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

Incidental Take Permit (ITP No. 21516) Conservation Plan

December 10, 2025

Chesterfield Power Station

Chesterfield, Virginia

This page is intentionally left blank

Table of Contents

1 Introduction 1
1.1 Overview 1
1.2 Background 1
1.3 Statement of Changes from ITP No. 21516-02 Conservation Plan 2
2 Anticipated Impact on Species and Habitat 3
2.1 Direct and Indirect Effects 3
2.1.1 Cooling Water Intake Operations 3
2.1.2 Clean Water Act 316(b) Studies 7
2.1.3 Dredging 8
2.1.4 Constituent Discharge 10
2.1.5 Thermal Discharge 10
2.1.6 Vessel Movements 11
2.1.7 Shoreline and Structure Maintenance 13
2.1.8 Cumulative Effects 13
3 Estimating Take 13
3.1 Estimated Entrainment Resulting from CWIS Operations 15
3.1.1 Estimated Take of Atlantic Sturgeon Larvae from CWIS Operations 16
3.1.2 Estimated Take of Atlantic Sturgeon Eggs from CWIS Operations 20
3.2 No Estimated Impingement Resulting from CWIS Operations 22
3.3 Estimated Take for Clean Water Act 316(b) Entrainment Studies 25
3.4 No Anticipated Take from Exposure to Constituents and Thermal Plume 26
3.5 No Anticipated Take from Dredging 26
3.6 No Anticipated Take from Vessel Movements 27
3.7 No Anticipated Take from Shoreline Maintenance 28
3.8 Assignment of Take to Atlantic Sturgeon DPS 28
3.9 Impacts of the Take on Atlantic Sturgeon 28
4 Mitigation Strategy 30
4.1 Background 30
4.2 Biological Goals and Objectives 31
4.3 ITP No. 21516-02 Conditions to Avoid, Minimize, and Mitigate Unavoidable Impacts 32
4.4 Measures to Avoid and Minimize Take 33
4.4.1 Cooling Water Intake 33
4.5 Measures to Mitigate Unavoidable Impacts 34
4.5.1 Genetic Relationship Research 35

4.5.2 Sturgeon Movement Research 37
4.5.3 Digital Holography Entrainment Pilot Study 41
5 Alternatives Considered 42
5.1 No Action Alternative 43
5.2 Alternative Avoidance and Minimization 43
5.2.1 Modifying Water Withdrawals 43
5.2.2 Cooling Water Intake Structure Modifications 44
5.3 Mitigation Measures Considered but Eliminated 44
5.3.1 Restoration or Creation of Spawning Habitat 45
5.3.2 Restocking with Hatchery Raised Sturgeon 46
5.3.3 Outreach, Education, and Partnerships 46
6 Monitoring Requirements 47
6.1 Cooling Water Intake Structure 48
6.1.1 Entrainment Monitoring 48
6.1.2 Entrainment Monitoring Details 49
6.1.3 Impingement Monitoring 51
6.2 Clean Water Act 316(b) Studies 56
6.3 Dredging 57
6.4 Constituent Discharge 57
6.5 Thermal Discharge 57
6.6 Vessel Movements 57
7 Reporting 57
7.1 Annual Reporting Plan 57
7.2 Incidental Take Reporting 57
7.3 Annual Reporting 59
7.3.1 Semi-annual Reports 59
7.3.2 Annual Reports 59
7.3.3 Final Report 60
8 Changed Circumstances 60
9 Funding for Mitigation Measures and Monitoring 61
10 Plan Implementation 61
11 Works Cited 62

Tables

Table 3-1 Projected Volume of Water Withdrawal at Chesterfield Power Station during September-October for Take Estimates of Atlantic Sturgeon Eggs and Larvae 15

Table 3-2 Estimated Entrainment of Atlantic Sturgeon Larvae from Chesterfield Power Station Cooling Water Intake Operation 19

Table 3-3 Estimated Entrainment of Atlantic Sturgeon Eggs from Chesterfield Power Station Cooling Water Intake Operation 21

Table 3-4 Summary of Intake Velocities for Intake Guards, Trash Racks, and Traveling Screens at Chesterfield Power Station 23

Table 6-1 Proposed ITP Entrainment Monitoring Details 51

Figures

Figure 3-1. Typical Profile of Chesterfield Power Station Intake Structure 24

Figure 4-1. Virginia Commonwealth University VEMCO receiver locations as of July 2024. The black points are typical receivers that need to be downloaded on the water while the red squares are the five active Live receivers. The black star within the Fall Sampling Area is the Chesterfield Power Station. 40

Appendices

Appendix A: Methods

Appendix B: Intake Guard Job Hazard Analysis Application

Acronyms and Abbreviations

ASMFC	Atlantic States Marine Fisheries Commission
ASSRT	Atlantic Sturgeon Status Review Team
BE	Biological Evaluation
CFR	Code of Federal Regulations
CI	Confidence interval
CPS	Chesterfield Power Station
CWA	Clean Water Act
CWIS	Cooling water intake structures
cfs	Cubic feet per second
cy	Cubic yards
DIF	Design intake flow
DPS	Distinct Population Segment
EA/FONSI	Environmental Assessment/Finding of No Significant Impact
ECC	Environmental Compliance Coordinator
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
ERDC	Engineer Research and Development Center
ESA	Endangered Species Act
fps	Feet per second
GARFO	Greater Atlantic Regional Fisheries Office
GLM	Generalized linear model
HFEM	High flow events model
IAP	Integrated Ash Project
ICTF	Invasive Catfish Task Force
ITP	Incidental Take Permit
LVWWTS	Low Volume Wastewater Treatment System
m^3	Cubic meters
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
PNNL	Pacific Northwest National Laboratory
PPE	Personal protective equipment
SOP	Standard Operating Procedures
SCDNR	South Carolina Department of Natural Resources
TMDL	Total maximum daily load
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VCU	Virginia Commonwealth University
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries
VDWR	Virginia Department of Wildlife Resources
VEPCO	Virginia Electric and Power Company
VPDES	Virginia Pollutant Discharge Elimination System

1 Introduction

1.1 Overview

National Marine Fisheries Service (NMFS) issued an Incidental Take Permit (ITP) to Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion) for the Chesterfield Power Station (CPS). NMFS issued ITP No. 21516 on December 10, 2020, which authorized 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, the ITP 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 take of Atlantic Sturgeon eggs. Specifically, modified ITP No. 21516-02 authorizes the entrainment of up 10,949 larvae and up to 18,363 eggs for the remaining permit period during normal operation of CPS. This Conservation Plan accompanies the Incidental Take Permit Renewal Application for ITP No. 21516-02 (ITP Renewal Application) and provides the information required by 50 Code of Federal Regulation (CFR) §222.307(b)(5). The 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.

1.2 Background

The CPS is a power generation facility located in Chesterfield, Virginia in the upper tidal freshwater portion of the James River. CPS is authorized to withdraw and discharge water under VPDES Permit Number VA0004146, effective on October 1, 2016, and currently administratively continued. The VPDES permit is one of several authorizations required for the operation of CPS. Additional details on CPS are provided in Sections 1 and 3 of the ITP Renewal Application.

As detailed in Section 1 of the original 2017 ITP application, during entrainment sampling conducted at CPS to comply with CWA 316(b) sampling requirements, two Atlantic Sturgeon yolk sac larvae were inadvertently collected on October 7 and 8, 2015. Consistent with a NMFS recommendation, Dominion suspended the 316(b) sampling at CPS on March 2, 2016. Dominion and NMFS met on August 12, 2016, to discuss obtaining authorization through Endangered Species Act (ESA) Section 10(a)(1)(B) for take of Atlantic Sturgeon incidental to CPS operations, maintenance, and completion of sampling pursuant to VPDES-permitting requirements. NMFS issued an ITP for CPS (ITP No. 21516) on December 10, 2020, which authorized incidental take of Atlantic Sturgeon larvae during normal operation of CPS and CWA 316(b) sampling. Specifically, over the 5-year permit duration, the ITP 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 at CPS was completed in December 2020 and no additional Atlantic Sturgeon were collected in the impingement or entrainment samples. Dominion submitted the final CWA 316(b) package to VDEQ on September 30, 2021. The original ITP did not authorize take of Atlantic Sturgeon eggs because Dominion determined, and NMFS concurred that entrainment of sturgeon eggs was unlikely to occur at CPS. However, the entrainment monitoring samples collected on September 25, 2021, September 26, 2022, and September 26, 2023, supported that the collection of non-viable Atlantic Sturgeon eggs can occur. On February 8,

2024, Dominion Energy submitted a revised methodology for estimating incidental egg take at CPS to NMFS, who published a notice of the ITP Modification Application to the Federal Register on December 20, 2024. Following review of the revised Conservation Plan and associated documents, NMFS submitted their Biological Opinion dated August 6, 2025, stating that incidental take of 18,363 eggs annually and an annual average incidental take of 10,949 larvae would likely not jeopardize the continued existence of the Chesapeake Bay DPS of Atlantic Sturgeon. The modified ITP No. 21516-02 which allowed for the incidental take of eggs and larvae was executed on August 13, 2025, for the remaining duration of the originally issued permit.

Recent evidence suggests that Atlantic Sturgeon spawn in the tidal freshwater portion of the James River and early life stages (i.e., eggs and larvae) and adult Atlantic Sturgeon might be vulnerable to effects of the permitted activities at CPS. Shortnose Sturgeon (*Acipenser brevirostrum*) are rare in the upper Chesapeake Bay and nearly non-existent in the lower Chesapeake Bay, including the upper James River, where CPS is located (Kynard, Breece, Atcheson, Kieffer, & Mangold, 2007; Spells, 1998; Virginia Department of Wildlife Resources (VDWR), 2025), personal communication with Dr. Matthew Balazik [U.S. Army Corps of Engineers (USACE)]). Only two verified Shortnose Sturgeon have been documented in the James River (Balazik M. , 2017),(Grange, 2019).. Shortnose Sturgeon have not been collected or observed during the recent or historic sampling efforts conducted at CPS, which includes entrainment and impingement sampling (1977, 2005-2006) and ichthyoplankton and fish community sampling completed in the James River near the station (1997-1999, 2005-2006). Therefore, the permitted activities are not expected to result in incidental take of Shortnose Sturgeon. Accordingly, Shortnose Sturgeon are not covered under this Conservation Plan, and thus not discussed further.

Section 2 of the ITP Renewal Application provides additional details on Atlantic Sturgeon and their distribution in the James River.

1.3 Statement of Changes from ITP No. 21516-02 Conservation Plan

- 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,
- Expansion of mitigation measures including:
    - Duration of Genetic Relationship Research and Sturgeon Movement Research, and
    - Scope of Digital Holography studies.

2 Anticipated Impact on Species and Habitat

2.1 Direct and Indirect Effects

2.1.1 Cooling Water Intake Operations

Potential effects of cooling water intake operations can be characterized as effects of entrainment of Atlantic Sturgeon eggs and larvae, and impingement of adult Atlantic Sturgeon.

Entrainment occurs when fish eggs or larvae are drawn into the cooling water intake structure (CWIS) with cooling water past the traveling screens. Viable Atlantic Sturgeon eggs are adhesive and demersal and are expected to attach to the substrate within 20 minutes after spawning; therefore, for optimal survival, Atlantic Sturgeon eggs should be retained on the spawning ground substrate through hatching (Hildebrand & Schroeder, 1928; Jones, Martin, & Hardy, 1978). Spawning has been described as occurring 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 [fps]), depths are 11 to 27 m (36 to 88.5 feet), with a preferred temperature range of 13-21°C (Atlantic States Marine Fisheries Commission (ASMFC), 2012; NMFS, 2022); (temperatures for spawning can range from 13 to 26°C). While the published literature states depths of 11 to 27 m (36 to 88.5 feet), video recordings of Atlantic Sturgeon spawning have been documented in depths of less than 1 m (3.3 feet) in river systems (Matthew Balazik, Personal Communication, May 16, 2025). 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, 2012; Balazik & Musick, 2015). 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 (which is 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, Virginia (river mile 95 [rkm 153]), approximately 13 river miles (20.9 km) upstream of CPS. During late summer, Atlantic Sturgeon exhibited a preference for the riverine section at the confluence of the upper James and Appomattox Rivers (river mile 73 [rkm 117.5]), approximately 9 miles (14.5 km) downriver from CPS Hager (2011).

Balazik and Musick (2015) also documented Atlantic Sturgeon suspected of fall spawning as far as river mile 96 (rkm 155), approximately 8.7 miles (14 km) upstream of CPS, indicating that potential fall spawning fish utilize the river in the vicinity of CPS. Age-0 juvenile Atlantic Sturgeon,

also known as young-of-year, were captured by researchers downriver of CPS in October 2018, providing additional evidence of spawning upriver of CPS in the fall (Balazik, Garman, Van Eenennaam, Mohler, & Woods, 2012; Greenlee, et al., 2017). Therefore, the capture of young-of-year downstream of CPS suggested these offspring move downriver, past CPS, within weeks of hatching which would potentially make them susceptible to entrainment as they pass the CPS CWIS (NMFS, 2020a). Further confirmation of Atlantic Sturgeon spawning in the James River was provided by the collection of yolk sac larvae in CPS entrainment samples in October 2015, and the collection of eggs in CPS ITP monitoring samples in September 2021, 2022, 2023, and 2025 after the ITP issuance in December 2020.

At hatching, Atlantic Sturgeon yolk sac larvae are large bodied and are assumed to undertake a demersal existence in the same areas where they were spawned (ASMFC, 2012; Bath, O'Conner, Alber, & Arvidson, 1981). Bath et al. (1981) only collected Atlantic Sturgeon larvae in bottom samples. Theodore et al. (1980) reported that hatchery-reared Atlantic Sturgeon larvae grew from 7.1 mm total length at hatching to 115.2 mm by day 131. The newly hatched larvae were active swimmers, swimming throughout the entire water column. However, once the yolk sac was absorbed, in 9 to 10 days, the larvae demonstrated a benthic existence (Theodore, Smith, Dingley, & Marchette, 1980). Kynard and Horgan (2002) observed that after the yolk is absorbed (at approximately 13-14 mm standard length) the larvae move downstream to the rearing grounds over a 6 to 12-day period.

Larvae transition into juveniles and develop a tolerance to salinity as they move downstream into brackish waters (ASMFC, 2012). Young-of-year (i.e., age-0 juvenile) Atlantic Sturgeon collections by Virginia Institute of Marine Science (VIMS) and Chesapeake Bay Foundation as summarized by Balazik (2012), indicate all historical young-of-year collections were downstream of CPS. This is supported by a recent documented capture of age-0 juvenile Atlantic Sturgeon downstream of CPS in the James River in October 2018 (NMFS, 2020a). Atlantic Sturgeon Status Review Team (ASSRT) (2007) indicates that the migratory behavior of larval sturgeon generally allows them to avoid intake structures, since their migration is active and occurs in deep water (Kynard & Horgan, 2002). Taken all together, these behavioral observations indicate that Atlantic Sturgeon larvae might be susceptible to entrainment in some instances for a brief portion of this early life stage when they are transient out-migrants.

Based on the demersal nature of Atlantic Sturgeon eggs and yolk sac larvae, and the affinity of post yolk sac larvae for deeper waters near the bottom, the risk of entrainment of the early life stages of Atlantic Sturgeon at CPS is considered to be low. Sturgeon researchers that have targeted collection of Atlantic Sturgeon eggs and larvae upstream or in the vicinity of CPS in the James River have been unsuccessful (Garman, 2016). There were no collections of Atlantic Sturgeon eggs or larvae during entrainment sampling at CPS conducted from June 2005 to June 2006 (Engineering Science and Technology, 2007) or January to December 1977 (Virginia Electric and Power Company (VEPCO), 2000). More recent sampling events include the collection of two Atlantic Sturgeon yolk sac larvae on October 7-8, 2015, three Atlantic Sturgeon eggs on September 25, 2021, forty-two Atlantic Sturgeon eggs on September 26, 2022, eleven eggs on September 26, 2023, and one egg on September 10, 2025. The eggs that have been collected were considered to be non-viable. The data is limited to support the potential for

collection of those early life stages in the entrainment samples to reach and become entrained at CPS.

Impingement occurs when a fish cannot swim fast enough to escape the area of influence from intake flow e.g., the fish's swimming ability is overtaken by the velocity of water being drawn into the intake. It should be noted that the intake flow and associated risk for impingement exists only when the CWIS is in operation for a particular unit at CPS. Adult Atlantic Sturgeon are not expected to be impinged on the CPS intake guards or be able to pass through and be susceptible to impingement on the trash racks.

As described above, juvenile Atlantic Sturgeon inhabit the James River downstream of the CPS and subadults are known to use estuarine and coastal habitats[1], including extensive coastal migrations; thus, it is assumed that juvenile and subadult Atlantic Sturgeon are not likely to occur in the vicinity of the CPS (Balazik M. , 2012; Hager, 2011; Balazik & Musick, 2015). Additionally, subadults typically spend multiple years outside of their natal rivers on coastal migrations (Balazik M. , 2012).

The approach velocity at the CPS' intake guards is 0.67 to 1.01 fps (20.4 to 30.8 centimeters per second (cm/s)), with a through guard velocity of 0.85 to 1.35 fps (25.09 to 41.1 cm/s). The approach velocity at the trash racks is 0.49 to 1.09 fps (14.9 to 33.2 cm/s), with a through-rack velocity of 0.51 to 1.13 fps (15.5 to 34.4 cm/s). In order for impingement to happen, a fish must be overcome by the intake or approach velocity. In experiments designed to show effects of exposure to suspended sediments on juvenile Atlantic Sturgeon, Wilkens et al. (2015) measured critical swimming speeds at 0.69 to 1.02 fps (21.0 to 31.0 cm/s). Based on Wilkens et al. (2015) and evidence presented below, it is expected that healthy Atlantic Sturgeon adults are generally capable of maneuvering against the intake approach velocities at the CPS CWIS and would not be subject to impingement, particularly given the relatively limited area affected by intake velocities.

Atlantic Sturgeon share similar life history strategies with Green and White Sturgeon; that is, besides morphological similarities and taxonomic relationships, all three species are estuarine dependent during substantial portions of their juvenile and subadult stages, make forays or long-distance migrations through marine waters, and require similar habitat attributes for reproduction. Similar life history features and requirements support an assumption of similar swimming capabilities and behavioral responses to altered flows.

Verhille et al. (2014) tested the swimming capacity of Green Sturgeon (*Acipenser mediocris*) and White Sturgeon (*Acipenser transmontanus*) through the completion of metamorphosis to juveniles, ranging in size from 4 to 22 cm (1.6-inch [in] to 8.7-in). Green Sturgeon swimming capacity, based on critical swimming velocity (the speed at which a fish can no longer propel itself forward), was not significantly different, but slightly greater than White Sturgeon swimming capacity, throughout larval development. Results indicated that 4.3-cm (1.7-in) and 6.5-cm (2.6-

[1] Based on NMFS Endangered Species Act Section 7 Consultation Biological Opinion for CPS ITP Application (2020), "juvenile" is used in reference to immature fish that have not emigrated from the natal river estuary, and "subadult" is used for immature Atlantic Sturgeon that have emigrated from the natal river estuary.

in) Green Sturgeon could sustain 35.7-cm/s (1.17 fps) and 45.4-cm/s (1.49 fps) for 5 minutes, while 4.7-cm (1.8-in) and 8.0-cm (3.1-in) White Sturgeon could sustain 25.3-cm/s (0.83 fps) and 35.4-cm/s (1.16 fps) for 5 and 10 minutes, respectively. Critical swimming velocity for 15.4-cm (6.0-in), 22.1-cm (8.7-in), and 22.2-cm (8.7-in) Green Sturgeon reported in other studies was 43.3-cm/s over 20 minutes (1.42 fps over 20 minutes), 48.2-cm/s over 20 minutes (1.58 over 20 minutes), and 52.7-cm/s over 5 minutes (1.73 fps over 5 minutes) (Allen, Hodge, Werner, & Cech, 2006; Mayfield & Cech, 2004). Critical swimming velocity ranged from 6.1-cm/s to 79.4-cm/s for 20 to 30 minutes (0.2 fps to 2.6 fps for 20 to 30 minutes) for larger Green Sturgeon (34.7 cm to 68.3 cm [13.7-in to 26.9-in]). All Green Sturgeon were tested at 18-19°C. Critical swimming velocity for larger White Sturgeon (24.8 cm to 38.3 cm [9.8-in to 15.1-in]) ranged from 64.3-cm/s to 69.2-cm/s for 20-30 minutes (2.11 fps to 2.27 fps for 20-30 minutes). White Sturgeon were tested at 11-12.5°C and 18-19°C. Absolute swimming capacity increased with increasing body size. Poletto et al. (2014) reported Green Sturgeon and White Sturgeon rarely became impinged when tested at velocities of 20.4-cm/s and 35.6-cm/s (0.67 and 1.2 fps).

Shortnose Sturgeon, while not expected to occur in the vicinity of the CPS CWIS, are well-studied and also have swimming capabilities expected to be representative of Atlantic Sturgeon (NMFS, 2012b). Juvenile and adult Shortnose Sturgeon (body lengths greater than 58.1 cm [22.9-in]) can avoid impingement at intakes with velocities as high as 91.4-cm/s (3.0 fps) (Kynard, Pugh, & Parker, 2006) as cited in (NMFS, 2012b)). Shortnose Sturgeon with body lengths greater than 28 cm have been demonstrated to avoid impingement at intakes with velocities of 30.5-cm/s (1.0 fps) (Kynard, Pugh, & Parker, 2006) as cited in (NMFS, 2012b)).

Adult Atlantic Sturgeon may be susceptible to being impinged on operating CPS CWIS if they are damaged, unhealthy or exhausted from stressful activities such as spawning or events such as high river flows. While one adult Atlantic Sturgeon was collected on October 3, 2015, with debris during trash rack operation; this was a rare occurrence. The fish was approximately 1.7 m (5.5 feet) long and was released back to the James River alive. The collection may have been the result of the exhaustion from spawning (personal communication with Dr. Matthew Balazik [USACE]) or a severe rain event that occurred in the days leading up to and on October 3, 2015. No Atlantic Sturgeon were collected in impingement samples between July and December 2015, or during prior impingement sampling at CPS conducted from June 2005 to June 2006 (EA, 2006) and January to December 1977 (VEPCO, 1977). One Atlantic Sturgeon was collected as part of ambient CWA 316(a) field studies (June 2005 through April 2006) in a gillnet in June 2005 and released alive (EA, 2007; Dominion, 2013). On September 22, 2018, four adult Atlantic Sturgeon, all in apparent post-spawn condition, were impinged and found dead on the Unit 5A trash racks. High river flows were likely a contributing factor as the Atlantic Sturgeon moved downriver past CPS (M. Balazik, personal communication, September 30, 2018). Dominion examined all of the intake guards following this event and discovered the Unit 5 intake guard was missing and all but one of the intake guards for the remaining units was degraded.

On October 9, 2022, CPS Operators performing the daily visual observation of the intakes and daily trash raking identified a deceased and decomposed adult Atlantic Sturgeon in the space between the trash rake/rack and the intake guard on CPS Unit 6A intake which is approximately 1.7 m (5 feet 6.25-in). Following the discovery of the deceased adult male Atlantic Sturgeon and transfer to Dr. Matt Balazik, Research Scientist at U.S. Army Engineer Research and

Development Center, Dr. Balazik completed further analysis which included a determination that there was no immediate evidence indicating an apparent cause of death. The individual was highly decomposed and assumed to be at least one week postmortem. Based on the level of decomposition, the measured specimen dimensions being below 20.8-cm (8-in), the dive inspection confirming the 6A intake guards were in as built condition, no circulating water flow for greater than a week prior to the discovery and confidence that a live adult sturgeon would be easily visible and identified during daily inspections if it were occupying the small area between the trash rake and the intake guards prior to October 9, 2022, the evidence supports that the deceased and decomposed adult Atlantic Sturgeon was in that condition and that it drifted into the intake structure due to ambient river flow conditions. CPS operation was not the cause of the deceased adult Atlantic Sturgeon's death or presence in the intake bay.

Subsequent to the 2018 impingement event and based on expert opinion regarding the size of the smallest adult Atlantic Sturgeon in the James River, the intake guards upstream of the debris trash racks were repaired and upgraded to specifically prevent adult Atlantic Sturgeon from entering the intake structure. Based on the documented swimming capabilities of sturgeon juveniles and adults representing several *Acipenser* species, as well as the upgrades to the intake guards and resulting intake velocities, there appears to be low risk of impingement of a live adult Atlantic Sturgeon. For this reason, no incidental take of Atlantic Sturgeon due to impingement is requested. Dominion will continue to monitor the trash racks and traveling screens at operating CWIS (those actively withdrawing water) as necessary during the fall sturgeon spawning season to confirm that take does not occur as described in Section 3.3 of this document. Visual inspections of the trash racks of the operating CWIS for impingement of Atlantic Sturgeon is noted in Section 6.1.3. Monitoring at the intake guards is not practicable due to a lack of access to the intake guard wall to safely deploy equipment to monitor for impingement. In addition, the typically turbid waters of the James River makes visual observation below the surface ineffective at the intake guards. For these reasons, and because no impingement is expected, no monitoring is proposed at the intake guards during the fall sturgeon spawning season.

