Endangered Species Act Section 10(a)(1)(B)

Incidental Take Permit (ITP No. 21516) Renewal Application

December 10, 2025

Chesterfield Power Station

Chesterfield, VA

This page is intentionally left blank

Table of Contents

1 Introduction 4
1.1 Overview 4
1.2 Background 4
1.3 Statement of Changes from ITP No. 21516-02 Application 6
1.4 Permit Type 7
1.5 Date of Application 7
1.6 Permit Duration 7
1.7 Contact Information 7
2 Species Covered by the Application 8
2.1 Overview 8
2.2 Atlantic Sturgeon 8
2.2.1 Population Distribution 8
2.2.2 Life History 12
2.2.3 Stock Assessment 14
2.2.4 Recovery and Critical Habitat 15
3 Chesterfield Power Station 16
3.1 Location 17
3.1.1 Areas Considered for Coverage Under the Permit 17
4 Environmental Baseline 23
4.1 Environmental Setting 24
4.2 Biological Resources 29
4.3 Water Quality 31
5 Activities 33
5.1 Activities to be Covered Under the Renewed Incidental Take Permit 34
5.1.1 Cooling Water Intake 34
5.2 Other Activities Considered (For Which No Incidental Take Anticipated to Occur) 38
5.2.1 Clean Water Act 316(b) Studies 38
5.2.2 Dredging 38
5.2.3 Constituent Discharge 41
5.2.4 Thermal Discharge 45
5.2.5 Vessel Movements 45
5.2.6 Shoreline and Structure Maintenance 47
6 Works Cited 47

Tables

Table 3-1 Geographic Coordinates for Chesterfield Power Station Outfalls 22
Table 4-1 Summary of USACE Maintenance Dredging in Permitted Area 28
Table 4-2 Median Total Suspended Sediments in the Freshwater James River 33
Table 5-1 Chesterfield Power Station Outfall Water Sources and Flows 43

Figures

Figure 2-1 Range of the Atlantic Sturgeon Distinct Population Segments 9
Figure 3-1 Aerial Photograph of Chesterfield Power Station 17
Figure 3-2 Plan View of 2003 Dredging Location(s) for Chesterfield Power Station CWIS 19
Figure 3-3 Plan View of Barge Slip Dredging 20
Figure 3-4 Locations of Chesterfield Power Station Outfalls 21
Figure 3-5 Location of CPS in James River 23
Figure 4-1 The James River Watershed 25
Figure 4-2 Chesterfield Power Station Area Map 25
Figure 4-3 General Water Depths in James River near Chesterfield Power Station (Soundings in Feet at Mean Lower Low Water) 26
Figure 4-4 USACE James River Project Condition Survey 2022 27
Figure 4-6 Map Depicting the Study Area and Sampling Stations for CWA 316(a) Studies Conducted April 1997 – February 1999 30
Figure 4-7 Water Quality Monitoring Locations Downstream of Chesterfield Power Station 33
Figure 5-1 Chesterfield Power Station Cooling Water Intake Structure Configuration 35
Figure 5-2 Typical Plan View of Chesterfield Power Station Cooling Water Intake Structure 36
Figure 5-3 Typical Section View of Chesterfield Power Station Cooling Water Intake Structure 37
Figure 5-4 Typical Cross-section View of 2003 Dredging Location for Chesterfield Power Station CWIS, February 12, 2003 39
Figure 5-5 Dragline Dredge 40
Figure 5-6 Typical Towboat Design 46

Appendices

Appendix A: Chesterfield Power Station 24-Month Entrainment Characterization Study Report

Appendix B: Chesterfield Power Station 12-Month Impingement Characterization Study Report

Appendix C: Dredging Joint Permit Applications

Appendix D: VPDES Permit No. VA0004146

Appendix E: Vessel Movement Summary

Acronyms and Abbreviations

AOI	Area of influence
CFR	Code of Federal Regulations
CPS	Chesterfield Power Station
CWA	Clean Water Act
CWIS	Cooling water intake structures
cy	Cubic yards
DIF	Design intake flow
DPS	Distinct Population Segment
ESA	Endangered Species Act
FFCP	Fossil fuel combustion product
fps	Feet per second
ft/min	Feet per minute
IAP	Integrated Ash Project
ITP	Incidental Take Permit
LAP	Lower Ash Pond
LVWWTS	Low Volume Wastewater Treatment System
mg/L	Milligrams per liter
MGD	Million gallons per day
MLLW	Mean lower low water
MLW	Mean low water
MSL	Mean sea level
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OTC	Once-through cooling system
TSS	Total suspended solids
UAP	Upper Ash Pond
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
VDEQ	Virginia Department of Environmental Quality
VDWR	Virginia Department of Wildlife Resources
VPDES	Virginia Pollutant Discharge Elimination System

1 Introduction

1.1 Overview

This application requests renewal of the National Marine Fisheries Service (NMFS) Incidental Take Permit (ITP) issued to Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion) for the Chesterfield Power Station (CPS) (ITP Renewal Application). NMFS issued ITP No. 21516 on December 10, 2020, authorizing take of Chesapeake Bay Distinct Population Segment (DPS) of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) incidental to CPS facility operations and sampling activities required under Clean Water Act (CWA) Section 316(b). Specifically, over the 5-year permit duration, ITP No. 21516 authorized entrainment of up to 54,745 Atlantic Sturgeon larvae during normal operation of CPS, and one larva during CWA 316(b) sampling. NMFS issued a modified ITP No. 21516-02 on August 13, 2025, authorizing additional take of Atlantic Sturgeon eggs. Specifically, ITP No. 21516-02 authorizes the entrainment of up to 10,949 larvae and up to 18,363 eggs for the remaining permit period during normal operation of CPS. This ITP Renewal Application requests to renew ITP No. 21516-02 for a period of 10-years using the same methodology to calculate take. This ITP Renewal Application requests the authorization of up to 109,490 larvae and 183,630 eggs over the duration of the requested 10-year ITP. The ITP is accompanied by a Conservation Plan describing measures designed to minimize and mitigate, to the maximum extent practicable, the impacts of the incidental take of Atlantic Sturgeon. Dominion developed the Conservation Plan in coordination with NMFS and diligently implemented the Plan over the permit duration.

1.2 Background

CPS is a power generation facility located in Chesterfield, Virginia in the upper tidal freshwater portion (approximately river mile 82 [river kilometer, rkm 132]), of the James River and has been in operation since 1945. CPS currently is authorized to withdraw and discharge water under the Virginia Pollutant Discharge Elimination System (VPDES) Permit Number VA0004146 issued and effective on October 1, 2016, and currently administratively continued. The original application for the renewal of VPDES Permit No. VA0004146 (VPDES Permit) was submitted to the Virginia Department of Environmental Quality (DEQ) on April 1, 2021. DEQ issued a letter on August 25, 2021, stating that the VPDES Permit would be administratively continued, and Dominion Energy would remain responsible for complying with all conditions of the VPDES Permit VA0004146 issued on October 1, 2016, until such time as the permit is reissued. Subsequently, Dominion Energy notified the DEQ of the decommissioning of the coal burning Units 5 and 6. The DEQ requested that Dominion Energy submit a revised application to account for changes that have occurred at the facility, or that are anticipated, since the April 1, 2021 application submittal. Dominion Energy submitted an updated application on April 9, 2025, which is currently under review by DEQ. The VPDES permit is among several state and federal permit authorizations required for CPS operations. The VPDES permit program is authorized under Section 402 of the CWA, which requires all point source discharges of pollutants to Waters of the United States to obtain a National Pollutant Discharge Elimination System (NPDES) permit 33 U.S.C. § 1342. The

CPS discharges authorized under the VPDES permit are resulting from non-contact cooling water associated with the generation of electricity.

The original ITP application was submitted in 2017 following the collection of two Atlantic Sturgeon larvae on October 7 and 8, 2015, during entrainment sampling which was conducted to comply with the final CWA 316(b) Rule's requirements for CPS's VPDES permit renewal application. The entrainment sampling was originally scheduled twice a month from July 1, 2015, to June 30, 2017 (Appendix A) and impingement sampling was scheduled twice a month from July 1, 2015, to June 30, 2016 (Appendix B). Impingement and entrainment sample collections started July 13, 2015. During CWA 316(b) sampling two Atlantic Sturgeon yolk-sac larvae were collected on October 7-8, 2015. The samples were processed according to standard operating procedures (Dominion, 2015). The samples were preserved and transported to the HDR Environmental Measurement Laboratory in Nanuet, New York for sorting and analysis. During sample processing, the HDR taxonomic staff preliminarily identified two specimens as Atlantic Sturgeon larvae on January 8, 2015. Identification of the specimens as *Acipenser* sp. was verified by Dominion's Millstone laboratory on January 15, 2016.

Dominion reported the incidental collection of these Atlantic Sturgeon larvae to Virginia Department of Wildlife Resources (VDWR; formerly Virginia Department of Game and Inland Fisheries [VDGIF]) and NMFS immediately following identification verification on January 15, 2016. On NMFS' recommendation, Dominion suspended CWA 316(b) sampling at CPS on March 2, 2016.

On December 10, 2020, NMFS issued ITP No. 21516 which authorized entrainment of up to 54,745 Atlantic Sturgeon larvae during normal operation of CPS, and one larva during CWA 316(b) sampling. CWA 316(b) sampling resumed and was completed in December of 2020. No additional Atlantic Sturgeon larvae were collected in the impingement or entrainment samples. Dominion submitted the final CWA 316(b) package to VDEQ on September 30, 2021.

ITP No. 21516 did not authorize incidental take of Chesapeake Bay DPS Atlantic Sturgeon eggs because Dominion determined, and Virginia Commonwealth University (VCU) sturgeon researchers and NMFS concurred, that entrainment of Atlantic Sturgeon eggs was unlikely to occur at CPS. Following issuance of the permit, however, the unexpected collection of three Atlantic Sturgeon eggs on September 25, 2021, forty-two Atlantic Sturgeon eggs on September 26, 2022, and eleven eggs on September 26, 2023, during entrainment monitoring (as required by the Conservation Plan) supported that collection of eggs can occur. Therefore, Dominion requested a modification of ITP No. 21516 to authorize incidental take of Atlantic Sturgeon eggs, which was approved by NMFS and executed on August 13, 2025.

Since issuance of ITP No. 21516-02, Dominion's coordination with NMFS included the following after the collection of one Atlantic Sturgeon egg on September 10, 2025:

- September 11, 2025: 24-hour take notification via email to NMFS regarding the one suspected Atlantic Sturgeon egg collected during 2025 annual entrainment monitoring.

- September 17, 2025: 7-day take report via email to NMFS confirming one Atlantic Sturgeon egg was collected during 2025 annual entrainment monitoring.

1.3 Statement of Changes from ITP No. 21516-02 Application

- Removed request for separate incidental take coverage for completion of sampling for CWA section 316(b) studies,
- Entrainment of non-viable Atlantic Sturgeon eggs can occur at CPS,
- The proposed incidental take in this ITP Renewal Application utilizes the previously NMFS approved incidental take number of eggs and larvae over a period of 10-years instead of 5 years,
- Updated contact information,
- Updated information regarding CPS operations and generating capacity, and
- VPDES compliance updates.

1.4 Permit Type

Renewal of ITP No. 21516-02 under ESA Section 10(a)(1)(B) is being requested.

1.5 Date of Application

The date of this ITP Renewal Application for renewal is December 10, 2025.

1.6 Permit Duration

ITP No. 21516-02 expires on December 30, 2025. Permit renewal is being requested for a period of 10-years.

1.7 Contact Information

Facility Name and Address:

Virginia Electric and Power Company
Dominion Chesterfield Power Station
5000 Dominion Boulevard
Glen Allen, Virginia 23060

Location:

500 Coxendale Road
Chester, Virginia 23836

Primary contact's name:

Stephen Dwyer; Environmental Services
Business phone number: 860-444-5731
Alternate phone number: 860-287-7751
Business fax number: 860-444-5240

Officer's name:

Robert W Sauer
VP Power Generation System Operations

Business tax identification number:

54-0418825

2 Species Covered by the Application

2.1 Overview

As discussed in Section 1 and in greater detail in Section 5 of this document, CPS has two combined-cycle power-generating units, (Units 7 and 8), and utilizes a once-through cooling (OTC) system that withdraws cooling water from the tidal freshwater portion of the James River through four CWIS. The CPS net generating capacity is approximately 450 megawatts (MW) but may fluctuate based on operation and maintenance requirements.

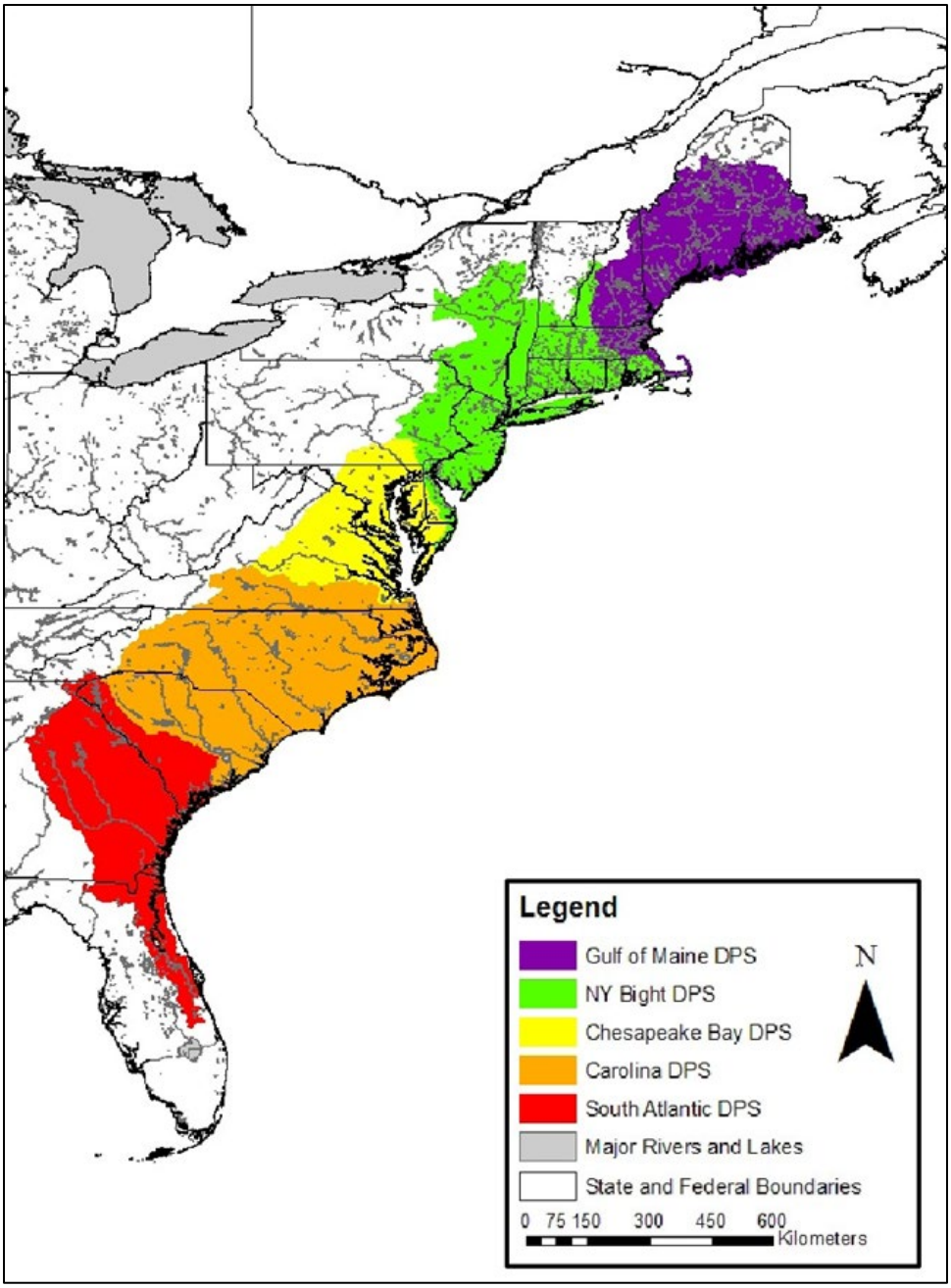
Certain activities associated with CPS operations, maintenance, and sampling pursuant to CWA 316(b) requirements have the potential to affect Atlantic Sturgeon (see Section 5 of this document for a description of activities). The Shortnose Sturgeon (*Acipenser brevirostrum*) rarely occurs in the James River. Incidental take coverage is not anticipated for any other federally listed species.

2.2 Atlantic Sturgeon

2.2.1 Population Distribution

Effective April 6, 2012, Atlantic Sturgeon originating from the New York Bight, Chesapeake Bay, South Atlantic and Carolina DPS were federally listed as endangered under the ESA (Figure 2-1). Those originating from the Gulf of Maine DPS are listed as threatened. Atlantic Sturgeon are also listed as endangered by the Commonwealth of Virginia. Based on genetic studies, adult Atlantic Sturgeon from each of these five DPS have the potential to occur throughout the full range of the five DPS, including the James River and in the vicinity of CPS (NMFS, 2012).

The majority of spawning adults found in the James River are likely to originate from the Chesapeake Bay DPS. The Chesapeake Bay DPS of Atlantic Sturgeon includes all anadromous Atlantic Sturgeon that are spawned in the watersheds that drain into the Chesapeake Bay and into coastal waters from the Delaware-Maryland border from Fenwick Island to Cape Henry, Virginia.



Source: (NMFS, 2020)

Figure 2-1 Range of the Atlantic Sturgeon Distinct Population Segments

Essential Fish Habitat in terms of both spawning and nursery habitats for Atlantic Sturgeon in Virginia waters of the Chesapeake Bay, including the James River, was described by Bushnoe et al. (2005) and Niklitschek and Secor (2005). NMFS issued a final rule designating critical habitat for the Atlantic Sturgeon on August 17, 2017, which became effective September 18, 2017 (82 CFR 39160). Within the James River, critical habitat has been designated for the entire width of the mainstem James River from Boshers Dam downstream for 99 river miles (160 river kilometers) to where the river discharges into the Chesapeake Bay at Hampton Roads.

The James River historically supported the largest stock of Atlantic Sturgeon in the Chesapeake Bay and the majority of the adults in the river are likely to originate from the James River and thus, the Chesapeake Bay DPS (Hildebrand & Schroeder, 1928; ASSRT, 2007; Hager, 2011; NMFS, 2012). Because early life stages (eggs and larvae), yearlings, and juveniles do not leave their natal river or estuary, any Atlantic Sturgeon from these life stages in the James River would have originated from the Chesapeake Bay DPS. Subadult Atlantic Sturgeon (greater than 50 cm but not yet sexually mature) move outside their natal rivers; therefore, subadult and adult Atlantic Sturgeon present in the James River and in the vicinity of the CWIS could be from any of the five DPS.

Within the Chesapeake Bay DPS, Atlantic Sturgeon were historically known to spawn in six river systems: the Susquehanna, Potomac, James, York, Rappahannock, and Nottoway Rivers (ASSRT, 2007). Atlantic Sturgeon continue to use the James River for spawning. While the availability of suitable benthic substrates (i.e., rock and cobble gravel) might be a limiting factor for sturgeon spawning habitat, hydrodynamic characteristics could also be important (Bilkovic, Angstadt, & Stanhope, 2009). Bushnoe et al. (2005) indicated that the Turkey Island and Jones Neck oxbows, which are approximately 3 to 7 miles (4.8 to 11.3 km) downstream of CPS, were potential spawning habitats due to their hydrodynamic characteristics.

