannock Academy
State Watershed No.:	RA49 Rappahannock River
TMDL Status:	Fish consumption – PCB in fish tissue

4. Project Description:

Project Purpose
This permit reissuance is for the continued operation of an existing surface water withdrawal from the Rappahannock River to support an electric power generating station in King George County. The facility consists of one coal-fired boiler and one steam turbine generator which can generate 242 Megawatts (MW). Surface water withdrawn for use at the facility is used to supply cooling and process water. The water withdrawal rates previously permitted were based upon the facility's originally designed generating capacity. The station is a peaking facility that operates in response to varying electricity demand and therefore the facility's water demand is also variable.

The facility was issued VWP No. 91-1962 in 1992 for a new water withdrawal from the Rappahannock River to supply water for the generating station. The facility began operations in November, 1996. The permit authorized a maximum daily withdrawal of 6.6 million gallons per day (Mgal/d) and a maximum annual withdrawal volume of 1,475 million gallons (Mgal). The permit did not include a limit on monthly withdrawal volumes. The permit was re-issued in October 2002 with the same withdrawal limits and the reissuance permit expired in October 2017. The current application, which was assigned a new VWP number (17-0702), was deemed complete on August 25, 2017. The applicant was notified on that date that VWP Permit No. 91-1962 would be administratively continued during completion of the application review and preparation of a new draft permit. No new facility structures or modifications to existing structures, or surface water impacts were proposed in this application for reissuance.

Existing Water Supply System
The applicant operates a coal-fired electricity generation station in King George County. The existing surface water intake structure is located on the north bank of the tidal Rappahannock River about 1.7 miles south of the facility. The intake consists of two 24-inch diameter intake pipes that extend approximately 100 feet (ft) into the river. The bottoms of the intake screens are positioned approximately 30 inches above the river bottom and the tops of the screens are 10 ft below the Mean Low Water level of the river. Cross sections of the river measured at the intake, as well as both 100 ft upstream and downstream of the intake, indicated that depth in the area ranges between 15 ft and 30 ft between 50 ft and 320 ft away from the north bank, and less than 5 ft across the remaining nearly 200 ft to the south bank.

Each of the two redundant intake pumps is rated at 5,000 gallons per minute (gal/min), allowing the plant to operate at capacity using one pump at a time. The intake screens are 66 inches in diameter and approximately 111 inches long and have 1 millimeter (mm) mesh openings. The design intake velocity for each screen is 0.25 foot per second (ft/s).

The water-supply line from the surface water intake discharges into an upland water storage impoundment at the generating station. The station is operated as a "zero liquid discharge facility", meaning that water not consumed by the generation process is recycled through this impoundment and reused. The applicant reported that the facility has not discharged wastewater since 2006.

There are also two active groundwater production wells and one inactive well at the facility. Groundwater is used for cooling and process water, as well as to supply potable water to employees under a VDH waterworks permit. The groundwater withdrawals make up approximately 1% of the total water

use and are regulated by Groundwater Withdrawal Permit GW00187EU, issued in 2016. This permit limits the facility's groundwater withdrawal to no more than 288,000 gallons per day (gal/d).

5. Water Withdrawal Use, Need and Demand:

Purpose of Water Uses
The purpose of the surface water withdrawal is to supply cooling and process water for electricity generation.

Basis of Need
Water withdrawals are a function of the demand for electricity generation, which fluctuates seasonally. Power generation is typically highest during the summer (June through August) and winter (December through February). The withdrawal volumes and rates originally requested in the Joint Permit Application (JPA) were equivalent to those authorized by the original (1992) permit and the current administratively continued permit (issued in 2002). These volumes and rates were proposed to enable the facility to operate at the rated generation capacity of 242 MW at any given time.

Monthly surface water withdrawal volumes reported for the facility since 1997 have ranged from zero during April and May of 2016 to 87.5 Mgal in July, 2008. Reported total annual withdrawals ranged from a low of 223 Mgal (16% of permitted annual limit) in 2017 to a high of 789.78 Mgal (54% of permitted annual limit) in 2005. The average annual total volume withdrawn since operations began (1997-2018) is 480 Mgal, or 32.5% of the permitted annual limit. In a response, dated June 7, 2017, to a request for additional information regarding the discrepancy between actual and permitted withdrawals, the applicant explained that the currently permitted withdrawal limits is a function of the facility's potential to be required to produce electricity at maximum capacity for a full year. This potential production rate is based upon electricity dispatch needs governed by the facility's current power purchase agreement (PPA) with Dominion Energy. This agreement obligates the facility to be prepared at all times to produce power at 100% of the rated capacity. Therefore, there is always the potential to be required by this agreement to run at full capacity for an entire year.