In summary, it is assumed that juvenile and subadult Atlantic Sturgeon are not likely to occur in the vicinity of the CPS (Hager, 2011; Balazik M. , 2012; Balazik & Musick, 2015). The estimated approach or intake velocities through CPS intake structures designed to prevent entry of debris and organisms (see Section 3) were calculated to be less than 2 fps at the intake guards, trash racks and traveling screens. In order for impingement to happen, a fish must be overcome by the approach or intake velocity. Based on evidence summarized above, which demonstrated adult White Sturgeon are capable of critical swim speeds of up to 69.2-cm/s (2.27 fps) and Green Sturgeon are capable of up to 76.2-cm/s (2.6 fps), it is expected that healthy Atlantic Sturgeon adults would be capable of escaping the 61.0-cm/s (2 fps) approach velocities at the CPS intake and would not be subject to impingement. No indirect effects on Atlantic Sturgeon are expected to occur as a result of the cooling water intake operations.

2.1.2 Clean Water Act 316(b) Studies

The purpose of the CWA 316(b) sampling efforts was to characterize impingement and entrainment associated with CPS operations to comply with VPDES permit application

requirements. Therefore, effects associated with CWA 316(b) sampling were impingement and entrainment.

As described in Section 1, two Atlantic Sturgeon yolk sac larvae were collected during 316(b) entrainment sampling in October 2015. This was a rare occurrence as Atlantic Sturgeon had not been collected in prior entrainment samples at CPS (EA, 2007; VEPCO, 1977). Atlantic Sturgeon had not been caught in 316(b) impingement samples at CPS (EA, 2007; VEPCO, 1977)). The CWA 316(b) sampling at CPS was completed in December 2020. No additional Atlantic Sturgeon were collected in the CWA 316(b) impingement and entrainment samples. Dominion submitted the final CWA 316(b) package to VDEQ on September 30, 2021.

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 of the ITP Renewal Application. Therefore, while 316(b) studies may occur during the ITP (*e.g.*, as part of the next VPDES renewal process), an incidental take identified during this activity would be a result of the CWIS operation and therefore would be associated with the CWIS operation's incidental take estimate.

2.1.3 Dredging

Dredging activities associated with CPS operations and maintenance could result in direct effects such as entrainment (e.g., if a cutterhead dredge was used to maintain the barge slip) or entrapment in a mechanical dredge bucket or dragline and potential vessel-sturgeon interactions related to vessel activities associated with dredging, or indirect effects such as modification of possible spawning habitat, disruption of migratory and spawning behavior, alteration of sturgeon prey and foraging behavior due to dredging, as well as effects associated with increases in suspended sediments and underwater noise generated during dredging operations.

Dredging occurs within a limited area of the river at the CPS barge slip and CWIS. The permitted dredging associated with the CPS CWIS has involved a dragline method; permitted dredging in the barge slip has generally involved a hydraulic cutterhead dredge although clamshell dredging is also an option. The effects of dredging activities within the federal navigation channel have been addressed by the NMFS Biological Opinion on maintenance dredging of the James River navigation channel (NMFS, 2012a).

Reine et al. (2014) summarizes sturgeon takes associated with navigation dredging in Atlantic and Gulf of Mexico waters from 1995 through January 2013 based on sea turtle observer data. In that time period, a total of 42 sturgeon (3 Gulf Sturgeon, 11 Shortnose Sturgeon, 34 Atlantic Sturgeon) takes were recorded during dredging. Hydraulic dredging (i.e., cutterhead pipeline and trailer suction hopper dredges) accounted for the majority of the takes, comprising a total of 22 sturgeon. Four were captured by mechanical dredges (clamshell/bucket). These takes represent a very wide geographic area over a very long time. Sturgeon takes by any form of dredging have been shown to be exceedingly rare events unless special circumstances exist that raise the risks of interactions. For example, the Bath Iron Works facility in the Kennebec River is a known location for sturgeon to aggregate in the summer months. At this facility, dredging occurs every 2 years with 100 percent observer coverage for approximately 15 years. In this time, they reported three takes via mechanical dredge, providing evidence that the risk of interactions between sturgeon

and dredges is thought to be highest in areas where sturgeon are known to congregate (NMFS, 2017). Similar circumstances do not exist at the CPS and there is no reason to suspect that dredging conducted there would pose a substantial risk. Juvenile and adult Atlantic Sturgeon are suction feeders, processing sediment to remove prey items. While foraging, sturgeon are at the bottom of the river interacting with the sediment, which would conceivably pose a risk of entrainment by hydraulic dredges or entrapment by mechanical dredges. There is no credible evidence to infer that CPS operations would attract sturgeon, as in the case of foraging, that would increase risks of interactions.

Increased exposure to suspended sediments and sedimentation associated with dredging on fish such as Atlantic Sturgeon could result in indirect effects such as reduced water quality and reduced light intensity in the water column (Wilber & Clarke, 2001; Wilber, Brostoff, Clarke, & Ray, 2005). Viable spawning habitat presumably is located where ambient bottom flows are adequate to sweep accumulations of silt off the substrate. Sediment redeposition could also cause larval mortality by clogging gill tissues and through gill abrasion (Wilber & Clarke, 2001). However, sturgeon in general, including Atlantic Sturgeon, are likely to be very tolerant of exposures to suspended sediment. Wilkens et al. (2015) exposed juvenile Atlantic Sturgeon to concentrations as high as 500 mg/L and observed no significant effect on short-term survival.

There is little available information on the impacts of dragline dredging; because it is a mechanical dredge, it is assumed that impacts would be similar to the impacts of a bucket or clam shell dredge. All impacts associated with dredging would depend on the dredging methods deployed. However, because the areas and sediment volumes that would be dredged for maintenance are small (less than a total of 11,000 cubic yards [cy]) and would be conducted for a relatively short duration (e.g., days to a week) outside of the spawning periods, impacts associated with increased noise, suspended sediments, and interrupted foraging behavior are expected to be negligible. Additionally, sturgeon are mobile species and would likely move from the immediate area once dredging begins.

Balazik et al. (2020) presented telemetry data that showed 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. Additionally, Balazik & Clarke (2024) determined that there was no mortality or avoidance behavior in juvenile Atlantic Sturgeon in the presence of cutterhead suction dredging activity. This indicates Atlantic Sturgeon are capable of avoiding vessels as they navigate the James River. Additionally, in the past, Virginia Department of Wildlife Resources (VDWR; formerly Virginia Department of Game and Inland Fisheries [VDGIF]) has recommended a time-of year-restriction from February 15 through June 30, in order to avoid impacts on anadromous species (VDEQ, 2023).

Based on the analysis above, the limited area of disturbance, the infrequent occurrence of dredging, and limited seasonal occurrence of Atlantic Sturgeon in the vicinity of CPS, dredging activities are not expected to affect Atlantic Sturgeon habitat or migratory behavior, and unlikely (i.e., the potential is so low that it is discountable and not anticipated to occur) to entrain or entrap individual fish.

2.1.4 Constituent Discharge

The constituent discharges are not expected to result in direct or indirect effects on Atlantic Sturgeon. As described in the Environmental Baseline under Section 4 of the ITP Renewal Application, CPS began operating in 1952 and has operated at various capacities over its operational lifetime. As described in Section 5 of the ITP Renewal Application, all discharges are regulated according to VPDES Permit Number VA0004146. The constituents discharge both directly into the James River Main Channel and indirectly to the James River through Farrar Gut. As described in Section 5 of the ITP Renewal Application, the Main Channel is a Category 5D water body, meaning the Water Quality Standard is not attained and where total maximum daily loads (TMDLs) for a pollutant(s) have been developed, but one or more pollutants are still causing impairment requiring additional TMDL development. Farrar Gut is a Category 4A water body, which means that the water is impaired or threatened for one or more designated uses but does not require a TMDL because the TMDL for a specific pollutant(s) is complete and U.S. Environmental Protection Agency (EPA) approved (VDEQ 2016). As discussed in Section 5 of the ITP Renewal Application, because the James River and Farrar Gut are classified as Tier 1, the existing use of the water body must be maintained. As described in Section 5 of the ITP Renewal Application, implementation of the Integrated Ash Project (IAP) eliminated the previous process wastewater discharges from the station's two ash ponds and provided additional treatment for many waste streams substantially reducing the concentrations of key constituents in the remaining discharges. 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.

2.1.5 Thermal Discharge

No direct or indirect effects of the CWIS on Atlantic Sturgeon are expected from the cooling water discharge. Water temperatures measured in the mainstem of the James River, as well as the lower Farrar Gut and Jones Neck oxbow stations during the fish sampling for the CWA 316(a) demonstration study in May of 1997 and October 1997 (Atlantic Sturgeon spawning seasons), ranged from 17°C to 21°C and 18°C to 22°C, respectively. These temperatures are within the temperature tolerance range recorded for Atlantic Sturgeon spawning (13–26°C) (see Figure 7.4 of (VEPCO, 2000)). Thermal modeling done under full operating load conditions resulted in average modeled increases in temperature for the entire Farrar Gut as 1.1°C (2.0°F) and 0.6°C (1.2°F) in the James River. The modeling analysis concluded that these temperature increases would not produce significant changes to the hydrodynamic characteristic of the James River system (HydroQual, 2003) and the VDEQ concurred.

Temperature regimes in the James River as affected by the CPS thermal discharges are not expected to inhibit upstream migration of adults or seaward migration of larvae and juveniles. This is supported by the results of the CWA 316(a) demonstration study (VEPCO, 2000) as well as the CPS CWA 316(a) Demonstration Update Study (Normandeau Associates, Inc., 2020). The CWA 316(a) Demonstration Update Study included 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 the thermal discharges from CPS: (1) maximum permitted heat rejection limits for all units in operation at the time of the analysis (Units 5, 6, 7, and 8), and (2) at permitted maximum heat rejection limits for only Units 7 and 8, which is the configuration that started in 2023 after Units 5 and 6 were retired. The study concluded that during spring and fall, when most migrations take place, temperatures were not predicted to create a barrier for Atlantic Sturgeon attempting to reach or return from spawning grounds in the mainstem of the James River (Normandeau Associates, Inc., 2020).

Additionally, evidence of successful spawning of Atlantic Sturgeon upstream from CPS suggests that CPS' thermal discharges do not create an impediment to their migration. Furthermore, NMFS Biological Opinion for CPS ITP No. 21516 stated "There is no information on the thermal plume to suggest that there are times in October when bottom temperatures would exceed the maximum thermal tolerance for larvae (24.5°C) (ASMFC, 2012) as they move past CPS at or near the bottom, thus the thermal plume is not expected to impact the habitat in a way that would affect their downstream migration during October" (NMFS, 2020a).

2.1.6 Vessel Movements

Incidents of Atlantic Sturgeon strandings due to propeller strikes have been reported in both the Delaware (Brown & Murphy, 2010) and James Rivers (Balazik M. , et al., 2012). Sturgeon-vessel interactions (i.e., propeller strikes) appeared to be linked to maneuvering of deep-draft ocean cargo vessels through a 25-rkm (15.5 rm) stretch of the federal navigation channel upstream of rkm 120 (rm 74.5), characterized by narrow width and channel depth which formed an area of increased injury and mortality risk compared to downstream areas that contained deeper refuge areas (Balazik M. , et al., 2012). Monitoring of telemetered Atlantic Sturgeon determined that fish were rarely located at depths utilized by tugboats (≤ 2.3 m) and small recreational craft (≤ 1.0 m); however, the number of study fish was small. The James River Sturgeon Partnership, a collaboration of multiple federal and state agencies, academia, and the Riverkeeper organization, led efforts to characterize sturgeon movements by establishing and maintaining a long-term deployment of passive acoustic receivers at strategic locations in the James River between its confluence with the Chesapeake Bay and the Richmond Deepwater Terminal. This led to an increased awareness of Atlantic Sturgeon on the James River and an accumulation of observations of stranded Atlantic Sturgeon carcasses with clear evidence of trauma indicative of propeller strikes. A summary of these observations indicates that a large majority of incidents of propeller strikes was associated with deep-draft ocean cargo vessel traffic (Balazik M. , et al., 2012) within 2.5 miles (4 km) of the downriver reach of the Turkey Island Cutoff. Twenty-five of 31 sturgeon carcasses released for this study were recovered in that reach. Twenty-six of the carcasses had gashes from vessel propellers and the remaining five carcasses were too decomposed to allow determination of the cause of death. In brief, the evidence indicated that propeller strikes were linked to maneuvering of deep-draft ocean cargo vessels. Although the rate of strikes has substantially decreased coincident with the reduction of deep-draft vessel traffic in the James River, propeller strikes continue to be observed (personal communication with Dr. Matthew Balazik [USACE]).

An additional risk factor associated with barge movements involves the propulsion system of the towboat used to maneuver the barge. Concerns for barge/towboat propeller entrainment and

injury of sturgeon have previously arisen in connection with vessel traffic through pools in the Upper Mississippi River (Gutreuters, Dettmers, & Wahl, 2003). Concerns focused on protection of the listed Pallid Sturgeon as well as the more abundant Shovelnose Sturgeon. Ensuing studies collected empirical data on towboat entrainment rates (entrained by the propulsion system) by modifying trawls to sample the wakes of operating vessels (Killgore, et al., 2011; Miranda & Killgore, 2013). Miranda and Killgore (2013) estimated that sturgeon were entrained (entrained by the propulsion system) on an annual basis at rates of 0.02 sturgeon per river km and 0.38 sturgeon per hectare. Their estimates were based on extrapolations of their sampling data to rates reflecting up to 3,967 barge transits through a given pool. Direct comparisons of these reported rates cannot be made due to differences in the river conditions, prevailing navigation depths, barge configurations, and potentially different susceptibility of the sturgeon species involved. Navigation depths in the Mississippi and Illinois River studies varied from less than 9 feet to as deep as 30 feet (personal communication with Dr. Jack Killgore [ERDC]). However, an estimate of up to three barge deliveries on an annual basis to the CPS supports a conclusion that the rates of potential propeller interaction would be substantially lower than the Miranda and Killgore (2013) rates.

During active tracking of Atlantic Sturgeon by the James River Sturgeon Partnership to assess risks of entrainment by hydraulic dredges in the James River (Reine, et al., 2014), individual tagged sturgeon were observed to remain in the navigation channel or move to the adjacent shoals during the passage of commercial vessels. No evidence of vessel interactions was seen, although the number of potential encounters was small. Similar to Balazik et al. (2012), Reine et al. (2014) stated the tagged juvenile Atlantic Sturgeon spent the majority of time in deeper waters.

Vessel movements associated with the operation of CPS are not expected to result in sturgeon-vessel interactions. Between 2020 and 2025 during implementation of ITP No. 21516, two to three deliveries of fuel oil by means of barge per year have occurred. The vessels associated with CPS are shallow draft vessels. A fully loaded barge would provide a minimum of 14 feet of below keel clearance during upriver transits, and a minimum of 23 feet of below keel clearance on the downriver transits. Actual clearances would generally be deeper in those reaches where shoaling is less prevalent and where the natural channel depth exceeds the project depth. The peak risk of propeller strike would occur during docking/undocking maneuvers and would decline progressively with distance downriver as the below keel clearances increase and the cross-sectional profile of the river widens.

Currently, there are no known risks caused by barge movements in and out of CPS or any specific measures that can be taken to further reduce the risk of those operations. The number of barge deliveries on an annual basis to CPS has decreased since the original application in 2017 which simultaneously reduces the potential for interaction. Regardless, the most commonly recommended measure is to reduce the forward speed of vessel movements to maximize opportunities for sturgeon to avoid interactions. However, behavioral responses of sturgeon to approaching vessels are poorly understood except for the recent publication from Balazik et al. (2020) wherein the 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.

2.1.7 Shoreline and Structure Maintenance

Shoreline and structure maintenance has the potential to result in noise and turbidity effects on Atlantic Sturgeon. The installation of sheet pile is one example of shoreline maintenance. Turbidity associated with the installation of sheet pile is expected to be similar to anchors. Turbidity levels during these activities would be expected to be less than 50 mg/L above background, diminishing to 5 to 10 mg/L above background within a few hundred feet (NMFS, 2017). NMFS (2017) indicates that the acoustic footprint of sheet piling is small. Acoustic levels associated with impact pile driving can be variable and dependent on pile size, type, driving methods, and sediment, among other factors. Shoreline and structure maintenance is expected to be infrequent. Additionally, in the past, VDWR (formerly VDGIF) has recommended a time-of-year restriction from February 15 through June 30 in order to avoid impacts on anadromous species.

2.1.8 Cumulative Effects

Cumulative effects are those effects of *future* state or private activities, not involving federal activities, which are reasonably certain to occur within the action area (50 CFR 402.02). To identify activities that should be considered, during the Conservation Plan Renewal development in 2025, electronic searches were conducted of regional, county, and local news outlets for the eight counties that encompass the action area; county and city planning documents for those counties; and the Virginia Water Resources Plan (see Appendix A of this document for a detailed description of the search strategy). To qualify for consideration, an activity had to (a) be proposed to occur in the foreseeable future, (b) occur in the action area, (c) be described in sufficient detail to allow an assessment of direct and indirect effects, and (d) would not receive or require funding or authorization from a federal agency. No activity was identified as satisfying these criteria in the Project Area.

3 Estimating Take

Section 5 of the ITP Renewal Application identifies activities associated with CPS CWIS operations and maintenance that have the potential to affect Atlantic Sturgeon and those activities for which Dominion seeks coverage under an ESA Section 10(a)(1)(B) ITP. The activities to which sturgeon may be exposed but for which incidental take is unlikely (i.e., the potential was so low that it is discountable and not anticipated to occur) and for which incidental take coverage is not requested, include impingement, dredging, constituent discharges, thermal discharges, vessel movements, and shoreline maintenance.

CPS began operation in 1945 and was in base-load operation until March 2019 when Units 3 and 4 were retired, leaving Units 7 and 8 base-loaded as Units 5 and 6 were cycled more frequently. In May of 2023, Units 5 and 6 were retired from generation and base-loading Units 7 and 8 remained in full operation. Entrainment and impingement studies at CPS were conducted from January through December 1977, from June 2005 to May 2006, and intermittently from July 2015 to December 2020. ITP entrainment monitoring was conducted from September 2021 through the permit expiration date of December 2025. From these years of operations and these studies, evidence of CPS' operational effects on Atlantic Sturgeon is limited to the following occurrences:

- Two (2) Atlantic Sturgeon larvae captured in entrainment sampling on October 7 and 8, 2015,
- A single (1) adult collected in the CPS trash rack on October 3, 2015,
- Four (4) adult Atlantic Sturgeon found in the Unit 5A cooling water intake structure on September 22, 2018.
- Three (3) non-viable eggs were collected during ITP entrainment monitoring (ITP No. 21516) on September 25, 2021,
- Forty-two (42) non-viable Atlantic Sturgeon eggs were collected during ITP entrainment monitoring sampling on September 26, 2022, and
- Eleven (11) non-viable Atlantic Sturgeon eggs were collected during ITP entrainment monitoring on September 26, 2023.
- One (1) non-viable Atlantic Sturgeon egg was collected during ITP entrainment monitoring on September 10, 2025.

As discussed in greater detail later in this sub-section, based on a review of the data available, impingement, dredging, constituent discharge, thermal discharge, vessel movements, and shoreline and structure maintenance associated with CPS are not expected to result in take of egg, larvae or adult Atlantic Sturgeon.

The data suggests that interactions between CPS and Atlantic Sturgeon are rare events (i.e., they have very low probabilities of occurring but are anticipated); but most coincide with the fall spawning season of September and October. Considering the short seasonal temporal window that Atlantic Sturgeon and their early life stages are present in the James River in the vicinity of CPS, these collections and interactions could be best described as rare events. Most of the time, operations at CPS do not entrain, impinge, or otherwise interact with Atlantic Sturgeon. This pattern of interactions can be meaningfully described as a Poisson process, which is a random process that produces “successes” (interactions) at random points in a continuous time series, area or volume and “failures” (no interactions) for the remainder of the time, area or volume. For this reason, the Poisson distribution was relied on to estimate the expected number of Atlantic Sturgeon that might be taken on rare occasions. This is the same approach that was previously used to calculate incidental take estimates for this ITP.

Modeling data samples using the Poisson distribution has the added benefit of requiring only a single variable: a rate parameter (usually denoted “lambda”) that represents the mean number of occurrences or interactions in a sample, time interval, or area (Ewart, Ford, & Lin, 1974; Gotelli & Ellison, 2004). After calculating this rate parameter, the Poisson model was used to determine the expected take rate per cubic meter (m^3) of water volume and the 95 percent confidence interval (CI) around the estimated take rate of Atlantic Sturgeon entrainment events associated with CPS (see Appendix A of this document for a technical discussion of calculation methods for incidental take estimates of Atlantic Sturgeon larvae [Appendix A.2] and eggs [Appendix A.3]). A 95 percent CI denotes an interval which likely encloses the true take rate at the 95 percent probability level. In other words, the true take rate would have a value most likely to fall in the

interval 19 times out of 20. There is only a 1 in 20 chance that it would lie outside that interval. The rate parameter for the Poisson model was calculated by dividing the number of interactions by the volume of water sampled during entrainment sampling events conducted at CPS.

3.1 Estimated Entrainment Resulting from CWIS Operations

This ITP Renewal Application renewal requests the authorization of up to 109,490 larvae and 183,630 eggs over the duration of the requested 10-year ITP. To calculate the estimated incidental take of Atlantic Sturgeon eggs and/or larvae during CPS CWIS operations, it was estimated the CPS facility would continue to operate base loading of Units 7 and 8 and would withdraw water at approximately 50 percent of the total design intake flow (DIF) during the September-October period. The selection of approximately 50 percent of the CPS total DIF to characterize expected future operations was based on a) 2017 CWIS operations, when the station retired units and first began operating Units 5 and 6 in a cycling mode, and b) assumption of plant operations continuing in this manner. Cycling refers to operating generating units at varying load levels in response to changes in system load requirements. CPS CWIS 2018 data was not used because the station minimized water withdrawals during September and October 2018 as the intake guards were refurbished. Table 3-1 presents a summary of the estimated total volume of water withdrawal used for calculating incidental take estimates of early-life stage Atlantic Sturgeon (i.e., eggs and larvae).

Table 3-1 Projected Volume of Water Withdrawal at Chesterfield Power Station during September-October for Take Estimates of Atlantic Sturgeon Eggs and Larvae

Unit	Daily Flow (m^3)	Total Volume of Water Withdrawal during 6-week Period (m^3) used for Take Estimates
Unit 4[A]	98,705	4,145,589
Unit 5[A]	395,197	16,598,274
Unit 6[A]	817,649	34,341,258
Unit 7	328,574	13,800,097
Unit 8	328,574	13,800,097
Total	**1,968,698**	**82,685,315**

Note:
[A] Units 4, 5 and 6 have been retired for power generation however pumps will be operated intermittently as necessary for non-cooling water needs and to comply with VPDES Permit No. VA0004146.

The requested level of incidental take is based on the assumption that interactions between CPS and Atlantic Sturgeon are rare events. Most of the time, operations at CPS would not entrain early life stages of Atlantic Sturgeon; however, at random points in those operations, very small numbers of sturgeon larvae and non-viable eggs could be entrained and collected. For this reason, a Poisson probability model was used to estimate the probability of Atlantic Sturgeon being taken at CPS as well as the number of Atlantic Sturgeon that might be "taken" in the unlikely event that occurs.

The Poisson model has the added benefit of requiring only a single variable: a rate parameter (or "lambda (λ)") that represents the mean number of occurrences or interactions in a sample, time

interval, or area (Ewart, Ford, & Lin, 1974; Gotelli & Ellison, 2004). With lambda, the Poisson model can be used to estimate the probability of a number of events, or "takes," in a similar number of samples, time intervals, or area.

Take will be incidental to otherwise lawful activities described in the ITP Renewal Application and Conservation Plan. Takes may only occur in conjunction with the operation of the CWIS, the completion of entrainment sampling for CWA section 316(b) studies as described in the application, and the monitoring requirements of this ITP. Dominion requests that the ITP cover incidental take for a ten-year period from the date of issuance.

3.1.1 Estimated Take of Atlantic Sturgeon Larvae from CWIS Operations

The method for take estimate of Atlantic Sturgeon larvae described below is consistent with that used to derive incidental take authorization in the issued ITP No. 21516.