However, empirical evidence of actual spawning activity or capture of early life stages at these potential spawning habitats is still lacking. Bilkovic et al. (2009) and Austin (2012) conducted Atlantic Sturgeon spawning habitat evaluations using hard substrate classifications based on side-scan sonar mapping in the upper James River. Austin (2012) characterized sturgeon spawning beds as dominated by hard substrates clean of fines/silt and ≥ 1.2 inches (30 millimeters [mm]) in size, and depths ≥ 32.8 feet [ft] (10 meters [m]). Atlantic Sturgeon have been seen spawning in the James and Appomattox River fall lines in water depths of less than 1 m (3.3 feet) (Balazik M. , Personal Communication via email with Dwyer, S. regarding James River Atlantic Sturgeon spawning habitat, 2025). Based on these parameters and sonar mapping data, Austin (2012) described essential sturgeon spawning habitat as located in major bends of the river where scouring occurs. The author also compared historical and present-day availabilities of hard bottom habitat and identified a 24 percent loss of hard bottom since 1853 over the area of river evaluated, with the greatest losses in hard bottom in the upper portions of the study area (55% loss in hard bottom habitat). The loss in availability of hard substrates was attributed to increased sediment loading and channel alterations (Austin, 2012). Some of the losses were thought to be offset by increased availability of hard-bottomed habitat within the confines of the shipping channel. Results of both studies described potential rather than confirmed Atlantic Sturgeon spawning habitat. Austin (2012) noted the areas of hard substrate identified as potentially suitable also needed to be further evaluated for the presence of silt layers covering hard substrate that may negatively impact the quality of spawning substrates by smothering eggs or impairing adhesion.

Spawning typically occurs in flowing water between the salt front of estuaries and the fall line of large rivers, where optimal flows are 46 to 76 centimeters per second (cm/s) (1.5 to 2.5 feet per second [ft/s]), depths are 11 to 27 m (36 to 88.5 ft), with a preferred temperature range of 20° to 26°C (ASMFC, 2012; NMFS, 2022); temperatures for spawning can range from 13–26°C. While spawning has generally been characterized as occurring for the entire spawning population in

April and May, strong empirical evidence suggests that spawning also occurs in the fall in the tidal freshwater portion of the river upstream of river mile 67 (rkm 108) (Balazik, Garman, Van Eenennaam, Mohler, & Woods III, 2012a; Balazik & Musick, 2015; NMFS, 2022). Further research has also determined that these fall and spring spawning groups are genetically distinct (Balazik, Farrae, Darden, & Garman, 2017). The capture of yolk-sac larvae by CPS in October 2015 entrainment samples further corroborates the evidence of fall spawning.

CPS is located at approximately river mile 82 (rkm 132). In a telemetry study, Hager (2011) observed these two seasonal migrations by adult Atlantic Sturgeon in the James River; in the spring during April and May and in the late summer and early fall from August into October. No fish passed above river mile 67 (rkm 108) in the spring (located downstream of CPS). The tagged adult Atlantic Sturgeon and majority of subadult Atlantic Sturgeon exited the James River when temperatures reached 24°C in early June. During the late summer to early fall residency (August-October), fish ascended the river rapidly and congregated in upriver sites between river mile 48 (rkm 77) and the fall line near Richmond, VA (river mile 95 [rkm 153]), approximately 13 miles (20.9 km) upstream of CPS. During late summer, Atlantic Sturgeon exhibited a preference for the river section at the confluence of the upper James River and Appomattox River (river mile 73 [rkm 117.5]), approximately 9 miles (14.5 km) downriver from CPS (Hager, 2011).

From 2009 to 2011, Balazik et al. (2012a) conducted spring (April–June) and fall (August–October) Atlantic Sturgeon telemetry surveys upstream of river mile 67 (rkm 108). No Atlantic Sturgeon were collected during the three years of spring sampling; however, 122 Atlantic Sturgeon were collected during the fall surveys, from August 5 to October 9 and none were captured during the spring. All collections were made between river mile 67 and 82 (rkm 108 to 132). Of the 122 captures, 106 Atlantic Sturgeon were verified as mature males, and one post-spawned female was collected on September 9. A total of 40 fish were tagged during the three-year study and monitored with acoustic telemetry similar to Hager (2011). The study showed that most males staged at the upper edge of the salt wedge, then migrated upstream during September to early October before dropping back downstream. The upstream migration lasted 1 to 12 days, with fish exiting the river and entering Chesapeake Bay from October 6 to November 8.

These studies were continued from 2012 to spring of 2014 (Balazik & Musick, 2015). Based on the results of previous studies, which indicated Atlantic Sturgeon did not migrate upstream of river mile 67 (rkm 108) during the spring and observations of breaching at river mile 56 (rkm 90), spring sampling was conducted further downstream between river mile 54 and 60 (rkm 87 and 97) and at river mile 20.5 (rkm 33). Fall sampling continued to be conducted upstream of river mile 67 (rkm 108). Balazik and Musick (2015) reported capturing a recently spent (post-spawning) female Atlantic Sturgeon on May 11, 2011, and three adult males in spawning condition (expelling milt on capture) from April 17 to May 8; all captured at approximate river mile 58 (rkm 93-94). Similar to the previous studies, the fall surveys were significantly more productive, with 236 Atlantic Sturgeon captured between August 16 and October 13, including two mature females (carrying eggs) captured on September 6 and 14. As of June 2025, VCU had tagged 53 adult females and 191 adult males from the fall spawning cohort of Atlantic Sturgeon in the James River. Some of

those tags are no longer pinging due to battery death. In June 2025, VCU had active telemetry tags in 50 adult females and 46 adult males.

2.2.2 Life History

Sturgeon breaching and captures of post-spawn Atlantic Sturgeon by Balazik and Musick (2015) indicate that spring spawning may occur between river miles 55 and 60 (rkm 88.5 through rkm 96.5), more than 20 miles (32 km) downstream of CPS. Balazik and Musick (2015) also documented Atlantic Sturgeon suspected of fall spawning near river mile 72 (rkm 116), approximately 10 miles (16 km) downstream of CPS indicating that potential fall spawning fish utilize the river in the vicinity of CPS. Recently, age-0 juvenile Atlantic Sturgeon, also known as young-of-year, were captured by researchers downriver of CPS, providing additional evidence of successful spawning upriver of CPS in the fall (Balazik, McIninch, Garman, & Latour, 2012b; Greenlee, et al., 2017). The capture of young-of-year downstream of CPS suggests these offspring move downriver within weeks of hatching which would potentially make them susceptible to entrainment as they pass the CPS CWIS (NMFS, 2020).

Atlantic Sturgeon are highly fecund, spawning between 400,000 to 2 million eggs in a spawning season (NOAA, 2024). The reported numbers of eggs an individual female can produce when they spawn ranges from 400,000 to 4 million eggs per fall spawning season (Boreman, 1997; Van Eenennaam & Doroshov, 1998; Gross, Repka, Robertson, & Van Winkle, 2002), although Balazik (2012) reported fecundities as high as 8 million eggs per spawning female per year. Adhesive, demersal eggs are broadcast in flowing water over hard substrate where they are expected to attach to the substrate within 20 minutes of fertilization; therefore, viable Atlantic Sturgeon eggs should occur only on the spawning grounds (Hildebrand & Schroeder, 1928; Jones, Martin, & Hardy Jr., 1978; ASMFC, 2012). Eggs typically hatch in 4 to 7 days depending on temperature (Hildebrand & Schroeder, 1928; Gilbert, 1989; Smith, Flowers, & Hightower, 2014; Mohler, 2003).

Research by Hardy and Litvak (2004) assessed the effects of temperature on the development, survival and growth of yolk-sac larvae of both Atlantic and Shortnose Sturgeon. Their study documented a faster rate of yolk-sac absorption at increasing temperatures, with Atlantic Sturgeon yolk-sac absorption from a mean of 27 days at 13°C to nine days at 21°C. Research suggests that growth slows above and below their optimum temperature range, though this exact range is not well-defined (NMFS, 2022). At hatching, Atlantic Sturgeon larvae are large bodied and are assumed to undertake a demersal existence in the same areas where they were spawned (ASMFC, 2012; Bath, O'Connor, Alber, & Arvidson, 1981). Bath et al. (1981) only collected sturgeon larvae in bottom samples. Larvae are active swimmers and leave the bottom within 8 to 10 days to swim in the water column (Kynard & Horgan, 2002). The yolk-sac larval stage is completed in about 8 to 12 days while (Jones, Martin, & Hardy Jr., 1978) reports 6 days. Snyder (1988) reports that Atlantic Sturgeon complete yolk absorption by 0.5 inches (13–14 mm) standard length in 6 to 7 days. After the absorption of the yolk, larvae move downstream to the rearing grounds (Kynard & Horgan, 2002). During the first half of this migration, larvae move only at night and use benthic structure (e.g., gravel matrix) as refuge during the day (Kynard & Horgan, 2002). During the latter half of migration to the rearing grounds, when larvae are more fully developed, movement occurs during both day and night. Larvae move downstream as they

transition into the juvenile phase at approximately 30 mm (1.2 in) total length and develop a tolerance to salinity during this transition. Eventually Atlantic Sturgeon become residents in estuarine waters for months to years before emigrating to the open ocean (ASSRT, 2007; ASMFC, 2012). ASMFC (2012) notes that some Atlantic Sturgeon occupy freshwater habitats for two or more years, while others move downstream to brackish waters when the water temperature drops.

Bain et al. (2000) reported that early juveniles were collected from salinities ranging from 0–5 parts per thousand (ppt) from April through October in the Hudson River and from 3–18 parts per thousand from October through March. However, temperature and dissolved oxygen are likely key habitat parameters (ASMFC, 2012). Bain (1997) reported that from July through September, juvenile Atlantic Sturgeon use deep channels in the Hudson River. Juvenile Atlantic Sturgeon in North Carolina use deep and cool areas as thermal refuges, particularly in the summertime (Moser and Ross 1995 as cited in (ASMFC, 2012)).

Atlantic Sturgeon are benthic feeders, using their snouts and barbels to rout through sediments, sucking up organisms with their soft mouths (NOAA, 2024). They feed on worms, snails, shellfish, crustaceans, and small fish (Secor, et al., 2000; NOAA, 2024). Nursery and foraging habitat typically contain productive benthic invertebrate communities in soft sediments, including freshwater mussel and marine shellfish beds.

Based on existing research, which has been further informed by the coordination with local sturgeon researchers, the spawning season of Atlantic Sturgeon in the James River fall cohort is estimated to occur during September-October. A September–October spawning period is based upon telemetry studies conducted in the James River by Virginia Commonwealth University Rice Rivers Center researchers and is comparable in timing and duration to spawning periods in other similar river systems. Based on telemetry data in the upper Altamaha system in Georgia, adult Atlantic Sturgeon migrated upstream to potential spawning sites in early to mid-October, as water temperatures dropped below 25°C (Ingram & Peterson, 2016). Similarly, spawning activity in the Roanoke River was estimated to occur when temperature ranged from 25.3 to 24.3°C (Smith, Flowers, & Hightower, 2014). Telemetry data in the James River indicate the fall spawning population migrate upstream as water temperatures approach 26°C.

The fall spawning period for the James River is thought to occur during an approximate three-week period typically in September (Balazik M. , 2019b). As noted above and described in more detail in the Conservation Plan, eggs typically adhere to the bottom substrate after fertilization. For viable Atlantic Sturgeon eggs to reach and become entrained at CPS, there would have to be extraordinary circumstances (see Section 3 of the Conservation Plan Renewal). Once hatched, it is anticipated that it takes approximately three weeks for Atlantic Sturgeon larvae to develop into young-of-year fish and move downstream of the CPS facility. Based on this information, it was estimated that Atlantic Sturgeon larvae could be present within the water column in the vicinity of CPS for up to six weeks during September and October.

2.2.3 Stock Assessment

Information on the status of Atlantic Sturgeon populations is limited throughout the species native range, but data from long-term monitoring efforts in New York and North Carolina indicate the occurrence of significant annual population fluctuations (ASMFC, 2025). Based on a status review initiated by NOAA Fisheries in 2009, the Atlantic Sturgeon was listed under the ESA as endangered (New York Bight, Chesapeake Bay, Carolina and South Atlantic DPS) and threatened (Gulf of Maine DPS) in 2012.

NMFS developed an index of population abundance for Atlantic Sturgeon using fishery bycatch estimates, data from the USFWS Atlantic Coast Sturgeon Tagging Database, and published values of Atlantic Sturgeon life history parameters. The abundance index generated by this analysis was intended for use by managers prior to completion of comprehensive stock assessments. The analysis resulted in a wide range in population estimates with a mean abundance of Atlantic Sturgeon in oceanic waters off the Northeast coast of the US and Canada as 417,934 fish, with a 95 percent confidence interval of 165,381 to 744,597 fish (Kocik, Lipsky, Miller, Rago, & Shepherd, 2013). The Chesapeake Bay DPS oceanic population was estimated to comprise 14 percent of the total Atlantic coastal population with a mean population of 58,511 fish, with a 95% confidence interval of 23,153 to 104,244 fish (Kocik, Lipsky, Miller, Rago, & Shepherd, 2013). The Chesapeake Bay DPS 5-year review conducted by NMFS (2022) asserts an absolute minimum population of 373 Atlantic Sturgeon in the James River based on the number of individuals captured between 2009 and 2014.

After receiving federal protection as a listed species, a coast-wide benchmark stock assessment was initiated to delineate stocks and evaluate stock status and bycatch (ASMFC, 2025). Balazik and Musick (2015) hypothesized that a dual spawning strategy (spring and fall) could substantially affect previous population status assessments. Based on samples collected from the James River, Balazik (2012) suggested that year classes 6 through 9 were underrepresented in the James River due to the oceanic migration of subadults. He further suggested the James River stock showed symptoms of depletion because data indicates that, historically, the maximum age and length of Atlantic Sturgeon was almost three times greater than recent data collections indicate. The 2024 stock assessment update concluded that Atlantic Sturgeon are currently depleted as a result of historic removals and estimated effective population sizes. There is a 14% likelihood that the number of Chesapeake Bay DPS has increased since the 1988 fishing moratorium, however the coastwide population index of Atlantic Sturgeon is likely increasing above the 1998 value (ASMFC, 2024).

The female spawning population in the James River was estimated based on the known the male spawning population. According to Matthew Balazik (2019a), the estimated male population for the fall cohort is approximately 3,707 individuals based on modified Schnabel mark recapture methods. Per Balazik, a 1:1 sex ratio for the fall cohort is a reasonable assumption and was used to estimate the female population. Given that, on average, females return to spawning grounds once every three years, and the known male population of 3,707 individuals, the annual fall-spawning female population in the James River is estimated at 1,250 individuals.

2.2.4 Recovery and Critical Habitat

NMFS published a recovery outline intended as an interim guidance document to direct recovery efforts and the overall recovery program (NOAA, 2018). At the time of ESA listing, NMFS identified ongoing threats to Atlantic Sturgeon from degraded water quality, habitat impacts from dredging, bycatch in state and federally managed fisheries, and vessel strikes (77 FR 5880). Climate change has since been identified as a major risk to Atlantic Sturgeon populations due to changes in water temperature and flood frequency (NMFS, 2022).

The final rule designating critical habitat throughout all five DPS was issued by NMFS and became effective September 18, 2017 (82 FR 39160). Within the Chesapeake Bay DPS, and specifically the James River, critical habitat has been designated for the entire width of the mainstem James River from Boshers Dam downstream for 99 river miles (160 rkm) to its confluence with the Chesapeake Bay at Hampton Roads. Occupied critical habitat is designated based on the physical or biological features essential to the conservation of the species that may require special management considerations or protections. Per 50 CFR Part 226, the physical features essential to the conservation of the Chesapeake Bay DPS of Atlantic Sturgeon for reproduction and recruitment consist of:

- Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0-0.5 parts per thousand range) for settlement of fertilized eggs, refuge, growth, and development of early life stages.

- Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 parts per thousand and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development.

- Water of appropriate depth absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: (1) unimpeded movements of spawning adults to and from spawning sites; (2) seasonal and physiologically-dependent movement of juvenile Atlantic Sturgeon to appropriate salinity zones within the river estuary; (3) staging, resting, or holding of subadults or spawning condition adults. Water depths in main river channels must also be deep enough (e.g., at least 1.2 m) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river; and,

- Water, between the river mouth and spawning sites especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support: (1) spawning; (2) annual and interannual adult, subadult, larval, and juvenile survival; and (3) larval, juvenile, and subadult growth, development, and recruitment (e.g., 13°C to 26°C

for spawning habitat and no more than 30°C for juvenile rearing habitat and 6 milligrams per liter [mg/L] dissolved oxygen for juvenile rearing habitat)[1].

The NMFS concluded that unoccupied habitat is not essential to the recovery of the Gulf of Maine, New York Bight, and Chesapeake Bay DPS because Atlantic Sturgeon reproduction and rearing habitat within each DPS is available downriver of dams or in rivers that are not dammed, and the boundaries of the critical habitat areas incorporate the seasonal and annual variations in the salt wedge location, which influences life stage-specific distributions of Atlantic Sturgeon within the estuary as well as any potential shifts that may occur as a result of climate change. Therefore, NMFS did not designate unoccupied habitat for these DPS (82 FR 39171).

3 Chesterfield Power Station

Figure 3-1 provides an aerial view of CPS and its environs. When Dominion applied for ITP No. 21516, CPS operated as a base-load facility with six power-generating units: four coal-fired units (Units 3, 4, 5, and 6) and two natural gas/distillate oil-fired combined cycle units (Units 7 and 8). Since that time, Units 3 and 4 were retired from generation in 2019 and Units 5 and 6 were retired from generation in 2023. The pumps associated with Unit 3 were also retired while the pumps associated with Unit 4 remain in service for operational water. Units 7 and 8 remain operational as baseload units and occupy the sites of former Units 1 and 2 which were retired in 1981.

[1] The specific oxygen concentration and temperature values are provided as examples and guidance to inform the combinations of temperature, salinity, and oxygen that support successful reproduction and recruitment. Temperature, salinity, and oxygen are ephemeral by nature, fluctuating daily and seasonally in estuaries. Specific areas designated as critical habitat based on the four features are not expected to have water with oxygen concentration of 6 mg/L and the specific water temperatures at all times and within all parts of the area.

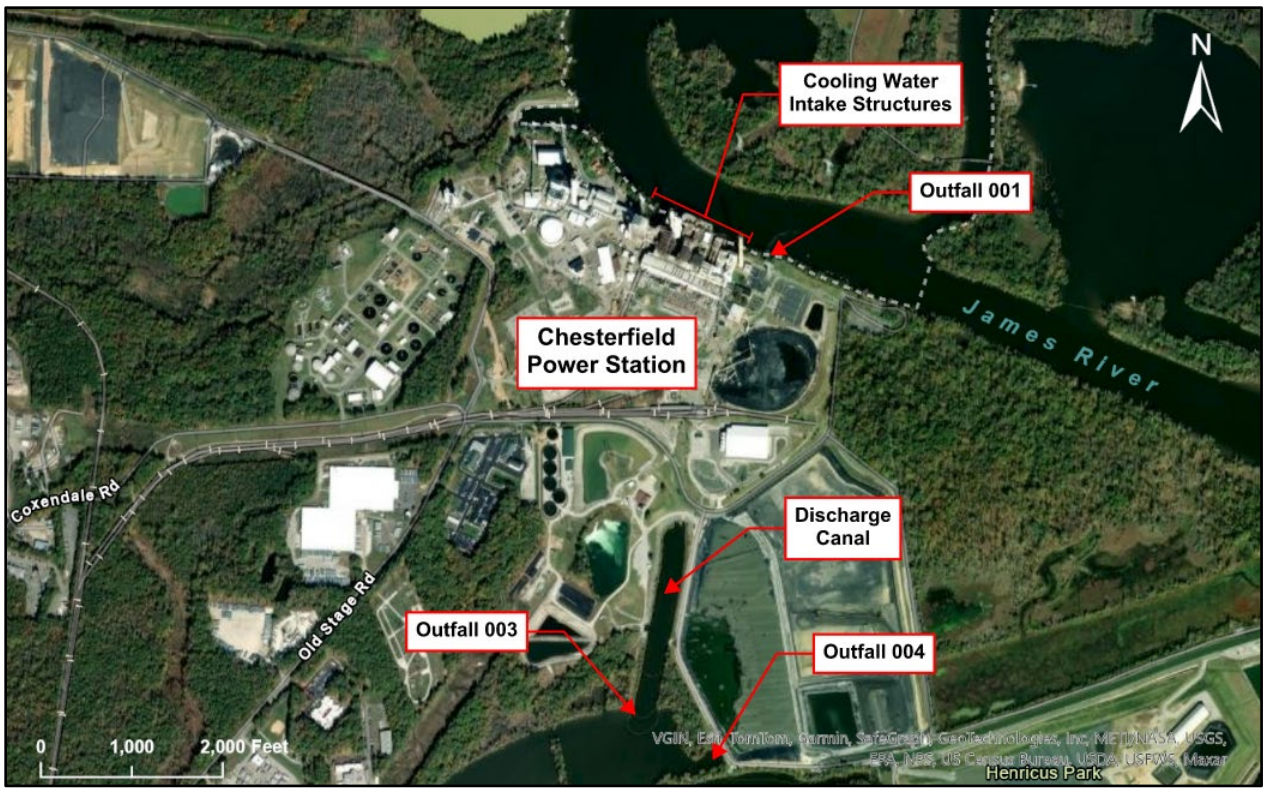


Figure 3-1 Aerial Photograph of Chesterfield Power Station

CPS utilizes OTC water systems, withdrawing water from the James River via submerged CWIS located at the base of a bluff on the south side of the river. Water withdrawn for non-contact cooling purposes is through the two-remaining operational CWIS for Units 7 and 8; however, CPS may require water withdrawal through Unit 4, Unit 5, or Unit 6 CWIS for other operational needs. The total current design intake flow (DIF) at CPS with all pumps working (CWIS 4 through 8) at full capacity is 939 million gallons per day (MGD). The actual amount of water withdrawn is expected to vary based on load demands and scheduled outages. Major outages for maintenance purposes on the generating units are typically scheduled for the spring and/or fall months after the end of the summer and winter peaking seasons. The duration of the maintenance outages depends on the scheduled work that needs to be done on the units. This ITP Renewal Application assumes the same level of water withdrawals used in ITP No. 21516-2, which includes continued water withdrawals by Units 4, 5, and 6 CWIS for conservative estimation purposes.