Water Demand
The applicant explained in a response dated June 21, 2018 that the current permitted withdrawal limits were based upon the withdrawal requirements of the original design operation of the facility at full generation capacity. However, the applicant also explained that once constructed (and as currently operated) the facility has lower withdrawal requirements. This lower requirement is based upon three factors:

1. The flue gas desulfurization scrubbers operate at a lower process water flow than originally designed
2. In 2006, the facility voluntarily initiated water recycling measures that result in zero wastewater discharge. However, use of the recycled water cannot be relied upon as a consistent flow during all operations because, at higher generation levels, process water constraints limit recycled water use.
3. The original permitted volumes allowed the facility to supply steam to a neighboring greenhouse facility. In 2006, this "Steam Host" operation was discontinued, reducing the withdrawal by 100,800 gal/d.

In the same response, the applicant revised the requested annual maximum withdrawal volume from 1,475 mgal/yr (current permit) to 1360 Mgal/yr, based upon the facility as constructed and currently operated. The applicant also requested a revised maximum monthly withdrawal volume of 136 Mgal. The applicant did not revise the previously requested (and currently permitted) maximum daily withdrawal rate of 6.6 Mgal/d.

To address the question regarding whether the proposed demand will remain throughout the next permit term, the applicant explained that when the current PPA expires in 2021, the Birchwood facility may operate as an independent "merchant" facility that bids its generated power into the transmission system on a daily basis, making it possible that its generation would increase beyond the utilization factors observed during the previous permit term. The applicant also listed four additional factors that would contribute to the Birchwood facility operating at maximum capacity during the next permit term:

1. Birchwood is a relatively newer, cleaner coal-burning facility with higher relative efficiencies and lower operating costs than other coal-burning facilities. As the demand for gas-fueled energy increases and coal-fueled power decreases, those cost-efficiencies may be leveraged to its benefit.
2. Because Birchwood stores its fuel on-site (unlike gas-fired plants), it may be called upon to bridge outage gaps during periods of unanticipated natural disasters or significant equipment failures at regional power stations.
3. As a modern coal facility, Birchwood is not recognized as being at risk of reduced operations due to environmental regulations.
4. The operational capacity of Birchwood as a coal fired power plant will be needed to support increasing electric power demands and associated Operating Reserves required for the grid Reliability Standards as mandated by the Energy Policy Act of 2005.

The demand for surface water is based upon the power generation demand and power purchase agreement described above. The requested withdrawal volumes were compared to nationwide estimates of water volumes used per kilowatt-hour (kWh) of thermoelectric power generation made by the U. S. Geological Survey (USGS) Circular 1405 (Maupin, M. A., et al, 2014). The requested maximum annual withdrawal volume of 1,360 Mgal/yr is equivalent to an average daily withdrawal rate of 3.73 Mgal/d to produce the plant's full generation capacity of 217.8 MW, or 217,800 kWh. The requested average withdrawal rate (3.73 Mgal/d) therefore is approximately equal to 17.1 gal/d/kWh. This ratio is less than the 2010 nationwide average (19 gal/d/kWh) reported in Circular 1405. The same publication also reported that a total of 6 billion gal/d of surface water was used in Virginia during 2010 for thermoelectric power generation to produce 53,500 million kWh (146,575 MW). These totals equate to a Virginia-wide average ratio of approximately 40 gal/d/kWh, which is significantly greater than the Birchwood water use/production ratio. The revised value for the requested maximum annual withdrawal represents a reduction of 8% from the currently permitted annual maximum withdrawal volume. The requested maximum monthly withdrawal volume (136 Mgal) represents an average daily withdrawal over a month-long period (30 days) of 4.53 Mgal/d, producing a maximum monthly to annual average ratio of approximately 1.22. This ratio is lower than the monthly maximum factor of 1.25 that is typically accepted by Staff. Therefore, the requested maximum annual and maximum monthly withdrawal volumes are justified.

In the June 7, 2017 response to Staff's request for additional information regarding the requested water volumes, the applicant explained that the facility reuses cooling tower blowdown as process water to create lime slurry for the flue gas scrubber. This process also reduces both surface water withdrawals and outfall discharges. However, it is difficult to maintain cooling tower water chemistry using this process. Upsets in cooling tower water chemistry could require short-term increases in daily surface water

withdrawals (e.g., withdrawing for longer periods during a single day), up to the requested maximum daily rate. The ratio of maximum daily to average daily withdrawal rates (6.6 Mgal/d : 3.73 Mgal/d) is approximately 1.77, which is greater than the daily maximum factor of 1.6 that is typically accepted by Staff. However, the applicant's explanation of the need for this rate due to upsets in water chemistry because of recycling of cooling water blowdown indicates that pumping at this rate would be infrequent and of relatively short duration. The reported historical monthly withdrawal data support this explanation because the historical maximum monthly volume reported (87.50 Mgal) would equate to a monthly average of just 2.9 Mgal/d. The requested maximum monthly volume would be reached in approximately 20 days if withdrawals were conducted constantly at the requested maximum daily rate. Therefore the requested maximum daily demand of 6.6 Mgal/d is justified.