To estimate the number of Atlantic Sturgeon larvae that might be taken from CWIS operations, the interaction rate of larval Atlantic Sturgeon in entrainment sampling conducted from September and October of 2005 and 2015 was calculated. During September and October in 2005 and 2015, there were eight sampling events, totaling 144 subsamples (approximately 100 m^3 each) collected during the time when Atlantic Sturgeon larvae are most likely to be in the vicinity of the CPS. This results in a mean interaction rate of 0.000132423 (95% CI 0.000022013 – 0.000408657). The 95 percent confidence interval for the interaction rate was calculated after fitting a generalized linear model (GLM) with Poisson distribution assumptions to the sampled data. The profile likelihood ratio method for confidence intervals was used to calculate the lower and upper bounds of the confidence interval for the ITP Renewal Application.

To ensure that the interaction rate estimate considered relevant time intervals, sampling events that occurred during the spring, summer, and winter months were not included because larval Atlantic Sturgeon are not expected to occur upstream or in the vicinity of the CPS CWIS during those seasons; including those months would have artificially deflated the mean interaction rate.

No Atlantic Sturgeon larvae have been reported to have been entrained by CWIS operations independent of the 2015 CWA 316(b) entrainment sampling program. As a result, to estimate the number of Atlantic Sturgeon larvae that might be entrained when the CWIS is in operation, the estimated interaction rate of 0.000132423 larvae per m^3 was used.

To determine the estimated take, the interaction rate of 0.000132423 larvae per m^3 was multiplied by the anticipated water volume to be withdrawn over the 6-week Atlantic Sturgeon spawning period in September and October. The expected total water volume was estimated using the projected CWIS operation after the retirement of Units 3 and 4, assuming one pump operation for Unit 4 for other plant needs (50% of Unit 4 DIF), cycling of Units 5 and 6 (50% of Units 5 and 6 DIF) and base loading of Units 7 and 8 (100% of Units 7 and 8 DIF) over the six-week sturgeon spawning period.

Fall migrating Atlantic Sturgeon have been collected by researchers in the James River (fall collections were made between river kilometer (rkm) 108 and 132) from August 5 to October 13

(Balazik, Garman, Van Eenennaam, Mohler, & Woods, 2012; Balazik & Musick, 2015) with telemetry tagged fish departure from the river and entering Chesapeake Bay between October 6 and November 8 (Balazik, Garman, Van Eenennaam, Mohler, & Woods, 2012). Fish were first collected in early August before spawning that occurs starting in late August or September. Based on telemetry data, spawning lasts up to three weeks. Most of the captured adults were males and were considered ripe in that the fish expressed milt. Additionally, two females were captured and were considered post-spawn based on the presence of a few remaining mature eggs. Telemetry data show adults staging near the salt wedge in the lower river and then migrating upriver around September (Balazik & Musick, 2015). A known female returning to the James River on 6 May 2013 staged below rkm 67 (41.6 rm) from May to November except for two quick suspected spawning movements, one to rkm 120 (74.6 rm) on September 1 and the other to rkm 132 (82.0 rm) on September 24 (Balazik & Musick, 2015). This would indicate individual spawning events are brief, which is supported by additional sampling conducted by Balazik (personal communication) indicating that the peak spawn lasted approximately 3 weeks in 2017 and 1 week in 2018. Catch data from 2011 and 2012 in the James River were used to estimate the adult male population at 2,760 individuals (Balazik M. , 2012). 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. At Dominion's request, a revised population estimate was developed which provided an annual fall spawning female population estimate of 1,250 individuals in the James River (Balazik personal communication).

Preferred or suitable egg incubation temperatures are described as 20-21°C for culturing purposes (Mohler, 2003). Other lab and field studies suggest optimal egg survival and hatching occurs at 13–25°C (Borodin, 1925; Smith T. , 1985; Kieffer & Kynard, 1993; Hatin, R., & Caron, 2002; Smith, Flowers, & Hightower, 2015). Aquaculture studies have reported successful incubation of eggs at temperatures of 15–20°C (Dean, 1895; Chapman & Carr, 1995; Theodore, Smith, Dingley, & Marchette, 1980), with high mortality at water temperatures ≥25°C (Chapman & Carr, 1995). However, Smith et al. (2015) collected eggs spawned in the Roanoke River near temperatures of 24.5°C and estimated spawning period temperatures ranged from 25.3 to 24.3°C. The egg sampling in the Roanoke River ran from September 13 to October 4, but eggs were only collected on September 18 and 20. Ingram and Peterson (2016) found that adult Atlantic Sturgeon reached hard substrates in the upper Altamaha system in Georgia in early to mid-October, just as water temperatures dropped below 25°C.

Based on the temperature data from 2007 through 2018 at the U.S. Geological Survey (USGS) station 02035000 James River at Cartersville, temperatures typically drop below 25°C during the first or second week of September. Typically, water temperatures at Cartersville are more responsive to changes in air temperatures than the James River near CPS and so tend to cool somewhat sooner. In some years, temperatures near Cartersville drop below 25°C during August, but if that happens, there tend to be fluctuations above and below 25°C. Balazik (personal communication) has indicated that adult female Atlantic Sturgeon could be expected to be in the vicinity of CPS when water temperatures fall below 26°C.

Eggs are strongly adhesive and demersal and occur only on the spawning grounds attaching to the substrate in 20 minutes (Jones, Martin, & Hardy, 1978). Eggs can hatch in 4 to 7 days at

temperatures of 17.8°C to 20°C (Gilbert, 1989; Hildebrand & Schroeder, 1928), but may occur faster in warmer temperatures, which is more typical during the fall spawning season.

The yolk-sac larval stage is completed in about 6 to 12 days (Jones, Martin, & Hardy, 1978), or 8 to 10 days old (Kynard & Horgan, 2002) at which time the larvae move downstream to the rearing grounds (Kynard & Horgan, 2002). Downstream dispersal near the bottom lasts 6 to 12 days (Kynard & Horgan, 2002). Snyder (1988) listed yolk sac absorption occurring at 13-14 mm standard length or 6 to 7 days, and Hardy and Litvak (2004) state yolk is absorbed in 9 days at 21°C. As described in the literature, yolk sac larvae are expected to inhabit the same areas where they were spawned (Bain, Haley, Peterson, J.R., & Arend, 2000; ASMFC, 2012). Due to the collection of two yolk sac larvae in October 2015, this life stage should be considered vulnerable to entrainment for the purposes of this review.

Based on the above egg and larvae development information, it is estimated the yolk sac larvae collected on October 7 and 8, 2015 might have been spawned in late September. This is within the period of collected upstream migrating ripe adults and the estimated spawning period of September and October as described in the ITP Renewal Application. This is also in agreement with temperature data dropping below 25°C.

The estimated spawning season occurring from September to October is comparable in timing and duration to other systems. Based on telemetry data, adult Atlantic Sturgeon migrated upstream to suspected spawning sites in the upper Altamaha system in Georgia in early to mid-October, just 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, 2015). Tagged adult Atlantic Sturgeon arrived at the Weldon, NC spawning site between August 9 and September 3; and departed between September 18 and October 9. Spawning was confirmed through deployment of spawning pads where eggs were collected on September 18 and 20. Based on the literature reviewed above, it is estimated that early life-stage Atlantic Sturgeon would be entrainable by CPS CWIS for a period of 6 weeks. This includes the 3-week spawning period and 3 weeks for early life-stage larvae to mature to post yolk-sac larvae, or young-of-the year where they would have moved downstream and would no longer be entrainable by the CPS CWIS operations.

Based on the most recent information presented above, it is expected that in any given year, there is a 6-week period in the September-October timeframe when Atlantic Sturgeon larvae would be susceptible to entrainment by CPS CWIS operations.

The number of larval Atlantic Sturgeon that might be taken during the 10-year duration of the permit was estimated based on projected operation of the CWIS (i.e., approximately 50% of the CPS total DIF).

Table 3-2 provides a summary of the analysis. Based on this analysis, it was estimated approximately 10,949 Atlantic Sturgeon larvae would be incidentally entrained per year over the course of the 10-year ITP period and result in a total estimated incidental take of 109,490 larvae. Based on the 95 percent CI for the estimated interaction rate, the total estimated incidental take could be as low as 91,000 larvae or as high as 1,689,450 larvae. The limited number of entrainment samples collected during the estimated 6-week spawning period, the small volume

of water sampled during this period, the rare nature of Atlantic Sturgeon larvae having been collected at CPS, and the atypical river conditions under which the larvae were collected in October 2015 have likely affected the take estimate. In its December 2020 Section 10 Findings, NMFS confirmed that using 10,949 as the average annual estimated take with 1,820 and 33,789 sturgeon larvae as the lower- and upper-95 percent confidence interval of the estimate is "the best available information." That is still the case.

Table 3-2 Estimated Entrainment of Atlantic Sturgeon Larvae from Chesterfield Power Station Cooling Water Intake Operation

Parameter	Value
Time interval used to estimate interaction rate	September and October 2005; September and October 2015
Volume of water sampled (m^3)	15,103
Time interval for forecast	10-years
Interaction rate of monitoring program (larvae per m^3)	0.000132423
95 percent Confidence Interval for interaction rate	(0.000022013 – 0.000408657)
Estimated volume of water to be withdrawn at CPS CWIS over 6-week spawning period (m^3)	82,685,315
Estimated annual take for CPS CWIS operations (larvae)	10,949
Estimated take for CPS CWIS operations over 10-year period (larvae)	109,490
95 percent Confidence Interval for estimated take over 10-year period (larvae)	(91,000 – 1,689,450)

Though the incidental take of up to 10,949 Atlantic Sturgeon larvae annually may seem like a large number without context, it is important to view those numbers in the context of the fecundity of Atlantic Sturgeon. As noted above, the annual female spawning population in the James River is approximately 1,250 individuals. 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 J. , et al., 1996; Van Eenennaam & Doroshov, 1998; Gross, Repka, Robertson, Secor, & Van Winckle, 2002), although Balazik (2012) reported fecundities as high as 8 million eggs per spawning female per year. It is expected that a spawning population of 1,250 adult Atlantic Sturgeon would produce an estimate of 41,294,134 larvae in a given fall spawning season (Range = 41,264,367 to 43,074,900). Therefore, the incidental take of about 10,949 Atlantic Sturgeon larvae resulting from CPS entrainment would represent about 0.03 percent of the larvae produced annually by the estimated Atlantic Sturgeon spawning population in the James River. Dominion determined, and NMFS previously agreed, that this level of incidental take would not have a material impact on the James River Atlantic Sturgeon population. In its 2020 Section 10 Findings, NMFS stated, "the best available information is that the take will have only a minor impact on the survival and recovery of the Chesapeake Bay DPS because even in the worst case scenario, the take of up to 54,746 Atlantic Sturgeon larvae over the 5-year duration of the permit is a fraction of the eggs produced by even a single female in a single spawning year of a single spawning population belonging to the Chesapeake Bay DPS." NMFS Section 10 Findings at 12. In addition, NMFS stated in the December 2020 Environmental Assessment/ Finding of No Significant Impact (EA/FONSI) that "the proposed monitoring and mitigation measures … will provide new information about sturgeon populations that support improvements to future management and mitigation measures," and found that the monitoring

and mitigation set forth in the Conservation Plan would have "a positive impact on the survival of adult Atlantic sturgeon and on their offspring." See EA/FONSI at 21-22.

As described in Section 3.1, juveniles and subadults are unlikely to occur in the vicinity of the CPS CWIS and the potential for incidental take of juveniles and subadults is unlikely (i.e., the potential to occur is so low that it is discountable and not anticipated to occur). Therefore, no incidental take coverage for entrainment resulting from CWIS operation was requested for juvenile and subadult Atlantic Sturgeon.

Dominion is requesting that NMFS authorize the following incidental takes for the Chesapeake Bay DPS of Atlantic Sturgeon larvae:

- Up to 109,490 Atlantic Sturgeon larvae over the 10-year duration of the permit based on an average annual take of 10,949 (range 1,820-33,789) larvae per year as a result of entrainment during normal operation of CPS

3.1.2 Estimated Take of Atlantic Sturgeon Eggs from CWIS Operations

The method for take estimate of Atlantic Sturgeon eggs described below is consistent with that used to derive incidental take authorization in the issued ITP No. 21516-02.

As NMFS has observed, there is very limited data available to support an evaluation of the likelihood of future collection of Atlantic Sturgeon eggs. For Atlantic Sturgeon eggs to reach and become entrained at CPS, there would have to be extraordinary circumstances. This scenario potentially could occur if an Atlantic Sturgeon egg is 1) underdeveloped and potentially more buoyant than the typical demersal Atlantic Sturgeon egg; 2) diverted from reaching substrate after spawning due to river flows resuspending a portion of the eggs; or 3) dislodged from the hard substrate on the river bottom and suspended into the water column; in other words, the critical fluid motion of the river must prevent the eggs from settling and attaching to the substrate or overcome the adhesive force of the eggs bonded to the substrate. Additionally, Dominion recognizes that there may be other scenarios than the three scenarios outlined here. The likelihood of the first two scenarios is unknown and seemingly impossible to study in a natural setting which would limit the ability to predict the proportion of eggs naturally more susceptible to entrainment. Determining the likelihood of the third scenario would require infeasible empirical studies as neither the critical shear stress which would initiate dislodging of the eggs from the substrate nor the threshold river flow that could exert such force on the river bottom is known. Previously, a threshold river flow with a peak flow of 30,000 cfs was suggested as a key factor in determining possible egg entrainment periods, strictly based on the limited and best available information of observed collection of early-life stage (i.e., eggs and larvae) Atlantic Sturgeon at CPS. However, due to the later entrainment of eggs during normal river flow in 2022 and 2023 and the lack of information on the processes which would cause an egg to be entrained, Dominion decided to calculate its estimated take from available sampling data without consideration of river flow.

For ITP No. 21516-02, Dominion estimated the number of Atlantic Sturgeon eggs that might be taken from CWIS operations by calculating an Atlantic Sturgeon egg interaction rate. When

calculating this rate, Dominion tested several statistical scenarios that excluded different sampling periods, as including all data from 2005, 2015, 2021, 2022, and 2023 led to unlikely take estimates. Dominion determined that excluding all sampling data from 2022 and 2023, including the take of 42 eggs in 2022 and 11 in 2023, resulted in the most reasonable estimates. The Poisson model created by excluding these years had the highest significance among all other scenario alternatives.

Using this scenario, data from entrainment sampling conducted from September and October 2005, 2015, and 2021 was used to calculate an Atlantic Sturgeon egg interaction rate. During September and October 2005, 2015, and 2021, there were 30 sampling events totaling 133 subsamples (approximately 100 m^3 each) collected. Three Atlantic Sturgeon eggs were collected during the ITP entrainment monitoring in 2021, and no eggs were collected in any other 316(b) entrainment samples for these periods. This results in a mean interaction rate of $2.220850 X10^{-4}$ (95% CI $5.522990X10^{-5}$ to $5.758866x10^{-4}$). Table 3-3 provides a summary of the analysis for the number of Atlantic Sturgeon eggs that might be taken during the duration of the permit based on projected operation of the CWIS at approximately 50 percent of the CPS total DIF.

Table 3-3 Estimated Entrainment of Atlantic Sturgeon Eggs from Chesterfield Power Station Cooling Water Intake Operation

Parameter	Value
Time interval used to estimate interaction rate	September and October 2005, September and October 2015, September and October 2021
Volume of water sampled (m^3)	13,508
Time interval for forecast	10-years
Interaction rate of monitoring program (eggs per m^3)	0.00022209
95-percent Confidence Interval for interaction rate	($5.522990X10^{-5}$ to $5.758866x10^{-4}$)
Estimated volume of water to be withdrawn at CPS CWIS daily(m^3)	1,968,698
Estimated yearly take for CPS CWIS operations	18,363
Estimated take for CPS CWIS operations over 10-years	183,630
95 percent Confidence Interval for estimated take	(45,670-476,170)

Eggs are strongly adhesive and demersal and occur only on the spawning grounds attaching to the substrate in 20 minutes (Jones, Martin, & Hardy, 1978). Eggs can hatch in 4 to 7 days at temperatures of 17.8°C to 20°C (Gilbert, 1989; Hildebrand & Schroeder, 1928). This is expected to be shorter for warmer temperatures that may be more typical for the fall spawning cohort in the James River. Based on the above egg development information paired with the telemetry data from 2021, it is estimated that the eggs collected at CPS on September 25, 2021, were spawned within the 48 hours preceding collection at CPS (Balazik personal communication).

In this ITP Renewal Application, Dominion is requesting an estimated take of up to 18,363 eggs per year during normal operation of CPS over the duration of the permit, numbers in line with ITP No. 21516-02, issued on August 13, 2025. This is based on testing the Poisson model on all available data and not just the data on high-flow event days to find the most reasonable estimate.

Similar to the analysis above for the ecological effects of larval take, the incidental take of up to 183,630 Atlantic Sturgeon eggs over the course of 10-years may seem like a large number without context. First, eggs entrained at CPS would not be considered viable or likely to recruit to the

larval life stage (NMFS, 2021). Second, even if the eggs were considered viable, this level of incidental take would not have an ecologically relevant impact on the James River Atlantic Sturgeon population. As noted above, the annual female spawning population in the James River is approximately 1,250 individuals. 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 J. , et al., 1996; Van Eenennaam & Doroshov, 1998; Gross, Repka, Robertson, Secor, & Van Winckle, 2002), although Balazik (2012) reported fecundities as high as 8 million eggs per spawning female per year. A spawning population of 1,250 adult Atlantic Sturgeon would be expected to produce an estimate of 5,000,000,000 eggs in a given fall spawning season (Range = 500,000,000 to 10,000,000,000). Therefore, the incidental take of about 18,363 Atlantic Sturgeon eggs resulting from CPS entrainment would represent about 0.0004 percent of the eggs produced annually by the estimated Atlantic Sturgeon spawning population in the James River.

For these reasons, the estimated incidental take would not have an ecologically relevant impact on the James River Atlantic Sturgeon population. Furthermore, the estimate is conservative due to the extraordinary circumstances that would need to be present for an egg to reach the CPS CWIS and the assumption that all three eggs collected on September 25, 2021 were Atlantic Sturgeon eggs (also see Appendix A).

In sum, ITP No. 21516-02 allows for the incidental take of up to 18,363 Atlantic Sturgeon eggs per year during normal operation of CPS. The proposed incidental take in the ITP Renewal Application utilizes the previously NMFS approved incidental take number over a period of 10-years, resulting in a maximum incidental take allowance of 183,630 eggs over the duration of the permit.

3.2 No Estimated Impingement Resulting from CWIS Operations

Eggs and larvae are too small to be impinged as a result of CWIS operations. As discussed in Section 2.1.1, the swimming capabilities and habitat preferences of Atlantic Sturgeon post yolk sac larvae, juveniles/subadults and adults, should generally prevent Atlantic Sturgeon from being impinged at CPS. No Atlantic Sturgeon were collected in impingement samples collected intermittently between July 2015 and June 2019, or during prior impingement sampling at CPS conducted from June 2005 to June 2006 (EA, 2006) and January to December 1977 (VEPCO, 1977). Nevertheless, one adult Atlantic Sturgeon was collected with debris during trash rack maintenance in October 2015, and four adult Atlantic Sturgeon were found in the CPS Unit 5A trash racks in September 2018.

One possible explanation of the impingement collections involved the occurrence of particularly high river flows following severe storms that occurred during the periods leading up to the incidents, coupled with degraded intake guards. As discussed in more detail below, since the September 2018 collection, intake guards have been repaired to meet design criteria specifically designed to prevent adult Atlantic Sturgeon from entering the intakes.

Following the impingement event of adult Atlantic Sturgeon on September 22, 2018, Dominion completed an underwater survey of the intake guards that are the first of three structures intended

to prevent debris and organisms from entering the intake structure (Figure 3-1). Inside the intake guards are trash racks that prevent some debris and organisms from entering, followed by rotating traveling screens that exclude some smaller debris and organisms. During the survey it was discovered that most of the intake guards were degraded, and in one case missing. As a result of the survey, Dominion submitted an application to the USACE and Virginia Marine Resources Commission on February 8, 2019, to repair and/or replace the intake guards at CPS facility. As part of the intake guard renovations, the grid openings of the intake guards were designed to prevent the smallest adult male Atlantic Sturgeon in the James River from entering the intake structure. This reduced the grid openings from approximately 30.5-cm (12-in) on center to 20.3-cm (8-in) on center. The opening size was developed in coordination with Dr. Balazik and based on specimens collected as part of the VCU Atlantic Sturgeon research programs (Balazik personal communications).

Following the issuance of the USACE permit, intake guards for Units 3, 4, and 8 were removed and replaced. The Unit 5 and 6 intake opening was expanded to reduce water velocities and new intake guards were installed. A copy of the intake guard submittal to the USACE is provided in Appendix B of this document. The installation of intake guards in front of intake structures for Units 3, 4, 5, 6, and 8 was completed as of April 2019. The intake guard for Unit 7 did not need to be modified, as it met the new design criteria.

As noted above, there are three locations where impingement of organisms could occur at the CPS intakes: the intake guards, the trash racks, and traveling screens. Dominion has calculated the through-rack (or through-screen) velocities for the intake guards, trash racks, and traveling screens for each intake (Table 3-4, Figure 3-1).

Table 3-4 Summary of Intake Velocities for Intake Guards, Trash Racks, and Traveling Screens at Chesterfield Power Station

Intake Structure	Intake Velocity in feet per second (fps) based on Design Intake Flow				
	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
Approach to intake	0.79	0.84	1.01	0.74	0.67
Intake guards	1.07	1.12	1.35	0.85	0.88
Trash racks	0.51 – 1.13				
Traveling screens*	1.19	1.53	1.99	1.30	1.30
Note: *Assumed open area of 67.9 percent for a 3/8-inch mesh traveling screen					

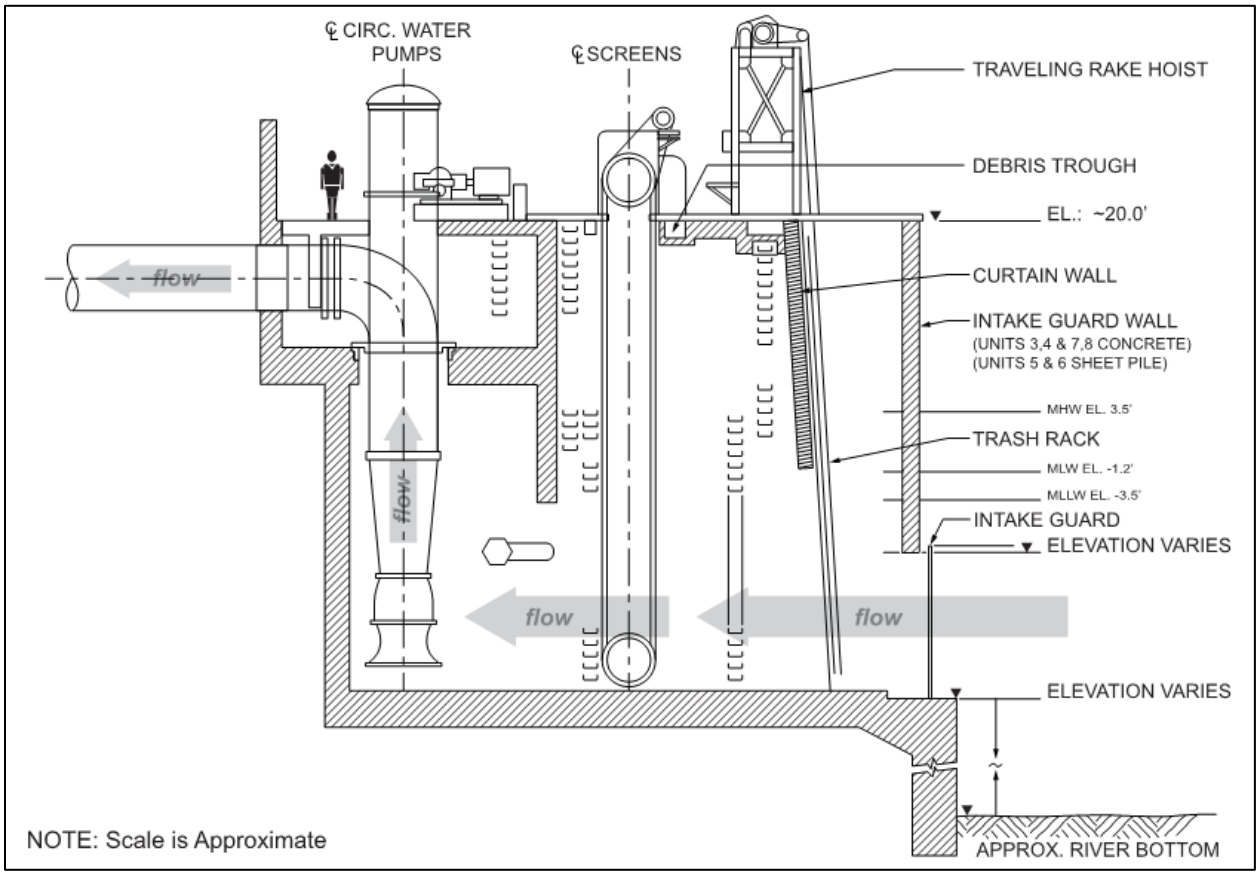

Figure 3-1. Typical Profile of Chesterfield Power Station Intake Structure

The intake velocities for intake guards, trash racks, and traveling screens (provided in Table 3-4), demonstrate that Dominion has ensured water velocities at the approach to the intake guards at CPS are less than the expected swimming speed of an adult Atlantic Sturgeon under normal river conditions. In addition, during high-flow conditions, the sweeping velocity of the ambient river would be greater than the approach or through-trash rack velocity, so it is more likely that organisms would be swept past, rather than being drawn into the CWIS. High-flow conditions also have the capacity to transport and disrupt significant quantities of debris from upstream locations, which may interact with the river bottom, thereby disturbing or dislodging benthic biota. Therefore, in the unexpected circumstance of an adult Atlantic Sturgeon approaching near the CPS CWIS, the adult Atlantic Sturgeon generally would be guided by the river's sweeping flow and capable of maneuvering against the intake approach velocities.