3.1 Location

CPS is located approximately 82 river miles (132 rkm) upstream from the mouth of the James River. Details of the specific locations for each permitted activity are provided in the following sub-sections.

3.1.1 Areas Considered for Coverage Under the Permit

The area to be covered by the permit is the geographic extent of environmental changes (i.e., physical, chemical, and/or biological) resulting from the permitted activities (area of direct and

indirect effects). The areas affected by each activity to be permitted, which have not changed from the initial ITP application, are described in the subsequent paragraphs.

Cooling Water Intake

The approximate geographic coordinates for the CWIS are Latitude: 37°23'2.32"N, Longitude: 77°22'57.72"W. The CWIS area of influence (AOI) was calculated using CPS' total DIF of 939 MGD as a conservative zone of hydraulic influence (i.e., it errs on the side of overestimating the size of the AOI) on the movement of motile, non-motile, and limited mobility life stages of fish and shellfish. The AOI does not represent an area of potential direct impact, but instead a conservative estimate of the potential area of hydraulic influence of the CPS CWIS. Fish and shellfish can occur in the AOI and avoid or not be drawn into the facility. The AOI is calculated based on conservative assumptions including no ambient velocity and low water depth; thus, it represents the maximum areal extent associated with the evaluated threshold velocities of 0.5 fps, 0.3 fps and 0.1 fps. The AOI is included to define the area to be permitted; however, AOI relevance does not extend beyond this aspect of the areal extent of the area to be permitted. Based on these conservative assumptions, the AOI is estimated as follows:

- The AOI based on a threshold velocity of 0.5 fps is conservatively calculated as a semi-circle with a radius of 69 feet centered at the CWIS. The threshold velocity of 0.5 fps is associated with motile fishes, where it is generally assumed that fish subject to 0.5 fps and lower velocities are able to swim freely and avoid impingement. For example, the CWA 316(b) rule assumes impingement is minimized at intakes with 0.5 fps through-screen velocities.

- Ambient velocities are typically expected to predominate and therefore influence movement of non-motile and limited mobility life stages (e.g., eggs and larvae). The AOI based on a range in velocity thresholds from 3.0 cm/s (0.1 fps) to 9.1 cm/s (0.3 fps), representing these ambient velocities (e.g., at slack tide or under gentle breeze conditions in a lacustrine system) is calculated as a rectangular area ranging from:

    - 2,772 feet along the river axis (1,386 feet upstream and 1,386 feet downstream from the CWIS) and 359 feet wide across the river (for comparison, the James River is approximately 500 feet wide at this location), centered at the CWIS using a velocity threshold of 0.3 fps.

    - 8,315 feet along the river axis (4,158 feet upstream and 4,158 feet downstream from the CWIS) and extending across the river (which is approximately 500 feet wide at this location), centered at the CWIS using a velocity threshold of 0.1 fps.

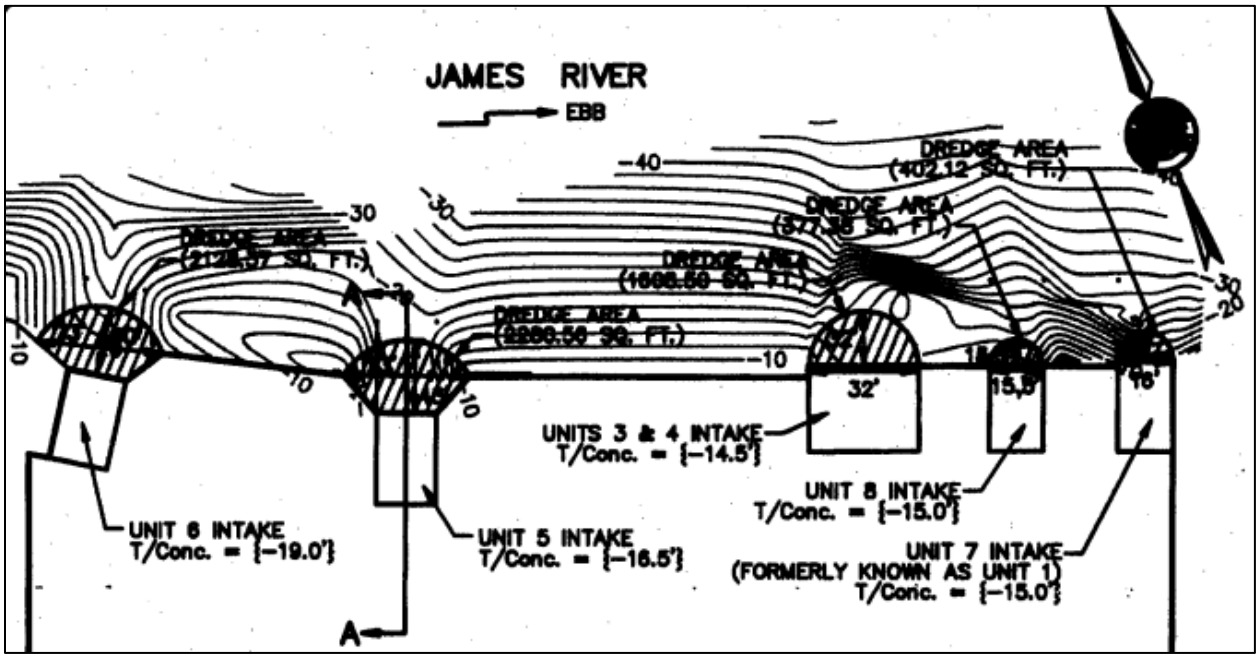
Clean Water Act 316(b) Studies

The CWA 316(b) studies that were part of the initial ITP application have been completed, but additional studies may be required as part of a future VPDES renewal process. The purpose of the biological sampling studies was to characterize entrainment and impingement associated with CPS operations pursuant to CWA 316(b) for existing facilities. Entrainment samples were collected directly in front of the trash racks at the Unit 6 CWIS. Impingement samples were

collected from the fish/debris return troughs at the east end of the intake structures after the last screen. Individual samples were collected from Unit 7, Unit 8, Units 3 and 4 together, Unit 5, and Unit 6 (a total of five sample locations). Therefore, the area of effect for entrainment and impingement sampling activities was a subset of the AOI for the CWIS operation, which is described above. The approximate geographic coordinates for the CWA 316(b) sampling are the same as the CWIS (Latitude: 37°23'2.32"N, Longitude: 77°22'57.72"W).

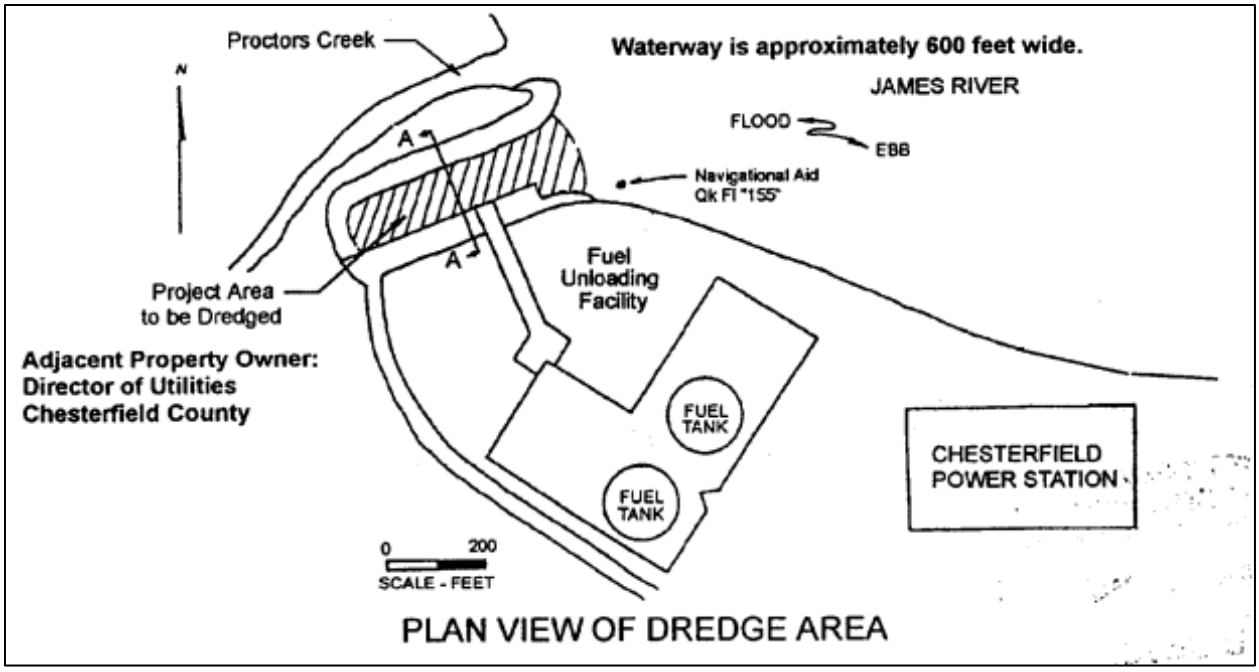
Dredging

Periodic dredging is necessary to remove accumulated sediments in the vicinity of each of the CPS CWIS to allow for reliable and efficient generation of electricity. Therefore, the approximate geographic coordinates used for the CWIS are also used for dredging (Latitude: 37°23'2.32" N, Longitude: 77°22'57.72" W). Figure 3-2 provides a plan view of the location(s) where sediment accumulates in front of CWIS and where dredging is required (Dominion, 2003). Periodic maintenance dredging is also necessary within the barge slip located northwest of the CPS (Latitude: 37°23'11.42"N, 77°23'12.12"W) (Figure 3-3). Dominion will comply with time of year restrictions when performing dredging.



Source: (Dominion, 2003)

Figure 3-2 Plan View of 2003 Dredging Location(s) for Chesterfield Power Station CWIS



Source: (Dominion, 2003)

Figure 3-3 Plan View of Barge Slip Dredging

Constituent Discharge

The locations of the CPS VPDES outfalls are shown on Figure 3-4. The geographic coordinates for the CPS outfalls are provided in Table 3-1. CPS has three outfalls that discharge to the James River. Outfall 001 discharges to the mainstem and Outfall 005 discharges to Farrar Gut. Internal Outfalls 301 and 304 are part of the station's wastewater management and FFCP leachate management, respectively. With the closure efforts of the Upper Ash Pond and Lower Ash Pond, CCR contact water will be treated and discharged via internal outfall 101 to Outfall 001 or 301. All discharges are regulated according to the December 2020 modified VPDES Permit Number VA0004146.

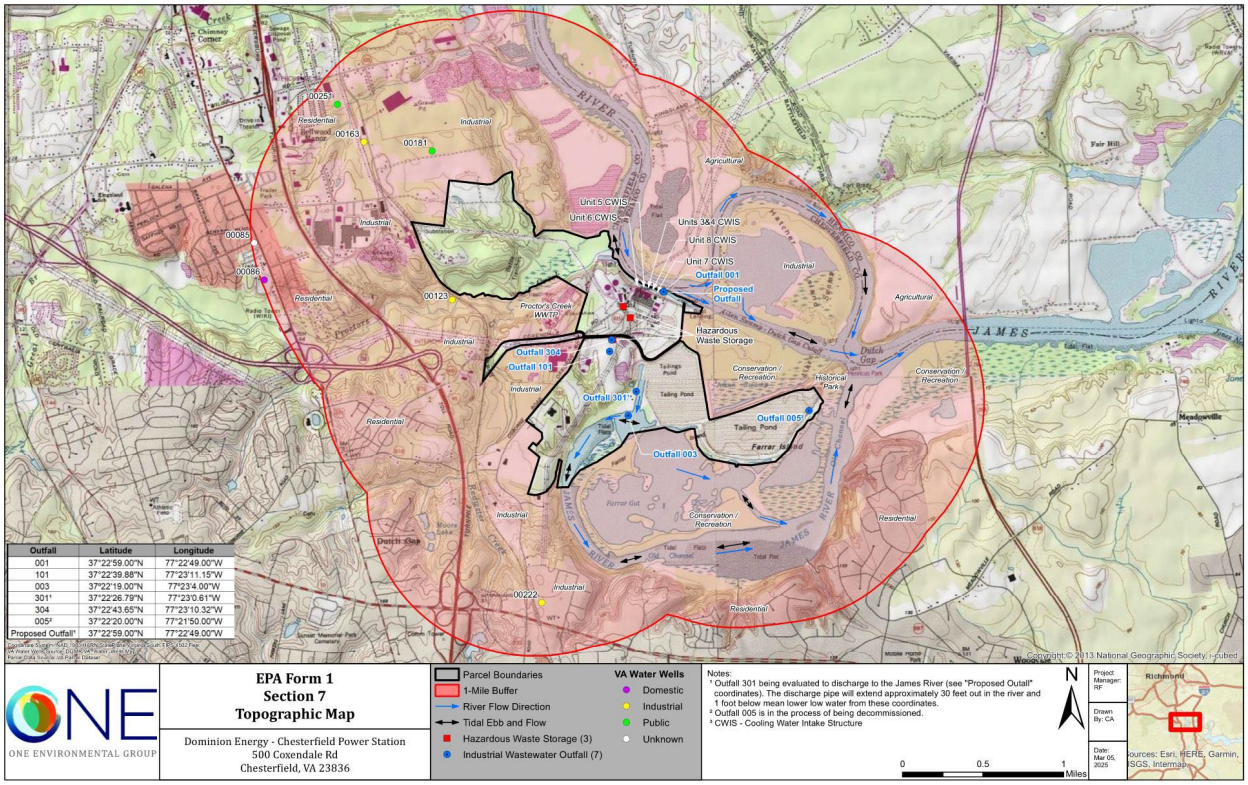


Figure 3-4 Locations of Chesterfield Power Station Outfalls

Table 3-1 Geographic Coordinates for Chesterfield Power Station Outfalls

Outfall	Latitude	Longitude
001*	37°22’59” N	77°22’49” W
101	37°22’39.88” N	77°23’11.15” W
003*	37°22’19” N	77°23’4” W
301	37°22’26.79” N	77°23”0.61” W
304	37º 22' 43.65” N	77º 23’ 10.32” W
005*	37°22’20” N	77°21’50” W

*Indicates an external outfall.

Thermal Discharge

The area of effect for the thermal discharge is in the immediate vicinity of Outfalls 001 (Unit 7 and 8 cooling water) and 003 (Units 4, 5, and 6 cooling water) (Figure 3-4 and Table 3-1). CPS conducted a CWA 316(a) demonstration study (VEPCO, 2000) with field surveys conducted from 1997 through 1999. The study analyzed water quality characteristics, and the biological communities located upriver and downriver of the CPS discharge (with sampling locations representative of the thermal mixing zone as well as ambient conditions). A report presenting the results of these studies was submitted to VDEQ on February 29, 2000. The report concluded that the heat rejection limits were “more stringent than necessary to assure the protection and propagation of a balanced, indigenous, aquatic community in the James River” (VEPCO, 2000). The 2016 VPDES permit Special Condition I.C.29 requires the development and implementation of a detailed plan for updating the studies to support renewal of the CWA 316(a) variance during the next permit reissuance. This plan was provided to VDEQ on December 29, 2020 (see Section 5.2 for additional detail).

Vessel Movements

Vessels ship materials to the CPS facility via the James River which meets the Chesapeake Bay at Hampton Roads (Figure 3-5). The area of effect for vessel movements is from the offloading facility or barge slip at CPS to the mouth of the James River. The peak risk of propeller strike would occur during docking/undocking maneuvers. Water depths in the navigation channel adjacent to CPS range from 25 to 55 feet (USACE, 2022) (Figure 4-4). Because shallow draft vessels are used for deliveries, the risk of vessel-sturgeon interactions is generally low. Risk of propeller strike would decline progressively with distance downriver as the below keel clearances increase and the cross-sectional profile of the river widens.

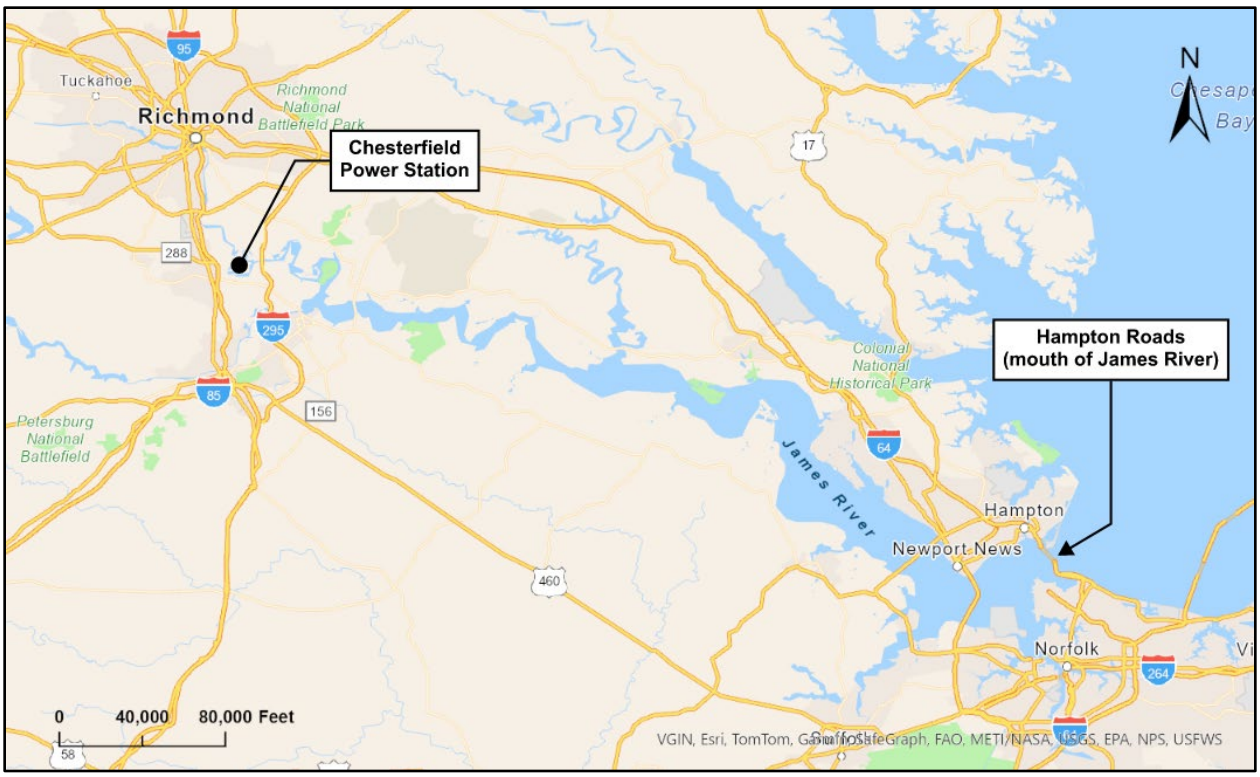


Figure 3-5 Location of CPS in James River

Vessel activities between 2020 and 2025 during implementation of ITP No. 21516 consisted of two to three barge deliveries of fuel oil each year, as discussed in more detail in Section 5.25. The vessels associated with CPS operations are shallow draft. A fully loaded barge would provide a minimum of 14 feet of below keel clearance during upriver transits. An empty barge would provide a minimum of 23 feet of below keel clearance on the downriver transits. Clearances would generally be deeper in those reaches where shoaling is less prevalent and where the natural channel depth exceeds the navigable depth.