Table 1: Withdrawal volumes proposed by the applicant and recommended by Staff for the Rappahannock River intake:

	Currently Permitted Withdrawal Volumes	Withdrawal Volumes Requested by Applicant	Staff Recommended Withdrawal Limits
Maximum daily rate (Mgal/d)	6.6	6.6	6.6
Maximum monthly volume (Mgal)	no limit	136	136
Maximum annual volume (Mgal)	1,475	1,360	1,360

Staff Recommended Maximum Withdrawal Volumes

The system-wide volumes listed as calculated by Staff in Table 2 will be used as the basis for any potential permit drafted for this project. (See the Withdrawal Limitations and Instream Flow Requirement subsection under Section 7 below.) Staff concluded that the water demand and statement of need is reasonable and has been adequately justified by the application through the information submitted in the VWP permit application process.

6. Alternatives Reviewed:

The applicant conducted an alternative sources analysis as part of the original permit application. The alternative options considered were 1) increased groundwater withdrawal, which would require additional well drilling and permitting; and 2) purchase of water from neighboring municipalities, which would require significant infrastructure changes. The application stated that the Rappahannock River source was the only viable option and remains the preferred alternative.

Based upon staff review of the reissuance application, the preferred alternative avoids and minimizes surface water impacts to the maximum extent practicable and it is the least environmentally damaging and practicable alternative.

Further information regarding project alternatives can be found in the JPA dated April 19, 2017.

7. Water Withdrawal Volumes and Instream Flow Requirements:

Staff reviewed the proposed withdrawal using the water demand volumes proposed for the 15-year permit term.

Water Withdrawal Volumes Requested in JPA
The applicant requested authorization for the maximum allowable withdrawal volumes listed in Table 2.

Return Flow
The applicant explained in the JPA and in subsequent correspondence that all surface water withdrawn is eventually used in the generation process or evaporated from the storage pond and cooling tower. Therefore, the water use was considered 100% consumptive under current plant operations.

Cumulative Impact Analysis
A cumulative impact analysis was conducted by staff on the proposed water withdrawal. A summary of staff's modeling analysis is attached to this fact sheet (Appendix A).

Permit Withdrawal Limitations and Instream Flow Criteria
The permit limits surface water withdrawals to the volume justified based upon the application materials submitted and staff technical evaluation. Based upon this information, the permit proposes the following limits on the withdrawal volumes for each source:

Table 2: Proposed withdrawal limits

Withdrawal Limit	Rappahannock River intake
Maximum daily rate (Mgal/d)	6.6
Maximum monthly volume (Mgal)	136
Maximum annual volume (Mgal)	1,360

8. Water Supply Plan Review:

The JPA was coordinated with DEQ Water Supply Planning staff on August 25, 2017, who responded on September 20, 2017. The King George Water Supply Plan dated September 15, 2009, submitted for King George County, was developed in accordance with the Virginia Administrative Code providing for local and regional water supply planning (9VAC25-780).

The Birchwood Power facility is listed in the King George Water Supply Plan (WSP) as a large self-supplied user of surface water (Rappahannock River) and groundwater (Well #1). Groundwater withdrawals are provided for 2004 and 2006 with daily average withdrawals of around 4,500 gallons. According to the WSP, the water use at the facility will remain the same over time. The plans states that the majority of water used by the power plant is returned to the atmosphere in the form of vapor.

According to page 132 of the WSP, additional water may be needed for community water systems in King George County after 2030, based on available well yields and demand projections. The WSP also notes the uncertainty of increased groundwater withdrawals in the future. All alternatives are described as a way to address the possible deficit in community water system needs. The Rappahannock River is

listed as a reasonable quantity of surface water with a preferred intake location above the Hopyard wastewater treatment facility discharge. This alternative is only viable if the county has a significant customer base, as the water will need additional treatment and there will need to be infrastructure upgrades. The water withdrawal is located in the tidally influenced section of the Rappahannock River and therefore was not analyzed for surface water impacts as part of the State Water Supply Plan.

9. Surface Water Impacts:

The proposed withdrawal activity involves no changes to the existing surface water intake or water transmission infrastructure. Therefore, no wetland or stream impacts are proposed.

Water quality impacts are expected to be temporary and minimal provided the permittee abides by the conditions of the permit.

10. Compensation for Unavoidable Impacts:

Compensation is not needed because there are no proposed wetland or stream impacts.

11. Site Inspection:

A site inspection was conducted on the same day as a pre-application meeting held at the facility on January 25, 2017.

12. Relevant Regulatory Agency Comments:

As part of the application review process, DEQ contacted the appropriate state regulatory agencies. Any relevant agency comments were addressed in the VWP individual permit Part I - Special Conditions. Therefore, the staff anticipates no adverse effect on water quality and fish and wildlife resources provided the applicant adheres to the permit conditions.

Summary of State Agency Comments and Actions
By email dated May 9, 2017, comments were requested from the following state agencies: Virginia Department of Game and Inland Fisheries (DGIF), Virginia Department of Conservation and Recreation (DCR), Virginia Marine Resources Commission (VMRC), Virginia Department of Health (VDH), the U.S. Army Corps of Engineers (USACE), and the U.S. Fish and Wildlife Service (USFWS). Failure to provide comments within 45 calendar days of the DEQ request for comments infers that the agency has no comments on the project activities.