As described in Section 2.1.1, juvenile Atlantic Sturgeon inhabit the James River downstream of the CPS and subadults are known to use estuarine and coastal habitats, including extensive coastal migrations; thus, it is assumed that juvenile and subadult Atlantic Sturgeon are not likely to occur in the vicinity of the CPS (Hager, 2011; Balazik M. , 2012; Balazik & Musick, 2015). Additionally, subadults typically spend multiple years outside of their natal rivers on coastal migrations (Balazik M. , 2012).

Adult Atlantic Sturgeon may be susceptible to being impinged on the CPS intake guards or trash racks if they are damaged, unhealthy or exhausted from a stressful activity. In order for impingement to happen, an adult Atlantic Sturgeon must be overcome by the intake or approach velocity which is expected to be less than 2 fps and only exists when the CWIS is withdrawing water. Based on evidence summarized in Section 2.1.1 which demonstrated adult White Sturgeon are capable of critical swim speeds of up to 69.2-cm/s (2.27 fps) and Green Sturgeon are capable of up to 79.2-cm/s (2.6 fps), it is expected that healthy Atlantic Sturgeon adults would be capable of maneuvering against the intake approach velocities at the CPS intake. The intake guards are designed to prevent debris and large organisms, specifically adult Atlantic Sturgeon, from entering the intake structure. Indeed, monitoring in 2021 did not observe any impingement of Atlantic Sturgeon. That no Atlantic Sturgeon were observed in the trash racks during impingement monitoring for the duration of ITP No. 21516-02 indicates the intake guard design is successful in preventing impingement, even during high-flow events. For these reasons, no incidental take of Atlantic Sturgeon due to impingement is being requested.

To confirm that no take of Atlantic Sturgeon will occur, monitoring for impingement of Atlantic Sturgeon will be conducted at the traveling screens and trash racks of the operating CWIS (i.e., those withdrawing water) as noted in Section 6.1.3.

In its December 2020 Section 10 Findings, NMFS concluded that the best available information demonstrates that “pre- and post-spawned Atlantic Sturgeon will not be overcome by the intake velocities at CPS and, thus, will not be impinged. The best available information supports a conclusion that impingement is also unlikely for even post-spawned Atlantic Sturgeon that are migrating downriver during atypical high flow events and may have weakened swimming abilities,” NMFS Section 10 Findings at 4 (NMFS, 2020b). One dead and decomposing Atlantic Sturgeon was found floating in the Unit 6A intake bay on October 9, 2022, however this was determined to be unrelated to CPS operations, as there were no units or river circulating pumps in operation between October 1, 2022, and the date of discovery. Because this incident was unrelated to CPS operations, the assumption that Atlantic Sturgeon will not be impinged is still applicable. NMFS confirmed the 2020 conclusions in its August 2025 Section 7 Consultation Biological Opinion (NMFS, 2025).

3.3 Estimated Take for Clean Water Act 316(b) Entrainment Studies

The purpose of the CWA 316(b) sampling effort was to characterize entrainment and impingement associated with CPS operations. In response to the collection of one adult Atlantic Sturgeon at the trash rack and two larvae in CWA 316(b) entrainment samples in October 2015, Dominion stopped the sampling activities on March 2, 2016. In a letter dated April 20, 2018, NMFS advised that Atlantic Sturgeon larvae were unlikely to occur near CPS in the spring and early summer (NMFS, 2018). Following receipt of this letter, Dominion resumed and completed the CWA 316(b) sampling program in December 2020 after sufficient data was collected to provide 24 months of entrainment data at the CPS CWIS. No early-life stage Atlantic Sturgeon were collected during the remainder of the CWA 316(b) entrainment sampling activities after the resumption of the field sampling in May 2018 and conclusion in December of 2020. Dominion submitted the final CWA 316(b) package to VDEQ on September 30, 2021.

If additional CWA 316(b) studies are required by VDEQ during the duration of the ITP, it would not result in additional incidental take of Atlantic Sturgeon. The water sampled by the 316(b) studies is a subset of the water entrained by the CWIS described in Section 3.3, therefore no additional take is requested.

3.4 No Anticipated Take from Exposure to Constituents and Thermal Plume

As described in the ITP Renewal Application, all discharges are regulated according to VPDES Permit VA0004146; discharge limits are in compliance with CWA Section 303(d) with respect to TMDL for the receiving water body; the Main Channel of the James River, a Category 5D water body, meaning the Water Quality Standard is not attained; and where TMDLs for a pollutant(s) have been developed.

Although Atlantic Sturgeon might be exposed to increased water temperatures from the cooling water discharge, temperatures in the discharge area are expected to remain within the temperature tolerance range recorded for Atlantic Sturgeon rearing and spawning. Water temperatures measured in the mainstem of the James River, as well as the lower Farrar Gut and Jones Neck oxbow stations during the fish sampling for the CWA 316(a) demonstration study in May of 1997 and October 1997 (Atlantic Sturgeon spawning seasons) ranged from 17°C to 21°C and 18°C to 22°C, respectively, in the mainstem of the James River. These temperatures are within the temperature tolerance range reported for Atlantic Sturgeon spawning (13–26°C). Moreover, Dominion's 2020 CWA 316(a) Demonstration Update Study reflected that the retirement of Units 3 and 4, 5, and 6 from generation reduces the overall heat rejection from CPS. The CWA 316(a) Demonstration Update Study included 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 the thermal discharges from CPS: (1) maximum permitted heat rejection limits for Units 5, 6, 7, and 8, and (2) at permitted maximum heat rejection limits for only Units 7 and 8, which is the current configuration since the retirement of Units 5 and 6 from generation. The study concluded that during spring and fall, when most migrations take place, temperatures were not predicted that would create a barrier for Atlantic Sturgeon attempting to reach or return from spawning grounds in the mainstem of the James River (Normandeau Associates, Inc., 2020).

Consequently, discharges are not expected to adversely affect Atlantic Sturgeon. Indeed, NMFS evaluated potential impacts of thermal discharges in the December 2020 EA/FONSI and reasonably determined that thermal discharges will not result in the incidental take of Atlantic Sturgeon (See EA/FONSI). The potential for incidental take is unlikely (i.e., the potential is so low that it is discountable and not anticipated to occur); and, therefore, no incidental take coverage is being requested for exposure to constituents or thermal plume.

3.5 No Anticipated Take from Dredging

As more fully discussed in Section 2.1.3, periodic dredging is necessary to remove accumulated sediment and debris in the vicinity of the CPS CWIS and barge loading/offloading slip to allow for reliable and efficient generation of electricity. CPS dredged up to 10 cy of material in front of the

CWIS in 1990 to facilitate removal of accumulated sediments. CPS 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 (sf) through 2013. Sediment has been and would continue to be removed using dragline dredges and transferred to trucks for disposal at an upland facility to prevent the sediment from re-entering the waterway (Dominion Resources Services, Inc., 2003).

Periodic maintenance dredging is also necessary within the barge slip located northwest of the CPS. CPS has been permitted to dredge up to 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. Dredging in the barge slip is accomplished via hydraulic cutterhead or mechanical bucket methods with direct transfer to trucks for disposal. (Dominion Resources Services, Inc., 2003).

Because Atlantic Sturgeon are only present near CPS during spring and fall spawning seasons and Dominion, will abide by the time of year restrictions to protect the Atlantic Sturgeon included in the station's dredging permits, Atlantic Sturgeon are not expected to be exposed to the potential impacts of dredging activities. Therefore, incidental take of Atlantic Sturgeon as a result of dredging activities is unlikely (i.e., the potential is so low that it is discountable and not anticipated to occur) and no incidental take coverage is requested for dredging. If dredging activities are needed within the spawning season, which is unlikely, Dominion will conduct monitoring as described further in Section 6.3 of this Conservation Plan to consider whether such as dredging would impact Atlantic Sturgeon.

3.6 No Anticipated Take from Vessel Movements

As discussed in Section 2.1.6, CPS accepts two to three barge deliveries of fuel oil per year. The barges depart from a variety of locations, so the focus is on their movement from the mouth of the James River upriver to CPS.

There has been some concern about the number of Atlantic Sturgeon that have been struck and killed by interactions with vessels in the tidal freshwater portion of the James River. For example, between 2007 and 2010, researchers documented 31 carcasses of adult Atlantic Sturgeon in this portion of the river. Twenty-six (84%) of those carcasses had gashes from vessel propellers. Most (84%) of the carcasses were found in relatively narrow reaches of the river, such as at Jones Neck Cutoff and Turkey Island Cutoff, that are adjacent to known sturgeon congregating areas (Balazik M. , et al.). The primary risk factors identified are propeller strikes and propeller entrainment (for example, see Gutreuters et al. (2003) who discuss the risks of propeller entrainment of sturgeon on the Mississippi River).

Based on the data available, most ship strikes of sturgeon on the James River appear to be linked to maneuvering of deep-draft vessels through bends in the navigational channel. Male Atlantic Sturgeon have been found to spend 62% of their time within 1 meter of the river bottom, making interactions with shallow-draft vessels, such as the vessels used at CPS, rare (Balazik M. , et al., 2012). A fully loaded barge used for a delivery at CPS would provide a minimum of 14 feet of below keel clearance during upriver transits, and a minimum of 23 feet of below keel clearance on the downriver transits. Actual clearances would generally be deeper in those reaches where shoaling is less prevalent and where the natural channel depth exceeds the project area depth.

Because of their shallow draft and relatively slow speeds, vessels headed to and from CPS are not likely to take Atlantic Sturgeon while in the navigation channel. For these vessels, the greatest risk of propeller strikes would occur during docking/undocking maneuvers at the CPS barge slip. However, because adult Atlantic Sturgeon — the life stage at greatest risk of being struck by a vessel — tend to remain in the navigation channel or adjacent shoals, Atlantic Sturgeon are not expected to be taken during these docking/undocking maneuvers. That is, the potential for incidental take is considered unlikely (i.e., the potential is so low that it is discountable and is not anticipated to occur) and, therefore, no incidental take coverage is requested for vessel movement.

3.7 No Anticipated Take from Shoreline Maintenance

Shoreline and structure maintenance has the potential to result in noise and turbidity effects on Atlantic Sturgeon. However, because Atlantic Sturgeon are only present near CPS during spring and fall spawning seasons, Dominion proposes to avoid shoreline maintenance during these periods. As a result, incidental take of Atlantic Sturgeon is not expected to occur as a result of shoreline maintenance activities. That is, the potential for incidental take is expected to be unlikely (i.e., the potential is so low that it is discountable and not anticipated to occur) and, therefore, no incidental take coverage is requested for shoreline maintenance activities. Nonetheless, as described in Section 6, monitoring will be conducted to provide additional information on potential sturgeon interactions during shoreline maintenance.

3.8 Assignment of Take to Atlantic Sturgeon DPS

It was assumed that Atlantic Sturgeon eggs and/or larvae entrained incidental to CPS CWIS operations would represent individuals from the James River spawning population of the Chesapeake Bay DPS because it is the only population that is known to spawn in the James River.

Because individuals from the five different listed populations of Atlantic Sturgeon occur in the Chesapeake Bay, it was assumed that adult Atlantic Sturgeon in the James River spawning grounds could belong to any one of those five listed populations, but are most likely to represent the Chesapeake Bay DPS (Damon-Randall, Colligan, & Crocker, 2013). According to Damon-Randall et al. (2013) at least 92 percent of the sturgeon in the spawning region of the James River are from the Chesapeake Bay DPS and that the remaining 8 percent could be from any of the other four DPS. However, because of its upriver location (approximately river mile 82 [rkm 132]), it is expected that adult Atlantic Sturgeon would only occur near CPS to spawn. Therefore, it is assumed that any adults impinged at CPS during spawning season would be from the Chesapeake Bay DPS.

3.9 Impacts of the Take on Atlantic Sturgeon

Dominion estimates that CPS CWIS operations will result in the entrainment of a total estimated take of 183,630 eggs and/or 109,490 larvae over the course of the 10-year ITP permit.

As noted above, eggs entrained at CPS would not be considered viable or likely to recruit to the larval life stage (NMFS, 2021). Even if they were considered viable, Dominion does not believe

that this level of incidental take would have an ecologically relevant impact on the James River Atlantic Sturgeon population. The reported number of eggs an individual female can produce when they spawn ranges from 400,000 to 4 million eggs per spawning year (Boreman, 1997; Van Eenennaam J. , et al., 1996; Van Eenennaam & Doroshov, 1998; Gross, Repka, Robertson, Secor, & Van Winckle, 2002), although Balazik (2012) reported fecundities as high as 8 million eggs per spawning female per year. Per Balazik (2019a), the annual female spawning population in the James River is estimated to be approximately 1,250 individuals which, based on an assumed spawn of 4,000,000 eggs each, produce approximately 5 billion eggs per year. The loss of about 18,363 eggs over the September-October spawning season would represent only 0.0004 percent of the eggs produced annually by this spawning population. The overall percentage of eggs to survive to become larvae, and larvae to become juveniles is very small due to natural mortality.

To illustrate this and the proportional impact on larvae recruitment, a conceptual model was constructed assuming that CPS only interacts with Atlantic Sturgeon from the Chesapeake Bay population (although Dominion recognizes that adult Atlantic Sturgeon in the James River could represent other populations). Dominion was unable to locate life history models for Atlantic Sturgeon or other species of sturgeon that estimated the probability or proportion of eggs that would be expected to survive to the larval stage. However, Caroffino et al. (2010) published data on egg-to-larval and larval-to-age-0 juvenile survival for Lake Sturgeon which were used to estimate mortality and survival rates for the egg and larval stages: mean egg-to-larval mortality in their study was 99.17 percent (95% CI = 99.14 to 99.17%) while mean larval-to-age-0 juvenile mortality was 94.36 percent (95% CI = 90.62 to 95.43). These mortality estimates are within the general range of estimates other authors have published for other species of sturgeon (Gross, Repka, Robertson, Secor, & Van Winckle, 2002; Duong, et al., 2011; Jarić, Gessner, & Lenhardt, 2015).

If these mortality rates were applied to the previous estimates of eggs that might be produced in a year, it would be expected that a spawning population of 1,250 adult sturgeon would produce approximately 41,294,134 larvae in a given fall spawning season (95% CI = 41,264,367 to 43,074,900). If 10,949 larvae were lost in a year as a result of entrainment from CPS CWIS this would represent 0.03 percent of the larvae that might occur in the James River in that year. These estimates treat potential entrainment at CPS as a risk factor that would have been captured in the literature-derived mortality estimates.

Dominion also considered the possibility that entrainment at CPS represents an additional risk factor for Atlantic Sturgeon larvae in the James River by subtracting the mean number of larvae that might be entrained at CPS from the larval abundance estimates produced by life history table models. To capture the potential effect of this reduction, the effect of larval losses associated with CPS operations on the number of age-0 sturgeon in the population was estimated. This spawning population would produce between 1,883,944 and 4,039,630 Age 0 juveniles. Thus, reducing the number of larvae in a spawning population by 10,949 might reduce the number of age-0 juveniles by an average of 618 (95% CI Range = 509 to 1,008) or between 0.02 and 0.03 percent of the Age-0 juveniles that might occur in the population in any given year. Extending these estimates over the 10-year term of the ITP permit – these very minor losses should not have measurable

individual or cumulative effect on the size, reproductive potential, or growth of Atlantic Sturgeon in the James River population.

Recent analyses of catch rates of Atlantic Sturgeon spawning in the fall suggest that the adult population of James River spawning population has increased in numbers into the thousands of individuals rather than the 300 which were the best available information used in the analysis above (Hilton, Kynard, Balazik, Horodysky, & Dillman, 2016; Balazik M. , 2019a) . The calculations presented above represent Dominion's estimate based on limited data collected at the CPS from 2005, 2015, and 2021 entrainment samples. The implementation of the Renewed Conservation Plan will provide the necessary data to further characterize entrainment at the CPS facility. Dominion would not expect reductions of this small magnitude to have ecologically meaningful effect on the abundance, growth, or viability of the James River spawning population of Atlantic Sturgeon.

In the December 2020 EA/FONSI that was issued with the original ITP, NMFS determined that issuance of the ITP authorizing incidental take of Atlantic Sturgeon associated with CPS operations and sampling "will not significantly impact the quality of the human environment." Modification of the ITP to authorize incidental take of Atlantic Sturgeon eggs likewise was stated to "not jeopardize the continued existence of the Chesapeake Bay DPS of Atlantic Sturgeon…is not likely to adversely affect the James River critical habitat unit for the Chesapeake Bay DPS" (NMFS, 2025). The proposed incidental takes in the current proposal would not result in significant impacts and therefore would not alter NMFS' conclusion with respect to the ITP. These conclusions from the original and modified ITP remain relevant and valid to support the renewal of the ITP and Conservation Plan.

4 Mitigation Strategy

4.1 Background

The Conservation Plan that was submitted for Permit No. 21516-02 considered several avoidance, minimization, and mitigation measures for Atlantic Sturgeon while balancing those efforts against the limited understanding of Atlantic Sturgeon biology, ecology, population dynamics, and of the specific stressors that cause Chesapeake Bay DPS of Atlantic Sturgeon to be threatened. Following a comprehensive review of potential mitigations, Dominion Energy has identified three mitigation efforts to avoid, minimize, and mitigate the take of Atlantic Sturgeon in the James River. The mitigation strategy for this Conservation Plan is designed to continue to build on the success of those implemented avoidance, minimization, and mitigation measures by building upon what was learned from these measures and by Atlantic Sturgeon researchers through the terms of Permit No. 21516 and Permit No. 21516-02. Knowledge gaps still exist that make it difficult to identify additional specific measures that can be taken to benefit this species without creating additional risks. With reference to the James River, fundamental knowledge gaps still persist regarding population size and age structure, specific locations and extent of viable spawning habitat, sex ratios of spawning cohorts, natural mortality and growth rates of early life stages, timing and pathways of larval and juvenile stage migrations, and habitat and environmental requirements. Similar knowledge gaps are present for almost all populations and

subpopulations of Atlantic Sturgeon, which severely constrains recommendations based on populations outside of the James River or Chesapeake populations.

The mitigation strategy proposes measures 1) to avoid and minimize take by avoiding certain activities during the currently understood spawning seasons, 2) monitoring to confirm take estimates, and 3) research to continue filling in identified knowledge gaps.

Benefit to the species can potentially be accrued by filling knowledge gaps, thereby benefitting the conservation and recovery of the species by allowing better informed and tailored decisions regarding protection and conservation of Atlantic Sturgeon. Section 4(f)(1) of the ESA requires that NMFS develop and implement recovery plans for the conservation and survival of endangered species and threatened species listed pursuant to this section (unless a plan would not promote the conservation of the species). Recovery plans should include a description of site-specific management actions necessary to achieve the plan's goal for the conservation and survival of the species; objective, measurable criteria to determine that the species can be removed from the endangered or threatened list; and estimates of the time required and the cost to carry out the measures to achieve the plan's goal. In this case the listed species is defined as the Chesapeake Bay DPS.

Currently, the recovery plan for the Atlantic Sturgeon Chesapeake Bay DPS is in the development phase. NOAA has released an interim recovery outline that provides guidance for recovery efforts. The plan suggests further research and increased monitoring on distribution and abundance, vessel strikes, climate change effects, and bycatch (NOAA Fisheries, 2018). Several opportunities exist to participate in ongoing research related to the topics covered in the recovery outline as well as expand cooperation among stakeholders with vested interests in preserving Atlantic Sturgeon in the James River. Coordination of future monitoring efforts at CPS, including studies directed in conjunction with sturgeon movement within the James River is one example. Monitoring efforts can contribute to the knowledge of threats to the Chesapeake Bay DPS. Researchers and resource managers identified several data gaps relating to threats on Atlantic Sturgeon, such as system-specific information on the effects of dredging, river-specific threats, and the impact of blue catfish as a predator (NMFS and USGS, 2016).

In issuing ITP No. 21516-02, NMFS stated that Dominion's ITP application and Conservation Plan contain measures to avoid and minimize impacts to, the Chesapeake Bay DPS of Atlantic Sturgeon. NMFS concluded that "Dominion's Conservation Plan measures will, to the maximum extent practicable, minimize and mitigate the impacts" of the authorized incidental take. NMFS Section 10 Findings at 13 (NMFS, 2020b). This continues to be the case for this Conservation Plan.

4.2 Biological Goals and Objectives

The goals of this Conservation Plan are to:

1. Confirm incidental take estimates in Section 3. If monitoring indicates that take, or the probability of take, is underestimated, Dominion will work with NMFS to determine what additional measures could be implemented to protect the species (as described in Section 5). The monitoring and associated research would also contribute to filling

knowledge gaps pertinent to threats on the James River component of the Chesapeake Bay DPS. Section 4.3 describes the measures that will be implemented to achieve this goal.

2. Aid in the conservation of Atlantic Sturgeon Chesapeake Bay DPS by supporting two ongoing research initiatives that would increase knowledge of Atlantic Sturgeon in the James River. The first is to build on the existing knowledge of genetic structure of cohorts spawning in the James River. The Chesapeake Bay DPS Survey by VIMS for the James, York, Rappahannock (JYR) and James River (J) Spring cohorts started in 1998 and terminated in 2019. Research recommendations per the Atlantic States Marine Fisheries Commission include expanding and improving the genetic stock definitions of Atlantic Sturgeon, including developing an updated genetic baseline sample collection at the coast-wide, DPS, and river-specific level for Atlantic Sturgeon, with the consideration of spawning season-specific data collection.

   The possibility of improved modeling in next benchmark (2028) with maintained or increased tagging network:

   - Include covariates and
   - Use finer temporal or spatial resolution

The second is to characterize tagged Atlantic Sturgeon spatial and temporal use of the upper tidal portion of the James River. As described in Section 4.4, both of these initiatives would provide information to enhance future conservation and recovery.

4.3 ITP No. 21516-02 Conditions to Avoid, Minimize, and Mitigate Unavoidable Impacts

Dominion will continue to implement the following permit conditions from ITP No. 21516-02 to avoid, minimize and mitigate impacts to Atlantic Sturgeon during the 10-year permit period.

1. Avoidance Measures

Dominion will annually inspect (i.e., by divers) the intake guards at each CPS CWIS no earlier than March 1 and no later than August 15 to confirm that the guards are intact and capable of excluding any adult Atlantic sturgeon as designed. Dominion will make repairs to the guards, as needed, prior to September 1. For additional details on the intake guards refer to Section 4.4.1.

2. Minimization Measures

Cooling water intake trash racks (and the immediate area upstream) will be inspected visually during daylight hours at least once per each 12-hour shift from September 1 through October 31 to ensure that there are no impinged adult Atlantic Sturgeon. For additional impingement monitoring details refer to Section 6.1.3.

Results from the “Sturgeon Movement Research” and “Digital Holography” studies will be used to better define the Atlantic sturgeon spawning season and will be used by Dominion to plan and implement routine maintenance outages, when practicable, to coincide with peak larval

abundance periods - thereby minimizing the incidental take of Atlantic sturgeon eggs and larvae by entrainment. See below for additional details on those studies.

3. Mitigation Measures

Dominion will mitigate the impacts of taking sturgeon eggs and larvae by entrainment through the advancement of science and support of the Genetic Relationship Research, Sturgeon Movement Research and Digital Holography studies. For additional details regarding these studies refer to Sections 4.5.1, 4.5.2 and 4.5.3 respectively.

4.4 Measures to Avoid and Minimize Take

4.4.1 Cooling Water Intake

There are three locations where impingement of organisms could occur at the CPS intakes: the intake guard, the trash racks, and the traveling screens. As described in Section 3.2, following the impingement event of adult Atlantic Sturgeon on September 22, 2018, Dominion completed an underwater survey of the guards which are the first of three structures that are intended to prevent debris and organisms from entering the intake structure. During the survey it was discovered that most of the intake guards were degraded, and in one case missing. As a result of the survey, Dominion initiated a program to repair and/or replace the intake guards at CPS facility that would further minimize the chance for incidental take of Atlantic Sturgeon due to impingement. As part of the intake guard renovations, the grid openings of the intake guards were designed to prevent the smallest adult male Atlantic Sturgeon in the James River from entering the intake structure. This reduced the grid openings from approximately 12 inches on center to 8 inches on center. The opening size was developed in coordination with Dr. Balazik and, based on specimens collected as part of the VCU Atlantic Sturgeon research programs (Balazik personal communication).