Shoreline and Structure Maintenance

Shoreline and structure maintenance is limited to CPS waterfront property and the river adjacent to the CPS waterfront property. Shoreline and structure maintenance is infrequent but could include activities such as barge slip maintenance, and maintenance of ductwork over state-owned subaqueous land. See Table 3-1 for latitude and longitude locations of the outfalls and CWIS locations where shoreline and structure maintenance may occur.

4 Environmental Baseline

By regulation, environmental baselines for biological opinions include past and present impacts of all state, federal or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02, emphasis added). The

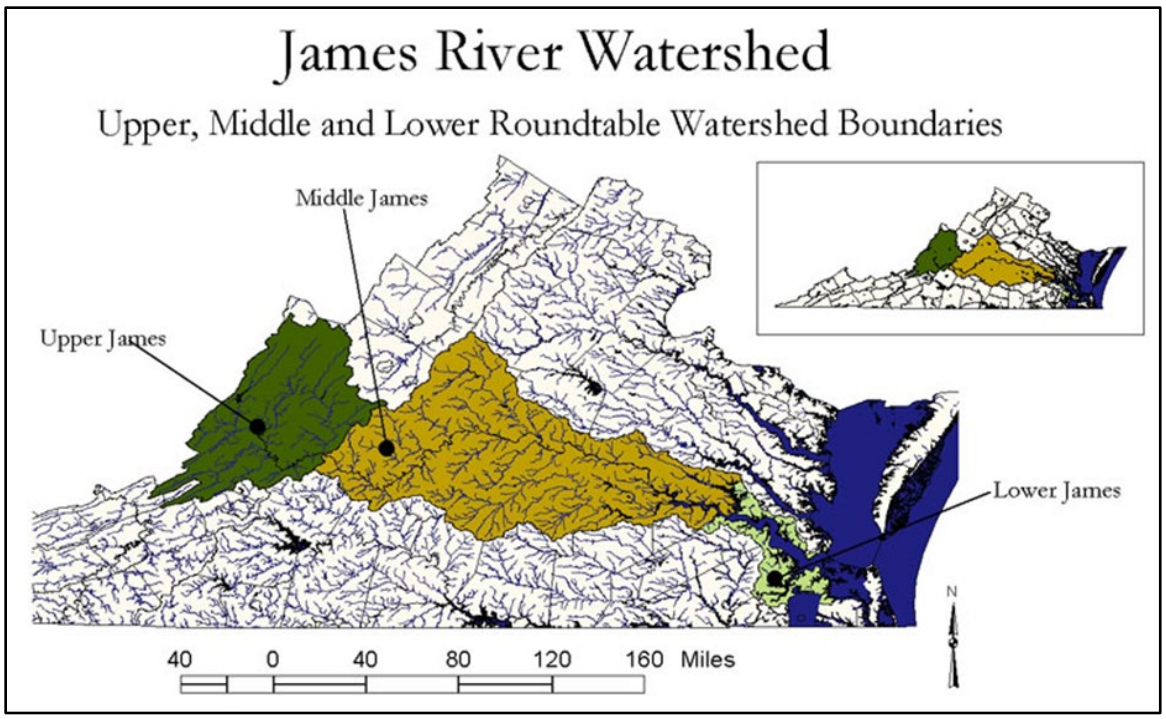
“impact” of the activities normally included in environmental baselines represents the prior experience, state, or condition of the endangered and threatened individuals and areas of designated critical habitat that occur in an action area and therefore, the areas considered for coverage under the permit. Knowing the prior experience, state, or condition of listed individuals or populations and areas of critical habitat is important because that prior experience, state, or condition will determine or influence the new effects of a proposed or continuing action. Activities that influence the current condition of the Atlantic Sturgeon, its habitat (e.g., water quality), and other biological resources in the areas considered under the permit include the following existing activities:

- Power generation,
- Dredging,
- Commercial and recreational fisheries,
- VPDES discharges,
- Scientific research,
- In-water construction,
- Regional permit 20 for the creation of artificial reefs,
- Runoff from surrounding land uses,
- Dam removal for fish passage, and
- Mining and leachate from abandoned coal mines.

4.1 Environmental Setting

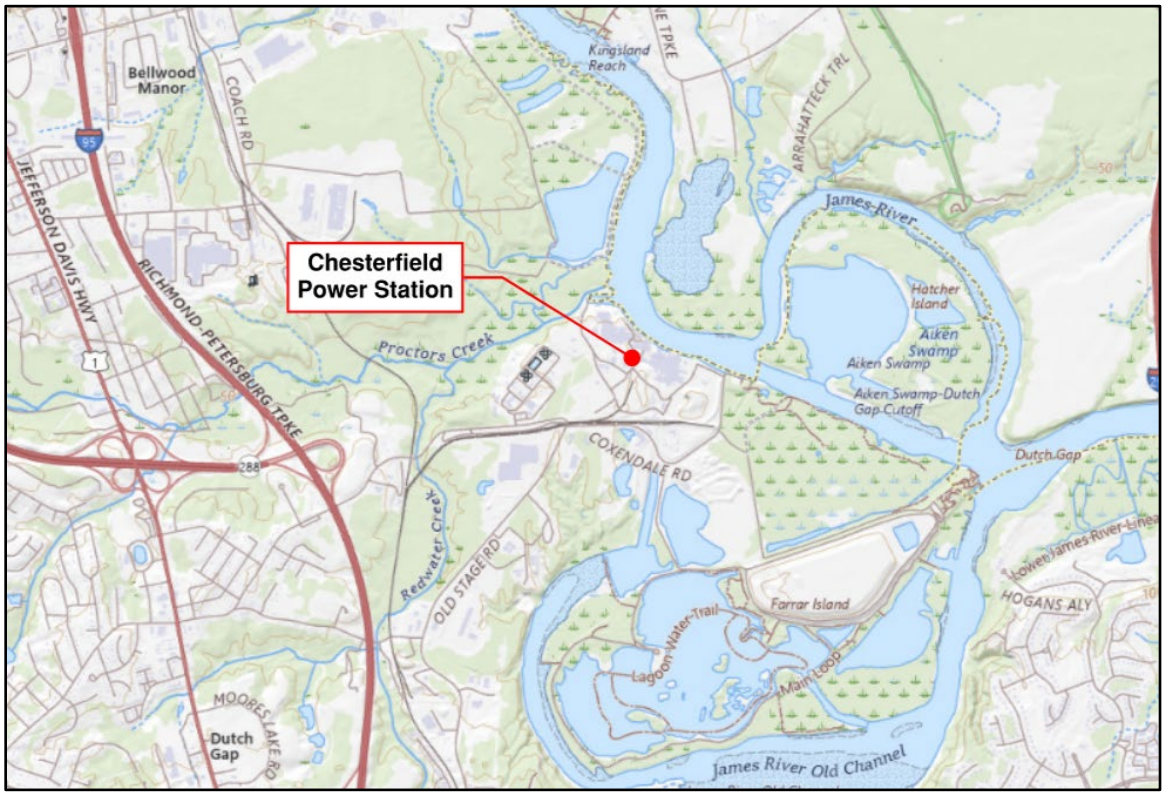
The climate in the Lower James River watershed is typically warm and humid in the summer, and generally mild in the winter with average precipitation of 40 to 48 inches of rain and approximately 3 inches of snow annually (Ingram, Dow, Carter, Anderson, & Sommer, 2013).The James River watershed encompasses approximately 10,000 square miles, which makes up almost 25 percent of the state. The James River watershed covers about one-third of the Chesapeake Bay drainage area in Virginia. The river flows approximately 340 miles from the Alleghany Mountains of western Virginia to the Chesapeake Bay. The watershed is comprised of three sections: the Upper James watershed begins in Allegheny County and travels through the Allegheny and Blue Ridge Mountains until Lynchburg; the Middle James watershed runs from Lynchburg to Richmond; and the Lower James watershed stretches from Richmond to the Chesapeake Bay (Figure 4-1).

CPS is located in the Coastal Uplands Physiographic Province where the James River begins its transition from a steep-banked, narrow-channeled river to a classical meandering river with oxbows. CPS is situated directly adjacent to and across the river from Farrar Gut and Hatcher Island, respectively, two oxbows on the James River (Figure 4-2). Man-made channels were constructed across these and other oxbows to reduce travel miles for river traffic. The river channel itself is also dredge-maintained to allow deep-draft vessels travel to the port of Richmond (VEPCO, 2000).



Source: (Middle James Roundtable, 2024)

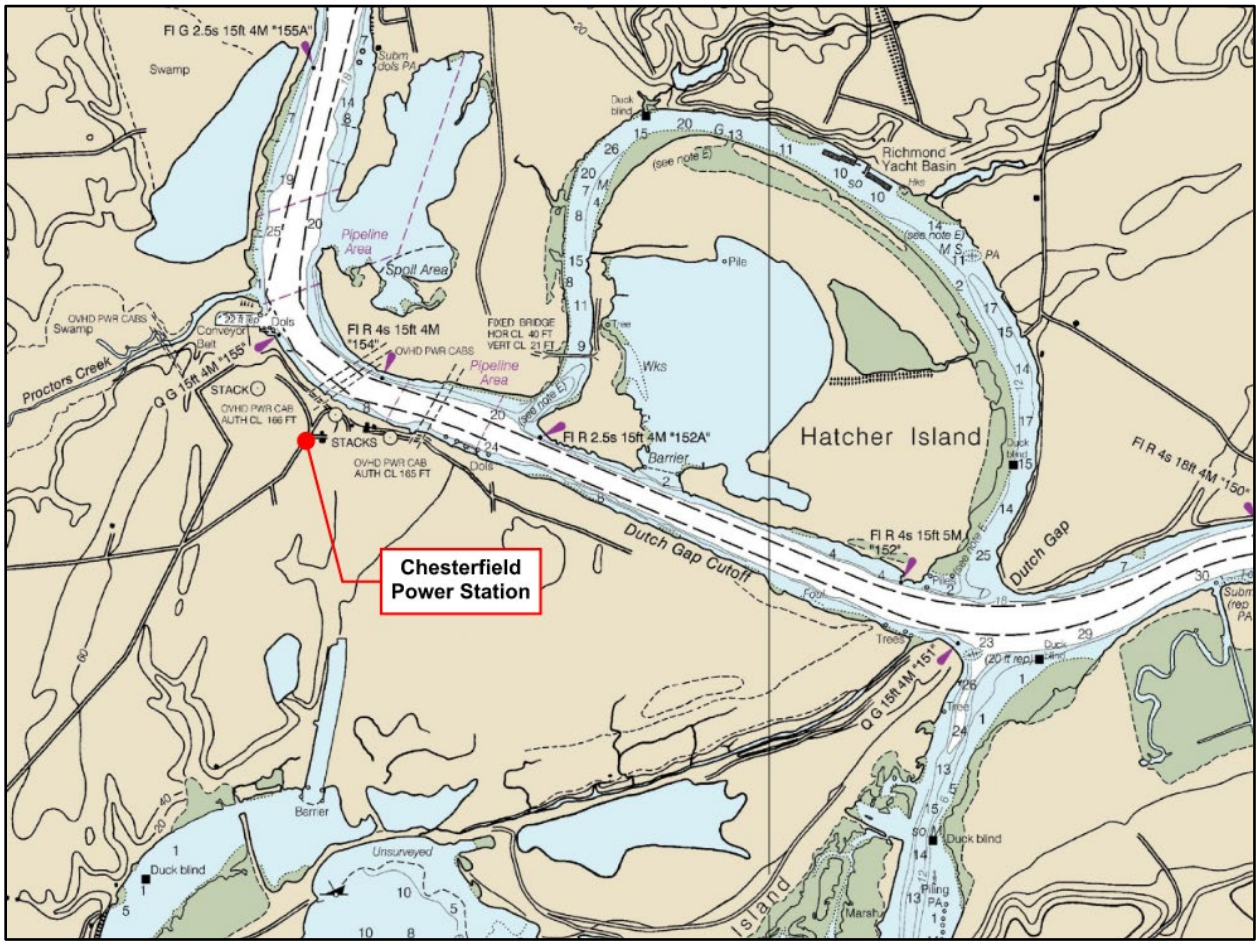
Figure 4-1 The James River Watershed



Map Source: (U.S. Geological Survey, 2019)

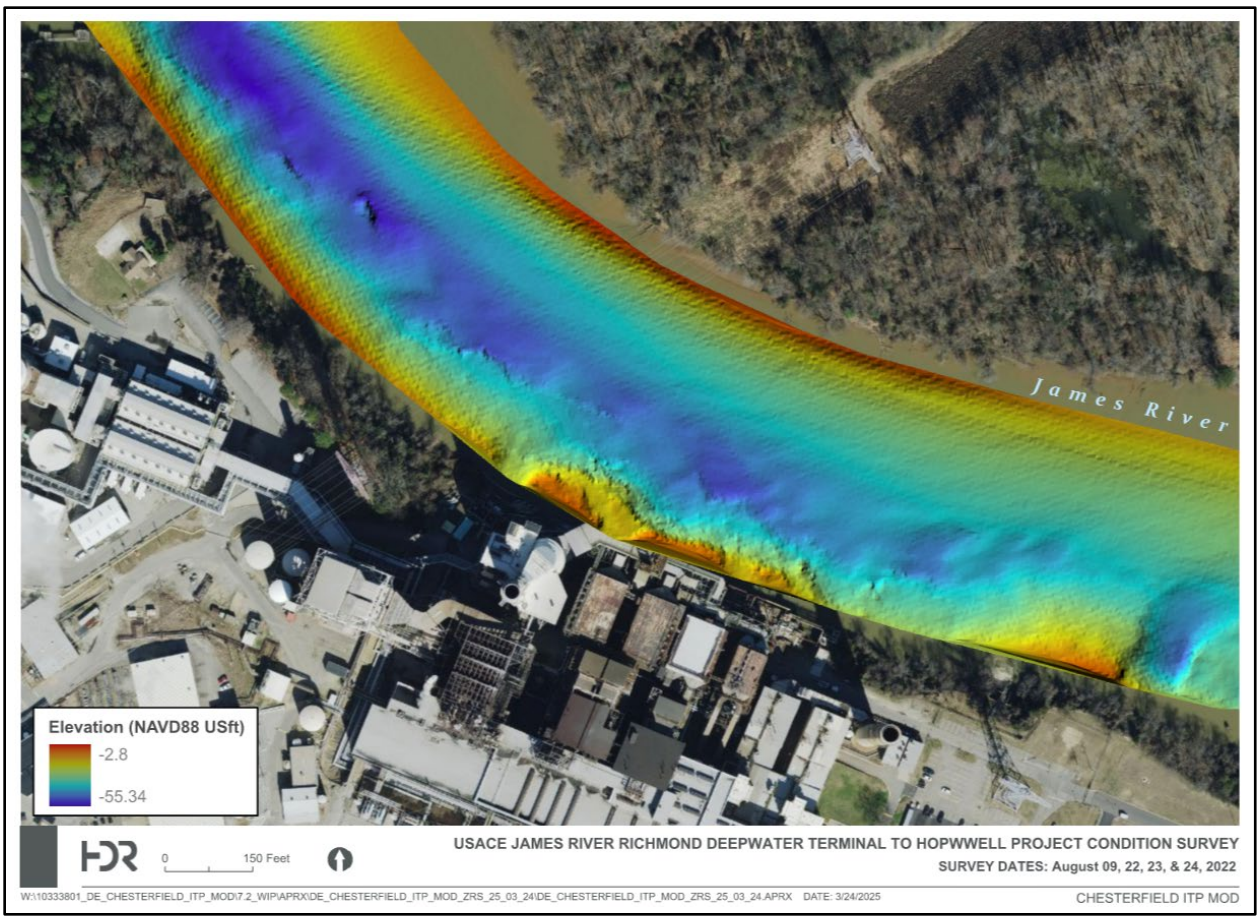
Figure 4-2 Chesterfield Power Station Area Map

General river depths near CPS vary from 2 to 39 feet at mean lower low water (MLLW) (Figure 4-3) and the navigational channel is maintained at 35 feet of water depth at MLLW. A bathymetric survey in front of CPS was conducted in 2011. Water depths near the outfalls range from 1 to 15 feet. Bathymetric data from the 2022 U.S. Army Corps of Engineers (USACE) James River Project Condition Survey from Richmond Deepwater Terminal to Hopewell, is provided in Figure 4-4.



Source: (NOAA, 2022)

Figure 4-3 General Water Depths in James River near Chesterfield Power Station (Soundings in Feet at Mean Lower Low Water)



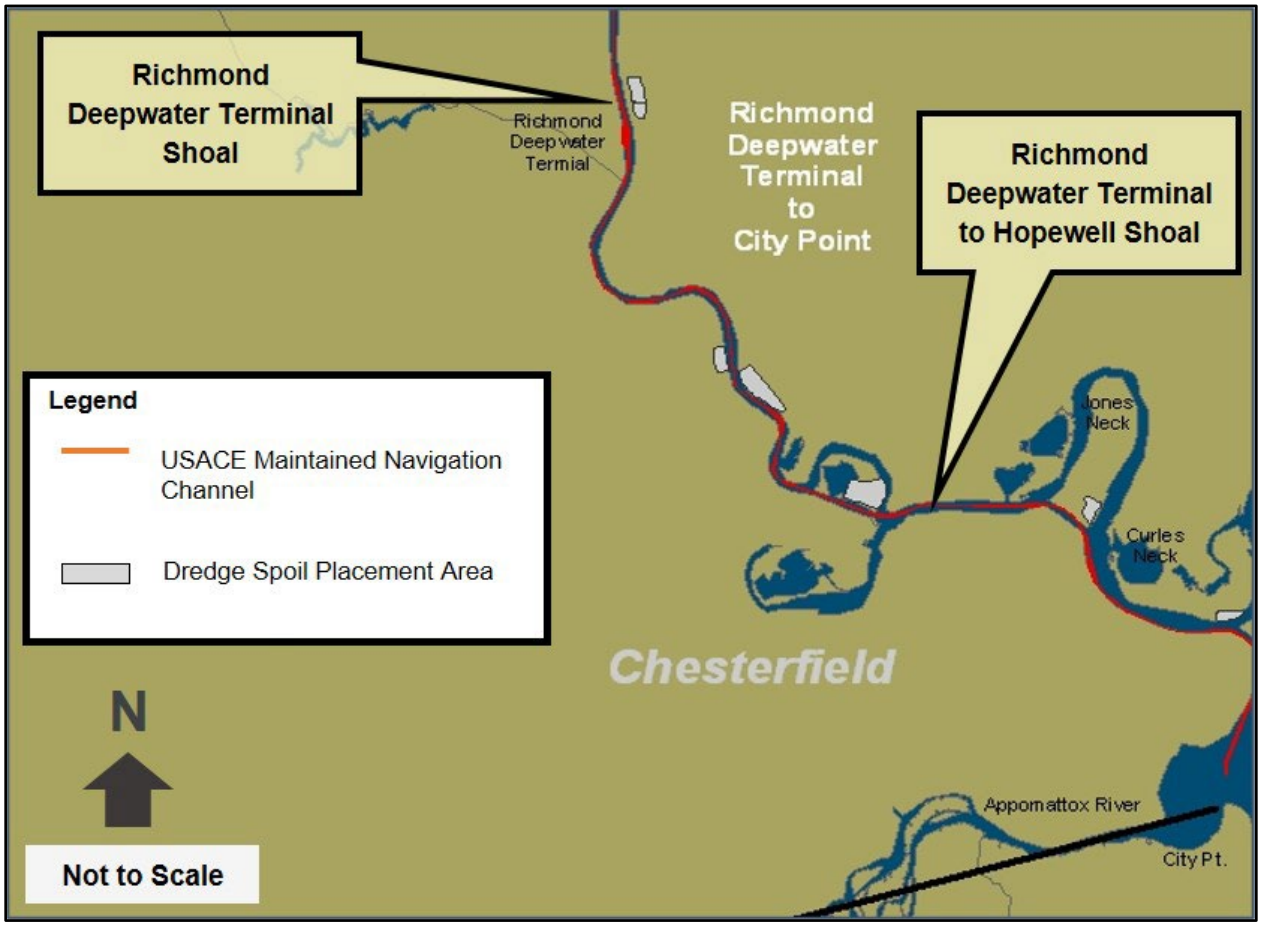
Source: (USACE, 2022)

Figure 4-4 USACE James River Project Condition Survey 2022

The James River at the CPS experiences a mean tidal amplitude of approximately 2.0 feet. The water level in this portion of the James River fluctuates greatly with an extreme high of elevation 19.0 feet and an extreme low of elevation -3.5 feet. The mean high and low water range is 5.2 feet; the mean high water is at grade elevation 3.5 feet and the mean low water is at elevation -1.7 feet. Maximum tidal current is approximately 2.8 fps with average maximum ebb and flood tidal currents of 1.34 fps and 1.5 fps, respectively. The James River in the vicinity of CPS is a temperate zone river with average temperatures generally ranging from 0°C in February to 34°C in August.