DGIF
DGIF responded by email on June 28, 2017. Although the comments were not received within the 45 day comment period, DEQ accepted the comments as the comments were late by less than one week. The comments are summarized below:

- The Rappahannock River at this project location has been designated a Threatened and Endangered Species Water due to the presence of federally Endangered Atlantic sturgeon. The Rappahannock River at this site also has been designated a Confirmed Anadromous Fish Use Area. DGIF recognized that this intake currently adheres to the recommendation that the intake be fitted with a 1mm mesh screen and that the intake velocity not exceed 0.25 ft/s, minimizing impingement and entrainment of resident aquatic species, including anadromous fishes and

Atlantic sturgeon. However, it was not clear to DGIF whether the proposed withdrawal would take no more than 10% of instantaneous flow, as is typically recommended to allow continued access to instream habitats, or that salinity studies/water quality monitoring was performed prior to permitting this project. DGIF noted that recent discussions regarding tidal river intakes have included assessment of the impact the intake may have on water quality (using salinity as a surrogate for water quality parameters). DGIF recommended confirmation that these issues have been addressed and/or that DEQ consider ways to ensure water quality in this area is being protected to the greatest degree possible.

Staff provided DGIF with additional information regarding water quality on July 15, 2017 and requested a response regarding whether the new information adequately addressed their water quality concerns. This information was provided by the applicant as part of a response (received June 7, 2017) to an additional information request. DGIF did not provide a response to this request by Staff. However, Staff evaluated the potential effects of the proposed withdrawal upon water quality (see Appendix A) and incorporated the results of the analysis into the development of permit conditions.

- Recommended coordination with NOAA Marine Fisheries Service regarding protection of Atlantic sturgeon.

  Staff requested comments from NOAA on the application and supporting materials via email on August 25, 2017. No response was received from NOAA Marine Fisheries Service.

DCR

DCR responded by email dated June 20, 2017 with the following comments:

- A search of DCR's Biotics database indicated the presence of natural heritage resources within two miles of the project area. However, due to the scope of the activity and the distance to the resources, DCR did not anticipate that this project will adversely impact these natural heritage resources.
- There are no State Natural Area Preserves under DCR's jurisdiction in the project vicinity.
- DCR represents VDACS in comments regarding potential impacts on state-listed threatened and endangered plant and insect species. The current activity will not affect any documented state-listed plants or insects.
- The Virginia Department of Game and Inland Fisheries (VDGIF) maintains a database of wildlife locations, including threatened and endangered species, trout streams, and anadromous fish waters that may contain information not documented in this letter. Their database may be accessed from http://vafwis.org/fwis/ or contact Ernie Aschenbach at 804-367-2733 or Ernie.Aschenbach@dgif.virginia.gov.
  Section 7 and Attachment D of the JPA included the results of a search of the VaFWIS database and other databases made by the applicant. This search did not indicate the presence of state or federally threatened or endangered species that would be affected by the project.

VMRC

VMRC did not respond to the request for comments.

VDH

VDH responded via letter dated May 11, 2017 that no public raw water intakes in Virginia were found downstream from the intake point.

Summary of Federal Agency Comments and Actions
USACE, USFWS, and NOAA Marine Fisheries Service did not respond to requests for comments.

13. Public Involvement during Application Process:

Riparian/Adjacent Landowner and Local Government Notification
Staff notified King George County regarding the application on May 10, 2017. The County did not respond to the request for comments.

Notifications of riparian and adjacent landowners were not conducted because, in accordance with DEQ's Guidance Memorandum No. 11-2005 (Revised Local Government, Riparian Property Owner, Adjacent Property Owner or Resident, and General Public Notification Procedures for VPDES, VPSA and VWP Permit Applications and Draft Permits), these notifications are not required for reissuances where no changes are proposed to the existing permit.

14. Public Comments received during Comment Period:

The Public Notice was published in the Fredericksburg Free-Lance Star on August 1, 2019.

No public comments were received during the public comment period. Therefore, no changes have been made to the permit conditions.

15. Special Conditions:

The following conditions were developed to protect instream beneficial uses, to ensure compliance with applicable water quality standards, to prevent significant impairment of state waters or fish and wildlife resources, and to provide for no net loss of wetland acreage and function through compensatory mitigation and success monitoring and reporting.

Section A Authorized Activities

Nos 1 & 2 address the activity authorized by this permit.
No. 3 states that the authorized activities shall be conducted in accordance with the application materials and any subsequent materials received during the application process.
No. 4 requires the applicant to notify DEQ of any changes to the authorized activities or of new activities which require a VWP permit.

Section B Permit Term

Nos. 1 & 2 address the permit term and re-issuance process to ensure that all permit conditions are completed.

Section C Standard Project Conditions

No. 1 addresses the requirement for the minimization of adverse impacts to instream beneficial uses.
No. 2 ensures that the project will be executed in a manner that limits the disruption of the movement of aquatic life.
No. 3 ensures that downstream flows will be maintained to protect both instream and off-stream beneficial uses.
No. 4 ensures that there will be no more than minimal impact on navigation.
No. 5 prohibits any project activity from impeding the passage of high flows and requires associated structures to withstand expected high flows.
No. 6 requires measures to be employed to prevent and contain spills of fuels, lubricants or other pollutants into surface waters.
No. 7 prohibits the violation of Water Quality Standards in surface waters as a result of project activities.
Nos. 8 through 14 set forth all reporting requirements concerning as required by the permit and current law and regulations.