As a result of the program, intake guards for Units 3, 4, and 8 were removed and replaced. The Unit 5 and 6 intake opening was expanded to reduce water velocities and new intake guards were installed. The installation of intake guards in front of intake structures for Units 3, 4, 5, 6, and 8 was completed as of April 2019. The intake guard for Unit 7 did not need to be modified, as it met the new design criteria.

The addition of the intake guards was intended to prevent debris and large organisms, specifically adult Atlantic Sturgeon, from entering the intake structure. For this reason, no incidental take of Atlantic Sturgeon due to impingement is being requested. Dominion monitors the trash racks and traveling screens at operating CWIS (i.e., those withdrawing water) to confirm that take does not occur as described in Section 3.3. Monitoring of the trash racks for impingement of Atlantic Sturgeon is noted in Section 6.1.3. Monitoring at the intake guards while the CWIS is active is not practicable due to a lack of access to the intake guard wall to safely set up and deploy equipment to monitor for impingement. In addition, the normal turbidity of James River water makes visual observation below the surface ineffective at the intake guards. For these reasons, and because no impingement is expected, no monitoring is proposed at the intake guards during CWIS

operations. For a description of intake guard monitoring as required by Permit 21516-02 and proposed by Dominion for this ITP renewal please refer to Section 4.3.2.

In issuing ITP No. 21516-02, NMFS concluded, “based on the best available information, Dominion’s minimization measures will reduce the risk of impingement for adult sturgeon at CPS to zero.” NMFS Section 10 Findings at 11. NMFS also concluded that “Dominion’s Conservation Plan measures will, to the maximum extent practicable, minimize and mitigate the impacts of taking 54,746 Atlantic Sturgeon larvae over the 5-year duration of the permit.”

It is expected that measures outlined in this Conservation Plan will continue to minimize and mitigate the impacts of take over the 10-year duration of the permit.

As described in Section 2.1.2, the CWA 316(b), entrainment and impingement sampling was needed to characterize the entrainment and impingement cooling water intake. As described in Section 5.2.1 of the ITP Renewal Application, 24 months of CWA 316(b) sampling program have been completed with no additional early-life stage Atlantic Sturgeon collected. Dominion submitted the final VPDES permit renewal package to VDEQ on September 30, 2021. VDEQ is currently reviewing.

4.5 Measures to Mitigate Unavoidable Impacts

Although estimated rates of take by the span of activities at CPS are small, any degree of unavoidable take must be mitigated to offset impacts of the taking. Adopted measures should have a substantial probability of success. Because almost all species of sturgeon worldwide have experienced declines due to multiple stressors, such as habitat loss and degradation, over-fishing and by-catch, impaired water quality, migration barriers, and water diversions, significant international attention by fishery resource managers has been focused on conservation strategies. Sturgeon conservation strategies have been examined for many species of sturgeon, including Atlantic Sturgeon (Beamesderfer & Far, 1997; Saura & Faria, 2011). As stated in Section 4.2, one of the objectives of this Conservation Plan is to collaborate with researchers to fill in data gaps identified by fisheries managers that will promote the management of and conservation strategies for Atlantic Sturgeon.

Collaborative studies targeting prioritized knowledge gaps meaningfully contribute to better informed conservation efforts. Important knowledge gaps with respect to assessing risks include identifying the genetic signature of Atlantic Sturgeon spawned in the James River and identifying the temporal and spatial patterns of Atlantic Sturgeon in proximity to the cooling water intakes. Collaboration with researchers to fill in these data gaps could lead to better understanding of factors that relate to risk for both early and later life stages, as described in Sections 4.5.1 and 4.5.2, respectively.

The research proposed in this Conservation Plan would contribute to filling the numerous and critical knowledge gaps that persist related to a basic understanding of Atlantic Sturgeon biology, ecology, and population dynamics. As described in the subsequent paragraphs, the results could contribute to future stock assessments and recovery plans, which would be instrumental in defining objective, measurable criteria to determine that the Chesapeake Bay DPS has recovered.

The mitigation measures proposed by Dominion were designed while taking into account the large degree of uncertainty associated with some potential mitigation measures, the large degree of uncertainty associated with the Atlantic Sturgeon's life history in the James River and are commensurate with the estimated take. The impacts of taking Atlantic Sturgeon eggs and larvae by entrainment will be mitigated through the implementation and results from these two studies.

The Atlantic States Marine Fisheries Commission (ASMFC) manages Atlantic Sturgeon through Amendment 1 to the Interstate Fishery Management Plan for Atlantic Sturgeon and its associated Addenda I-IV, with the goal of stock recovery. ASMFC issued a moratorium on fishing for Atlantic Sturgeon in state waters in 1998 and NMFS followed with a similar moratorium for Federal waters. Amendment 1 to ASMFC's Atlantic Sturgeon Fishery Management Plan also includes measures for preservation of existing habitat, habitat restoration and improvement, monitoring of bycatch and stock recovery, and breeding/stocking protocols (ASMFC, 2025). Scientific stock assessments are critical to fisheries management. Stock assessments describe past and current status of a fish population and stock and make predictions about stock size and how a stock would respond to management measures. Addendum IV of Amendment 1 of the Atlantic Sturgeon Fishery Management Plan identifies research needs for the management of the stock (ASMFC, 2012). While the ASMFC updated the stock assessment for Atlantic Sturgeon in 2024, data collected under this Conservation Plan can contribute to future stock assessments (ASMFC, 2024).

4.5.1 Genetic Relationship Research

As recently as 2024 ASMFC identified further genetic studies as a high priority – "Expand and improve the genetic stock definitions of Atlantic sturgeon, including developing an updated genetic baseline sample collection at the coast-wide, DPS, and river-specific level for Atlantic sturgeon, with the consideration of spawning season specific data collection" (ASMFC, 2024). Dominion is proposing to provide any entrained egg and larvae specimens to determine the genetic signature of James River-spawned Atlantic Sturgeon. This will help to fulfill this identified data gap. Genetic screening of any egg or larvae take during entrainment will assist in species confirmation of the take, adding a secondary measure to assist in confirmation of any incidental take during scheduled entrainment monitoring. The genetic information is being pursued in collaboration with Atlantic Sturgeon researchers on the James River who have indicated that additional information and data derived from genetic testing can potentially be used to: calculate effective population size; provide information on stock mixing in the upper river; and identify the periodicity of Atlantic Sturgeon spawning, location of spawning activity, and age and growth of early life stages (personal communication with Mr. Albert Spells [USFWS]).

The monitoring and mitigations implemented as part of ITP No. 21516-02 have shown that the James River supports a viable fall spawning population of Atlantic Sturgeon. For example, one year old juvenile sturgeon (40-41 cm) were collected in the Hopewell area, providing evidence of successful spawning and recruitment, although the precise location of the spawning habitat remains unknown (personal communication with Dr. Matthew Balazik [USACE]). The confirmed evidence to date of the presence of early-life stage Atlantic Sturgeon near CPS was the collection of two yolk sac larvae in the CPS CWA 316(b) entrainment sampling efforts in October 2015, three Atlantic Sturgeon eggs collected during ITP entrainment monitoring in September 2021,

forty-two Atlantic Sturgeon eggs collected on September 26, 2022, eleven eggs collected on September 26, 2023 and one egg collected on September 10, 2025. Genetic analysis of the yolk sac larvae from the 2015 collection was not possible as they were preserved in formalin per study plan protocol (Dominion, 2016), which damages genetic material. The genetic analysis of the three 2021 Atlantic Sturgeon eggs resulted in a confirmation of one egg as an Atlantic Sturgeon egg using the microsatellite screening protocol; however, the DNA contained in the other two eggs collected did not amplify enough to produce a result (South Carolina Department of Natural Resources (SCDNR), 2021). Of the forty-two eggs sent for testing in 2022, only thirty-six were able to be used for DNA extraction. While none of these eggs produced sufficient DNA for the microsatellite panel, a secondary qPCR assay was used that was developed for a non-related eDNA screening protocol (SCNDR, 2022). Using this protocol that utilizes mitochondrial DNA, all 36 eggs were able to be confirmed as Atlantic Sturgeon eggs. From the 11 eggs collected in 2023, only one amplified enough using the microsatellite protocol to indicate that it may have been a fertilized egg (SCDNR, 2024). From the one egg collected in 2025, genetic analysis has not yet been completed. Genetic analysis of James River stocks in the form of evaluation of specific mitochondrial DNA markers would identify the genetic signature of Atlantic Sturgeon known to spawn in the James River (Waldman, Grunwald, Stabile, & Wirgin, 2002; Wirgin, et al., 2012; Fritts, Grunwald, Wirgin, King, & Peterson, 2016; White, Johnson, Lubinski, Eackles, & Kazyak, 2023). It would also help to further investigate the genetic distinction of spring and fall spawning stocks.

In terms of a conservation benefit for the James River Atlantic Sturgeon, genetic characterizations could provide insights into optimal recovery strategies (Waldman & Wirgin, 1998; Waldman, Grunwald, Stabile, & Wirgin, 2002). For example, there is a likelihood that sturgeon spawning in different tributaries are genetically distinct. The recent discovery of a fall spawning cohort also points to the potential distinctions between spring and fall spawned recruits. Research indicates that fall and spring fish in the Edisto River, South Carolina are genetically distinct, with potentially greater differentiation between fall and spring Edisto River populations than across the river population (Farrae, Post, & Darden, 2017). Not only could genetic characterizations yield insights into the potential for the viability of inter-basin transfer of sturgeon to provide a stable genetic population to offer the best opportunities for recovery, but this information could provide information on complicated stock structure and inform future stock assessments (e.g., river/season specific analysis as identified by fisheries managers (NMFS and USGS, 2016). Genetic information for eggs and larvae can be used to determine the true genetic signature for Atlantic Sturgeon spawning population in the James River. Furthermore, genetic data on early life stages (eggs, larvae and juveniles) is needed to support a statistical analysis of effective population size (personal communication, Mr. Albert Spells [USFWS]). For larger sturgeon, genetic data can be used for an upriver mixed stock analysis, assuming fish from other rivers might migrate upriver. As described above, stock assessments would be instrumental in defining objective, measurable criteria to determine the Chesapeake DPS recovery status.

Dominion has provided any collected specimens of entrained Atlantic Sturgeon eggs and/or larvae to the James River researchers and proposes to continue this practice. Dominion would preserve the specimens following protocols established to prevent damage to the genetic materials and notify NMFS and any previously approved stakeholders for final disposition of salvage specimens. Dominion would support handling and processing of any specimens and the

conduct of appropriate genetic analyses at an approved laboratory. The disposition of “salvage specimens” requires careful documentation under the ESA. The transfer of any Atlantic Sturgeon specimens to the NMFS or researchers for genetic testing would further research on the genetic relationships of early-life stages occupying the James River and support filling knowledge gaps related to genetics or other aspects of life history.

Dominion proposes to further this genetic relationship research through the duration of the proposed 10-year ITP to maintain genetic confirmation of any incidental take of putative early-life staged Atlantic Sturgeon during permit required entrainment monitoring. This genetic data will continue to be used for genetic confirmation as well as use to enhance the knowledge base of the fall spawning Atlantic Sturgeon population by characterizing the genetics at defined microsatellite loci to elucidate genetic diversity of the early-life stages.

4.5.2 Sturgeon Movement Research

Adult Atlantic Sturgeon move throughout the James River between its confluence with the Chesapeake Bay and the upriver terminus of tidal freshwater influence. Historically, Atlantic Sturgeon may have occupied the river up to Boshers Dam below the City of Richmond (Bushnoe, Musick, & Ha, 2005). Data describing these movements in recent years have been collected by the James River Sturgeon Partnership through long-term deployment and maintenance of an array of passive acoustic receivers at multiple points along the river. The receivers are strategically placed to form “gates” through which acoustically tagged Atlantic Sturgeon are detected. Through partnership between VCU and Dominion starting in early 2019, two VEMCO Live monitors (real-time acoustic telemetry instruments) were installed on United States Coast Guard daymarkers, R-152, 2km downstream of CPS in 2019 and G-155A, 1km upstream of CPS in 2020. VCU and Dominion initiated a research agreement in 2021 to proactively monitor acoustic tagged adult Atlantic Sturgeon in the James River with adequate coverage near CPS during the fall spawn for the permit duration of ITP No. 21516. As of 2025, 5 additional VEMCO live receivers are currently active which are stationed throughout the James River to assist in monitoring including Presquile, Rice Center (R98), Sturgeon Point, Jamestown Ferry Light, and R40. These real-time monitoring stations will be used to inform CPS station operations and to further confirm the presence of tagged Atlantic Sturgeon moving upriver and in the vicinity of the CPS facility. This data will be accessible to Dominion to correlate Atlantic Sturgeon movements with results of entrainment sampling as well as the start and end of impingement monitoring requirements. The data will also aid VCU in their research relating to Atlantic Sturgeon movements and spawning periods during the fall in the James River.

Atlantic Sturgeon captured in the James River since 2009 have been released with acoustic tags. The capture and release effort is ongoing, ensuring that as batteries in old tags expire newly tagged individuals are present for detection and tracking. VCU began tagging males with acoustic transmitters in 2010 and females in 2014. Several hundred Atlantic Sturgeon captured in the James River since 2009 have been released with acoustic tags. In 2021 during the initial research agreement between VCU and Dominion that lasted 2021-2025 in support of ITP No. 21516, VCU had active tags in 40 adult females and 106 males which assume a 10-year life span at a 180 second ping rate. As of June 2025, VCU has active tags on 49 adult females and 47 adult males

from the fall spawning cohort of Atlantic Sturgeon in the James River, with 43 males and 11 females being detected within the receiver array during the 2025 fall spawning time period. The sharp reduction in tagged males reflects the batteries dying from the initial tags starting in 2010. As time goes on more tags will die in tagged adult Atlantic Sturgeon and begin to lose sufficient representation in the acoustic array. As the battery life on some telemetry tagged individuals expires, Dominion proposes to continue to support VCU in maintaining a representative number of tagged adults in the fall spawning population. A total of 20 tags will be purchased annually, in support of maintaining tags that are expected to die out from initial tagging stages during VCU's initial research, batteries that will die that were tagged during the duration of the initial ITP No. 21516 permit, as well as those tagged at the beginning of the proposed 10-year ITP that will likely die come end of the proposed permit timeline.

This mitigation measure would take advantage of the large number (approximately 96 adults currently) of acoustically tagged Atlantic Sturgeon already occupying the James River. Tag detections in the existing array are currently shared among all parties engaged in the Atlantic coast-wide network of Atlantic Sturgeon researchers and managers. As presently configured, the acoustic receiver array's closest downriver gate is an active telemetry receiver located at the R152 daymarker on the James River downstream from CPS and upstream from the Interstate 295 river crossing. Likewise, the closest upriver gate is another active telemetry receiver at the U.S. Coast Guard daymarker G155A upstream from CPS. The objective of this array is to gain an improved understanding of the behavior patterns of Atlantic Sturgeon as they enter the reach of the James River potentially influenced by CPS operations. The deployment could also provide additional evidence of seasonal patterns of movement that distinguish the size and behaviors of cohorts in the fall versus spring spawning migrations. Derived data would be processed and shared with sturgeon researchers, including academia, and state wildlife managers, based on a formal understanding coordinated with James River Atlantic Sturgeon researchers as approved by NMFS.

As a result of the previous research agreement between VCU and Dominion, new insights into the fall spawning stock of Atlantic Sturgeon in the James River have been elucidated that filled a previous knowledge gap and will assist Dominion in mitigating potential incidental take of early life stage Atlantic Sturgeon. As a result of utilizing the acoustic telemetry data, James River water temperature and pulses in river discharge, a Bayesian model was developed that was able to elucidate when females were likely releasing eggs compared to staging around spawning habitat in anticipation of spawning (Balazik, Draper, & Garman, 2025) [In Review at CJAFS]. This manuscript demonstrates that the fall-run Atlantic Sturgeon females in the James River release eggs in water typically around 20-26 ℃ as well as pulses in river discharge, with most egg releases being confined to a few days. This model can be used to help Dominion correlate weather forecasts, river temperatures, and female location in the telemetry array to mitigate incidental take of early life stages of fall-run Atlantic Sturgeon.

Dominion proposes to continue the partnership with the VCU Rice Rivers Center to make use of data from a real time telemetry monitoring stations throughout the James River (Figure 4-1) for the duration of the proposed 10-year ITP renewal. Exact details and contracts are still being drafted. VCU will provide Dominion access to the real-time telemetry monitoring data to gather information as to when fall Atlantic Sturgeon are migrating upstream towards CPS to spawn.

Dominion will coordinate the completion and renewal of the existing contract with VCU to deploy and maintain real-time telemetry monitoring stations upstream and downstream of the CPS facility from August or September through October for the duration of the ITP entrainment monitoring program. The research agreement with VCU for the life of the ITP No. 21516-02 for CPS includes telemetry support, genetics analysis, salvage support, and a publication of the results from the studies conducted at CPS as part of the Conservation Plan. Dominion proposes specifically that in conjunction with VCU researchers Dominion will fund:

- 20 acoustic tags annually with the goal of tagging 10 males and 10 females to maintain a representative number of adult Atlantic Sturgeon in the James River
- Specific cost of service, maintenance, and associated costs of the VEMCO LIVE units in the vicinity of CPS (R152 and G155A)
- The utilization of VCU vessels at an agreed rate per vessel day to support activities associated with the research agreement
- Personnel costs directly related to project objectives, contract management, and reporting
- Genetic testing of any putative Atlantic Sturgeon egg or larvae obtained during entrainment monitoring in September and October
- In the instance of any Atlantic Sturgeon be collected during CPS operations, VCU response to salvage the specimen following the conditions of VCU's salvage permit

As a result of this proposed research agreement with VCU Rice Rivers Center, ongoing research into the fall-run Atlantic Sturgeon will be maintained for the duration of the proposed 10-year ITP permit duration. The resulting data and efforts as a result of this research agreement will assist in: maintaining a representative sample of tagged adult Atlantic Sturgeon in the live telemetry array, continued maintenance and utilization of the live receiver array during September and October to track when fall-run adult Atlantic Sturgeon are in the vicinity of CPS, using the insights gained from the model generated during the previous research agreement in conjunction with the live receiver array to most accurately predict spawning to assist in mitigating incidental take of early life stage Atlantic Sturgeon at CPS, genetic confirmation to the species level of any putative early life staged Atlantic Sturgeon collected during entrainment monitoring, contribution of genetic data to population genetic research of any genetically confirmed early life stage Atlantic Sturgeon, use of mark-recapture data generated over the course of the proposed research agreement to estimate the number of adult Atlantic Sturgeon in the fall-run stock to generate updated population level statistics to enhance the biological understanding of the stock, with a resulting peer-reviewed publication of the mark-recapture data to be published to update the literature and fill the knowledge gap of the current stock size of adult fall-run Atlantic Sturgeon in the James River as a part of the Chesapeake Bay DPS.

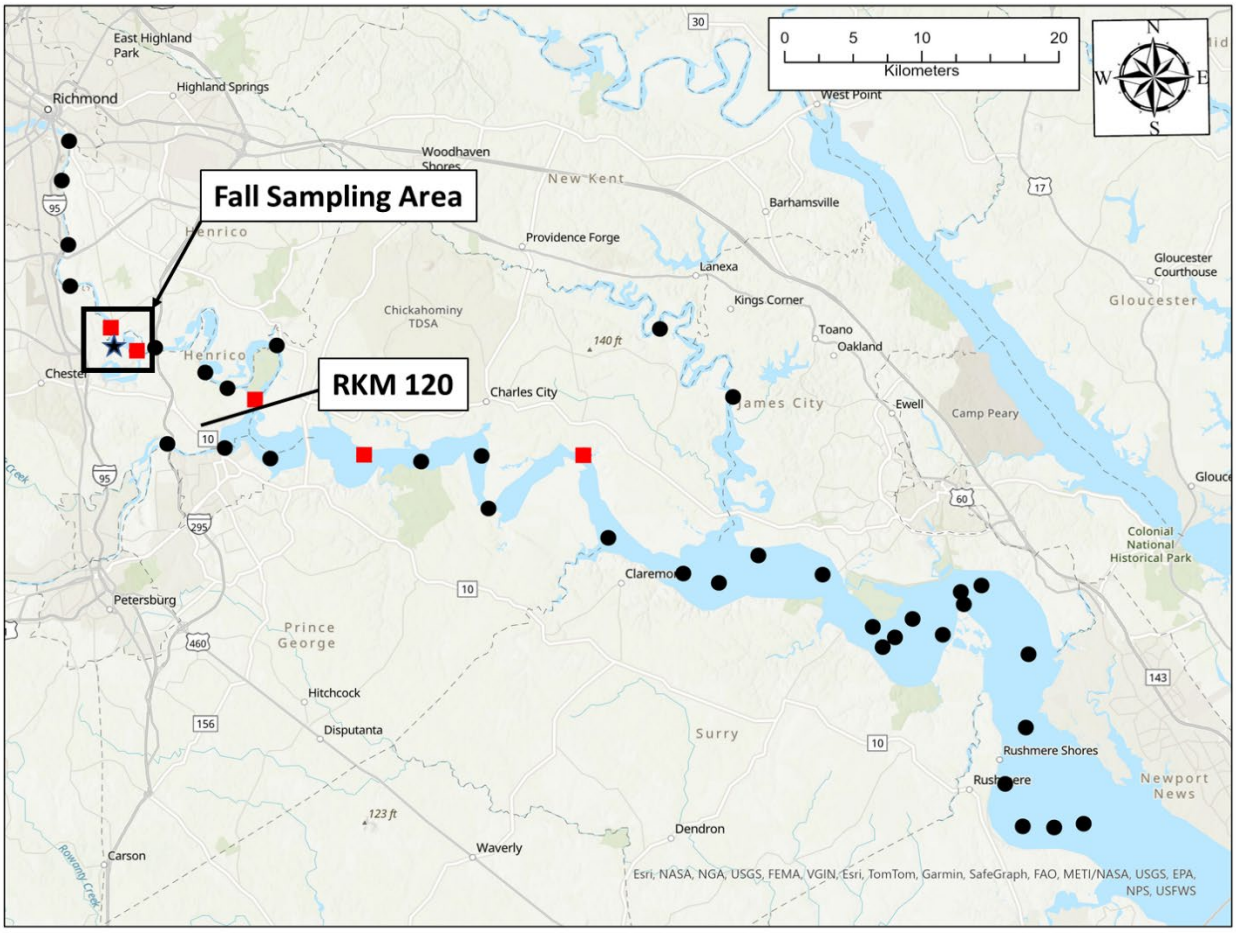

Figure 4-1. Virginia Commonwealth University VEMCO receiver locations as of July 2024. The black points are typical receivers that need to be downloaded on the water while the red squares are the five active Live receivers. The black star within the Fall Sampling Area is the Chesterfield Power Station.

Data derived from the deployment could contribute to the research already being conducted to define spawning periods (spring and fall) and better define spawning locations. These results would provide useful insights into the levels of risk posed by the various plant operations, such as attraction, avoidance, or neutrality in response to intake flows. This research will also help to develop site-specific management actions that would directly benefit the conservation of the species by further minimizing incidental take, such as planning and implementing routine maintenance outages, when practicable, to coincide with peak spawning movements, as well as to assess other threats to Atlantic Sturgeon, based on movement patterns. The proposed deployment would be fully coordinated with the James River Sturgeon Partnership to ensure that a rigorous plan of receiver positioning, maintenance, downloading, and data analysis was integrated into future data collection efforts.

Additional data defining spawning seasons and spawning locations would benefit and conserve the species by informing stock assessments, recovery plans, and management practices, so that effective measures such as seasonal restrictions protecting spawning habitat can be developed.

These data would provide insights on their migratory behavior and where mortality is occurring, which was identified as a high priority data need Atlantic Sturgeon Management Board Summer Meeting Draft Agenda (2024). This data will inform future stock assessments; Stock assessments are instrumental to the conservation of Atlantic Sturgeon and in defining objective, measurable criteria to determine that the Chesapeake DPS has recovered (see Section 4.4). In the 2024 Atlantic Sturgeon Stock Assessment Update, the population of Chesapeake Bay Atlantic Sturgeon was only 27% likely to be higher than 1998 abundance, emphasizing the importance of conservation and research efforts such as those proposed in this Conservation Plan (2024).