USACE conducts regular maintenance dredging of the James River Federal Navigation Channel every 5 years to accommodate deep-draft vessels. The most recent USACE maintenance dredging in the James River began in July 2019 and ended in March 2022. The authorized channel is maintained at a width of 300 feet and depth of 35 feet from Hampton Roads to Richmond Deepwater Terminal, Virginia, for a total distance of 86.1 miles via three cut-off channels in the upper section of the river. Figure 4-5 shows the navigation channel in the vicinity of CPS. Dredging occurs at nine shoals from the mouth of the James River to Richmond: Tribell Shoal, Goose Hill Shoal, Dancer Point-Swann Point Shoal, Jordan Point-Harrison Bar-Windmill Point Shoal, City Point Shoal, Richmond Deepwater Terminal to Hopewell Shoal, Richmond

Deepwater Terminal Shoal (turning basin), Richmond Harbor to Richmond Deepwater Terminal Shoal, and Richmond Harbor (NMFS, 2012).



Source: (NMFS, 2012)

Figure 4-5 USACE Navigation Dredging Locations in the James River in Vicinity of Chesterfield Power Station

Table 4-1 summarizes the volumes and frequency of USACE maintenance dredging for the reaches located in the vicinity of the CPS.

Table 4-1 Summary of USACE Maintenance Dredging in Permitted Area

Location	Average Dredge Volume (cubic yards)	Dredging Frequency
Richmond Deepwater Terminal to Hopewell Shoal	243,151	1-3 years
Richmond Deepwater Terminal Shoal	143,151	1-3 years

Source: (NMFS, 2012)

James River dredging is typically completed using a hydraulic cutterhead dredge which combines a movable rotating cutter apparatus surrounding the intake of a suction pipe (Taylor 1990 as cited in (NMFS, 2012)). The combination of mechanical cutting and hydraulic suction allows the efficient dredging of a wide variety of substrates including clay, silt, sand, and gravel. Cutterhead dredges on the James River are typically small with a maximum pipe diameter of 36 inches. The

mechanical cutterhead agitates the river sediments into a slurry which is hydraulically pumped to the dredged material placement area (NMFS, 2012). In the case of the USACE maintenance dredging of the James River, the dredge slurry is pumped to designated overboard placement areas adjacent to the shoals along the channel, or upland disposal sites for the upper river segment. Dredged material is placed along the centerline of overboard placement areas and assumed to spread out to even thickness (NMFS, 2012).

Due to the necessity to continually maintain the James River navigation channel, USACE maintenance dredging projects on the James River are indefinite with a total project life of fifty years (NMFS, 2012). Dredging activities associated with CPS are discussed in Section 5. In the lower James River dredging is permitted to occur annually between June 15 and February 15. The middle and upper James River dredging is permitted to occur annually from July 1 to February 15 (NMFS, 2020; VDWR, 2025). Annual dredging typically does not exceed several weeks within the permitted dredging window or several days per shoal, however the duration of dredging is subject to several factors such as the volume of material to be dredged, size and type of dredge utilized, and distance to the placement area (NMFS, 2012).

The Commonwealth of Virginia has been delegated authority to issue pollutant discharge permits by the U.S. Environmental Protection Agency (VDEQ, 2025) and authorizes the discharge of pollutants through issuance of VPDES permits. These permits authorize the discharge of pollutants in the area considered for coverage. Some of the facilities that operate pursuant to these permits include municipalities for sewage treatment plants and other industrial users.

Recreational and commercial fishing activities in state waters have the potential for take of Atlantic Sturgeon. Under Amendment 1 of the Atlantic Sturgeon Fishery Management Plan, states must maintain complete closure of any directed fishery for Atlantic Sturgeon and prohibit landings from any fishery (ASPRT, 2016). There is no indication that reopening a commercial fishery is reasonably certain to occur. However, the Chesapeake Bay supports numerous commercial and recreational fisheries for other species (CBFEAP, 2006). A number of Atlantic Sturgeon are taken through non-directed fisheries bycatch. However, Virginia supports a program that monitors Atlantic Sturgeon in Virginia state waters (ASPRT, 2016), and it is not clear to what extent these continued activities would affect Atlantic Sturgeon.

4.2 Biological Resources

Biological resources in the vicinity of CPS include phytoplankton, zooplankton, benthic macroinvertebrates, juvenile and adult fishes, aquatic macrophytes, and vertebrate wildlife and are characterized based on the results of the CPS CWA 316(a) demonstration study conducted 1997–1999 (Figure 4-6). Phytoplankton was diverse and dominated by green algae and diatoms, which varies seasonally. Rotifers were the most abundant of 25 taxonomic groups of zooplankton, followed by two groups of crustacean zooplankton, copepods and cladocerans. Zooplankton diversity and density vary seasonally and by location (VEPCO, 2000).

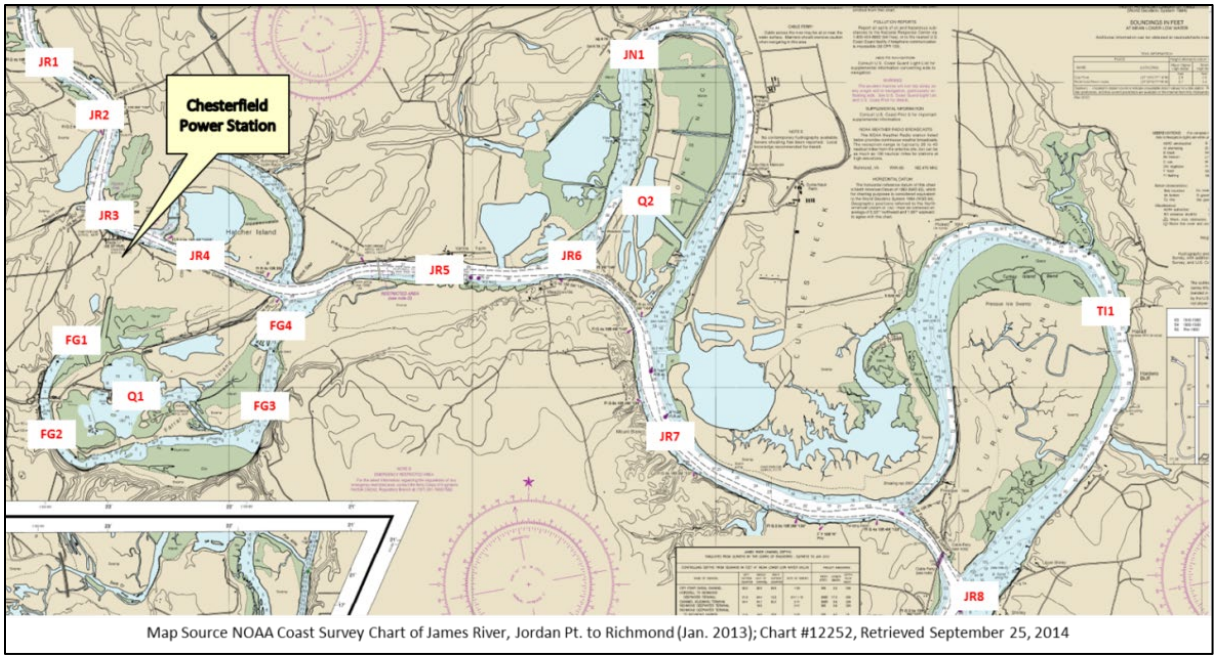


Figure 4-6 Map Depicting the Study Area and Sampling Stations for CWA 316(a) Studies Conducted April 1997 – February 1999

Benthic macroinvertebrates near CPS are dominated numerically (98%) by Oligochaeta (worms) and Chironomidae (midges). Overall abundance of phytoplankton, zooplankton, and benthic invertebrates increased from upstream to downstream (VEPCO, 2000). Additionally, Blue Crab (*Callinectes sapidus*), Asiatic Clam (*Corbicula fluminea*), and Common Grass Shrimp (*Palaemonetes pugio)* were collected in the 2005–2006 finfish surveys using electrofishing and gill netting and impingement study (EA, 2007).

Juvenile and adult fish species most frequently caught in 1997–1999 electrofishing samples included Gizzard Shad (*Dorosoma cepedianum)*, Threadfin Shad (*Dorosoma petenense)*, Bluegill Sunfish (*Lepomis macrochirus)*, Largemouth Bass (*Micropterus salmoides)*, Common Carp (*Cyprinus carpio*), Spottail Shiners (*Notropis hudsonius*), and White Perch (*Morone americana*). The most frequently caught juvenile and adult fish taxa using gillnets included Gizzard Shad, Threadfin Shad, White Perch, Blue Catfish (*Ictalurus furcatus*), and Channel Catfish (*Ictalurus punctatus*). A total of 35 native and introduced, riverine, and estuarine species have been collected (VEPCO, 2000).

Hydrodynamics in the James River drive the presence of aquatic macrophytes and plant community diversity. Protected oxbows, such as the Farrar Gut support richer and more diverse plant communities consisting of Pickerelweed (*Pontederia cordata*), wild rice, Smartweed (*Polygonum pensylvanicum*), Arrow-Arum (*Peltandra virginica*), and Broadleaf Cattail (*Typha latifolia*). Conversely, regions of the river subject to current scouring appear to support reduced plant diversity consisting of Water-willow (*Justicia americana*) and Smartweed patches (VEPCO, 2000).

The CWA 316(a) demonstration study conducted 1997–1999 characterized the interaction of the thermal discharge from CPS Outfall 003 with spatial and temporal variation of biological resources near CPS. The study compares results from sampling from 1997–1999 to sampling from 1968–1971 (VEPCO, 2000). The CWA 316(a) study indicated the following:

- Phytoplankton abundance overall increased while nutrient concentrations decreased in concentration from 1970 and 1971 sampling. These results indicate that water quality has improved and that station operations do not negatively impact the phytoplankton community.

- Crustacean zooplankton abundance overall increased from 1970 and 1971 sampling to 1990s sampling. These results indicate that that station operations do not negatively impact the zooplankton community.

- The benthic macroinvertebrate communities were similar during both study periods. Benthic macroinvertebrate density in the areas closest to the station's Outfall 003 in the upper section of Farrar Gut was lower than in the lower section and at the mouth of Farrar Gut, and in the James River. The results of the CWA 316(a) demonstration study (VEPCO, 2000) indicate the fish assemblage has remained relatively stable over 30 years when compared to populations in the 1960s (Jensen, 1974), with exceptions that included the following:

    - Introduced Blue Catfish and Flathead Catfish (*Pylodictis olivaris*) replaced White Catfish (*Ameiurus catus*) and Brown Bullhead Catfish (*Ameiurus nebulosus*).

    - Gizzard and Threadfin Shad, which comprised the most abundant species collected, were less prominent in the 1960s.

The results of the CWA 316(a) study demonstrated that heat rejection limits are "more stringent than necessary to assure the protection and propagation of a balanced, indigenous, aquatic community in the James River" (VEPCO, 2000). The 2016 VPDES permit contains Special Condition I.C.29 that requires the development and implementation of a detailed plan for updating the studies to support renewal of the CWA 316(a) variance during the next permit reissuance. An updated study was provided to VDEQ on December 29, 2020.

4.3 Water Quality

VDEQ 2022 CWA Section 305(b)/303(d) Water Quality Assessment Integrated Report (VDEQ, 2022) provides a summary of the water quality conditions in Virginia from Jan. 1, 2015, to Dec. 31, 2020. The Lower James River was designated as a 5A impaired water body for aquatic life and fish consumption. The 305(b)/303(d) assessment identified the significant cause for use impairment to the James River Basin, ranked by percentage of the water body that is impaired, was due to bacteria (79%), followed by impaired benthos (20%), dissolved oxygen (DO) (8%), polychlorinated biphenyls (PCBs) in fish (9%), pH (7%), and temperature (4%) (VDEQ, 2022). In review of the sources of these water body impairments, ranked by percentage of the water body that is impaired, it was determined that the predominant suspected source was agriculture (61%),

followed by on-site septic treatment systems (59%), non-point sources (58%), urban runoff/storm sewers (43%), wildlife other than waterfowl (42%), and unknown sources (25%) (VDEQ, 2022).

The VDPES permit for CPS does not include a municipal sewage or other bacterial load to the James River, which was determined to be one of the main causes of impairment for recreational (swimming) use. For aquatic life, the most significant impairment for rivers was low dissolved oxygen levels which were found in only 4% percent of assessed rivers, and all the James River segments met the open water dissolved oxygen criteria (VDEQ, 2022). CPS CWA 316(a) sampling demonstrated that oxygen levels in Farrar Gut were adequate to support aquatic life, particularly during the hottest summer months (VEPCO, 2000).

Temperature, DO and nutrient monitoring were conducted from May of 1997 through February 1999 for the CWA 316(a) study (VEPCO, 2000). These results indicated that despite the influence of the thermal discharge at Outfall 003, river water temperature mirrored seasonal changes in air temperature. Additionally, the oxbows act as heat sinks, but the tidal cycle influences the thermal plume, confining it to Farrar Gut on the incoming tide and extending it downriver on the outgoing tide. Aquatic life is fully supported by the observed dissolved oxygen values and dissolved oxygen has improved since the 1970s (VEPCO, 2000). Dissolved oxygen in the tidal freshwater James River varies between 13 mg/L during winter months to typically 6 mg/L during the summer, with no values of less than 5 mg/L recorded (Moore, Neikirk, Anderson, & Jarvis, 2007).

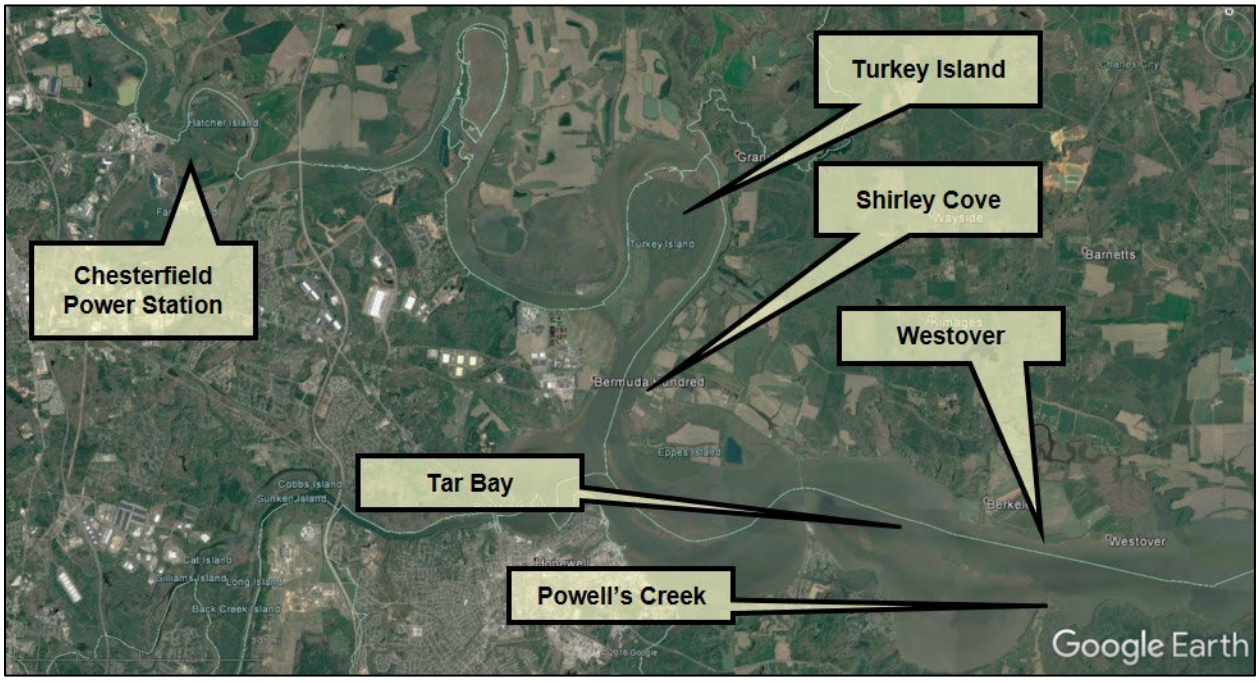
Nutrient concentration data indicate that water quality in the James River, Farrar Gut, and associated oxbows has shown improvement since 1971 (VEPCO, 2000). Concentration of total phosphorus, total Kjeldahl nitrogen, and ammonia and nitrate & nitrite concentrations in the James River, Farrar Gut, and oxbows suggest that the nutrient load upstream of the James River is greater than that of the discharge to the Farrar Gut (VEPCO, 2000).

Median total suspended solids (TSS) in the area of Turkey Island and Shipley Cove (approximately 8 miles downstream of the CPS) ranged from 16.0 to 35.0 mg/L during April through October over the period of 1999 to 2005 (Moore, Neikirk, Anderson, & Jarvis, 2007). These TSS levels are typical of the freshwater, tidal portions of the James River as shown in comparison to locations monitored downstream of the CPS (Table 4-2) shown in Figure 4-7 (Moore, Neikirk, Anderson, & Jarvis, 2007).