Section D Surface Water Withdrawal Conditions

No. 1 restricts surface water withdrawal to the use authorized.
No. 2 states the withdrawal limits for the withdrawal system. The annual limit is based upon calendar year.
No. 3 identifies the method the permittee shall use to estimate the previous day's stream flow at the intake. This equation is to be used to determine the maximum allowable daily withdrawal volume as described by Part I.D.2.
No. 4 limits the daily withdrawal volume to no more than 50% of the 7-day rolling average of the previous day's estimated freshwater flow to the intake location, as estimated using the equation described by Part I.D.3.
No. 5 requires the permittee to develop a drought management plan for DEQ review and approval that identifies specific drought stages, the conservation measures to be implemented for each drought stage, includes a schedule for identifying and developing an alternative supply or supplies to be used whenever the surface water withdrawal is limited, prohibited or unavailable, and an operational plan that describes how the alternative source(s) will be used.
No. 6 requires conservation measures be implemented to protect instream flows when a drought emergency is declared.
No. 7 ensures that intake structure specifications protect aquatic wildlife resources.
No. 8 requires submittal of a Monitoring and Operations plan for DEQ approval that describes the procedures to be taken to ensure compliance with the withdrawal and monitoring conditions of the permit.

Section E Monitoring, Recordation and Reporting Conditions

Nos. 1 and 2 require the daily monitoring and recording of water withdrawal activities to determine compliance with the withdrawal limitations, and specify daily monitoring requirements.
No. 3 requires the permittee to submit a water withdrawal monitoring report to DEQ semi-annually on the schedule stipulated in the condition. The information shall be submitted electronically using the Virginia Water Withdrawal Reporting System, and in the event the system is not available, via electronic mail. These reporting requirements will also satisfy the annual reporting requirement of 9VAC25-200 et seq.
No. 4 states that the monitoring and reporting activities shall comply with the permit. Any records shall be retained for the life of the permit and potentially longer due to any unresolved litigation.

16. General Conditions:

General Conditions are applied to all VWP individual permits, as stated in the VWP Permit Program regulation.

17. General Standard:

This project may result in minimal, temporary impacts to beneficial uses related to the propagation and growth of aquatic life as defined in the General Standard. Provided the permittee abides by the conditions of the permit, no substances shall enter state waters in concentrations, amounts or combinations that would contravene established standards or interfere with beneficial uses or are inimical or harmful to human, animal, plant, or aquatic life.

18. Staff Findings and Recommendations:

- The proposed activity is consistent with the provisions of the Clean Water Act and State Water Control Law, and will protect beneficial uses.
- The proposed permit addresses avoidance and minimization of surface water impacts to the maximum extent practicable.
- The effect of the impact will not cause or contribute to significant impairment of state waters or fish and wildlife resources.
- The proposed permit conditions address no net loss of wetland acreage and function through compensatory mitigation.
- This permit is proposed to prevent unpermitted impacts.
- The draft permit reflects the required consultation with and full consideration of the written recommendations of VMRC, VDH, DCR and DGIF. The staff invited, but did not receive, comments from USACE, USFWS, and NOAA Marine Fisheries Service.

Staff recommends VWP Individual Permit Number 17-0702 be issued as proposed.

Approved:

Director, Office of Water Supply

10/28/19
Date

Appendix A – Cumulative Impact Analysis

Introduction

Birchwood Power operates an existing coal-fired power plant used as a peaking facility in King George County. The plant uses surface water withdrawn from an existing intake on the tidal freshwater section of the Rappahannock River for cooling and process water. The water-supply line from the surface water intake discharges into an upland water storage impoundment of approximately 5 acres in area next to the generating station. Water is pumped from this impoundment into the plant as needed. The impoundment is only a few feet deep; therefore it does not provide more than 1 or 2 days of storage and the river withdrawal is relatively constant when the plant is in operation. Water within the impoundment is recycled and not discharged; therefore all withdrawals from the river are considered 100% consumptive. The application for reissuance of VWP IP No. 91-1692 for the river withdrawal included a requested maximum annual withdrawal volume of 1,098 million gallons per year (Mgal/yr) and a requested maximum daily withdrawal rate of 6.6 million gallons per day (Mgal/d).

The goal of this analysis was to estimate the potential impacts of the requested water withdrawal upon existing beneficial uses, including both in-stream and off-stream uses. For this analysis, the proposed maximum withdrawals from the intake were compared with 1) estimated freshwater inflow to the Rappahannock upstream of the intake location during the Drought of Record and other low flow periods, 2) available salinity data from the tidal Rappahannock River, and 3) an estimate of the tidal excursion volume within the river around the intake location.