4.5.3 Digital Holography Entrainment Pilot Study

Dominion, in collaboration with the Electric Power Research Institute (EPRI), Verdantas Flow Labs, Pacific Northwest National Laboratory (PNNL), and Florida Atlantic University (FAU), has completed multiple phases of a pilot study evaluating the use of digital holography for identifying Atlantic Sturgeon eggs and larvae at (CPS). Currently, no non-lethal techniques exist for accurately observing and quantifying fish susceptible to entrainment at cooling water intake structures (CWIS). Advances in underwater imaging systems offer an opportunity to transition from lethal sampling to real-time, non-invasive monitoring of early life stages of endangered species. The overarching goal of this research was to determine the feasibility of using an autonomous holographic imaging system (AUTOHOLO) to identify Atlantic Sturgeon larvae during entrainment sampling events. Because Atlantic Sturgeon eggs and larvae are rarely captured at CPS, surrogate species were used in the first two phases of research as proof of concept. Atlantic sturgeon larvae were obtained from USFWS's Bears Bluff Hatchery for testing in Phase 3. In total, this work represents an important step toward developing continuous, non-lethal monitoring methods that support conservation objectives.

Phase 1 focused on laboratory testing of AUTOHOLO under turbidity and flow conditions representative of CWIS operations. Using White Sturgeon (*Acipenser transmontanus*) larvae as a surrogate, the system successfully captured high-quality holograms at elevated turbidity levels by adjusting sampling volume. At flow velocities up to 4.8 m/s, AUTOHOLO imaged larvae effectively. A database of several thousand images was generated to support development of automated classification algorithms for rapid species detection. This phase established the technical foundation for non-lethal identification of Atlantic Sturgeon larvae in field conditions.

Phase 2 expanded testing to include White Sturgeon eggs and larvae and Fathead Minnow (*Pimephales promelas*) larvae, while introducing environmental "noise" such as bubbles and detritus. AUTOHOLO produced clear holograms at still water and at velocities up to 0.3 m/s. A labeled image database was created to train deep learning models for species recognition. Imaging eggs proved challenging due to rapid sinking, limiting time in the field of view. A temporary solution, threading eggs on wire, enabled successful imaging and confirmed feasibility. Although rudimentary, this approach met the objective of demonstrating egg detection capability.

Phase 3 utilized a closed-loop facility simulating CPS conditions to compare AUTOHOLO and a laboratory-based system (LabHolo). Traditional entrainment sampling methods (Section 6.1.2) served as the control. The AUTOHOLO, designed for field deployment, operates at 1 Hz, whereas LabHolo captures images at 20 Hz, offering superior detection in dynamic flows. AUTOHOLO's higher resolution sensor contrasts with LabHolo's adjustable field of view, though neither system

captured the full channel height in the laboratory. Results indicated AUTOHOLO's collection efficiency was lower than traditional methods, primarily due to frame rate limitations. By contrast, LabHolo achieved performance comparable to conventional sampling. Recovery rates varied by species and velocity, with larger larvae exhibiting higher detection rates. While net collection increased with velocity, image-based performance declined because of frame rate constraints. Additionally, larvae tended to occupy channel boundaries, underscoring the need for optimized field-of-view placement in future designs.

Future Development and Field Deployment

Dominion will continue to apply a scientific, stepwise approach to AUTOHOLO development, with results reviewed and reported to NMFS in accordance with ITP No. 21516 § IV.C.4. Building on results from 5 years of research conducted under ITP No. 21516, Dominion will implement an adaptive, iterative approach over the next 10-year ITP/HCP term. Planned enhancements include higher-speed cameras, expanded field-of-view coverage, and adaptive positioning strategies to address species behavior. Future phases of the research and testing will be developed in coordination with NMFS pending permit conditions, study goals, and contractual details. Potential goals of the upcoming study plan phases include site-specific evaluations at CPS, refining egg detection methods, mitigating biofouling, refining turbidity tolerance, and integrating continuous monitoring capabilities. These advancements will strengthen conservation outcomes by enabling proactive management decisions and supporting objectives for minimizing incidental take. These capabilities could provide continuous (24/7) sampling of intake flows, offering a more comprehensive assessment of entrainment risk under varying river and plant operating conditions. Data generated from these efforts will inform operational planning, when practicable, to include scheduling maintenance outages during peak sturgeon spawning periods to minimize incidental take.

A separate sampling program will be developed for NMFS approval prior to implementation. While digital holography remains an emerging technology, its potential to transform entrainment monitoring and advance conservation of Atlantic Sturgeon is significant. This pilot study provides the foundation for achieving those objectives over the permit term.

5 Alternatives Considered

Alternatives were identified for each activity described in ITP Section 5 Permitted Activities were considered practical, based on the nature of the activity. Alternatives were evaluated based on 1) their ability to further avoid, reduce or minimize the estimated take of Atlantic Sturgeon below the levels anticipated for the proposed activities; 2) their anticipated effect on CPS operations and ability to reliably meet power generating demands; 3) their level of effort and schedule for designing, permitting and implementing; and 4) their effect on ongoing studies, projects or plant modifications to meet other and related regulatory requirements.

5.1 No Action Alternative

Under the No Action Alternative, existing operations and maintenance would continue at CPS, but the renewal of ITP No. 21516-02 authorization of incidental take of Atlantic Sturgeon eggs and larvae would not be issued. CPS would continue to operate in accordance with VPDES Permit VA0004146 (Effective Date October 01, 2016) and other regulatory requirements. There would be the potential for direct and indirect effects on Atlantic Sturgeon, but without the proposed monitoring and conservation benefits of mitigation. While the potential direct and indirect effects of the proposed activities on early-life stage Atlantic Sturgeon are considered negligible and the likelihood of these effects to occur extremely small, the No Action Alternative is considered impractical because it does not afford the certainty of incidental take authorization for Atlantic Sturgeon eggs provided by ESA Section 10(a)(1)(B).

5.2 Alternative Avoidance and Minimization

5.2.1 Modifying Water Withdrawals

CPS operation requires the withdrawal of water from the James River for condenser cooling and service water purposes. As a base-load facility, CPS serves as one of the primary means of generating the minimum amount of power necessary to meet demands. Accordingly, the facility is generally available on a twenty-four hour per day, seven days per week basis, although there is seasonal variation in its operations. Modifying CPS operations would be impractical because of the base-load nature of the facility and the lengthy time required for designing and implementing meaningful modifications.

Operational modifications designed specifically to protect sturgeon have few precedents nationally upon which to base predictions of effectiveness. Knowledge of species-specific behavioral responses of Atlantic Sturgeon to altered flows is totally lacking. Moreover, operational changes, such as time-of-year restrictions, would limit the collection of useful Atlantic Sturgeon data and research. The monitoring and studies provided for in this Renewed Conservation Plan will provide vital information about movement and spawning patterns of Atlantic Sturgeon in the James River. The new information will be used by Dominion to better anticipate when sturgeon eggs and/or larvae are likely to be in the James River within the vicinity of CPS. It will also be shared with sturgeon researchers. As noted by NMFS in the December 2020 EA/FONSI, this data will be beneficial for the recovery of the Chesapeake Bay DPS of Atlantic Sturgeon. See EA/FONSI at 20. Therefore, the large cost of operational modifications, when considered in light of the high uncertainty of their effectiveness equate to unreasonable and imprudent measures that would not provide a corresponding environmental benefit. Moreover, the low probability of take does not warrant such onerous modifications.

In addition, while CPS operations vary to accommodate seasonal demand and plant maintenance requirements (i.e., maintenance outages), the timing and duration of these outages are unpredictable and depend on a number of variables outside of Dominion's control, including base-load demand and other generating station outage requirements. Operational changes, such as time-of-year restrictions, are not practicable because they would significantly hinder Dominion's ability, as a public utility on a regional scale, to meet its statutory mandate to provide a reliable source of electricity to its customers. (See Code of Virginia § 56-234 A – It shall be the duty of

every public utility to furnish reasonably adequate service and facilities at reasonable and just rates to any person, firm or corporation along its lines desiring same.) CPS is an integral part of Dominion's generation fleet, without which Dominion may not be able to meet its statutory obligations. During times of planned outages across the fleet or during unanticipated severe weather events such as extreme heat or extreme storms (which are common from August to October) that could overwhelm or otherwise disable other generating assets on the grid, CPS must be flexible in its availability to generate power in order to preserve efficient grid operation or, in the most extreme scenario, to preserve the reliability of the electric grid to prevent cascading outages that could result in health, safety and economic risks to the public.

Additionally, even when CPS is not generating power, the CWIS associated with some units may continue to withdraw water during maintenance outages for service water requirements. Dominion must maintain the ability to operate the CWIS at either Unit 5 or Unit 6 to ensure compliance with CPS' VPDES permit requirement. Water withdrawal from either Unit 5 or Unit 6 CWIS provides dilution flow to discharge to Outfall 301 from the Low Volume Wastewater Treatment System (LVWWTS)[2] and supports proper water balance considering other water demands (stormwater, etc.) on site at CPS. Dominion intends to maintain the operations of the CWIS for Units 5 and/or 6 and thereby its ability to meet the VPDES permit compliance requirements even as Units 5 and 6 are retired from generation.

In sum, for all these reasons, relying on these outages to further reduce water withdrawals as a measure to avoid or further minimize Atlantic Sturgeon take is not practicable nor would such modifications have environmental benefits that would justify their cost even if such outages were feasible.

5.2.2 Cooling Water Intake Structure Modifications

Modifications to the cooling water structures to reduce entrainment of all species were considered in the 40 CFR 122.21(r)(10) section of the CWA 316(b) report submitted to VDEQ on September 30, 2021. These technologies also can have an impact on entrainment of Atlantic Sturgeon. Under the 316(b) Rule, the Director of the VDEQ is charged with determining the Best Technology Available, taking the recommendations for Threatened and Endangered Species from the Services under consideration, any modifications will be required by the VPDES permit. Dominion will implement the VPDES permit requirements when the permit is renewed, including cooling water intake structure modifications (if any).

5.3 Mitigation Measures Considered but Eliminated

Mitigation for estimated take by CPS must take into account the uncertainty and Dominion's ability to effectively implement the measures. The following sections describe mitigation measures that were considered but were eliminated because: they might not provide the intended benefits;

[2] The LVWWTS has been added to address changes to the coal combustion residuals management system in response to the Disposal of Coal Combustion Residuals from Electric Utilities final rule signed April 17, 2015.

because of the uncertainty associated with their efficacy; or Dominion's ability to implement the measures.

5.3.1 Restoration or Creation of Spawning Habitat

Mitigation efforts have often targeted restoration or creation of spawning habitat, particularly for species perceived to be experiencing recruitment bottlenecks due to loss of access to suitable spawning habitat. Location and quantity of spawning habitat is a recognized critical knowledge gap for guiding stock recovery efforts. Several rivers that historically have supported Atlantic Sturgeon stocks have been the subject of spawning habitat surveys in recent years (Litts & Kaeser, 2016). In fact, the tidal freshwater portion of the James River is perhaps one of the most extensively surveyed systems. Acoustic mapping efforts of substrate characteristics have been conducted by Bushnoe et al. (2005), Bilkovic et al. (2009), and Austin (2012). Atlantic Sturgeon have been reported to use a range of "hard" substrates for spawning, including exposed rock, gravel or consolidated sediment to which their demersal adhesive eggs attach (Gessner, Kamerichs, Kloas, & Wertz, 2009). All three surveys have detected potentially suitable Atlantic Sturgeon spawning habitat at multiple locations between the salt front below Hopewell upriver almost to Richmond, as well as in the Appomattox River. Although substantial potential spawning habitat has been identified, the degree to which the individual sites are used remains unknown.

Several attempts have been made to create viable spawning habitat in the James River by the deposition of broken granite stone to form artificial spawning reefs elevated 2 feet above the prevailing bottom profile. In concept, the gravel bars were designed to take advantage of river flows to maintain clean, silt-free substrates matching conditions assumed to optimize spawning success. Permits for three reefs stipulated the use of rip rap comprised of stones having a mean weight of 232 lbs per stone and capped with smaller stone having a mean weight of 6.25 lbs per stone. The reef footprints were designed to cover an area approximately 70 feet by 300 feet (personal communication with Mr. Albert Spells [USFWS]). Differential spawning success might be determined by the presence or absence of even thin veneers of silt over the hard substrate during the spawning seasons.

While one mitigation option could consist of designing and creating artificial spawning reefs to take advantage of hydraulic forces that would minimize or eliminate accumulations of silt, previous attempts indicate that the probability of successfully creating or enhancing spawning habitat is low. Monitoring would be required to assess occupation of the enhanced spawning habitat and support of viable embryos, and according to members of the James River State Park, attempts to monitor the success of the artificial spawning reefs proved inconclusive (personal communications with Dr. Matthew Balazik [VCU], Dr. Greg Garman [VCU], and Mr. Albert Spells [USFWS]). Without a more extensive effort to determine design factors that influence success, additional attempts to create or enhance spawning habitat cannot be assigned a definite, quantifiable benefit to James River Atlantic Sturgeon. Pursuing additional efforts of this mitigation approach would be premature until basic research has identified design factors that govern success (e.g., micro-topography and water quality conditions that induce spawning, micro-topography and flow fields that maintain appropriate conditions for settlement and attachment of viable eggs, and suitable habitat that provides cover for newly hatched yolk sac larvae). Again,

monitoring methods to evaluate the performance of created or enhanced spawning habitat have yet to be determined with confidence.

5.3.2 Restocking with Hatchery Raised Sturgeon

A second potential mitigation option would consist of restocking the James River with hatchery raised fish to compensate for any Chesterfield Plant-related take, or to similarly augment other stocks within the Chesapeake DPS. Restocking would take advantage of a long history of research into sturgeon culture methods (St Pierre, 2007; ASMFC, 2006), including precautionary measures to maintain genetic integrity of stocks. An extensive body of knowledge exists concerning Atlantic Sturgeon hatchery procedures (Smith T. , 1985; Smith & Clugston, 1997; Mohler, King, & Farrell, 2000; King, 2004; Williot, Rochard, & Kirschbaum, 2009; Theodore, Smith, Dingley, & Marchette, 1980). A previous program in which hatchery raised Atlantic Sturgeon from Hudson River broodstock were released in Maryland waters of the Chesapeake Bay has been reported to benefit stocks along the Eastern Shore (Secor, et al., 2000; Niklitschek & Secor, 2005). Evidence of the success of the program has been reported by Welsh et al. (2002). Sponsorship of a restocking program could accrue several potential benefits. Release of sturgeon at ages and sizes imparting some protection from predation could offset high natural mortalities. Scaling of the restocking program could be calculated to provide confidence in adequate replacement of lost recruitment represented by the take associated with plant operations.

Although restocking has received a great deal of attention as described above, at present this measure is not viable due to prohibitions imposed by listing of the species. Due to concerns for maintenance of genetic integrity of the various stocks comprising the Chesapeake DPS, mitigating for take within the James River stocks could only be accomplished by development of broodstock representing confirmed James River Atlantic Sturgeon. This mitigation alternative could only be pursued if endorsed as a component of an approved recovery plan.

5.3.3 Outreach, Education, and Partnerships

Mitigation can take the form of reducing threats to Atlantic Sturgeon through indirect means. Investments in increasing awareness of the ecological and economic benefits of sturgeon conservation, both among CPS personnel and the general public, can accrue long-term benefits. Increasing awareness of other significant threats to sustaining Atlantic Sturgeon stocks in the James River and the Chesapeake Bay can contribute to improved conservation strategies. One salient example is the threat of introduced or invasive species. However, as demonstrated in the paragraph below, there is uncertainty on whether investments in increasing public awareness would solicit the intended conservation benefits.

The fish assemblages in the James River no longer are typical of their composition just several decades ago. These changes have major implications for the sustainability of Atlantic Sturgeon stocks. For example, several decades ago Blue Catfish (*Ictalurus furcatus*) were introduced to Virginia waters from the Mississippi River drainage with the intention of improving recreational fishing. Blue Catfish are capable of growing to very large sizes and support valuable local recreational fishing efforts. However, Blue Catfish have become a dominant component of tidal freshwater fish assemblages in the Chesapeake Bay region. The National Oceanic and Atmospheric Administration (NOAA) Chesapeake Bay Office has estimated that Blue Catfish

represent up to 75% of the total fish biomass in the James River (NOAA Fisheries, 2018). Blue Catfish are omnivorous but become increasingly piscivorous at lengths greater than 30cm (Chandler, 1998; Graham, 1999; Schloesser, et al., 2011). As such, they potentially pose a threat to Atlantic Sturgeon, particularly for early life stages and juveniles.

An Invasive Catfish Task Force sponsored by NOAA's Chesapeake Bay Office released the Invasive Catfish Management Strategy (Invasive Catfish Task Force (ICTF), 2020) with recommendations for management of the Blue Catfish population. One of the management needs was monitoring data on Blue Catfish in various tributaries to the Chesapeake Bay. One mitigation measure could be collaboration or increased coordination of future monitoring efforts to address the threat posed by Blue Catfish on Atlantic Sturgeon in the James River, with the objective to identify options for reducing Blue Catfish in selected reaches of the James River. However, in their 2014 report, NOAA assumes the feasibility of eradication is low and thus it is uncertain whether investments in increasing public awareness would solicit the intended conservation benefits (ICTF, 2014). One public program under consideration by NOAA would be to provide information on the capture and consumption of Blue Catfish. However, nutrition and contaminant studies are still ongoing and will determine the feasibility of recreational and commercial markets in the future (ICTF, 2020).

6 Monitoring Requirements

ESA Section 10 regulations require a Conservation Plan to specify the measures to be taken to monitor the incidental take associated with the proposed activities, the effect of any incidental take on the species and the results of mitigation measures. Monitoring should be commensurate with the potential direct and indirect effects of the proposed activities and reflect the goals and objectives of the mitigation measures.

Dominion proposes monitoring programs for the proposed activities described in Section 6, as well as the proposed mitigation described in Section 4. The monitoring programs are designed to monitor for the incidental take of Atlantic Sturgeon at CPS and incorporate adaptive or evidenced-based management thresholds to modify monitoring as appropriate based on the measured incidental take and/or effect on Atlantic Sturgeon in the James River during the permit period.

As described in Section 3, Dominion anticipates incidental take of early life stages (i.e., eggs and/or larvae) of Atlantic Sturgeon from operation of the CWIS. Although incidental take from these activities is unexpected, it can occur, and therefore, monitoring has been included as part of this Conservation Plan. Monitoring of incidental take is described further below. Dominion does not anticipate incidental take from impingement, dredging, vessel movements, or shoreline and structure maintenance. Additionally, no incidental take is anticipated for the constituent or thermal discharges associated with the plant and no monitoring is proposed, because these discharges are monitored under VPDES Permit VA0004146.

6.1 Cooling Water Intake Structure

6.1.1 Entrainment Monitoring

Monitoring of the cooling water intake structures for the entrainment of Atlantic Sturgeon at CPS is based on the established means and methods used during the most recent CWA 316(b) study sampling; the best available information on Atlantic Sturgeon spawning seasons in the James River (i.e., the period(s) when early-life stage Atlantic Sturgeon may be susceptible to entrainment at CPS); the established knowledge that Atlantic Sturgeon early life stages prefer demersal habit and their past occurrence in near-bottom entrainment samples; and a monitoring goal of confirming the rate at which early-life stage Atlantic Sturgeon may be entrained at the CPS CWIS. The capture of Atlantic Sturgeon eggs and/or larvae can provide information on spawning activity to within a day or so and also indicates that spawning habitat is in close proximity of the CPS CWIS.

Entrainment monitoring will target the expected water depth and frequency/period where Atlantic Sturgeon early life stages most likely occur in the vicinity of CPS. Although there are limited data on the buoyancy of non-viable eggs, the eggs are expected to be either neutrally buoyant or demersal regardless of viability; therefore, the near-bottom sample depth at the CPS CWIS (i.e., 3 feet off the bottom of the intake bay, not the main river bottom)[3] would be adequate to successfully detect (and collect) Atlantic Sturgeon eggs as indicated by the egg collection in September 2021. Entrainment monitoring will be conducted for each year for the duration of the ITP No. 21516. Dominion will monitor entrainment of fall-spawned Atlantic Sturgeon eggs and/or larvae by collecting four 24-hour diel entrainment samples (one every 6 hours), three times per week during September and October for a total of 96 samples per year for the permit duration. The frequency of three times per week sampling should be more than adequate to detect Atlantic Sturgeon eggs or larvae if they are present because the maximum duration of a sampling gap between two sampling events is only about 48 hours (i.e., the end of sampling on Fridays and start of sampling on Mondays). Furthermore, if Atlantic Sturgeon eggs and/or larvae are found, entrainment sampling will continue each day during September and October until no Atlantic Sturgeon eggs or larvae are collected within a full 24-hour sampling event; sampling will then resume at a frequency of three times per week. This sampling frequency is designed to cover fall-spawning activity and potential entrainment of Atlantic Sturgeon eggs and/or larvae at CPS CWIS. It should be noted that the entrainment sampling depth and frequency of sampling that was conducted during 2021 was adequate to successfully detect (and collect) Atlantic Sturgeon eggs.

As explained in the 2020 Final Annual Report submitted to NMFS on May 14, 2021, Dominion understands that entrainment samples will be collected except during the rare occasion that all CPS river circulating pumps are not operating, such as unit outages. Should the conditions arise where no water is being withdrawn for operations, Dominion will provide NMFS with a 24-hour notification e-mail describing the reason(s) for the shutdown and the expected duration, as requested in the letter from NMFS on May 10, 2021.

[3] The near-bottom sample depth in the CPS CWIS is related to about a mid-depth of the main river water column.

Monitoring for incidental take of Atlantic Sturgeon during cooling water withdrawals will specifically consist of the following:

- Collect four 24-hour diel entrainment samples (one every 6 hours) three times per week for eight continuous weeks during September and October, as safely feasible.
- Collect standardized-by-volume pump samples with a target sample volume of 100 m^3 based on calibrated pump flows from the near-bottom depth.
- Process entrainment samples on site (except as noted below) and count the number of early-life stage Atlantic Sturgeon collected. If Atlantic Sturgeon eggs and/or larvae are found, entrainment sampling will continue each day during September and October until no Atlantic Sturgeon eggs or larvae are collected within a full 24-hour sampling event; sampling will then resume at three times per week intervals.

Sampling protocols will generally follow the procedures as those of the most recent CWA 316(b) studies; however, on-site sample processing will focus on the identification and counting of early-life stage Atlantic Sturgeon only. On-site sample processing will be conducted by a trained taxonomist and the use of a microscope. The large size and distinctive morphology of Atlantic Sturgeon early life stages will provide for an effective process. Atlantic Sturgeon eggs or larvae found in the sample will be removed and placed in a labeled container and preserved with RNA*later*® RNA Stabilization Solution, or 95 percent ethanol, to be determined. Samples with large amounts of debris that may inhibit field sorting will be preserved in RNA*later*® RNA Stabilization Solution, 95 percent ethanol, or similar to allow further genetic testing and sent to a laboratory for processing. Atlantic Sturgeon collected in the entrainment samples will be reported to NMFS within 24 hours of initial screening and identification of Atlantic Sturgeon eggs and/or larvae. Within 7 days, Dominion will electronically submit a report of each confirmed Atlantic Sturgeon collected to NMFS (nmfs.gar.incidental-take@noaa.gov) with additional information described in Section 6.4.

6.1.2 Entrainment Monitoring Details

Unit 6 was previously determined as a primary sampling location because it withdrew the highest volume (approximately 40%) of the total DIF water withdrawn at the CPS; additionally, pumps at Unit 6 have been operated most often. Previously, if Unit 6 was not operating or it was unsafe or infeasible to sample for other reasons, a secondary sample location was Unit 4 in front of the trash rack. Unit 4 was appropriate as the secondary location because it had relatively close access to the water and sufficient space to facilitate entrainment sampling and maintained the ability to operate the river water circulating pumps if necessary.

As noted elsewhere in the ITP Renewal Application and Conservation Plan, since the original ITP No. 21516 issuance, Units 3 and 4 have been retired from generation and Dominion retired Units 5 and 6 in 2023. As Unit 4 has been retired from generation, the river water circulating pumps at Unit 4 are not operated unless necessary and the accompanying equipment has not been maintained as it would be if it were continuing to serve as a generating unit. Therefore, Unit 4 is no longer considered a reliable location to conduct entrainment sampling, compared to other units that continue to generate power. Units 5 and 6 will remain operational for water balance needs

and on-demand usage. Unit 6 is still the most suitable location for entrainment sampling since the retirement from generation in 2023.

Dominion will collect entrainment samples on the river side, at the upstream-most operational CWIS, which will provide the most suitable sampling location because the entrainment samples would be collected from the first intake structure that may interact with early-life stage Atlantic Sturgeon. Samples will be collected as planned as provided in 2026-2035 Chesterfield Incidental Take Permit Entrainment Monitoring Sampling Schedules in Appendix A - Standard Operating Procedures (SOP) of the ITP 2021 Semi-Annual Report.