Table 4-2 Median Total Suspended Sediments in the Freshwater James River

Location	1999 TSS (mg/L)	2000 TSS (mg/L)	2001 TSS (mg/L)	2002 TSS (mg/L)	2003 TSS (mg/L)	2004 TSS (mg/L)	2005 TSS (mg/L)
Turkey Island	33.5	26.0	31.5	30.0	26.0	35.0	32.0
Shirley Cove	21.0	19.0	22.0	24.0	16.0	21.0	24.0
Tar Bay	31.0	28.0	29.5	34.5	24.0	32.0	28.0
Powell's Creek	37.5	29.0	36.0	35.5	31.0	38.0	38.0
Westover	--	--	30.0	30.0	26.0	32.0	36.0
Note: -- No data							

Source: (Moore, Neikirk, Anderson, & Jarvis, 2007)



Source: (Moore, Neikirk, Anderson, & Jarvis, 2007)

Figure 4-7 Water Quality Monitoring Locations Downstream of Chesterfield Power Station

5 Activities

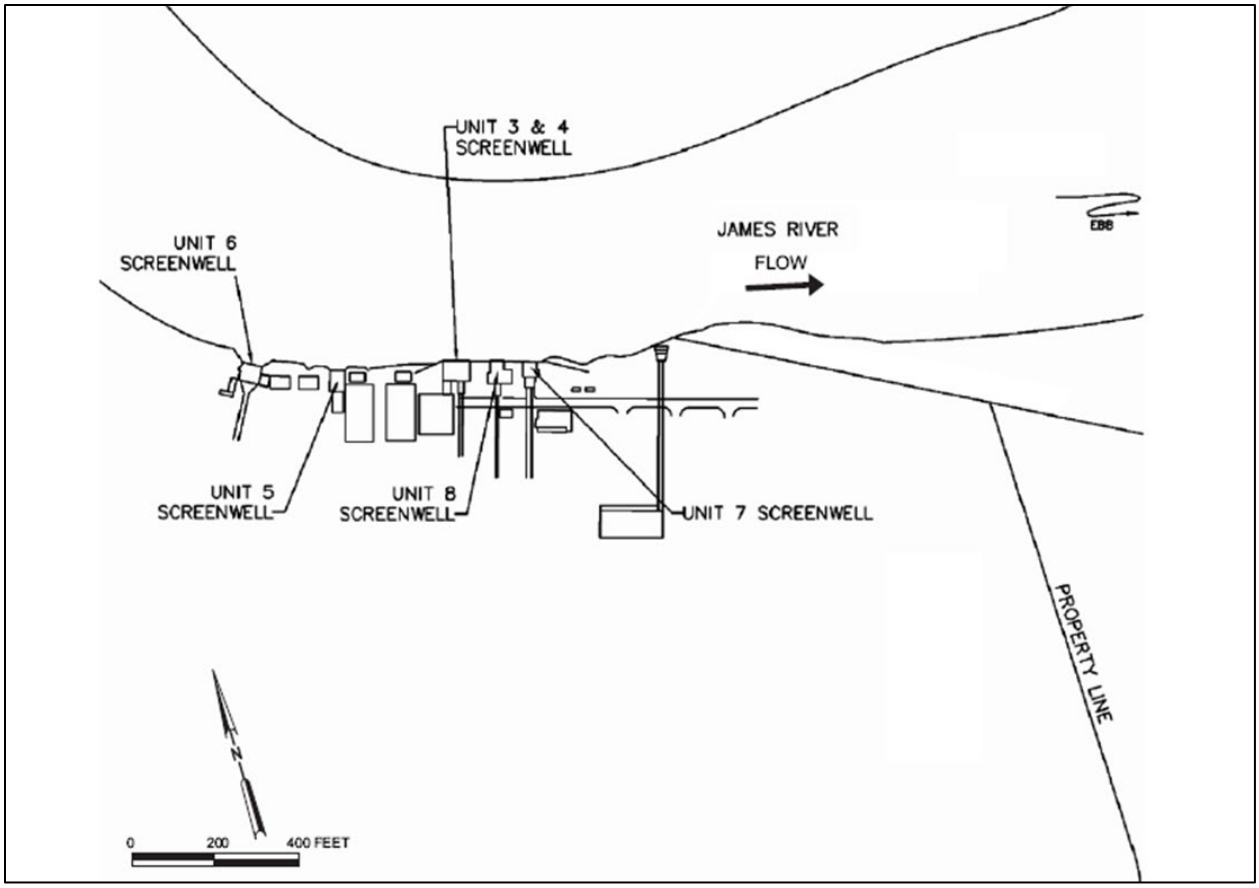
This section describes activities associated with CPS operations and maintenance that were identified as having the potential to affect Atlantic Sturgeon during the 10-year permit duration, as well as activities that Dominion considered but for which no incidental take is anticipated to occur. Activities considered include the necessary cooling water withdrawal or operation of CWIS, CWA 316(b) studies, dredging, constituent discharge, thermal discharge, vessel movement, and shoreline and structure maintenance. Some of these activities, such as dredging and shoreline maintenance, would occur intermittently or infrequently (e.g., only once) within the authorized 10-year duration of the permit. Operation of the CWIS is the only activity for which incidental take is anticipated; therefore, the requested permit renewal is for authorization of incidental take associated with this activity. The remainder of activities were considered, but incidental take is not anticipated, and therefore, coverage is not being requested. Potential effects of all activities and the estimated take are presented in Sections 2 and 3 of the Conservation Plan Renewal.

5.1 Activities to be Covered Under the Renewed Incidental Take Permit

5.1.1 Cooling Water Intake

Units 3 and 4 were retired in March 2019 and Units 5 and 6 were retired in May 2023. Some flow continues to be provided by one or more of the Unit 4, 5, or 6 river water pumps to support other non-cooling needs at CPS; therefore, descriptions associated with these intake structures are included in this section. The two-remaining power-generating units (Units 7 and 8) at CPS utilize an OTC that withdraws cooling water from the tidal freshwater portion of the James River through two CWIS (one CWIS per unit) with two river intake pumps per CWIS. All intake pipes associated with the CWIS are constantly submerged and aligned flush with and parallel to the south shoreline. See Figure 5-1 for the unit configuration layout. The total DIF at CPS with all pumps working at capacity is approximately 939 MGD. Additional service waters are drawn through dedicated pumps to test and maintain fire suppression and other facility support functions. Intakes to these pumps go through traveling screens and are de minimis compared to the other intake volumes.

The James River in the vicinity of CPS CWIS is approximately 500 feet wide and flows in a generally southeasterly direction. Water depths directly in front of the intakes generally range from 29 to 33 feet with a typical depth of 31 feet. Depths generally increase to 40 to 50 feet with distance from the shoreline along the upriver reach fronting the plant and barge slip but gradually decrease to approximately 30 feet proceeding downriver. The intake structures are designed to operate at river levels ranging from 3.5 feet below mean sea level (MSL) to 19.0 feet above MSL. The mean high and low water levels differ by approximately 5.2 feet with the mean high-water mark at 3.5 feet above MSL while the mean low water mark is 1.7 feet below MSL.

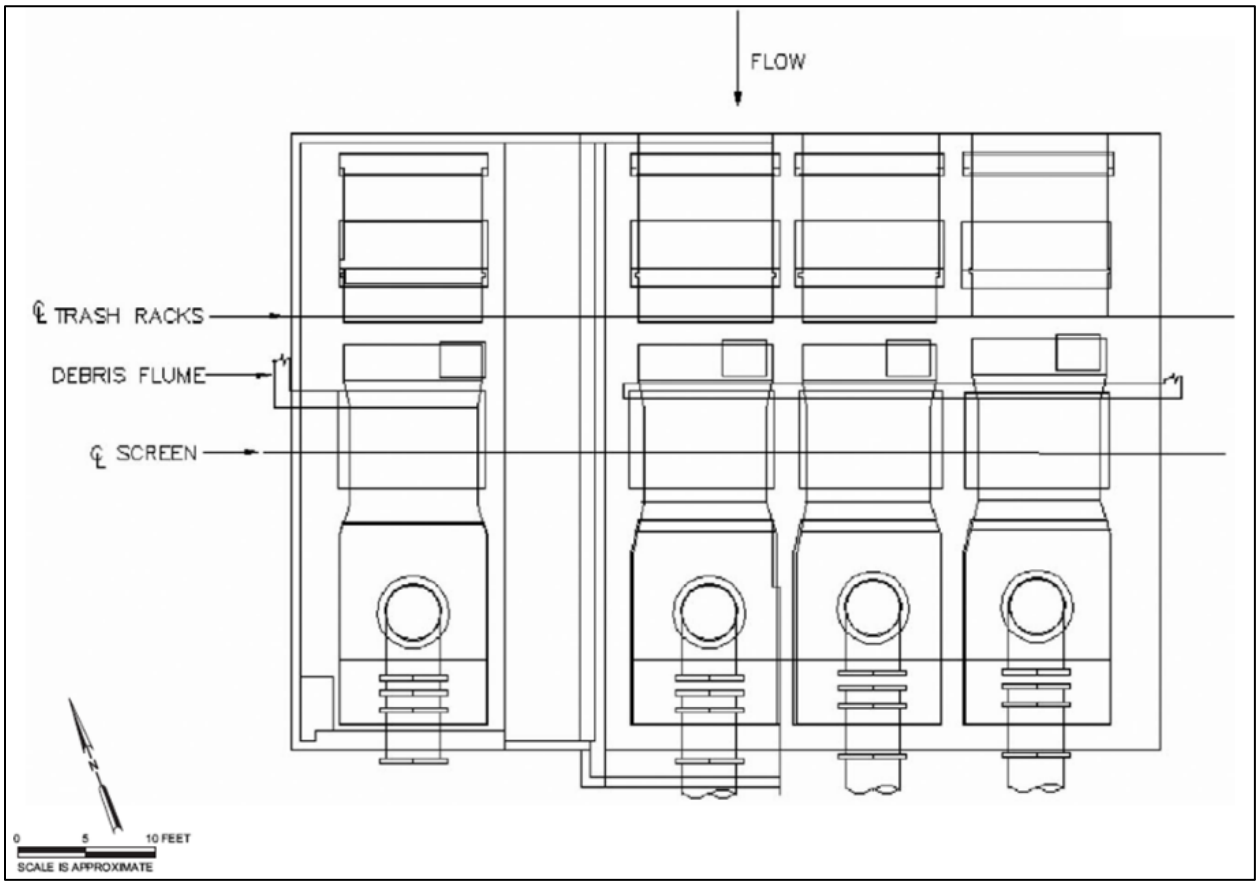


Source: Provided by Dominion Energy

Figure 5-1 Chesterfield Power Station Cooling Water Intake Structure Configuration

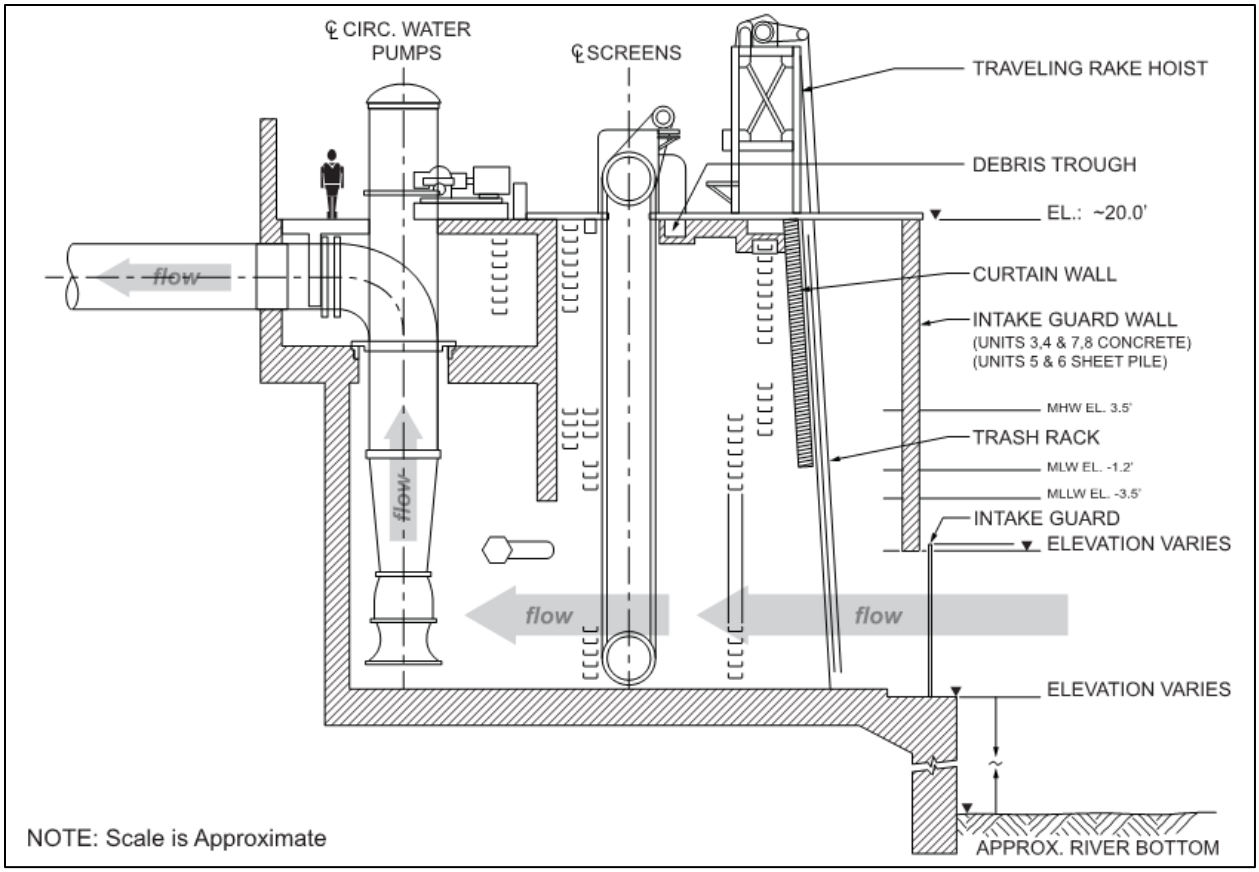
As river water is drawn toward the intakes, it first encounters an intake guard wall extending from the intake deck and ending below the MLLW elevation. The top of the intake guard opening is located below MLLW elevation and above the river bottom with bar racks that are intended to prevent larger debris and organisms from entering the intake structure. Trash racks are installed downstream of the intake guard wall and upstream of a curtain wall. Each unit at CPS has one mechanical trash rake that can move between the specific intake bays on rails and is typically operated when necessary, should the trash rack become clogged with debris. The curtain walls for the common CWIS for Units 3 & 4, and the CWIS for 7 and 8, extend to 4.5 feet below MSL, while the curtain wall for Units 5 and 6 CWIS drop down to approximately 4.0 feet below MSL. Trash racks extend across the entire length of each intake structure (i.e., from the intake structure invert to the intake deck) and prevent large debris from entering the screen houses. The trash racks for the common CWIS for Units 3 and 4 are approximately 14.5 ft tall by 9.9 ft wide with 0.375-inch bars placed vertically on 4.0-inch centers. The Unit 5 trash rack is approximately 16.5 feet tall by 12.5 feet wide with 0.375-inch bars on 4.5-inch centers. The Unit 6 trash rack is approximately 19.0 feet high by 15.0 feet wide with 0.375-inch bars on 4.0-inch centers. Units 7 and 8 have trash racks that are approximately 14.5 feet high by 11.0 feet wide with 0.375-inch bars on 3.0-inch centers (Appendix A). The approach velocity at the CPS's trash racks is 0.49 to 1.09 fps, with a through-rack velocity of 0.51 to 1.13 fps.

Plan and section drawings of typical portions of the CPS CWIS are provided in Figure 5-2 and Figure 5-3, respectively.



Source: Provided by Dominion Energy

Figure 5-2 Typical Plan View of Chesterfield Power Station Cooling Water Intake Structure



Source: Appendix A

Figure 5-3 Typical Section View of Chesterfield Power Station Cooling Water Intake Structure

Traveling water screens are located between 10 and 20 feet inside of the trash racks (Figure 5-2 and Figure 5-3). The vertical travelling screens rotate up and, while out of the water, debris and impinged organisms are washed off by a spray into a water-filled fish and debris return trough. This water-filled trough conveys spray wash water and materials that adhered to the travelling screen back into the James River. These discharges are permitted in the VPDES Permit (VA0004146).

Each of the power-generating units contains two traveling screens except Unit 6, which has three traveling screens, for a total of 11 traveling screens (excluding Unit 3 because its screens have been out of service since the unit retirement). Units 4, 7, and 8 have 8-foot-wide screens, and Units 5 and 6 have 10-foot-wide screens. All of the screens have standard 3/8-inch mesh.

Each of the screens are designed for continuous operation. Units 4, 5, and 6 rotate at a single speed of approximately 10 feet per minute (ft/min) while Units 7 and 8 can rotate at either 5 ft/min or 10 ft/min depending on loading. During normal operation, the screens are typically manually controlled for all units. Screen wash pumps for Units 7 and 8 draw water from the individual unit pump house. Units 4, 5, and 6 do not have operating screen wash pumps, and the wash water for these screens is fed from the service water system from each unit.

Cooling water that has travelled through the screens is conveyed to the circulating water pumps, located 12 and 18 feet inside the traveling screens, through individual bays. Each unit has a separate circulating water system comprised of 13 vertical shafts, wet-pit, circulating cooling water pumps, two each for Units 4, 5, 7, and 8 and three for Unit 6. The circulating pumps are located in the respective unit's pump house. Upon exiting the circulating cooling water system, the water is returned to the James River via one of two cooling water discharge points: one for Units 7 and 8, and one for Units 4, 5, and 6. Units 7 and 8 discharge directly into the James River, approximately 100 feet downstream from the CWIS (via Outfall 001). Units 4, 5, and 6 currently discharge into a discharge canal and then into Farrar Gut, an oxbow that flows into the James River approximately 1.2 miles downstream from the intake structures via Outfall 003. The outfall configuration is provided in Figure 3-4.

5.2 Other Activities Considered (For Which No Incidental Take Anticipated to Occur)

5.2.1 Clean Water Act 316(b) Studies

As described in Section 1, the CPS impingement and entrainment sampling program began on July 13, 2015 and completed in December 2020 after sufficient data had been collected to provide 24 months of entrainment data at the CPS CWIS. No Atlantic Sturgeon early life stages were collected during the remainder of the CWA 316(b) entrainment sampling after the resumption of sampling in May 2018 and through the end of sampling in December 2020. The final CWA 316(b) package for CPS was submitted to VDEQ on September 30, 2021. Dominion intends to inform NMFS of any change in circumstances at CPS resulting from completion of the VPDES permit renewal through their annual reporting as required in the current ITP § IV.4.C.d.

If CWA 316(b) studies were to be required during the ITP, it would not result in additional incidental take of Atlantic Sturgeon as the water sampled for the studies is a subset of the water entrained within the CWIS described in Section 5.1.1. Therefore, while 316(b) activities may occur during the ITP, an incidental take identified during this activity would be a result of the CWIS operation and therefore would be associated with the CPS operation's incidental take estimate.

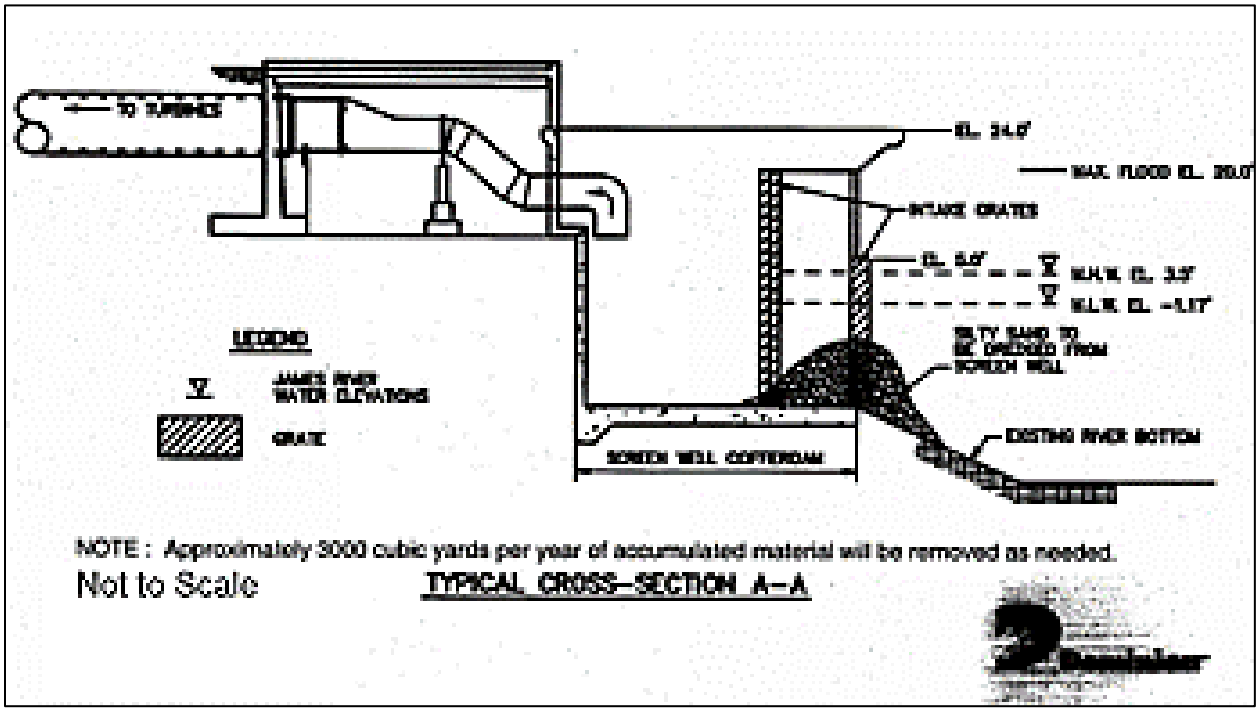
5.2.2 Dredging

Periodic dredging is necessary to remove accumulated sediments and debris in the vicinity of the CPS CWIS and barge offload slip to allow for reliable and efficient generation of electricity. All applicable permits including CWA Section 404/Rivers and Harbors Act Section 10 dredging would be obtained prior to completing any dredging.