Determination of Drought of Record Period

The Rappahannock River at the intake has a drainage area of approximately 1720 square miles. The intake is located just above Skinkers Neck, within the freshwater tidal portion of the Rappahannock River estuary. It is approximately 16 miles downstream of the falls of the Rappahannock at Fredericksburg and approximately 17.5 miles upstream of Port Royal.

No stream flow records are available within this tidal reach of the river. The closest gaging station is Station No. 01668000 (Rappahannock River near Fredericksburg, VA); located approximately 4.5 miles upstream of Fredericksburg on the non-tidal reach of the river. Records of stream discharge are available from this station since 1907. The station has a drainage area of 1595 square miles (mi^2), 125 mi^2 smaller than that of the intake.

The USGS Water-Year Summary 2016 for Station 01668000 indicated that the lowest annual mean (440 cubic feet per second, or ft^3/s) occurred in 1931, and the lowest daily mean (5.0 ft^3/s) and lowest 7-day minimum (8.3 ft^3/s) occurred in 1930. The lowest monthly means for the months of July through December also occurred in either 1930 or 1931, and below-normal flows continued into 1932. Therefore, the multi-year drought period of 1930-1932 was determined to be the drought of record for the Rappahannock River basin.

Estimation of Freshwater Inflow at the Intake Location

Estimates of freshwater inflow to the Rappahannock River at the intake location were made by multiplying reported daily stream discharge records at Station 01668000 by the ratio of the intake drainage area to that of the gaging station. This ratio (1,720 mi^2 : 1,595 mi^2) equals 1.078. Estimates of freshwater inflow for several low-flow statistics reported for Station 01668000 for the DOR and selected additional time periods are listed below. The August Low Flow, September Drought Warning Flow, and

the 7Q10 flow were used as metrics to indicate moderate to severe drought conditions in the State Water Resources Plan.

Table 1: Estimated freshwater inflow (in ft^3/s) for selected low-flow statistics

Statistic (ft^3/s)	Year	Flow at Station 01668000 (ft^3/s)[1]	Estimated Freshwater Inflow at Intake (ft^3/s)[2]
Lowest annual mean	1931	440	474
August Low Flow[3]	POR[5]	232	250
September Drought Warning Flow[4]	POR[5]	149	161
7-day, 10-year low flow (7Q10)	POR[5]	46	49
Lowest daily mean	1930	5.0	5.4

1: from USGS Streamstats Report for Station 01668000
2: calculated by multiplying flow statistic for Station 01668000 by 1.078
3: median of all the lowest daily flows recorded for August during the POR
4: Tenth percentile of all September flows during the POR
5: Period of Record

Data Review and Withdrawal Comparison

The statistics listed in Table 1 were compared to the requested maximum daily withdrawal rate (6.6 Mgal/d, or 10.2 ft^3/s) and the annual average daily withdrawal rate (3.73 Mgal/d, or 5.8 ft^3/s) derived from the requested maximum annual withdrawal volume. Both the maximum daily and the annual average withdrawal rates are greater than the estimated lowest daily mean freshwater inflow rate for the POR. The requested maximum daily withdrawal rate is approximately 20% of the 7Q10 rate, 6% of the September Drought Warning Flow, and 4% of the August Low Flow. Limiting withdrawal to no more than 10% of the estimated instantaneous flow is a threshold for instream flow protection commonly recommended by DGIF.

The time series of estimated freshwater flow at the intake was examined to determine how often the requested maximum daily withdrawal rate would be larger than selected percentages of the estimated freshwater inflow (Table 2).

Table 2: Occurrences of requested maximum daily withdrawal rate surpassing selected percentages of estimated daily inflow[1]

Frequency[2]	> 10%	> 20%	> 30%	> 40%	>50%
1-7 days	31	12	9	7	6
7-14 days	23	11	7	5	4
14-30 days	15	9	4	1	1
>30 days	10	3	1	1	1

[1]: Number of years containing occurrences during the 111-year period of record of Station 01668000 (1907-2018)
[2]: Nonconsecutive

The comparison indicated that the requested maximum daily withdrawal would be greater than 10% of the estimated freshwater inflow for at least one to seven days during approximately one year out of every four. The withdrawal would eclipse the 10% threshold for up to 30 total days (nonconsecutively) more than one in ten years, and for more than 30 days nearly one year in ten. A 40% threshold, which corresponds to freshwater inflows of approximately 25 ft^3/s, would be surpassed only during conditions equivalent to the drought years of 1930, 1932, 1954, 1966, 1999, 2002, and 2010. Such a threshold would

be tripped for 14 or more days only during the 1930 drought of record conditions. The numbers of occurrences based upon the 7-day rolling average of estimated freshwater inflow were very similar.