On the rare occasion that no CPS river circulating pumps are in operation during the 8-week entrainment sampling period, Dominion would not be required to conduct entrainment sampling or operate river circulating pumps in order to collect samples. As ITP Section 5 indicates, operation of the pumps is necessary for entrainment sampling. Dominion expects that at least one CPS river circulating pump typically will be in operation during the 8-week entrainment sampling period. However, in the rare absence of river circulating pump operations, such as unit outages which typically require disabling the circulating water pumps, no entrainment samples will be collected. NMFS will be contacted within 24 hours of shutting down all water intake at the circulating water pumps and that notification will include information describing the reason(s) for the shutdown and the expected duration of the shutdown. In that scenario, Dominion may collect fewer than 96 samples during the 8-week entrainment sampling period in a given year during the permit period.

Near-bottom pumped samples will be collected from intake piping installed upstream of an operating traveling screen approximately 3 feet above the CWIS bottom. Samples will be collected by pumping water through a 0.5-m diameter mouth plankton net constructed of 335-µm netting suspended in a buffering tank. A total of four samples representing 6-hour sampling intervals will be collected from near bottom over a 24-hr period sampling event. Table 6-1 provides the details of proposed ITP entrainment monitoring.

Table 6-1 Proposed ITP Entrainment Monitoring Details

Entrainment	Details
Units to be Sampled	Unit 6 (Primary Location) and Unit 7 or 8 (Secondary Location)
Sampling Events	Three times per week sampling during September and October months (12/month x 2 months = 24 sampling events)
Daily Collection Schedule	Samples collected every 6 hours in a 24-hr period (4 collections / 24-hr period) per sampling event
Targeted Organisms	Atlantic Sturgeon egg and larvae life stages
Depth	Near-bottom of CWIS
Number of Samples Collected per Depth	1 near-bottom sample by pumping water through a 335-µm net suspended in a buffering tank
Sample Duration	~100 minutes per 6-hour period (or time required to get 100 m^3 per 6-hour sample)
Number of Samples per Sampling Event	4 collections/sampling event x 1 depth/collection x 1 sample/depth = 4 samples/sampling event
Total Number of Samples	4 samples/sampling event x 12 sampling events/month x 2 months = 96 samples

Sample flows will be monitored and adjusted as necessary; a flow of 250-275 gpm has been selected to minimize potential damage to the organisms in the net during the sample collection interval. An inline flowmeter will be used to monitor and maintain the flow for each sample. The target water volume for each entrainment sample is 100 m^3 (26,417 gallons).

Samples will consist of four sub-samples of approximately 25 m^3 each (~25 minutes) will be collected and composited for each sample collection. After each sub-sample collection, the net will be removed from the buffer tank and switched with a second net (this is to be performed without shutting down the pump). The removed net containing the first sub-sample will then be washed down from the outside of the net into the cod-end bucket and the sample will be transferred to a sample container for sorting. The second, third, and fourth sub-samples will be washed down and transferred to the same container for sorting. The samples will be sorted on site by a trained taxonomist with the use of magnifying equipment as needed. If Atlantic Sturgeon eggs or larvae are collected, they will be placed in a labeled container with the pertinent sample information. Label information shall include sample number/ID, date, time (start and end), sample location, sample depth, and crew member initials. The sample containers will be preserved in RNA*later*® RNA Stabilization Solution, 95 percent ethanol, or similar to allow further genetic testing. All preserved eggs or larvae will be transported to the appropriate laboratory for genetic analysis.

6.1.3 Impingement Monitoring

As described below, debris inspection at the trash racks is being proposed for impingement monitoring. The trash racks are located in front of each intake structure and form a barrier to debris between the James River and the intake traveling screens that passes beyond the intake guards. Upon approach, river water passes an intake guard before encountering a curtain wall that extends beyond the low water level 4.0 to 4.5 feet depending on intake. Figure 3-1 in Section 3.2 provides a typical cross section of CWIS at the CPS**.** The trash racks are in front the curtain wall and extend to the bottom of the intake structure. The trash rack installed for Unit 4 is approximately 14.5 feet tall by 9.9 feet wide with 0.375-inch bars on 4.0-in 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. The traveling screens are located between 10 and 20 feet on the interior side of the trash racks.

The first monitoring method will be to conduct daily visual inspections of the debris on the water surface at the trash racks. Daily monitoring conducted from May 2021 through 2024 have found no presence of a sturgeon outside of the fall spawning window. Accordingly, Dominion proposes that daily monitoring at the trash racks at each operating unit (CWIS in operation) be conducted only during the fall spawning period instead of year-round. Specifically, Dominion will monitor the telemetry system for presence of any tagged adults in the river, especially in the vicinity of CPS. As detailed in Section 4.4.2, Dominion will monitor the movements of the telemetry tagged fall adult individuals (currently 82 individuals) to implement the impingement monitoring which would begin when the first acoustic tagged adult is detected at the R152 real-time receiver located downstream of CPS, or September 1, whichever occurs first. Impingement monitoring would continue through October 31, or until no tagged adults are detected upstream of CPS for 48 hours, whichever occurs later.

It should be noted that some tags may expire, and not all tagged adults return to the James River in consecutive years so the tagged population will fluctuate on a yearly basis. For example, between August 1 and October 31, 2021, the telemetry system detected 72 male and 6 female telemetry tagged adult Atlantic Sturgeon in the James River that reached fall spawning habitat. Fall spawning habitat is deemed areas above Presquile, rkm 120 (74.6 rm). In the event an Atlantic Sturgeon is observed, attempts to gently dislodge the fish from the trash rack into the James River flow will be made as described below. Failing that, the fish will be removed with the trash rake and handled as described below.

The second monitoring method that is being proposed as additional monitoring consists of an annual dive inspection of each intake guard at potentially operating CPS CWIS to confirm that the intake guards are intact and capable of excluding any adult Atlantic Sturgeon as designed. Should deficiencies be discovered on the dive inspection, best efforts will be made to repair in advance of the fall Atlantic Sturgeon spawning season.

Dominion considered impingement monitoring at the intake guards, including use of a remote video camera system, but determined that monitoring at the intake guards is not practicable for a number of reasons. First, the James River in the vicinity of CPS is often muddy with low visibility, especially during high-flow conditions. As NMFS acknowledged in the EA/FONSI, monitoring the intake guards below the water surface is not practicable because “turbidity of the river hinders or precludes visibility of Atlantic Sturgeon below the water surface.” See EA/FONSI at 4. Second, there is a lack of access to the intake guard wall to set up and deploy equipment to monitor for impingement. There are approximately 1,000 sf of intake guard surface area to observe all four intakes. It would be difficult to position cameras to observe this large area for a short touch by Atlantic Sturgeon. Third, mud, silt, and algae grow rapidly, and foul structures immersed in the water; the same would be expected for camera lenses. In addition, there is a considerable amount of debris in the water that could foul or strike the camera and/or its container, obscuring the view or damaging the camera. Finally, although Atlantic Sturgeon have a distinct body shape, the

murkiness of the water and the large surface area to observe could make it very difficult to distinguish Atlantic Sturgeon from other fish or debris. For these reasons, it is impracticable for Dominion to monitor the intake guards and unlikely that doing so would provide useful data. The monitoring set forth in this Conservation Plan appropriately allows monitoring for impingement in a manner that is safe and practicable.

Dominion also proposes that trash raking be performed only when deemed necessary due to an observation of an impinged Atlantic Sturgeon (detailed above), or when operationally necessary due to back pressure or pump cavitation typical with debris loading during normal operations. Special attention will be paid to the flows of the James River to identify periods where increased raking may be necessary while higher than normal debris loads are expected (i.e., after a precipitation event upstream in the James River watershed, etc.). If a unit specific intake guard is found to be in jeopardy of functioning as designed, trash raking will be performed twice per day (once per 12-hour shift during daylight hours) during the fall sturgeon spawning window as identified by the real-time telemetry system. Dominion does not anticipate encountering any issues with operating the trash rake; however, conditions may occur during the life of the ITP that may impact the ability to operate the trash rake at a specific unit as designed. Should Dominion encounter issues that render a portion of any units CWIS inoperable for a period of time during the fall sturgeon spawning season (including the trash rake), the current VPDES Permit condition (VA0004146 I. D. 4) provides a reasonable approach for remediating any issues[4]. Once the CWIS is repaired and returned to normal functionality, CPS will resume the condition where trash raking is only conducted when operationally necessary.

Mechanical trash rakes, consisting of steel grabs that lift and hold debris as they clean the racks, will be used as needed to clear large debris from the trash racks. The rakes were designed to bring moderately large debris (most often woody debris) that has been filtered by the trash racks up to the level of the intake deck as needed and deposit the debris into a bin.

Daily trash raking occurred on all operational CWIS during the fall spawning season in 2021 and no adult Atlantic Sturgeon were observed, which demonstrated the biological efficacy of the intake guards in preventing the impingement of adult Atlantic Sturgeon. Operational experience from daily trash raking during the fall 2021 provided insight on the increased mechanical and physical demands of daily rake operation on both equipment and personnel and indicated daily raking is not necessary due to the efficacy of the intake guards. Further, rake operation in the absence of CWIS operation, or in an all pumps-off condition, has no benefit to Atlantic Sturgeon and poses an operational risk of equipment malfunction due to increased use. Due to this, Dominion proposes to primarily perform visual inspection and operate the trash racks only when necessary.

Visual inspection of the debris and other material collected during trash rack cleaning operations will be performed by operators trained in the identification and handling of Atlantic Sturgeon. In the extreme event that an Atlantic Sturgeon is somehow able to bypass the intake guard and is collected, the fish will be removed from the trash bin and handled as described below.

[4] VPDES VA0004146 I.D.4 “Any deficiencies found during a visual inspection or remote monitoring event shall be corrected as soon as possible, but no later than 30 days following discovery, unless permission for a later date is granted by DEQ in writing.”

Debris Inspection

Debris and other material collected will be visually inspected from the intake deck and during trash rack cleaning operations (i.e., operating the trash rake), when performed. The following procedures will be employed:

1. Dominion will inspect annually by diver(s) to confirm that the intake guards at CPS CWIS Units 3-6 and 8 are intact and capable of excluding any adult Atlantic sturgeon as designed. Should deficiencies be discovered on the dive inspection, best efforts will be made to repair in advance of the fall Atlantic sturgeon spawning season, Unit 7 does not require intake guards and will not be inspected.
2. Cooling water intake trash racks (and immediate area upstream) will be inspected visually during daylight hours at least once per 12-hour shift during the fall spawning period (September 1 – October 31).
    a. The times of inspections, including those when no Atlantic Sturgeon were sighted, will be recorded.
    b. In the event an Atlantic Sturgeon is observed to be impinged on the trash rack, station personnel will use extension poles or, as last resort, the trash rake to dislodge the fish from the rack so long as the fish can be reached safely.
3. Trash racks will be cleaned via a mechanical trash rake only as operationally necessary If a unit specific intake guard is found to be in jeopardy of functioning as designed, trash raking will be performed twice per day (once per 12-hour shift during daylight hours) during the fall sturgeon spawning window as identified as the real-time telemetry system.
    a. Cleaning will include the full length of the trash rack, i.e., down to the bottom of each intake bay.
    b. Personnel will be instructed to look at surface debris beneath the rake, before operating the rake.
    c. The raking process will be closely monitored. If an Atlantic Sturgeon is observed, it will be recovered from the trash rake as soon as it is accessible by a net or other equipment and can be safely removed (see details of Atlantic Sturgeon handling procedures below).
    d. Personnel cleaning the racks will inspect all debris that is deposited in the debris trough to ensure that no Atlantic Sturgeon are present within the debris.
    e. Atlantic Sturgeon will be removed from the trash rake as quickly and carefully as possible. Note that a net or sling will be used, if possible. In all cases, personnel safety will be given the highest priority.
    f. Personnel will report and handle Atlantic Sturgeon present within the debris, as specified below.
4. Equipment such as nets, baskets, and a tank will be available for Atlantic Sturgeon removal and handling. Application of specific handling procedures will be contingent upon safety and practicality.

Due to emphasis on return of live Atlantic Sturgeon to the river, the operators will not obtain measurement metrics (e.g., mouth width to interorbital distance ratio) except an estimate of fork length. CPS will provide operators training on Atlantic Sturgeon identification and handling and will also provide Atlantic Sturgeon alerts and post signs with pictures of Atlantic Sturgeon during spawning season or if any Atlantic Sturgeon are observed at the station in order to heighten awareness. Training will include measurement of fork length and identification of gross Atlantic Sturgeon morphometric features such as subterminal mouth, heterocercal tail, and the presence of scutes. Visual aids (posters) will be displayed at strategic locations at CPS. The verification of identity will occur at distance if the Atlantic Sturgeon is impinged on the trash rack, or within the trash trough if brought to the intake deck during normal trash rack cleaning operations. All procedures will be incorporated into the CPS Equipment Inspection Guidelines.

Atlantic Sturgeon Handling

The handling and return of any adult Atlantic Sturgeon to the James River will be conducted in accordance with the following handling procedures, depending on condition. Note: Immediately upon retrieval, each Atlantic Sturgeon will be assessed to confirm status (live/dead).

For live Atlantic Sturgeon

1. The Operator that identifies the Atlantic Sturgeon will immediately notify the Control Room that will in turn notify the station Environmental Compliance Coordinator (ECC). The ECC will then immediately notify Dominion Environmental Biology.
2. In the event an Atlantic Sturgeon is brought to the intake deck, operators will ensure the following personal protective equipment (PPE) is in use prior to attempting to handle the fish or assist those attempting to handle the fish: hard hat, safety glasses, protective gloves, and safety shoes. This PPE is routinely worn when working on the intake deck, and so donning PPE should not delay attending to the fish.
3. A live Atlantic Sturgeon will be placed into a tub filled and overflowing with aerated ambient river water continuously supplied to the tub while it contains a fish.
4. The Atlantic Sturgeon will then be measured if a measurement can safely be obtained. The Atlantic Sturgeon will be kept wet throughout the data collection procedure. The fork length (mm) will be quickly recorded.
5. If possible, while maintaining the fish in a wet condition, photographs will be quickly taken of the top, bottom and sides of fish to document the condition of the fish. Injuries and physical abnormalities will also be photographed.
6. Atlantic Sturgeon will be visually inspected for external tags or markings.
7. Priority will be given to sturgeon survival over data collection.
8. After the requisite measurements have been collected, live fish will be returned to the river away from the intakes as quickly and as gently as possible. The size of the Atlantic Sturgeon will dictate how the fish will be handled.
    a. For live fish greater than 1 m, operators will move the fish to the screenwash debris/fish return for immediate release to the James River. While it will be

desirable to return the fish to the river away from the intakes, manually moving a large fish at the CPS intakes will be difficult and unsafe for the fish and workers, due to the narrow stairwells leading from the intake decks to ground level where vehicular traffic is possible, and due to the weight and strength of large Atlantic Sturgeon. Similarly, use of a crane to move the Atlantic Sturgeon from the intake deck to ground level, which is standard procedure for movement of heavy objects on the intake deck, will entail significant delay in moving the fish and potential injury.

b. Live fish that are 1 m or less will be transported in a 150 cm cradle-style net (i.e., stretcher) for transport to a holding tank at ground level. The holding tank will be of sufficient size to accommodate a 1 m Atlantic Sturgeon, contain fresh river water, and will be aerated while the Atlantic Sturgeon is transported to the Dutch Gap boat ramp, located approximately 0.6 km downstream of the intakes. The fish will be released at the boat ramp after informing boaters to stay clear of the release point.

For dead Atlantic Sturgeon

The Operator that identifies the Atlantic Sturgeon will notify the Control Room, which will in turn notify the station ECC. The ECC will then notify Dominion Environmental Biology.

1. In the event an Atlantic Sturgeon is brought to the intake deck, operators will ensure the following PPE is in use prior to attempting to handle the fish: hard hat, safety glasses, protective gloves, and safety shoes. This PPE is routinely worn when working on the intake deck, and so donning PPE should not delay attending to the fish.
2. The fork length (mm) will be recorded.
3. Photographs will be taken of the top, bottom and sides of fish to document the condition of the fish. Injuries and physical abnormalities will also be photographed.
4. Atlantic Sturgeon will be visually inspected for external tags or markings.
5. The Atlantic Sturgeon will be transported by crane or cradle-style net to ground level and transported by vehicle to an onsite container. If requested by NMFS, the fish will be iced and held for release to a party authorized by the NMFS.
6. If the specimen is not requested by NMFS, the Atlantic Sturgeon carcass will be spray-painted orange and placed along the riverbank, above the high-water line in a secluded area away from populated or public places. The location of the fish will be included in the reporting described below.

6.2 Clean Water Act 316(b) Studies

Dominion completed the CWA 316(b) studies to characterize the entrainment and impingement of all life stages of fish and shellfish at CPS water intakes in order to meet VPDES permit requirements in December 2020.

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 3.3. 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 CWIS operation's incidental take estimate.

6.3 Dredging

If dredging of the CPS barge slip or water intakes is required within the Atlantic Sturgeon spawning seasons (April 1 - May 15; September 1 - October 15), a designated observer will visually monitor for the presence of Atlantic Sturgeon at or near the water surface in the vicinity of the dredging activities. An inspector trained to identify Atlantic Sturgeon will monitor all dredging operations.

Atlantic Sturgeon observations will be reported to NMFS within 24 hours of observation and identification. Additional information to be reported will include date and time of the observation, condition, estimated length and weight of any Atlantic Sturgeon observed and river conditions, as appropriate.

6.4 Constituent Discharge

CPS constituent discharges are regulated under VPDES Permit VA0004146 which requires regular monitoring and monthly reporting of discharges. Because no direct or indirect effects of constituent discharges on Atlantic Sturgeon are expected (see Section 2.1.4 Constituent Discharge), no additional monitoring is proposed beyond that required by the CPS VPDES permit.

6.5 Thermal Discharge

CPS thermal discharge is regulated under VPDES Permit VA0004146. Because no direct or indirect effects of the thermal discharge on Atlantic Sturgeon are expected (see Section 2.1.5 Thermal Discharge), no additional monitoring is proposed beyond that required by the CPS VPDES permit.

6.6 Vessel Movements

Monitoring of vessel movements during delivery and shipment of bulk material at the CPS barge slip will be conducted during the fall spawning season.

7 Reporting

7.1 Annual Reporting Plan

Dominion will prepare an annual reporting plan that details how observed take of Atlantic sturgeon will be extrapolated to generate an accurate and reliable estimate of total take at the facility.

7.2 Incidental Take Reporting

For the take report of early life stages (i.e., egg, yolk-sac larvae, and/or post yolk-sac larvae) of Atlantic Sturgeon, entrainment samples will be sorted on-site for initial screening and identification of Atlantic Sturgeon eggs and/or larvae, and any suspected Atlantic Sturgeon eggs and/or larvae will be transported to VCU laboratory for verification and genetic analysis. Any suspected

incidental take will be reported to NMFS Greater Atlantic Regional Fisheries Office (GARFO) via email sent to nmfs.gar.incidental-take@noaa.gov within 24 hours of the on-site identification. Notification will include the date of the take and the condition and life stage of the Atlantic Sturgeon. Dominion will provide NMFS GARFO with additional information once VCU has conducted its analysis and provided verification.

For the take report of the adult Atlantic Sturgeon, all sturgeon incidental takes (e.g., capture, injuries, mortalities) that occur during CPS operational activities via observation during Impingement Monitoring will be reported within 24 hours of their occurrence or confirmed identification to the NMFS GARFO incidental take reporting email at nmfs.gar.incidental-take@noaa.gov. Notification will include the date of the take and the condition and life stage of the Atlantic Sturgeon.

Within 7 days, Dominion will electronically submit a report of each confirmed take of Atlantic Sturgeon to NMFS (nmfs.gar.incidental-take@noaa.gov). The same written report will be submitted to NMFS by mail. For non-early life stage Atlantic Sturgeon, these reports will include the information consistent with data fields on the reporting form included in Appendix A of ITP No. 21516, and information for the activity being conducted when the Atlantic Sturgeon was taken (i.e., CPS operations or CWA 316(b) sampling), and the circumstances (e.g., where and how) if any live Atlantic Sturgeon was released. For early-life stage Atlantic Sturgeon, these reports will include:

a. The date and time when take was observed or occurred (e.g., based on entrainment sample collection)

b. The number of Atlantic Sturgeon taken in the individual take event (e.g., if multiple Atlantic Sturgeon were taken in an entrainment sample)

c. The preservative used for any early-life stage Atlantic Sturgeon

d. The activity being conducted when the Atlantic Sturgeon was taken (e.g., CPS operation entrainment, CWA 316(b) sampling)

e. Operational data and river conditions

f. Any unique or unusual circumstances when take occurred

g. The circumstances (e.g., where and how) if any live Atlantic Sturgeon were released

h. A summary of NMFS' directions (per the 24-hour incidental take report) for disposition of dead specimens (any life stage) and the status of carrying out the disposition directions. If Dominion has not yet received directions from NMFS, Dominion will provide a statement to the effect that direction from NMFS is pending and confirm that dead Atlantic Sturgeon (any life stage) are being held by Dominion.

7.3 Annual Reporting

7.3.1 Semi-annual Reports

Dominion will prepare and submit a semi-annual report for each year of the permit. Semi-annual reports are due by July 31 for the time period from January 1 through July 1 of each calendar year. The semi-annual report will include:

a. A narrative describing the progress made for implementing each of the mitigation measures

b. A narrative describing any issues encountered that interfered with implementation of the Conservation Plan

c. A narrative describing any changed circumstances as a result of Dominion completing the VPDES renewal for CPS, particularly changes resulting from identification of the Best Technology Available measures.

7.3.2 Annual Reports

Dominion will prepare and submit an annual report for each year of the ITP detailing all observed takes of Atlantic Sturgeon at CPS. Draft annual reports are to be submitted to NMFS by February 15 of each year. NMFS will provide any comments or suggestions to Dominion by April 1 and a final report is due to NMFS by May 15. The review of this annual report will provide an opportunity to monitor the ongoing take at CPS and detect any trends that may indicate a potential exceedance of the ITP before such an event occurs. Each annual report will include:

a. A consistent and reliable estimate of the total amount of take derived from the observations using the agreed to methodology outlined in the annual reporting plan

b. A detailed narrative describing the progress made toward implementing each of the mitigation measures and the results to date, including for “Sturgeon Movement Research”, how Dominion used the real-time data from VCU’s acoustically-tagged Atlantic Sturgeon during the reporting period (e.g., scheduling maintenance outages based on receiver detections of tagged Atlantic Sturgeon); an update on the contract with VCU to deploy and maintain receivers to detect acoustically-tagged Atlantic Sturgeon downriver of CPS; and how Dominion has shared the new information with sturgeon researchers, including academia, and state wildlife managers, during the reporting period

c. A narrative describing any issues encountered that interfered with implementation of the Conservation Plan, including monitoring

d. A narrative describing any changed circumstances at CPS as a result of completion of the VPDES permit renewal, particularly changes resulting from identification of the Best Technology Available measures

e. A summary (e.g., table) of the incidental takes that occurred, if any, including the date taken, life stage taken, and the cause of the incidental take (e.g., take by CPS operation/entrainment, take by CPS CWA entrainment sampling)

f. A summary (e.g., narrative or spreadsheet) for impingement monitoring during the reporting period including the times of inspections, whether Atlantic Sturgeon were sighted, and the outcome of any impingement event

g. A summary (e.g., narrative or spreadsheet) for entrainment monitoring during the reporting period including the following: the eight-week time period from September through October when entrainment sampling was conducted; specific entrainment sampling days; number of entrainment samples collected; number of entrainment samples that contained Atlantic Sturgeon eggs and/or larvae; total number of Atlantic Sturgeon eggs and/or larvae found in the samples; life stage of the entrained Atlantic Sturgeon; total volume of water sampled; unit(s) where sampling occurred; river conditions during the total sampling period; any changed circumstances from the entrainment monitoring plan and why, and any response to the changed circumstances.

7.3.3 Final Report

Dominion will submit a final report within 180 days of the expiration of the ITP summarizing the total take that occurred under the permit and the circumstances surrounding it.

8 Changed Circumstances

Changed circumstances means changes in circumstances affecting a species or geographic area covered by a Conservation Plan that can reasonably be anticipated by plan developers and NMFS and that can be planned for (50 CFR § 222.102). Examples include the listing of new species, or a fire or other natural catastrophic event in areas prone to such events.

The following changed circumstances can be reasonably anticipated:

1. Listing or delisting of species within the geographic area covered by the permit: In such case, NMFS will re-evaluate the Section 10 permit for CPS and activities covered by the Habitat Conservation Plan may be modified, as necessary, to ensure that those activities are not likely to jeopardize the continued existence of the newly-listed species or result in take of that species. If the newly listed species is under the jurisdiction of NMFS, Dominion would contact NMFS and apply for an amendment to the Conservation Plan to address the newly listed species. If the newly listed species is under the jurisdiction of the USFWS, Dominion would contact the appropriate USFWS office to determine the appropriate course of action.