Figure 5-4 and Figure 3-2 provide a cross section and plan view of the location(s), respectively, where sediments accumulate in the vicinity of the CWIS and where periodic dredging is required to occur (Dominion, 2003).

Dominion dredged up to 10 cubic yards (cy) of material in front of the CPS CWIS in 1990 to facilitate removal of accumulated sediments. Dominion was also permitted to dredge up to 3,000

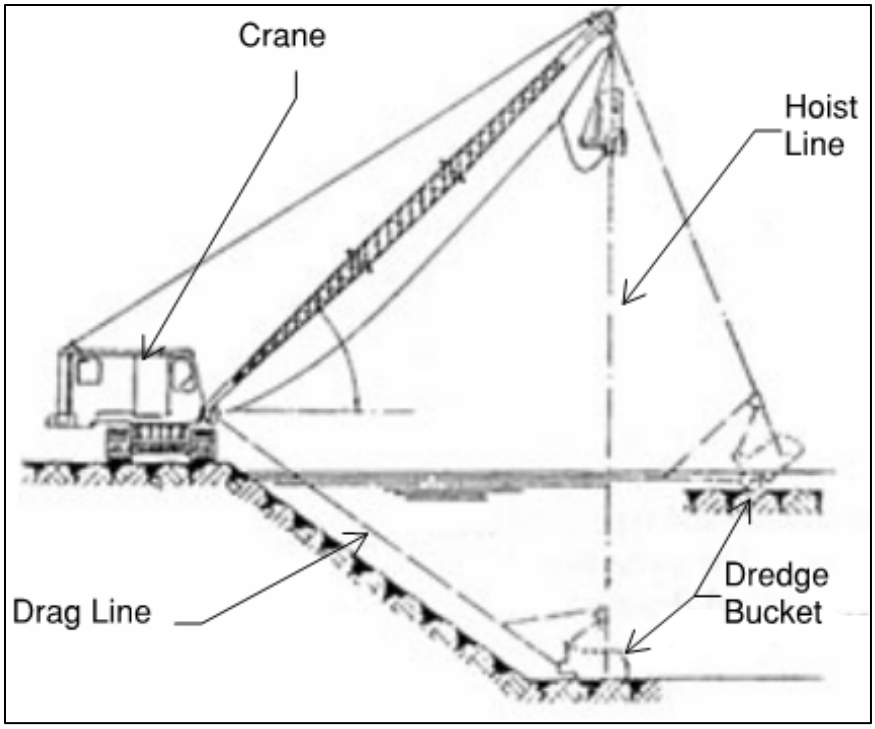
cy of material annually as necessary over an area of approximately 6,500-7,000 square feet through 2013. River sediments in the vicinity of the intake structure are composed of approximately 60 percent silt and 40 percent sand. The sediments are dredged via dragline dredges and transferred to trucks for disposal at an upland facility to prevent the sediment from re-entering the waterway (Dominion, 2003). Dominion expects a similar level of dredging (i.e., similar volume, area, and location) will be required intermittently over the life of the ITP.



Source: (Dominion, 2003)

Figure 5-4 Typical Cross-section View of 2003 Dredging Location for Chesterfield Power Station CWIS, February 12, 2003

A dragline is used for the dredging within the vicinity of the CWIS (Appendix C). Dragline dredging consists of barge-mounted or land-based crane equipped with a dragline bucket (Figure 5-5) (Sciortino, 1995).



Source: (Sciortino, 1995)

Figure 5-5 Dragline Dredge

A large open-topped and open-faced drag bucket suspended by a hoist cable from the crane is lowered to the river bottom then a drag cable drags the bucket along the river bottom towards the dredge while removing river sediment. The bucket is then lifted from the river bottom and dumped into a scow or other dredged material receiving vessel. The volume of the bucket varies with the size of the crane operating the dragline bucket. A dragline bucket is lowered to the bottom of the channel and then dragged back to the crane across the bottom while remaining in contact with the river bottom over the duration of the drag (Constro Facilitator, 2024). Dragline dredging is a common method applied for near-shore dredging scenarios (Sciortino, 1995).

VDWR recommended that dredging occur outside the February 15 through June 30 timeframe to avoid impacts to anadromous fish such as Striped Bass (*Morone saxatilis*), Alewife (*Alosa pseudoharengus*), American Shad (A*. sapidissima*), Hickory Shad (*A. mediocris*), and Blueback Herring (*A. aestivalis*) (VDWR, 2023). Dominion has complied with this recommendation and has planned its dredging operations to occur outside of that timeframe. Dominion further proposes to avoid dredging within the proposed Atlantic Sturgeon spawning seasons (April 1–May 15; September 1–October 15). If dredging within the proposed Atlantic Sturgeon spawning seasons cannot be avoided, Dominion proposes to implement monitoring; Section 6 of the Conservation Plan provides additional details on proposed mitigations.

Periodic maintenance dredging is also necessary within the barge slip located northwest of the CPS (Figure 3-3). CPS was permitted between 2003 to 2008 to dredge a total of 8,000 cy of material as necessary over an area of approximately 1.4 acres to achieve an elevation of -21.0 feet mean low water (MLW). River sediments in the vicinity of the barge slip and intake structures

are composed of approximately 60 percent silt and 40 percent sand. Dredging in the barge slip is accomplished via hydraulic or clamshell methods with direct transfer to trucks for disposal. (Dominion, 2003). Dominion expects that a similar level of intermittent dredging (i.e., similar volume, area, and location) will be required over the life of the renewed ITP.

Hydraulic dredging consists of barge-mounted, rotating cutterhead fitted to the terminus of a suction pipe (NMFS, 2012). This is the preferred method for the removal of material from the James River (NMFS, 2012). Rotating cutterheads disrupt bedded river sediments to create a sediment/water slurry which is then pumped to a nearby dredged material placement location. Typical cutterhead dredge suction pipes used in the James River vary between 18 to 20 inches in diameter, with a maximum of 36 inches (NMFS, 2012). As discussed in more detail in Section 2 of the Conservation Plan, Dominion does not anticipate that incidental take will result from dredging activities.

5.2.3 Constituent Discharge

VPDES Permit No. VA0004146 authorizes the discharge of various constituents and contains monitoring requirements and limitations for the CPS outfalls, shown in Figure 3-4, to the James River and Farrar Gut. Dominion has completed an integrated ash project (IAP) at CPS. The IAP was an extensive multi-year project being driven by recently promulgated regulatory requirements (i.e., Federal Effluent Guidelines and the Coal Combustion Residuals Rule) that affected almost every aspect of how the station managed wastewater. Work performed during the IAP included:

- closure of the Upper Ash Pond (UAP) and Lower Ash Pond (LAP);
- construction of a new Fossil Fuel Combustion Product (FFCP) Management Facility;
- conversion from a wet to dry ash management system;
- construction of a new Low Volume Wastewater Treatment System (LVWWTS) to manage wastewater that will remain following closure of the LAP and UAP and that will be generated by the new FFCP Management Facility; and
- installation of a new wastewater treatment system to process water to meet VPDES permit limits the station's FFCP leachate and legacy ash contact water.

As described below, implementation of the IAP eliminated the previous process wastewater discharges from the station's two ash ponds and provided additional treatment for many waste streams, thereby substantially reducing the concentrations of key constituents in the remaining discharges.

As shown in Table 5-1, outfalls at the CPS discharge to multiple water bodies and from a variety of wastewater sources. The VPDES permit contains conditions for each discharge that were developed with consideration for the IAP and the resulting transition in wastewater management and discharges that will occur. In developing the proposed permit conditions, the VDEQ, in many cases, went beyond existing regulatory requirements and agency permitting guidelines to ensure the protection of water quality in the receiving waterbodies. To comply with EPA's Coal

Combustion Residuals Rule and the Virginia Solid Waste Management Regulations, CPS has closed the LAP and UAP sedimentation basins and converted to a dry ash management system. This water is treated to meet stringent discharge limits at the exit point of the CPS treatment plant and is conveyed via Outfall 101 to Outfalls 001 and/or 301 for discharge to the James River. Additionally, a new LVWWTS was constructed (Outfall 301 below) to receive and treat the various CPS waste steams as detailed in Table 5-1. Effluent from the LVWWTS is monitored at the plant discharge for compliance with VPDES requirements. The LVWWTS plant effluent is then conveyed through a diffuser to Outfall 003 prior to discharge to the Farrar Gut. At all times the CPS will be subject to VPDES Permit No. VA0004146, or a subsequent VPDES permit as appropriate, to meet CWA requirements. CPS monitors for and reports effluent limits of the VPDES Permit No. VA0004146 as required.

Virginia's State Water Control Board has designated the James River and Farrar Gut as Tier 1 with respect to the Water Quality Standards antidegradation policy. Tier 1 or existing use protection, the existing water quality and the existing uses of the water body must be maintained (VDEQ, 2020). This is the lowest of three tiers with regards to water body protection and expanded water body uses. Based on the CWA water body designation and VDEQ antidegradation policy, chemical discharges are permitted through the VDEQ VPDES as summarized in Appendix D.

Table 5-1 Chesterfield Power Station Outfall Water Sources and Flows

Outfall[a]	Receiving Water Body	CWA Section 303(d) List[b]	Wastewater Source	Treatment	Flow, MGD (max. of 30-day averages)
001	James River, Main Channel	Category 5D	Unit 7 and 8 cooling water	Chlorination, Dechlorination	212
101	Outfall 001 or 301	Not Applicable	Discharge from Centralized Source Water Treatment Facility – receives CCR contact water from Lower Ash Pond and Upper Ash Pond during closure process	Sedimentation, Coagulation, Flocculation, Thickening, Neutralization, Precipitation, Centrifugation, Ion Exchange, Pressure Filtration, Electrochemical Treatment	0.285
003	James River, Farrar Gut	Category 4A	Unit 4, 5, and 6 cooling water	Chlorination, Dechlorination	144
301	Outfall 003	Not Applicable	Discharge from Low Volume Wastewater Treatment System	Sedimentation, pH adjustment, recirculation	2.73
302	Internal Outfall 301	Not Applicable	Flue gas desulfurization wastewater	Treatment and discharge was discontinued after retirement of all coal units.	0.0
303	Internal Outfall 301	Not Applicable	Metals cleaning wastewater	Treatment and discharge was discontinued after retirement of all coal units.	0.0
304	Internal Outfall 301	Not Applicable	Leachate form the Fossil Fuel Combustion Product Management Facility	Sedimentation, Flocculation, Filtration, Neutralization, Thickening	0.288
005	James River, Farrar Gut	Category 4A	Storm water runoff, toe drains surrounding the upper ash pond, interceptor trench system	Sedimentation, pH adjustment	0.56

[a] The James River is tidally influenced at the discharge points. Flow frequencies cannot be determined for tidal waters; therefore, conservative tidal dilution rates were used to establish waste load allocations (WLAs) and effluent limits. Historically the standard tidal dilution ratios (2:1 acute, 50:1 chronic) were used to establish WLAs for Outfalls 001 and 002. In the current permit VDEQ restricted the chronic mixing zone to 2:1, This is also true for internal Outfall 101. Farrar Gut is also tidal; however, the gut is dominated by the discharge from the facility's Outfall 003. Outfalls 003 and 004 discharge at the head of Farrar Gut where tidal influence is minimal; therefore, these outfalls are evaluated without dilution. At Outfall 005, which is near the mouth of Farrar Gut, conservative tidal dilution ratios of 2:1 acute and 2:1 chronic (historically 50:1) were used to evaluate discharge. Note that the Fossil Fuel Combustion Product Management Facility is considered an "Existing Facility" under the recently promulgated Effluent Limitation Guidelines (ELG) Rule; however, VDEQ applied the more restrictive "New Facility" ELG limits to Outfall 304.

[b] Category 5D means the Water Quality Standard is not attained where total maximum daily limits (TMDLs) for a pollutant(s) have been developed but one or more pollutants are still causing impairments requiring additional TMDL development. Category 4A means the water is impaired or threatened for one more designated uses but does not require a TMDL because the TMDL for specific pollutant(s) is complete and USEPA approved.

This page is intentionally left blank

5.2.4 Thermal Discharge

CPS conducted a CWA 316(a) demonstration study (VEPCO, 2000) during the period from 1997 through 1999. The study analyzed water quality characteristics, and the biological communities located upriver and downriver of the CPS discharges (with sampling locations representative of the thermal mixing zone as well as ambient conditions). A report presenting the results of these studies was submitted to VDEQ on February 29, 2000. The report concluded that the heat rejection limits were “more stringent than necessary to assure the protection and propagation of a balanced, indigenous, aquatic community in the James River” (VEPCO, 2000). VDEQ concurred with this determination and granted the CWA 316(a) variance with issuance of the VPDES permit in 2004.

The CWA 316(a) variance was renewed with the most recent reissuance of the permit effective October 1, 2016. The VPDES permit fact sheet states that "The Heat Rejected limitations are supported by the CWA 316(a) variance approved with the 2004 permit reissuance. The limitations are appropriate to ensure that heat rejection does not exceed the values in the CWA 316(a) study" (VEPCO, 2000), Appendix D). The current CPS VPDES permit (VA0004146) contains heat rejection limits of 11.3×10^8 British thermal units/hour (Btu/hour) for Outfall 001 (Units 7 and 8), and 5.55×10^9 Btu/hour (Units 4, 5, and 6) (see Figure 3-4 for outfall locations).

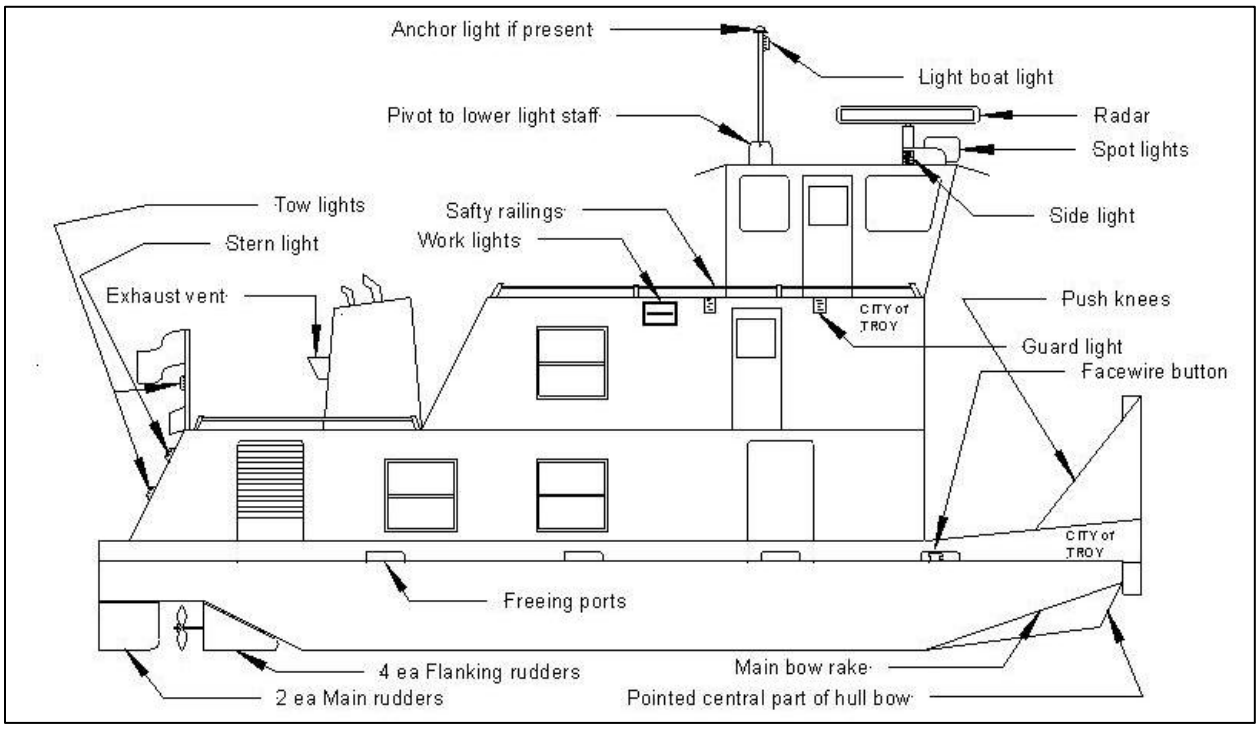
The reissued VPDES permit Special Condition I.C.29 required the development and implementation of a detailed plan for updating the studies to support renewal of the CWA 316(a) variance during the next permit reissuance. To satisfy this requirement, Dominion performed similar thermal modeling using a hydrothermal model of the James River near the CPS developed using the computational fluid dynamics software, Delft3D, and bio-thermal assessment under two operational scenarios with respect to CPS’s thermal discharge: (1) maximum permitted heat rejection limits for all Units currently in operation (Units 5, 6, 7, and 8, and (2) at permitted maximum heat rejection limits for only Units 7 and 8, which is the configuration as of 2023 after Units 5 and 6 stopped generating power. The CWA 316(a) Demonstration Update Study concluded that during spring and fall, when most migrations take place, temperatures that would create an issue for Atlantic Sturgeon attempting to reach or return from spawning grounds in the mainstem of the James River were not predicted (Normandeau Associates, Inc, 2020). Results of the updated studies or demonstration were submitted to VDEQ on December 29, 2020. As discussed in more detail in Section 2 of the Conservation Plan, Dominion does not anticipate that incidental take will result from thermal discharge.

5.2.5 Vessel Movements

Operation of the CPS requires periodic deliveries of fuel oil by means of barge. Based on records of multiple barge deliveries for the 12-month period preceding October 2016 (Appendix E), these vessel activities can be characterized as routinely consisting of barges having a loaded draft of approximately 10.5 feet, whereas empty barges have a draft of approximately 2.0 feet. According to National Oceanic and Atmospheric Administration (NOAA) Chart 12252, the navigation channel in the reach of the James River from Hopewell to Richmond has a project depth (authorized navigable depth) of 35 ft, which the USACE maintains to a depth of 25 feet (NOAA, 2022).

Consequently, the fully loaded barge would provide a minimum of 14 feet of below keel clearance during transits, and a minimum of 23 feet of below keel clearance when empty. Actual clearances would generally be deeper in those reaches where shoaling is less prevalent and where the natural channel depth exceeds the project depth. Per Balazik M, et al. (2020), telemetry data showed that Atlantic Sturgeon were unaffected by hydraulic dredging in the lower James River. There was no noticeable difference in swim behavior regardless of whether a dredge barge was working or absent within the study area. This indicates Atlantic Sturgeon are capable of avoiding vessels as they navigate the lower James River.

The CPS barge deliveries are typically performed via contracted towboats. These vessels are typically compact, square-bowed, and shallow-draft, designed for use on inland waterways. Although capable of transporting arrays of multiple barges, the CPS activities involve maneuvering a single barge. CPS utilizes an outside contractor to provide tow services for the barge deliveries described above. The towboats typically used vary in draft between 8.7 and 10.5 feet when handling fully loaded barges. These towboats utilize propellers that range in width between 63 and 79 inches (Figure 5-6). While navigating the James River, towboats adhere to U.S. Coast Guard Navigation Rules and Regulations regarding vessel speed, navigation, communications, and other aspects of navigating safely within inland waterways.