As described above, the intake is located within the tidal freshwater portion of the Rappahannock River and therefore more freshwater is available than that supplied by recent inflow from upstream. Salinity data collected from several long-term monitoring stations within the tidal Rappahannock indicate that freshwater (salinity < 0.5 Practical Salinity Units, or psu) generally extends to between 40 and 55 miles downstream of the intake (Figure 1 and Table 3). The designated downstream boundary of the tidal freshwater zone in the Rappannock (9VAC25-260-140.C.1) is located approximately 48 miles below the Birchwood intake. This boundary is not static, however. Intrusion of brackish water into the freshwater tidal zone sometimes occurs during drought periods (Figure 2). Freshwater also extends below the boundary, as can be seen by the low salinity values for station 3-RPP051.01 in early 2003. Note that, even during the fall of 2002, when freshwater inflow dropped to values below 20 ft^3/s, salinity at station 3-RPP091.55 remained below the 0.5 psu threshold.

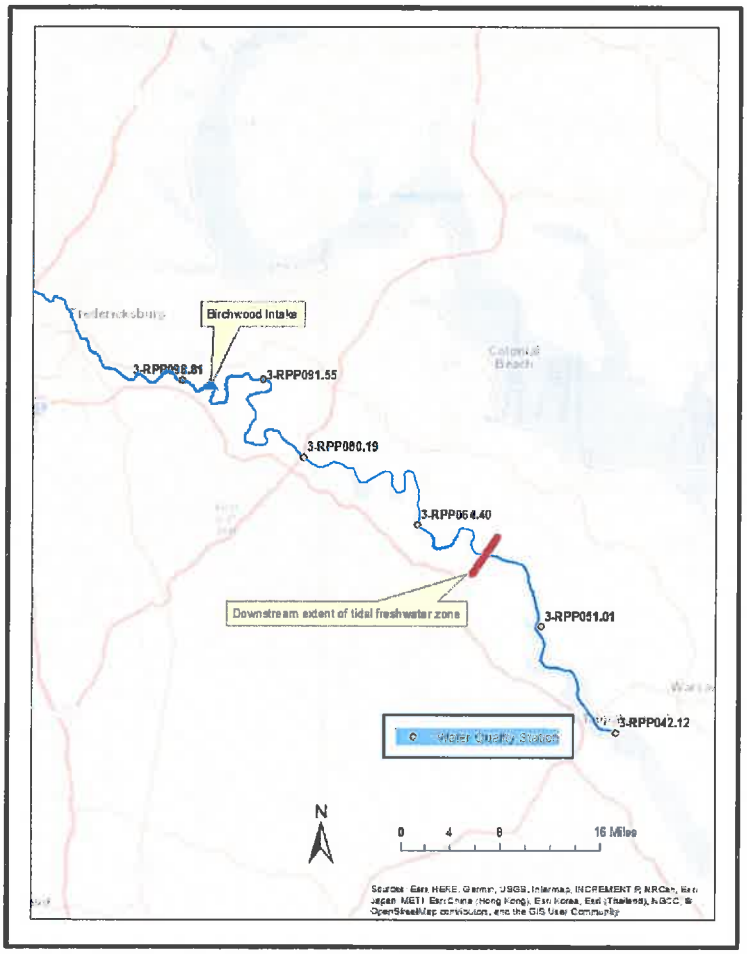

Figure 1: Map of Water Quality Monitoring Stations

Table 3: Salinity Data from Rappahannock River Tidal Water Quality Stations[1]

Station ID	POR[2]	# Salinity Records	25th pctile[3]	Median[3]	95th pctile[3]	Maximum[3]	Distance[4]
3-RPP041.12	2/1985 – 11/2017	466	3.66	6.34	12.20	16.58	68
3-RPP051.01	2/1985 – 11/2017	385	0.20	1.22	7.30	13.00	55
3-RPP064.40	1/1994 – 11/2017	260	0.05	0.07	2.30	6.10	40
3-RPP080.19	2/1985 – 11/2017	371	0.04	0.05	0.31	3.86	21
3-RPP091.55	6/1988 – 11/2017	268	0.03	0.04	0.07	0.25	8
3-RPP098.81	2/1991 – 11/2017	255	0.03	0.05	0.07	0.18	-3

1: all samples from bottom of water column
2: Period of record
3: PSU
4: Approximate distance downstream of intake (river miles)