   If Atlantic Sturgeon were delisted, the permit would no longer be necessary or valid.

2. Designation of critical habitat for Atlantic Sturgeon in the vicinity of the CPS: If NMFS were to designate critical habitat and the designated area encompassed the portion of the James River that includes CPS or occurred downstream of CPS, Dominion would contact NMFS to determine if further action is required. An example of an action that could be

taken is that Dominion would prepare a Biological Evaluation (BE) of the potential impacts of CPS operations on critical habitat. This BE would be submitted to NMFS for their review and concurrence or request for an amendment to the Conservation Plan if deemed necessary.

3. Change in Cooling Water Intake Flows or Intake Structure in response to changes to the CWA 316(b) rule: Should the CWA 316(b) rule or VPDES permit mandate a revision to the CPS cooling water flow or intake structure design, Dominion would contact NMFS to discuss the change in operating condition mandated by the rule. If NMFS and Dominion deem it necessary, Dominion would prepare a BE to determine if there would be additional impacts as a result of the new operating condition. This BE would be submitted to NMFS for their review and concurrence or request for an amendment to the Conservation Plan if deemed necessary.

4. Change in Cooling Water Intake Flows or Intake Structure in response to changes to the baseload conditions: Should the baseload power supply needed from CPS change such that a power unit and intake structure were to be taken offline (as was previously done with Units 3 and 4) the CPS would modify the multiplier used to estimate take based on the new operation flows.

5. New data establishes that abundance estimates, growth rates, or viabilities of the James River spawning population of Atlantic Sturgeon or of the Chesapeake Bay Atlantic Sturgeon population (i.e., 300, based on the NOAA undated information sheet) that form the foundation for this Conservation Plan substantially changes: In this circumstance, Dominion would meet with NMFS to discuss whether or not permit incidental takes should be re-evaluated relative to new spawning population data.

6. Change or shift in known spawning windows from those listed in this Conservation Plan: If it is determined through published literature that the Atlantic Sturgeon spawning window in the James River is different from that listed in this Conservation Plan, Dominion will notify NMFS to discuss whether the monitoring and mitigation efforts to be implemented during the spawning window in the Conservation Plan should be modified to reflect the most recent published literature.

9 Funding for Mitigation Measures and Monitoring

Dominion will provide such funds as may be necessary to carry out its obligations under the Conservation Plan. Refer to the cover letter of this ITP Renewal Application submittal package signed by Robert Sauer, which confirms that the mitigation and monitoring will be fully funded. Dominion will notify NMFS if Dominion's funding resources have materially changed.

10 Plan Implementation

Dominion shall undertake all activities set forth in the Conservation Plan in order to meet the terms of the Conservation Plan and comply with the ITP, including the changed circumstances described in Section 7 above, if applicable.

11 Works Cited

Allen, P., Hodge, B., Werner, I., & Cech, J. (2006). Effects of ontogeny, season, and temperature on the swimming performance of juvenile green sturgeon (Acipenser medirostris). *Canadian Journal of Fisheries and Aquatic Sciences, 63*, 1360-1369. doi:10.1139/f06-031

ASMFC. (2006). *Guidelines for stocking cultured Atlantic Sturgeon for supplementation or reintroduction.* Atlantic States Marine Fisheries Commission Special Report No. 87.

ASMFC. (2024). *2024 Atlantic Sturgeon Stock Assessment Update.*

ASMFC. (2025, March 4). *Atlantic Sturgeon Fact Sheet*. Retrieved from https://asmfc.org/species/atlantic-sturgeon/

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

Atlantic Sturgeon Management Board. (2024, August 7). Draft Agenda. Retrieved March 19, 2025, from https://asmfc.org/wp-content/uploads/2025/01/AtlSturgeonBoard_August2024.pdf

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

Austin, G. (2012). Essential spawning habitat for Atlantic Sturgeon in the James River, Virginia. *MS Thesis, Virginia Commonwealth University*. doi:10.25772/GCYV-RT80

Bain, M., Haley, N., Peterson, D., J.R., W., & Arend, K. (2000). Harvest and habitats of Atlantic sturgeon Acipenser oxyrinchus Mitchill, 1815, in the Hudson River estuary: Lessons for sturgeon conservation. *Boletin-Instituto Español de Oceanografía, 16*, 43-53.

Balazik, M. (2012). Life history analysis of James River Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus) with implications for management and recovery of the species. *Doctoral Dissertation, Virginia Commonwealth University*. doi:10.25772/0YJQ-TT50

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). Email with B. Graham regarding James River Atlantic Sturgeon population.

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

Balazik, M., & Clarke, D. (2024). Juvenile Atlantic sturgeon survival and movement in proximity to an active cutterhead suction dredge. *PLOS One, 19*(11), e0300489. doi:10.1371/journal.pone.0300489

Balazik, M., & Musick, J. (2015). Dual annual spawning races in Atlantic Sturgeon. *PLOS One, 10*(5), e0128234. doi:10.1371/journal.pone.0128234

Balazik, M., Barber, M., Altman, S., Reine, K., Katzenmeyer, A., Bunch, A., & et al. (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), e0230029. doi:10.1371/journal.pone.0230029

Balazik, M., Draper, A., & Garman, G. (2025). Spawning Drivers of Female Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus) in the James River: A Fine-Scale Temporal Analysis. *Canadian Journal of Fisheries and Aquatic Sciences*. Retrieved from Under Peer Review

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, L. (2012). Empirical evidence of fall spawning by Atlantic Sturgeon in the James River, Virginia. *Transactions of the American Fisheries Society, 141*(6), 1465-1471. doi:10.1080/00028487.2012.703157

Balazik, M., McIninch, S., Garman, G., & Latour, R. (2012). Age and growth of Atlantic Sturgeon in the James River, Virginia, 1977-2011. *Transactions of the American Fisheries Society, 141*(4), 1074-1080. doi:10.1080/00028487.2012.676590

Balazik, M., Reine, K., Spells, A., Fredrickson, C., Fine, M., Garman, G., & McIninch, S. (2012). The Potential for Vessel Interactions with Adult Atlantic Sturgeon in the James River, Virginia. *North American Journal of Fisheries Management, 32*(6), 1062-1069. doi:10.1080/02755947.2012.716016

Balazik, M., Reine, K., Spells, A., Fredrickson, C., Fine, M., Garman, G., & McIninch, S. (n.d.). The Potential for Vessel Interactions with Adult Atlantic Sturgeon in the James River, Virginia.

Bath, D., O'Conner, J., Alber, J., & Arvidson, L. (1981). Development and identification of larval Atlantic Sturgeon (Acipenser oxyrhynchys) and Shortnose Sturgeon (A. brevirostrum) from the Hudson River estuary, New York. *Copeia, 1981*(3), 711-717. doi:10.2307/1444581

Beamesderfer, R., & Far, R. (1997). Alternatives for the protection and restoration of sturgeons and their habitat. *Environmental Biology of Fishes, 48*, 407-417. doi:10.1023/A:1007310916515

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. Glouchester Point, Virginia: Virginia Institute of Marine Science, Center for Coastal Resources Management.

Boreman, J. (1997). Sensitivity of North American sturgeons and paddlefish to fishing mortality . *Environmental Biology of Fishes, 48*, 399-405. doi:10.1023/A:1007345806559

Borodin, N. (1925). Biological Observations on the Atlantic Sturgeon (Acipenser sturio). *Transactions of the American Fisheries Society, 55*(1), 184-190. doi:10.1577/1548-8659(1925)55[184:BOOTAS]2.0.CO;2

Brown, J., & Murphy, G. (2010). Atlantic Sturgeon vessel-strike mortalities in the Delaware Estuary. *Fisheries, 35*(2), 72-83. doi:10.1577/1548-8446-35.2.72

Bushnoe, T., Musick, J., & Ha, D. (2005). *Essential Spawning and Nursery Habitat of Atlantic Sturgeon (Acipenser oxyrinchus) in Virginia.* Virginia Insitute of Marine Science, William and Mary.

Caroffino, D., Sutton, T., Elliott, R., & Donofrio, M. (2010). Early life stage mortality rates of lake sturgeon in the Peshtigo River, Wisconsin. *North American Journal of Fisheries Management, 30*(1), 295-304. doi:10.1577/M09-082.1

Chandler, L. (1998). Trophic ecology of native and introduced catfishes in the tidal James River, Virginia. *MS Thesis, Virginia Commonwealth University*. doi:10.25772/9V56-V640

Chapman, F., & Carr, S. (1995). Implications of early life stages in the natural history of the Gulf of Mexico sturgeon, Acipenser oxyrinchus de sotoi. *Environmental Biology of Fishes, 43*, 407-413. doi:10.1007/BF00001178

Damon-Randall, K., Colligan, M., & Crocker, J. (2013). *Composition of Atlantic sturgeon in rivers, estuaries, and in marine waters.* Glouchester, Massachusetts: NOAA/NMFS Protected Resources Division.

Dean, B. (1895). The early development of gar-pike and sturgeon. *Journal of Morphology, 11*(1), 1-62. doi:10.1002/jmor.1050110102

Dominion. (2013). Draft 316(b) Six Month Requirements Submittal for the Chesterfield Power Station.

Dominion. (2016). Entrainment Characterization Study Plan. Prepared by HDR Engineering, Inc.

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

Duong, T., Scribner, K., Crossman, J., Forsythe, P., Baker, E., Kanefsky, J., & Homola, J. D. (2011). Relative larval loss among females during dispersal of Lake Sturgeon (Acipenser fulvescens). *Environmental Biology of Fishes, 91*(4), 459. doi:10.1007/s10641-011-9804-4

EA. (2006). Draft Impingement and Entrainment Mortality Characterization Report June 2005-May 2006, Chesterfield Power Station.

Engineering Science and Technology. (2007). Impingement Mortality and Entrainment Characterization Report, Chesterfield Power Station, June 2005-2006. Sparks, Maryland.

Ewart, P., Ford, J., & Lin, C. (1974). *Probability for statistical decision making.* Englewood, New Jersey: Prentice-Hall, Inc.

Farrae, D., Post, W., & Darden, T. (2017). Genetic characterization of Atlantic Sturgeon, Acipenser oxyrinchus, in the Edisto River, South Carolina and identification of genetically discrete fall and spring spawning. *Conservation Genetics, 18*, 813-823. doi:10.1007/s10592-017-0929-7

Fritts, M., Grunwald, C., Wirgin, I., King, T., & Peterson, D. (2016). Status and genetic character of Atlantic Sturgeon in the Satllia River, Georgia. *Transactions of the American Fisheries Society, 145*(1), 69-82.

Garman, G. (2016). 10 years of Atlantic Sturgeon research on the James River. EPRI American Eel Interest Group Joint Workshop. Richmond, Virginia.

Gessner, J., Kamerichs, C., Kloas, W., & Wertz, S. (2009). Behavioral and physiological responses of early life phases of Atlantic Sturgeon (Acipenser oxyrhynchus Mitchill 1815) towards different substrates. *Journal of Applied Ichthyology, 25*, 83-90.

Gilbert, C. (1989). *Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic Bight)--Atlantic and Shortnose Sturgeons* (Vol. 82(11.100)). U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers TR EL82-4.

Gotelli, N., & Ellison, A. (2004). *A Primer of Ecological Statistics.* Sunderland, Massachusetts: Sinauer Associates, Inc.

Graham, K. (1999). A review of the biology and management of Blue Catfish. *American Fisheries Society Symposium, 24*, 37-49.

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., Balazik, M., Hilton, E., & Fisher, M. (2017). Assessment of Critical Habitats for Recovering Chesapeake Bay Atlantic Sturgeon Distinct Population Segment. *Virginia Institute of Marine Science, College of William and Mary*. doi:10.21220/m2-3gvk-6j03

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

Gutreuters, S., Dettmers, J., & Wahl, D. (2003). Estimating mortality rates of adult fish from entrainment through the propellers of river towboats. *Transactions of the American Fisheries Society, 132*(4), 646-661.

Hager, C. (2011). *Atlantic Sturgeon Review: Gather data on reproducing subpopulation of Atlantic Sturgeon in the James River.* Contract EA133FICON0317.

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

Hatin, D., R., F., & Caron, F. (2002). Movements and aggregation areas of adult Atlantic sturgeon (Acipenser oxyrinchus) in the St. Lawrence River estuary, Quebec, Canada. *Journal of Applied Ichthyology, 18*, 586-594. doi:10.1046/j.1439-0426.2002.00395.x

Hildebrand, S., & Schroeder, W. (1928). Fishes of Chesapeake Bay. *U.S. Bureau of Fisheries Bulletin, 43*.

Hilton, E., Kynard, B., Balazik, M., Horodysky, A., & Dillman, C. (2016). Review of the biology, fisheries, and conservation status of the Atlantic Sturgeon (Acipenser oxyrinchus Mitchill, 1815). *Journal of Applied Ichthyology, 32*(Suppl. 1), 30-66.

HydroQual. (2003). *Thermal Modeling of Chesterfield Power Station on the James River and Farrar Gut, Virginia. Prepared for Dominion Generation.* Richmond, Virginia.

ICTF. (2014). *Final Report for the Sustainable Fisheries Goal Implementation Team.* Retrieved from http://www.chesapeakebay.net/documents/Chesapeake_Bay_Invasive_Catfish_Report_and_Recommendations_2-20-14_draft_FOR_STAC_REVIEW.pdf

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

Invasive Catfish Task Force (ICTF). (2020). *Invasive Catfish Management Strategy.* Retrieved from https://www.chesapeakebay.net/files/documents/Invasive_Catfish_Management_Strategy_Aug_2020_final.pdf

Jarić, I., Gessner, J., & Lenhardt, M. (2015). A life-table metamodel to support the management of data deficient species, exemplified in sturgeons and shads. *Environmental Biology of Fishes, 98*(12), 2337-2352.

Jones, P., Martin, F., & Hardy, J. (1978). *Development of fishes in the Mid-Atlantic Bight: An atlas of egg, larval and juvenile stages* (Vol. 1 Acipenseridae through Ictaluridae). U.S. Department of the Interior, U.S. Fish and Wildlife Service Biological Services Program FWS/OBS-78/12.

Kieffer, M., & Kynard, B. (1993). Annual Movements of Shortnose and Atlantic Sturgeons in the Merrimack River, Massachusetts. *Transactions of the American Fisheries Society, 122*, 1088-1103. doi:10.1577/1548-8659(1993)122%3C1088:AMOSAA%3E2.3.CO;210

Killgore, K., Miranda, L., Murphy, C., Wolff, D., Hover, J., Kevin, T., & Maynord, S. (2011). Fish entrainment rates through towboat propellers in the Upper Mississippi and Illinois Rivers. *Transactions of the American Fisheries Society, 140*(3), 570-581.

King, K. (2004). Growth, survial, and body composition of juvenile Atlantic Sturgeon fed five common diets under hatchery conditions. *North American Journal of Aquaculture, 66*, 53-60.

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 Behavior of Fishes, 63*, 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.* USGS Natural Resources Preservation Project E 2002-7. Washington, DC: National Park Service.

Kynard, B., Pugh, D., & Parker, T. (2006). *Experimental Studies to develop guidance and a bypass for Shortnose Sturgeon at Holyoke Dam.* doi:10.13140/RG.2.2.15434.57287

Litts, T., & Kaeser, A. (2016). Mapping potential spawning substrate for Shortnose and Atlantic Sturgeon in coastal plain rivers of Georgia using low-cost side-scan sonar. *Journal of the Southeastern Association of Fish and Wildlife Agencies, 3*, 80-88.

Mayfield, R., & Cech, J. (2004). Temperature effects on green sturgeon bioenergetics. *Transactions of the American Fisheries Society, 133*(4), 961-970.

Miranda, L., & Killgore, K. (2013). Entrainment of shovelnose sturgeon by towboat navigation in the Upper Mississippi River. *Journal of Applied Ichthyology, 29*, 316-322.

Mohler, J. (2003). Culture manual for Atlantic Sturgeon. *United States Fish and Wildlife Service Publication, Hadley, Massachusetts*.

Mohler, J., King, M., & Farrell, P. (2000). Growth and survival of first-feeding and fingerling Atlantic Sturgeon under culture conditions. *North American Journal of Aquaculture, 62*, 53-60.

National Marine Fisheries Service (NMFS). (2012a). *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 and the Cities of Richmond nad Hopewell, Virginia.* (FINER/2012/01183).

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. (2012b). Letter of concurrence, from Mr. D.M. Morris, NMFS, to Ms. Amy Hull, Nuclear Regulatory Commission, that continued operation of Surry Nuclear Power Station, Units 1 and 2 is not likely to adversely affect species listed by NMFS.

NMFS. (2017). Biological Opinion of the Tappan Zee Bridge Replacement Project (NER-2014-11317).

NMFS. (2018). Letter from Julie E. Crocker, Endangered Fish Recovery Branch Chief, Protected Resources Division, to Dominion Energy dated April 20, 2018. *They would not expect any Atlantic Sturgeon early life stages to be collected during sampling in the spring or early summer based on the best available information*.

NMFS. (2020a). 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, including completion of Clean Water Act 316(b) studies for the facility*.

NMFS. (2020b). Findings and Recommendations on the Issuance of an Incidental Take Permit (Permit No. 21516) to Virginia Electric Power Company, D.B.A. Dominion Virginia Power, for the Operation of the Chesterfield Power Station, Chesterfield, VA. *Statement of Findings and Recommendations*.

NMFS. (2021). A letter to Dominion from National Marine Fisheries Service in response to take report of Atlantic Sturgeon egg take at Chesterfield Power Station. Dated November 1, 2021.

NMFS. (2022). *Chesapeake Bay Distinct Population Segment of Atlantic Sturgeon (Acipenser oxyrinchus oxyrinchus) 5-Year Review: Summary and Evalution.* Retrieved from https://www.fisheries.noaa.gov/s3/2022-02/Atlantic%20sturgeon%20CB%205-year%20review_FINAL%20SIGNED.pdf

NMFS and USGS. (2016). Meeting Notes, Atlantic and Shortnose Sturgeon Research and Management: Past, Present, and Future. Shepherdstown, West Virginia. Retrieved from https://media.fisheries.noaa.gov/dam-migration/64404451may_2016_sturgeon_meeting_notes_final_revised.pdf

NOAA Fisheries. (2018, March 1). Atlantic Sturgeon Recovery Outline. Retrieved March 5, 2025, from https://www.fisheries.noaa.gov/s3//dam-migration/ats_recovery_outline.pdf

NOAA Fisheries. (2018, March 20). Bay Invaders: The Blue Catfish Fishery. New England/Mid-Atlantic. Retrieved March 5, 2025, from https://www.fisheries.noaa.gov/feature-story/bay-invaders-blue-catfish-fishery

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

Poletto, J., Cocherell, D., Ho, N., Cech, J., Klimley, A., & Fangue, N. (2014). Juvenile green sturgeon (Acipenser medirostris) and white sturgeon (Acipenser transmontanus) behavior

near water-diversion fish screens: experiments in a laboratory swimming flume. *Canadian Journal of Fisheries and Aquatic Sciences, 71*, 1030-1038.

Reine, K., Clarke, D., Balazik, M., O'Haire, S., Dickerson, C., Frederickson, C., . . . Turner, C. (2014). *Assessing Impacts of Navigation Dredging on Atlantic Sturgeon (Acipenser oxyrinchus).* U.S. Army Corps of Engineers, Engineer Research and Development Center, Environmental Laboratory. Report Number ERDC/EL TR-14-2.

Saura, M., & Faria, R. (2011). Genetic tools for restoration of fish populations. *Journal of Applied Ichthyology, 27*(Supplement 3), 5-15.

SCDNR. (2024). *Sample Comments. Prepared by Daniel Farrae of SCDNR Population Genetics. Dated January 26, 2024.*

Schloesser, R., Fabrizio, M., Latour, R., Garman, G., Greenlee, B., Groves, M., & Garland, J. (2011). Ecological role of blue catfish in Chesapeake Bay communities and implications for management. *American Fisheries Society Symposium, 77*, 369-382.

SCNDR. (2022). *Sample Comments.* Prepared by Daniel Farrae of SCDNR Population Genetics. Retrieved February 24, 2023

Secor, D., Niklitschek, E., Stevenson, J., Gunderson, T., Minkkinen, S., & Richardson, B. (2000). Dispersal and growth of yearling Atlantic Sturgeon, Acipenser oxyrhyncus, released into Chesapeake Bay. *Fishery Bulletin, 98*(4), 800-810.

Smith, J., Flowers, J., & Hightower, J. (2015). Fall Spawning of Atlantic Sturgeon in the Roanoke River, North Carolina. *Transactions of the American Fisheries Society, 144*(1), 48-54. doi:10.1080/00028487.2014.965344

Smith, T. (1985). The fishery, biology and management of Atlantic Sturgeon, Acipenser oxyrhynchus, in North America. *Environmental Biology of Fishes, 14*, 61-72.

Smith, T., & Clugston, J. (1997). Status and management of Atlantic Sturgeon, Acipenser oxyrhynchus, in North America. *Environmental Biology of Fishes, 48*, 335-346.

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. *An Atlantic Coastal Fisheries Cooperative Management Act Report for the National Marine Fisheries Service*.

St Pierre, R. (2007). Restoration of Atlantic Sturgeon in the northeastern USA with species emphasis on culture and restocking. *Journal of Applied Ichthyology, 15*(4-5), 180-182.

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

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. doi:10.1111/j.1095-8649.1998.tb01006.x

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*(4), 769-777.

VDEQ. (2016). *Fact Sheet: VA0004146, Dominion Chesterfield Power Station.*

VDEQ. (2023, September 29). Time of Year Restrictions and Other Recommendations, Wildlife Information and Environmental Services. Retrieved March 14, 2025, from https://dwr.virginia.gov/wp-content/uploads/media/Time-of-Year-Restrictions.pdf

VDEQ. (2025). *Draft 2024 305(b)/303(d) Water Quality Assessment Integrated Report.* Retrieved March 3, 2025, from https://www.deq.virginia.gov/our-programs/water/water-quality/assessments/integrated-report.

VEPCO. (1977). *Chesterfield Power Station Impingement and Entrainment Study. Final Report. Prepared by Virginia Electric and Power, Environmental Services Department.* Richmond, Virginia.

Verhille, C., Poletto, J., Cocherell, D., DeCorten, B., Baird, S. C., & Fangue, N. (2014). Larval green and white sturgeon swimming performance in relation to water diversion flows. *Conservation Physiology, 2*. doi:10.1093/conphys/cou031

Virginia Department of Wildlife Resources (VDWR). (2025). 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. Virginia Electric and Power Company, Environmental Policy and Compliance.* Glen Allen, Virginia.

Waldman, J., & Wirgin, I. (1998). Status and restoration options for Atlantic Sturgeon in North America. *Conservation Biology, 12*(3), 631-638.

Waldman, J., Grunwald, C., Stabile, J., & Wirgin, I. (2002). Impacts of Life history and biogeography on the genetic stock structure of Atlantic Sturgeon, Acipenser oxyrinchus oxyrinchus, Gulf sturgeon, A. o. desotoi, and Shortnose sturgeon, A. brevirostrum. *Journal of Applied Ichthyology, 18*, 509-518.

Welsh, S., Eyler, S., Mangold, M., & Spells, A. (2002). Capture locations and growth rates of Atlantic Sturgeon in the Chesapeake Bay. *American Fisheries Society Symposium, 28*, 183-194.

White, S., Johnson, R., Lubinski, B., Eackles, M., & Kazyak, D. (2023). Genetic population assignments of Atlantic sturgeon provided to National Marine Fisheries Service, 2022 (No. 2023-1054) US Geological Survey.

Wilber, D., & Clarke, D. (2001). Biological effects of suspended sediments: a review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. *National American Journal of Fish Management, 21*, 855-875.

Wilber, D., Brostoff, W., Clarke, D., & Ray, G. (2005). *Sedimentation: Potential biological effects from dredging operations in estuarine and marine environments, DOER Technical Notes Collection (ERDC TN-DOER-E20).* Vicksburg, Mississippi: U.S. Army Engineer Research and Development Center.

Wilkens, J., Katzenmeyer, A., Hahn, N., Hoover, J., & Suedel, B. (2015). Laboratory tests of suspended sediment effects on short-term survival and swimming performance of juvenile Atlantic Sturgeon (Acispenser oxyrinchus Mitchell, 1815). *Journal of Applied Ichthyology, 31*, 984-990.

Williot, P., Rochard, E., & Kirschbaum, F. (2009). Acceptability and prerequisites for the successful introduction of sturgeon species. In *Biology, conservation and sustainable development of sturgeons* (pp. 369-384). Springer Netherlands.

Wirgin, I., Maceda, L., Waldman, J., Wehrell, S., Dadswell, M., & King, T. (2012). Stock origin of migrating Atlantic Sturgeon in Minas Basin, Inner Bay of Fundy, Canada, determined by microsatellite and mitrochondrial DNA analysis. *Transactions of the American Fisheries Society, 141*(5), 1389-1398.