Source: Towboat Tour 2016

Figure 5-6 Typical Towboat Design

During arrivals at the barge slip, the towboat turns the barge from the axis of the navigation channel to face into the slip. The barge is initially tied off alongside dolphins that extend riverward. Final maneuvering into the slip to the off-loading/loading facility is accomplished by a cable winch system. During departures the process is reversed.

Dominion expects that there will be similar levels of vessel traffic associated with CPS operation over the life of the ITP. Vessel traffic associated with periodic dredging also occurs in the vicinity of the CPS CWIS and the barge slip. All required permits will be obtained prior to this activity. As discussed in more detail in Section 2 of the Conservation Plan, Dominion does not anticipate that incidental take will result from vessel movements.

5.2.6 Shoreline and Structure Maintenance

Examples of possible shoreline maintenance activities that would be required over the life of the ITP include barge slip maintenance and maintenance of ductwork over state-owned subaqueous land within the James River, as well as general shoreline and shoreline facilities maintenance. Barge slip maintenance could include widening to the north by removing alluvial sediments, with the installation of new 30-inch mooring dolphins and removal of the existing dolphins. Potential construction means and methods which may be implemented, but are not limited to, include:

- vibratory pile driving,
- impact pile driving,
- dewatering,
- concrete and/or riprap placements,
- excavation, and
- dredging.

All applicable permits including CWA Section 404/Rivers and Harbors Act Section 10 dredging would be obtained prior to initiating any dredging activity. As explained in more detail in Section 2 of the Conservation Plan, Dominion does not anticipate that incidental take will result from shoreline and structure maintenance.

6 Works Cited

ASMFC. (2017). *Atlantic Sturgeon Benchmark Stock Assessment and Peer Review Report.* Atlantic Sturgeon Stock Assessment Peer Review Panel.

ASMFC. (2024). *2024 Atlantic Sturgeon Stock Assessment Update.* Retrieved February 28, 2025, from https://www.fisheries.noaa.gov/s3//2024-09/66be3e37AtlanticSturgeonStockAssessmentUpdate_August2024_0.pdf

ASMFC. (2025). *Atlantic Sturgeon*. Retrieved February 28, 2025, from https://asmfc.org/species/atlantic-sturgeon/

ASPRT. (2020). *2018-2020 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus).* Retrieved March 3, 2025, from https://asmfc.org/wp-content/uploads/2025/01/SturgeonFMPReview_2018_2020.pdf

Atlantic States Marine Fisheries Commission (ASMFC). (2012). *Habitat Addendum IV to Amendment 1 to the Interstate Fishery Management Plan for Atlantic Sturgeon.*

Atlantic Sturgeon Plan Review Team (ASPRT). (2016). *2016 Review of the Atlantic States Marine Fisheries Commission Fishery Management Plan for Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus) for Fishing Year 2013 and 2014.*

Atlantic Sturgeon Status Review Team (ASSRT). (2007). *Status Review of Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus).* Report to National Marine Fisheries Service, Northeast Regional Office.

Austin, G. (2012). *Essential Spawning Habitat for Atlantic Sturgeon in the James River, Virginia.* Virginia Commonwealth University. Richmond, Virginia: VCU Scholars Compass.

Bain, M. (1997). Atlantic and shortnose sturgeons of the Hudson River: common and divergent life history attributes. *Environmental Biology of Fishes, 48*, 347–358.

Bain, M., Haley, N., Peterson, D., Waldman, J., & Arend, K. (2000). Harvest and habitats of Atlantic sturgeon Acipenser oxyrinchus Mitchill, 1815 in the Hudson River estuary: Lessons for sturgeon conservation. *Boletin-Instituto Espanol De Oceanografia, 16 (1-4)*, 43-54.

Balazik, M. (2012). *Life History Analysis of James River Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus) with Implications for Management and Recovery of the Species.* Virginia Commonwealth University. Richmond, Virginia: VCU Scholars Compass.

Balazik, M. (2017). First verified occurrence of the shortnose sturgeon (Acipenser brevirostrum) in the James River, Virginia. *Fishery Bulletin, 115*(2).

Balazik, M. (2019a, June 30). Personal communications via email with Graham, B. regarding James River Atlantic Sturgeon population.

Balazik, M. (2019b, June 9). Personal communications via email with Graham, B. regarding James River Atlantic Sturgeon spawning period.

Balazik, M. (2025, 05 16). Personal Communication via email with Dwyer, S. regarding James River Atlantic Sturgeon spawning habitat.

Balazik, M., & Musick, J. (2015, May 28). Dual annual spawning races in Atlantic Sturgeon. *PLoS ONE, , DOI:10.1371*. Retrieved March 3, 2025, from https://doi.org/10.1371/journal.pone.0128234

Balazik, M., Barber, M., Altman, S., Reine, K., Katzenmeyer, A., Bunch, A., & Garman, G. (2020). Dredging activity and associated sound have negligible effects on adult Atlantic sturgeon migration to spawning habitat in a large coastal river. *PLoS ONE, 15(3)*. Retrieved March 3, 2025, from https://doi.org/10.1371/journal.pone.0230029

Balazik, M., Farrae, D., Darden, T., & Garman, G. (2017). Genetic differentiation of spring-spawning and fall-spawning male Atlantic sturgeon in the James River. *PLOS One, 12*(7), e0179661. doi:10.1371/journal.pone.0179661

Balazik, M., Garman, G., Van Eenennaam, J., Mohler, J., & Woods III, L. (2012a). Empirical Evidence of Fall Spawning by Atlantic Sturgeon in the James River, Virginia. *Transactions of the American Fisheries Society, 141(6)*, 1465-1471.

Balazik, M., McIninch, S., Garman, G., & Latour, R. (2012b). Age and growth of Atlantic Sturgeon in the James River, Virginia, 1997-2011. *Transactions of the American Fisheries Society, 141(5)*, 1074-1080.

Bath, D., O'Connor, J., Alber, J., & Arvidson, L. (1981). Development and identification of larval Atlantic sturgeon (Acipenser oxyrinchus) and shortnose sturgeon (A. brevirostrum) from the Hudson River estuary, New York. *Copeia, 1981(3)*, 711-717.

Bilkovic, D., Angstadt, K., & Stanhope, D. (2009). *Atlantic Sturgeon Spawning Habitat on the James River, Virginia.* Final report to NOAA Chesapeake Bay Office, Award Number NA06NMF4570303, Virginia Institute of Marine Science, Center for Coastal Resources Management, Gloucester Point, Virginia.

Boreman, J. (1997). Sensitivity of North American sturgeons and paddlefish to fishing mortality. *Sturgeon biodiversity and conservation*, 399-405.

Bushnoe, T., Musick, J., & Ha, D. (2005). *Essential spawning and nursery habitat of Atlantic sturgeon (Acipenser oxyrinchus) in Virginia.* Virginia Institute of Marine Science, Gloucester Point, Virginia.

Chesapeake Fisheries Ecosystem Plan Technical Advisory Panel (CBFEAP). (2006). *Fisheries Ecosystem Planning for Chesapeake Bay, Trends in Fisheries Science and Management* (Vol. 3). (N. O. Office, Ed.) Bethesda, Maryland, United States: American Fisheries Society.

Constro Facilitator. (2024, October 23). *How dragline excavators transform large-scale earthworks?* Retrieved March 6, 2025, from https://constrofacilitator.com/how-dragline-excavators-transform-large-scale-earthworks/

Dominion. (2014). *Dominion - Chesterfield Power Station VPDES General Permit VAG83 Registration Statement.* Chesterfield, Virginia.

Dominion. (2015). *Fact Sheet Dominion – Chesterfield Power Station Attachments.* Chesterfield, Virginia.

Dominion. (2016). *Chesterfield Power Station Corrective Action Progress Report.* Chesterfield, Virginia.

Dominion Resources Services, Inc. (Dominion). (2003). *Intake Maintenance Dredging - Joint Permit Application, Chesterfield Power Station.* Chesterfield, Virginia.

EA Engineering, Science, and Technology, Inc. (EA). (2007). *Impingement Mortality and Entrainment Characterization Report, Chesterfield Power Station, June 2005 – 2006.* Sparks, Maryland: EA Engineering, Science, and Technology, Inc.

Gilbert, C. (1989). *Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic Bight): Atlantic and shortnose sturgeons (No. 4).* U.S. Fish and Wildlife Service. Biol. Rep. 82 (11.122). U.S. Army Corps of Engineers TR EL82-4.

Grange, B. (2019, December 13). NRC Assessment of Additional Information on Shortnose and Atlantic Sturgeon. Retrieved March 20, 2025, from https://www.nrc.gov/docs/ML1934/ML19347D221.pdf

Greenlee, B., Secor, D., Garman, G., Balazak, M., Hilton, E., & Fisher, M. (2017). *Assessment of Critical Habitats for Recovering the Chesapeake Bay Atlantic Sturgeon Distinct Population Segment.* Virginia Commonwealth University, Virginia Institute of Marine Science, University of Maryland Center for Environmental Science.

Gross, M., Repka, J., Robertson, C., & Van Winkle, W. (2002). Sturgeon conservation: insights from elasticity analysis. *American Fisheries Society Symposium, 28*, 13-30.

Hager, C. (2011). *Atlantic Sturgeon review: Gather data on reproducing subpopulation of Atlantic Sturgeon in the James River.* Contract EA133FlOCN0317.

Hardy, R., & Litvak, M. (2004). Effects of temperature on the early development, growth, and survival of Shortnose sturgeon, Acipenser brevirostrum, and Atlantic sturgeon, Acipenser oxyrinchus, yolk-sac larvae. *Environmental Biology of Fishes, 70*, 145-154.

Hildebrand, S., & Schroeder, W. (1928). *Fishes of Chesapeake Bay* (Vol. 43). Department of Commerce, Bulletin of the United States Bureau of Fisheries.

Ingram, E., & Peterson, D. (2016). Annual Spawning Migrations of Adult Atlantic Sturgeon in the Altamaha River, Georgia. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science, 8(1)*, 595–606.

Ingram, K., Dow, K., Carter, L., Anderson, J., & Sommer, E. (2013). Climate of the Southeast United States: variability, change, impacts, and vulnerability.

Jensen, L. (1974). *Environmental responses to thermal discharges from the Chesterfield Station, James River, Virginia. Report No. 13.* Johns Hopkins University, Geography and Environmental, Baltimore, Maryland.

Jones, P., Martin, F., & Hardy Jr., J. (1978). *Development of fishes of the Mid-Atlantic Bight, Anguillidae through Syngnathidae* (Vol. I). U.S. Department of Interior, U.S. Fish Wildlife Service. Prog. FWS/OBS-78/12.

Kocik, J., Lipsky, C., Miller, T., Rago, P., & Shepherd, G. (2013). *An Atlantic Sturgeon population index for ESA management analysis.* National Oceanic Atmospheric Administration. Retrieved March 3, 2025, from https://repository.library.noaa.gov/view/noaa/4383

Kynard, B., & Horgan, M. (2002). Ontogenetic behavior and migration of Atlantic sturgeon, Acipenser oxyrinchus oxyrinchus, and shortnose sturgeon, A. brevirostrum, with notes on social behavior. *Environmental Biology of Fishes, 63(2)*, 137-150.

Kynard, B., Breece, M., Atcheson, M., Kieffer, M., & Mangold, M. (2007). *Final Report Status of Shortnose Sturgeon in the Potomac River PART I – FIELD STUDIES.* Retrieved March 3, 2015, from https://awsassets.panda.org/downloads/19_2007_shrtonose_sturgeon_usa.pdf

Kynard, B., Breece, M., Atcheson, M., Kieffer, M., & Mangold, M. (2009). Life history and status of shortnose sturgeon (Acipenser brevirostrum) in the Potomac River. *Journal of Applied Ichthyology, 25*, 34-38.

Middle James Roundtable. (2024). *The Middle James Watershed*. Retrieved March 20, 2025, from http://www.mjrt.org/middle-james-watershed.html

Mohler, J. (2003). *Culture Manual for the Atlantic sturgeon: Acipenser oxyrinchus oxyrinchus.* U.S. Fish and Wildlife Service.

Moore, K., Neikirk, B., Anderson, B., & Jarvis, J. (2007). *Water Quality Conditions and Restoration of Submerged Aquatic Vegetation in the Tidal Freshwater James River 2006 Special Reports in Applied Marine Science and Ocean Engineering No. 396.* Virginia Institute of Marine Science, William and Mary. Retrieved March 3, 2025, from https://doi.org/10.21220/V5HX8C.

National Marine Fisheries Service (NMFS). (1998). *Recovery plan for the shortnose sturgeon (Acipenser brevirostrum).* Shortnose Sturgeon Recovery Team, Silver Spring, Maryland.

National Oceanic Atmospheric Administration (NOAA). (2024). *Atlantic Sturgeon - Chesapeake Bay Office*. Retrieved March 3, 2025, from http://chesapeakebay.noaa.gov/fish-facts/atlantic-sturgeon

Niklitschek, E., & Secor, D. (2005). Modeling spatial and temporal variation of suitable nursery habitats for Atlantic sturgeon in the Chesapeake Bay. *Estuarine, Coastal and Shelf Science, 64(1)*, 135-148.

NMFS. (2009). Letter from Patricia A. Kurkul, Regional Administrator, NMFS NE Region to Ms. Beth Bachur, Acting Chief, Maryland Section Southern, Department of the Army, dated May 7, 2009.

NMFS. (2012). *National Marine Fisheries Service Endangered Species Act Section 7 Biological Opinion of James River Federal Navigation Project: Tribell Shoal Channel to Richmond Harbor in Surry, James City, Prince George, Charles City, Henrico, and Chesterfield Counties.* FINER/2012/01183. GARFO-2012-00013.

NMFS. (2018). Letter from Julie E. Crocker, Endangered Fish Recovery Branch Chief, Protected Resources Division, to Dominion dated April 20, 2018.

NMFS. (2020). *Biological Opinion on the Greater Atlantic Region, Protected Resources Division, proposal to issue an Incidental Take Permit for Atlantic sturgeon affected by Dominion's operation of the Chesterfield Power Station, Virginia.* National Oceanic Atmospheric Administration. Retrieved March 3, 2025, from https://doi.org/10.25923/t752-tj46

NMFS. (2022). *Chesapeake Bay Distinct Population Segment of Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus) 5-Year Review: Summary and Evaluation.* National Oceanic Atmospheric Administration. Retrieved March 3, 2025, from https://repository.library.noaa.gov/view/noaa/35785

NOAA. (2018). *Recovery Outline for the Atlantic Sturgeon Distinct Population Segments.* Retrieved March 3, 2025, from https://www.fisheries.noaa.gov/resource/document/recovery-outline-atlantic-sturgeon-distinct-population-segments

NOAA. (2022). Office of Coast Survey Historic Navigation Chart. *Chart #12252*. Retrieved March 25, 2025, from https://www.historicalcharts.noaa.gov/

NOAA. (2023, June 6). Section 7 Species Presence Table: Shortnose Sturgeon in the Greater Atlantic Region. Retrieved March 20, 2025, from https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-species-presence-table-shortnose-sturgeon-greater

Normandeau Associates, Inc. (2020). *Biological Community Evaluation for Chesterfield Power Station §316(a) Demonstration Study Update.*

Sciortino, J. (1995). Construction and maintenance of artisanal fishing harbours and village landings. *FAO Training Series n. 25*. Food and Agriculture Organization of the United Nations.

Secor, D., Niklitschek, E., Stevenson, J., Gunderson, T., Minkkinen, S., Richardson, B., . . . Henderson-Arzapalo, A. (2000). Dispersal and growth of yearling Atlantic sturgeon, Acipenser oxyrinchus, released into Chesapeake Bay. *Fishery Bulletin, 98(4)*, 800.

Smith, J., Flowers, H., & Hightower, J. (2014). Fall Spawning of Atlantic Sturgeon in the Roanoke River, North Carolina. *Transactions of the American Fisheries Society, 144(1)*, 48-54. Retrieved March 3, 2025, from https://doi.org/10.1080/00028487.2014.965344

Snyder, D. (1988). Description and identification of shortnose and Atlantic sturgeon larvae. *American Fisheries Society Symposium, 5*, 7-30.

South Carolina Department of Natural Resources (SCDNR). (2021). *A Report on Sample Comments: James River unknown species eggs. Prepared by Daniel Farrae of SCDNR Population Genetics. Dated October 25, 2021.*

Spells, A. (1998). *Atlantic sturgeon population evaluation utilizing a fishery dependent reward program in Virginia's major western shore tributaries to the Chesapeake Bay.* Charles City, Virginia: U.S. Fish and Wildlife Service.

Theodore, I., Smith, J., Dingley, E., & Marchette, D. (1980). Induced Spawning and Culture of Atlantic Sturgeon. *The Progressive Fish-Culturist, 42(3)*, 147-151. Retrieved March 3, 2025, from https://doi.org/10.1577/1548-8659(1980)42[147:ISACOA]2.0.CO;2

U.S. Army Corps of Engineers (USACE). (2004). *United States Army Corps of Engineers, Norfolk District. James River Middle Reach.* Retrieved March 3, 2025, from https://www.nao.usace.army.mil/Portals/31/siteimages/civilworks/JamesRiverPartner/040304-A-CE999-001.jpg

U.S. Geological Survey. (2019). 3D Elevation Program 1-Meter Resolution Digital Elevation Model . *(published 20200606)*. Retrieved March 24, 2025, from https://www.usgs.gov/the-national-map-data-delivery

USACE. (2022). *James River, Richmond Deepwater Terminal to Hopewell, project condition survey 2022.* Retrieved March 3, 2025, from https://usace.contentdm.oclc.org/digital/collection/p16021coll10/id/15704/rec/10

Van Eenennaam, J., & Doroshov, S. (1998). Effects of age and body size on gonadal development of Atlantic sturgeon. *Journal of fish biology, 53(3)*, 624-637.

Van Eenennaam, J., Doroshov, S., Moberg, G., Watson, J., Moore, D., & Linares, J. (1996). Reproductive conditions of the Atlantic sturgeon (Acipenser oxyrinchus) in the Hudson River. *Estuaries, 19*, 769-777.

VDEQ. (2020). *Criteria, Designated Uses, Antidegradation*. Retrieved March 27, 2025, from https://www.deq.virginia.gov/our-programs/water/water-quality/standards/criteria-designated-uses-antidegradation

VDEQ. (2025). *Virginia Pollutant Discharge Elimination System Permit Program*. Retrieved March 6, 2025, from https://www.deq.virginia.gov/permits/water/surface-waters-vpdes

VDWR. (2023, September 29). *Time of Year Restrictions and Other Recommendations, Wildlife Information and Environmental Services*. Retrieved March 6, 2025, from https://dwr.virginia.gov/wp-content/uploads/media/Time-of-Year-Restrictions.pdf

Virginia Department of Environmental Quality (VDEQ). (2022). *Final 2022 305(b)/303(d) Water Quality Assessment Integrated Report*. Retrieved March 6, 2025, from https://www.deq.virginia.gov/our-programs/water/water-quality/assessments/integrated-report

Virginia Department of Wildlife Resources (VDWR). (2025). *Virginia Fish and Wildlife Information Service (VaFWIS)*. Retrieved March 3, 2025, from https://svcgis.dwr.virginia.gov/fwis

Virginia Electric and Power Company (VEPCO). (2000). *Section 316(a) Demonstration. VPDES Permit Number VA0004146 - Chesterfield Power Station.* Glen Allen, Virginia: Virginia Electric and Power Company, Environmental Policy and Compliance.

Welsh, S., Mangold, M., Skjeveland, J., & Spells, A. (2002). Distribution and movement of shortnose sturgeon (Acipenser brevirostrum) in the Chesapeake Bay. *Estuaries, 25*, 101-104.

Zydlewski, G., Kinnison, M., Dionne, P., Zydlewski, J., & Wippelhauser, G. (2011). Shortnose sturgeon use small coastal rivers: the importance of habitat connectivity. *Journal of Applied Ichthyology, 27*, 41-44.