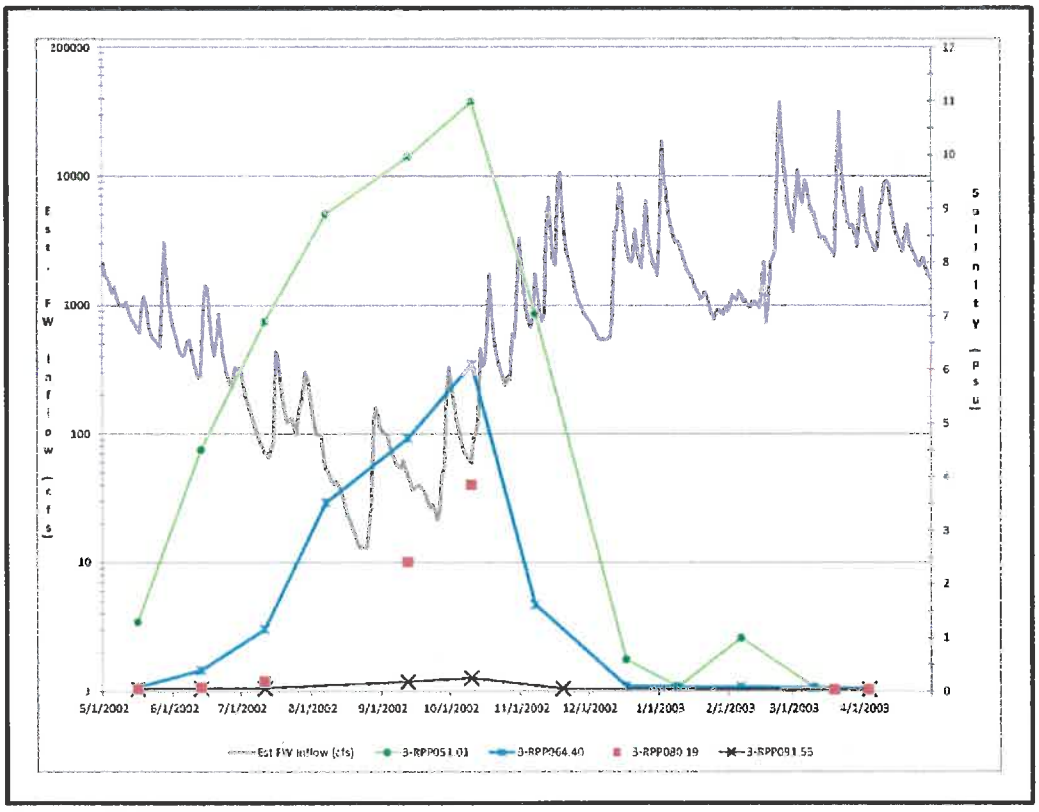

Figure 2: Salinity increase corresponds to low freshwater inflow during the 2002 drought,

Therefore, the question of concern for the Birchwood intake is whether withdrawals from tidal storage at the proposed maximum daily rate could potentially cause a significant increase in the natural upstream intrusion of salinity during drought periods that would be enough to affect aquatic resources at locations more than several miles downstream.

In order to estimate this potential, the proposed maximum daily withdrawal volume was compared to an estimate of the volume of water in the Rappahannock River enclosed by one tidal excursion. Tidal excursion is the distance that water moves during one tidal cycle of flood and ebb. The corresponding volume was estimated using the "simple method" described by the U.S. Environmental Protection Agency (EPA) for estimating Source Water Flow data (40 CFR Parts 9, 122 et al, page 65317). The applicant provided cross sections with depth measurements spanning the river near the intake; these depths were incorporated into the calculation. Using a conservative value for average depth of 10 feet, the tidal excursion volume is 663,418,800 ft^3, or 4,963 Mgal. The requested maximum daily withdrawal volume of 6.6 Mgal equals approximately 0.07% of this tidal volume. The flood and ebb tide excursion distances estimated using this method were each approximately 5.5 miles in length, indicating that the tidal volume encompassing the area around the intake remains fresh even during severe droughts (see Table 3). This suggests that the Birchwood withdrawal would have to remove a large percentage of the available freshwater input to the system before it could cause salinity in areas downstream of station 3-RPP091.55 to rise above the 0.5 psu salinity threshold.

Conclusion

Based on the data review and withdrawal comparison, the requested daily maximum withdrawal volume would have an insignificant impact upon instream flow and salinity concentrations during periods of normal freshwater inflow into the freshwater tidal reach of the Rappahannock River. During periods of low inflow (droughts), the proposed maximum daily withdrawal can be greater than 50% of the estimated freshwater inflow rate at the intake location. During these drought periods increases in salinity have been documented at monitoring station 3-RPP091.55, which is located well within the freshwater portion of the tidal Rappahannock (Figures 1 and 2). Although the observed increases at this monitoring station haven't reached the 0.5 psu salinity threshold, the Birchwood withdrawal should be limited during these periods so that it does not cause such increases to surpass the threshold. The authorized maximum daily withdrawal rate should therefore not exceed 50% of the rolling 7-day average of the estimated freshwater inflow to the Rappahannock River at the intake location.

Recommendations

The provisional daily flow at USGS gaging station 01668000 should be monitored on a daily basis and the estimated freshwater inflow at the intake should be calculated as follows:

- $Q_{fw} = (Q_{01668000} / 1.547) * 1.078$, where
- Q_{fw} = the estimated freshwater inflow at the intake in Mgal/d;
- $Q_{01668000}$ = the provisional daily flow for the previous day at USGS gaging station 01668000 in ft^3/s;
- 1.547 = the factor to convert Mgal/d to ft^3/s; and
- 1.078 = the drainage area conversion factor = the drainage area of the intake divided by the drainage area of Station 01668000.

The rolling 7-day average of the estimated freshwater inflow at the intake should be calculated daily; and the maximum daily withdrawal volume should be limited so that it does not exceed 50% of the rolling 7-day average freshwater inflow at the intake.

The permittee should be required to develop a drought management plan to provide a temporary alternative source of water supply for use during periods when the withdrawal of surface water from the Rappahannock River is limited or prohibited.